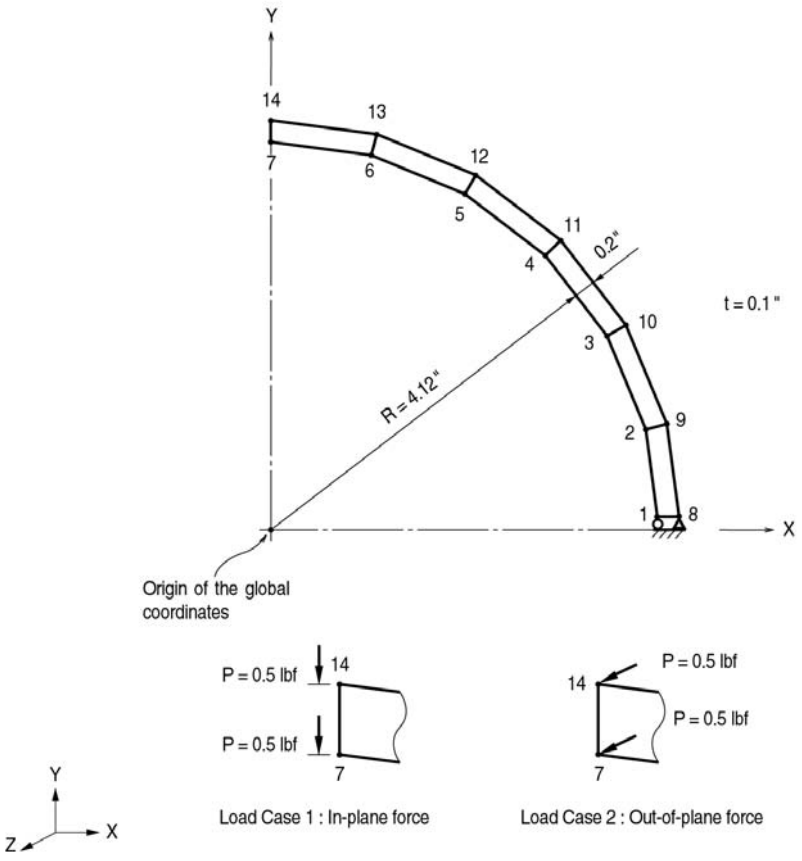
Static-17

Title

Curved cantilever beam subjected to forces at the free end

Description

Determine the deflections at the free end of a curved cantilever beam subjected to in-plane and out–of-plane forces.



Structural geometry and analysis model

Model

Analysis Type

3-D static analysis

Unit System

in, lbf

Dimension

Radius 4.12 in Width 0.2 in Thickness 0.1 in

Element

Plate element (Thick type)

Material

Modulus of elasticity $E = 1.0 \times 10^7$psi

Poisson's ratio $\nu = 0.25$

Element Property

Size $a \times b = \frac{\pi}{12} \times 4.12 \text{ in} \times 0.2 \text{ in}$

Thickness $t = 0.1$ in

Boundary Condition

Node 1 ; Constrain Dy, Dz, Rx, Ry and Rz (Roller support in the X direction)

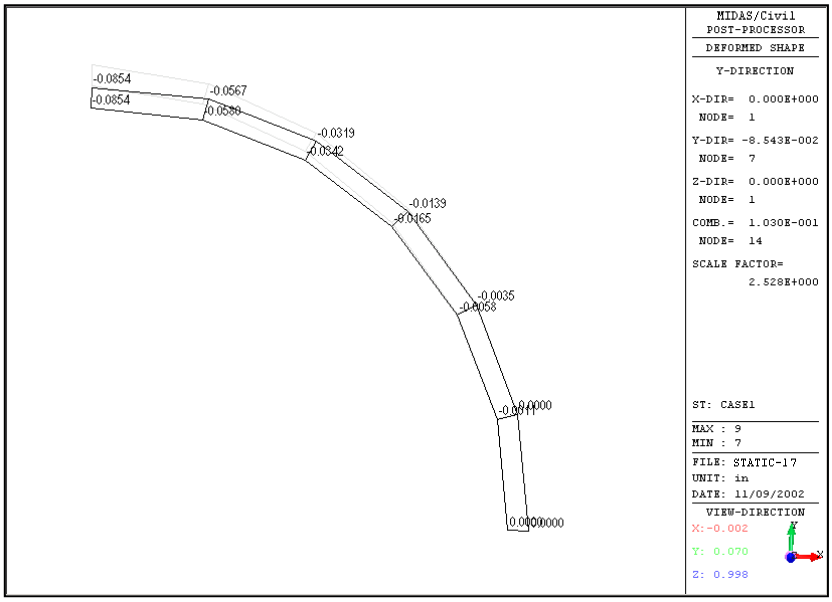
Node 8 ; Constrain Dx, Dy, Dz, Rx, and Rz (Hinge support)

Load Case

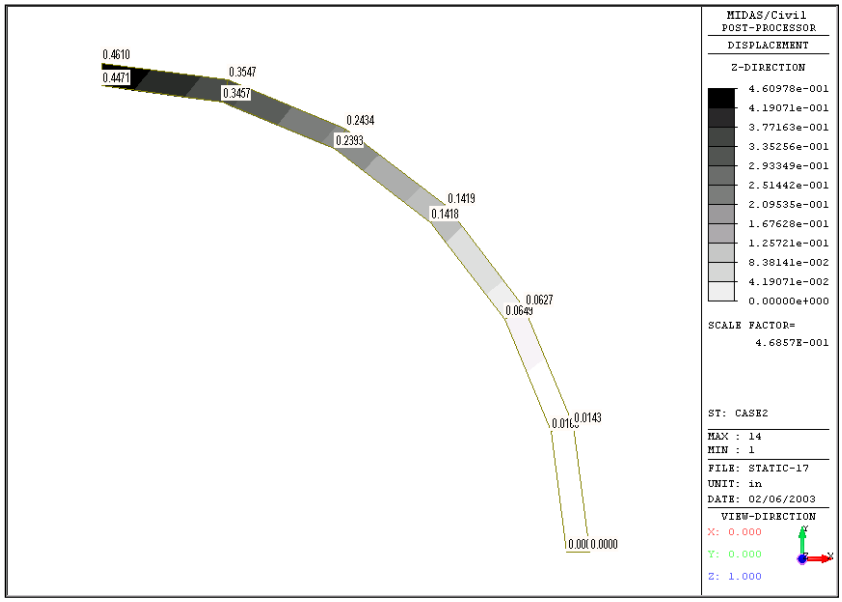
Load Case 1 ; In-plane unit forces are applied to the free end in the -Y direction.
2 @ P = 2 @ 0.5 lbf

Load Case 2 ; Out-of-plane unit forces are applied to the free end in the Z direction.
2 @ P = 2 @ 0.5 lbf

Results



Deformed shape of the structure due to in-plane shear



Displacements of the structure due to out–of- plane force

Comparison of Results

Unit : in

Load Case	Displacement		
	Theoretical	SAP 2000	MIDAS/Civil
1	0.0873	0.0852	0.0854
2	0.5022	0.4587	0.4610

References

MacNeal R. H. and Harder, R. C., "A *Proposed Standard Set of Problems to Test Finite Element Accuracy*", Finite Elements in Analysis and Design 1(1985), pp. 3-20, North Holland.

"*SAP90, A Series of Computer Programs for the Finite Element Analysis of Structures, Structural Analysis Verification Manual*", Computer and Structures, Inc., 1992, Example 11.