

PART 13

STRUCTURAL MEMBERS

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1 Structural Members - Access

Structural Members toolbar

How do I get this toolbar?

You can also acquire access to these commands from the Alternate **Design** pull-down menu. From the **Design** pull-down menu, pick **Structural Members >** and cascade to their respective command options - see image below, right.

Also illustrated to the right, I show the [Grids](#) toolbar and the [Layout Tools](#) toolbar because you can, and most likely will, use either of these in conjunction with Structural Members; particularly Columns. The Grid tools were not only designed to assist in managing the spacing of Columns but were also designed to be a part of your Construction Documentation by offering Labeling options. Layout Tools, on the other hand, were designed more for acting as an Anchoring Grid than something you would print. Both tools use Nodes that you can Anchor Structural Members to and consequentially control their spacing and position in 3D space.

Grids offer the option to automatically populate all of the Nodes with a Structural Member as you Add the Grid and therefore this tool is most likely your best choice.

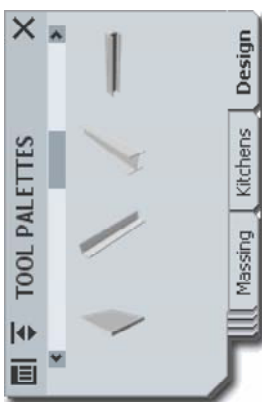
Structural Members pull-down menu

Alt.Menu **Design> Structural Members**



Keyboard **Member** or ColumnAdd, BraceAdd and BeamAdd

Links [Adjusting to the New Interface for AutoCAD and ADT Users](#) for how to activate the Design pull-down menu

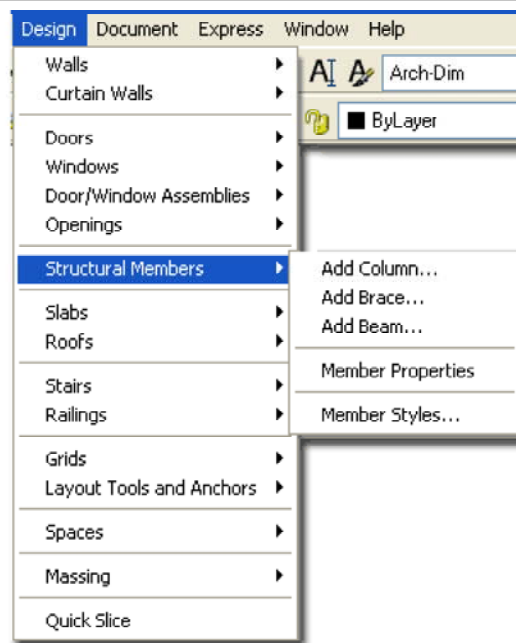


Whenever I focus on the subject of **Structural Members** in ADT I always find a smile surfacing on my face because this subject has to be treated with some humor; i.e., they are funny. In my classes structural engineers always get excited about this topic imagining fantastic features for details, connectors, analysis and so forth and invariably they become disheartened in no time at all. You see, these objects are little more than Profile shapes extruded along paths with a sprinkle of ADT-like options and display controls. There's nothing fancy about them at all but with each release they improve a little.

Now that I have taken all of your excitement and crushed it, lets take a realistic look at some of the neat things you can do with these Objects.

Like most other ADT Objects, you can access predefined Styles by Loading them from the Style Library but unlike most other ADT Objects, Structural Member Styles can be created on-the-fly by using a special [Catalog](#) of predefined sizes and shapes that conform to industry standards for Wood, Metal and Concrete members.

1-13 STRUCTURAL MEMBERS



On the command line, you can type "**Member**" when you want access to many of the Structural Member creation options. For direct access to an option within the Member command-line menu, you can type the primary command plus the option you want direct access to. For example, if you want to Add a Column, you can type "**ColumnAdd**". To modify the Structural Members, you only have one option to type on the command line: "**MemberProps**".

Below is the command line read-out for "**Member**":

Command: MEMBER
Member [Add/Convert/Properties/Styles]:

2 Loading Structural Member Styles

Opening Structural Member Styles in the Style Manager

Alt.Menu **Design> Structural Members> Member Styles...**



Keyboard **MemberStyle**

Links [Structural Member Styles](#) - for how to create a Structural Member Styles

[Structural Member Catalog](#) - for importing more Styles

For Structural Members the primary method for adding Styles is through the use of the Structural Member Catalog but there are two library files that come with ADT that you may want to investigate. Illustrated to the right I show that the default Imperial Style folder contains the "**Bar Joist Styles (Imperial).dwg**" and "**Member Styles (Imperial).dwg**" library files. Metric users do not have the Bar Joist Styles but they do have the Member Styles. You can also access these library styles through the [Content Browser Window](#) >> Architectural Desktop Design Tool Catalog >> Structural.

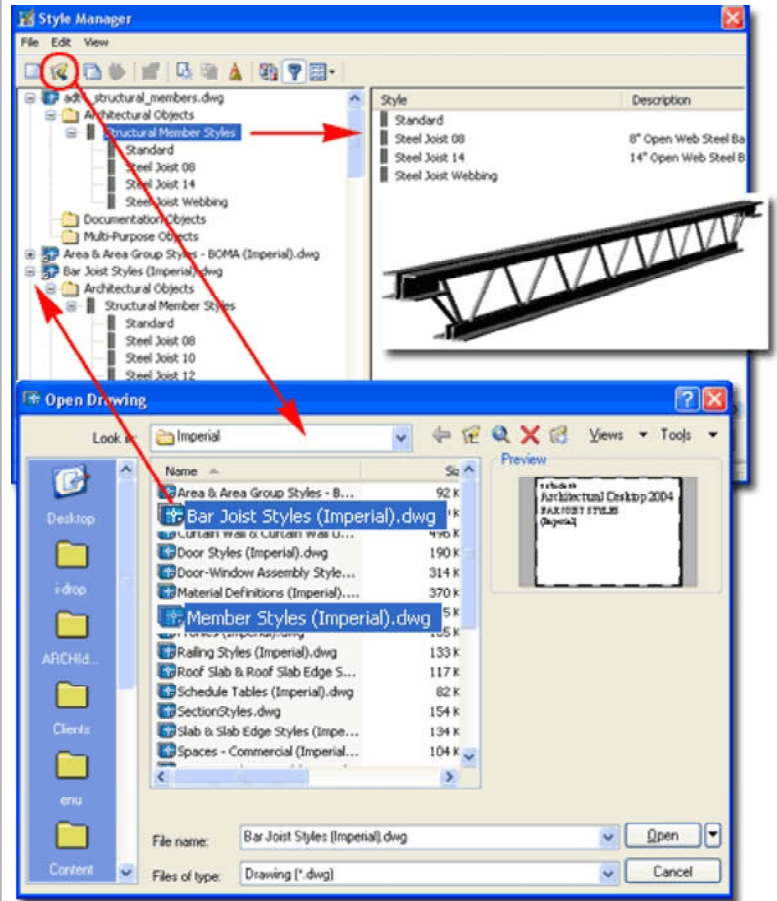


For local installations of ADT, you are likely to find the **Imperial** or **Metric Bar Joist and Member Styles** in the **Styles Folder** as illustrated to the left. The full path to this location may vary but typically it is as illustrated. On a Network based installation of ADT, these Styles should be on a captured drive (like "G:\office standards") or similar location with a folder name that indicates Styles.

Consult your CAD or IT manager if you cannot locate the Styles Folder.

For information on how to copy styles from the template file to the current drawing file, see discussion on [Wall Styles](#).

3 Adding Structural Members



Add Column Properties Palette

Alt.Menu **Design>Structural Members>Add Column...**



Keyboard **ColumnAdd**

When **adding Columns**, the **Properties Palette** offers a fairly simple list of options and features that should be easy to comprehend. Since a Column is basically a Profile shape extruded vertically, all you need to do is think about it as a vector that follows the Z-axis of your UCS icon.

GENERAL

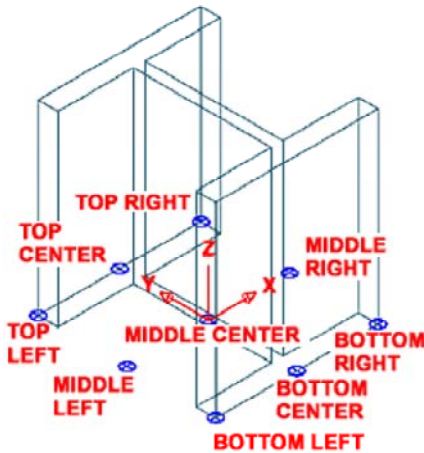
Style - a drop-down list offering a list of currently loaded Member Styles; all of them! Type "**MemberStyle**" or use the Content Browser to load other Styles. Illustrated to the right I show that all Member Styles are listed for Columns, Braces and Beams so Names become rather important if you plan to [Tag](#) and/or Schedule these Objects.

DIMENSIONS

Start Offset - a Z-axis distance relative to the UCS and Justification. In typical cases, plan view, this is an offset above the ground. This value does not affect the Logical Length value but it does affect the physical length as observed on your screen. Positive numbers represent a distance up from the base point thus shortening the member while a negative number extends it below the base point.

End Offset - a Z-axis distance relative to the UCS and Justification. In typical cases, plan view, this is an offset below a ceiling. This value does not affect the Logical Length value but it does affect the physical length as observed on your screen.. Positive numbers represent a distance up from the end or top point and thus lengthen the member while negative numbers reduce its length.

Logical Length - this is actually the height of your column and thus a more appropriate term for Beams. With Offsets, the Logical Length may not be the Physical Length observed in your drawing.

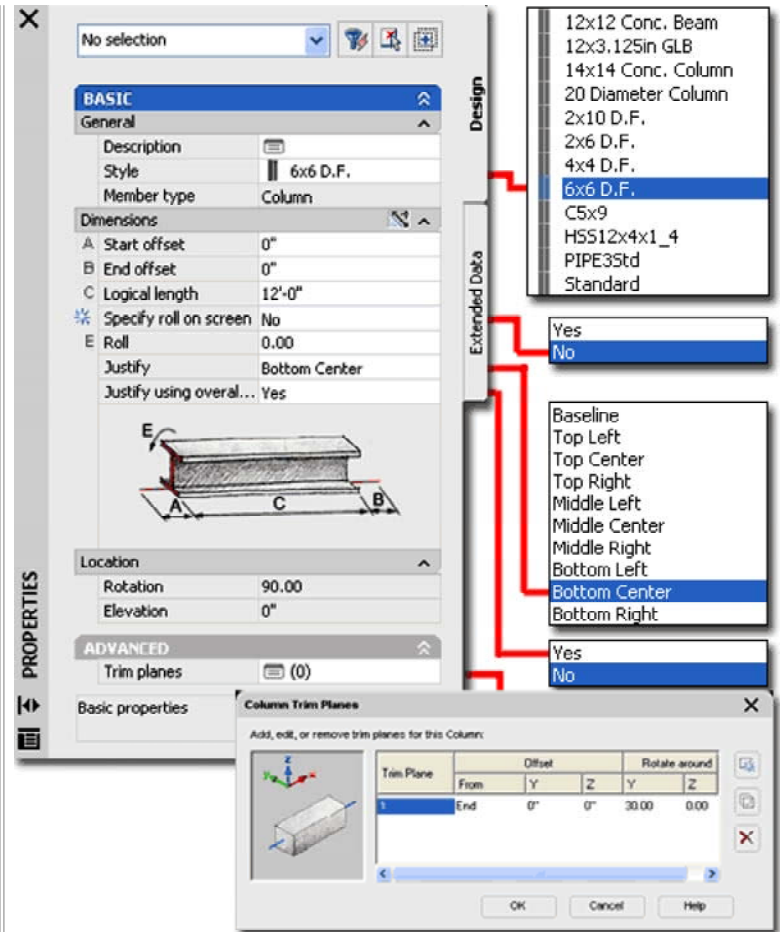


Specify Roll on Screen - a drop-down list offering a **Yes** or **No** option to controlling Roll with the Cursor as you Add the Column. This is basically identical to Rotating Objects when Inserting them.

Roll - tilt or rotation of column relative to the UCS icon. The UCS icon is usually in plan or World view, so Roll is simply the insertion rotation of the column (in the XY-plane through the Z-axis).

Justify - a drop-down list offering ten different positions relative to the column base; this means that Middle Center does not justify to the three dimensional centroid, but rather the absolute center of the column's base. Complex columns with multiple components are affected by the "**Justify using overall Extents**" setting. Baseline uses the original Base Point set by the Profile Definition and thus provides you with an option to create a very unique Justification Point should you need that.

Adding Columns



Justify using overall Extents - a drop-down list offering a **Yes** or **No** option that affects the results of the Justify settings if the Member has more than one component such as Steel I-Beams encased in Concrete Columns. In most cases where you are working with simple members this setting should not be an issue and will produce the same results whether set to Yes or No. For complex members with multiple components there is a [priority rating](#) for each Profile shape and the highest priority would rule the Justification if this setting is set to No; if set to Yes, the overall exterior extents of the shape will be used as the Justification reference.

ADVANCED

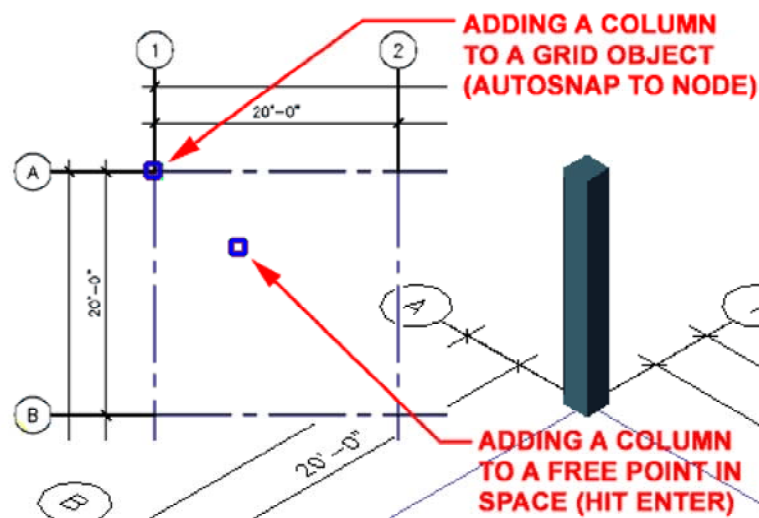
Trim Planes - activates the **Column Trim Planes** dialog where you can Chamfer your Column based on Angle and Offset Values. The main thing to observe is that Structural Members have their own coordinate system that always reads the X-axis as the "logical length" instead of the UCS Z-axis. Just look at the graphic to avoid getting confused.

When you **Add Columns**, notice that on the command line you will be queried to "**Select grid or RETURN:**" to place a column freely in space (un-anchored). If you select a **Column Grid** or **Layout Grid** object, you should find your Column automatically Anchoring to Nodes within the selected Grid.

The position a Column takes relative to a Grid Anchor Node depends upon the Justification choice and the Offset values set on the Add Columns Properties Palette.

Once you have selected a Grid, you can place numerous Column very rapidly by picking near every Anchor Node along the Grid object; the Autosnap to Node will place the Columns accurately. If you wish to populate other Nodes on a Grid at a later time, all you have to do is Copy one Anchored Column to a position near a Node on the Grid and it will automatically "snap" into position.

To populate your entire Grid with Columns, you can either do this as part of [Adding your Grid](#) or by using the [Node Anchor](#) tool.



Add Brace Properties Palette

Alt.Menu **Design> Structural Members> Add Brace...**



Keyboard **BraceAdd**

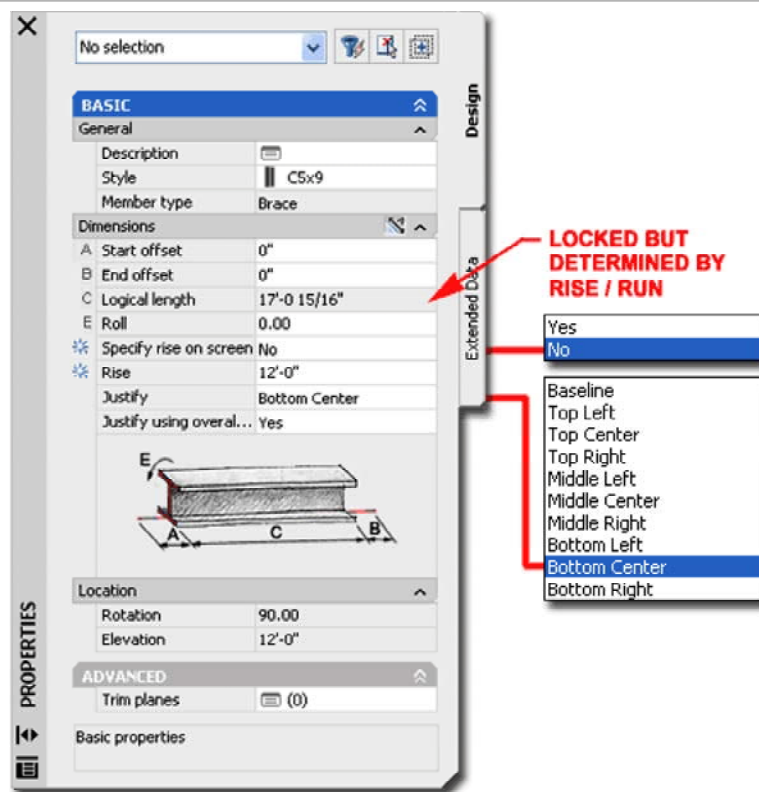
Links [Add Column Properties Palette](#) - for more information on the options not illustrated or discussed here.

When **adding Braces**, the **Properties Palette** offers nearly the same set of options as those for Columns. You may notice that the "Logical Length" value field is locked out but you now have a **Rise** value field to work with. Braces are basically Columns with slope that you control with a Rise over Run input. Given this structure for input of Braces, you may find them a bit difficult to draw (at least I do) but keep in mind that they are Objects and as long as you have the Slope correct, you can Move and Stretch them later. I have also found that [converting a Line to a Brace](#) is often an easier approach to creating this Object type.

DIMENSIONS

See Columns for other options.

Logical Length - this value field is not available for Braces because the value is determined by the Rise and Run you specify. Ironically, once you place a Beam the Modify Properties Palette does provide the option to set the Length while removing the Rise option (it becomes a Z-axis Location value field). My recommendation is to focus on getting the Slope right and then adjust the Length later with Grips.



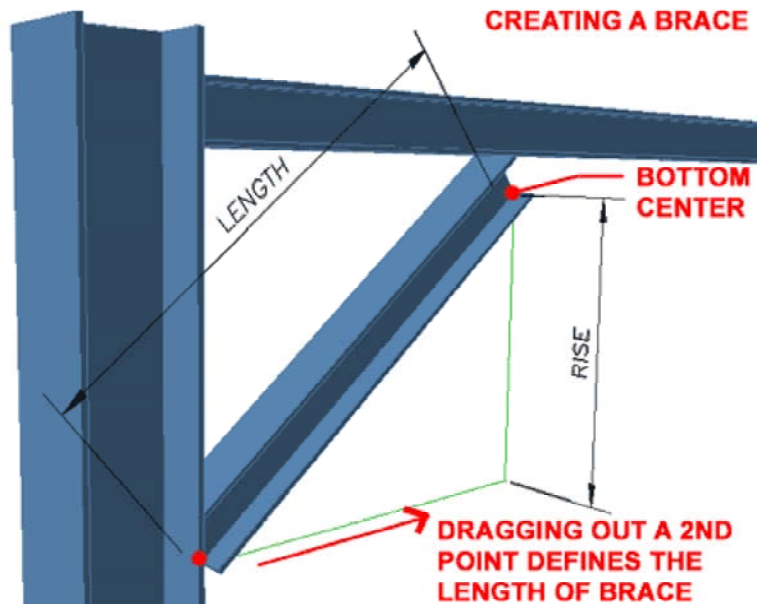
Specify Rise on Screen - a drop-down list offering a **Yes** or **No** option to set the Rise value on-screen or through the Rise value field.

Rise - use this value field to specify the vertical height of a Brace relative to the first point of placement and the full run as specified on-screen by typing a distance or by picking a specific point.

Adding Braces

Braces can be difficult to Add but there are several ways to tackle this problem. If you can draw a Line in the correct position, then you can simply Snap to the Endpoints of that Line or use the **Convert to Brace** tool to do the same thing. The main problem is that you are really forced into comprehending quite a bit about AutoCAD's 3D modeling tools in order to make this work smoothly. Obviously, you will have to work in an Isometric view and you will have to calculate Intersection points on other 3D objects in 3D space. This often requires great dexterity and sometimes UCS icon manipulation.

You may want to focus on just creating a Brace at the right slope and then move it into place later. Using Grips and Trim Planes, you can adjust the Length and cut angles after you have positioned it correctly - as per illustration to the right.



Add Beam Properties Palette

Alt.Menu **Design> Structural Members> Add Beam...**



Keyboard **BeamAdd**

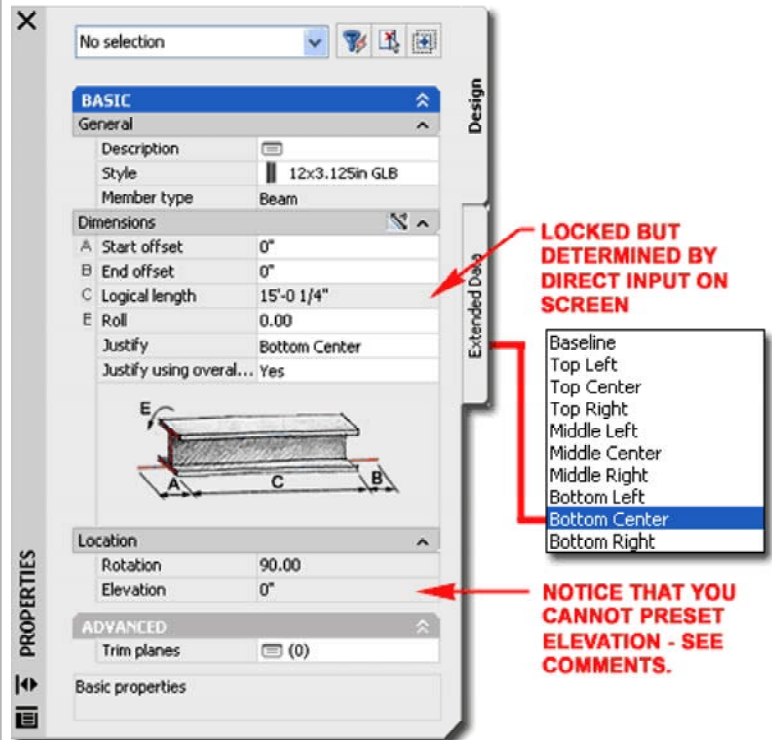
Links [Add Column Properties Palette](#) - for more information on the options not illustrated or discussed here.

When **adding Beams**, the **Properties Palette** offers the shortest list of options among the three Member Types. Logical Length is now the actual length of the Member so this value is set by specifying a distance or by picking points on-screen. Beams are relatively simple to add and comprehend but the one missing option is a height control. Because of this missing option, you will either find that all of your Beams end up on the ground or at whatever Elevation you Snapped to. If you Move your UCS icon to a New Z-axis value and don't Osnap to any 3D Geometry, you will be able to Add Beams at the adjusted Elevation height. Generally, I find that I don't have the time or patience for a lot of nonsense so I just draw the Beam in Plan and Move it up as needed later. Then, I simply Array or Copy that modified Beam. I am sure you will develop your own tricks for things like this.

DIMENSIONS

See Columns for other options.

Logical Length - this value field is not available for Beams because the value is determined by the points or values you specify on-screen. You can adjust this value using the Properties Palette after you have placed the Beam.



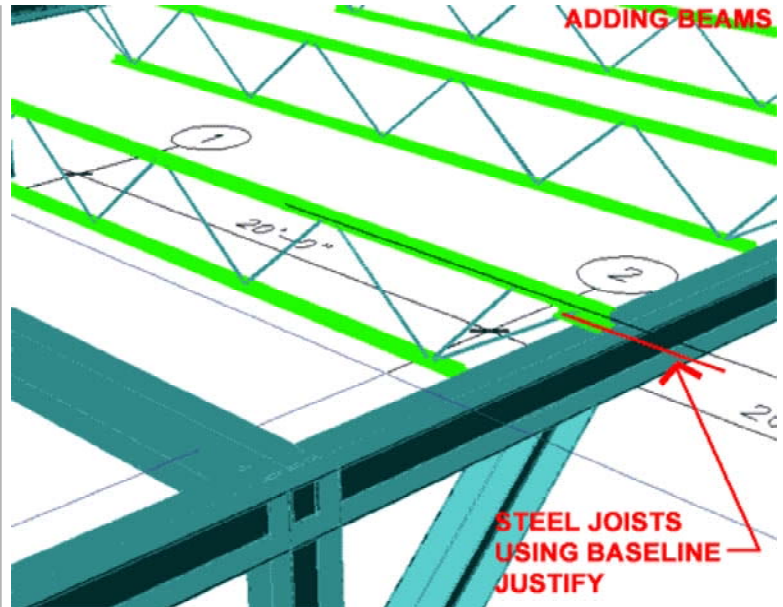
Adding Beams

Links [Loading Structural Member Styles](#) - for more information on accessing and loading the Bar Joists illustrated to the right.

Beams are probably the easiest objects, of the three, to create. Since you don't have a Length value field on the Properties Palette, the process is much like drawing a Line.

In the illustration to the right, I show two type of Beams: a **Steel Joist** from the **Bar Joist Styles (Imperial).dwg** file and another Wide Flange Beam from the standard Structural Member Style Catalog.

With Beams, you may find the **Baseline Justification** option one of the better choices, as illustrated to the right with the Steel Joists. Baseline for the Steel Joists has been set to be right where you would want to weld the joist to another beam.



4 Modifying Structural Members

Modify Structural Members Properties Palette

Alt.Menu **Design> Structural Members> Member Properties**



Keyboard **MemberProps**

Links [Add Column Properties Palette](#) - for more information on the options not illustrated or discussed here.

When **Modifying** Structural Members, the Properties Palette offers much of what you would expect but there are a couple of surprises to note. My favorite surprise is the the bizarre option to change the Member Types without actually changing more than the [Display Representations](#) (Braces, for example, don't stand up straight when changed to Columns).

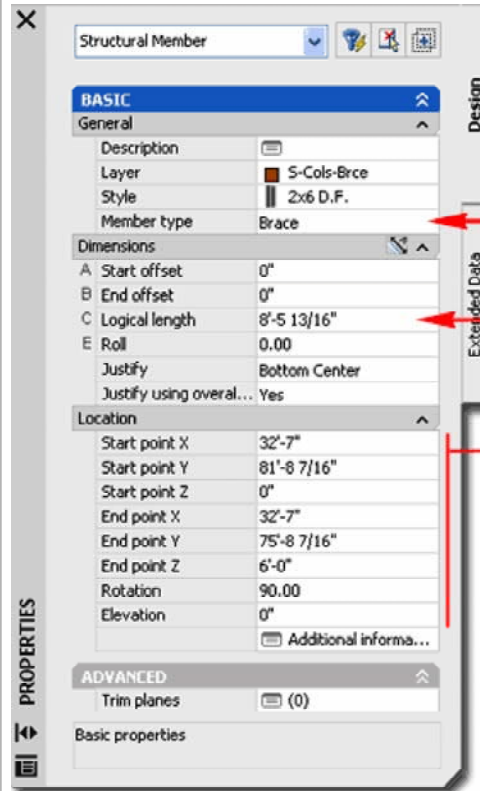
DIMENSIONS

See Columns or other Member Types for other information on options not discussed here.

Since Braces and Beams don't have a **Logical Length** option when these Objects are Added, it is nice to find that you can Modify them later with this value field.

LOCATION

By working with the X,Y and Z coordinates for the **Start** and **End Points** of your Structural Members you can control quite a bit that you may not have been able to do otherwise. For Braces, the "**End point Z**" value field replaces the Rise value field when Adding.



THIS IS A BIT OF A BIZARRE OPTION - SEE COMMENTS.

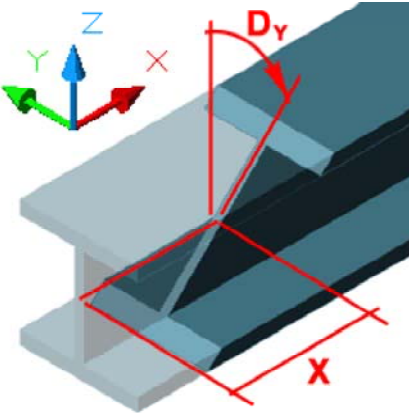
NOTICE LENGTH VALUE FIELD WHERE IT MAY NOT HAVE BEEN AVAILABLE DURING ADDING.

NOTICE ALL OF THESE LOCATION VALUE FIELDS THAT YOU CAN NOW USE TO ADJUST ROTATION, ELEVATION, RISE, RUN AND LENGTH.

Rotation - be careful with this value field since it is not necessarily the same thing as using the Rotate Command. A Brace, for example, will Rotate through its own Z-axis relative to its slope; in fact, it will Roll as you change the Rotation Value Field. For Columns, Rotation will rotate through the World UCS's X or Y Plane so you will most likely want to use the Roll option to turn it in Plan. For Beams, the Rotate Value Field is more of what you would expect for regular Objects since it uses the World UCS's Z-axis to Rotate around.

Structural Members Properties - Trim Planes dialog

Trim Planes provide the option to slice through Structural Members at one or more angles to create end conditions for connections or other needs. Though the concept is rather simple, getting the results you seek in a hurry can often prove frustrating and that typically has to do with comprehending the logic of the Offset Values and Axis of Rotation. My favorite element of disgust here is that you have to do your own trigonometry in order to calculate just how far back you have to Offset a Rotation in order to get it to meet a corner perfectly. If you take the attitude that you will just overshoot the Offset then you pay the price in not knowing what the actual length is. Okay, that's enough of my complaining; let's get an overview of this subject and then you can start complaining.

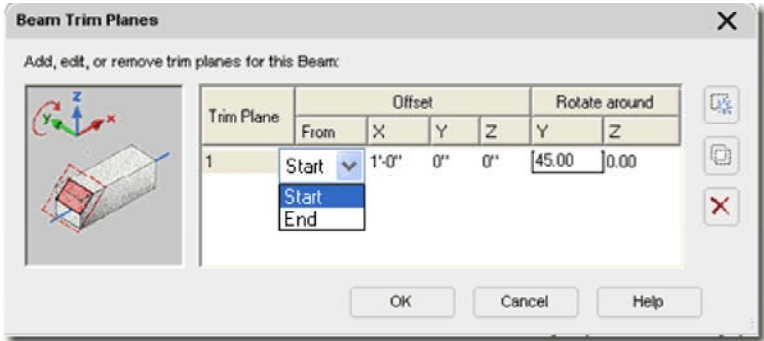


When you **Add a Trim Plane**, one of the first things you have to determine is which end of your Structural Member is the **Start** and which is the **End**. This, of course, was determined when you created it but you may have forgotten.

Trim Plane - numbered sequentially and unfortunately don't read multiple component Structural Members so a cut is a cut all of the way through. You can apply multiple Trim Planes to one end for stepped chamfers. These begin from the Start or End Member centerline and not the justification point.

Offset

From - the From column has a drop-down list that allows you to choose between Start and End points on the Member. **Pick under each column to see the graphic** change to assist you in determining what you will get as a result.



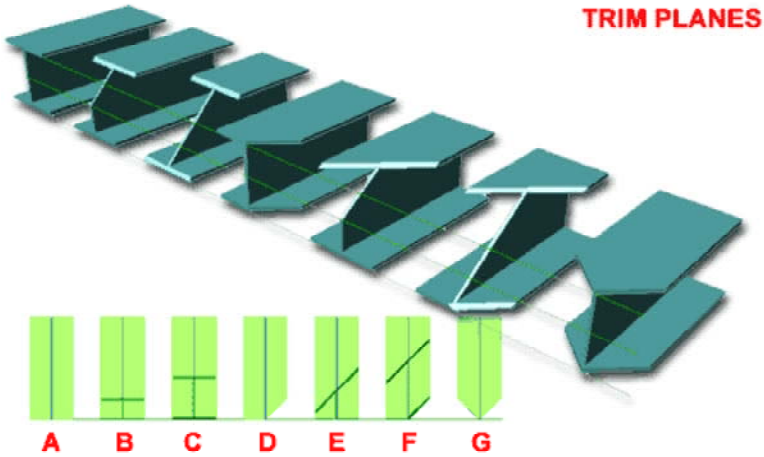
X, Y, Z - you can specify exactly where you want your Trim Plane positioned relative to the Start or End of your Member by typing in distance values for X, Y and Z. By default, the Trim Plane begins at the centerline so you can push it back with a positive X-axis value or forward with a negative X-axis value, for example. In many cases, Y is non-sense since you are working with an infinite plane but Z can be worked against X to push the plane around. For most simple cases, you only need to work with either X or Z and not both.

Rotate around

Y, Z - these are polar values and refer to the angle of the Trim Plane based upon the Offset position. You have two planes to choose from: one that chamfers the top and bottom of a member and one that chamfers the left and right sides. By combining the two, you can create compound Trim Planes.

Structural Members Properties - Trim Planes Examples

	Trim Plane	Offset			Rotate around	
		From	X	Y	Z	
A	1	Start				
B	1	Start				45
C	1	Start	4			45
D	1	Start				45
E	1	Start				45
F	1	Start	5.5			45
G	1	Start				45
	2	Start				315

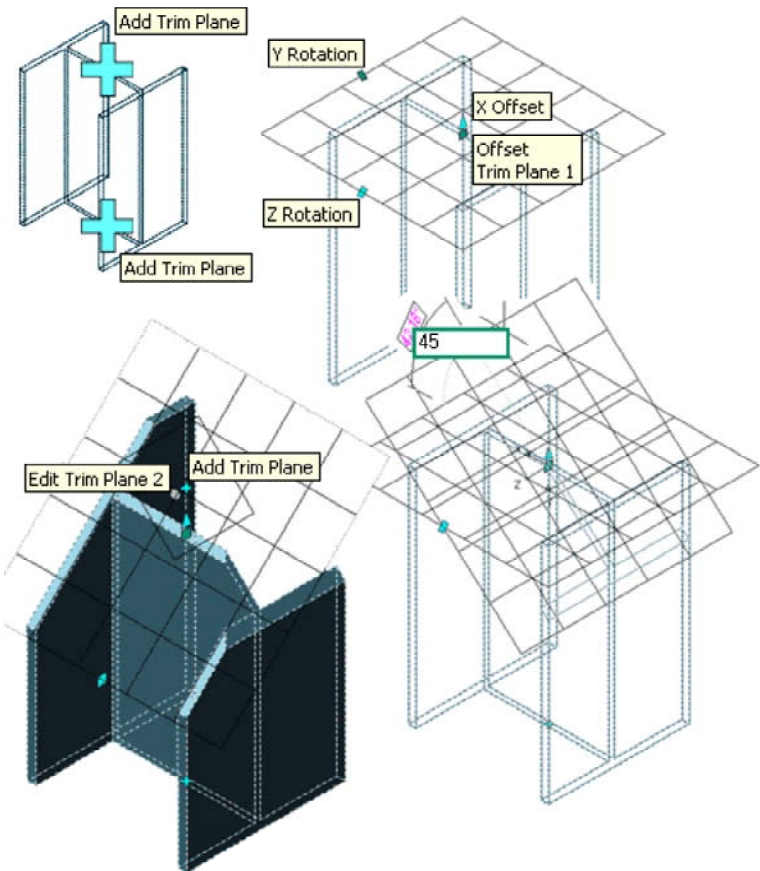


Edit Trim Planes

In the previous examples I discussed how to set and control Trim Planes through the Trim Planes dialog box but you can also **Edit Trim Planes** right in place by using the right-click object-specific (context) menu. To use the Edit Trim Planes in-place mode, Select one Structural Member, right-click to Select the Edit Trim Plane pop-up menu option as illustrated to the left. Though I have an illustration showing this mode while Shaded, I found that this is not an optimum setting to work in so I recommend working in Wireframe.

Illustrated to the right I show several phases of working with the Edit Trim Planes mode active; from adding a second Trim Plane. Remember that you can type in accurate values when working with one of the Grip points. When you have two or more Trim Planes you can toggle between them by picking on the round gray maker.

To **Remove** a Trim Plane use the **Properties Palette** and look for the **Trim Planes dialog** under the Advanced section.



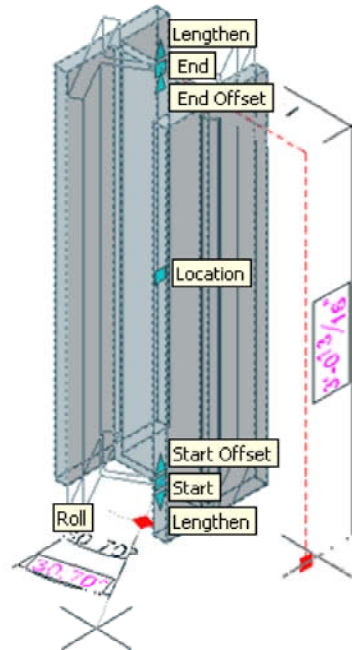
Structural Member Grip Points

All **Structural Members** have the same set of **Grip Points** and of the whole set I find that the Lengthen Grip is my favorite since it maintains slope no matter what View Direction you work in (even Plan).

Illustrated to the right I show a simple Column and all of the various Grip Points that you can use to Modify it. As with other Objects, you can use the Tab key to cycle through the temporary dimensions and angles when they appear. This will allow you to type in a value for more exact input.

One interesting aspect of working with Grips is that you can, for example, alter the Start or End Position of a Column and make it slope much like a Beam - notice the Rise and Run temporary dimensions illustrated to the right.

The Lengthen Grip locks the Slope of the Member so you can Osnap to any point in your drawing without altering the slope of the Member.



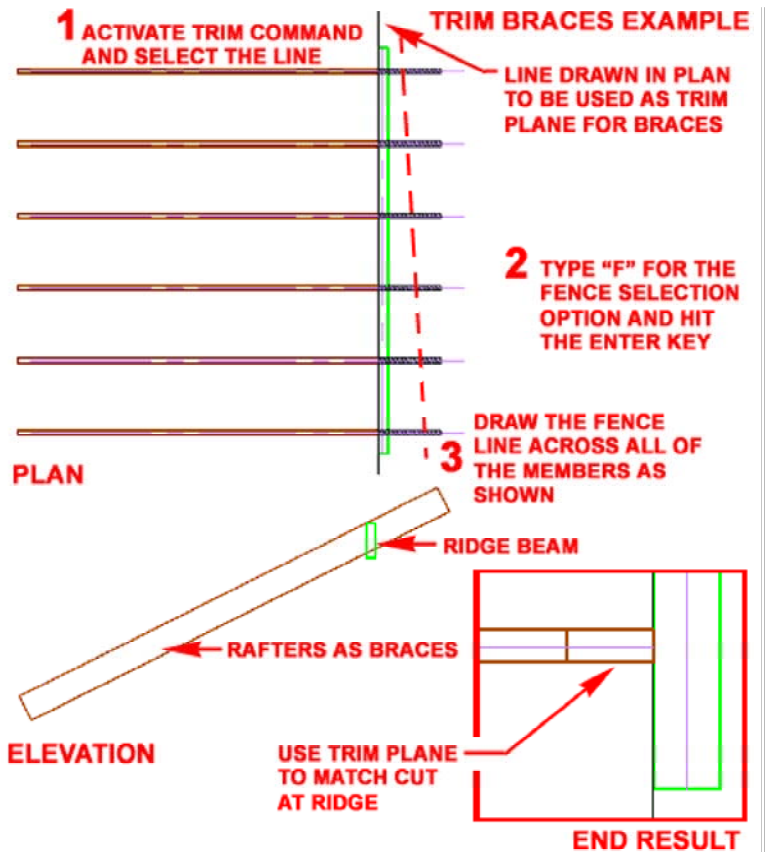
General Editing Commands for Structural Members

Most ADT users are well versed in AutoCAD commands and techniques so we also tend to try our old tricks for Lines, Arcs, Circles and Polylines on ADT Objects. With other Objects in ADT I have not discussed commands such as Trim, Extend and Stretch but with Structural Members I thought it would be a good idea to point out a few things.

Trim and **Extend** are great tools to use on Structural Members because they keep the Integrity of the Object in tact while Extending or Trimming to other Objects in Space. A Brace, for example can be Extended to a Line in Space to Lengthen either end at whatever slope the Brace is set to.

The **Stretch** command must be used with caution on Structural Members because it does not maintain Slope or Position of Member Ends and can thus not only change the Direction but also the Slope; turning Columns and Beams into Members that look like Braces. The key to using Stretch successfully on Structural Members has to do with monitoring the UCS icon so the X or Y-axis match the direction and slope of the Member. Combining the use of Osnaps with Stretch on Members can prove to be disastrous since the Stretch command can actually translate the Start or End Points of a Member across the Z-plane.

Illustrated to the right I show an example of how you might illustrate a simple Roof Framing system with a Ridge Beam and some Rafters. I have drawn the Rafters or Braces well beyond the Ridge Beam but show that by using a Line as a Trimming Edge, I can Trim all of the Braces back in one action using the "Fence" Selection option. This is the exact same technique many AutoCAD users have been practicing for years with conventional Linework. The use of the Line as a Trimming Edge was necessary because the Beam is only recognized by its centerline so Trimming to it would cut the Braces at the midpoint of the Beam instead of its outer edge (Walls have the same problem, have you noticed?).

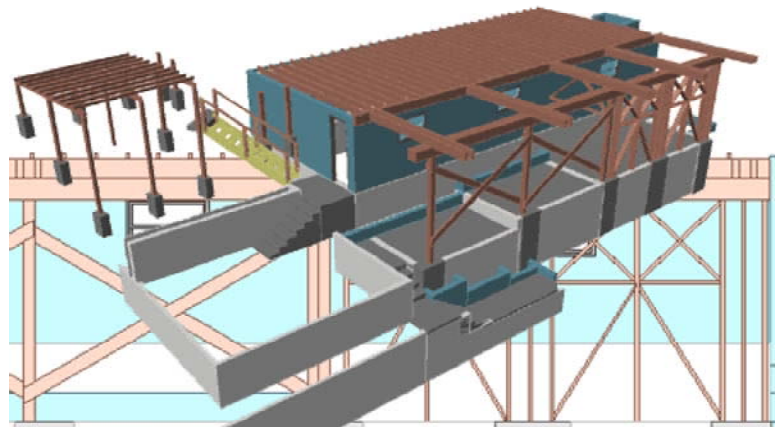


5 Converting to Structural Members

Overview:

For complicated structural systems you may find that drawing some of the Structural Members directly is a bit tricky, particularly Braces. In cases like this I find that using linework to more accurately calculate and position points in space makes framing easier. After drawing a Line or Polyline in space, you can use any of the three Convert options for Columns, Braces and Beams. For some Structural Members, Converting Plines is almost a necessity - see comments under Convert to Beams.

In the illustration to the right (work I had to survey from an existing residence on a steep hill), I had to use Lines to place my diagonal Braces exactly how I needed them. After Converting the diagonal lines to Braces, I had to use Trim Planes to chamfer the ends to match the members they were nailed or bolted to. By using the Lines again, I could determine the exact angles more efficiently to help determine the proper Trim Plane Angles.



Though you can convert any Line or Pline to any of the three Member Types, the Display Representations will be different so it is best to use the **BraceConvert** when creating diagonal brace-like members.

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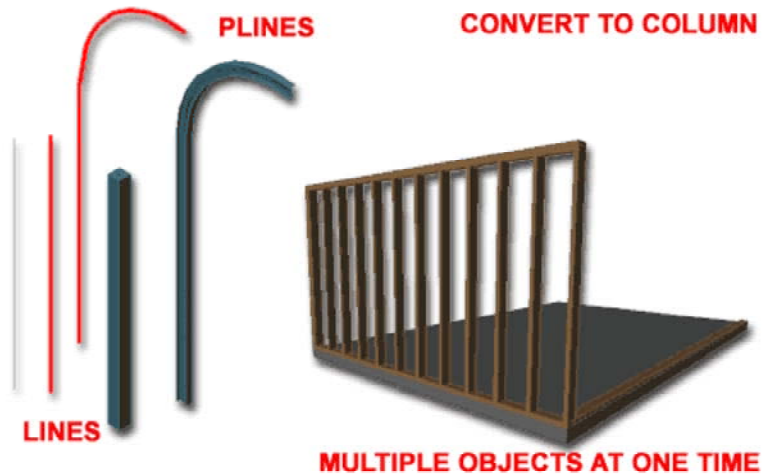
Convert to Column

Menu N.A.



Keyboard **ColumnConvert** or **Member**

Converting Linework to Columns is about as simple as it sounds. You can convert **Lines**, **Arcs** and non-closed **Polylines** into Columns, Braces and Beams. You cannot convert Splines or Splined Polylines. When converting, you can select many objects, like Lines, at one time and create a set of Columns in one quick set - as illustrated with the wood studs, right.



Convert to Brace

Menu N.A.

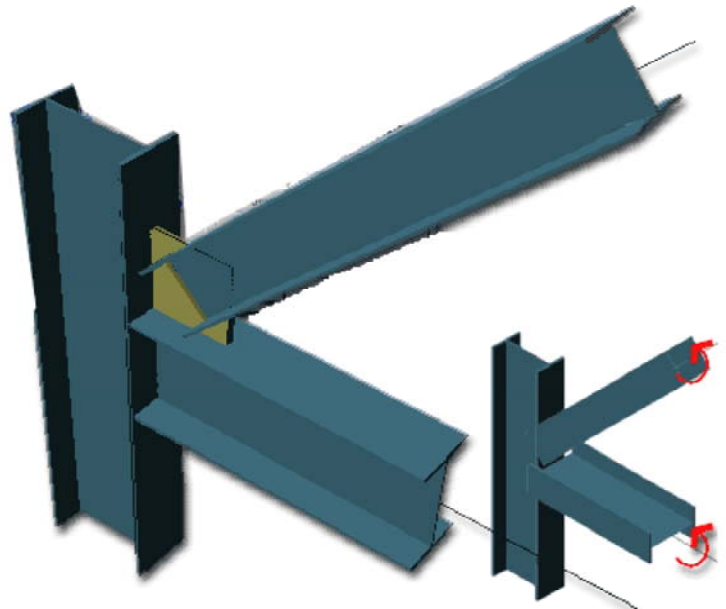


Keyboard **BraceConvert** or **Member**

Links [Structural Members Properties Palette](#) - for how to Roll a Brace.

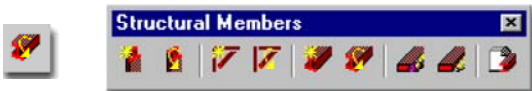
Converting Linework to a Brace is no different than converting Linework to a Column or Beam but you may find that when you want Braces, they don't come out rotated correctly - as illustrated to the right.

Illustrated to the right, I show one way to quickly solve a Structural Member rotation problem: Using the **Structural Member Properties Palette**, you can change the **E - Roll** value under the **Dimensions** section.



Convert to Beam

Menu N.A.



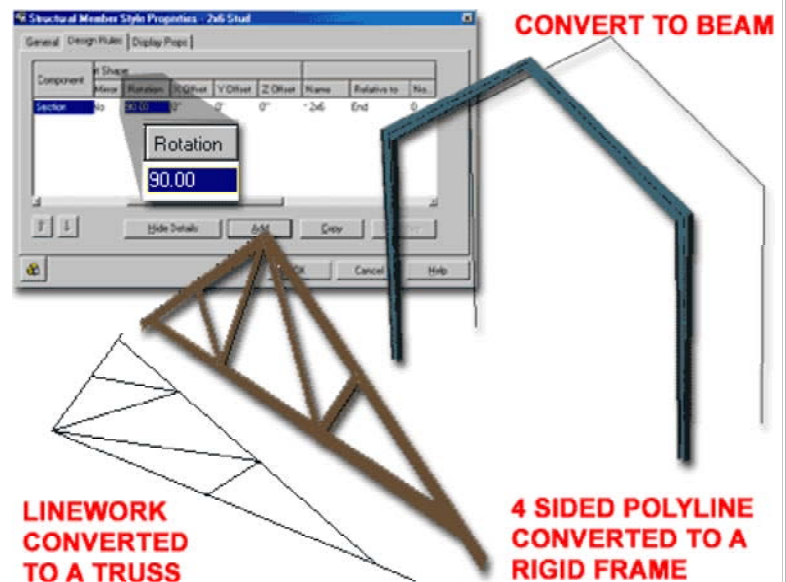
Keyboard **BeamConvert** or **Member**

Links [Structural Member Style Properties - Design Rules tab](#) - for dialog box illustrated.

Converting Linework to a Beam is no different than converting Linework to a Column or Brace but you may find that as with Braces, the members don't come out rotated correctly. Under Braces, discussed above, I illustrate one way to change the rotation (Roll) after Converting but in some cases you may want to create a Structural Member Style that is already Rotated correctly.

On the **Design Rules** tab of the [Structural Member Style Properties](#) dialog box, you can change the Shape **Rotation** for the Start and End positions to match your desired outcome. Be aware that this will affect all members based on this style, so you may want to create a new Structural Member Style to match the one you want but with a different Rotation.

Illustrated to the right I show an advanced Structural Member Style used for a Rigid Steel Frame. It was created by converting a 4 sided **Polyline** into a "Rigid Frame - Single Gable Span" Style from the [Member Styles \(Imperial\).dwg](#) or [Member Styles \(Metric\).dwg](#) files.



The Truss is actually more of an experimental solution that I have not yet perfected, but it can get the concept out quickly. The main gable shape was drawn as a **Pline** but the rest of the lines are **Lines**. The main problem is that this object does not behave as a single entity nor does it clean up correctly.

6

Structural Member Styles

Style Manager - Structural Member Style Properties

Alt.Menu **Design> Structural Members> Member Styles...**

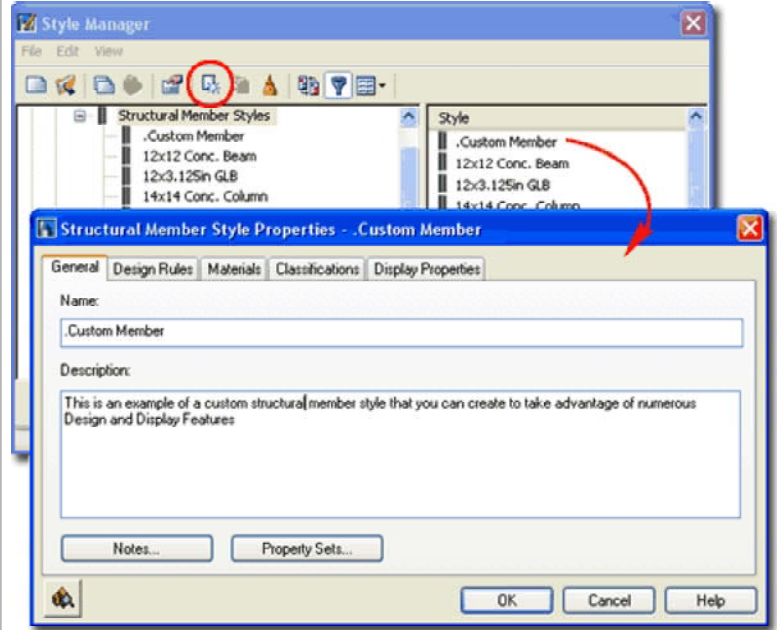


Keyboard **MemberStyle**

Links [Structural Member Catalog](#) - for how to create Industry Standard Structural Member Styles.
[-MemberShapeDefine](#) - for how to define your own Structural Member Shapes

For Structural Member Styles, you can use the **Style Manager** to load, modify, delete and create new Structural Member Styles. You can also use the **Structural Member Catalog** to **Load** an industry standard Structural Member Style instead of trying to create one from Scratch. Therefore, in the case of Structural Member Styles, this is usually not the place you start when wanting a New Member but rather the place you go to **Modify** or create permutations.

Illustrated to the right, I show the process of creating a **New** Structural Member Style that I have Named "**Custom Member**". By **double-clicking** on this new style, you will invoke the **Structural Member Style Properties** dialog box - as illustrated.



The **General** tab provides access to the **Name** and **Description** fields for a Style; plus access to the attachment of **Notes** and [Property Sets](#).

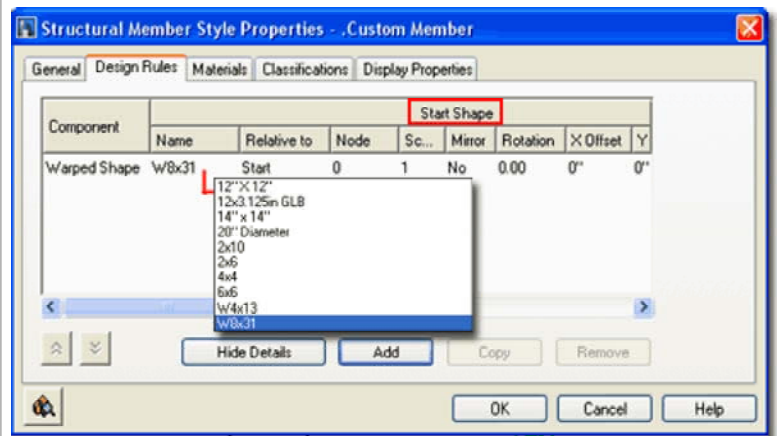
Structural Member Styles - Design Rules tab



On the **Design Rules** tab of the **Structural Member Style Properties** dialog box, illustrated to the right, you will find an amazing set of control options such as that illustrated to the left. Make sure to pick on the **Show Details** button so you can see the whole set of options including the fact that you can specify one **Shape** for the **Start** and another for the **End**. You can also add multiple structural components together for composite forms such as steel columns wrapped by concrete.

The Design Rules list is quite long and repeats all of the options for the Start Shape again for the End Shape. In the discussion below I will cover some of the amazing things you can do with these options.

The **Priority** setting can be used to assist with [Justifications](#) for Member Styles that have multiple Components; particularly those with off-center Components; higher priority equates to the source of Justification unless "Justify using overall extents" is chosen on the Properties Palette.



End Shape										Priority
Name	Relative to	No...	Sc...	Mirror	Rotation	X Offset	Y Offset	Z Offset		
W4x13	End	0	1	No	90.00	0"	0"	0"		1

OPTION TO SET ANOTHER SHAPE **OPTION TO TWIST**

Design Rules tab - Explained

Links [Structural Members Graphic](#) - for an expanded graphic of the illustration shown right.



Component	Start Shape					
	Name	Relative to	Node	Scale	Mirror	Rotation
Segment 1	W8x31	Start	0	1	No	90.00
Segment 2	W8x31					
	10in Plywood Web Wood Joist - Web					
	16" x 16"					
	2x6					
	Standard					
	W14x43					
	W8x31					

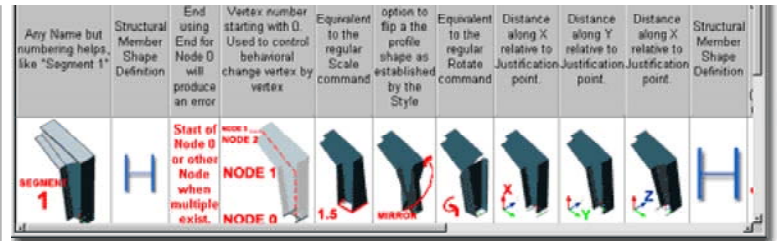
MULTI-SEGMENTED (COMPONENT) STRUCTURAL MEMEBERS



segmented Beam where you only see one or more segments along any portion of the beam.

Most of the options on the **Design Rules** tab should be easy to comprehend but you may have to do a lot of trial and error work to figure out exactly how different values affect your Structural Members. In the illustration to the right, expanded by picking on it, hopefully you will be able to reduce your trial and error time by looking at my trial and error graphics.

Comprehending the Node concept is probably the more difficult feature. It can be used to achieve strange results, like a multi-



To use successfully, you will need to use a **Pline** and one of the **Convert to...** commands, like **Convert to Beam**. If you try to use one of these Styles by Adding, picking several points, the segments just start over at each point you pick.

Structural Member Styles - Materials tab

Links [Object Style Properties - Materials Overview](#) - for an expanded step-by-step explanation of Materials

The subject of **Materials** is one of the most expansive and confusing topics in Architectural Desktop because it requires a complete comprehension of the product in order to take full advantage of this feature; from object styles to display representations. This subject will be discussed under [Part 1 - Display](#) and in the Presentation eGuide.

Illustrated to the right I show that Structural Members will offer as many **Components** as are defined under the Design Rules tab (by default you should see one labeled as "Section"). If you have imported any of the Architectural Desktop Structural Member Styles from the Object Style Library, you should find that you will be able to use the Material Definitions that come with those objects - as illustrated to the right where I have selected Concrete.Cast-in-Place.Flat.Grey and Metals.Structural Metal Framing.Steel.

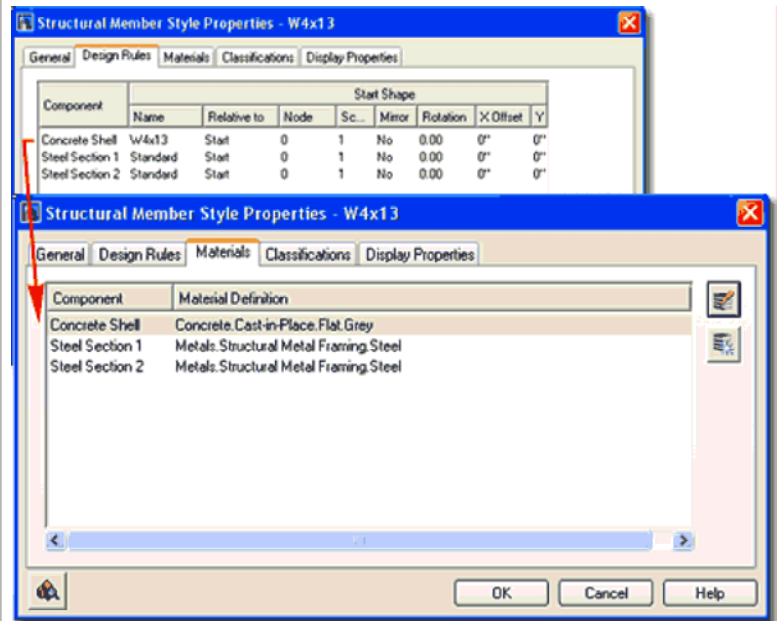
Materials and Structural Members will probably have a different relationship for many ADT users than with other Object Styles because of how framing plans are generally presented. Most Structural Engineers I have consulted for over the years not only don't care about Rendering but they don't care about 3D Models. If you plan to use Structural Members for framing plans you may want to look into how you can adjust the Display Representations more so than the Materials since there are options there that cannot be set to "By Material".

Structural Member Styles - Classifications tab

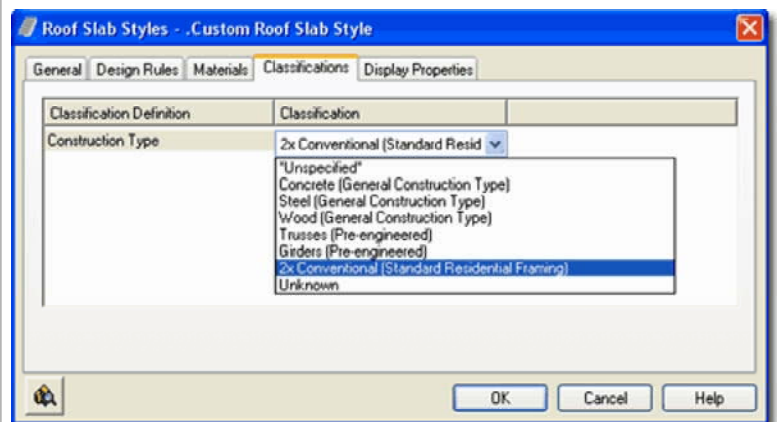
Links [Object Style Properties - Classifications Overview](#) - for an expanded step-by-step explanation of Classifications

The subject of **Classifications** is thankfully no where near as complicated as that of Materials so the only real question you will need to consider is if you need to use them. Classifications offer another way to separate Object Styles into categories that can be used in **Schedules** and even in **Display Representation Sets** (as "Show" or "Hide").

Since I am not a Structural Engineer I don't have a lot of experience with large scale framing systems where you might need classifications for various Structural Members so I can't come up with any examples. I can think of how I would like to differentiate Structural Members, particularly in remodeling work, but I would hate to create numerous sets of redundant Member Styles when I can just create separate drawing files. Should you have a good example, I would love to hear about it.



For designers wanting to emphasize exposed Structural Members, Rendering Materials should prove to be a valued asset.



To create a **Classification Definition** Style for Structural Members, use the **Format** pull-down. Create a Classification Name, "Apply To" Structural Members and add Classification items. You can also read a bit more about how to create Classification Definitions in [Part 1 - Display](#).

Structural Member Styles - Display Properties tab

Links [Object Style Display Properties Overview](#) - for the full story on Display Properties for Style
[Object Display Property Overrides - Object and Style Based](#) - for an explanation of the differences between using Display Properties via the Styles versus the Edit Object Display... option.

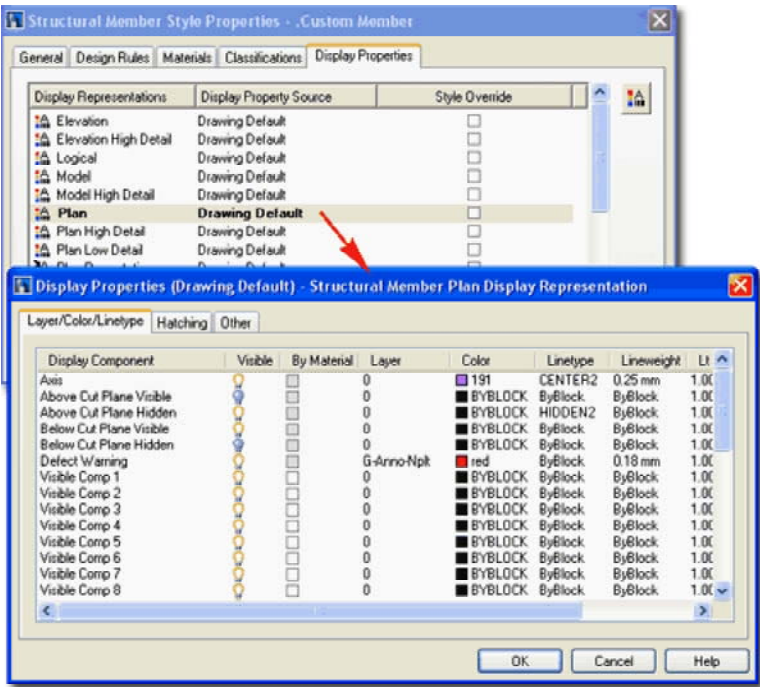
The **Display Properties** tab of the **Structural Member Styles** dialog box, illustrated right, provides access to the display characteristics of the components of your Structural Member objects; from Visibility to Cut Plane Height overrides. This is also where you would go to have Members change color or Materials, for example, when you switch from one Display Configuration to another. See the discussion on Structural Member Display Properties below for more information on this subject.

YOU CAN ALSO ACCESS DISPLAY PROPERTIES BY SELECTING AN OBJECT, RIGHT-CLICKING ON YOUR MOUSE AND USE THIS POP-UP MENU OPTION

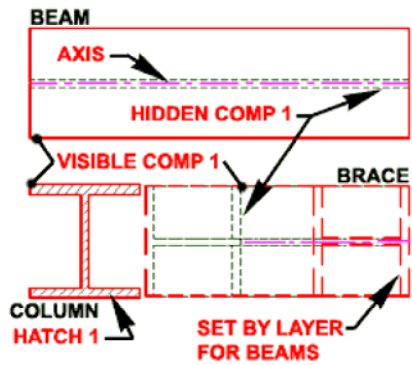


Illustrated to the left, is another way to access the **Display Properties** tab; select the specific object, right click on your mouse to invoke the object-specific pop-up menu and select **Edit Object Display...** Just be aware that when you use this approach, you can actually set an Object Override as opposed to a Style Override.

Object Overrides can be extremely useful because they allow you to add hatch patterns or change colors of any single object within a Style Family but they can also be problematic because they lock you out from more centralized, Style level, controls.



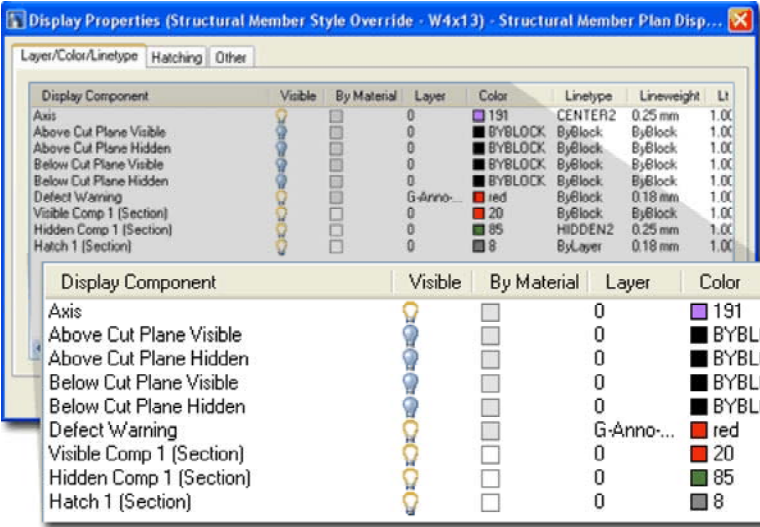
Structural Members - Display Properties - Component Layers



Illustrated to the right and left I show the basic list of **Display Components** for Structural Member Styles in **Plan**. Though there are different Display Representations for Plan, the list is virtually identical for each one (**Plan Low Detail** has less Components). The difference you may see between these Display Representations really has to do with how the same set of Display Components are

configured. This actually makes it easier to understand since more detail may just mean that more Components are Visible.

If you intend to do a bit of work with Structural Members, I suggest you invest a little time in creating some standard Member Styles with Display Properties that rise above the defaults (from the ADT Template Files) as illustrated to the right. Notice that the By Material checkboxes are not checked and you could certainly employ the Material Definitions to better manage some of the linework and hatch patterns; not to mention Rendering Materials.

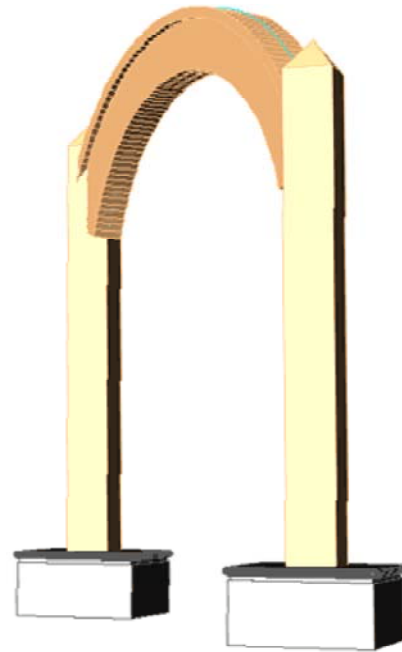


As with most other default Object Styles, the Display Components are set to specific Colors and you may want to set things like the **Visible Comp's** to **"By Material"** or at least **"ByBlock"** for greater display options.

7 Structural Member Display Properties

Most people take the appearance of Structural Members for granted and accept what they see for Columns, Beams and Braces but the reality is that you can create a multitude of unique Display Representations for Structural Members. If you look at the default template files that come with ADT, you should find that none of the Structural Members utilize unique Display Property Overrides and though this can make life easier, it also limits your options. In the case of Braces, for example, you can actually control where they are cut with the Cut Plane and how the lines above and below this Cut Plane are displayed. In the example immediately below I show how you can use these Display Representation options to work with tapered Members.

In the illustration to the right I show an example of an arch and post design I had to resolve for a project that used dozens of these around the base of a building. The arched beam shape uses a [custom shape](#) that I defined from a Polyline. The vertical Column Shape Dimensions were created with the [Structural Member Style Wizard](#) and the base and cap were assigned as [Custom Blocks](#) through the Display Properties tab of the Style.



Structural Members in Plan - Above and Below Cut Plane

Menu **Format> Display Manager...**



Keyboard **DisplayManager**

Keyboard **DisplayProps [Attach]**

Mouse Select Object, right-click, select Edit Door Style... or Edit Window Style... or Edit Object Display...

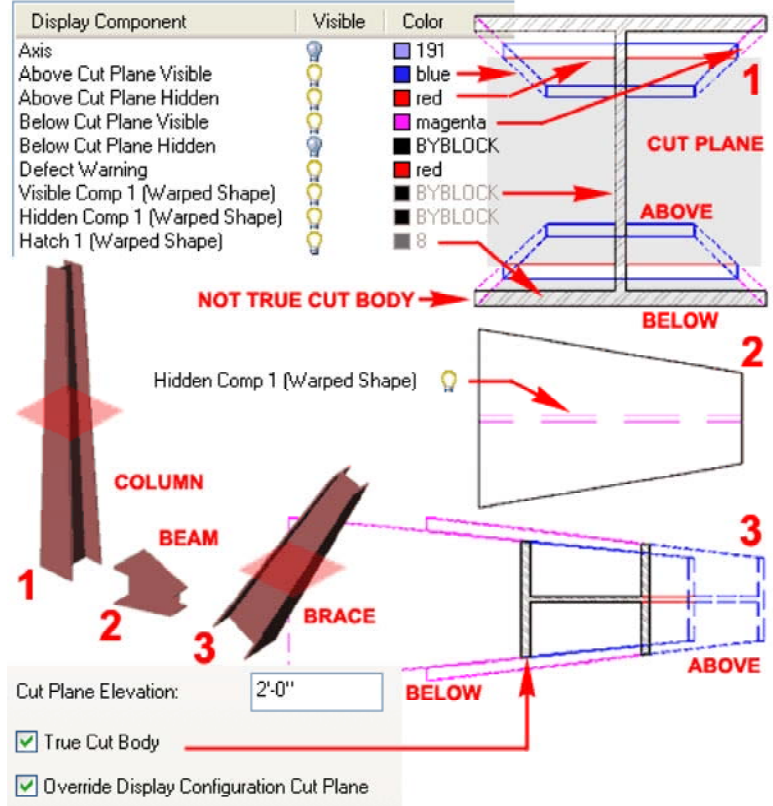
Links [Part 1 - Display - Object Display Properties Overview](#) - for more information on how to access the Display Properties of this Object.

Depending on how detailed your Structural Members need to be in your construction documents, you may find the need to delve deeply into the Display Representations to control how individual Components appear. For this discussion I will focus on the **Plan View** for Structural Members.

In the example illustrations to the right I used a custom Member Style that tapers to better clarify the **Above** and **Below** Display Components.

For the **Column**, example #1, reading all of the Display Components is actually more difficult than understanding their function on the Display Component list. In this example I did not change the default Body Cut so what you are seeing is the base of the tapered beam despite the fact that I moved the Cut Plane Elevation up to about the midpoint of this Column. Using the **True Cut Body** would help to read the Plan View but may not be ideal for Plan View Construction Documents since you may want to indicate the floor level footprint of the member. Personally, I would not use any of the Above or Below Display Component unless I was working on a detail.

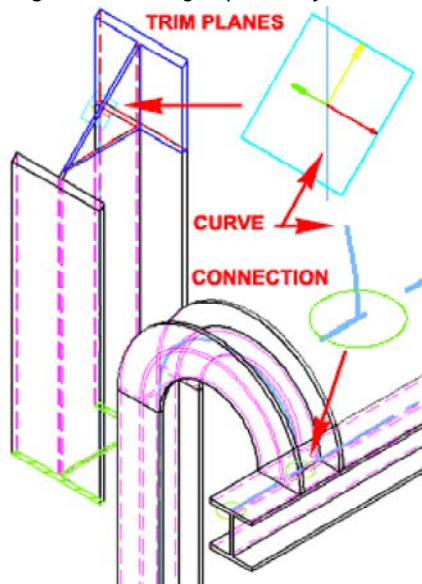
For the **Beam**, example #2, the Above and Below Cut Plane Display Components don't do anything and what's even more interesting is that the Cut Plane Elevation Override doesn't do anything either. And finally, I show the "Hidden Comp 1 (Warped Shape)" Display Component because that is actually what controls the fin in my example Beam. I played around with the Materials trying to figure out how to control the linetype only to discover that though there is a Material option, it too does nothing so you can set your preferences directly rather than By Material.



For the **Brace**, example #3, all of the Display Components discussed for the Column apply in the same way but in this example I show that I changed the Cut Plane Elevation and used the True Cut Body option to clarify where the beam is actually being cut. You can find these options on the "Other" tab of the Display Properties dialog box.

Structural Members - Logical

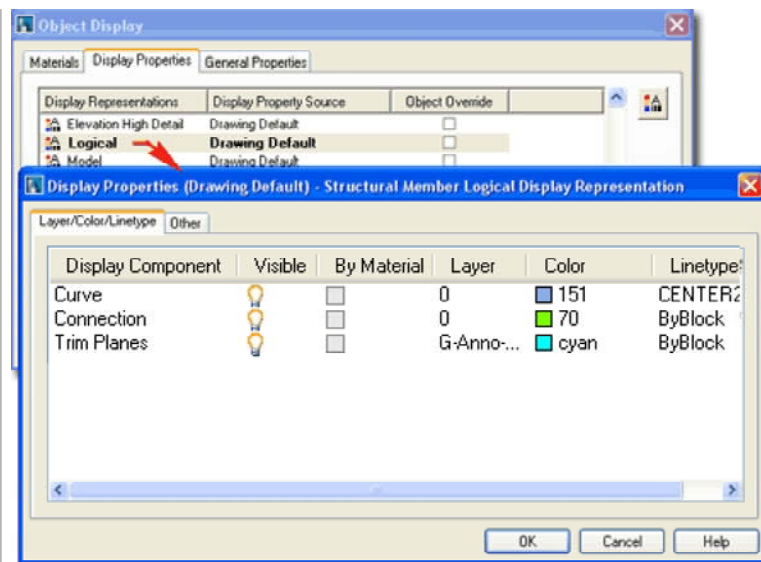
Structural Members have a unique **Display Representation** called "**Logical**" and though I personally don't find that it offers much, you may find that interesting graphical markers appear when using the default "**Diagnostic**" **Display Configuration**.



The Display Component that really has my attention is the "**Connection**" which may well hint at things to come in the future for Structural Members. For now, the Connection Display Component is just a circular Marker that displays where ever the Curve Display Component of two or more Members connect in space.

The **Trim Planes** Display Component is basically redundant given what you can work with using the **MemberEditTrimPlanes** command but it is a nice

option. I could not find any way to control the size of this Marker.

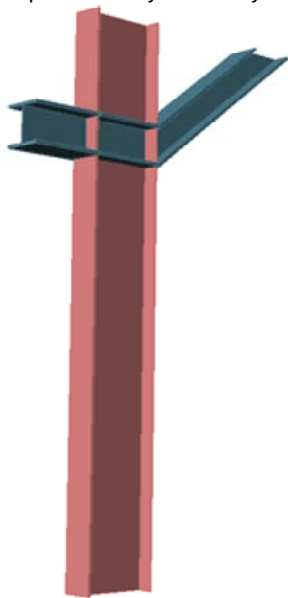


The **Curve** Display Component is similar to the Axis Display Component found under the Plan Display Representation. It matches the Justification and Length but not Axis Offsets so you can easily identify Offsets.

If you investigate the use of the Diagnostic Display Configuration, be aware that it also uses the Plan Display Representation. In the illustration to the right I turned On the Above and Below Display Components.

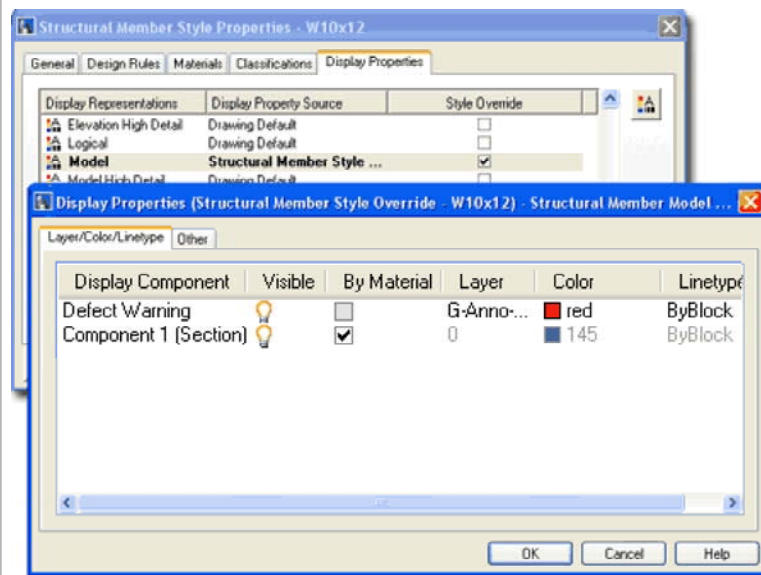
Structural Members in Model

The **Model Display Representations** for Structural Members are quite simple whether you use Style Overrides or the default settings. Illustrated to the left I show a Column that is controlled By Material and a Beam and Brace that are left in default mode (using Color 145).



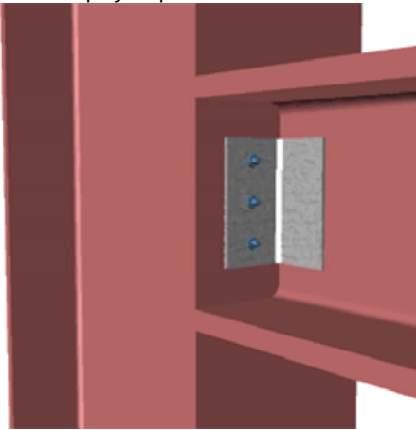
If you do not use a Style Override, the list will simply be a lot longer than what I illustrate to the right.

For 3D Details, such as those in Isometric form, you can actually use the Plan Display Representations instead of the Model. In order to do this, you will first have to create a special Display Configuration, Set and Representation by Object in which the Model View uses the Plan Display Representation instead of Model. This may sound complicated but it's rather impressive once you get it to work.



Display Properties - Structural Members - Other tab

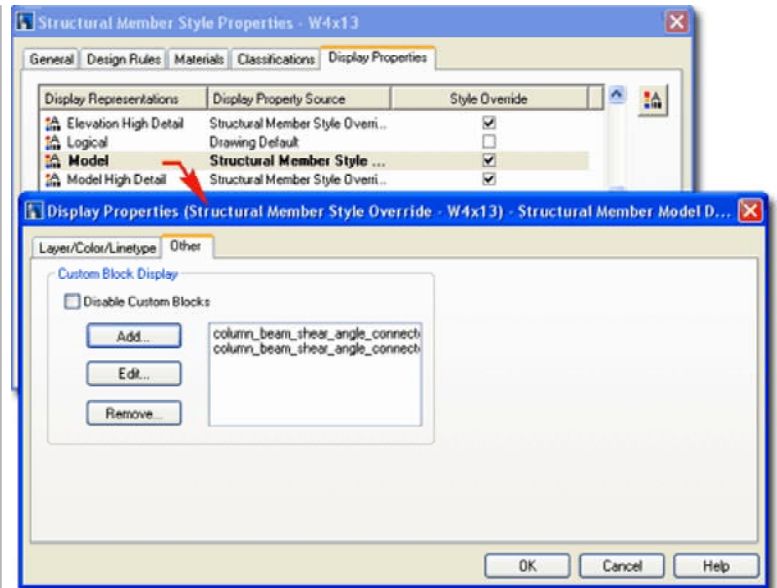
Most, if not all, of the Display Representations for Structural Members have the option to add custom Components by Attaching Blocks. To access this feature use the **"Other"** tab as illustrated to the right for the Model Display Representation.



In the illustration to the right notice that I have used a Style Override for all of the Display Representations that I have decided to add a custom Block to. If you don't use a Style Override, you will end up with your custom Block as a default and that is probably not something you will want.

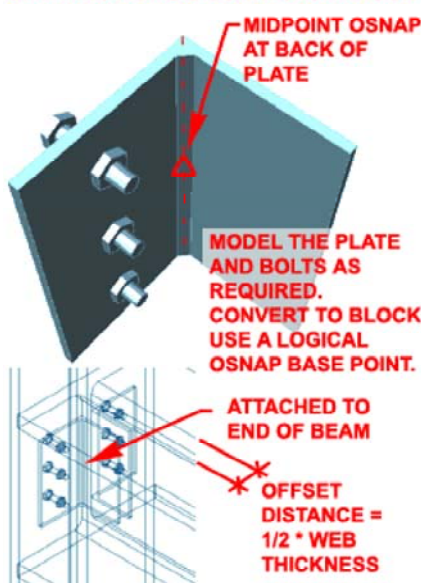
On the Other tab, illustrated to the right, I show that I have **Added** the same Block twice and this would be for

cases where you expect to have more than one copy of the Block on your Structural Member. One example of such a condition is a simple shear connector between a steel beam and a steel column; since there is one plate on each side you can attach the Block for one side and then again for the Mirrored side.



Structural Members - Custom Blocks

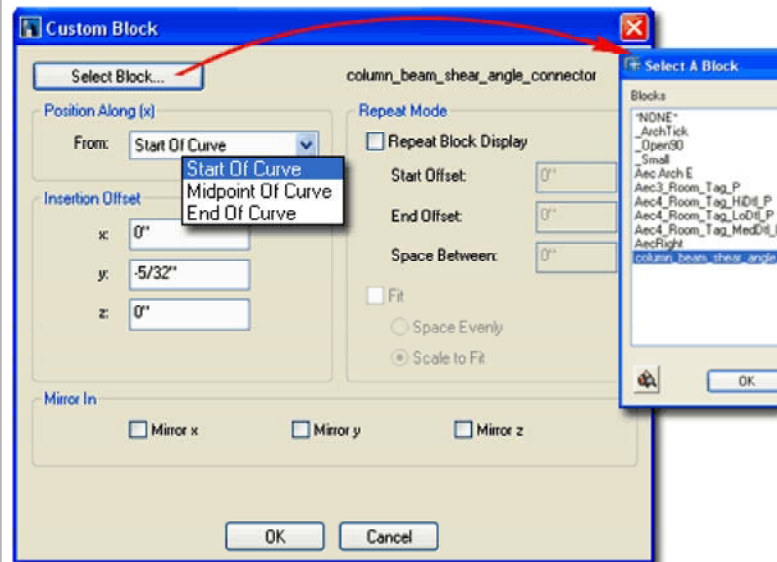
CREATING A BASIC CONNECTOR BLOCK



Once you get to the point where you are looking at the **Custom Block** dialog for a Structural Member Style, you should find that the options are relatively self-explanatory and that it's not Attaching a Block that is the problem but creating one that produces the results you seek.

Since you have three primary **Positions Along (x)** to choose from and the option to move the Block relative to those three positions, you should plan ahead for this when creating the Block Insertion Point.

In the illustration to the left I show a simple shear connector and Bolts that I created out of **Mass Elements** to take advantage of Materials and Display Representations. It was basically Modeled in place so I could see how it should be placed but you can model these anywhere. I find it best to Extrude in the direction of intended application (vertically in this case). For this connector, using the Midpoint OSNAP, at the back corner of the angle plate, as the Block **Insertion Base Point** works really well. Over on the Custom Block dialog box you can see that all I had to do is calculate the Y-axis Insertion Offset value to push the plate out of the Beam's Web (Offset = $1/2 * \text{Web Width}$). To have this Block appear on the opposite side of the Beam, I Added it again and used the **"Mirror Y"** checkbox to flip it over to the other side.



On the Custom Block dialog box you can use the **Repeat Mode** to Array a Block along a Structural Member (if **Space Between** is set to zero, only one Block is used). This option prevents you from having to Add the same Block several times when you just want copies along one axis. The **Fit** option can **Space Evenly** regardless of the actual Member Length and can thus produce results where your Custom Block repeats beyond the Member. **Scale to Fit** simply stretches one Custom Block and ignores the Space Between Repeat setting.

Keep in mind that Adding a Custom Block for one Display Representation only produces results whenever the current Display Configuration uses that Display. This means that you have to repeat the work for all other Display Representations in which you want the Custom Block to Appear - now how frustrating is that? Where's the "Apply to all Display Representations" check box like the one we have for Muntins?

Tip:

For Custom Blocks that you want to match the length of the Member such as decorative classical columns, use the Repeat Block Display, leave all values at zero but use the Fit with Scale to Fit option.

8 Structural Member Shapes

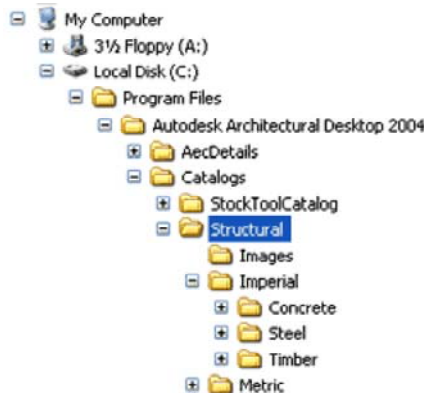
Structural Member Catalog

Menu **Format> Structural Member Catalog...**



Keyboard **MemberCatalog**

Creating or Importing New Structural Members is relatively easy and even fun as long as the Member you need is listed in the **Structural Member Catalog**. This catalog is actually an .xml (eXtensive Markup Language) file that uses a browser-like interface as illustrated to the right. This means that all of the sizes and images are written in a code similar to .html and thus opens the door for customization. The hope was probably that some day we could point our Catalog Browser to manufacturer websites for up-to-date framing member specifications but I have yet to see any evidence of this manifesting anywhere. If you are a hacker, you can create your own or customize the existing catalog which I have done simply to add missing member sizes under the Timber category. You can open the .xml files with Notepad but introducing new categories, sizes and images takes a bit of knowledge about writing code.



Ironically, given the strict adherence to user profiles in most of ADT, the Structural Member Catalog is stored, by default, under the Autodesk Architectural Desktop 2004 sub-directory as illustrated to the right. CAD or IT Managers may have or may want to relocate this catalog to the office server and then all you have to do is point the browser to the new location and it will remember it for the next use.

Structural Member Catalog - basic concept.

XML (eXtensive Markup Language) was developed by the World Wide Web Consortium (W3C) and is a permutation of the ISO's SGML (Standard Generalized Markup Language), used for large databases.



Since I am not a database person, this is not one of my strong areas but as I see the integration of XML in CAD, it offers a number of interesting and valuable by-products.

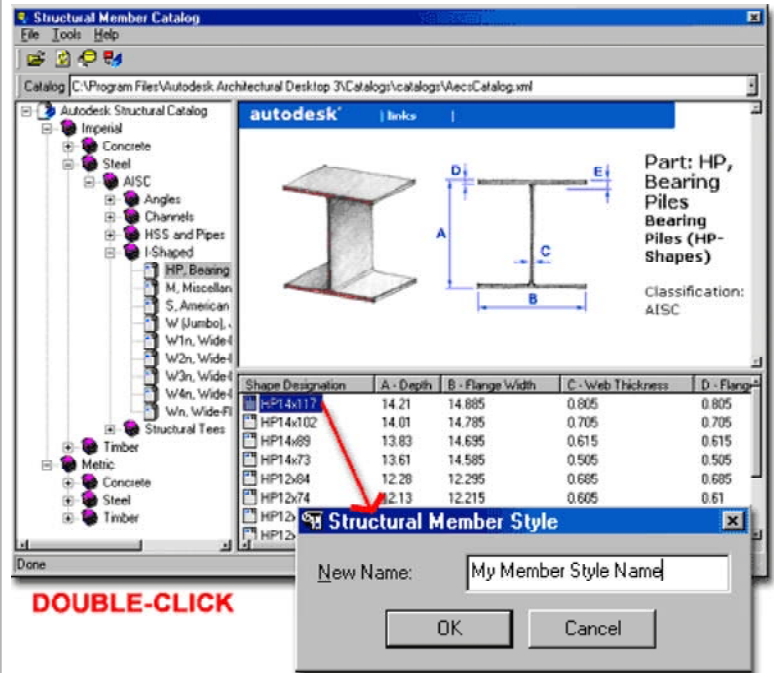
The first, and most important, is a common language that spans the great divide between CAD to CAD and CAD to non-CAD. XML is an object based language so information can be called in query fashion allowing non CAD programs to utilize data for such things as

Cost, Size, Manufacturer and Type.

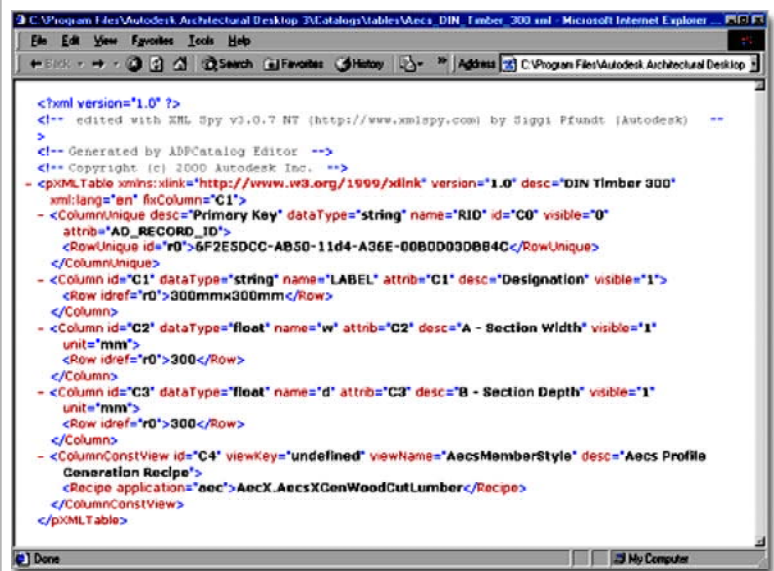
The second by-product, part of the first, is that we are working with a data language easily translated through the internet. This means that it should be fairly easy to acquire data from manufactures for use in our CAD files. I-drop, for example, uses .xml to allow us to drag blocks from manufacturer sites such as Herman Miller.

If this all sounds like something we dreamed of in the past with Blocks and Attributes, you are right. What makes this more likely to live up to the hype is that it is not isolated to AutoCAD but is used by many other products. What makes this questionable is that it hasn't become the

8-13 STRUCTURAL MEMBERS



Once you have navigated your way to a Structural Member Shape that you want to Import, you can **double-pick**, right-click or use the Generate Member Style... button to activate the **Structural Member Style** text box, illustrated to the above. You can accept the default Name or **Name** your Member as you see fit for use in your project. Since all Structural Member Shapes are equally accessible under Columns, Beams and Braces, you may want to include nomenclature to designate how it is to be used so you or someone else does not accidentally use a Concrete Column as a Beam, for example.



Illustrated below, I show a couple of lines that provide the data for how Wide this wood member is: **300**. Above, after the word "unit", you can see that the width is defined in Millimeters ("mm").

"industry standard" yet and like so many other languages, could be supplanted by yet another language.

Illustrated to the right, is one of the Structural Member Catalog files opened in Internet Explorer: "**Aecs_DIN_Timber_300.xml**" You can open an XML file in either a browser or with Notepad. Within the file is a lot of information to classify this particular object, including WC3 classification. If you look carefully at one of these files, though, even a non-programmer can read the data.

```
<Column id="C2" dataType="float" name="w" attrib="C2" desc="A - Section Width" visible="1" unit="mm">
  <Row idref="r0">300</Row>
```

You can learn more and even begin writing your own XML code by visiting <http://www.xmlspy.com>

Structural Member Style Wizard

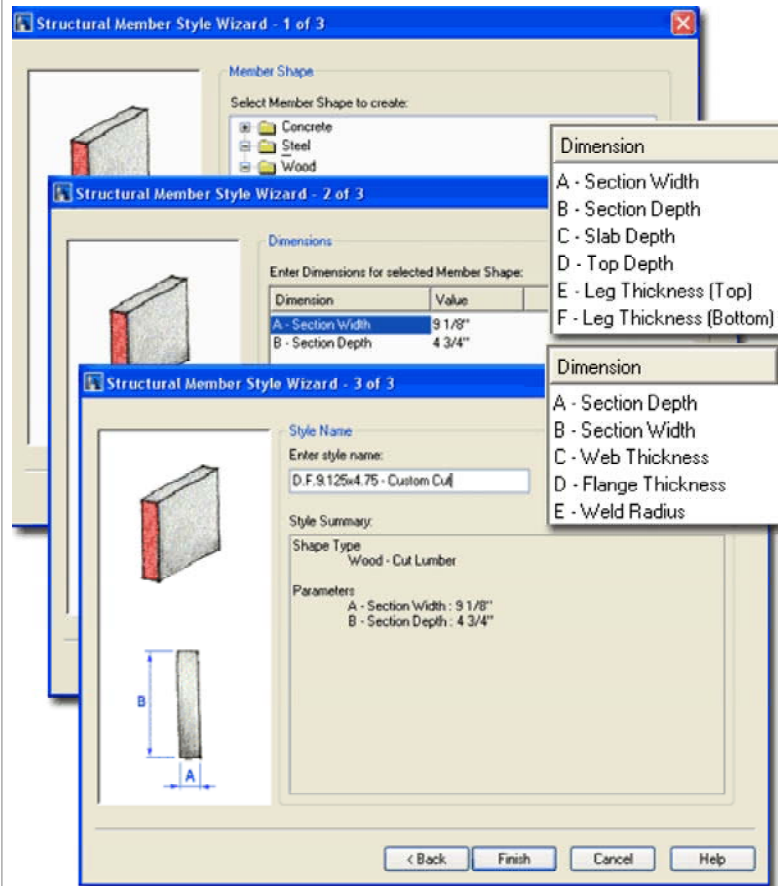
Menu **Format> Structural Member Style Wizard...**

Keyboard **MemberStyleWizard**

If the Structural Member Catalog does not have the specific dimensions for a Member Shape that you need, you can use the **Structural Member Style Wizard** to solve this problem.

Illustrated to the right I show how I have used the Structural Member Style Wizard to create a custom **Cut Lumber** (something I do more often than any of the other options). I also show that under other Shapes you will find different Dimensional options as they relate to the Shape.

Once you have run through the 3-step process, the result is identical to having Imported a Structural Member Style from the Catalog. You can add your new shape immediately by using the Add Column, Add Beam or Add Brace tools.



Structural Member Shape Define

Menu **Format> Define Custom Member Shape**

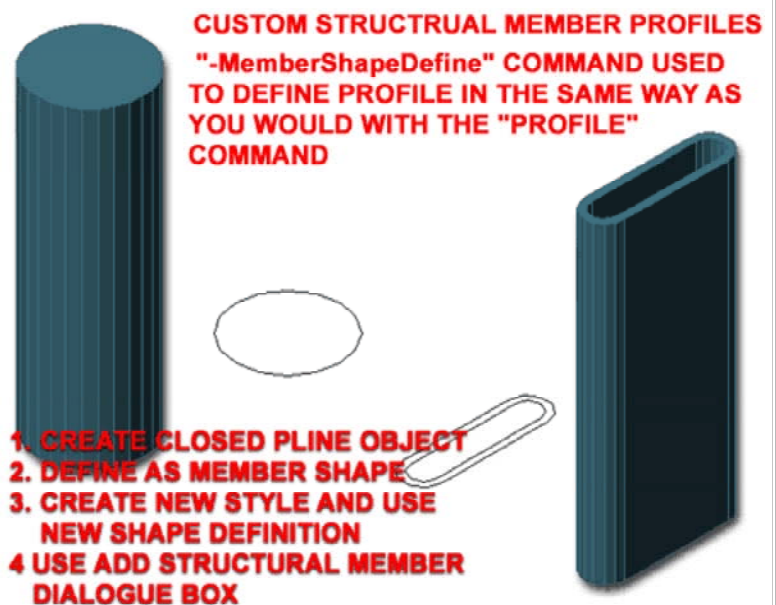
Keyboard **-MemberShapeDefine** (notice the dash)

Links [Structural Member Styles](#) - for working with Styles

To **create your own Member Shape** when it does not fall into any of the predefined shape categories under the Structural Member Style Wizard, you will need to use a Polyline and draw the cross-sectional shape. For hollow shapes, you can use concentric Polylines or off-center outlines as long as one is inside the other.

For Structural Member Shapes you have to use the **"-MemberShapeDefine"** command (not the Profile command) which uses no dialog box options and is entirely command line oriented as illustrated in the steps below:

Command: **_-AecsMemberShapeDefine**
 Shape [New/Copy/Edit/Purge/?]: **N**
 New style name or [?]: **Ionic_Column**
 New style Ionic_Column created.
 Shape definition [Name/Description/Graphics]: **G**
 Shape [plan Low detail/Plan/plan High detail]: **P**
 Erase polyline? [Yes/No] <No>:
 Select a closed polyline: **<Select Polyline>**



When going through the list of options within the **MemberShapeDefine** command, the objective is fairly logical and follows at listed below.

1. Use the New option to create a **New Shape** and **Name** it.

Add another ring? [Yes/No] <No>:
Insertion Point or <Centroid>:
Shape [plan Low detail/Plan/plan High detail]: **H** <See Comments>
Erase polyline? [Yes/No] <No>:
Select a closed polyline: <Select Polyline>
Add another ring? [Yes/No] <No>:
Insertion Point or <Centroid>:
Shape [plan Low detail/Plan/plan High detail]: **I** <See Comments>
Base Point for Sketch Representation: <Select Base Point to match others>
Select lines, arcs, or polylines for Sketch Representation: <Select Polyline>
Select lines, arcs, or polylines for Sketch Representation:
Shape [plan Low detail/Plan/plan High detail]:
Shape definition [Name/Description/Graphics]:
Shape [New/Copy/Edit/Purge/?]:
Command:

Structural Member Shape Assignment

Alt.Menu **Design> Structural Members> Member Styles...**



Keyboard **MemberStyle**

Links [Structural Member Styles](#) - for working with Styles

For all of the **Shapes** discussed in this section, you will find that they only work if they are listed as a **Component** in the **Name** drop-down list on the **Design Rules** tab of the **Structural Member Style Properties** dialog as illustrated to the right.

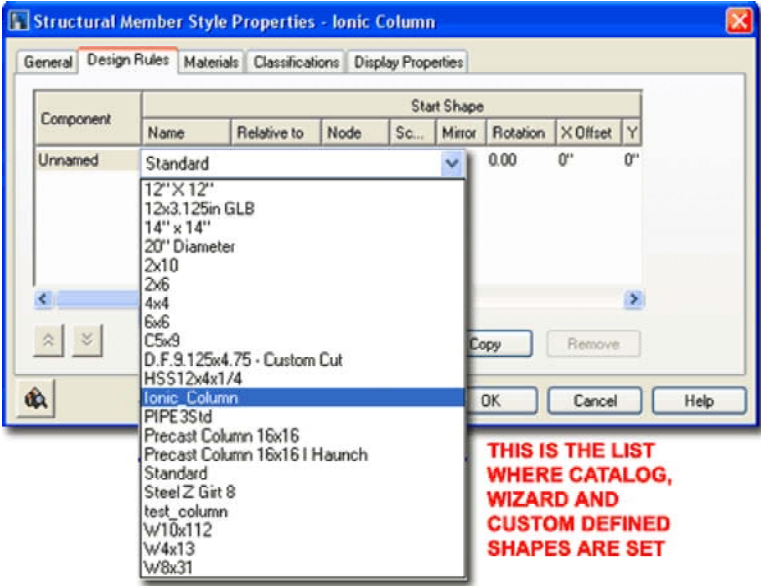
When using the Structural Member Catalog or Style Wizard, you should find that not only do you Import a new Shape but also a new Style where the Shape is automatically assigned for the Start and End position.

When using the **-MemberShapeDefine** command, however, nothing is created for you automatically and thus you have to manually set the new Shape Name as a Component.

Since Structural Member **Style Names** are not necessarily tied to the **Shape Name**, you can have several different Style Names that all use the same Shape Name. This might be advantageous for unique Materials, Classifications or Display Property settings.

- 2. Use the Graphics option to assign or **Select** your **Polyline(s)**.
- 3. Go through each of the "plan **Low** detail", "**Plan**" and "plan **High** detail" display representations and assign the Polyline(s) you want displayed for each representation. If you are in a hurry, simply reselect the same Polyline(s) for each.
- 4. The insertion point may need to be carefully chosen but I typically default to "**Centroid**".

After Defining your custom Member Shape, you will need to assign it as a Component to an existing or new **Structural Member Style**. See the discussion directly below for information on where to assign the Shape Name as a Component within a Structural Member Style.



Be aware that when you create new Shapes, even when you Import Member Shapes from the Structural Catalog, no unique Materials, Classifications or Display Properties are assigned and you may need to run through the Styles and adjust these settings. If you find that you need all sorts of custom Style Settings, you may find that using the Catalog just doesn't do the trick and this will force you into creating a Structural Member Style file similar to all of the other Style files for Doors, Windows, Slabs and so on. You can then create a Structural Member Tool Palette.

9 Structural Members - Customizing and Tricks

Structural Member Tags

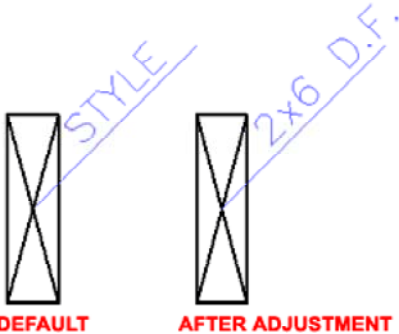
Alt.Menu **Document> Scheduling> Data Format Styles...**

Keyboard **PropertyFormatDefine**

Links [Property Set Definition Styles](#) - for more on Property Set Definition Styles and how they apply to Objects and Tags.

I can't believe that I actually need to discuss this topic but apparently someone left some important information out of the Structural Member Style **Property Set Definition** that is required to produce results in the Structural Member Tag. You should also be aware that when I dragged in my Structural Member Tag, it inserted the Plan 1-100 Display Configuration which comes from ADT 3 - 3.3 and should be Purged out of the Tag Drawing File.

COLUMN TAG



Illustrated to the left I show what you are likely to get when you use any of the three default Structural Member Tags and what is supposed to happen. The Tag is supposed to extract the Style Name.

Illustrated to the right I show how you can fix the problem. From the **Property Set Definitions** folder in the **Style Manager**, locate the **"StructuralMemberStyles"** Property Set and go to the

Definition tab. Use the **"Add Automatic Property Definition"** button to add the **"Style"** Property Source as illustrated. The Format should be fine as the default **"Standard"** so all you have to do is **OK** out and try tagging a Structural Member.

