NAFEMS P18 T3: one-dimensional transient heat transfer

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1 Objective

Verify transient thermal capacity and implicit time integration using Test T3 of *The Standard NAFEMS Benchmarks* [1]. This verifies the Coreform IGA thermal UEL through the Abaqus heat-transfer procedure.

2 Geometry

The rod has length $L = 0.1\ \mathrm{m}$, and point C is located at $x = 0.08\ \mathrm{m}$ from end A. Insulated lateral surfaces make the response one-dimensional.

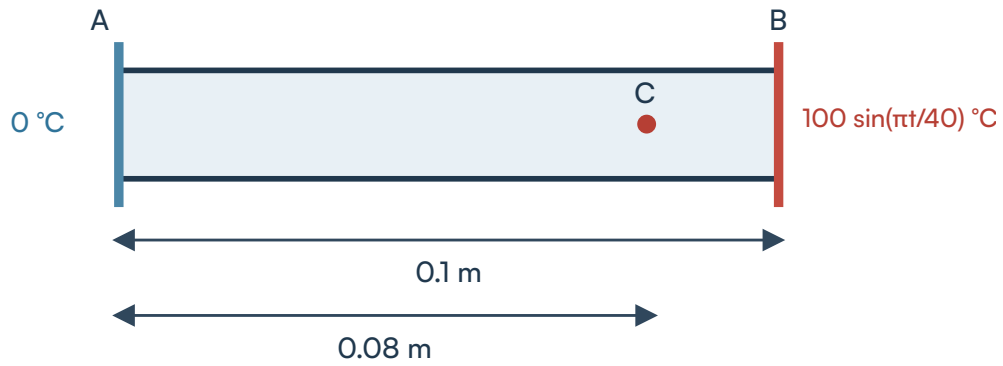

Figure 1: Geometry and time-dependent boundary condition for NAFEMS P18 T3.

3 Material

The material properties are $k = 35\ \mathrm{W}\ /(\mathrm{m}\ \mathrm{K})$, $\rho = 7200\ \mathrm{kg}\ /\mathrm{m}^3$, and $c = 440.5\ \mathrm{J}\ /(\mathrm{kg}\ \mathrm{K})$.

4 Loading & boundary conditions

The initial temperature is $0\ ^\circ\ \mathrm{C}$. End A remains at $0\ ^\circ\ \mathrm{C}$, and end B follows

$$T_B(t) = 100 \sin\left(\frac{\pi t}{40}\right)\ ^\circ\ \mathrm{C}\ .$$

All lateral surfaces are insulated.

5 Mesh & discretization

The Coreform/Abaqus model uses the same body-fitted $10 \times 1 \times 1$ linear, C^0 mesh as T2. The Abaqus transient heat-transfer step starts with a $0.1\ \mathrm{s}$ increment, permits increments up to $0.5\ \mathrm{s}$, and ends at $t = 32\ \mathrm{s}$.

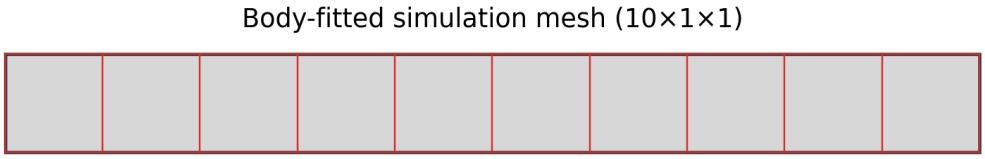

Figure 2: Exact body-fitted mesh used by the Coreform T3 simulation.

6 Reference & accepted solutions

The accepted temperature at C and $t = 32\ \mathrm{s}$ is $36.60\ ^\circ\ \mathrm{C}$ [1]. The automated test enforces a 2% relative-error limit.

7 Results

7.1 Temperature at point C

Table 1: NAFEMS P18 T3 verification result at 32 s.

Discretization	T_C (°C)	Relative error	Limit
Body-fitted Coreform/Abaqus IGA	37.25446	1.79%	2%

Figure 3: Coreform temperature field at 32 s for NAFEMS P18 T3.

8 Discussion

The result satisfies the published benchmark and directly exercises the volumetric capacity term and Abaqus transient thermal integration.

References

[1] *The standard NAFEMS benchmarks*. NAFEMS.

Appendix

8.1 Download artifacts

Download artifacts are available from the HTML version of this page.

8.1.a Geometry CAD files

Geometry CAD downloads are available from the HTML version of this page.

8.1.b Abaqus/CAE journal files

Individual journal downloads are available from the HTML version of this page.

8.2 Provenance

The record below identifies the Coreform/Abaqus verification evidence used by this page.

ℹ Test_abaqus_verification_nafems_p18_t3

Parameter	Value
Evidence type	Numerical verification
CTest result	Passed (Release)
Verification result	Passed — 1/1 enforced criterion passed
Test date	10-Sep-2026 16:03:46
Operating system	Ubuntu 22.04.4 LTS
Coreform IGA version	`2026.9+69838`
Source revision	`d88163e59ac0`
Abaqus version	`Abaqus 6.26-4`