Tutorial—Five Quick Problems

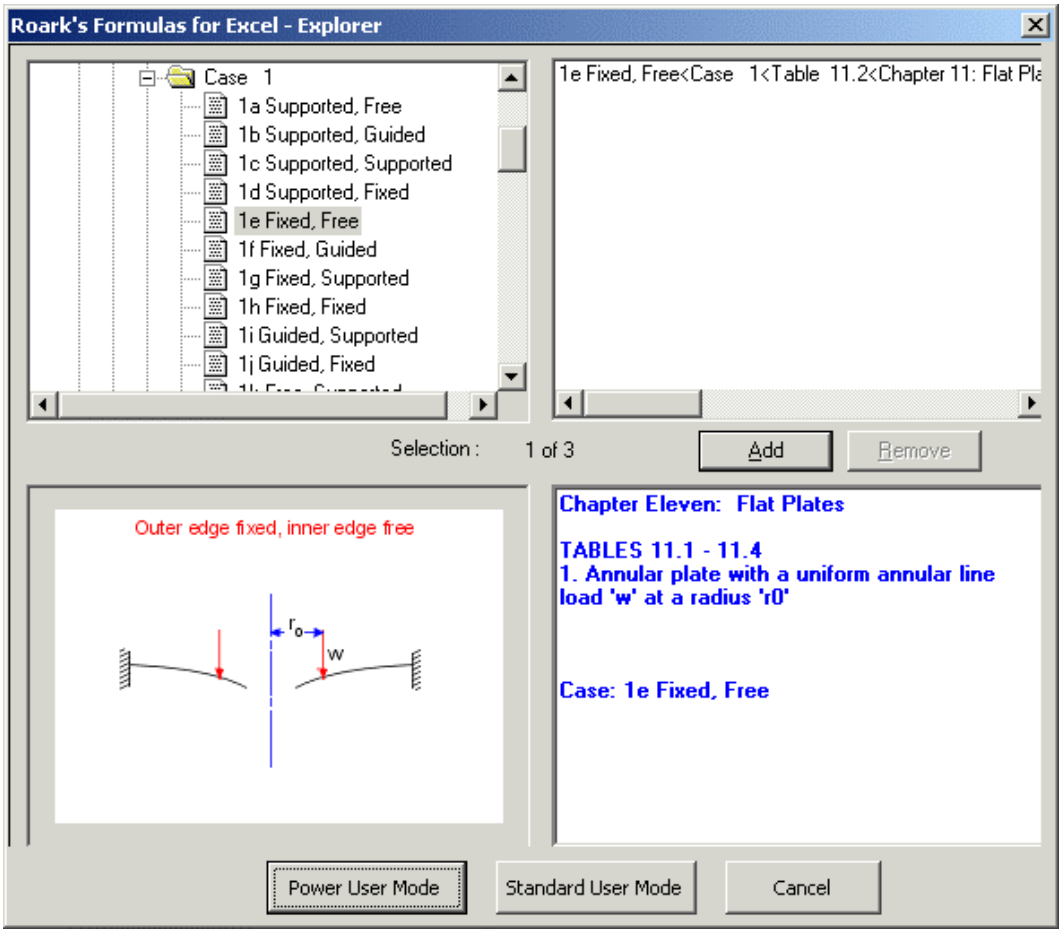
Tutorials will use the **Standard User Mode** to highlight the simplicity in using this software. Advanced Users may want to use the **Power User Mode** and examples are shown at the end of each Tutorial.

All Tutorials are shown with the US unit system.

Problem 4

Let's switch from beams to plates. The next problem involves a flat annular plate with uniform annular line load, fixed on the outside and free in the center.

Open the Roark's Formulas for Excel Explorer and select a case from Plates Table, **Table 11.2**, **Case 1e** -- a flat annular plate of constant thickness with uniform annular line load `w` at a radius `r0`, with the plate fixed on the outside and free in the center.



Click the **Standard User Mode** button to continue. Once loaded into Excel the Worksheet looks as follows:

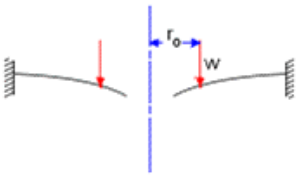
Roark's Formulas for Excel

Chapter Eleven: Flat Plates TABLES 11.1 - 11.4

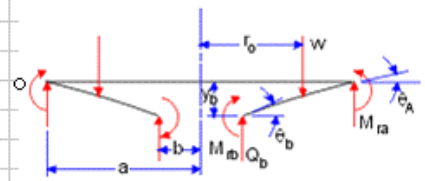
1. Annular plate with a uniform annular line load 'w' at a radius 'r0'

Case: 1e Fixed, Free

Outer edge fixed, inner edge free

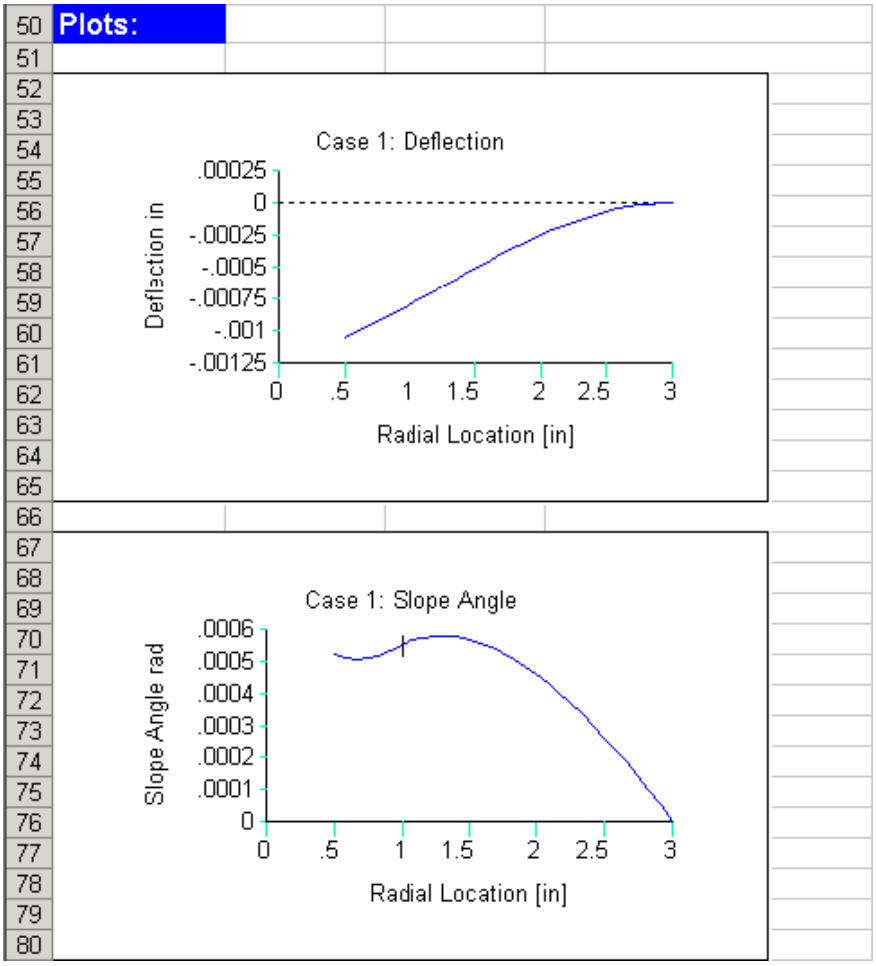


Annular plate with a uniform annular line load w at a radius r_o



Input	Value	Unit	Comment
w	50	lbf/in	Uniform annular line load
r0	1	in	Radius to annular line load
matnum	17		Material Number (See Material Table)
a	3	in	Outer Radius
b	0.5	in	Inner Radius
t	0.25	in	Plate Thickness
r	1	in	Sample radius, r

Output	Value	Unit	Comment
caution1	'		Dimension Check
caution2	'		Thickness Check
matl	"Steel - A.S.T.M. A7-61T"		Material name
E	29000000	psi	Young's Modulus
nu	0.27		Poisson's ratio
D	40729.60486	lbf-in	Plate Constant
y	-0.000798653	in	Deflection at radius r
th	0.000549609	rad	Radial Slope Angle at radius r
Mr	14.85928605	lbf-in/in	Radial Bending Moment at radius r
Mt	24.76547675	lbf-in/in	Tangential Bending Moment at radius r
Q	0	lbf/in	Shear Force at radius r
sigma_r	1426.491461	psi	Radial Bending Stress at radius r
sigma_t	2377.485768	psi	Tangential Bending Stress at radius r
ya	0	in	Deflection at outer edge
tha	0	rad	Radial Slope Angle at outer edge
Mra	-23.73001381	lbf-in/in	Radial Bending Moment at outer edge
Qa	-16.66666667	lbf/in	Shear Force at outer edge
yb	-0.001057756	in	Deflection at inner edge
thb	0.000524687	rad	Radial Slope Angle at inner edge
Mrb	0	lbf-in/in	Radial Bending Moment at inner edge
Qb	0	lbf/in	Shear Force at inner edge



Enter the following input values:

Uniform annular line load	**30** in
Radius to annular line load	**6** in
Material number	**20**
Outer radius of the plate	**18 in**
Inner radius	**1** in
Plate thickness	**.25 in**
Radius	**6** in

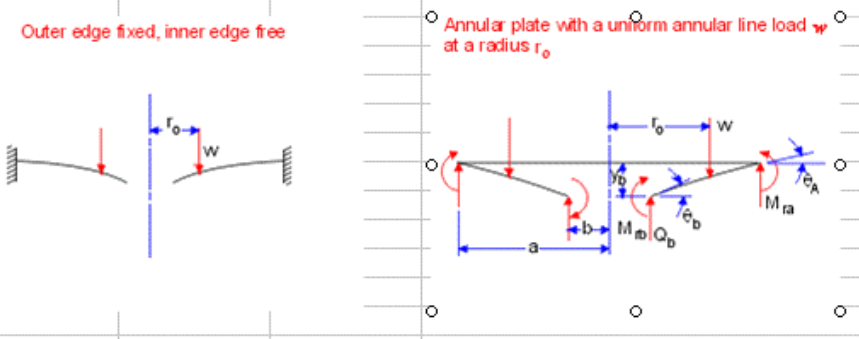
Note the new Worksheet.

Roark's Formulas for Excel

Chapter Eleven: Flat Plates TABLES 11.1 - 11.4

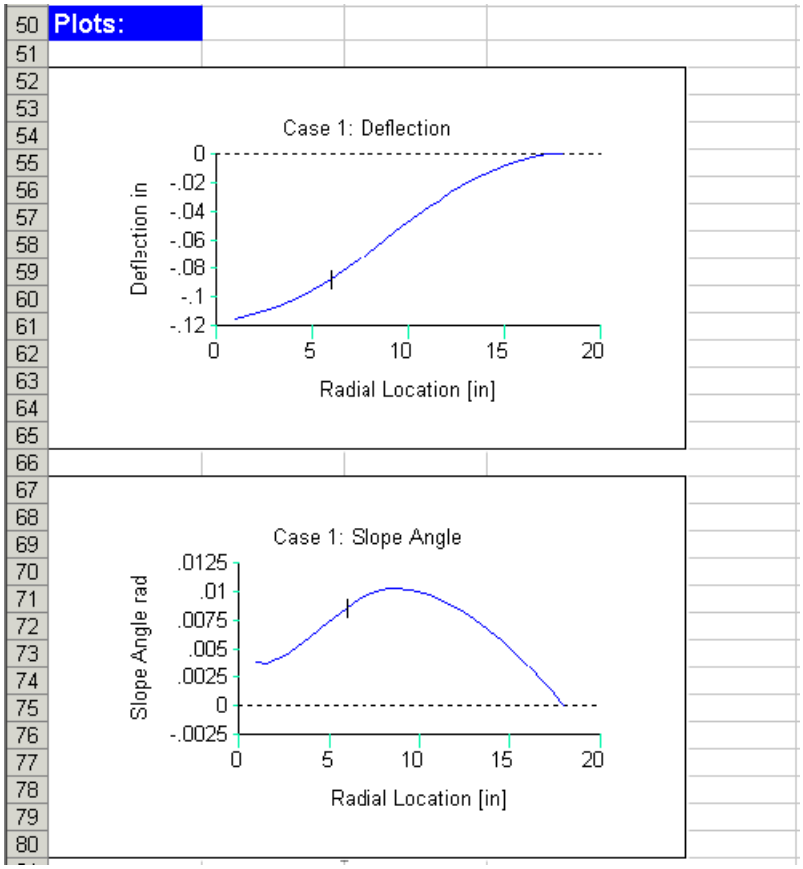
1. Annular plate with a uniform annular line load 'w' at a radius 'r0'

Case: 1e Fixed, Free



Input	Value	Unit	Comment
w	30	lbf/in	Uniform annular line load
r0	6	in	Radius to annular line load
matnum	20		Material Number (See Material Table)
a	18	in	Outer Radius
b	1	in	Inner Radius
t	0.25	in	Plate Thickness
r	6	in	Sample radius, r

Output	Value	Unit	Comment
caution1	'		Dimension Check
caution2	'		Thickness Check
matl	"Steel - spring, carbon, S.A.E.		Material name
E	30000000	psi	Young's Modulus
nu	0.285		Poisson's ratio
D	42515.84991	lbf-in	Plate Constant
y	-0.087245867	in	Deflection at radius r
th	0.008675348	rad	Radial Slope Angle at radius r
Mr	73.14725485	lbf-in/in	Radial Bending Moment at radius r
Mt	77.32709799	lbf-in/in	Tangential Bending Moment at radius r
Q	0	lbf/in	Shear Force at radius r
sigma_r	7022.136466	psi	Radial Bending Stress at radius r
sigma_t	7423.401407	psi	Tangential Bending Stress at radius r
ya	0	in	Deflection at outer edge
tha	0	rad	Radial Slope Angle at outer edge
Mra	-80.64954827	lbf-in/in	Radial Bending Moment at outer edge
Qa	-10	lbf/in	Shear Force at outer edge
yb	-0.115780448	in	Deflection at inner edge
thb	0.003852143	rad	Radial Slope Angle at inner edge
Mrb	0	lbf-in/in	Radial Bending Moment at inner edge
Qb	0	lbf/in	Shear Force at inner edge


Plots:
Case 1: Deflection
Deflection in
0
-.02
-.04
-.06
-.08
-.1
-.12
0
5
10
15
20
Radial Location [in]
Case 1: Slope Angle
Slope Angle rad
.0125
.01
.0075
.005
.0025
0
-.0025
0
5
10
15
20
Radial Location [in]

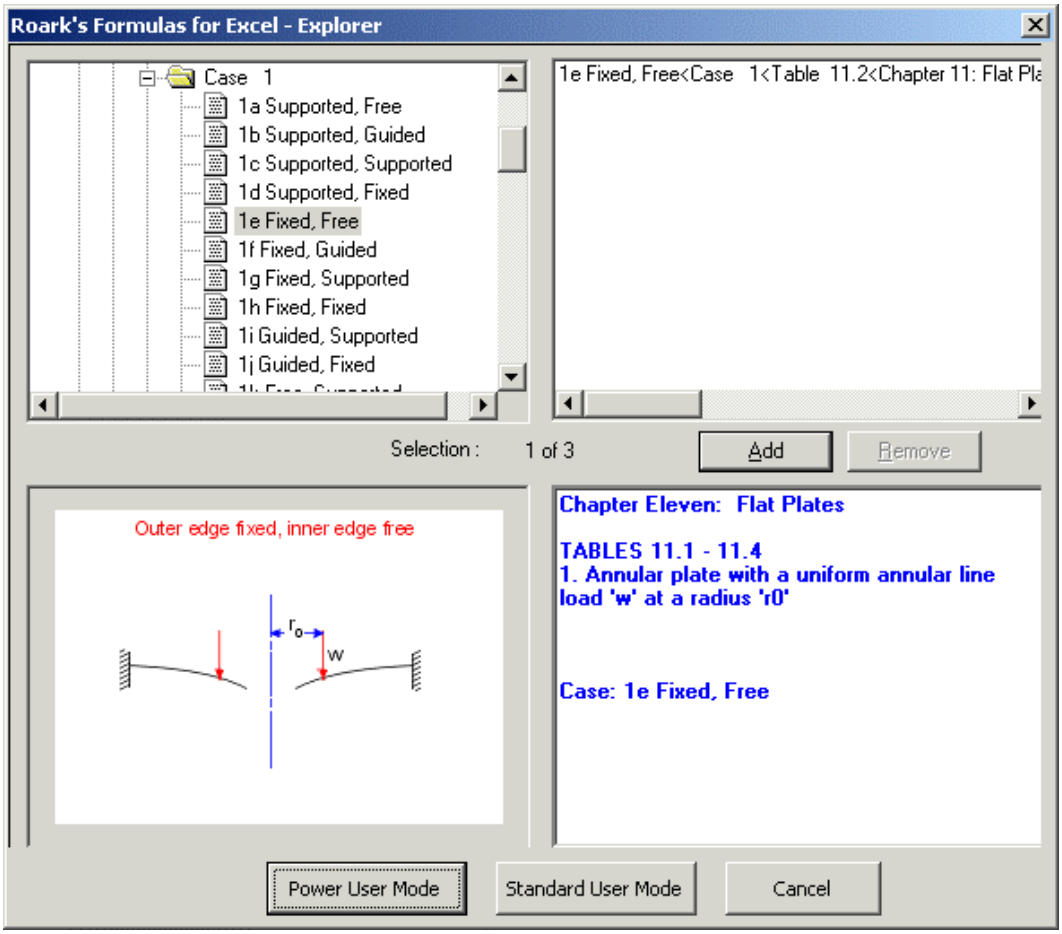
Power User Mode Approach

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

Problem 4

Let's switch from beams to plates. The next problem involves a flat annular plate with uniform annular line load, fixed on the outside and free in the center.

Open the Roark's Formulas for Excel Explorer, select a case from Plates Table, **Table 11.2**, **Case 1e** - a flat annular plate of constant thickness with uniform annular line load `w` at a radius `r0`, with the plate fixed on the outside and free in the center.

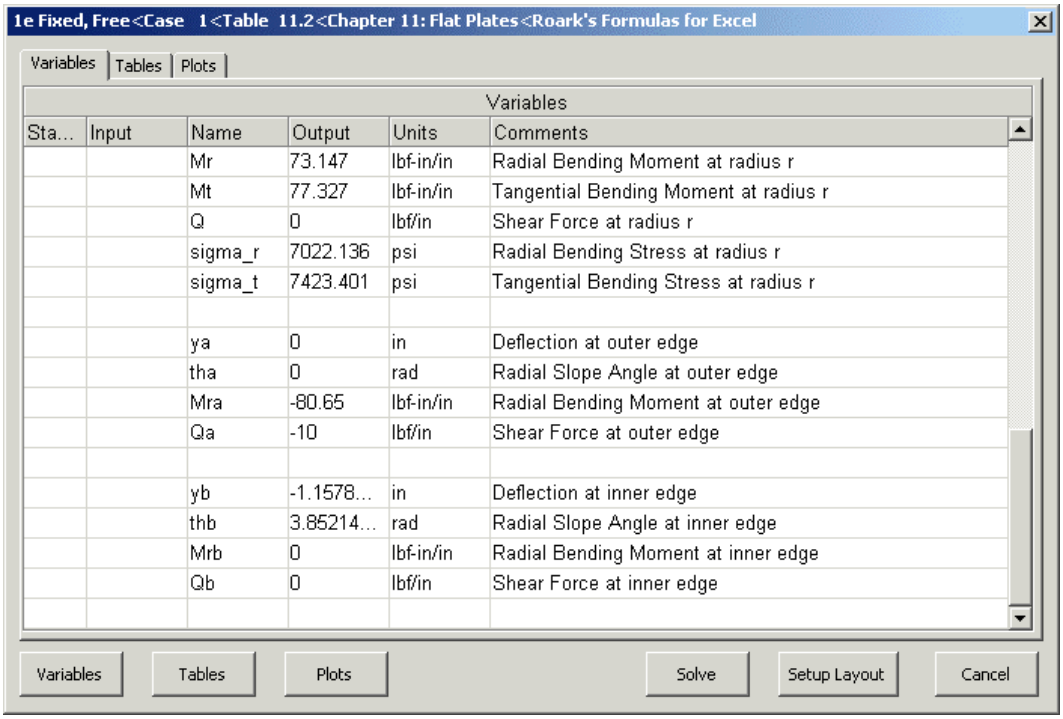


Click on the **Power User Mode** button.

Enter the following input values:

Uniform annular line load	**30** in
Radius to annular line load	**6** in
Material number	**20**
Outer radius of the plate	**18 in**
Inner radius	**1** in
Plate thickness	**.25 in**
Radius	**6** in

Now click Solve and observe the results.



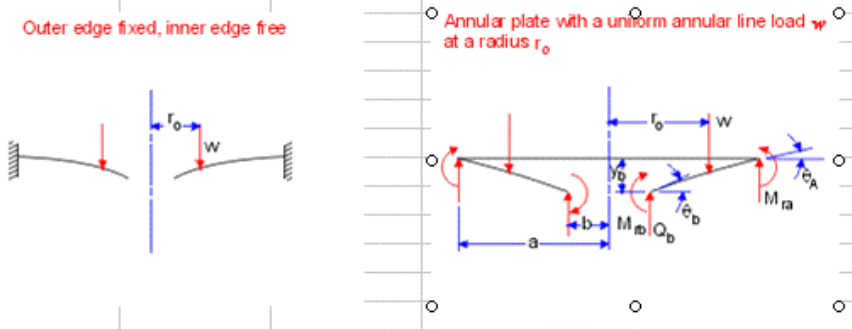
Click Setup Layout to transfer to the Excel Worksheet.

Roark's Formulas for Excel

Chapter Eleven: Flat Plates TABLES 11.1 - 11.4

1. Annular plate with a uniform annular line load 'w' at a radius 'r0'

Case: 1e Fixed, Free



Input	Value	Unit	Comment
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r0	6	in	Radius to annular line load
matnum	20		Material Number (See Material Table)
a	18	in	Outer Radius
b	1	in	Inner Radius
t	0.25	in	Plate Thickness
r	6	in	Sample radius, r

Output	Value	Unit	Comment
caution1	'		Dimension Check
caution2	'		Thickness Check
matl	"Steel - spring, carbon, S.A.E.		Material name
E	30000000	psi	Young's Modulus
nu	0.285		Poisson's ratio
D	42515.84991	lbf-in	Plate Constant
y	-0.087245867	in	Deflection at radius r
th	0.008675348	rad	Radial Slope Angle at radius r
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Mra	-80.64954827	lbf-in/in	Radial Bending Moment at outer edge
Qa	-10	lbf/in	Shear Force at outer edge
yb	-0.115780448	in	Deflection at inner edge
thb	0.003852143	rad	Radial Slope Angle at inner edge
Mrb	0	lbf-in/in	Radial Bending Moment at inner edge
Qb	0	lbf/in	Shear Force at inner edge