

Lab Assignment 3, 03/28/2019, 1800 -- 2000

D 2000
L G : A 20%, B 80%, B 20%

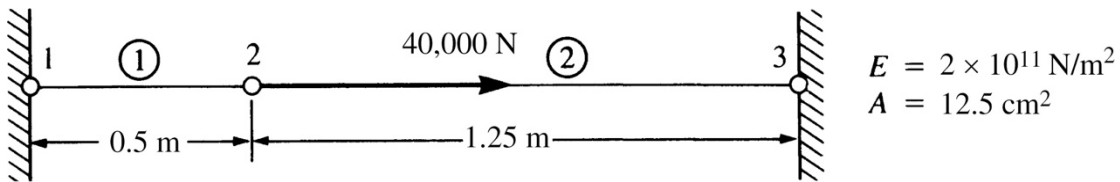
You are expected to complete the basic part during the Lab. In case you have difficulty in finishing the basic part on time, you should upload them before 2100 on Saturday and a penalty of 20% discount will be applied on your score. You are encouraged to complete the bonus part (no penalty applied). Basic and/or bonus parts should be submitted by **2100**

. We will in general post the reference solutions by .

Download `BarSimple.zip` from the course website and unzip it. You will find a folder containing a `problem1dSimple.m` file with two functions, `solution.m` and `outputDisplacementsReactions.m`.

1. (40%) Modify the MATLAB codes and determine the nodal displacements, the force in each element, and the reactions. Be aware of unit consistency.

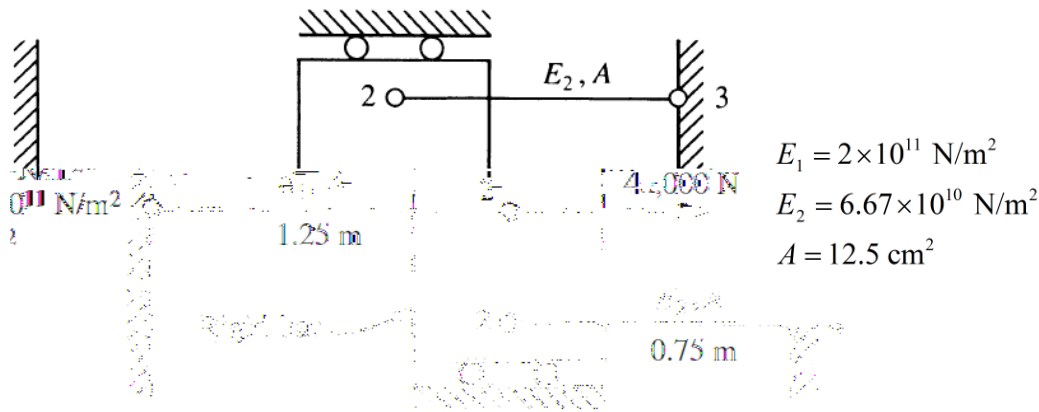
(a)



Sample output:

```
Displacements
node    displacements
1:      0.0000e+00
2:      5.7143e-05
3:      0.0000e+00
Reactions
node    reactions
1:      -2.8571e+04
3:      -1.1429e+04
Element Forces
element node_I node_J force I force J
1       1     2    -2.8571e+04  2.8571e+04
2       2     3     1.1429e+04 -1.1429e+04
```

(b)



Sample output:

```

Displacements
node      displacements
1:        0.0000e+00
2:        9.4712e-05
3:        0.0000e+00
4:        0.0000e+00
Reactions
node      reactions
1:        -1.8942e+04
3:        -1.0529e+04
4:        -1.0529e+04
Element Forces
element  node_I  node_J  force I  force J
1        1        2      -1.8942e+04  1.8942e+04
2        2        3       1.0529e+04 -1.0529e+04
3        2        4       1.0529e+04 -1.0529e+04

```

2. (40%) Let us reconsider Problem 1(a). In addition to the setup, we would also like to impose a displacement at node 3 so $u_3 = 1.0E - 6 \text{ m}$. Modify the MATLAB codes and determine the nodal displacements, the force in each element, and the reactions. Below is a sample output:

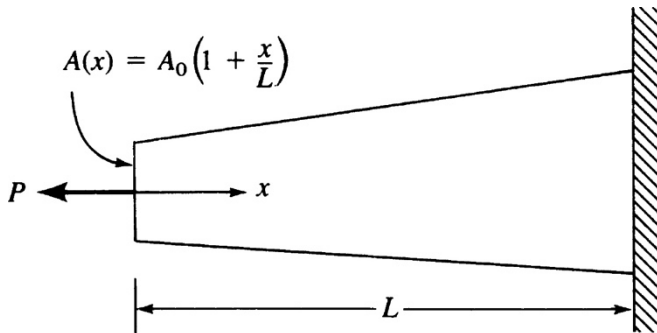
```

Displacements
node      displacements
1:        0.0000e+00
2:        5.7429e-05
3:        1.0000e-06
Reactions
node      reactions
1:        -2.8714e+04
3:        -1.1286e+04
Element Forces
element  node_I  node_J  force I  force J
1        1        2      -2.8714e+04  2.8714e+04
2        2        3       1.1286e+04 -1.1286e+04

```

3. (B 20%) Modify the MATLAB codes and solve for the axial displacement and stress in the tapered bar shown below using 1, 2, 4, 8, 16 constant-area elements. Evaluate the area at the

center of each element length. Use that area for each element. Let A_0 , $L = 0.5$ m, $E = 70$ GPa and $P = 5000$ N.



Compare your finite element results (displacements and stresses) with the exact solution.

• Sample MATLAB plots look like:

