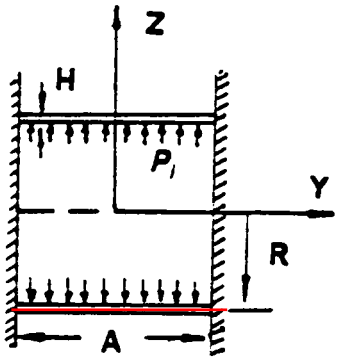
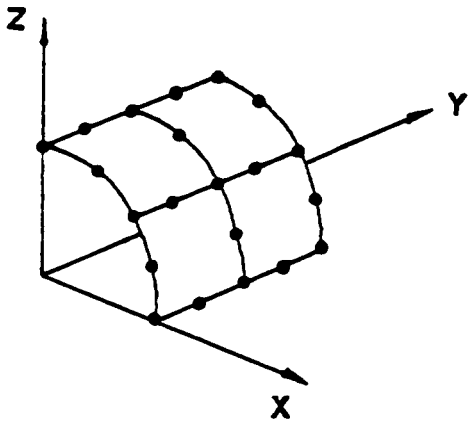
## 6.11 PROBLEM 10 : COMPOSITE CYLINDRICAL SHELL

The geometry, loading and finite element mesh of a clamped cylindrical shell subjected to internal pressure is shown below:




Considered Middle Radio

$$\begin{matrix} \frac{1}{E_1} & \frac{-\nu_{21}}{E_2} & \frac{-\nu_{31}}{E_3} \\ \frac{-\nu_{12}}{E_1} & \frac{1}{E_2} & \frac{-\nu_{32}}{E_3} \\ \frac{-\nu_{13}}{E_1} & \frac{-\nu_{23}}{E_2} & \frac{1}{E_3} \end{matrix}$$

Modern Convention

R = 20 in., A = 20 in., H = 1 in., $P_i$ = 2.0403664 psi

The lamina properties are :

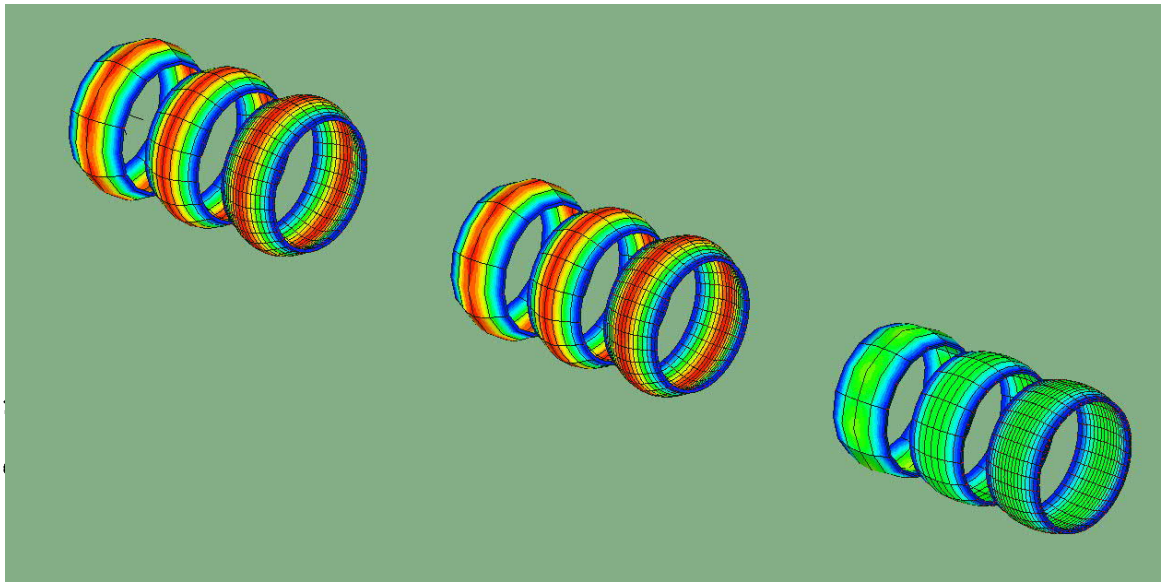
$E_1 = 7.5x10^6$psi, $E_2 = 2x10^6$psi,

$G_{12} = 1.25x10^6$psi, $G_{12} = G_{13} = G_{23}$, $\nu_{12} = \nu_{13} = 0.25$

This model is used for both static and transient analysis. In Table 6.19, the center deflections for orthotropic and two-layer (0/90) cross-ply shells are compared with known solutions.

**Table 6.19 Comparison of the Center Deflection (inch)**

| Lamination Static | Present | Ref.[1] | Ref.[72] | Analytical [73] | ccx | ccx | Internal | Internal |
|---|---|---|---|---|---|---|---|---|
| Schema | Work 2x2Q8 | 2x2Q9 | | | 2x4 | 4x8 | 2x4 | 4x8 |
| Cylindrical_Shell_Orthotropic S8R | | | | | 0,000369 | 0,000362 | 0,000304 | 0,000360 |
| Cylindrical_Shell_1_Ply_0 | 0,0003706 | 0,0003727 | 0,0003666 | 0,000367 | 0,000369 | 0,000362 | 0,000304 | 0,000360 |
| Cylindrical_Shell_Cross_Ply_0/90 | 0,0001841 | 0,0001803 | | | (0.0001607 - 0,0002488) | 0,0001857 | (0,000170 - 0,000209) | 0,000183 |
| Units w-[inch] | | | | | | | | |
| Present Work refers to : | LARGE DEFORMATION ANALYSIS OF LAMINATED COMPOSITE STRUCTURES BY A CONTINUUM-BASED SHELL ELEMENT WITH TRANSVERSE DEFORMATION . Pey M. Wung .(1989) | | | | | | | |



72. Rao, K.P., "A rectangular laminated anisotropic shallow thin shell finite," Compt. Methods Appl. Mech. Eng., Vol. 15, pp. 13-33, 1978
73. Timoshenko, S. and Woinowsky-Krieger, S., Theory of Plates and Shells, 2nd Ed., 1959. -

74. Chandrashekhara, K., "Geometric and material nonlinear analysis of laminated composite and shells," Ph.D. thesis, VPI&SU, Blacksburg, VA, 1985.