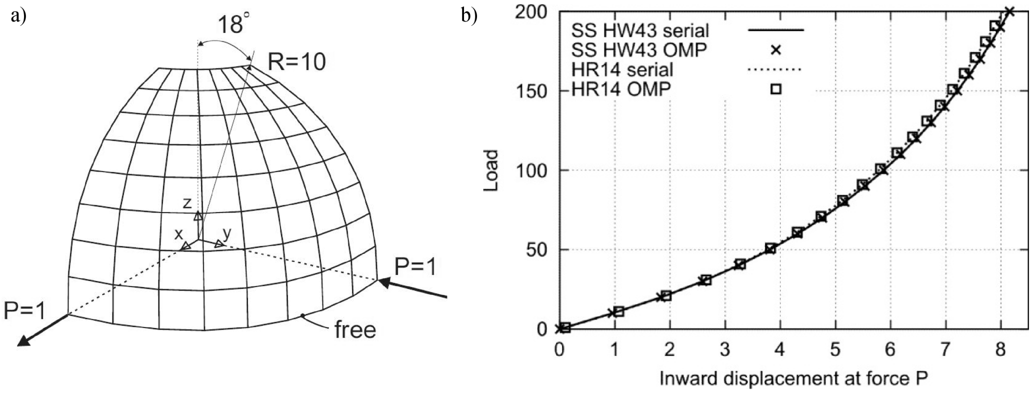

Fig. 1. Pinched hemispherical shell. $E = 6.825 \times 10^7$, $v = 0.3$: a) initial geometry and load, b) displacement ($-u_y \times 100$) for serial and parallel version for thin shell.

tests were performed on 1 node of the cluster GRAFEN [6]. One node has two 6-core processors Xeon X5650 2.66 GHz and 24 GB RAM.

The thick shell ($h = 0.4$) was computed using our 3D displacement-type 8-node solid element using 10 elements through the shell thickness. The mesh consisted of $316 \times 316 \times 10$ elements (about 3.3 millions unknowns). The results for computation of a tangent matrix and a residual vector for a linear problem are given in Table 1, and we see a good speed up ratio with the number of threads.

Table 1. Time of computation and speed up ratio for thick shell.

Version	Serial	OMP, number of threads						
		1	2	4	6	8	10	12
Time [secs]	52.48	53.61	27.08	13.63	9.45	7.11	5.68	4.79
Speed up ratio	0.98	1	1.98	3.93	5.67	7.54	9.44	11.19

The thin shell ($h = 0.04$) was computed using two non-linear elements: our solid shell element HW43 as well as the shell element with 2 rotational dofs of FEAP [5] (which we denote HR14), to demonstrate that the user as well as the FEAP elements are operational in the parallel version. The Newton method was used The results of nonlinear analyses are given in Fig. 1b, and we see that both versions, the serial and the parallel one, give exactly the same results. This indicates that our implementation of the OpenMP standard in FEAP is correct indeed.

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