

UNIVERSITY OF SASKATCHEWAN
 DEPARTMENT OF MECHANICAL ENGINEERING
ME 450.3 FINITE ELEMENT ANALYSIS
 MIDTERM EXAMINATION

Time: 1.5 hours
 Open-book examination
 Answer all questions

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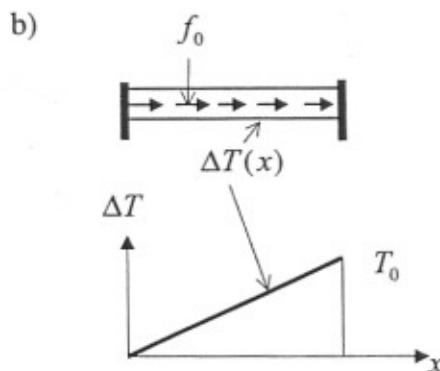
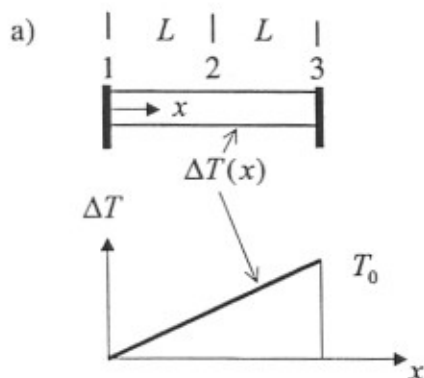
Q1. Use *two linear* elements to analyze the bar shown subjected to the following load cases:

- a) The linear change in temperature given by $\Delta T(x) = T_0 \frac{x}{2L}$ where $T_0 = 10^0 C$.
- Write the assembled stiffness matrix and substitute the BC (both ends fixed).
 - Determine the displacement of node 2 and plot $u(x)$.
 - Calculate the reaction forces.
 - Determine the element stresses and plot $\sigma(x)$.
- b) The temperature is changed as in (a), and a constant line load $f_0 = 2.4 \frac{N}{mm}$ is applied.
- Determine the displacement of node 2 and plot $u(x)$.
 - Calculate the reaction forces.
 - Determine the element stresses and plot $\sigma(x)$.

For each case comment on expected accuracy of:

- i) the displacement results,
- ii) the reactions,
- iii) the stress results.

Use: $E = 2 \cdot 10^5 MPa$, $A = 200mm^2$ $\alpha = 1.2 \cdot 10^{-5} \%$, $L=1000mm$



Q2. Use the symmetry (and the truss elements) to solve the truss shown.

- Determine the stiffness matrices for the elements and assemble them.
- Calculate the displacement of nodes 2 and 3.
- Calculate the reaction forces at nodes 1 and 4.
- Calculate the element stresses.
- Use the stress results to check equilibrium at node 2.

All results should be obtained in terms of E , A , L , and P

Note that the area of elements ① (between nodes 1 and 3) and ② (between nodes 2 and 4) is $\sqrt{2}A$.

