

Tutorial—Five Quick Problems

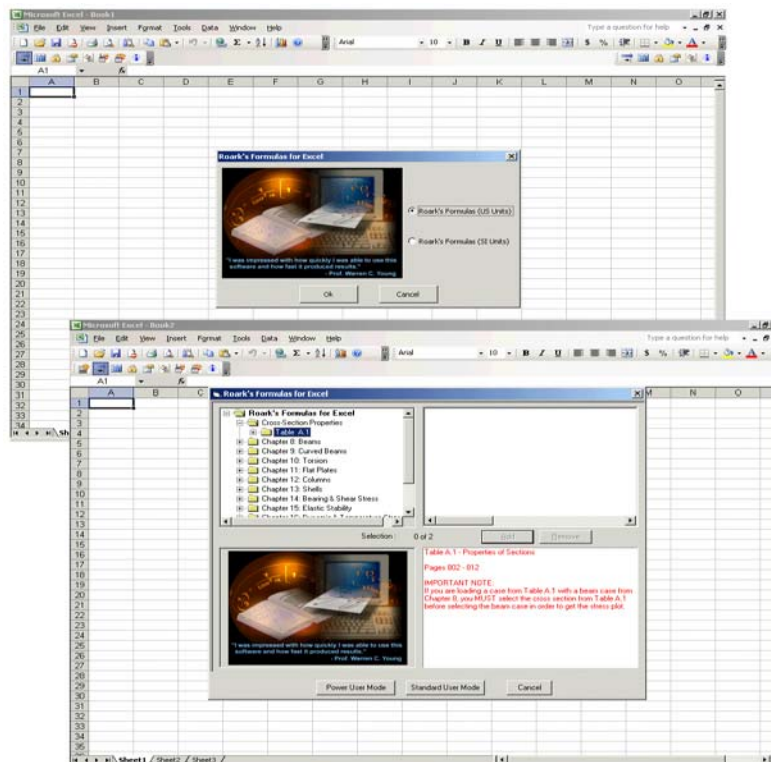
Tutorials will use the **Standard User Mode** to highlight the simplicity in using this software. Advanced Users may want to use the **Power User Mode** and examples are shown at the end of each Tutorial.

All Tutorials are shown with the US unit system.

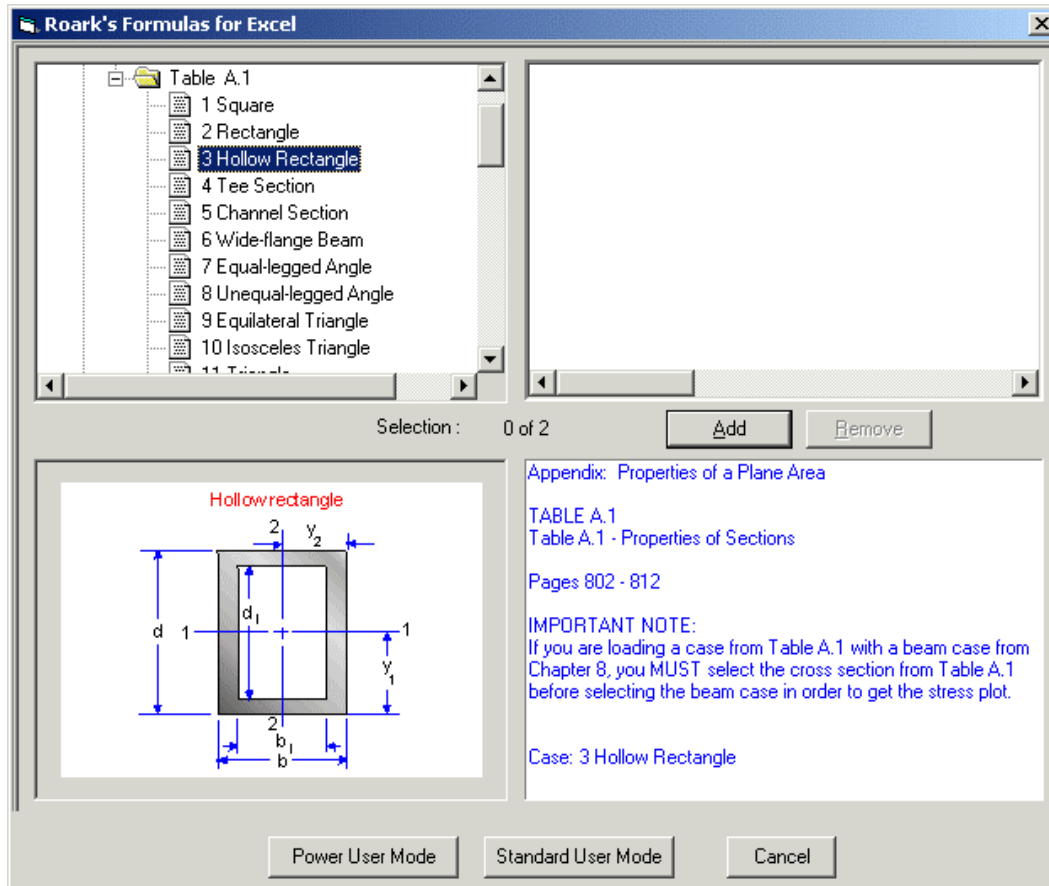
Problem 1

Suppose you are designing a beam with a hollow rectangular section and you need to know the area, moment of inertia, and plastic section modulus.

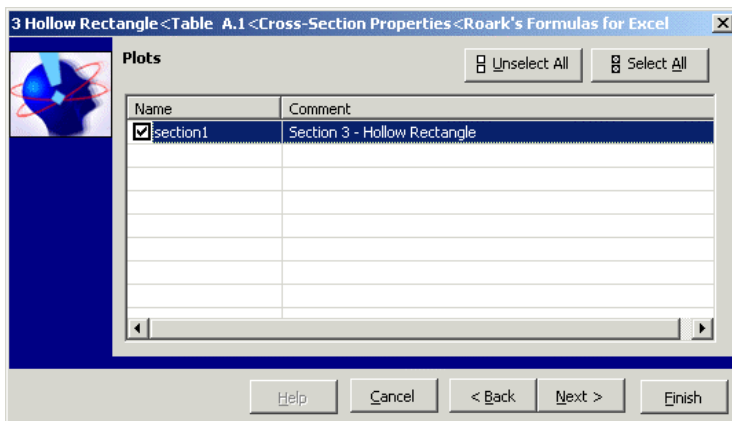
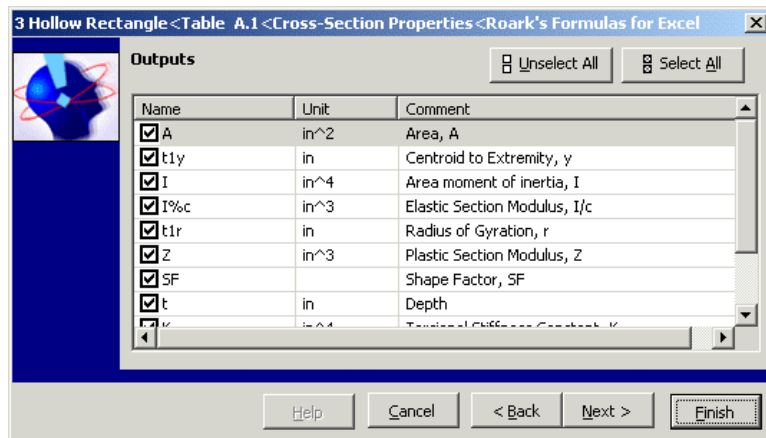
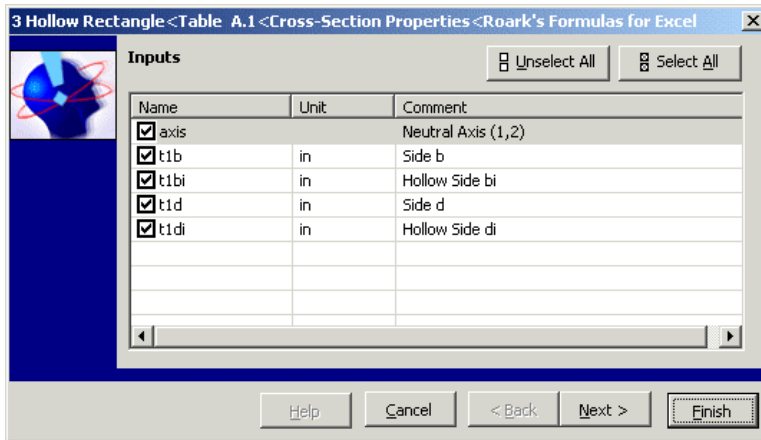
Start Excel and click on Roark's Formulas for Excel (RFE) Explorer on the Roark's Formulas for Excel Toolbar. Select the US unit system and click OK to open the **Roark's Formulas for Excel Explorer**.

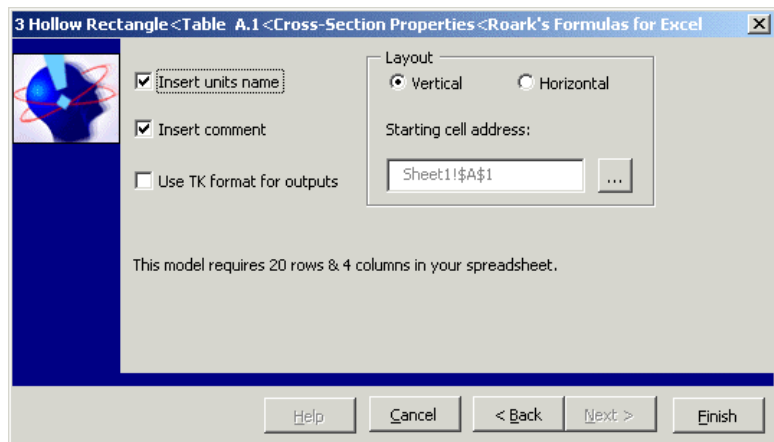
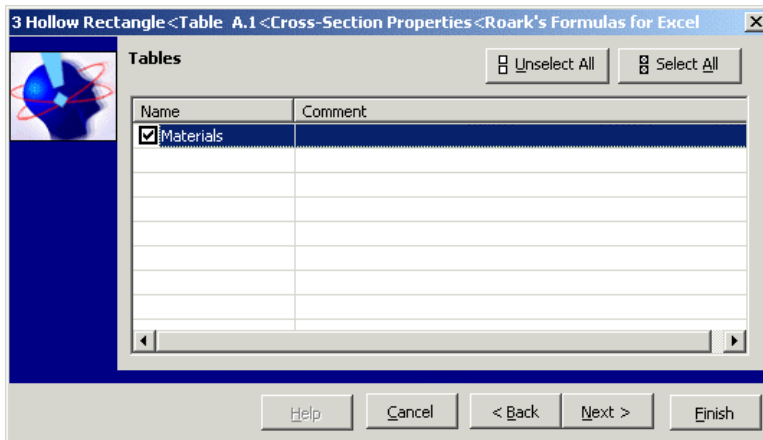


When the Explorer appears, select **Table A.1, Case 3** by either double-clicking it or by clicking on it then clicking the Add button. Your selection is confirmed when it is displayed in the upper right portion of the Explorer screen.



After making your selection, click the **Standard User Mode** button to continue.

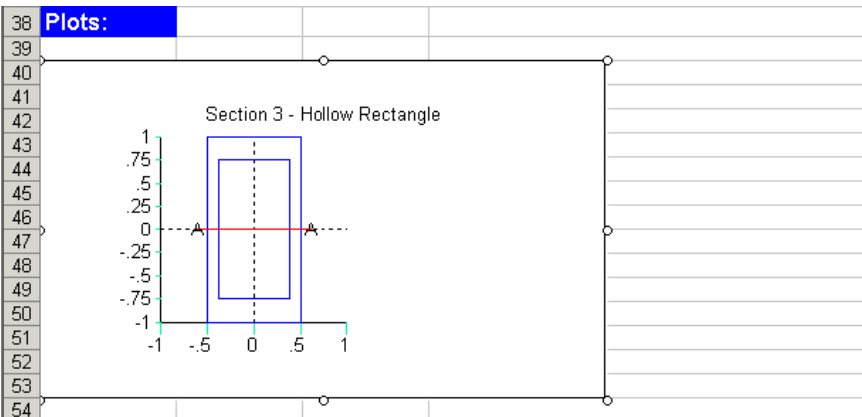




Click the Finish button to link the model into the Excel Worksheet.

Roark's Formulas for Excel by UTS

	A	B	C	D	E	F	G							
1	Roark's Formulas for Excel													
2	Appendix: Properties of a Plane Area TABLE A.1													
3	Table A.1 - Properties of Sections Pages 802 - 812													
4	Case: 3 Hollow Rectangle													
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14														
15														
16														
17														
18	Input	Value	Unit	Comment										
19	axis	1		Neutral Axis (1,2)										
20	t1b	1	in	Side b										
21	t1bi	0.75	in	Hollow Side bi										
22	t1d	2	in	Side d										
23	t1di	1.5	in	Hollow Side di										
24														
25	Output	Value	Unit	Comment										
26	A	0.875	in ²	Area, A										
27	t1y	1	in	Centroid to Extremity, y										
28	I	0.455729167	in ⁴	Area moment of inertia, I										
29	I%c	0.455729167	in ³	Elastic Section Modulus, I/c										
30	t1r	0.721687836	in	Radius of Gyration, r										
31	Z	0.578125	in ³	Plastic Section Modulus, Z										
32	SF	1.268571429		Shape Factor, SF										
33	t	2	in	Depth										
34	K	0.26796875	in ⁴	Torsional Stiffness Constant, K										
35	Q	0.765625	in ³	Shear Stress Constant, Q										
36	Q1	0.3828125	in ³	Shear Stress Constant, Long Side, Q1										
37														



You can now explore further on the Excel sheet. Change the inputs, change the units and see the results and plots instantly update.

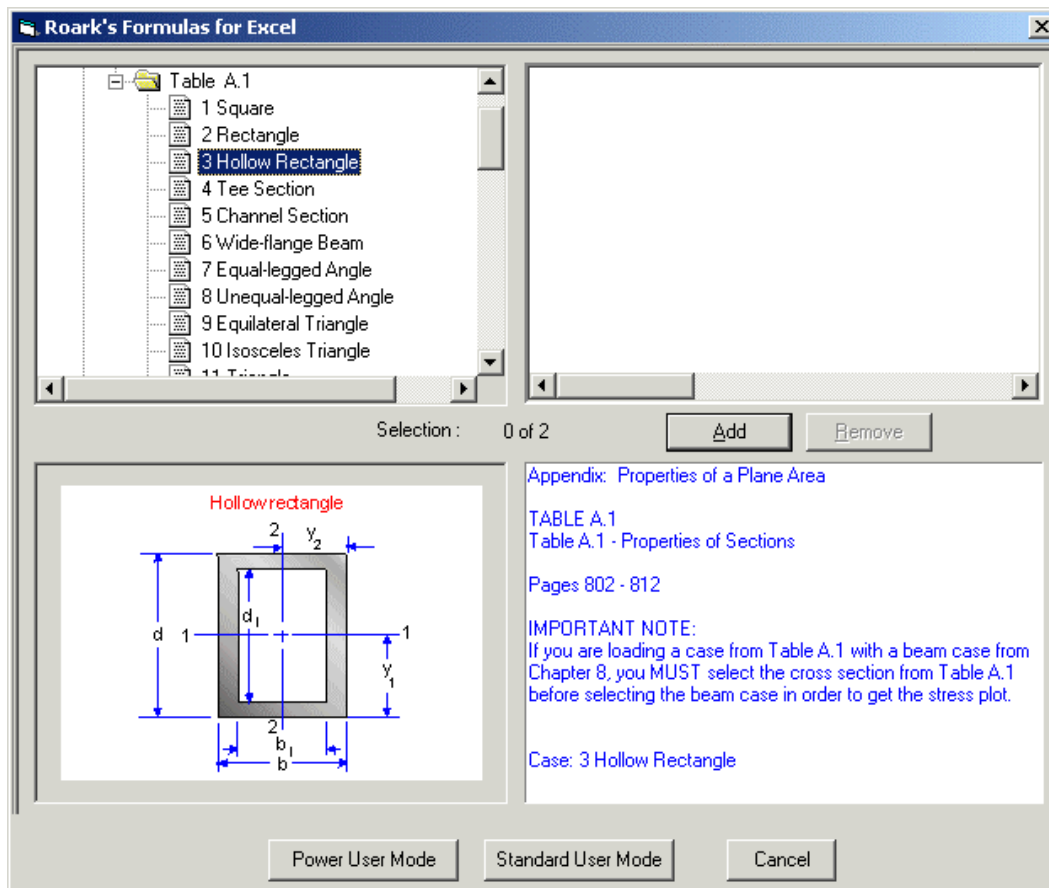
Power User Mode Approach

The following series of problems uses the Power User Mode approach in the Roark's Formulas for Excel Explorer.

Problem 1

Suppose you are designing a beam having a hollow rectangular section and you need to know the area, moment of inertia, and plastic section modulus.

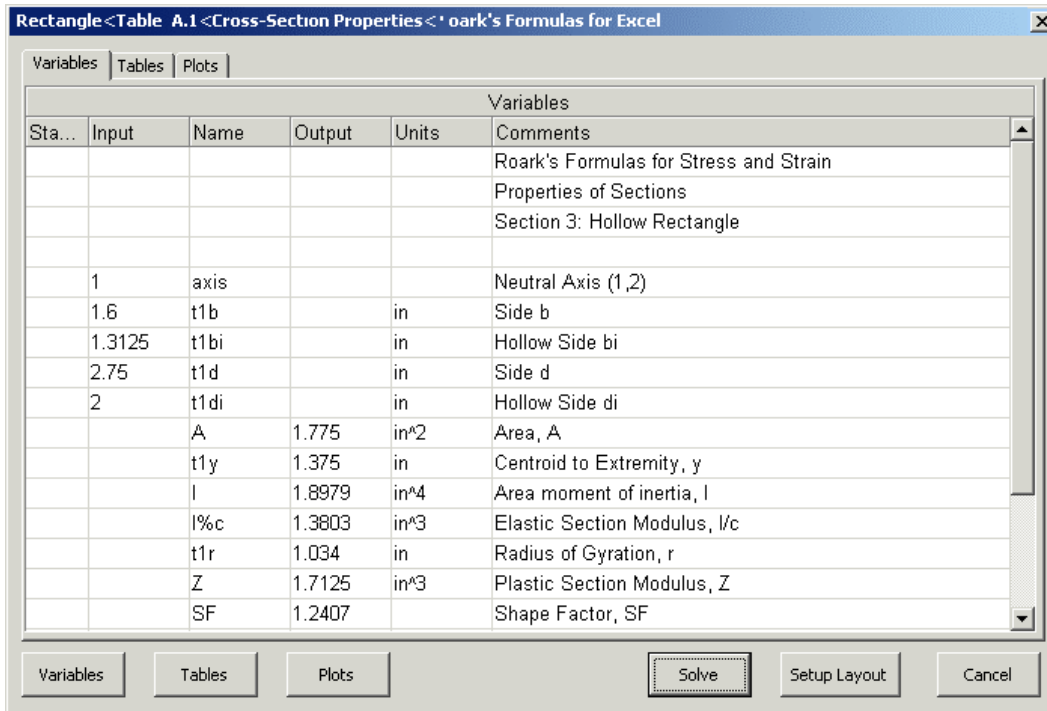
Using the Roark's Formulas for Excel Explorer, select **Table A.1, Case 3** by either double-clicking it or by clicking on it then clicking the Add button. Your selection is confirmed when it is displayed in the upper right portion of the Explorer screen.



The Power User mode allows you to change the *status* of any variables to one of the following:

- Output
- List
- Guess
- Blank

This unique ability of Roark's Formulas for Excel allows you to solve for a variety of combinations of input and output variables. We refer to this ability as *backsolving*. The Input form is shown below. There are three tabs – *Variables*, *Tables*, and *Plots*.



Enter the following five input values for the Variables in the Input column.

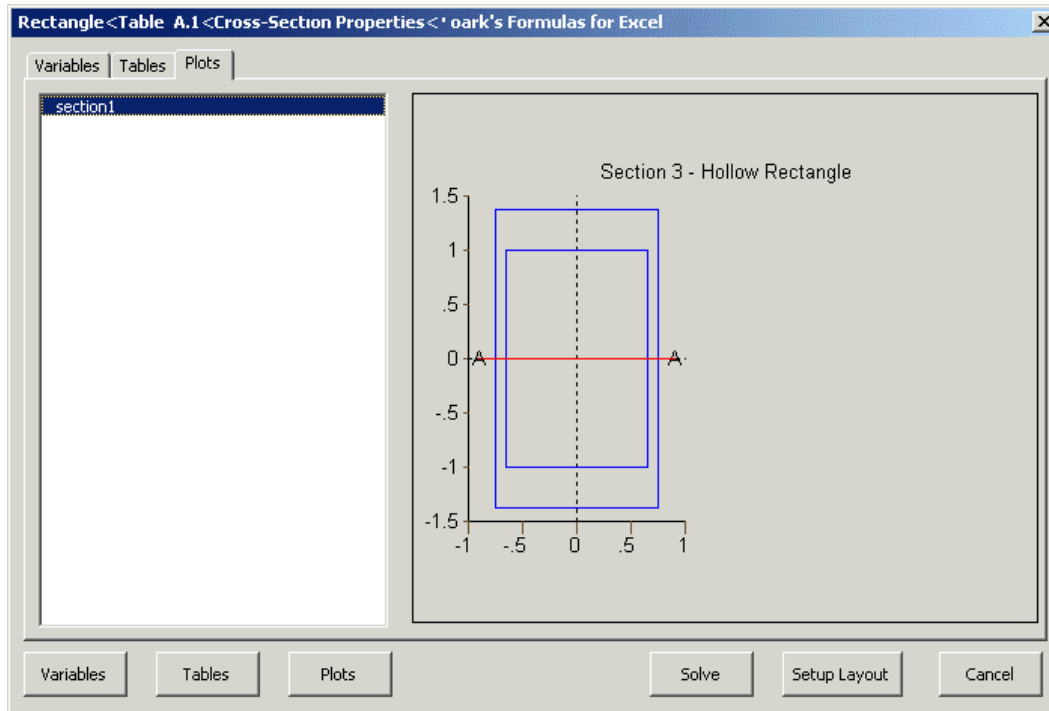
Neutral Axis	1
Side b	1.6 in
Hollow side bi	1.3125 in
Side d	2.75 in
Hollow side di	2 in

The Comments column provides a description for each variable, including the nomenclature from the Roark's Formulas for Stress and Strain, 7th Edition handbook.

The Name column includes the variable names used in the math model.

Click the Solve button and the calculations appear in the Output column.

Select the **Plots** tab and view a plot of the section with your specified dimensions and neutral axis.



Click the Setup Layout button and check the required options on the setup dialog boxes appearing in sequence and then click on Finish button. This transfers the model description, definition sketch, selected Input/Output Variables and Plots to the Excel sheet as shown in the following:

Microsoft Excel - Book1

File Edit View Insert Format Tools Data Window Help

H39 fx

1 **Roark's Formulas for Excel**

2 Appendix: Properties of a Plane Area TABLE A.1

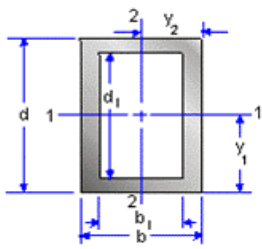
3 Table A.1 - Properties of Sections Pages 802 - 812

4 Case: 3 Hollow Rectangle

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7 **Hollowrectangle**

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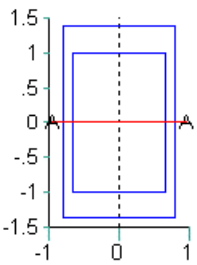
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18	Input	Value	Unit	Comment
19	axis	1		Neutral Axis (1,2)
20	t1b	1.6	in	Side b
21	t1bi	1.3125	in	Hollow Side bi
22	t1d	2.75	in	Side d
23	t1di	2	in	Hollow Side di
24				
25	Output	Value	Unit	Comment
26	A	1.775	in ²	Area, A
27	t1y	1.375	in	Centroid to Extremity, y
28	I	1.897916667	in ⁴	Area moment of inertia, I
29	I%c	1.380303003	in ³	Elastic Section Modulus, I/c
30	t1r	1.034044886	in	Radius of Gyration, r
31	Z	1.7125	in ³	Plastic Section Modulus, Z
32	SF	1.240669594		Shape Factor, SF
33	t	2.75	in	Depth
34	K	1.172440897	in ⁴	Torsional Stiffness Constant, K
35	Q	2.593945313	in ³	Shear Stress Constant, Q
36	Q1	0.994345703	in ³	Shear Stress Constant, Long Side, Q1
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38	Plots:			
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40	Section 3 - Hollow Rectangle			
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Now, suppose that other considerations require that the area moment of inertia, I , be 2.0 in^4 , and that you are willing to adjust the dimension of side b , t_1b . You have several options:

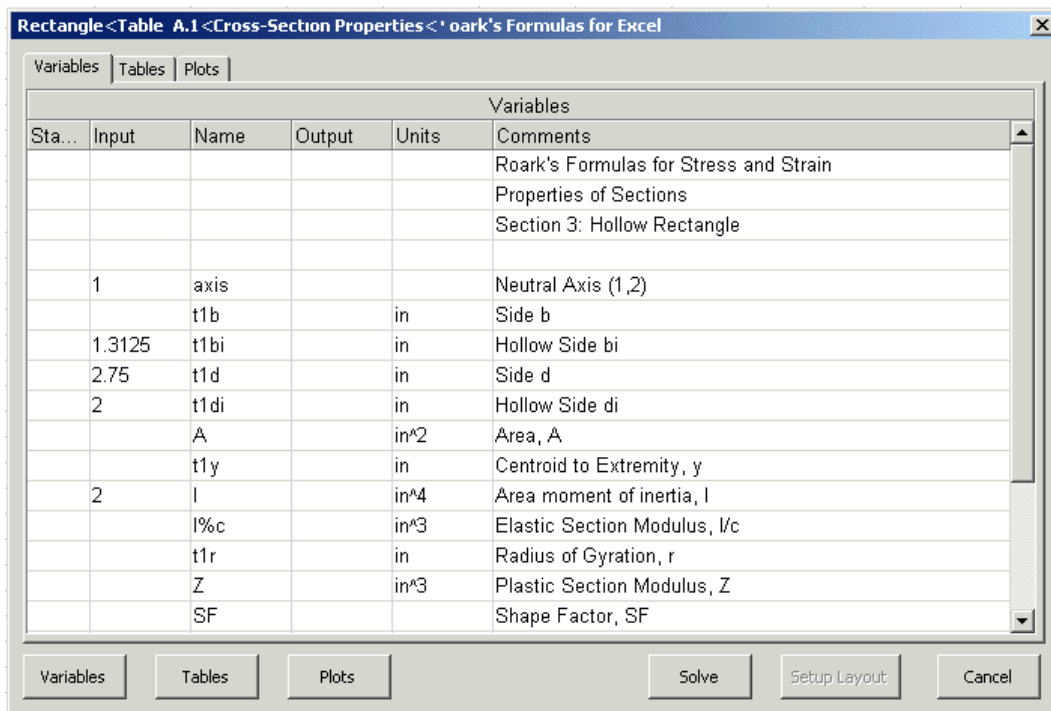
1. You can manually try making changes to the side b value until the moment of inertia gets close enough to 2.
2. You can use the Excel Solver add-in to automate the process.
3. You can reload the Roark's Formulas for Excel Explorer and change the inputs there.

If you have already linked the model with Excel, option 2 will usually be the most efficient in cases where just two variables are changing status. The Excel Solver will repeatedly run the model until the desired output is obtained. If more than two variables are changing between outputs and inputs, returning to the Power User input screen via the Roark's Formulas for Excel Explorer is the best approach. We assume that you are already familiar with the Excel Solver add-in and have it installed. If you need assistance in using it, consult with the Excel Help utility or Microsoft Support.

For this practice problem, we will return to the Roark's Formulas for Excel Explorer. Select **Table A.1, Case 3** (hollow rectangular cross-section) again and click the Power User button to open the input form.

Enter **2** as the input value for Area moment of inertia and blank the input for side b by pressing the **Spacebar** followed by **Enter**. (You can also blank an input by typing **B** in the Status field of the variable or double-clicking on the Status field and selecting **Blank** from the drop-down list box.)

Click Solve for the revised outputs.



Click on Setup Layout button, check the required options on setup dialog boxes appearing in sequence and click Finish button. The revised model including description, definition sketch, selected Input/Output Variables and Plots are transferred to Excel.

	A	B	C	D
1	Roark's Formulas for Excel			
2	Appendix: Properties of a Plane Area TABLE A.1			
3	Table A.1 - Properties of Sections Pages 802 - 812			
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17				
18	Input	Value	Unit	Comment
19	axis	1		Neutral Axis (1,2)
20	t1bi	1.3125	in	Hollow Side bi
21	t1d	2.75	in	Side d
22	t1di	2	in	Hollow Side di
23	I	2	in ⁴	Area moment of inertia, I
24				
25	Output	Value	Unit	Comment
26	t1b	1.65890308	in	Side b
27	A	1.936983471	in ²	Area, A
28	t1y	1.375	in	Centroid to Extremity, y
29	I%c	1.454545455	in ³	Elastic Section Modulus, I/c
30	t1r	1.016136474	in	Radius of Gyration, r
31	Z	1.823863636	in ³	Plastic Section Modulus, Z
32	SF	1.25390625		Shape Factor, SF
33	t	2.75	in	Depth
34	I	2	in ⁴	Area moment of inertia, I
35	K	1.408899824	in ⁴	Torsional Stiffness Constant, K
36	Q	2.646405868	in ³	Shear Stress Constant, Q
37	Q1	1.222297526	in ³	Shear Stress Constant, Long Side, Q1