



An Introduction to Point Verification in Mastercam X

This Paper should supply you with more than enough information to start verifying data in Mastercam X. It begins by showing the basics of point entry, creating surface offsets, and creating curves on edges. A spread of the Mastercam X interface is presented on pages 5 & 6 to give you a labeled map of just about every pertinent feature plus a brief explanation on navigation and view manipulation. Then, a brief introduction to the new selection tool bar is given followed by actual methods of data verification. An appendix is provide with various tips, shortcuts, and other information intended to enhance overall proficiency with Mastercam X (this will be updated over time).

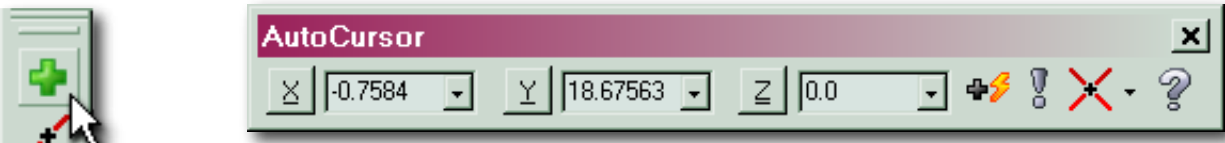
INDEX

Topic	Page
1. Creating the Point	1-2
2. Creating the Offset Surface - Changing the Normal.....	2
3. Creating the Offset Surface - Creating the Surface.....	3
4. Creating the Offset Surface - Shortcut, Skipping the Normal	3-4
5. Creating Curves on Surface	4
6. The Mastercam X Interface & View Manipulation.....	5-6
7. Introducing the General Selection Tool Bar	7
8. Verifying Properties of Holes and Slot	8
9. Verifying Surface Points	9
10. Verifying Trim Edge Points	10
11. Appendix.....	11+

For the most part, adjusting to point verification in Mastercam X requires a shift in thinking on how things were done in Mastercam 9. Once you make this shift the program becomes much more intuitive and you will find that the new interface has many serious advantages over version 9.



My challenge will be to highlight these advantages and in doing so encourage you to migrate.

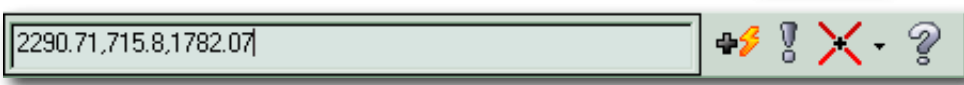
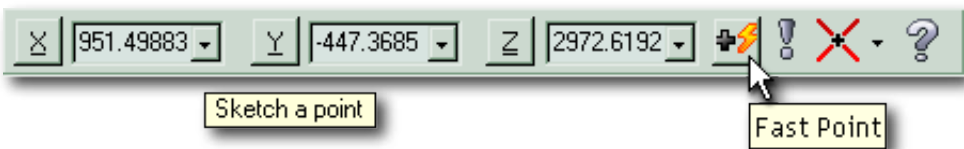
Creating the Point




The first Mastercam X feature for our consideration concerning point verification is the AutoCursor tool bar and how it is used specifically for point entry. It is a completely new interface for entering or creating points (among other geometric entities such as lines).

Creating or entering a point is usually the initial starting point in the process of point verification (of course).



The 'Create Point' button  will initialize or activate the AutoCursor bar. Pressing the 'Fast Point' button  or the **Space Bar** will activate 'Fast Point'.

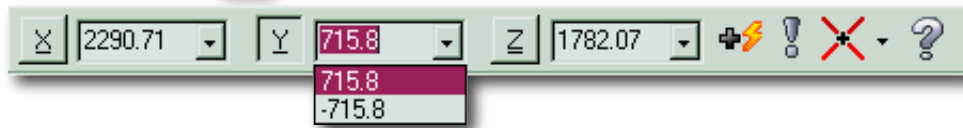


'Fast Point' allows you to type in the coordinates as you would in Mastercam 9. *This is a very frequent operation so I created a short cut for 'Create Point'; the F12 key. Pressing the **F12** key then following with the **Space Bar** will allow you to immediately enter your coordinates. Clicking 'Enter' plugs in your point – clicking the **Space Bar** again allows you to enter another point and so on. Clicking  fixes the last point entered and exits the Point creation function.*

You will notice the '**Ribbon Bar**' near the top of the Mastercam X screen (see below), it's *dynamic*, meaning that it will change as you pick different tools (it's title will indicate what tool is active – if none is active it will just say 'Ribbon Bar'. This feature is new in Mastercam X. It will display all possible options associated with the tool or function that is active at the time. In the case of 'Point' only two options are available, 'Edit Point' and 'OK'. More about this later.



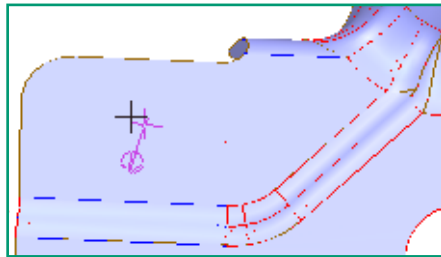
Note: If you believe you have miss typed a coordinate click  (Edit Point) then call up the last coordinates entered by sequentially clicking on the down arrow of each X, Y, and Z coordinate, make your corrections then click 'Enter'. A point will be created at the new coordinate. Clicking  fixes the last point entered and exits Point creation.



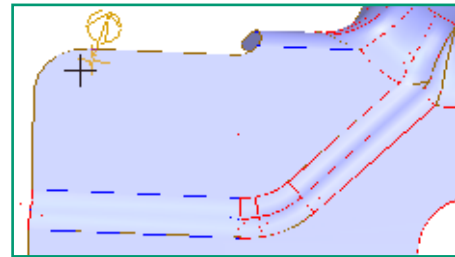
Creating the Offset Surface

Part 1: Changing the Normal

Changing the Normal of a surface implies finding the direction toward which the material's thickness extends (often described as the design side). For various reasons this direction is often reversed and needs to point in the opposite direct before the correct offset surface can be created.




Arrow indicates incorrect Normal direct.



Arrow indicates correct Normal direct.



At this point you must use the 'Ribbon Bar'. In the case of the 'Change Normal' ribbon (above) only two options are available; 'Flip' or 'OK'. Since our the arrow initially pointed in the wrong direction we need to reverse the direction by clicking the 'Flip' button. Clicking  saves and exits the Change Normal function.

A Note About the Vertical Tool Bar on the Left and Customization

The vertical tool bar on the left has been created from scratch. I designed it specifically as the all-in-one point verification tool bar. It contains virtually all the tools necessary for verifying points and I recommend that you use it.

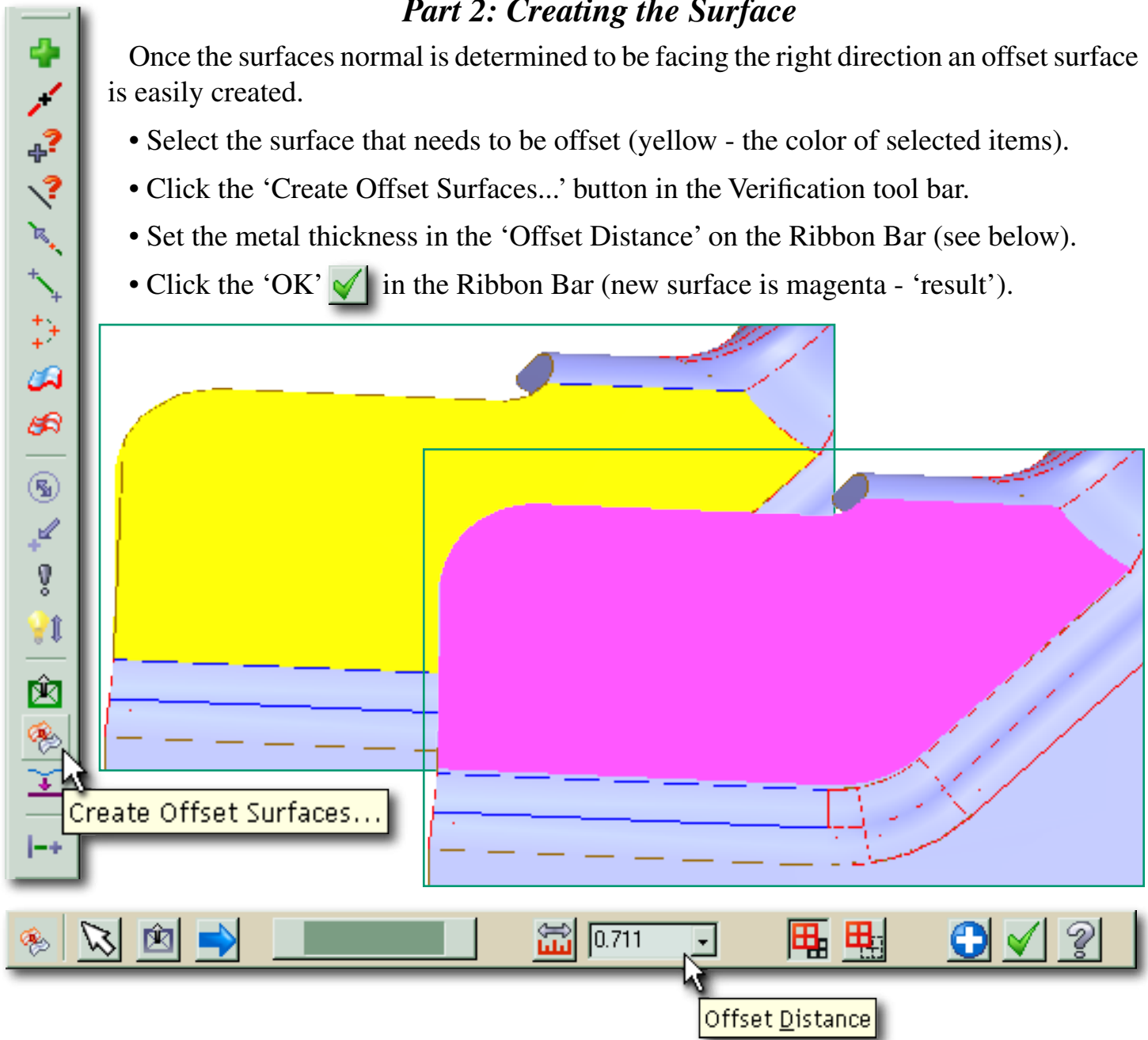
Inevitably, you will need to use other tools and this tool bar contains only a small fraction of tools available. In Mastercam X your can create all sorts of tool bars, customized for any specialized task imaginable. You *can* go through the **Menu** and find basically all the same commands. You can also easily create shortcut keys for frequently used commands.

Creating the Offset Surface

Part 2: Creating the Surface

Once the surfaces normal is determined to be facing the right direction an offset surface is easily created.

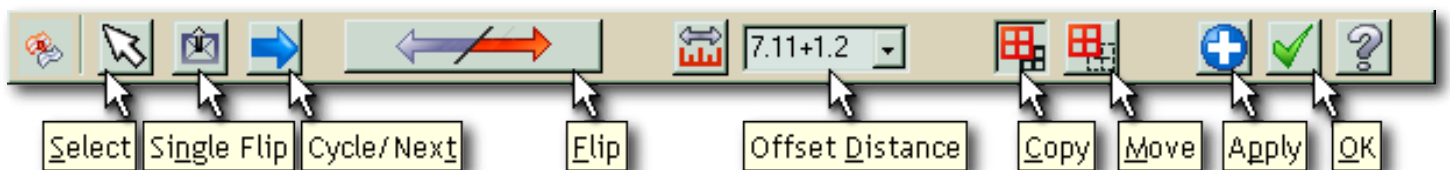
- Select the surface that needs to be offset (yellow - the color of selected items).
- Click the 'Create Offset Surfaces...' button in the Verification tool bar.
- Set the metal thickness in the 'Offset Distance' on the Ribbon Bar (see below).
- Click the 'OK' in the Ribbon Bar (new surface is magenta - 'result').







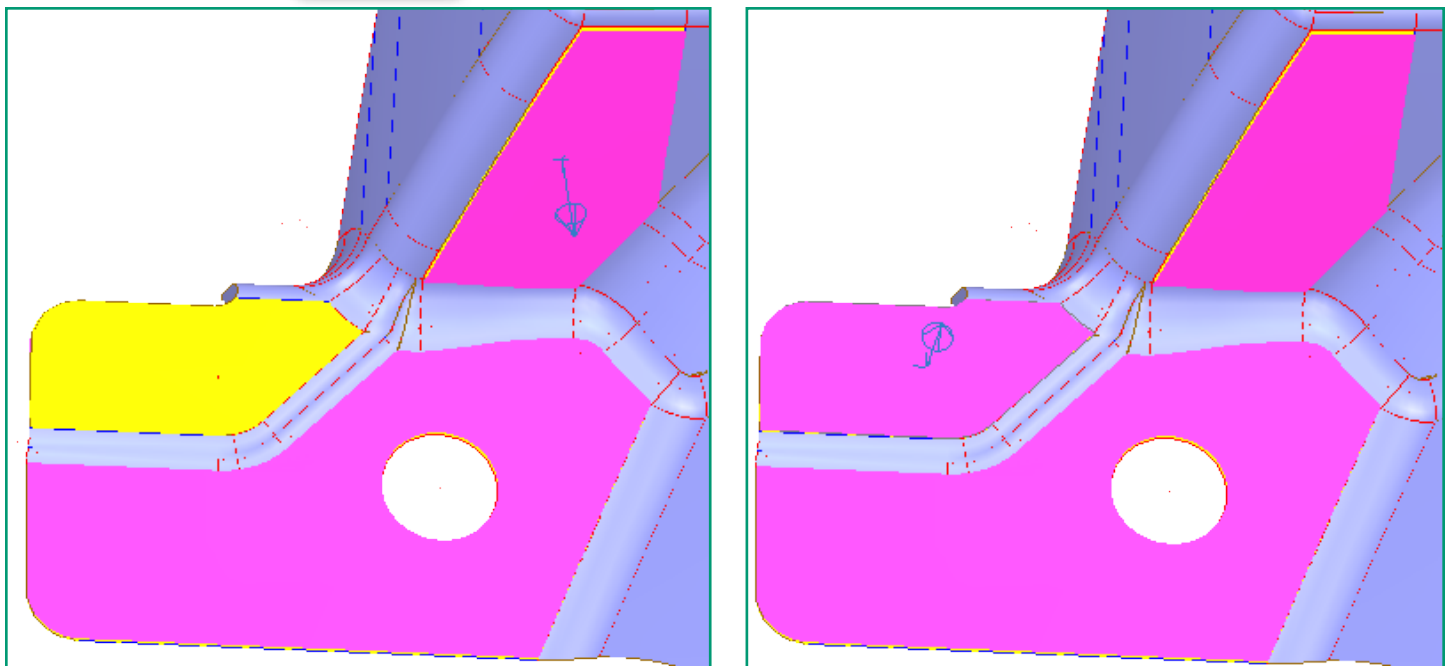
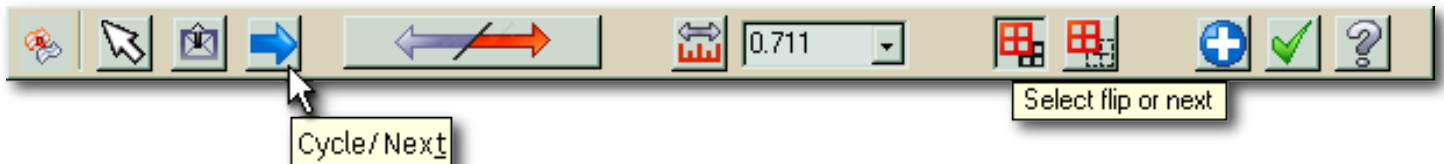
Creating the Offset Surface

Part 3: The Shortcut (skipping the 'Normal')

Actually, in Mastercam X it is not necessary to set the Normal before beginning the process of creating offset surfaces. In fact, that step can be completely eliminated. Not only can you set the direction of the offset surface in the process of creating the surfaces, but you can manipulate the direction of multiply surfaces and select completely new surfaces while your at it. The Mastercam X offset surface interface is much more comprehensive then Mastercam 9's.





Select two or more surfaces for creating offsets (without setting the normals) then type in the offset distance and click 'End Selection'  (see page 7 - General Selection Tool Bar), the automatic preview shows you how your surfaces will be generated (magenta). One selected surface is still yellow meaning that the offset is going in the wrong direct (below the yellow surface). By clicking the 'Cycle/Next' button you will notice an arrow indicating the direction of one of the offset surfaces. Clicking it repeatedly will cycle you through all the selected surfaces. When the arrow disappears it's on the one surface that is reversed. Clicking 'Flip'  will pop the offset surface around to the correct direct. Clicking 'Apply'  accepts the surfaces you have generated and allows you to go on to offset more surfaces. Clicking 'OK'  accepts the surfaces and leaves the Offset Surface command.

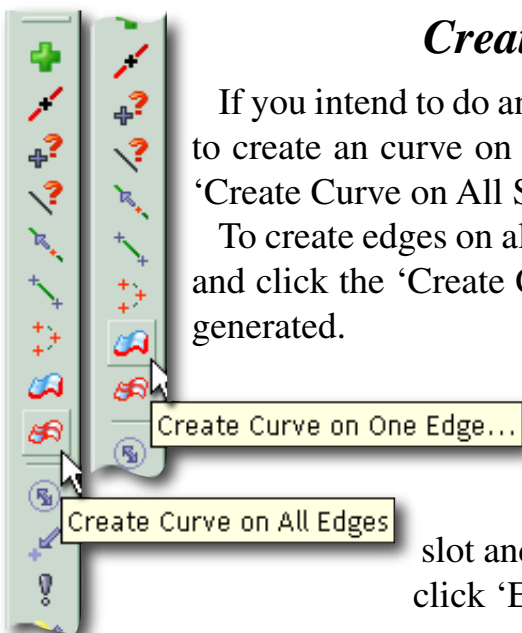


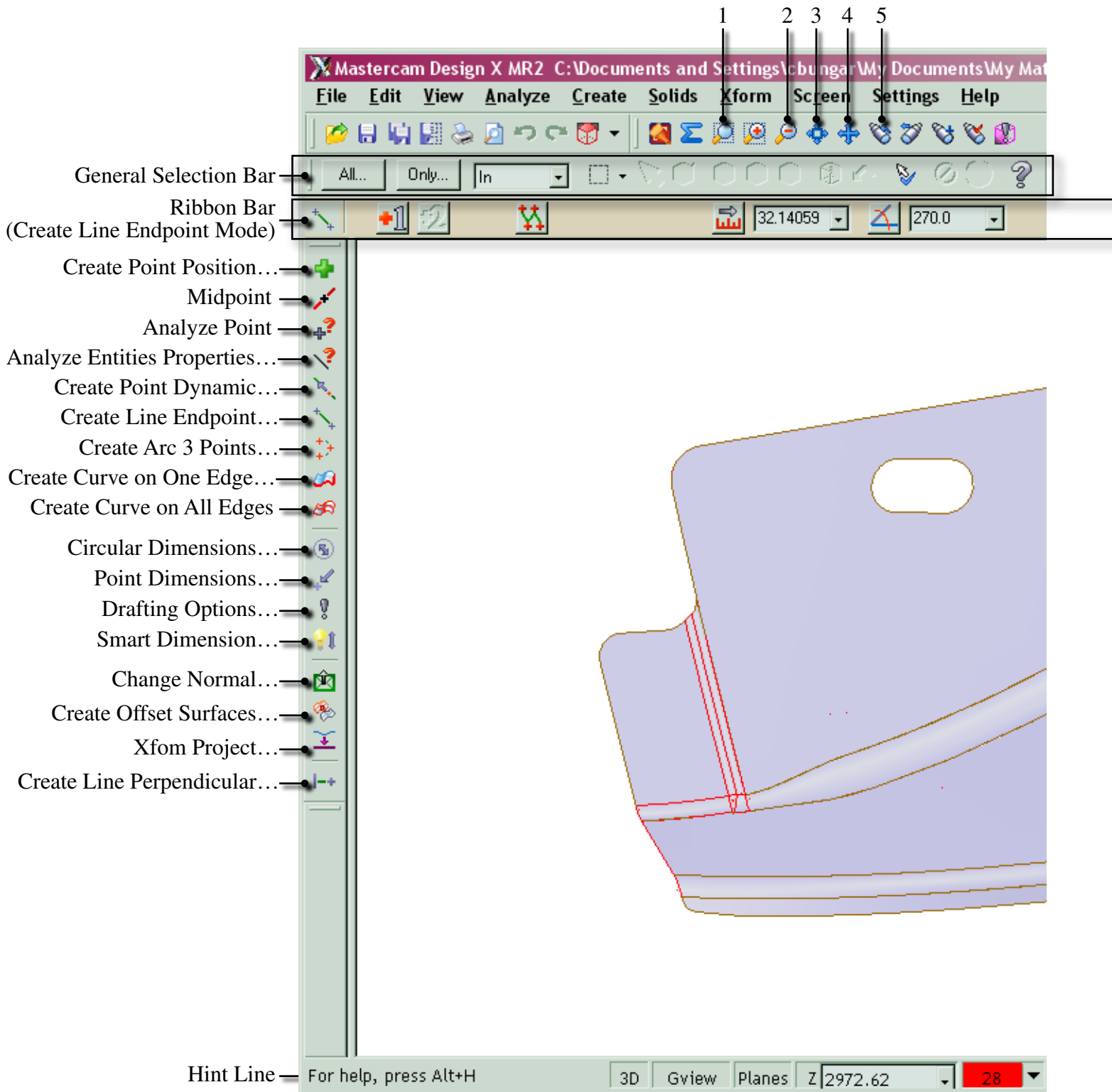
Creating Curves on Surfaces

If you intend to do any Edge Point or Hole/Slot Location verification you will need to create an curve on one or more of the surface edges. You can either choose the 'Create Curve on All Surface' or 'Create Curve on One Edge' commands.

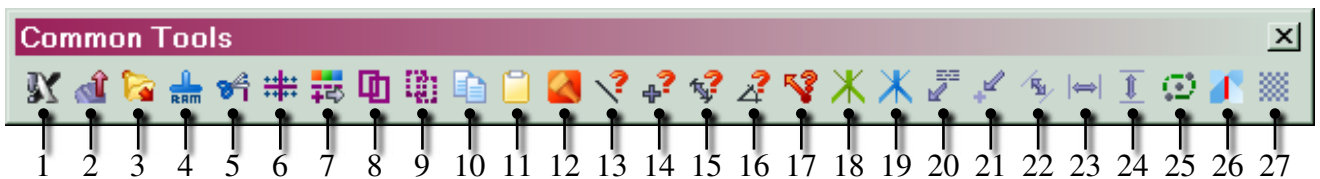
To create edges on all surfaces you select all the offset surfaces you've just created and click the 'Create Curve on All Edges'  command — all edge curves will be generated.

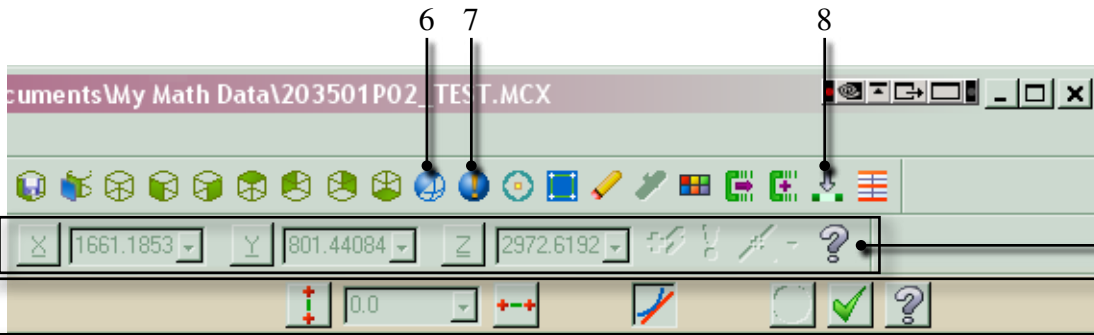
To create a curve on one edge (such as for finding the properties of a hole or slot) click on the 'Create Curve on One Edge'  command then select the surface adjacent the hole or slot. When an arrow appears slide it to the edge of the hole or slot and click. A single curve will be generated on that edge. You can click 'Escape' or 'Enter' to exit the command.





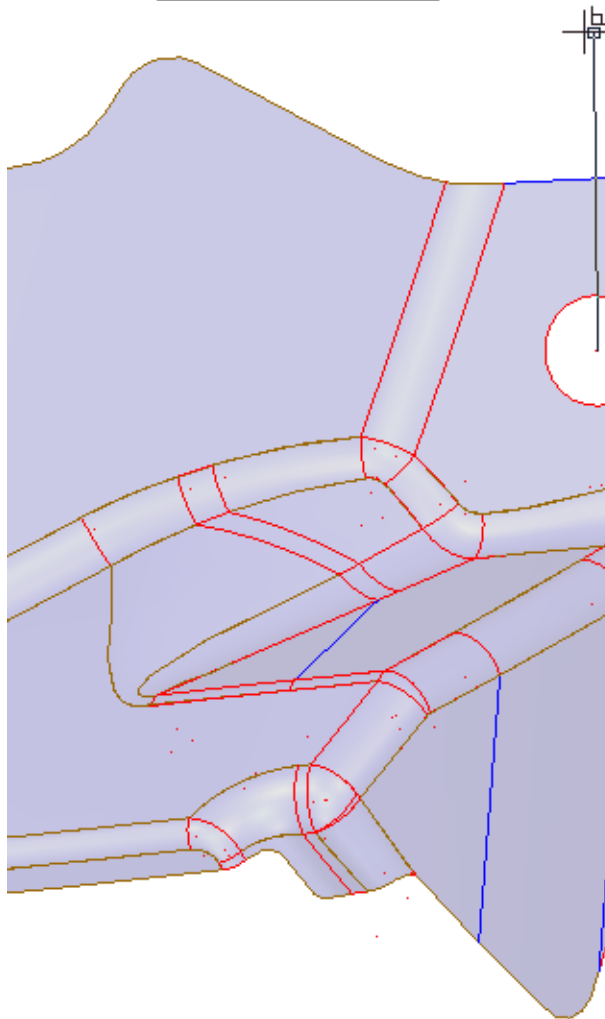
Common Tool Bar





AutoCursor Bar

Specify the second endpoint



Navigation and View Manipulation

I have my navigation and view manipulation tool bar across the top of the window. Getting around and about in Mastercam X is similar to version 9 (though the icons have changed a bit).

- 1 Zoom Window (F1)
- 2 Un-Zoom by .8% (F2)
- 3 Fit (Alt + F1)
- 4 Pan (custom; F10)
- 5 Dynamic Rotation (see appendix for optimizing)
- 6 Shading Toggle (Alt + S)
- 7 Shade Settings...
- 8 Toggle Auto Highlighting (turns off the highlighting that occurs as you move the cursor over a drawing - new)

All the other icons are much the same. The arrow keys work the same as in version 9.

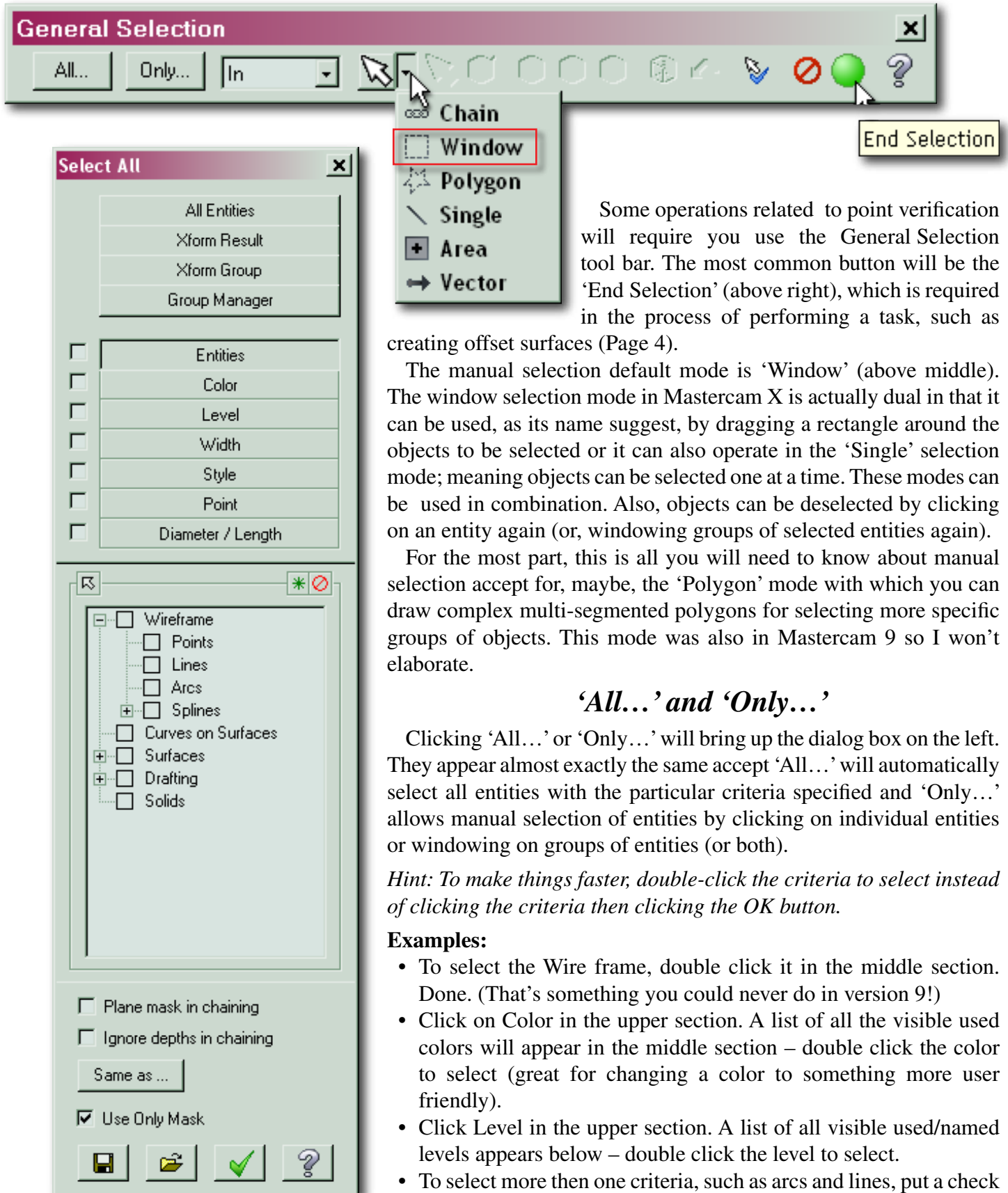
See Appendix for more Shortcut Keys.



- | | | |
|-------------------------------|----------------------------------|-------------------------------------|
| 1. Configuration... | 10. Copy | 19. WCS T/C Plane axes |
| 2. Key Mapping... | 11. Paste | 20. Create Note... |
| 3. File Merge/Pattern... | 12. Regenerate Display List | 21. Point Dimension... |
| 4. Ram Saver | 13. Analyze Entity Properties... | 22. Parallel Dimension... |
| 5. Trim / Break (custom: F11) | 14. Analyze Position | 23. Horizontal Dimension... |
| 6. Screen Grid Settings... | 15. Analyze Distance ... | 24. Vertical Dimension... |
| 7. Change Entity Attributes | 16. Analyze Angle... | 25. Create Rectangular Shape... |
| 8. Un-Blank Entity | 17. Analyze Dynamic... | 26. Create Curve at Intersection... |
| 9. Blank Entity | 18. Graphic View axes | 27. Create X-Hatch... |

The General Selection Tool Bar

Mastercam X's **General Selection** tool bar builds on Mastercam 9's selection features and provides a means to quickly and comprehensively select a specific entity or specific group(s) of entities. *This new interface can be intimidating, but it is more self explanatory than version 9's.*



The image shows the Mastercam X General Selection tool bar and two dialog boxes. The tool bar is at the top, featuring buttons for 'All...', 'Only...', 'In', and a dropdown menu. A mouse cursor is hovering over the 'Window' button, which has opened a dropdown menu with options: 'Chain', 'Window', 'Polygon', 'Single', 'Area', and 'Vector'. The 'Window' option is highlighted with a red box. To the right of the tool bar is the 'End Selection' button. Below the tool bar is the 'Select All' dialog box, which has two sections. The top section lists criteria: 'All Entities', 'Xform Result', 'Xform Group', and 'Group Manager'. The bottom section lists selection criteria: 'Entities', 'Color', 'Level', 'Width', 'Style', 'Point', and 'Diameter / Length'. Below this is a tree view of entity types: 'Wireframe' (with sub-items 'Points', 'Lines', 'Arcs', 'Splines'), 'Curves on Surfaces', 'Surfaces', 'Drafting', and 'Solids'. At the bottom of the dialog are checkboxes for 'Plane mask in chaining', 'Ignore depths in chaining', a 'Same as ...' button, and 'Use Only Mask'. The bottom of the dialog has icons for Save, Open, OK, and Help.

Some operations related to point verification will require you use the General Selection tool bar. The most common button will be the 'End Selection' (above right), which is required in the process of performing a task, such as creating offset surfaces (Page 4).

The manual selection default mode is 'Window' (above middle). The window selection mode in Mastercam X is actually dual in that it can be used, as its name suggest, by dragging a rectangle around the objects to be selected or it can also operate in the 'Single' selection mode; meaning objects can be selected one at a time. These modes can be used in combination. Also, objects can be deselected by clicking on an entity again (or, windowing groups of selected entities again).

For the most part, this is all you will need to know about manual selection accept for, maybe, the 'Polygon' mode with which you can draw complex multi-segmented polygons for selecting more specific groups of objects. This mode was also in Mastercam 9 so I won't elaborate.

'All...' and 'Only...'

Clicking 'All...' or 'Only...' will bring up the dialog box on the left. They appear almost exactly the same accept 'All...' will automatically select all entities with the particular criteria specified and 'Only...' allows manual selection of entities by clicking on individual entities or windowing on groups of entities (or both).

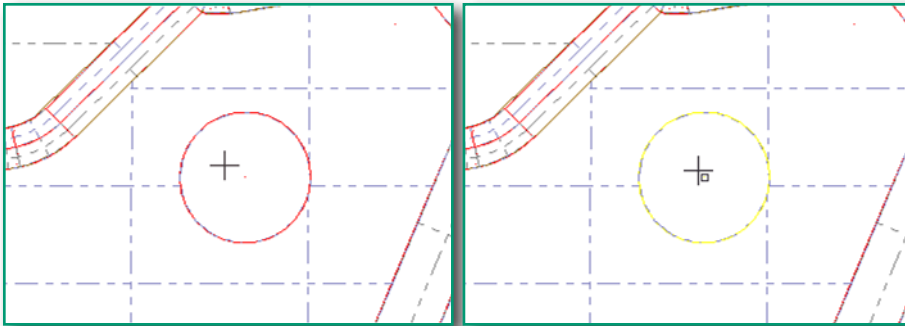
Hint: To make things faster, double-click the criteria to select instead of clicking the criteria then clicking the OK button.


Examples:



- To select the Wire frame, double click it in the middle section. Done. (That's something you could never do in version 9!)
- Click on Color in the upper section. A list of all the visible used colors will appear in the middle section – double click the color to select (great for changing a color to something more user friendly).
- Click Level in the upper section. A list of all visible used/named levels appears below – double click the level to select.
- To select more then one criteria, such as arcs and lines, put a check in the first box, hold 'Ctrl' then double click the second.

Verifying Properties of Holes and Slots

Mastercam X has simplified the process of verifying properties of **Holes** and **Slots**. With just a few clicks you can read the attribute of many hole and slots. (See 'IMPORTANT' on page 10)








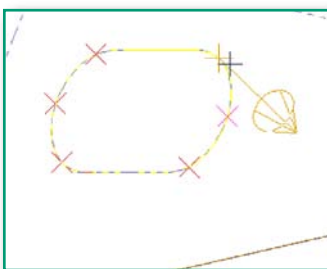
Mastercam X displays the centers of arcs with a single pixel point. This works to our advantage when we wish to identify arcs as opposed to splines. By selecting the 'Analyze Point'  button, you can analyze the position of a hole if a point that represents the center of the arc is visible. Simply approach that point with the cursor; when it snaps on, a small box will enclose the point. Clicking on this point will display the center coordinates.

To view all properties of the arc, use the 'Analyze Entity Properties...' button . For this operation, select the actual arc, not the center point. (Hint: always turn off surfaces before attempting to analyze holes, slots, and other wireframe geometry. 'Alt + S' or the  button will toggle surfaces on and off.) The dialog box on the left will open and displays all of the arc's properties.

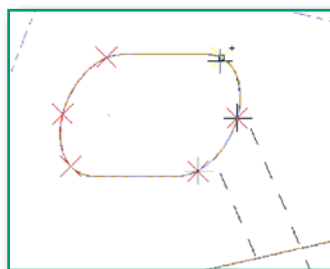


Determining Geometric Properties From Splines
(Refer to four pictures at bottom of page)

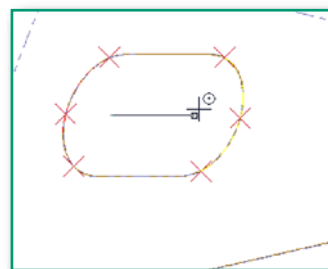
Some holes and slots will be composed of splines, not arcs (particularly when they are located on surfaces which are not flat). For these, arcs need to be created in order to find their *approximate* properties. Click the 'Create Point Dynamic...' button  and select the edge curve of the hole (make sure that the surface is not selected – the arrow should follow the direction of the spline). Make six points on the curved portion of the slot as shown. Click 'Create Arc 3 Points...'  and create two arcs at either end of the slot. Click 'Create Line Endpoints...'  and create a line between the centers of these arcs. Analyze position by clicking 'Analyze Position'  and click near middle of line (see picture on lower right, the cursor will take on that appearance). Analyze the diameter or width by clicking 'Analyze Entity Properties...'  and select one of the arcs. At the same time analyze the line – slot length will be the diameter plus the line length.



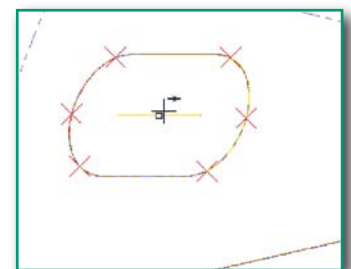
Create Point Dynamic...



Create Arc 3 Points...






Create Line Endpoints...

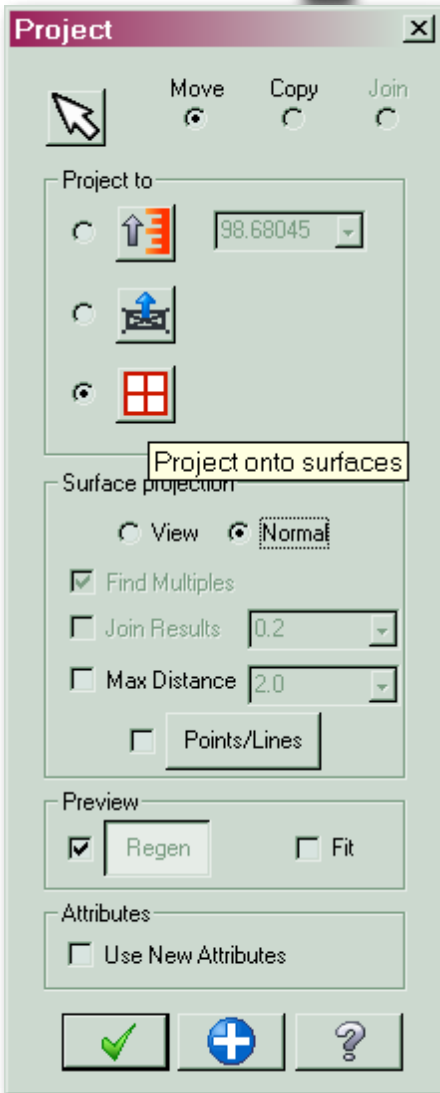
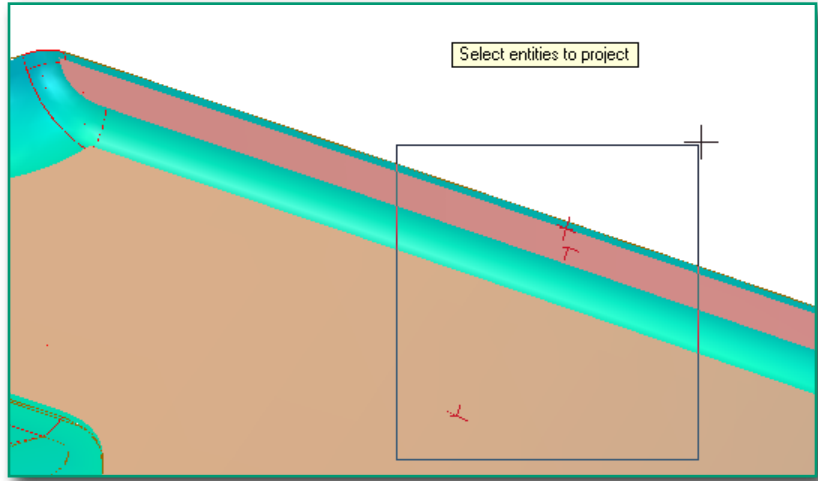



Analyze Position (middle)

Verifying Surface Points

I know everyone follows their own habit when plugging in points for surface point verification. I will take the simple example of a few points on a few surfaces. I've already explained how to enter points (page 1) and how to create offset surfaces (pages 2-4) so I will begin with the points and offset surfaces already drawn. (See 'IMPORTANT' on page 10)

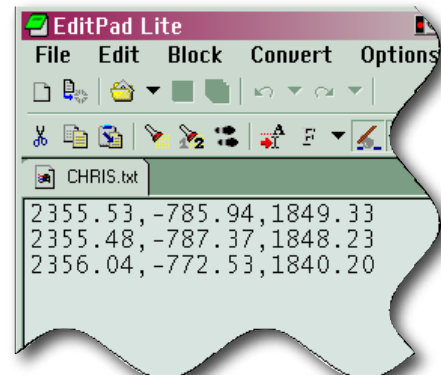
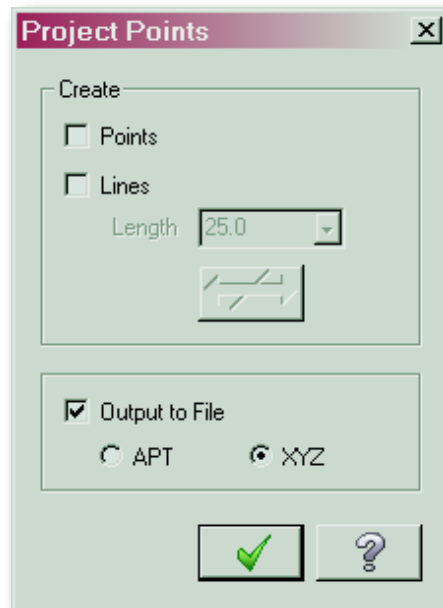
Click on the 'Xform Project...' button . Upon being prompted to select entities to project, window in the points (or, select singly) – they turn yellow when selected. After double clicking last point or 'End Selection' , the 'Project' dialog box will display (see lower left). Select 'Project onto surface'. When the prompt 'Select surfaces' appears – select the surface(s) adjacent to the points, double click last surface or 'End Selection'  again.



The 'Project' dialog box will display once more. Select 'Normal' under Surface Projection. Click on the 'Point/Lines' button and the 'Project Points' dialog box will display (see lower middle). Make sure all the items are chosen as shown; 'Points' checked, 'Output to File' checked, and the 'XYZ' radio button selected. Click  twice.


A prompt to 'Specify File Name to Write' will follow (click 'yes'), and another then prompts 'Append to exiting file?' (Click "No" so file will be overwritten).


An editor will open with the resulting coordinates of the projected points. (Note: In Mastercam X you can choose your favorite text editor. Here I have used EditPad, an excellent freeware program that allows you to choose your own font and open multiple files. See Appendix.)

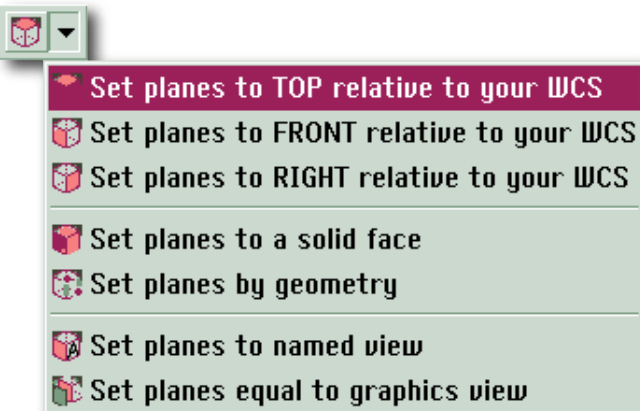
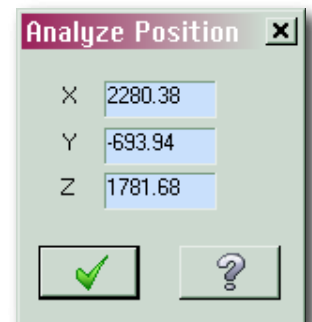
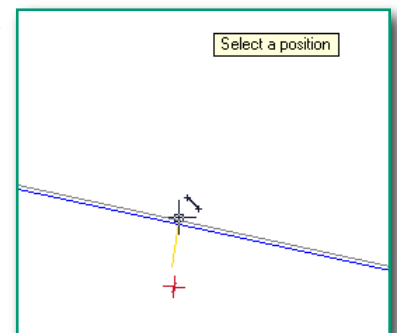
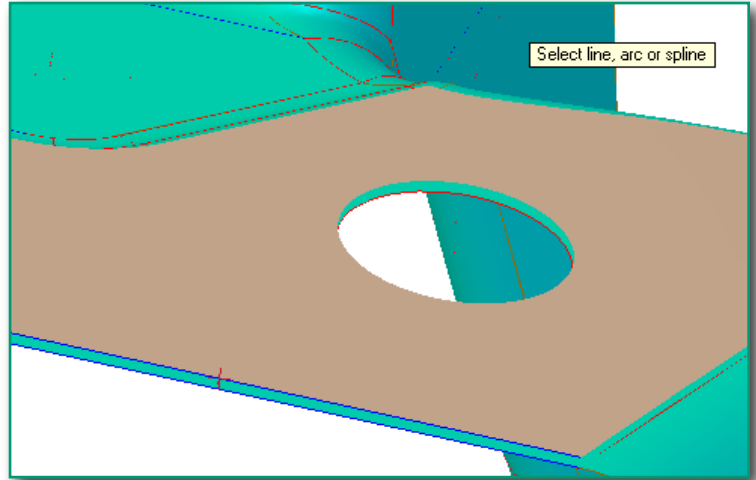


Verifying Trim Edge Points

Like Surface Points, everyone follows their own habit when plugging in points for Trim Edge point verification. I will take the simple example of a single point on an edge curve. I've already explained how to enter points (page 1), an offset surfaces (pages 2-4), and edge curves (page 4) so I will begin with the point and edge curve already drawn. (See 'IMPORTANT' below)

Click on the 'Create Line Perpendicular...' button . Upon being prompted, select the line, arc, or spline adjacent to the point made previously. After selecting the line or spline you will be prompted to sketch a point. Select the point.

After a line has been created, you will need to zoom in order to see it. Click the 'Analyze Position' button . (Reminder: Turn off surfaces before attempting to analyze wireframe geometry!) Upon being prompted to select a position, hover over the end point of the line just created – when in the correct position the line will turn yellow and the cursor will change to indicate that you have snapped to the end point (see left). Click this point and the 'Analyze Position' dialog box appears with the coordinates of the lines end point.



IMPORTANT:

Make sure, at all times when analyzing entities in Mastercam X, that you set planes to Top relative to your WCS (Work Coordinate System).

(This is actually the same as 'Cplane: 3D' in Mastercam 9, but is in more exact terminology.)

If this isn't set, all your coordinates will be off!


Appendix

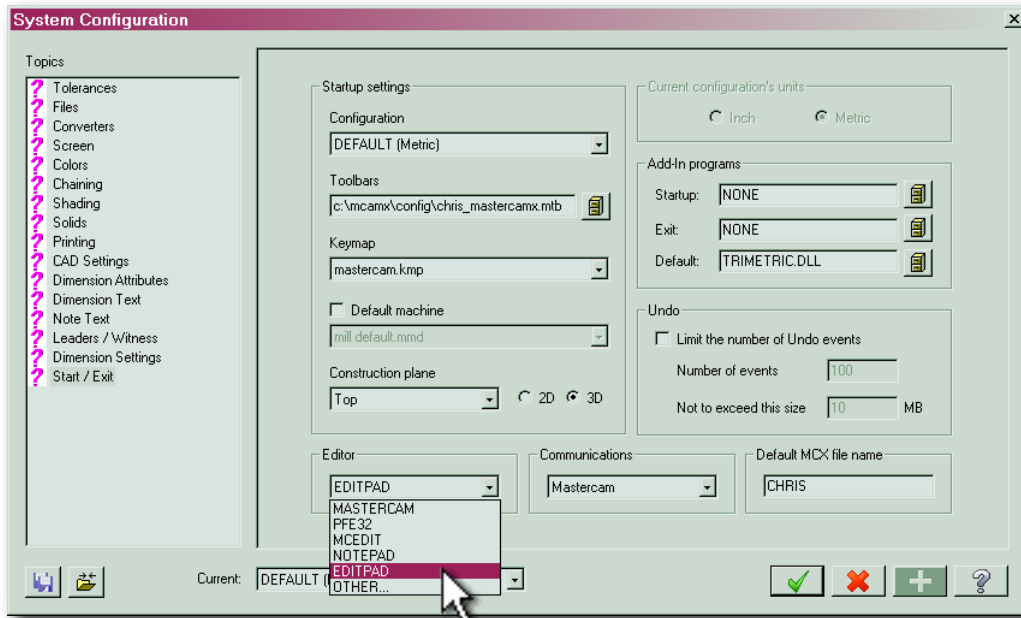
The Appendix begins a series of helpful techniques to further your proficiency with Mastercam X.

(Optimizing Mastercam X's Configuration) Setting Your Text Editor

You can leave the text editor to Mastercam's default or you can set it to open your editor of choice.

In my case, I have set it to open EditPad, an excellent freeware text editor that will open just about anything including IGES files and it can open multiple file (screen-shot on page 9).

Hit 'Alt + F8' or the 'System Configuration' button  to access these settings.



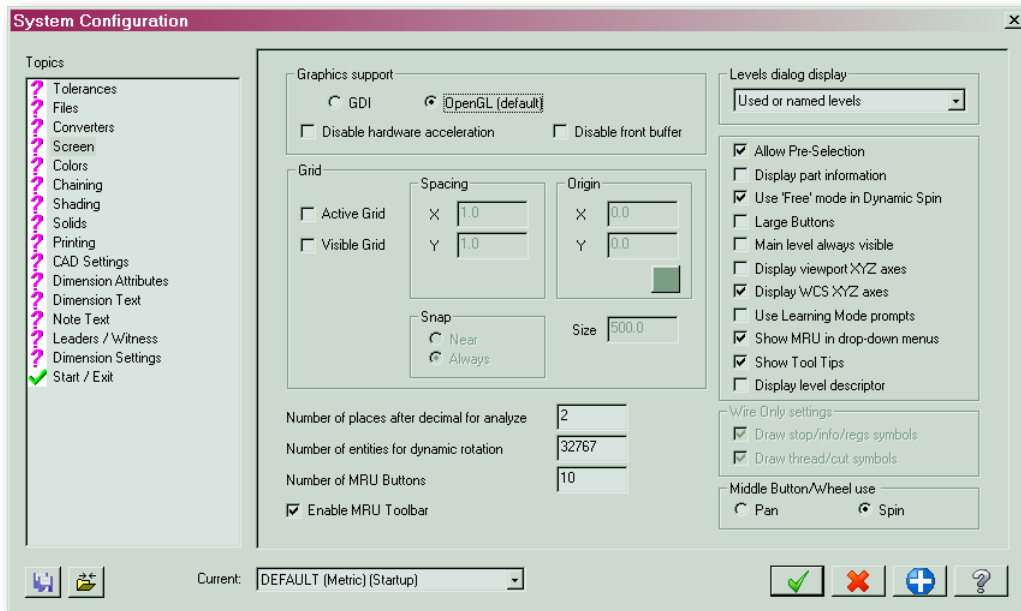
(Optimizing the Mastercam X's Configuration) Setting Screen Options

You can set the number of **Decimal Places** for analyzing to two.

You can set the number of entities for **Dynamic Rotation** to the maximum of 32767 to create a smoother image while rotating or spinning.


I recommend checking 'Free' mode in **Dynamic Spin**. This seems like a more natural, more flexible mode to manipulate the image.


While your here its not bad idea to check 'Show **Tool Tips**'. (The 'Learning Mode' is overkill – fair warning!)



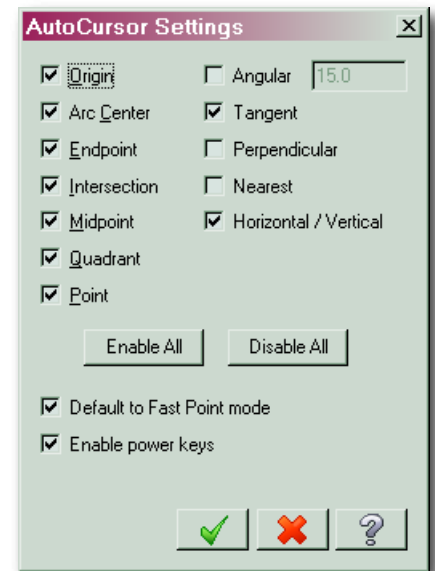
Setting AutoCursor Options

The AutoCursor snaps the cursor to predefined location on the geometry while analyzing or creating new geometry.

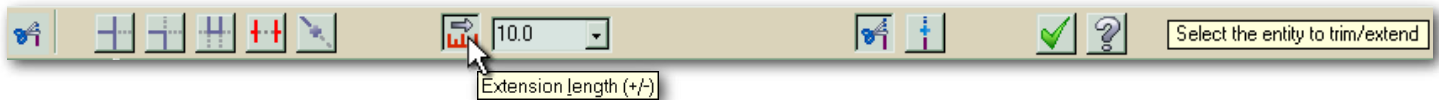
Access these settings by clicking the 'AutoCursor' button  under the right click menu.




Note: This dialog box is largely self explanatory but, if you need more information, as in ALL of Mastercam X's dialog box's, there is the help button  that will take you straight to the context related section of Help.

Very useful! Of all the innovations in Mastercam X, its extensive help features are perhaps the most advanced.



Extending a Line



To extend a line click 'Trim / Brake' , lock down the 'Extension length' button, type in how long you need to extend line, and then click on the line at the end you want extended. Putting a negative number in will shorten the line by that length. Click  or 'Enter' to apply, 'Esc' or  exit function ('Apply' allows you to stay in the function, repeatedly extending lines, or any other function for that matter).

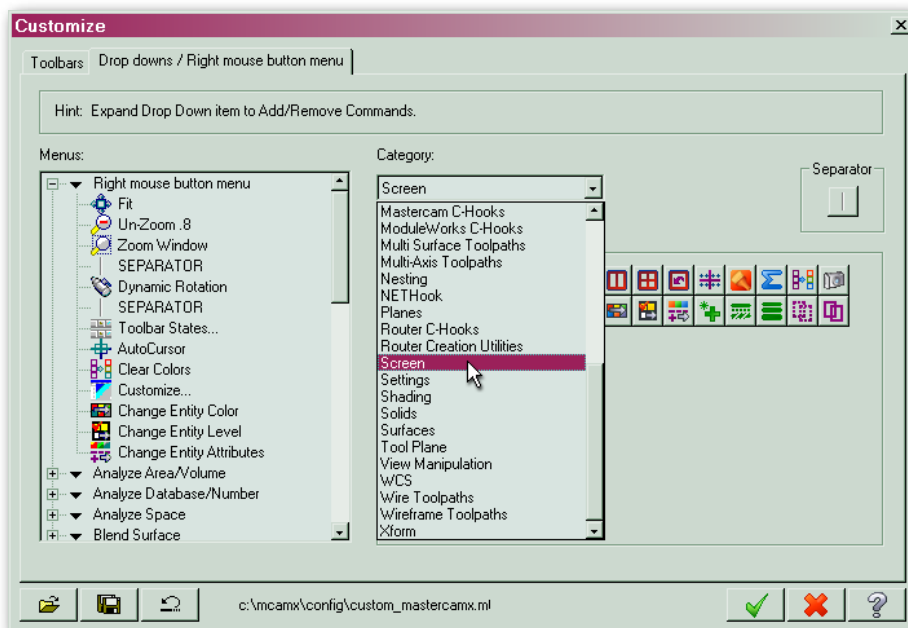
Monitor Settings

Monitor display recommendations (resolution)

- 1024 X 768 (minimum)
- 1280 X 1024 (recommended)

Warning: With anything less than **1280 X 1024** a portion of the Mastercam X window will be lost – it will slide off the right side of the screen.

The Right Mouse Button Menu



If you can think, you have to be able to appreciate the enormous time saving potential of this feature.



- Can you afford to live without it?

Warning: As with anything good, it can be easily abused.

This gem is found under the 'Settings' menu, 'Customize'. Click the tab shown and then click the '+' sign in front of 'Right mouse button menu'. From here you can add or remove any command available. Make your most used command one right click away.

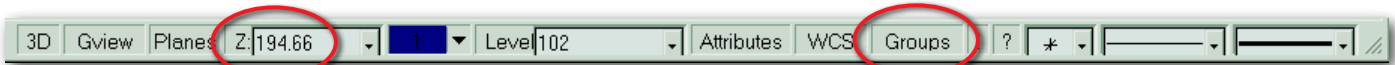
Enough said, I'll leave the rest up to your imagination.



Creating a 'Slice' or Section

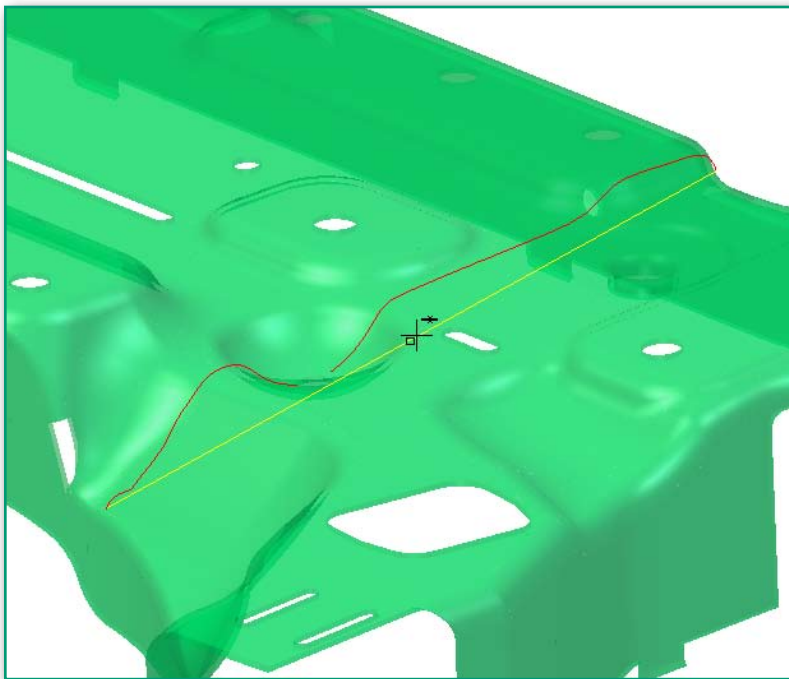
A Slice, preferably called a 'Section', is typically drawn adjacent to line scans to illustrate the deviation of the part (scanned) and the actual CAD model. My approach is to initially create a **Construction Surface**, "Create Rectangular Shapes..."  on the same plane as the scan line and then use this to 'Create Curve at Intersection...'  with the surface of the part. I believe this is the most reliable method in that you can also project the actual scan to this construction surface thereby eliminating irregularities in CMM line path (which tends to wander a bit from a perfect plane).



Prepare the file for this procedure by separating the surface from the Wireframe by placing them on separate layers. If feasible, separate the individual part from any others by changing it to a unique color (placing it on another layer wouldn't be a bad idea either). Refer the section on the 'General Selection Tool bar' for help in selecting the various entities to be separated. The strategy is to isolate the particular surface from which the section will be created.




Open the layers pallet and turn off all layers except the surface to be sectioned. Create a new layer and call it 'Scan Line'. From the menu select 'File' then 'File Merge/Pattern...'. Locate the IGES file created from the line scan in PC-DMIS. When it initially merges with the current file it appears as a red line. *(It appears red because Mastercam X groups any file it merges and all groups appear red by default. If you want to change its color you need to ungroup it. Click 'Groups' at the lower right of the screen (see below) and the 'Group' dialog box appears. Select all the groups in the list on the left and click Delete. The line will turn black and you will be free to change its color since it no longer is part of a group).*






Turn on transparency so you can clearly see the entire scan line. Draw a line from one end of the scan line to the other end then place a point  on the middle of this line (Note: the curser will change when it is at the middle of the line as shown below). Set the working plan to be the same as the scan line (in this case 'Front' ). Click the 'Z:' on the lower middle of the screen (see above) and click on this point. You have now made the working or construction plane and 'Z' depth as the same as the scan line. (If body parallel to lines) The image should look similar to this:



Click "Create Rectangular Shapes..." , expand the dialog box by clicking the  in the upper left hand corner (see opposite page left). Place a check in the 'Surface' box and set the anchor to center. From the point in the middle of the line drag outward till the rectangle encompasses the part – click 'OK' (*hint: create the rectangle in a contrasting color to the part's surface, see opposite page top*).




Change the construction color and open the layer pallet and create a layer called 'Section'. Click 'Create Curve at Intersection...' , select the surface you just created and click 'End Selection' . On the Selection Ribbon select 'all' then click 'Color', select the color of the part surface, click 'End Selection' . Mastercam now calculates the intersection (this may take some depending on the complexity of the surfaces), when done, press


Enter or click .

To project the scan line down to the construction surface click 'All' on the Selection Ribbon and pick the color of the scan line, click OK. Click the 'Xform Project...' , click the Surface box (third down), select the construction rectangle, and click 'End Selection' . When the Project dialog box opens click the 'Move' radio button (along the top of the box) and click OK (see opposite page middle).

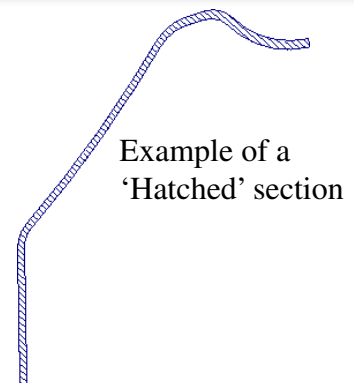
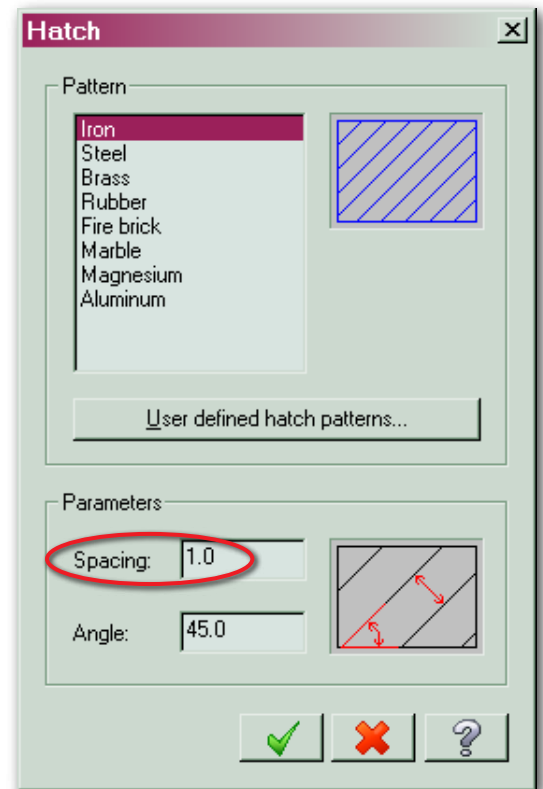
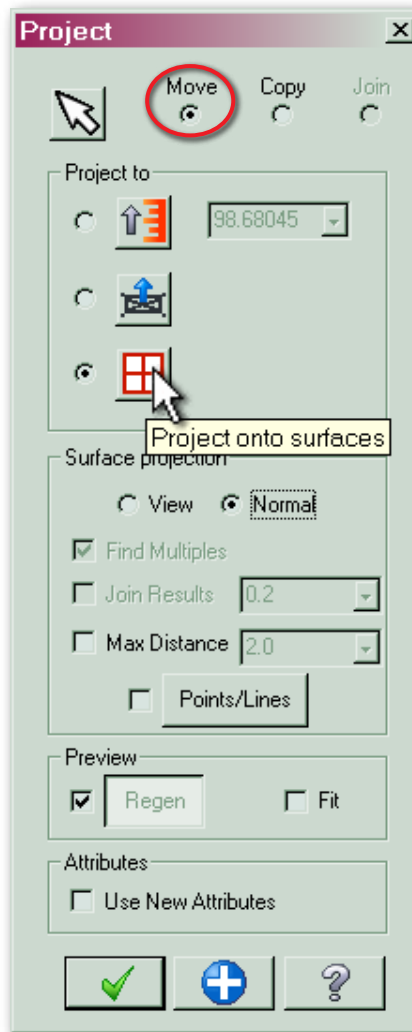
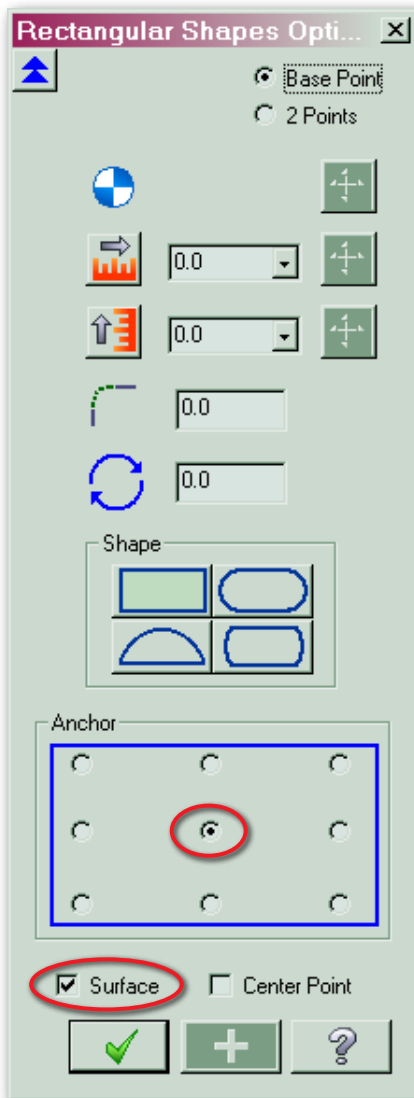
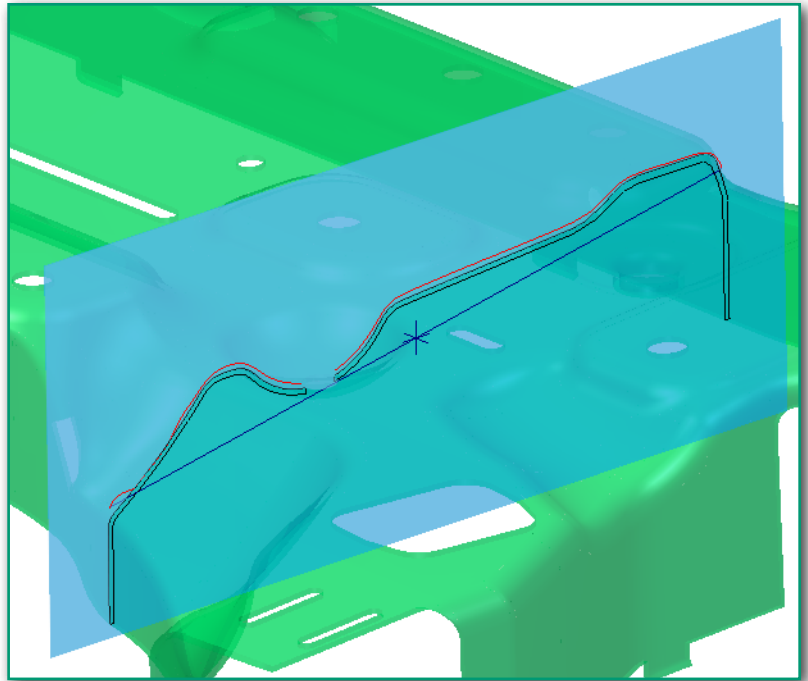
The Construction Surface (blue), Part Surface (green), Scan Line and Section will appear like this:

To enhance this drawing, 'hatch marks' can be added to the inside of the section outline to illustrate the metal thickness.

Click on 'Create X-Hatch...'  and the 'Hatch' dialog box opens (see below right). Select 'Iron' for material and set spacing at 1, click . The 'Chaining' dialog box will open – select a portion of the section and click .

*A continuous curve, without voids or overlapping, is needed for the chaining function to work properly. Also, the working plane must remain the same as the Construction Surface and 'Z' depth (see'  'opposite page).

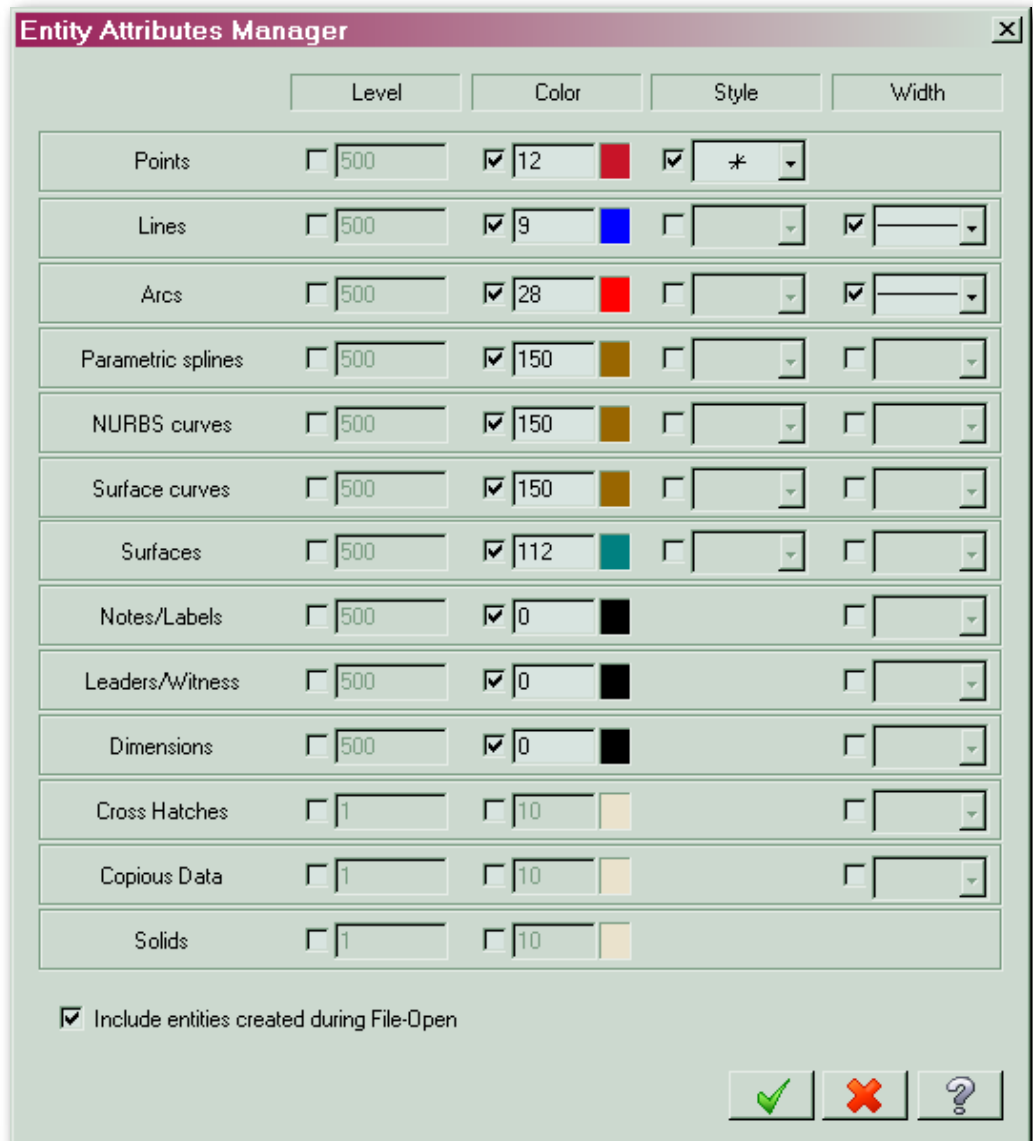
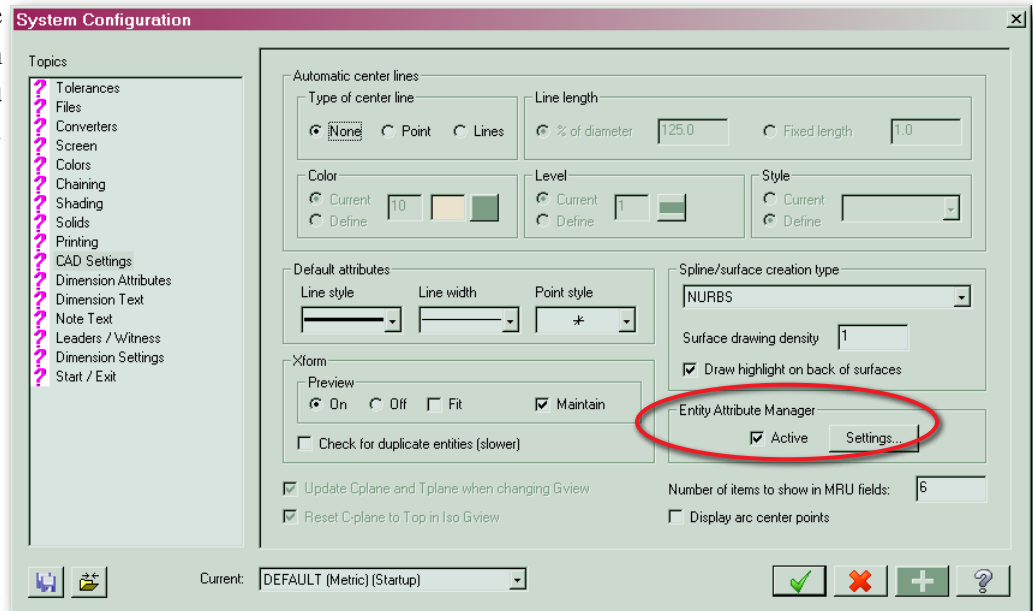
**If the hatch doesn't work, you need to carefully examine the section, eliminating any voids and overlapping segments. Overlapping segments can be difficult to locate – carefully examine where the arrows stop in the chaining process.*



The Entity Attribute Manager

A way to automatically assign entities with particular attribute (such as color, line style, and even level) is available when this feature is turned on. You may find this useful when creating 'Curves on All Surfaces' as a way identifying the wireframe's entities as being either arcs, lines, or splines.

You might want to disable this feature in the 'System Configuration' box unless you will specifically be wanting it.



Shortcut Keys

F1 = Zoom Window

F2 = UnZoom

F3 = Repaint

F4 = Analyze Entity Properties...

F5 = Delete Entities

F9 = Display Screen Info

Alt + F1 = Fit

Customized:

F6 = Dynamic Rotation

F7 = Toggle Auto Highlighting

F8 = Set Planes to Top WCS

F10 = Set Plane to Top

F11 = Trim / Break

F12 = Create Point...

Alt + T = Transparent

Ctrl + F = Mirror

Alt + S = Toggle Shading on-off