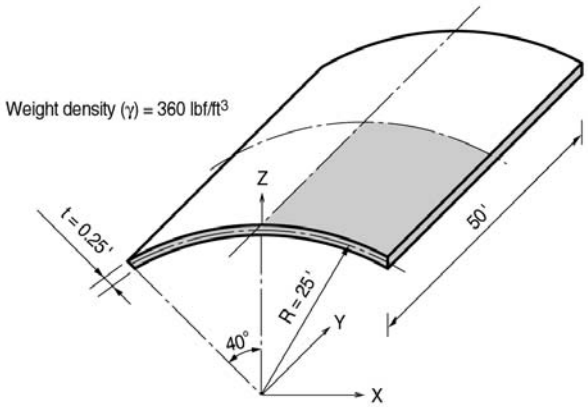
Static-22

Title

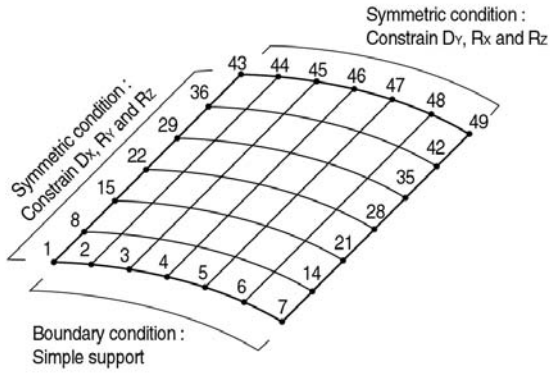
Simply supported cylindrical shell

Description

Compute the axial deformations and vertical displacements of a shell structure under its self weight.
Only a quarter model may be analyzed due to symmetry.



(a) Cylindrical structure with simple supports at longitudinal ends



(b) Quarter model

Structural geometry and analysis model

MODEL

Analysis Type

3-D static analysis

Unit System

ft, lbf

Dimension

Length 25 ft Radius 25 ft Central angle 40˚

Element

Plate element (Thick type)

Material

Modulus of elasticity $E = 4.32 \times 10^8$ lbf/ft^2

Weight density $\gamma = 360$ lbf/ft^3

Element Property

Element size $a \times b = [25/6 \text{ ft} \times 40 \times (\pi/180)] \times [25/6 \text{ ft}]$

Thickness $t = 0.25$ ft

Boundary Condition

Nodes 1 ~ 7 ; Constrain Dx, Dz and Ry. (Simple supports)

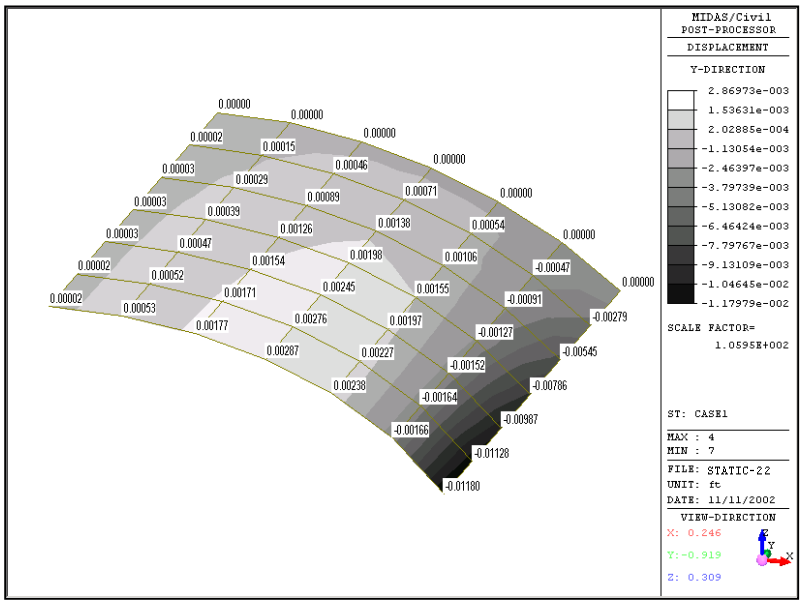
Nodes 1 ~ 43 ; Constrain Dx, Ry and Rz. (Symmetric about Y-Z plane)
(at an increment of 7)

Nodes 43 ~ 49 ; Constrain Dy, Rx and Rz. (Symmetric about X-Z plane at Y=25 ft)

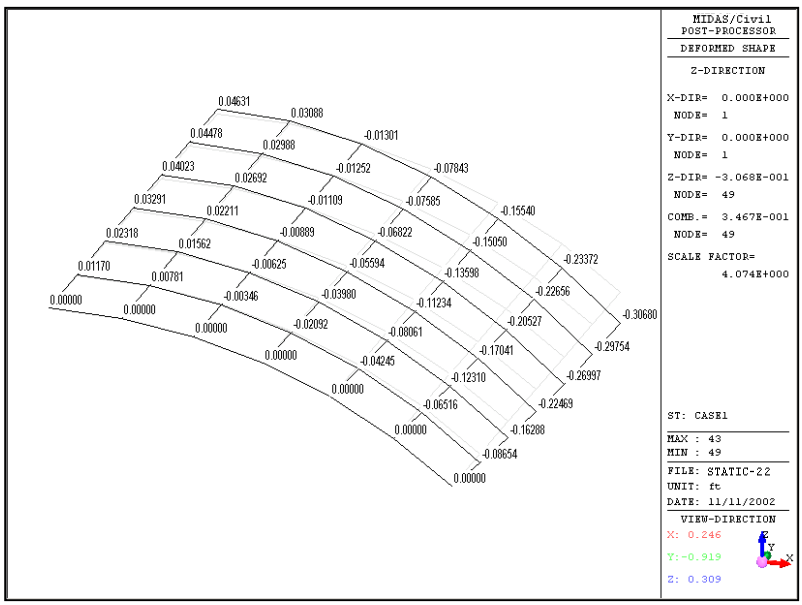
Load Case

Self weight is imposed in the -Z direction.

Results



Axial displacements of the structure



Vertical displacements of the structure

Displacements

	Node	Load	DX (ft)	DY (ft)	DZ (ft)	RX ([rad])	RY ([rad])	RZ ([rad])
▶	1	CASE1	0,000000	0,000018	0,000000	0,002796	0,000000	0,000000
	2	CASE1	0,000000	0,000530	0,000000	0,001865	0,000000	0,000153
	3	CASE1	0,000000	0,001773	0,000000	-0,000832	0,000000	0,000771
	4	CASE1	0,000000	0,002870	0,000000	-0,004996	0,000000	0,002237
	5	CASE1	0,000000	0,002381	0,000000	-0,010114	0,000000	0,004725
	6	CASE1	0,000000	-0,001664	0,000000	-0,015540	0,000000	0,008069
	7	CASE1	0,000000	-0,011798	0,000000	-0,019058	0,000000	0,014188
	43	CASE1	0,000000	0,000000	0,046312	0,000000	0,000000	0,000000
	44	CASE1	-0,000989	0,000000	0,030876	0,000000	0,010536	0,000000
	45	CASE1	-0,008815	0,000000	-0,013010	0,000000	0,019817	0,000000
	46	CASE1	-0,028478	0,000000	-0,078432	0,000000	0,026688	0,000000
	47	CASE1	-0,061735	0,000000	-0,155399	0,000000	0,030443	0,000000
	48	CASE1	-0,106984	0,000000	-0,233722	0,000000	0,031402	0,000000
	49	CASE1	-0,161394	0,000000	-0,306798	0,000000	0,031306	0,000000

Comparison of Results

Unit : ft

Node	Axial deformation(δ_Y)		Node	Vertical displacement(δ_Z)	
	Theoretical	MIDAS/Civil		Theoretical	MIDAS/ Civil
1	0.0004	0.0	43	0.045	0.046
2	0.0009	0.0005	44	0.027	0.031
3	0.0020	0.0018	45	-0.018	-0.013
4	0.0030	0.0029	46	-0.082	-0.078
5	0.0021	0.0024	47	-0.155	-0.155
6	-0.0016	-0.0017	48	-0.241	-0.234
7	-0.0120	-0.0118	49	-0.309	-0.307

References

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

Zienkiewicz, O. C., "*The Finite Element Method*", McGraw-Hill, 1977.

Scordelis, A. C., and Lo, K. S., "*Computer Analysis of Cylindrical Shells*", Journal of the American Concrete Institute, Vol. 61, May 1964.