

## 2.5 Elliptic membrane under uniform outward pressure

<b>REFERENCE</b>	NAFEMS [2-3]
<b>KEYWORDS</b>	membrane elements, solid elements
<b>MODEL FILENAME</b>	Linearstatic05.nfxa

Figure 2.5.1 shows the elliptic membrane problem. The membrane is subjected to uniform outward normal pressure of  $10\text{MPa}$  at the outer edge BC. A quarter of the elliptic membrane is discretized with symmetric boundary conditions using coarse and fine meshes of membrane and solid elements. Y-normal stress at point A is obtained and compared with the reference solution given in the standard NAFEMS benchmarks.

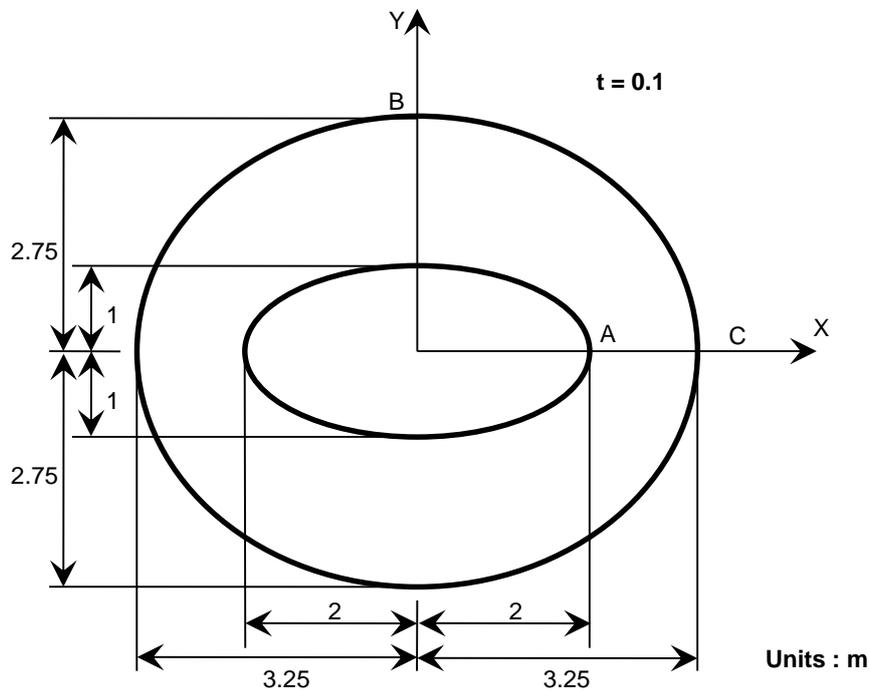


Figure 2.5.1 Elliptic membrane model

Material data	Young's modulus	$E = 210\text{ GPa}$
	Poisson's ratio	$\nu = 0.3$
Section property	Thickness	$t = 0.1\text{ m}$

**Table 2.5.1** Stress  $\sigma_{YY}$  at point A obtained using shell elements

		$\sigma_{YY}^A$ [MPa]	
Reference		92.7	
Number of elements per side		3×2	6×4
Element type	TRIA-3	52.9 65.4*	72.9 84.1*
	QUAD-4	60.9 67.0*	80.2 83.3*
	TRIA-6	87.7	93.0
	QUAD-8	85.4	91.7

\* obtained using shell element formulations with 6-dof per node.

**Table 2.5.2** Stress  $\sigma_{YY}$  at point A obtained using solid elements

		$\sigma_{YY}^A$ [MPa]	
Reference		92.7	
Number of elements per side		3×2	6×4
Element type	PENTA-6	53.3	73.4
	HEXA-8	60.9	80.4
	PENTA-15	89.2	93.4
	HEXA-20	86.8	91.9