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Autodesk Inventor Tutorials

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Linked & Embedded Parameters – Part One

Latest Revision: 9/16/02

Part One of this two-part tutorial is intended to illustrate the basic workflow for embedding Excel worksheets into Inventor parts or assemblies. Part two of this tutorial will deal with linking Excel sheets into parts and assemblies to give an assembly level control of a project.

Let's begin by making a simple angle extrusion. Create the part as shown. Not that the fillets are sketch geometry but the same logic could be applied if they were created as features (see Figure 1). It's often helpful to give the dimensions unique values (1.25/.126/.127" for fillets) so that you can tell which parameters references which dimensions later in the process)

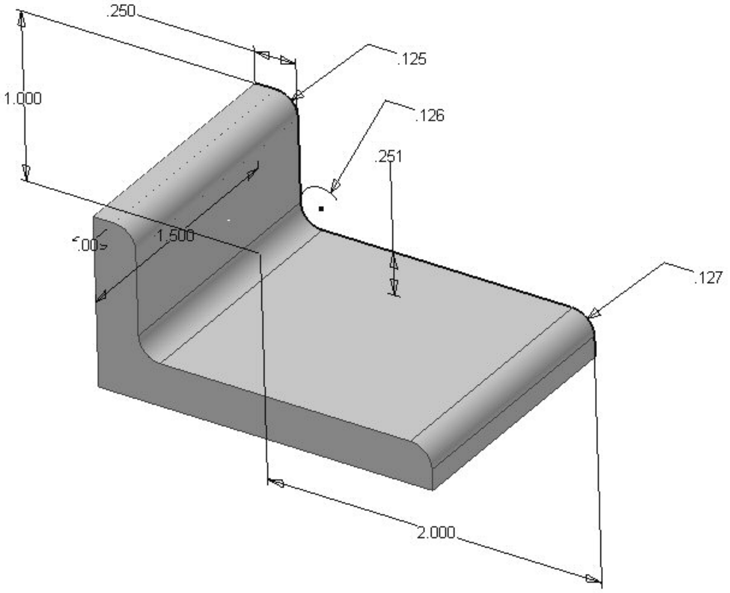
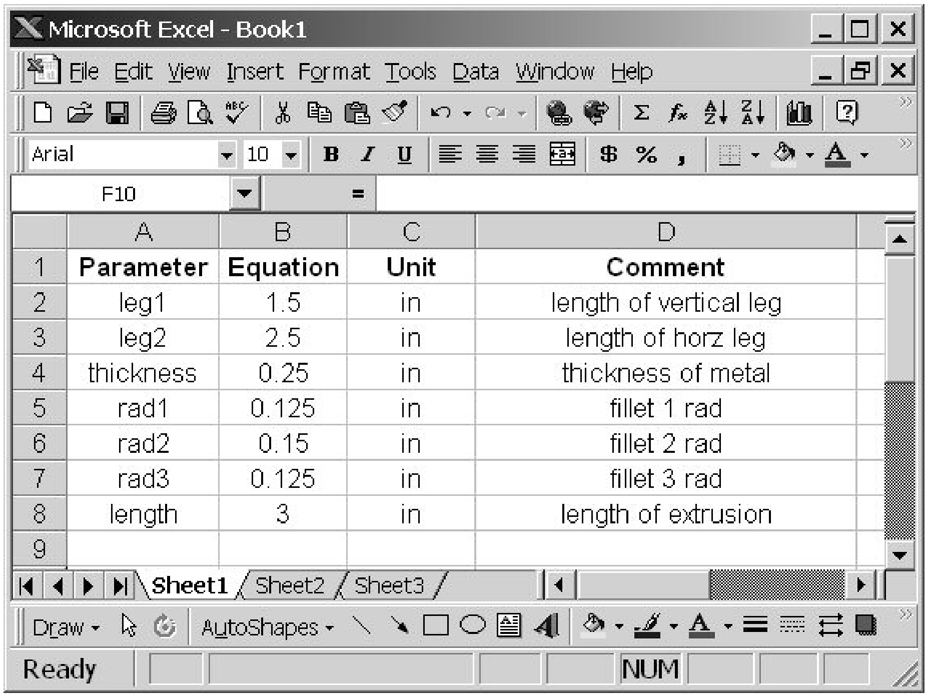


Figure 1 - Basic Angle Geometry

The next step is to create the Excel spreadsheet to which the part will be tied. Open excel and create a sheet as shown in Figure 2. Note that the order of the columns is different than the order used in the parameters dialogue in Inventor. In Inventor the unit and equation columns are flipped. I find it helpful to put he top row of headers in the sheet to avoid confusion. Also note that all parameter names must be one word (no spaces) and that there are restricted names for parameters (see my *Reserved Parameter Names & Characters*tutorial at http://www.sdotson.com) Finally remember that parameters are case sensitive (length is not the same as Length)

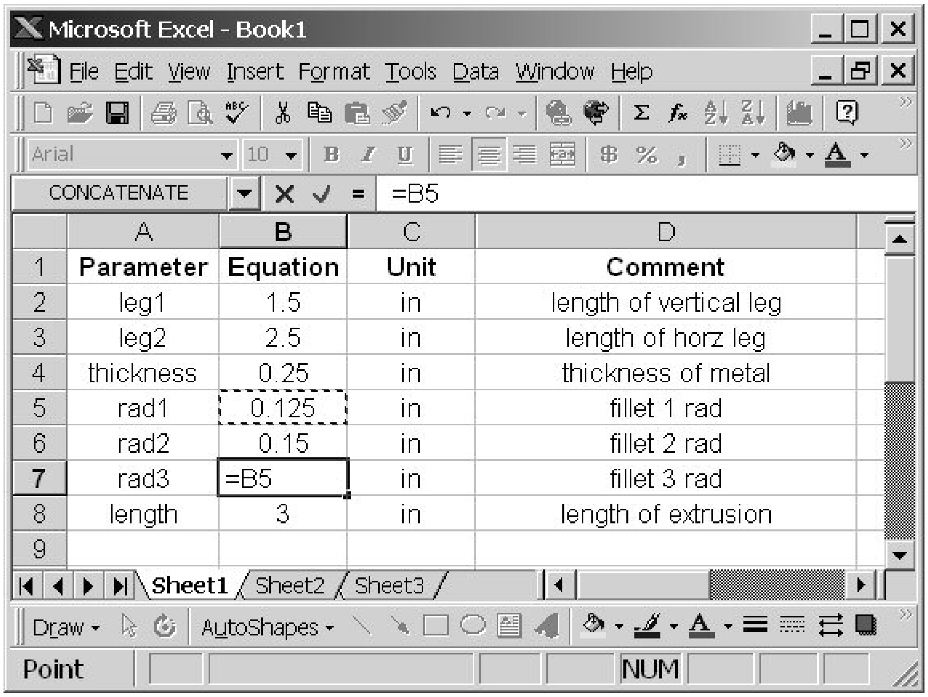
Another problem many users have is the manner in which Excel links parameter names in an equation. While you can type "height*width" in the Inventor parameter window and this is accepted, the Excel document only returns numeric values to Inventor. Thus if you wanted *rad3* to be equal to *rad1* you must link them together in the context of the Excel sheet as shown in Figure 3. This is basic Excel sheet forumla work. If you do not know how to do this, it is advised that you brush up on how formulas work in Excel before continuing this tutorial.



F10 =

	A	B	C	D
1	Parameter	Equation	Unit	Comment
2	leg1	1.5	in	length of vertical leg
3	leg2	2.5	in	length of horz leg
4	thickness	0.25	in	thickness of metal
5	rad1	0.125	in	fillet 1 rad
6	rad2	0.15	in	fillet 2 rad
7	rad3	0.125	in	fillet 3 rad
8	length	3	in	length of extrusion
9				

Figure 2 - Basic Excel Parameters Sheet



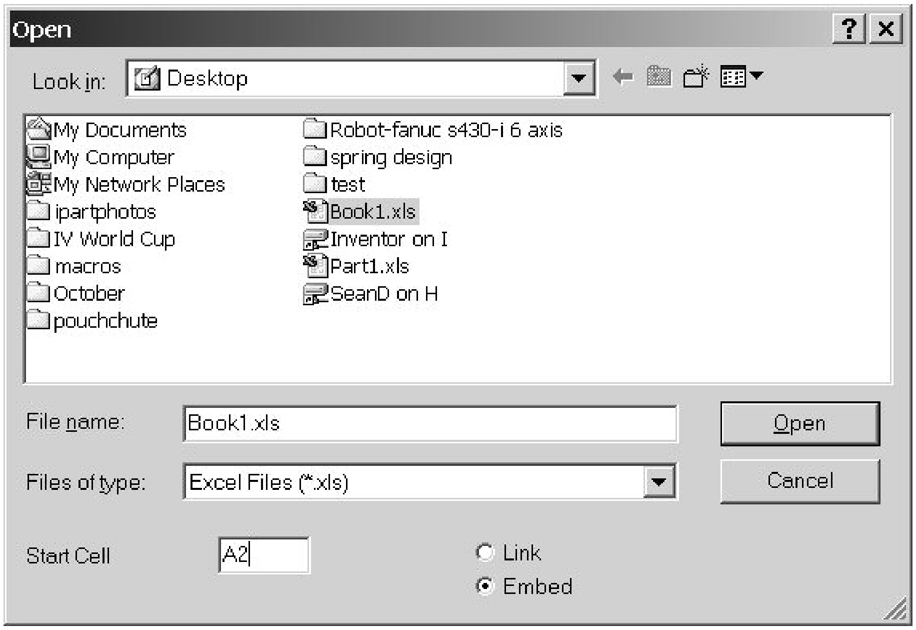
CONCATENATE = =B5

	A	B	C	D
1	Parameter	Equation	Unit	Comment
2	leg1	1.5	in	length of vertical leg
3	leg2	2.5	in	length of horz leg
4	thickness	0.25	in	thickness of metal
5	rad1	0.125	in	fillet 1 rad
6	rad2	0.15	in	fillet 2 rad
7	rad3	=B5	in	fillet 3 rad
8	length	3	in	length of extrusion
9				

Figure 3 - Creating Formulas in Excel

Be sure to save the Excel sheet and close it, however note the column and row position of the first parameter before you close the sheet. In this example it's A2 as we do not want to have the header info included in the parameter window.

Go back into Inventor and hit the parameter button to return to the parameters dialogue. At the bottom of the parameters window there is a button named “Link”. Push this button. You will be presented with a file dialogue like the one shown in Figure 4.



Look in: Desktop

File name: Book1.xls

Files of type: Excel Files (*.xls)

Start Cell A2

○ Link
● Embed

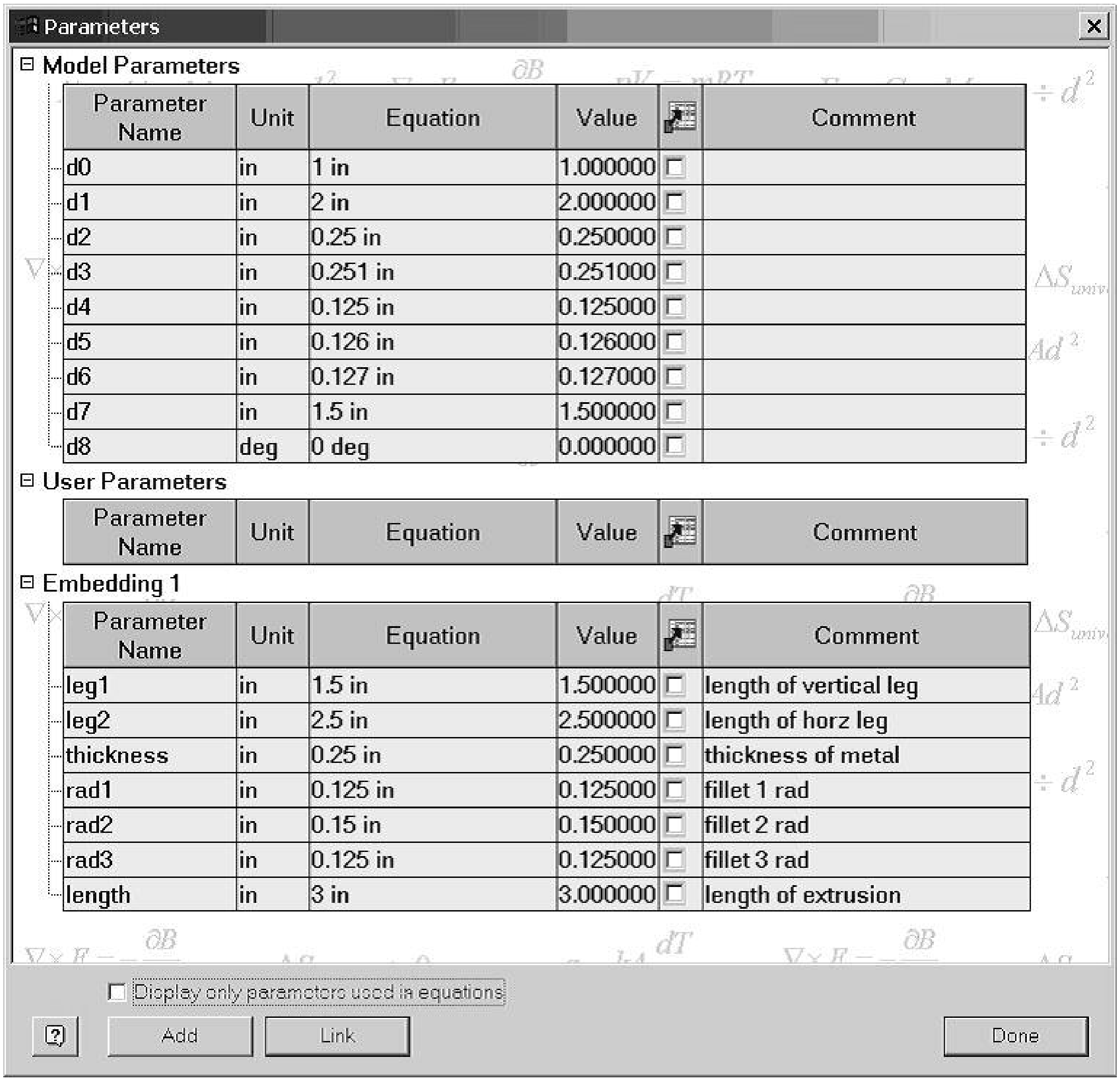
Figure 4 - Selecting the Excel File to Link/Embed

Find the Excel file you just created (in our example it's Book1.xls). Enter the cell where the parameters begin in the lower left-hand corner. In our example it's A2. Now comes the choice to embed or link the spreadsheet.

There are many reasons why you might choose one over the other. Embedding does what it says. It embeds the Excel file into the part or assembly file. After embedding you can delete the original Excel file without consequence. This makes the format nice and portable. You can still edit the Excel sheet from within Inventor (we will illustrate this later) but you do not have to maintain two files.

The disadvantage of embedding is that only this one file can reference the Excel data. If the data were mean to manage two or more files then linking would be the desired option. We shall discuss linking more in the second part of this tutorial. For this example select Embed and click Open.

Go back into the parameters menu and notice that there is an extra section in the table named Embedding1. This is the content of the Excel file we embedded. (See Figure 5).



Model Parameters

Parameter Name	Unit	Equation	Value		Comment
d0	in	1 in	1.000000	□	
d1	in	2 in	2.000000	□	
d2	in	0.25 in	0.250000	□	
d3	in	0.251 in	0.251000	□	
d4	in	0.125 in	0.125000	□	
d5	in	0.126 in	0.126000	□	
d6	in	0.127 in	0.127000	□	
d7	in	1.5 in	1.500000	□	
d8	deg	0 deg	0.000000	□	

User Parameters

Parameter Name	Unit	Equation	Value		Comment

Embedding 1

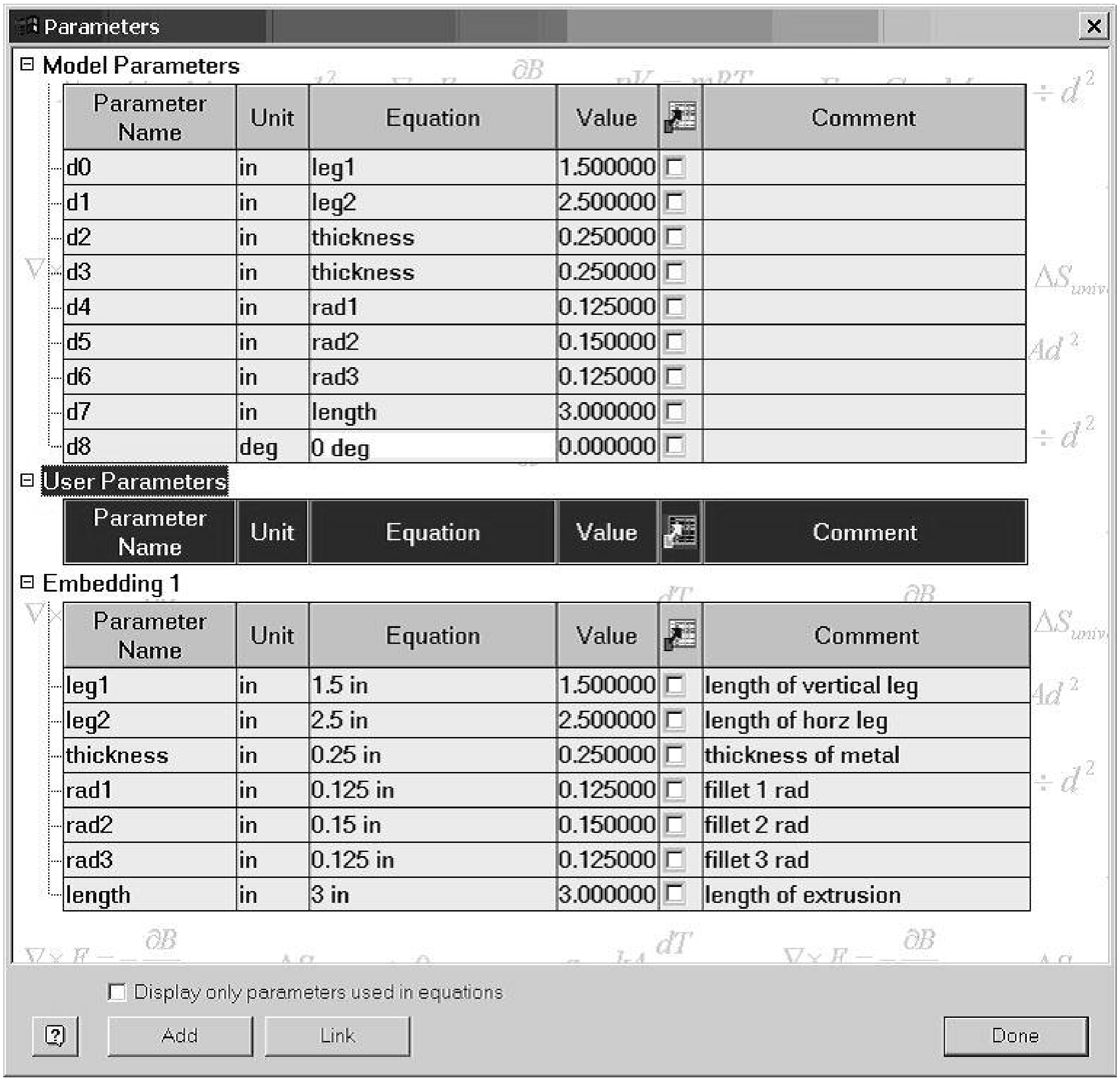
Parameter Name	Unit	Equation	Value		Comment
leg1	in	1.5 in	1.500000	□	length of vertical leg
leg2	in	2.5 in	2.500000	□	length of horz leg
thickness	in	0.25 in	0.250000	□	thickness of metal
rad1	in	0.125 in	0.125000	□	fillet 1 rad
rad2	in	0.15 in	0.150000	□	fillet 2 rad
rad3	in	0.125 in	0.125000	□	fillet 3 rad
length	in	3 in	3.000000	□	length of extrusion

□ Display only parameters used in equations

Figure 5 - Parameters Box After Embedding

We now have the information embedded into the Inventor part. We can now go to the top part of the parameters menu and reference the model parameters to the new embedded parameters. Link the parameters as shown in Figure 6.

The model parameters are now referenced to the embedded parameters. When the embedded parameters change the model parameters will change to reflect these modifications. Now exit out of the parameters window by clicking Done and return to your model. Hit the update button and the model should change shape to reflect the new values of the embedded (and hence model) parameters. (See Figure 7)



⊟ Model Parameters

Parameter Name	Unit	Equation	Value		Comment
d0	in	leg1	1.500000	□	
d1	in	leg2	2.500000	□	
d2	in	thickness	0.250000	□	
d3	in	thickness	0.250000	□	
d4	in	rad1	0.125000	□	
d5	in	rad2	0.150000	□	
d6	in	rad3	0.125000	□	
d7	in	length	3.000000	□	
d8	deg	0 deg	0.000000	□	

⊟ User Parameters

Parameter Name	Unit	Equation	Value		Comment

⊟ Embedding 1

Parameter Name	Unit	Equation	Value		Comment
leg1	in	1.5 in	1.500000	□	length of vertical leg
leg2	in	2.5 in	2.500000	□	length of horz leg
thickness	in	0.25 in	0.250000	□	thickness of metal
rad1	in	0.125 in	0.125000	□	fillet 1 rad
rad2	in	0.15 in	0.150000	□	fillet 2 rad
rad3	in	0.125 in	0.125000	□	fillet 3 rad
length	in	3 in	3.000000	□	length of extrusion

□ Display only parameters used in equations

Figure 6 - Referencing Model Parameters to Embedded Parameters

Editing the part is now very simple. At any time you may now expand the browser under the “3rd Party Icon” and right click on the icon labeled Book1.xls (or the name of your Excel file) and choose Edit.

This will open Excel and your worksheet where you can change the values of the parameters. When done editing be sure to save the Excel file before closing it via the (x) in the window corner. When you return to the model you can then simply update to see your changes.

You can make your parts more user friendly by adding some functionality in the Excel file. You can make it such that users only have predefined values to choose from. Let’s say in our example that we only want the user to be able to have

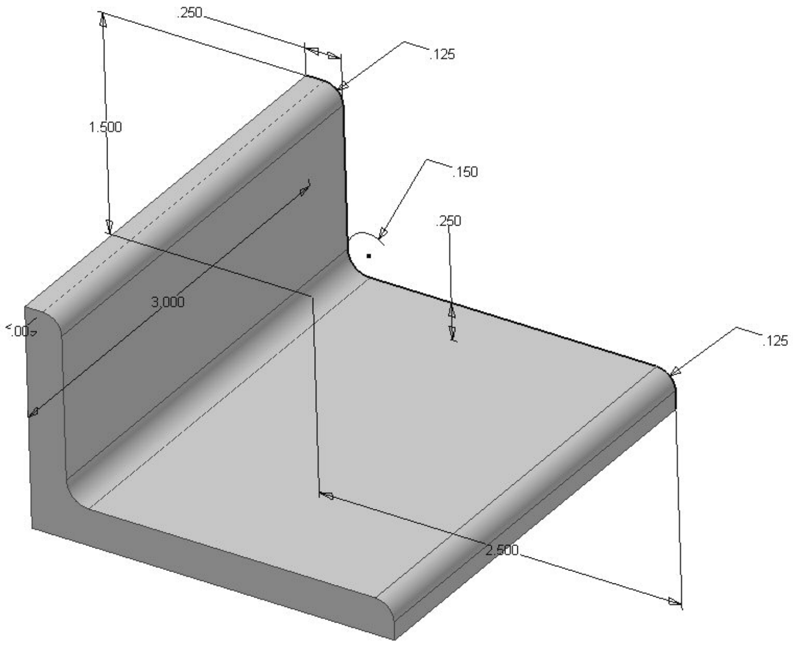


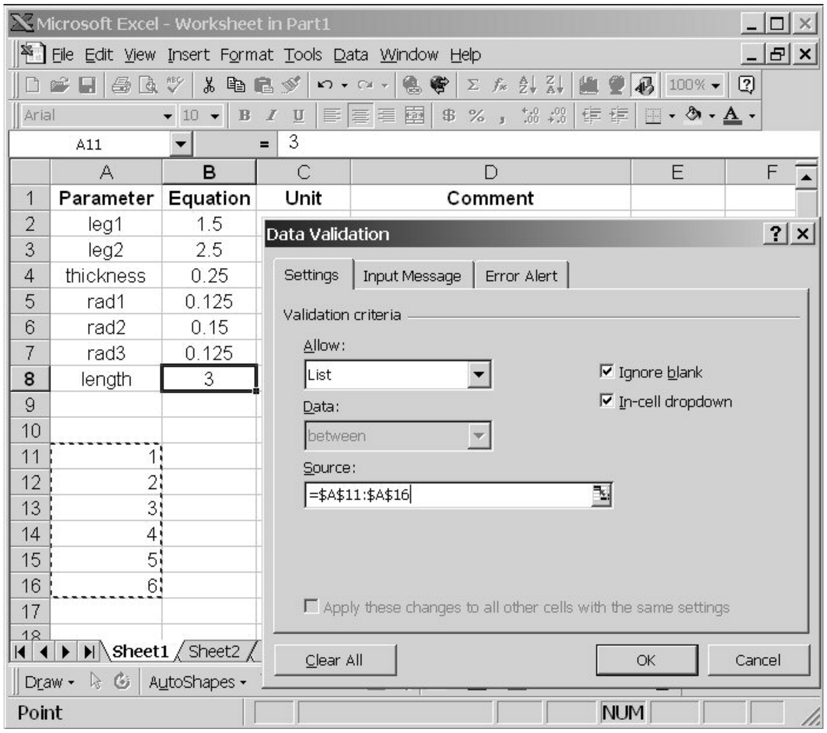
Figure 7 - Model After Updating

extrusion lengths of 1" -6" in 1" increments. We first simply create a column of choices (1-6 in our case). Next go to the Length's equation cell and choose Data>Validation from the menu. Choose List in the first pulldown menu then select the column of number we created (1-6) (see Figure 8).

Now when you select the Length's equation box you are presented with a pulldown menu that only allows the user to select values of 1"-6". (See Figure 9)

We are able to use the rest of the spreadsheet for "scratch space" to create these type of rules as Inventor ignores anything to the right of the comments column and anything below the last parameter entry (allow a single row spacing before entering any other information). Using Excel function like VLOOKUP and Validation in the context of the Excel sheet can create very powerful models. We can also place some user-friendly notations and highlighting in the Excel sheet above the parameters so that users are not tempted to change the Excel equations and to provide a simple interface for modifying the part. For an example, download the Sprocket file I created back in R3 from Charles Bliss' site. You can find it about ½ way down on this page http://www.cbliss.com/inventor/Parts.htm (Note that you'll have to move the EOP marker to the bottom in the browser window)

A screen shot of the Excel file can be found in Figure 10. The only tricky part to something like this is to remember where the parameters start and enter this info when embedding the Excel sheet (in this example it's A14)


Microsoft Excel - Worksheet in Part1
File Edit View Insert Format Tools Data Window Help
Arial
10
100%
Sheet1
Sheet2
Draw
AutoShapes
Point
NUM

A11 = 3

	A	B	C	D
1	Parameter	Equation	Unit	Comment
2	leg1	1.5		
3	leg2	2.5		
4	thickness	0.25		
5	rad1	0.125		
6	rad2	0.15		
7	rad3	0.125		
8	length	3		
9				
10				
11	1			
12	2			
13	3			
14	4			
15	5			
16	6			
17				

Data Validation

Settings | Input Message | Error Alert

Validation criteria

Allow: List

Data: between

Source: =$A$11:$A$16

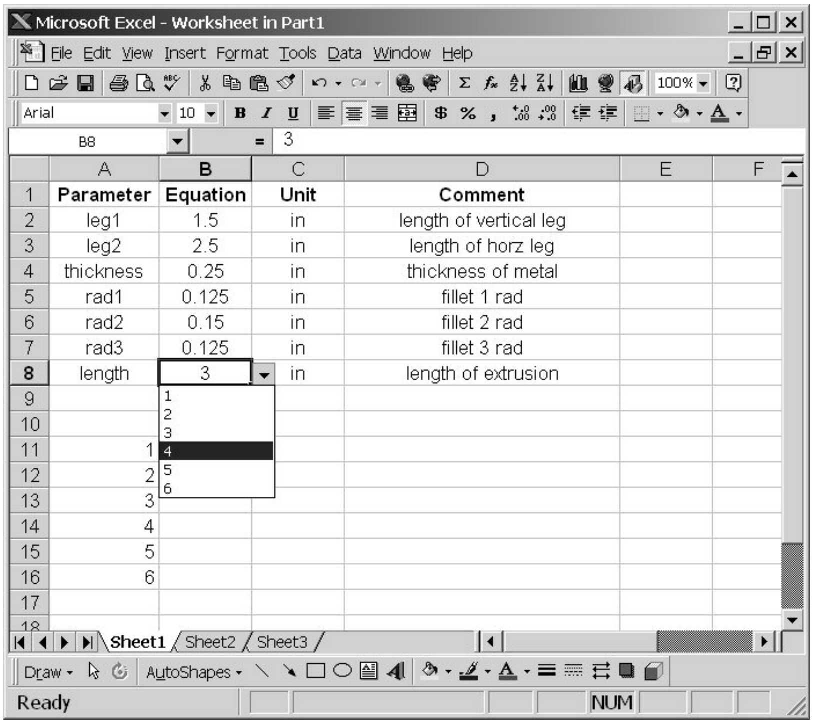
☑ Ignore blank

☑ In-cell dropdown

□ Apply these changes to all other cells with the same settings

Clear All | OK | Cancel

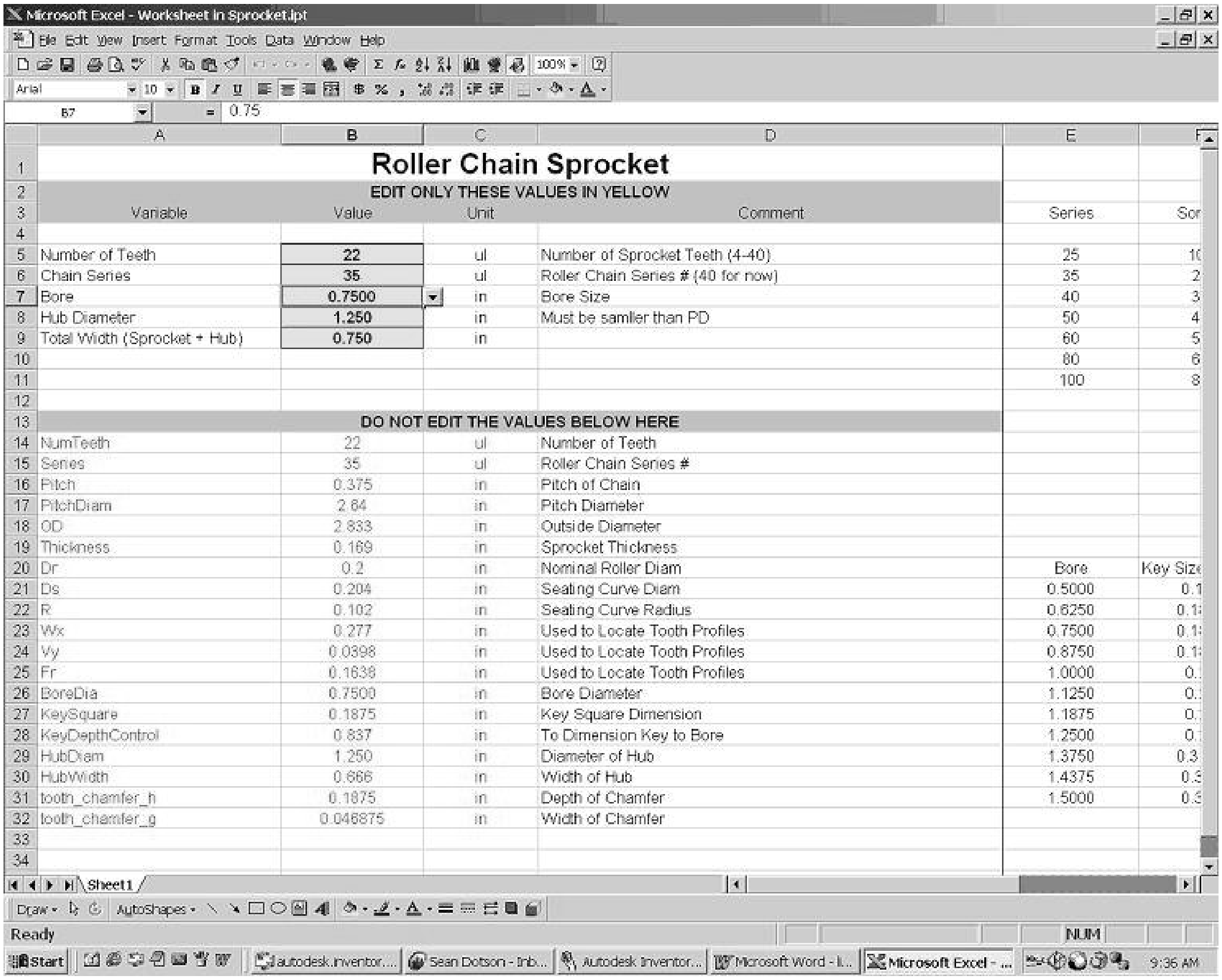
Figure 8 - Validating Data in Excel


Microsoft Excel - Worksheet in Part1
File Edit View Insert Format Tools Data Window Help
Arial
10
100%
Sheet1
Sheet2
Sheet3
Draw
AutoShapes
Ready
NUM

B8 = 3

	A	B	C	D
1	Parameter	Equation	Unit	Comment
2	leg1	1.5	in	length of vertical leg
3	leg2	2.5	in	length of horz leg
4	thickness	0.25	in	thickness of metal
5	rad1	0.125	in	fillet 1 rad
6	rad2	0.15	in	fillet 2 rad
7	rad3	0.125	in	fillet 3 rad
8	length	3	in	length of extrusion
9				
10				
11	1			
12	2			
13	3			
14	4			
15	5			
16	6			
17				

Figure 9 – Excel Only Allows Selectable Values



B7 = 0.75

	A	B	C	D	E	F
1		Roller Chain Sprocket				
2		EDIT ONLY THESE VALUES IN YELLOW				
3	Variable	Value	Unit	Comment	Series	Sor
4						
5	Number of Teeth	22	ul	Number of Sprocket Teeth (4-40)	25	1
6	Chain Series	35	ul	Roller Chain Series # (40 for now)	35	2
7	Bore	0.7500	in	Bore Size	40	3
8	Hub Diameter	1.250	in	Must be samler than PD	50	4
9	Total Width (Sprocket + Hub)	0.750	in		60	5
10					80	6
11					100	8
12						
13		DO NOT EDIT THE VALUES BELOW HERE				
14	NumTeeth	22	ul	Number of Teeth		
15	Series	35	ul	Roller Chain Series #		
16	Pitch	0.375	in	Pitch of Chain		
17	PitchDiam	2.64	in	Pitch Diameter		
18	OD	2.833	in	Outside Diameter		
19	Thickness	0.169	in	Sprocket Thickness		
20	Dr	0.2	in	Nominal Roller Diam	Bore	Key Size
21	Ds	0.204	in	Seating Curve Diam	0.5000	0.1
22	R	0.102	in	Seating Curve Radius	0.6250	0.1
23	Wx	0.277	in	Used to Locate Tooth Profiles	0.7500	0.1
24	Vy	0.0398	in	Used to Locate Tooth Profiles	0.8750	0.1
25	Fr	0.1638	in	Used to Locate Tooth Profiles	1.0000	0.
26	BoreDia	0.7500	in	Bore Diameter	1.1250	0.
27	KeySquare	0.1875	in	Key Square Dimension	1.1875	0.
28	KeyDepthControl	0.837	in	To Dimension Key to Bore	1.2500	0.
29	HubDiam	1.250	in	Diameter of Hub	1.3750	0.3
30	HubWidth	0.666	in	Width of Hub	1.4375	0.3
31	tooth_chamfer_h	0.1875	in	Depth of Chamfer	1.5000	0.3
32	tooth_chamfer_g	0.046875	in	Width of Chamfer		
33						
34						

Figure 10 - Embedded Sheet in Sprocket.ipt

There is an alternative workflow to linking or embedding Excel sheets. In our example we created the model then embedded the sheet and finally referenced the model parameters to the embedded parameters. The alternative method is to create the Excel sheet, embed the sheet and then create the geometry using the embedded parameter names during the creation of the part. For example in the dimension dialogue for the vertical height of the angle we would enter “leg1”. There are advantages and disadvantages to both methods and I leave it to the reader to determine the best workflow for their application.

In the next part of this tutorial we will discuss how to link Excel sheets to multiple files to achieve an assembly level control over several components.