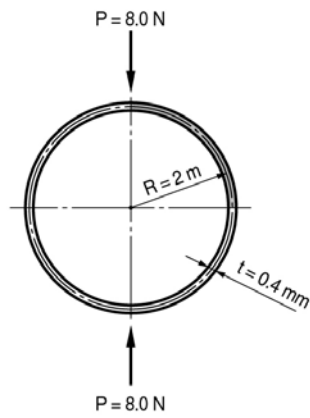# Static-4

Title

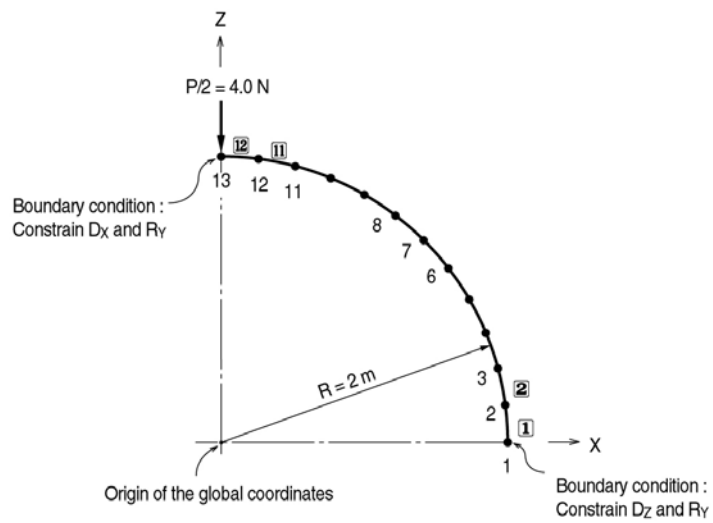Circular ring structure

Description

A circular ring is subjected to a pair of equal and opposite concentrated loads in the radial direction of the ring.
Determine the displacements and bending moments.
Only a quarter of the model may be analyzed due to symmetry.

P = 8.0 N

R = 2 m

t = 0.4 mm

P = 8.0 N

(a) Ring structure

Z

P/2 = 4.0 N

12 11

13 12 11

8

7

6

Boundary condition :
Constrain D_X and R_Y

R = 2 m

3

2

1

X

Origin of the global coordinates

Boundary condition :
Constrain D_Z and R_Y

(b) Quarter model

Structural geometry and analysis model

Model

Analysis Type
2-D static analysis (X-Z plane)

Unit System
m, N

Dimension
Radius 2.0 m   Thickness 0.0004 m   Width 1.0 m

Element
Beam element

Material
Modulus of elasticity $E = 2.0 \times 10^{11}$ Pa

Section Property
Area $A = 4.0 \times 10^{-4}$ m²
Effective shear area $A_{sz} = 2.66667 \times 10^{-4}$ m²
Moment of inertia $I_{yy} = 1.33333 \times 10^{-8}$ m⁴
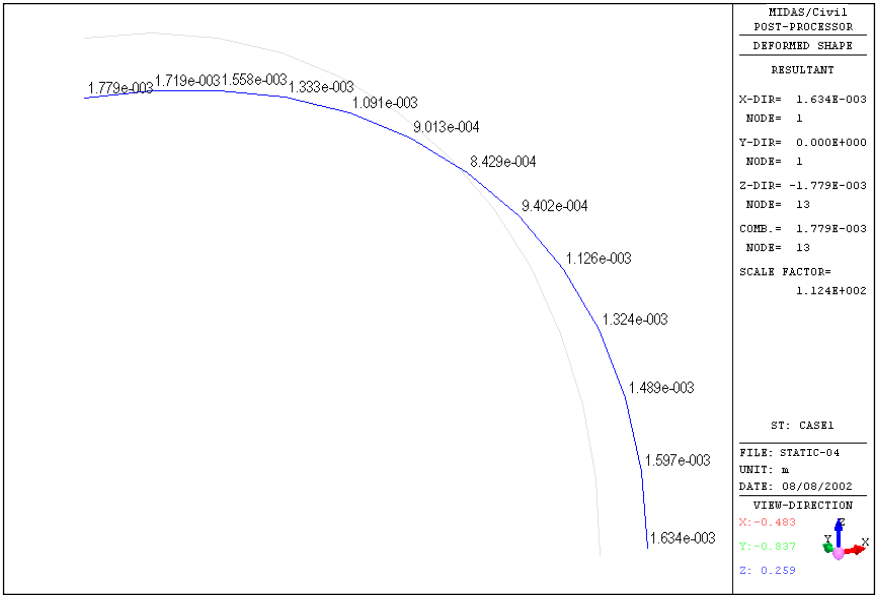
Boundary Condition
Node 1   ; Constrain Dz and Ry. (Symmetric about X-axis)
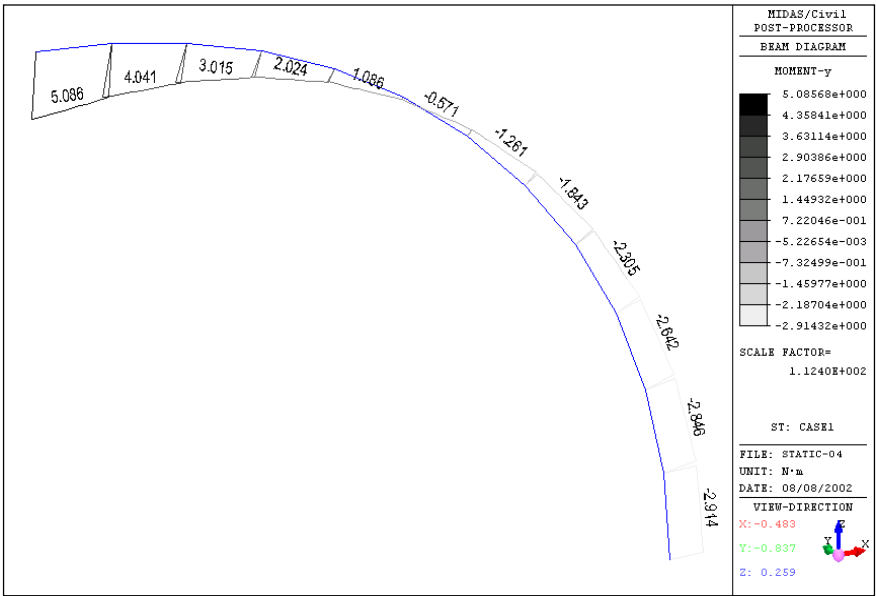Node 13 ; Constrain Dx and Ry. (Symmetric about Z-axis)

Load Case
With a quarter model a load, 8.0/2 N, is applied to the node 13 in the -Z direction.

3

Results

Deformed shape of the structure

Bending moment diagram of the structure

4

Comparison of Results

Unit : m, Nm

Results		Theoretical	ADINA	MIDAS/Civil
Displacement	δ_x(Node 1)	1.64×10^{-3}	1.63×10^{-3}	1.63×10^{-3}
	δ_z (Node 13)	-1.79×10^{-3}	-1.78×10^{-3}	-1.78×10^{-3}
Bending moment	M_y (Node 13)	5.09	5.09	5.09

References

Timoshenko, S., "*Strength of Materials, Part I, Elementary Theory and Problems*", 3rd Edition, D. Van Nostrand, 1955.

"*ADINA, Verification Manual - Linear Problems*", Version 6.1, ADINA R&D, Inc., 1992, Example A. 10.