2.13 Hemisphere under point loads

REFERENCE	NAFEMS [2-3]
KEYWORDS	shell elements, solid elements, layered solid elements
MODEL FILENAME	Linearstatic13.nfxa

Figure 2.13.1 shows a quadrant of the hemispheric shell with inward and outward forces at point A and point C. Utilizing symmetric conditions, the quadrant model is discretized using shell, solid and layered solid elements. Single element in the thickness direction is used for meshes with solid and layered solid elements. Radial displacement at point A is determined. The reference solution is taken from the standard NAFEMS benchmarks.

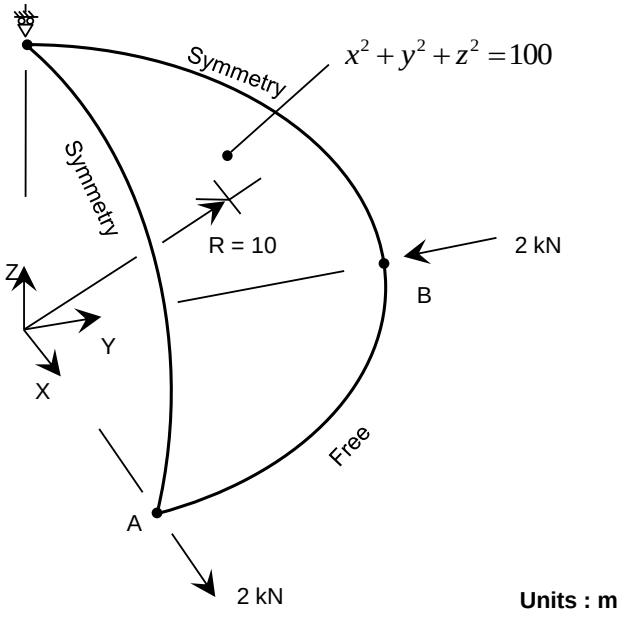

Figure 2.13.1 Hemisphere quadrant model

Material data	Young's modulus	*E = 68.25 GPa*
	Poisson's ratio	ν *= 0.3*
Section property	Thickness	*t = 0.04 m*

Table 2.13.1 Displacement u_X at point A obtained using shell elements

		u_X^A [m]	
Reference		1.850×10^{-1}	
Number of elements per side		4	8
Element type	TRIA-3	1.837×10^{-1}	1.850×10^{-1}
	QUAD-4	1.089×10^{-1}	1.832×10^{-1}
	TRIA-6	0.132×10^{-2}	0.703×10^{-2}
	QUAD-8	1.480×10^{-1}	1.832×10^{-1}

Table 2.13.2 Displacement u_X at point A obtained using solid elements

		u_X^A [m]	
Reference		1.850×10^{-1}	
Number of elements per side		4	8
Element type	PENTA-6	9.426×10^{-5}	3.534×10^{-4}
	HEXA-8	9.962×10^{-3}	1.193×10^{-1}
	PENTA-15	7.708×10^{-3}	0.621×10^{-1}
	HEXA-20	1.234×10^{-1}	1.818×10^{-1}

Table 2.13.3 Displacement u_X at point A obtained using layered solid elements

		u_X^A [m]	
Reference		1.850×10^{-1}	
Number of elements per side		4	8
Element type	PENTAL-6	0.165×10^{-1}	1.005×10^{-1}
	HEXAL-8	1.016×10^{-1}	1.786×10^{-1}
	PENTAL-15	7.708×10^{-3}	0.621×10^{-1}
	HEXAL-20	2.435×10^{-3} 1.203×10^{-1}*	0.312×10^{-1} 1.824×10^{-1}*

* obtained using higher order layered hexahedral elements with reduced integration

[Note]
If the mesh is not perfectly symmetric, averaged displacement from point A and B is used.
If there is no node at point A and B, the averaged value is calculated from the nearest two nodes.