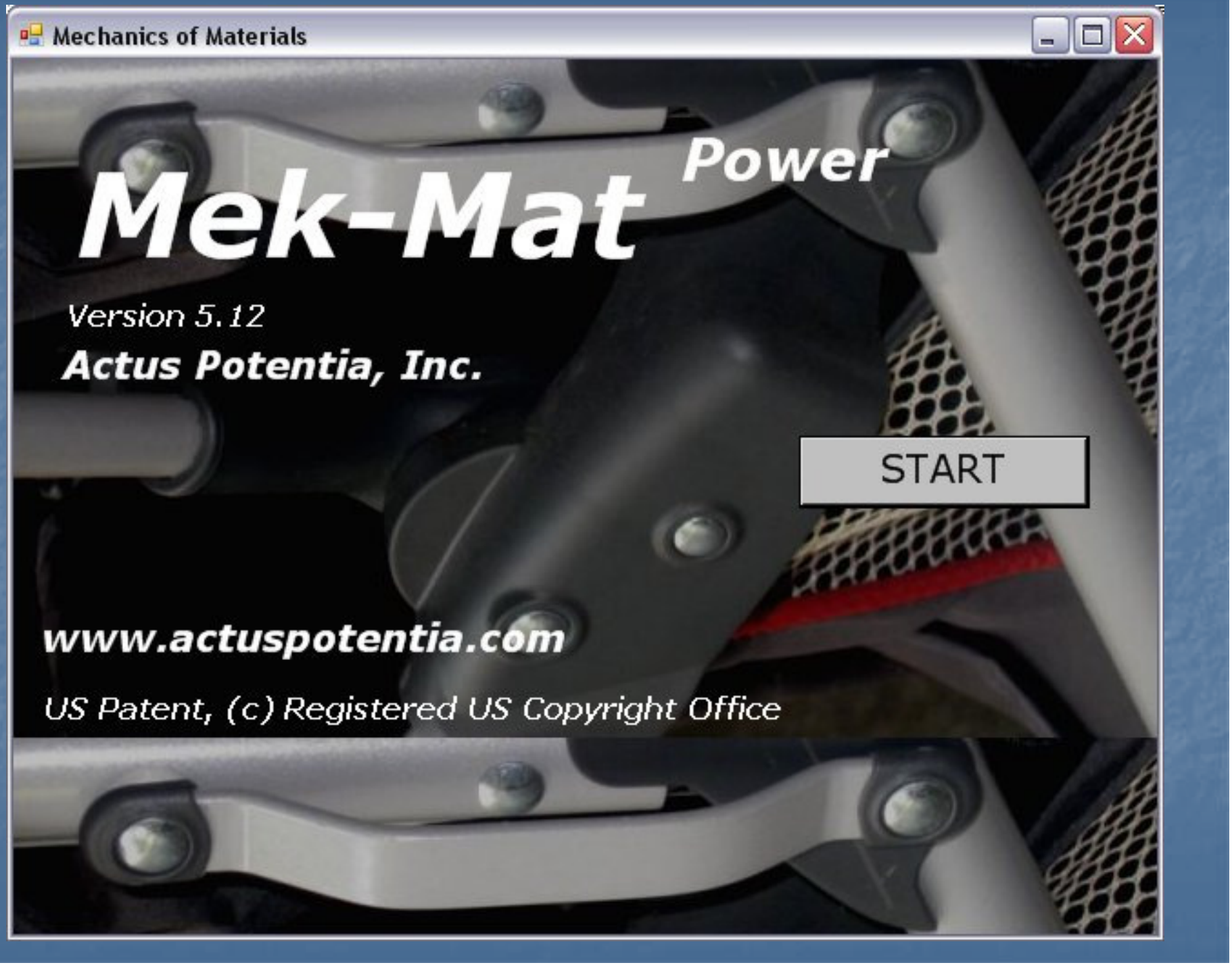
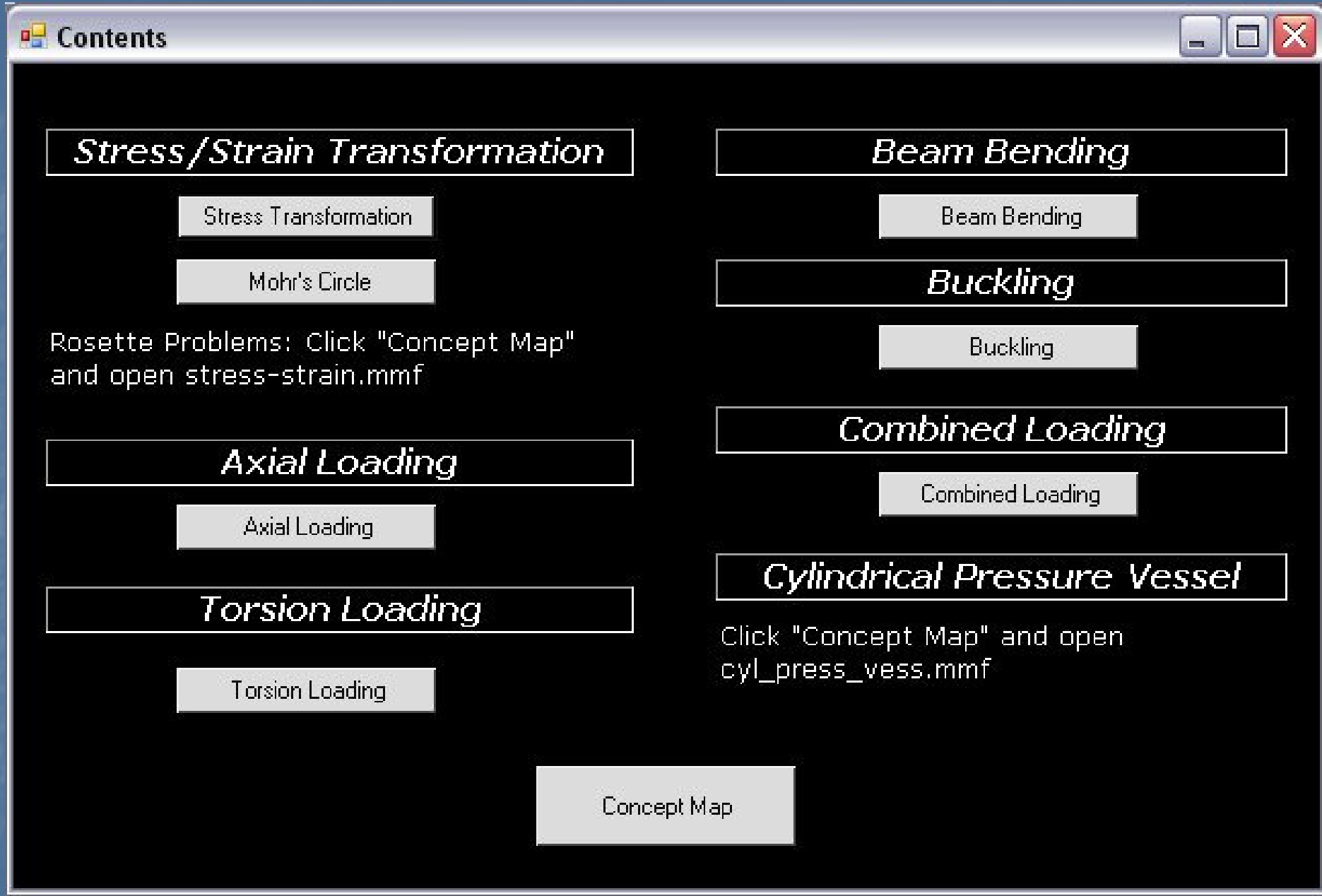

Mechanics of Materials
Mek-Mat
Power
Version 5.12
Actus Potentia, Inc.
START
www.actuspotentia.com
US Patent, (c) Registered US Copyright Office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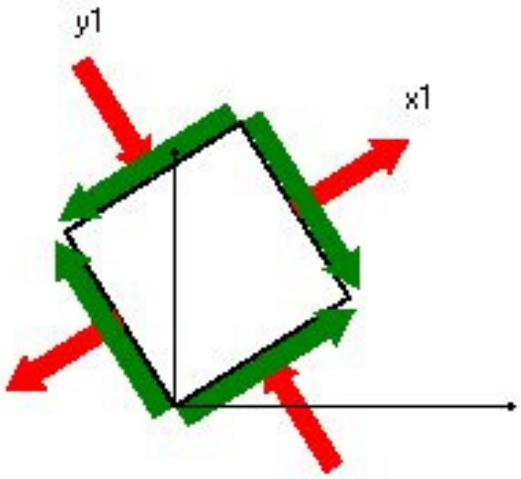
Torsion Loading
Torsion Loading
Beam Bending
Beam Bending
Buckling
Buckling
Combined Loading
Combined Loading
Cylindrical Pressure Vessel
Click "Concept Map" and open cyl_press_vess.mmf
Concept Map

Stress Transformation

Stress Transformation



Normal Stress (sigma-x) 2000

Normal Stress (sigma-y) -3000

Shear Stress (tau-xy) 1000

Calculate

Angle (degrees)

32

Change

Stress x1 1494.7219289

Stress y1 -2494.7219289

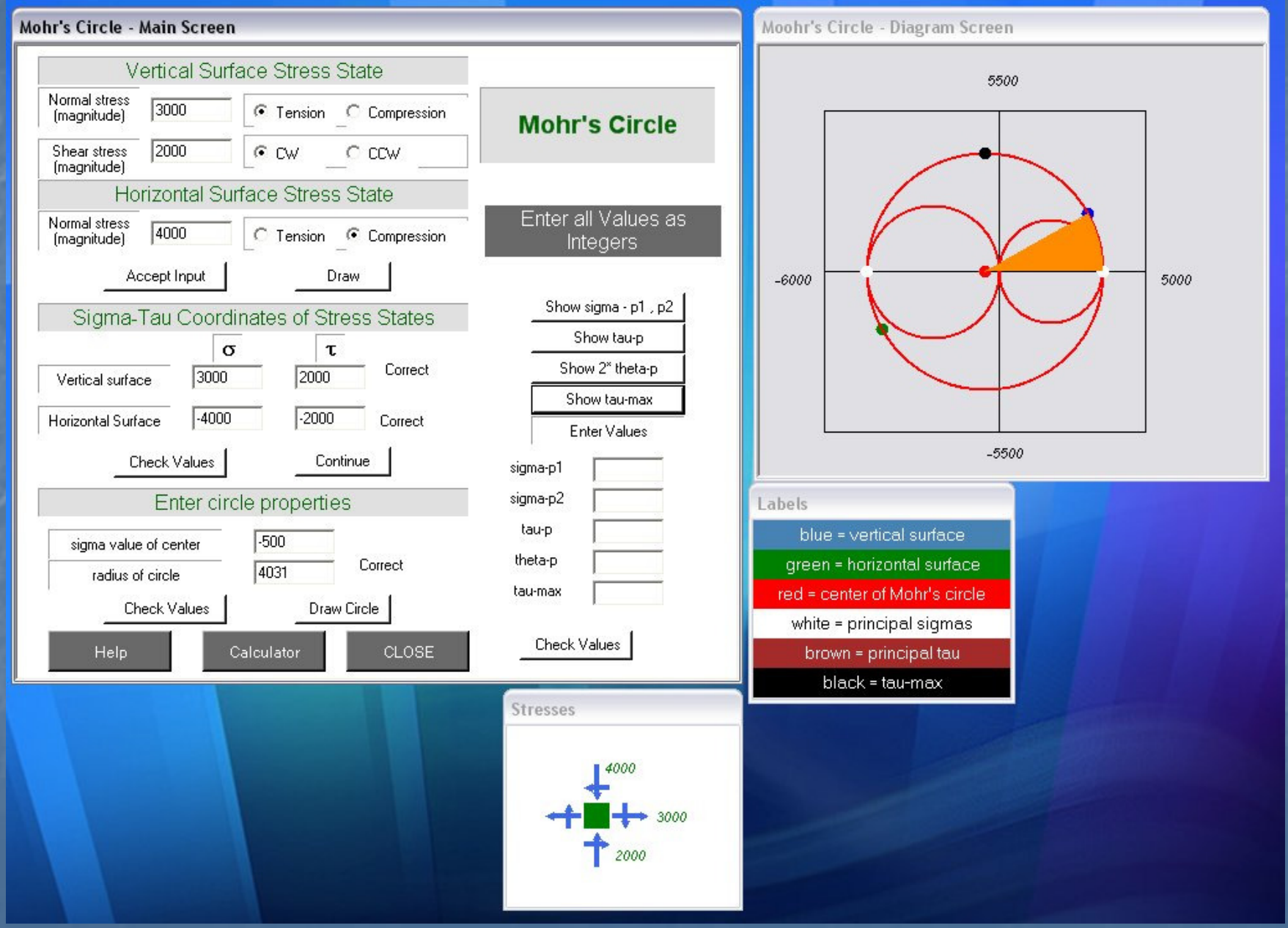
Shear -1808.6139516

Enter sigma-x, sigma-y, and tau-xy values. Click 'Calculate' to begin. Shift the dial towards right to rotate the coordinate system through an angle up to 90 degrees. Watch the stresses change in the rotated x1-y1 system.

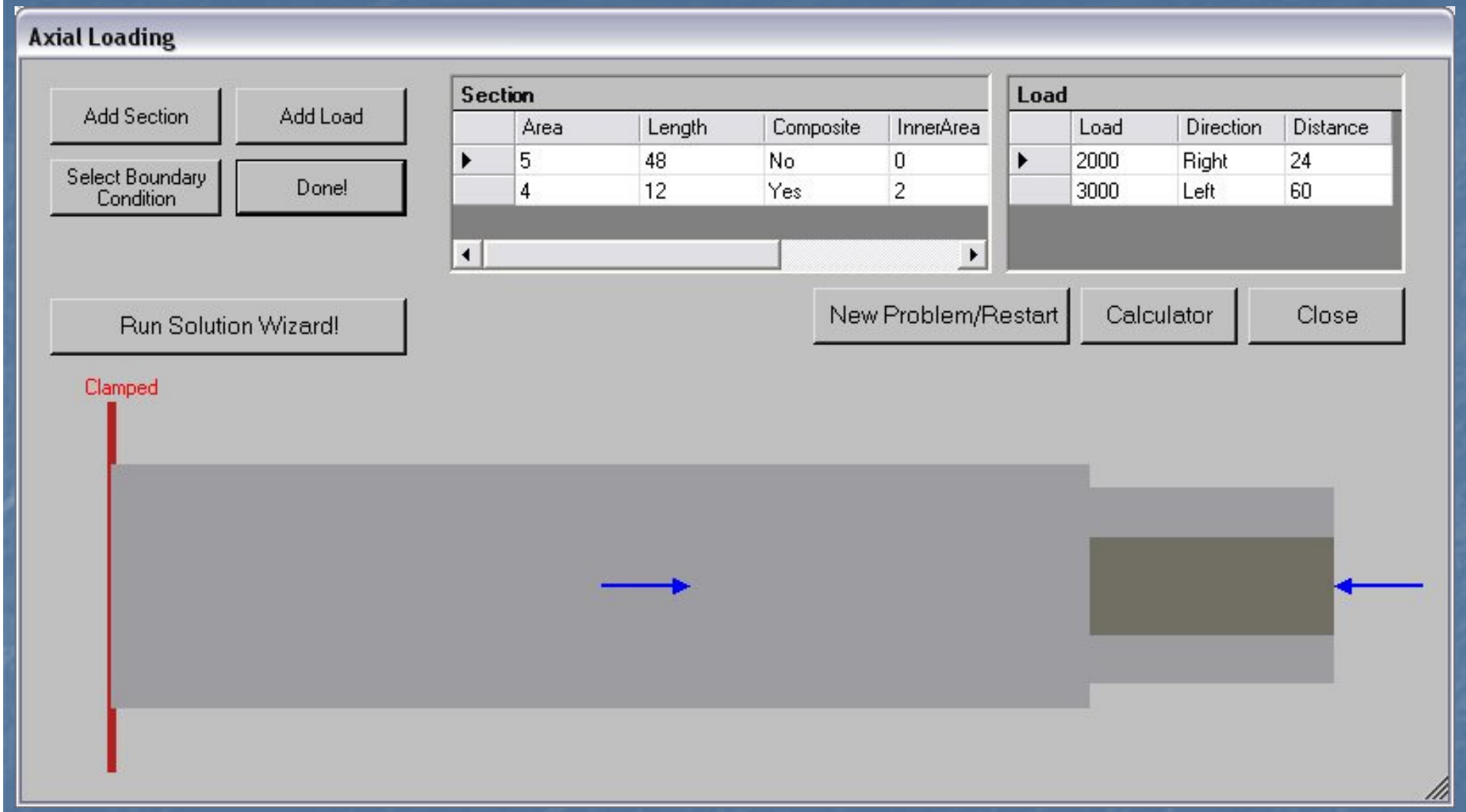
HELP

CLOSE

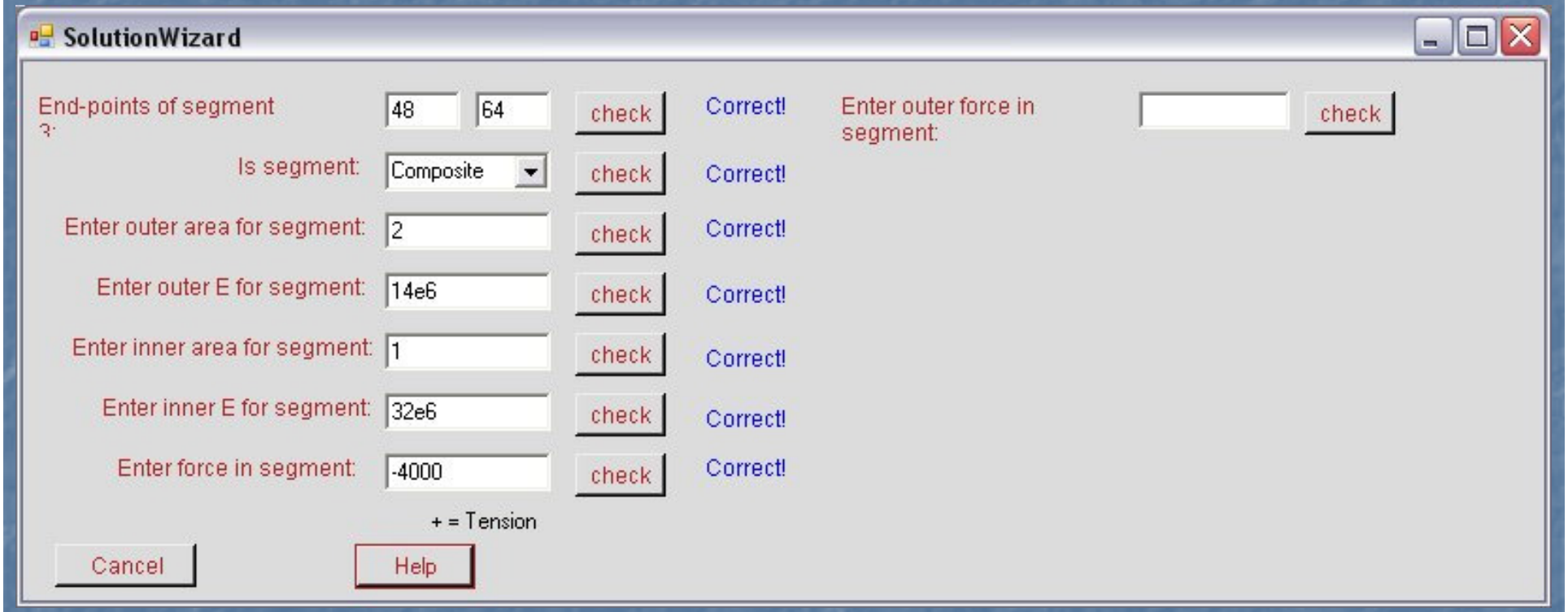
Mohr's Circle



Axial Loading – Problem Definition



Axial Loading – Queries to Lead User to the Solution Correct/Incorrect Feedback



Axial Loading – Help

composite.pdf - Adobe Reader

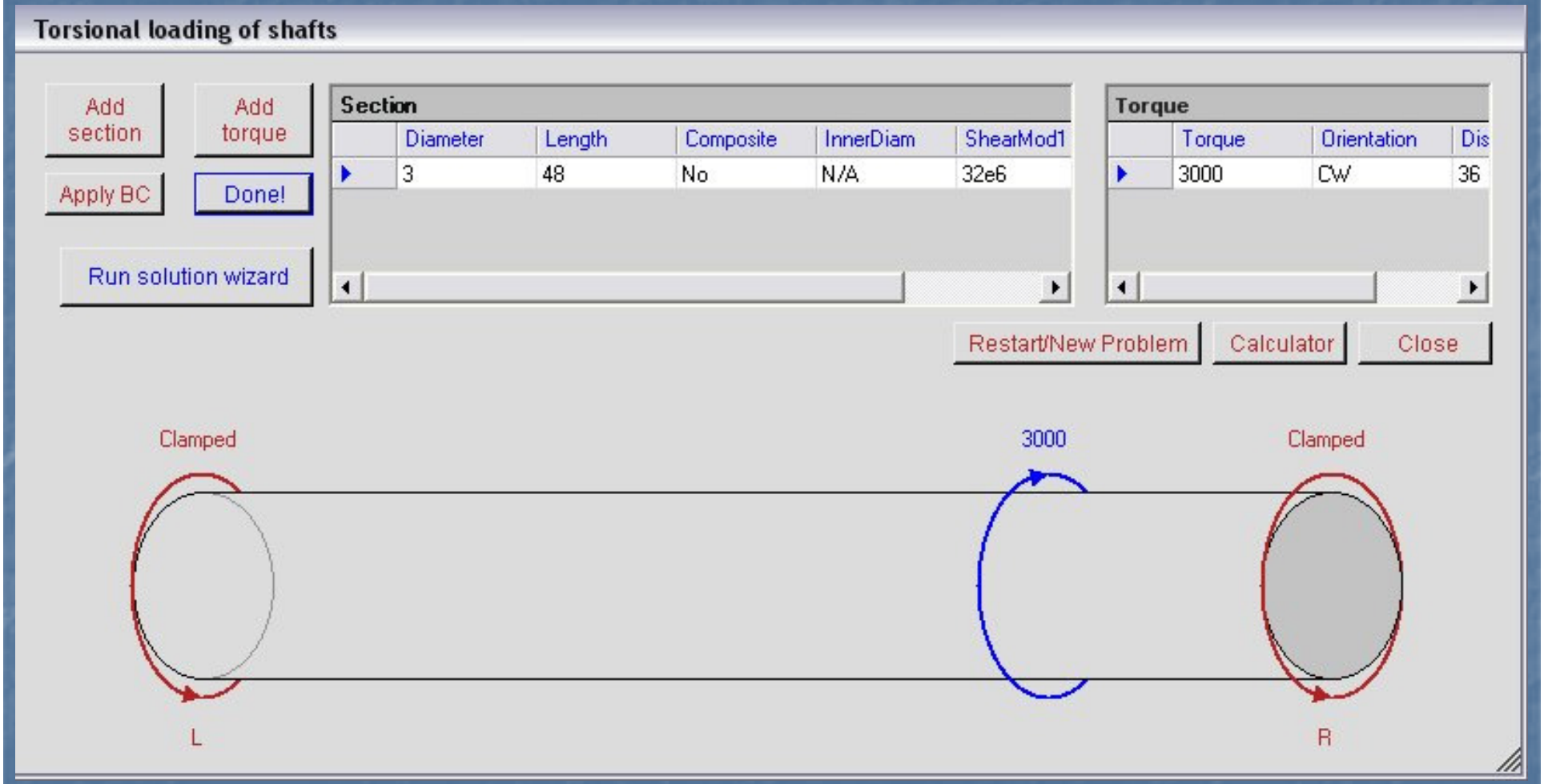
File Edit View Window Help

1 / 2 100% Tools Sign Comment

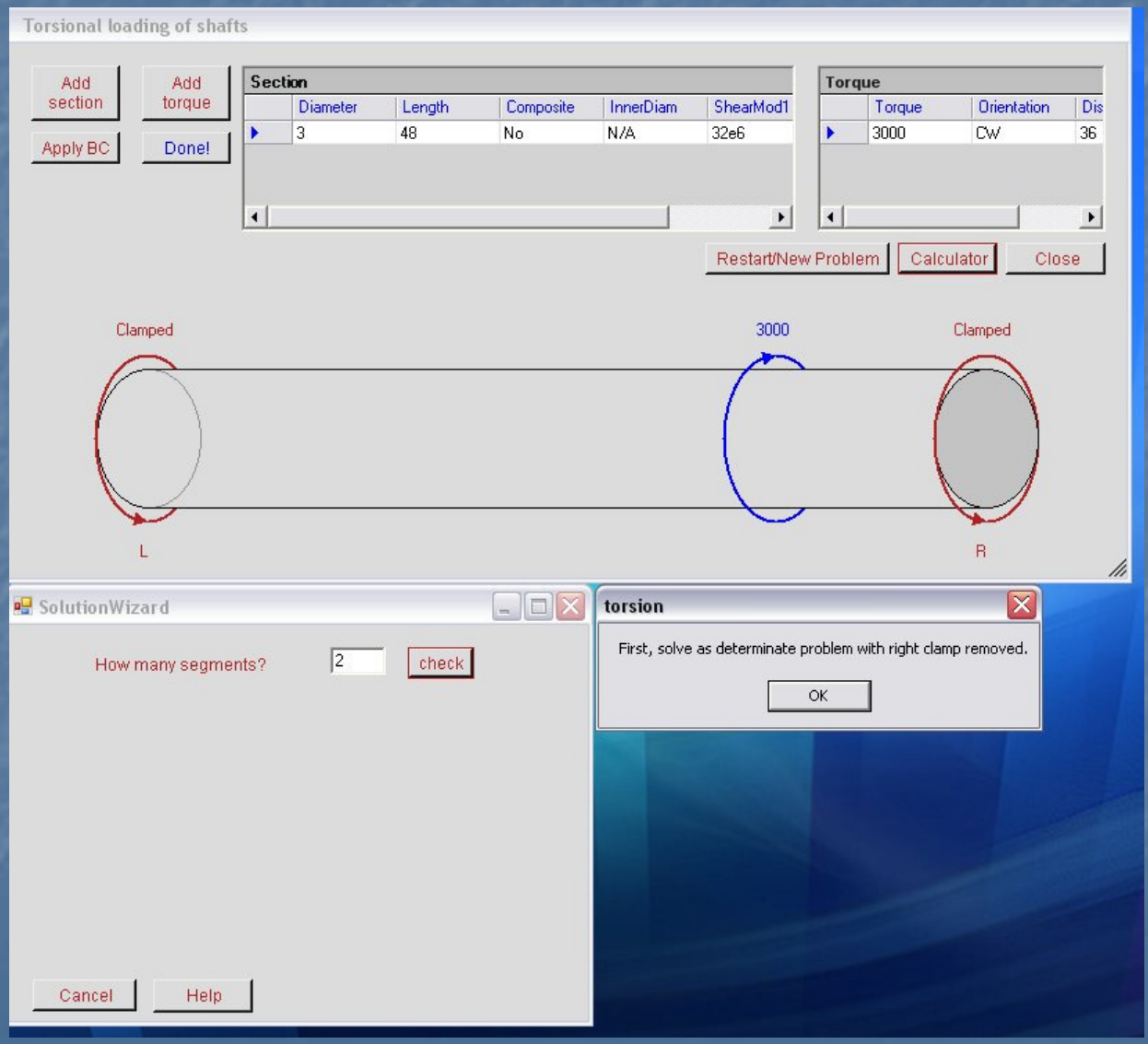
Example Problem:

A composite cantilever beam (L=100in) is axially loaded with a positive force of 2000 lbs. on its free, right end. The outer section of the beam is steel (E=30e6 psi) and has a cross-sectional area of 20 in^2. The inner section of the beam is aluminum (E=10e6 psi) and has a cross-sectional area of 10 in^2.

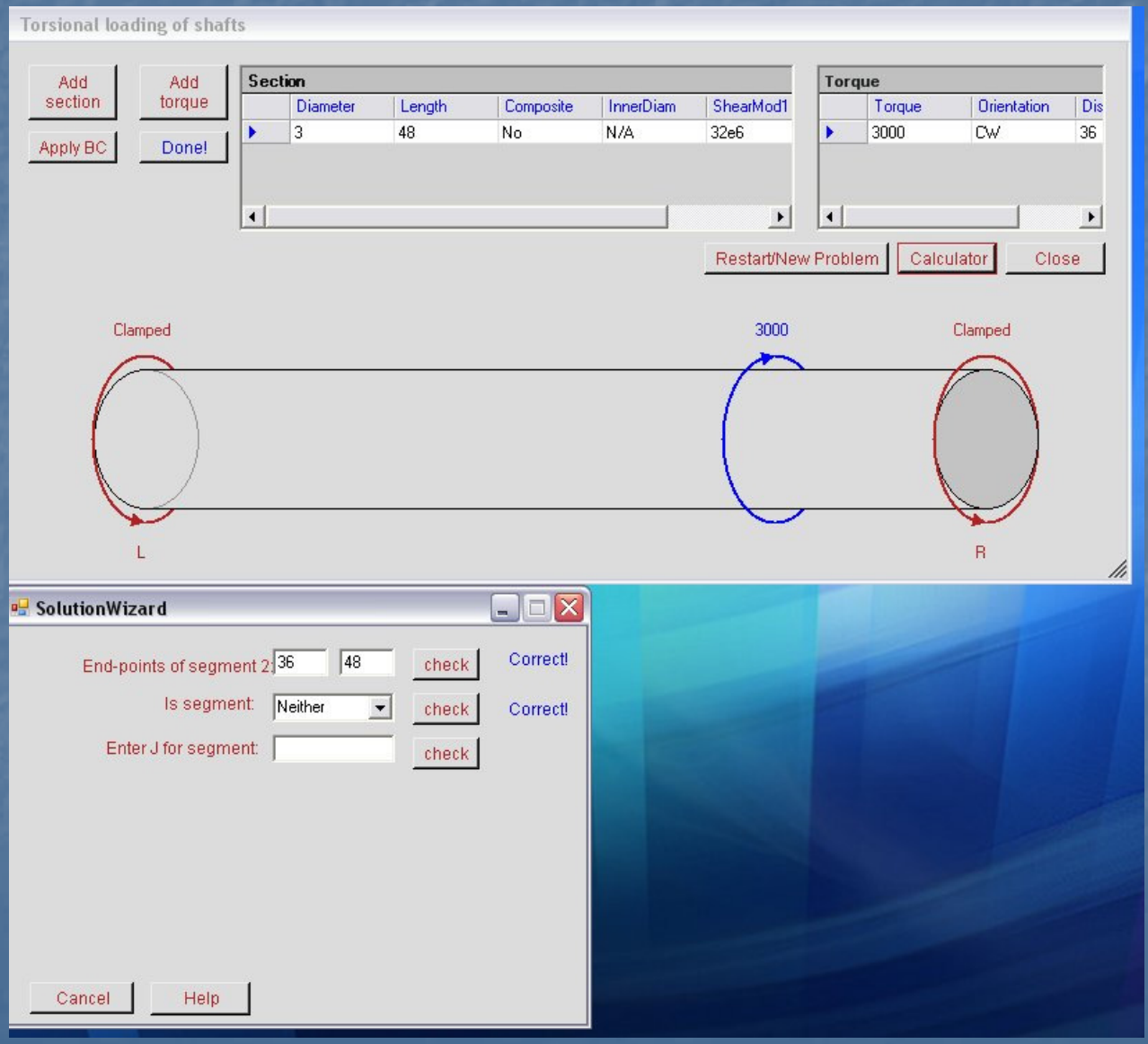
Torsion Loading – Problem Definition



Torsion Loading – Queries to Lead User to the Solution
Message Boxes for Guidance



Torsion Loading – Queries to Lead User to the Solution Correct/Incorrect Feedback



Torsion Loading – Help

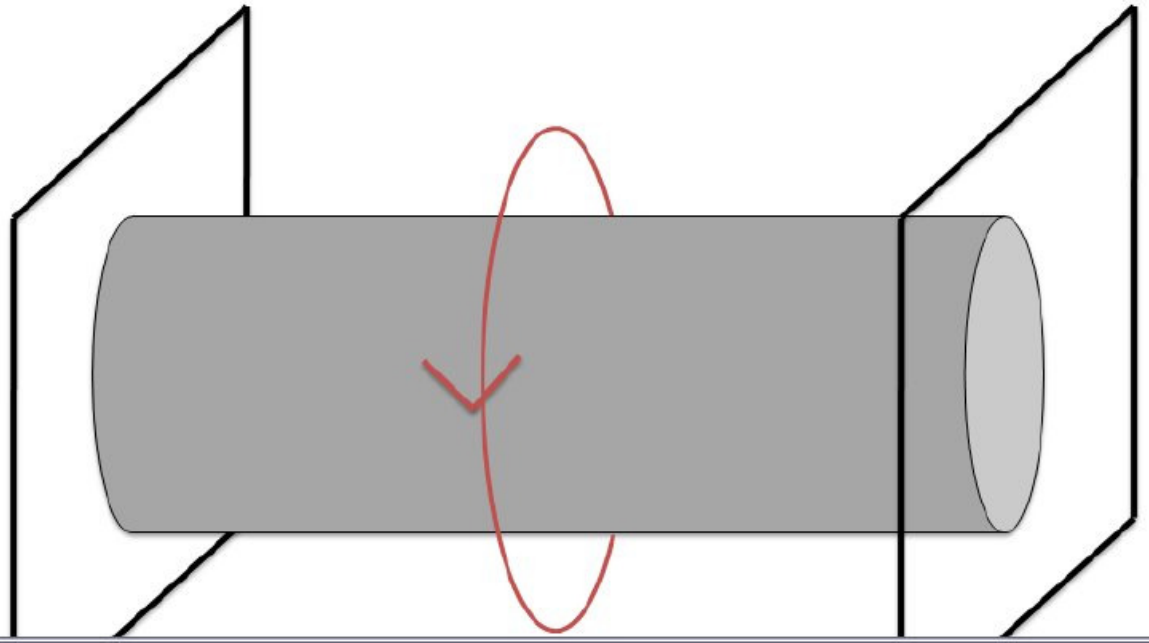
indeterminatetorsion.pdf - Adobe Reader

File Edit View Window Help

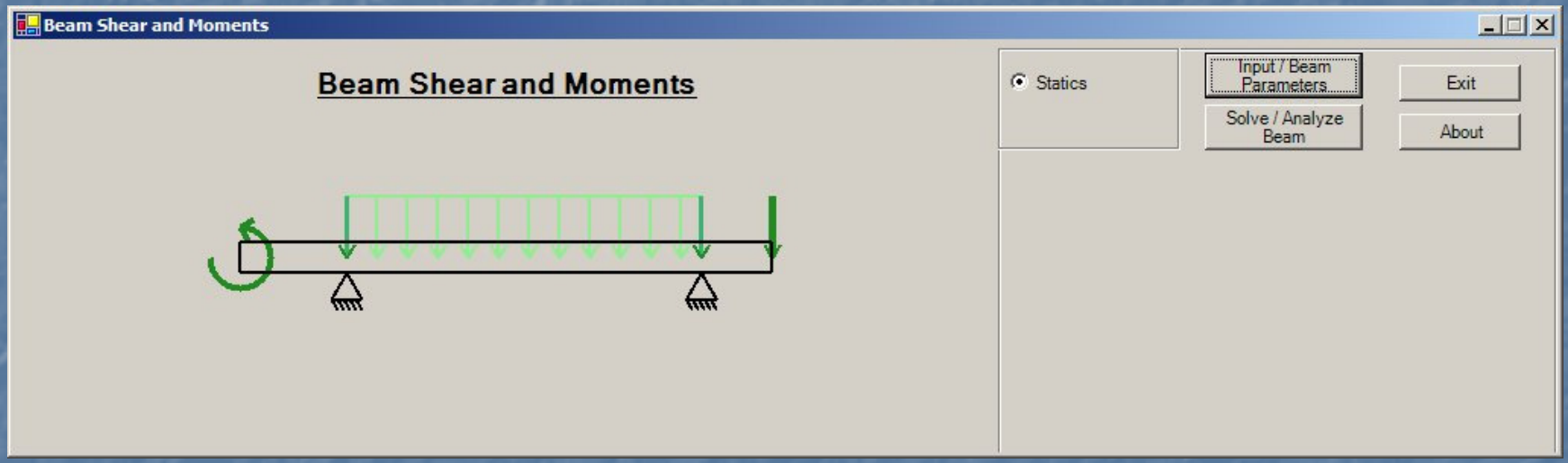
1 / 5 100% Tools Sign Comment

Example Problem:

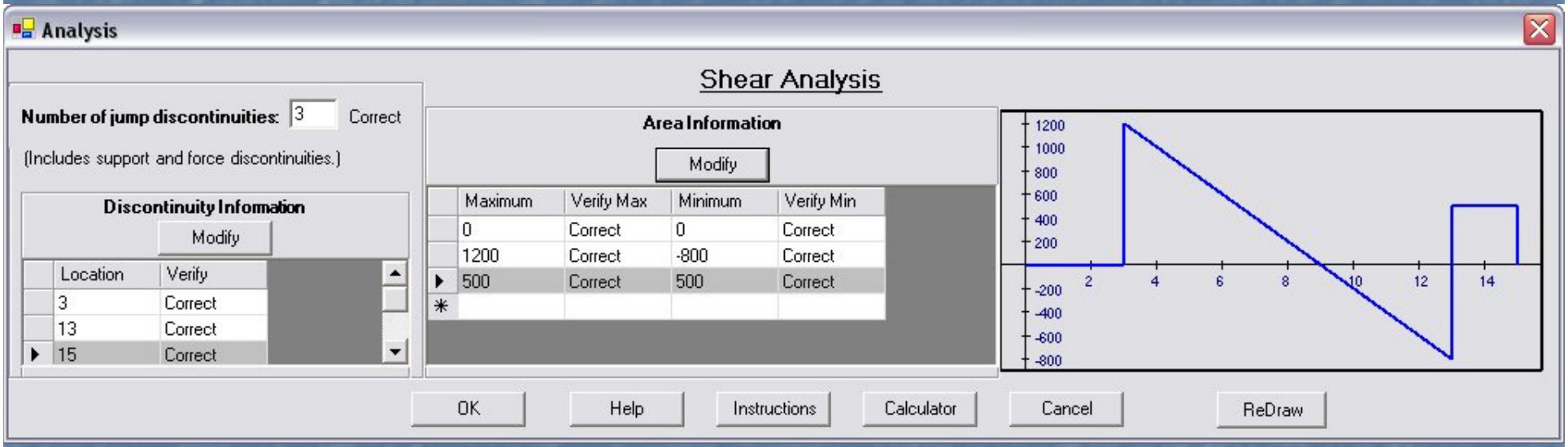
A uniform bar (L=60in) is clamped at each end. A load P=2000in-lb is applied to the right at a point x=30in from the left clamp. The bar is made of steel (G=11.5e6 psi) and has a diameter of 2 in.



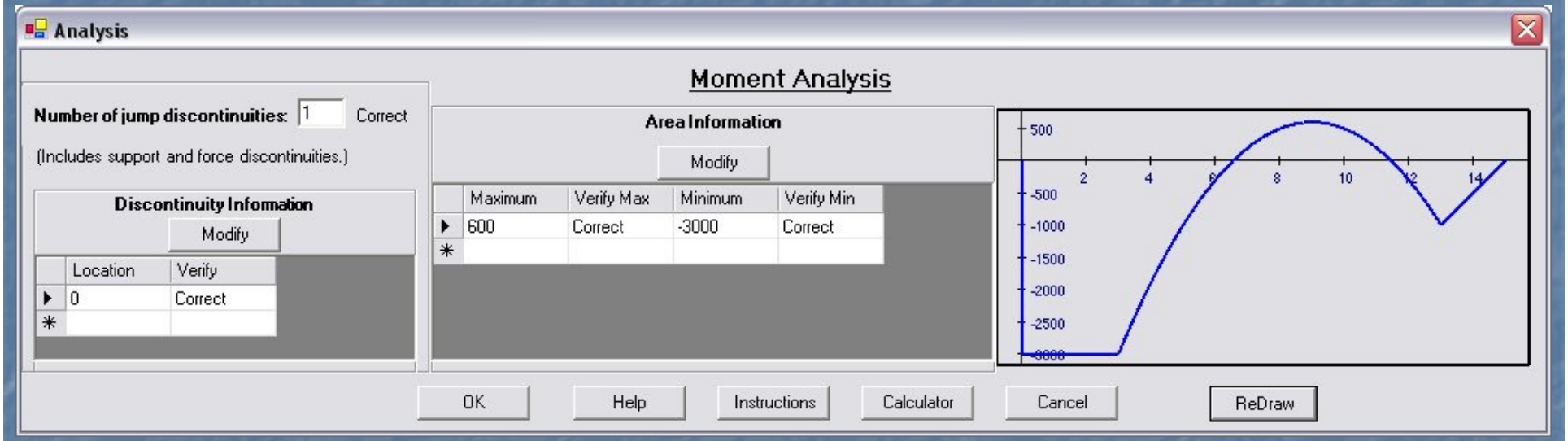
Bending – Problem Definition



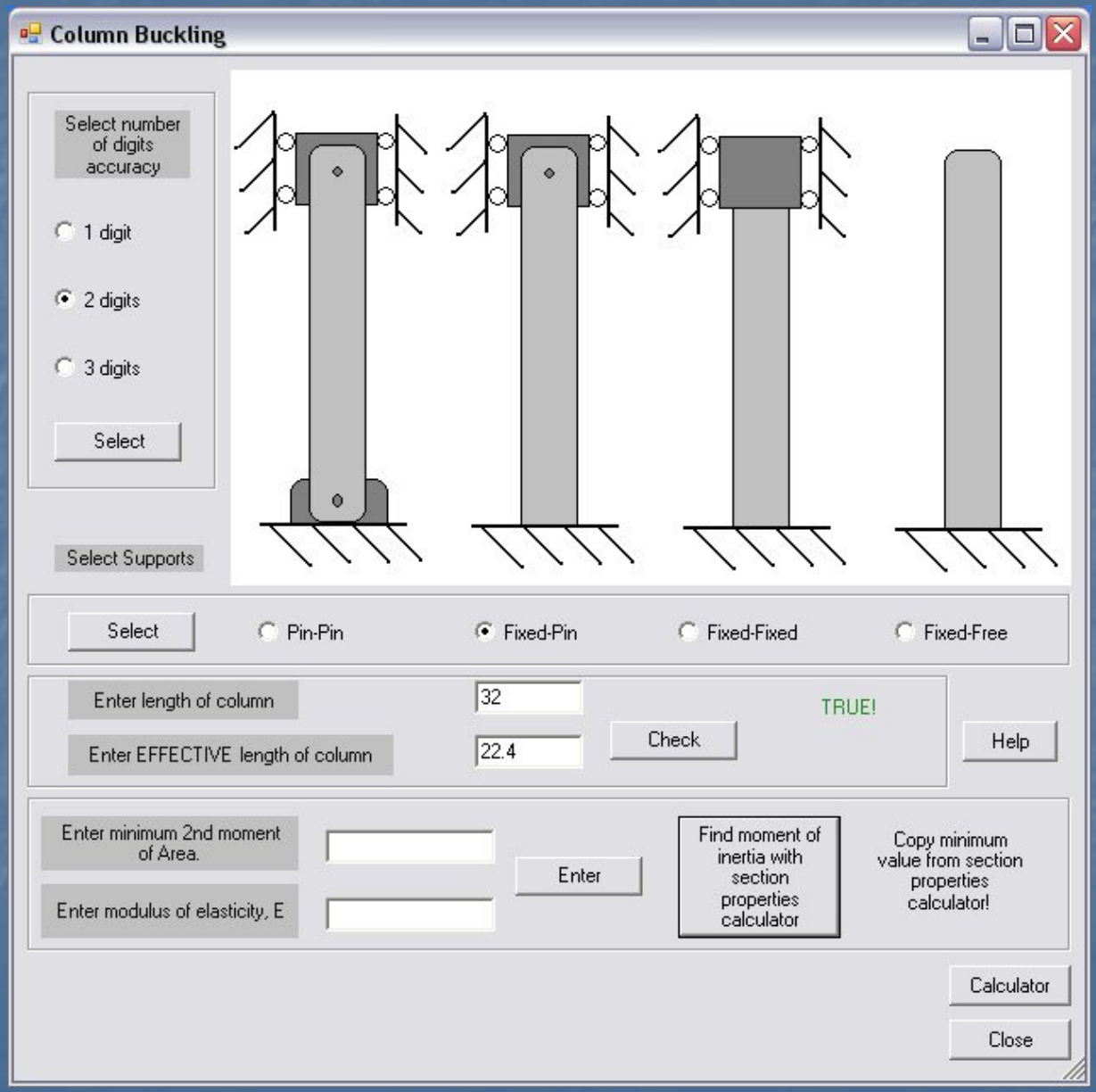
Beam Shear – Queries to Lead User to the Solution
Correct/Incorrect Feedback



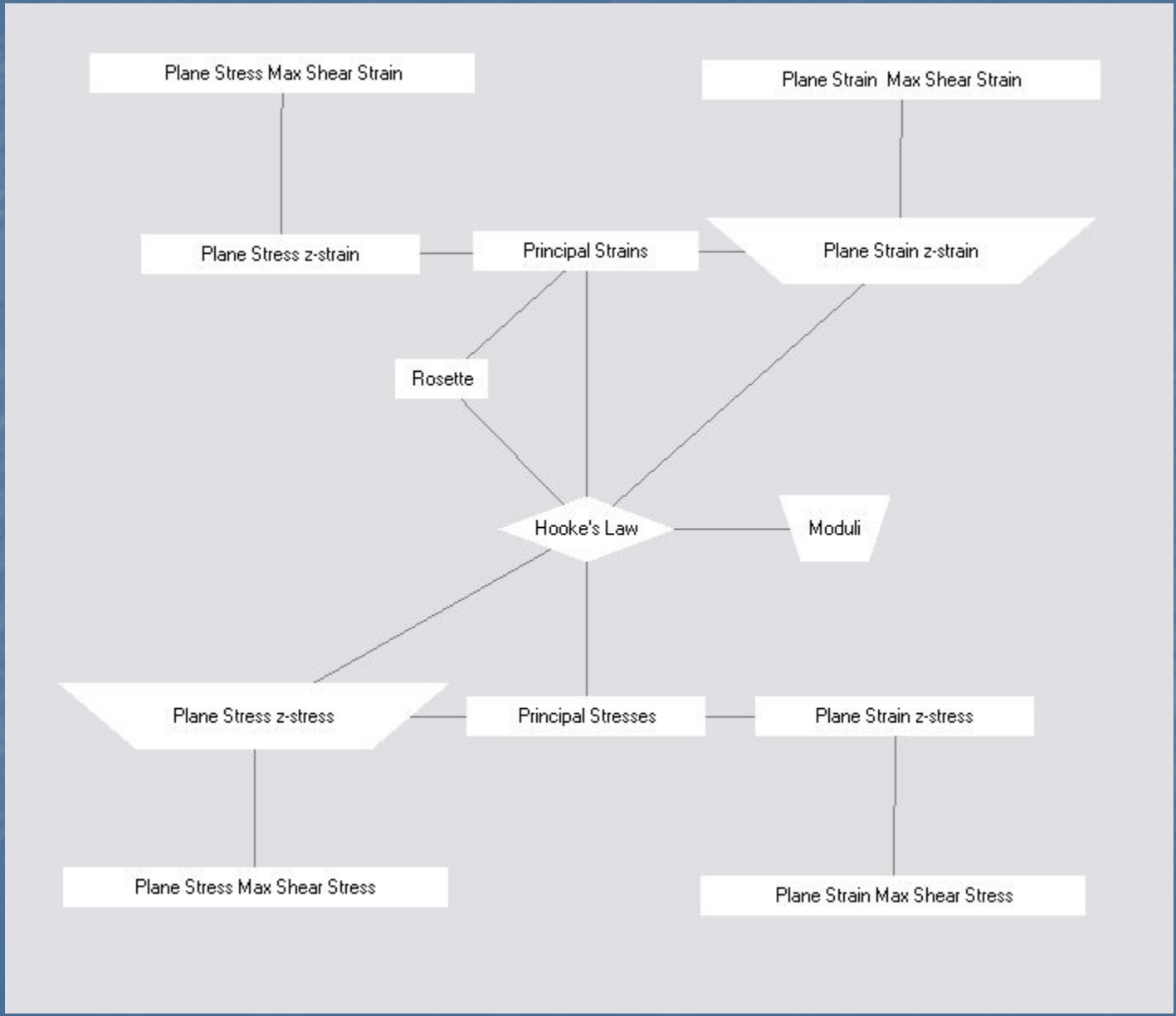
Beam Bending Moment – Queries to Lead User to the Solution Correct/Incorrect Feedback



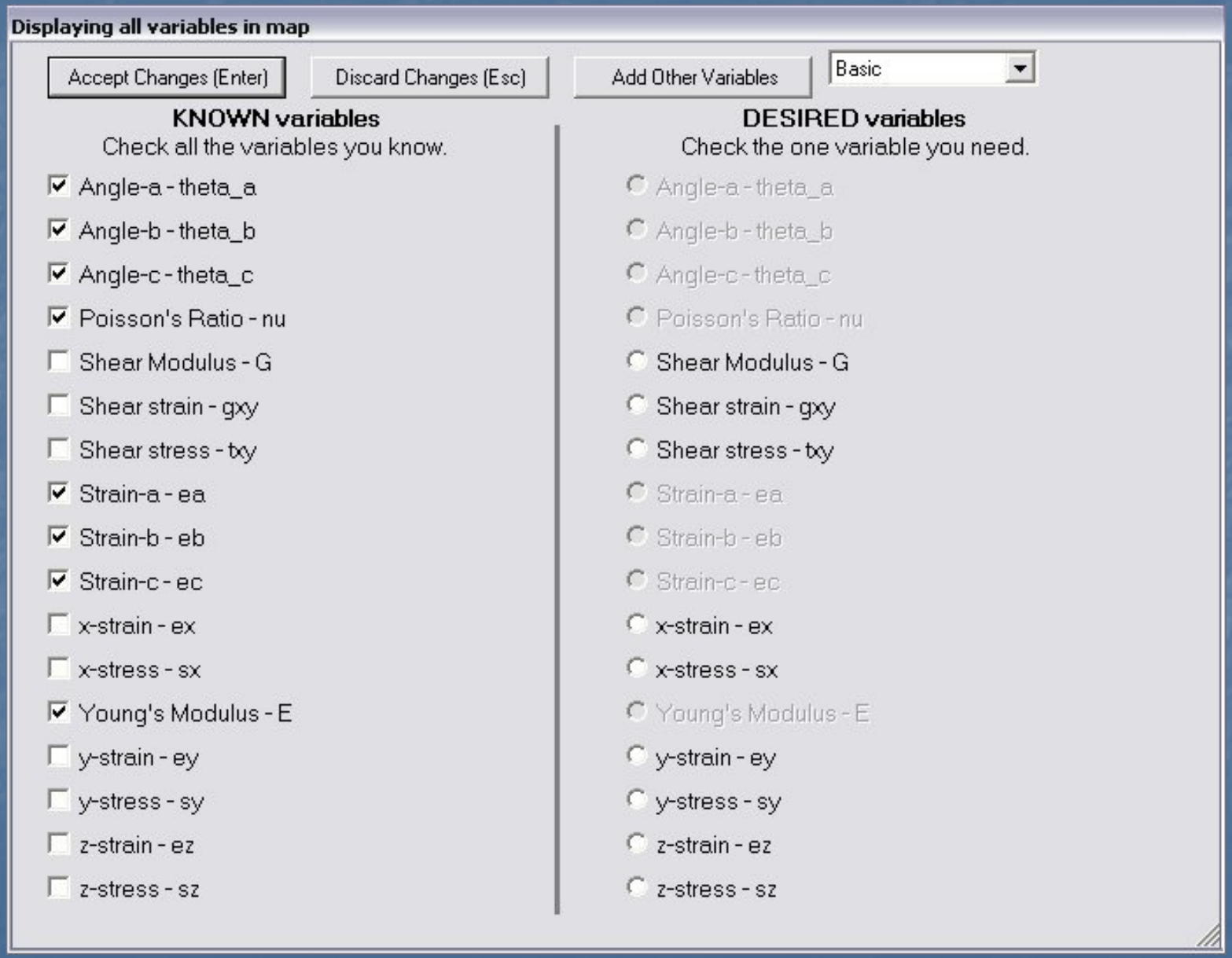
Buckling


Column Buckling
Select number of digits accuracy
1 digit
2 digits
3 digits
Select
Select Supports
Select
Pin-Pin
Fixed-Pin
Fixed-Fixed
Fixed-Free
Enter length of column
32
Enter EFFECTIVE length of column
22.4
Check
TRUE!
Help
Enter minimum 2nd moment of Area.
Enter modulus of elasticity, E
Enter
Find moment of inertia with section properties calculator
Copy minimum value from section properties calculator!
Calculator
Close

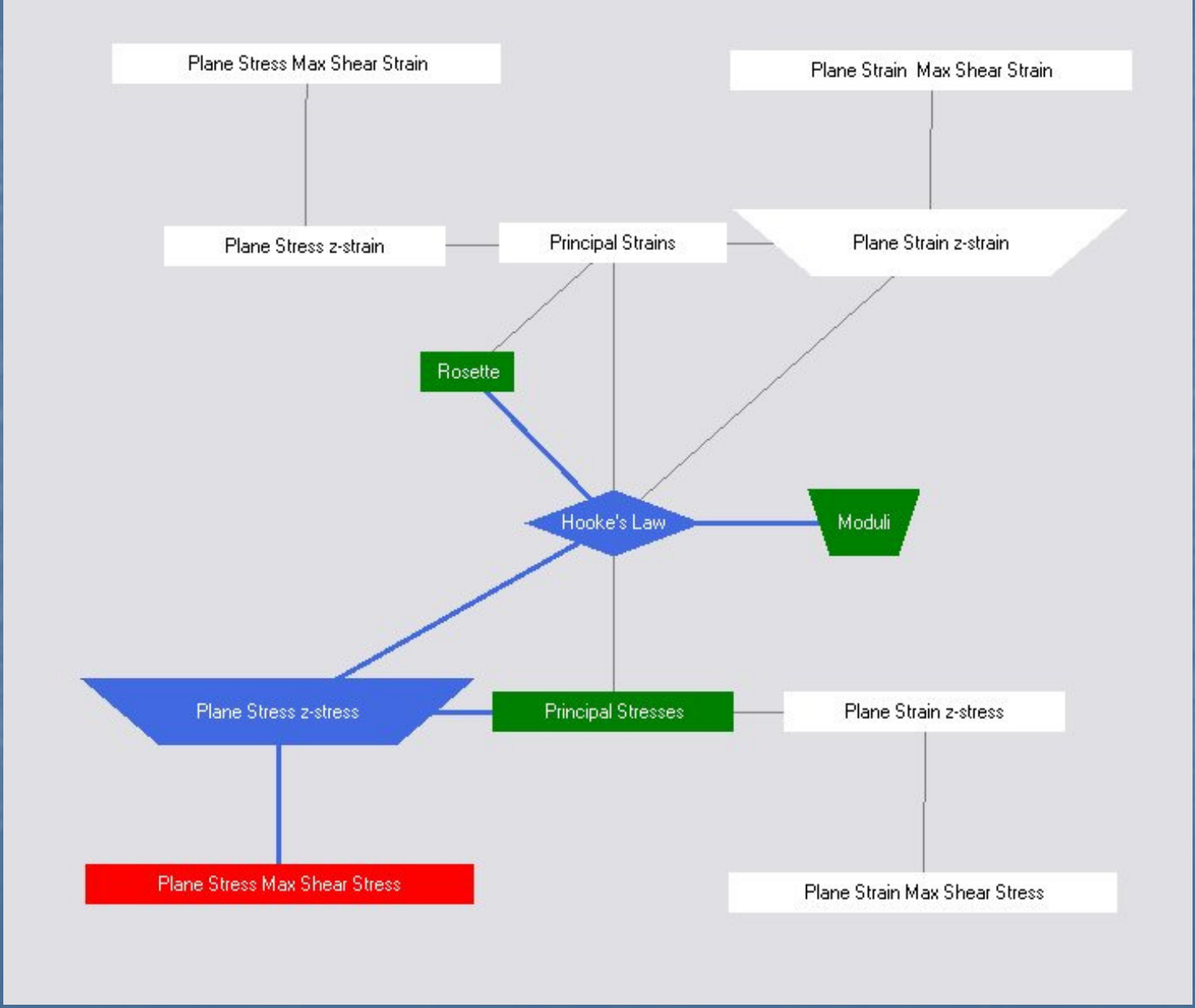
Concept Map – Rosette & Principal Stress/Strain



Concept Map – Variable List



Concept Map – Solution Path



Concept Map – Solution Steps

Step 1: Solved variable "Shear Modulus" in equation "Moduli"

Step 2: Solved variable "z-stress" in equation "Plane Stress z-stress"

Step 3: Solved variable "x-strain" in equation "Rosette"

Step 3: Solved variable "y-strain" in equation "Rosette"

Step 3: Solved variable "Shear strain" in equation "Rosette"

Step 4: Solved variable "Shear stress" in equation "Hooke's Law"

Step 5: Solved variable "x-stress" in equation "Hooke's Law"

Step 5: Solved variable "y-stress" in equation "Hooke's Law"

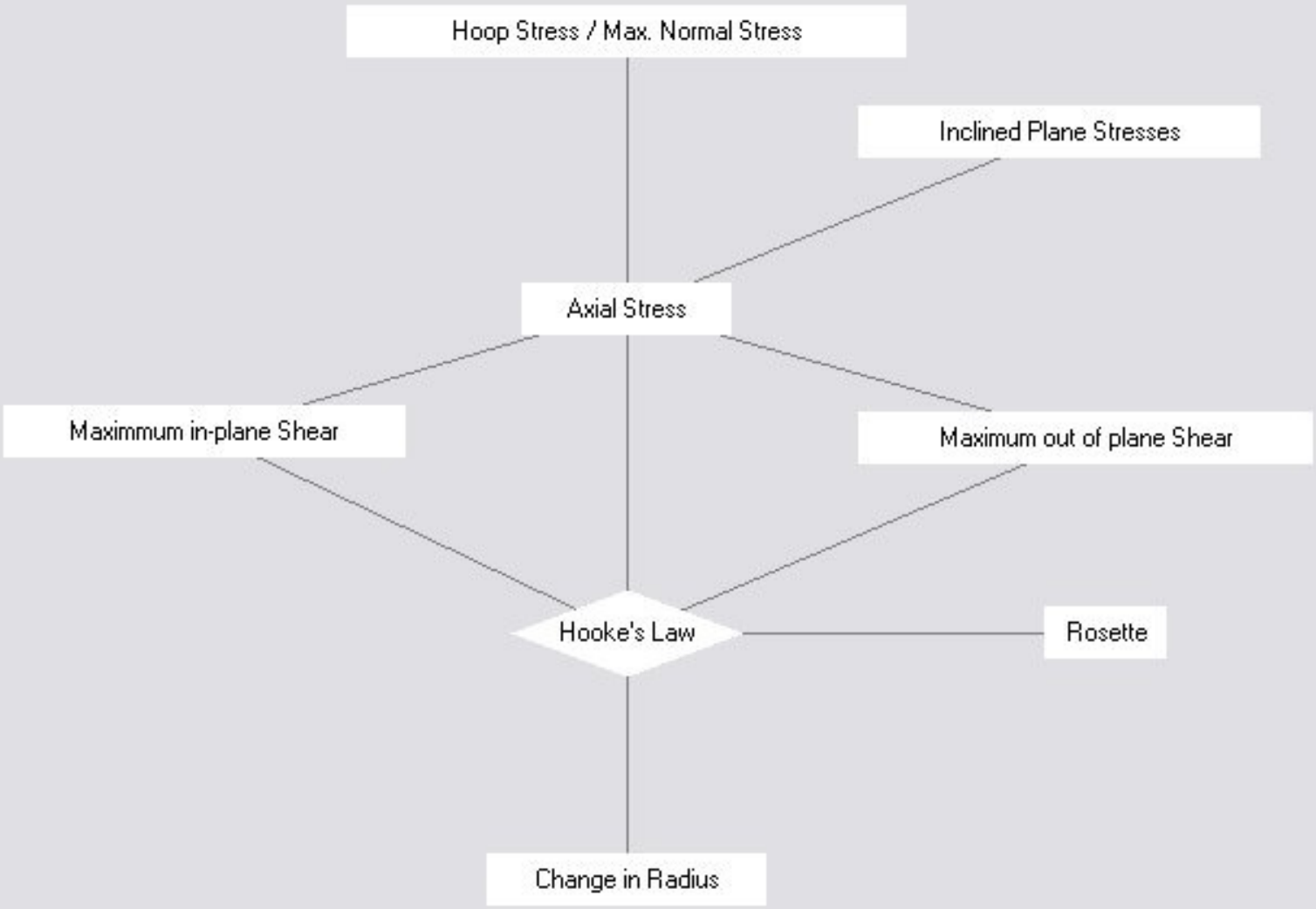
Step 6: Solved variable "Principal shear stress" in equation "Principal Stresses"

Step 7: Solved variable "Principal stress-2" in equation "Principal Stresses"

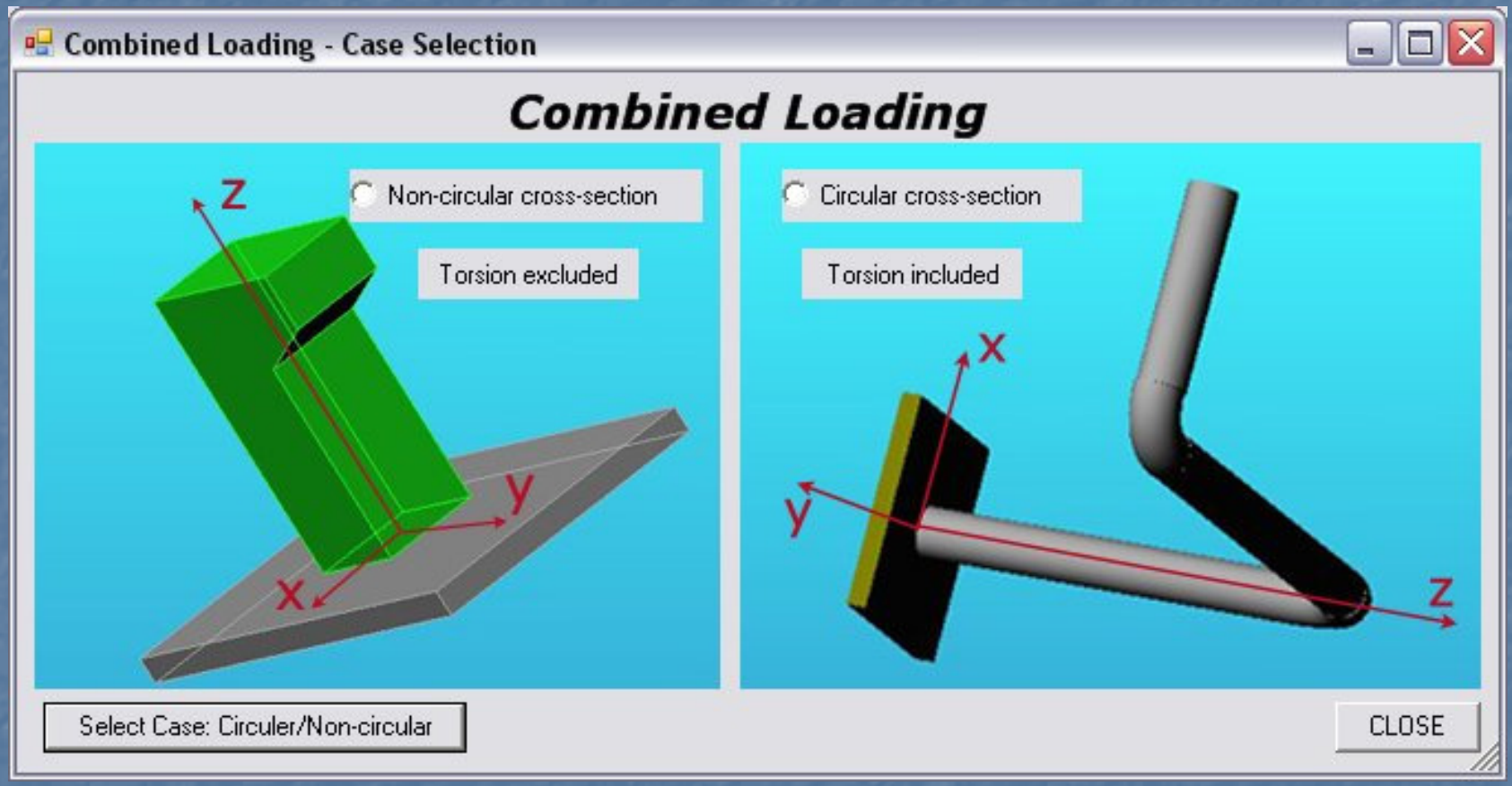
Step 8: Solved variable "Principal stress -1" in equation "Principal Stresses"

Step 9: Solved variable "z-strain" in equation "Hooke's Law"

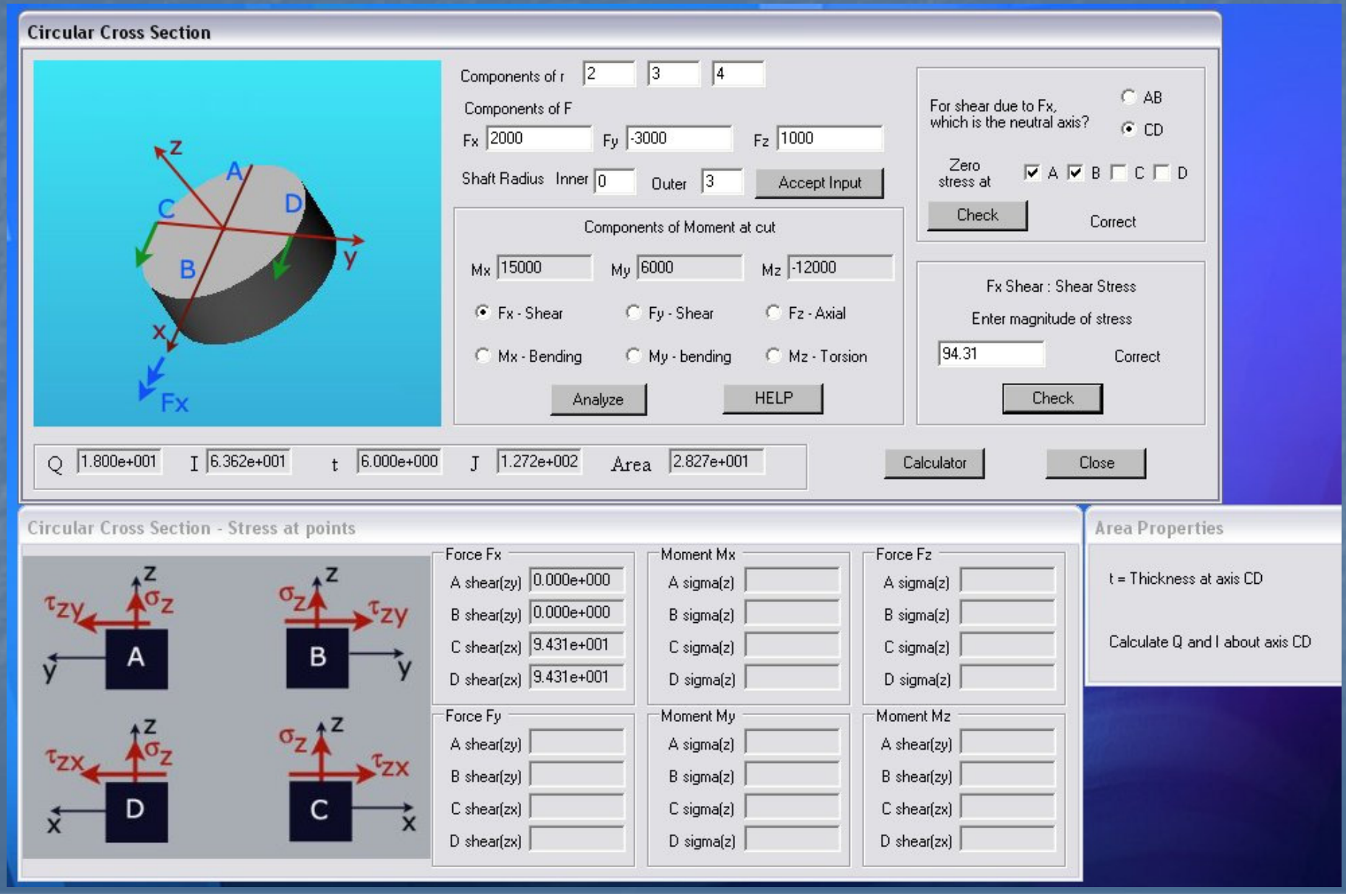
Concept Map – Cylindrical Pressure Vessel



Combined Loading

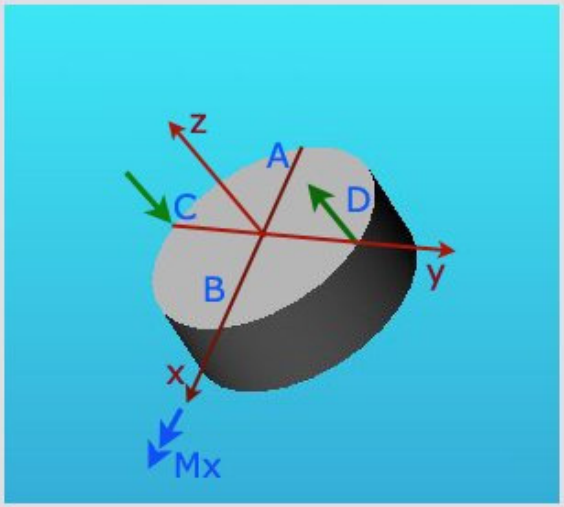


Combined Loading – Queries that Lead User to Solution



Combined Loading – Queries that Lead User to Solution

Circular Cross Section



Components of r: 2 | 3 | 4

Components of F

Fx: 2000 Fy: -3000 Fz: 1000

Shaft Radius Inner: 0 Outer: 3 Accept Input

Components of Moment at cut

Mx: 15000 My: 6000 Mz: -12000

○ Fx - Shear ○ Fy - Shear ○ Fz - Axial

◉ Mx - Bending ○ My - bending ○ Mz - Torsion

Analyze HELP

For bending due to Mx, which is the neutral axis? ◉ AB ○ CD

Zero stress at ☑ A ☑ B ☐ C ☐ D

Check Correct

Mx Bending : Normal Stress

Enter magnitude of stress

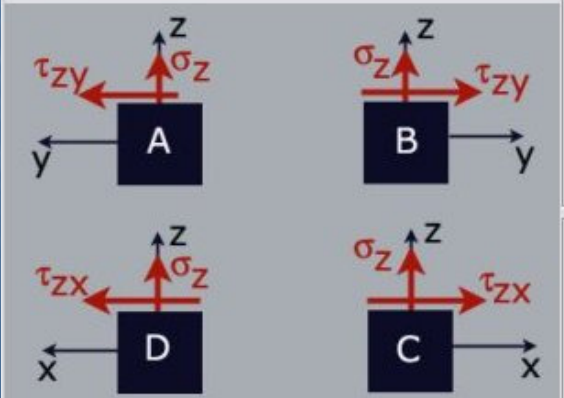
707.32 Correct

Check

Q: 1.800e+001 I: 6.362e+001 t: 6.000e+000 J: 1.272e+002 Area: 2.827e+001

Calculator Close

Circular Cross Section - Stress at points



Force Fx		Moment Mx		Force Fz	
A shear(zy)	0.000e+000	A sigma(z)	0.000e+000	A sigma(z)	
B shear(zy)	0.000e+000	B sigma(z)	0.000e+000	B sigma(z)	
C shear(zx)	9.431e+001	C sigma(z)	-7.074e+002	C sigma(z)	
D shear(zx)	9.431e+001	D sigma(z)	7.074e+002	D sigma(z)	

Force Fy		Moment My		Moment Mz	
A shear(zy)		A sigma(z)		A shear(zy)	
B shear(zy)		B sigma(z)		B shear(zy)	
C shear(zx)		C sigma(z)		C shear(zx)	
D shear(zx)		D sigma(z)		D shear(zx)	

Area Properties

D = Distance of C or D from axis AB

Calculate I about axis AB

Combined Loading – Help

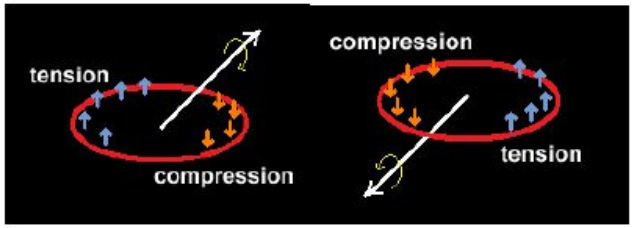
circ_help.pdf - Adobe Reader

File Edit View Window Help

1 / 1 100% Tools Sign Comment

Stresses in a Shaft with Circular Cross-section

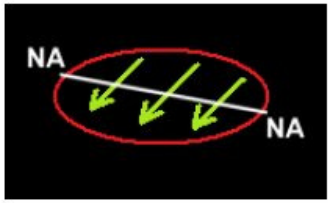
Bending



Normal stress (σ) has the largest magnitude at the end points of the diameter perpendicular to the moment vector.

$$r = radius \quad M = bending\ moment \quad I = \frac{\pi}{4} r^4 \quad \sigma = \frac{Mr}{I}$$

Shear



Shear stress (τ) has the largest magnitude at the diameter perpendicular to the force vector.

$$r = radius \quad V = shear\ force \quad Q = \frac{2}{3} r^3 \quad t = 2r \quad I = \frac{\pi}{4} r^4 \quad \tau = \frac{VQ}{It}$$

Axial

Section Properties, L-, T-, C-, I-Sections