Finite Element Method
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| Homework #1 | Spring and Bar Elements (Direct Stiffness Method) | Deadline: 94/12/1 |

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. (Problem 2-10, The First Course in the Finite Element, D. L. Logan, 4th Edition)

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 \(k = 50 \text{ lb./in.}, \ F_1 = 20 \text{ lb.}, \) and \(F_2 = 15 \text{ lb.}, \) compute the displacement of each trolley and the force in each spring. (Problem 2-7, 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. (Problem 2-11, Fundamentals of finite element analysis, D. V. Hutton)
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.

(Problem 4-25. An Introduction To The Finite Element Method, J N Reddy)

Steel, \( E_s = 30 \times 10^6 \) psi. Aluminum, \( E_a = 10 \times 10^6 \) psi