بسمه‌تعالی

# Finite Element Method

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| **Homework #2** | **Spring and Bar Elements** | |
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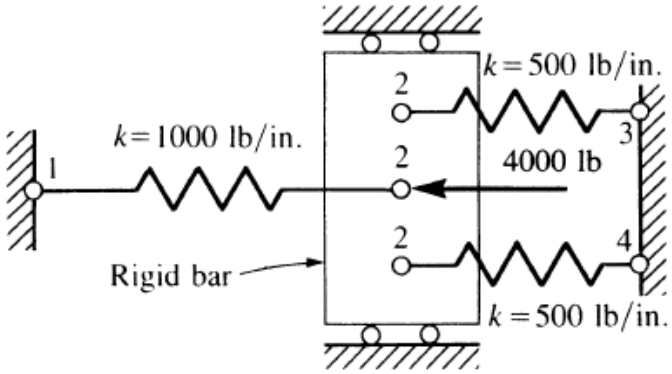
1-For the spring assemblages shown in Figure below, determine the nodal displacements, the forces in each element, and the reactions. Use the direct stiffness method.




(The First Course in the Finite Element, D. L. Logan, 4th Edition)

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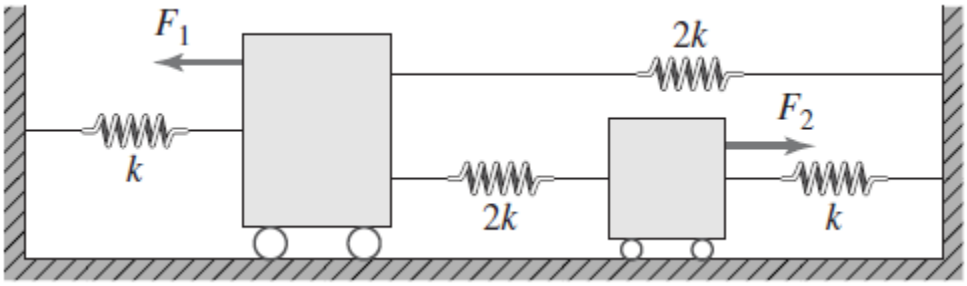
2-Two trolleys are connected by the arrangement of springs shown in Figure below.

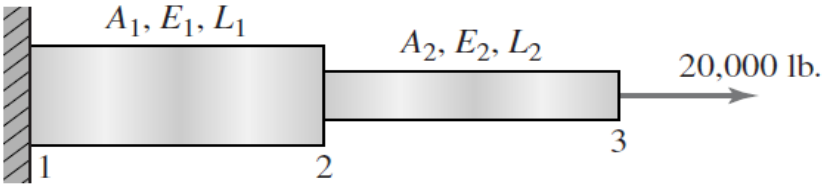
(a) Determine the complete set of equilibrium equations for the system in the form $[K]\{U\} = \{F\}$.

(b) If $k$ = 50 lb./in., $F1$ = 20 lb., and $F2$ = 15 lb., compute the displacement of each trolley and the force in each spring.




(Fundamentals of finite element analysis, D.V. Hutton)

3- Figure below depicts an assembly of two bar elements made of different materials. Determine the nodal displacements, element stresses, and the reaction force.




$A_1 = 4$ in.$^2$ $\quad A_2 = 2.25$ in.$^2$
$E_1 = 15 \times 10^6$ lb./in.$^2$ $\quad E_2 = 10 \times 10^6$ lb./in.$^2$
$L_1 = 20$ in. $\quad L_2 = 20$ in.

(Fundamentals of finite element analysis, D. V. Hutton)

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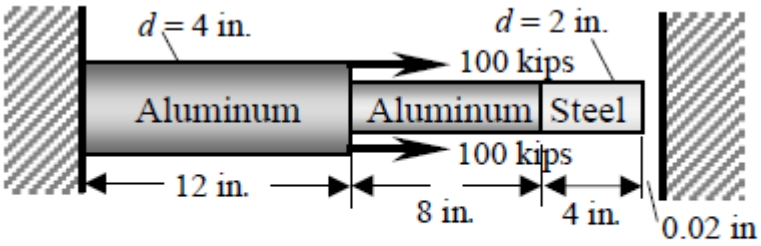
4- Find the three-element finite element solution to the stepped-bar problem. See figure below for the geometry and data.
Hint: Solve the problem to see if the end displacement exceeds the gap. If it does, resolve the problem with modified boundary condition at x = 24 in.




Steel, $E_s = 30 \times 10^6$ psi, Aluminum, $E_a = 10 \times 10^6$ psi

(An Introduction to the Finite Element Method, J N Reddy)