Thanks for all your hard work this semester, and best of luck in your future studies and professional endeavors. It has been a pleasure having each of you in this course. If you would like your final exam grade and your final course grade emailed to you, please indicate so here. O Y / N

1. (3 pts.) Which method of indeterminate analysis that we covered in class would probably be the most efficient choice (least computationally intensive) to determine support reactions for the following frame? You only have a pencil, calculator, and paper as tools with which to solve the problem. Your choices are: (1) Force Method, (2) Stiffness Method - Slope Deflection, and (3) Stiffness Method - Moment Distribution. Support your answer. (You will not receive any credit without sufficient reasoning.)

2. (4 pts.) Please supply the effective lengths for each of the following columns.

\[
\begin{array}{cccc}
\text{Le} = \sqrt{L} & \text{Le} = \frac{L}{2} & \text{Le} = L & \text{Le} = 2L
\end{array}
\]
3. (3 pts.) You have been asked by your boss to design a column of prescribed length L. The material and cross-section dimensions have been chosen for you by the architect. Your preliminary design shows that a pin-pin column of that length, material, and cross-section will buckle under the given loads. What can you do as the engineer-of-record to increase the capacity of the column without changing the overall length, material, or cross-section dimensions? Please be specific.

Change the connections to fixed - fixed. It will increase the critical stress of the column.

(Problem 4 got deleted...)

5. (3 pts.) What does a distribution factor in the moment distribution procedure physically describe?

It describes what portion of a moment at one end will be translated to the other end of a beam.
6. (8 pts.) Fill in the following moment distribution table given the following beam, distribution factors, and fixed end moments. Carry out your precision to 0.10 ft-kip. You may not need to use all the rows in the table to successfully complete this problem.

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>0.999</td>
<td>0.556</td>
<td>0.556</td>
<td>0.999</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Force</th>
<th>M at A</th>
<th>M at B</th>
<th>M at C</th>
<th>M at D</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEMs</td>
<td>-78.1</td>
<td>28.1</td>
<td>-78.1</td>
<td>-78.1</td>
</tr>
<tr>
<td>Bending</td>
<td>12.48</td>
<td>-18.1</td>
<td>28.1</td>
<td>-62.4</td>
</tr>
<tr>
<td>Long.</td>
<td>1,73</td>
<td>-2.47</td>
<td>3.74</td>
<td>-3.47</td>
</tr>
<tr>
<td>Long.</td>
<td>1,73</td>
<td>-2.17</td>
<td>2.11</td>
<td>-1.73</td>
</tr>
<tr>
<td>Long.</td>
<td>1,73</td>
<td>-0.17</td>
<td>0.17</td>
<td>-0.17</td>
</tr>
<tr>
<td>Long.</td>
<td>0.036</td>
<td>-0.036</td>
<td>0.047</td>
<td>-0.047</td>
</tr>
</tbody>
</table>

7. (4 pts.) For the beam in Problem 6, write the complete, numerical slope-deflection equation for M_{AB} if the support at B is subjected to a 4" upheaval due to soil swell.}

Assume $E = \text{constant}$

Write the equation in terms of $L_1$.

$$ M_{NP} = \frac{2EI}{L} \left( \Theta_0 + \Theta_1 + \Theta_2 \right) + F_{EM_{NP}} $$

$$ = \frac{2EI}{L} \left( \Theta_0 - 3 \frac{\Theta_1}{4} \right) + 78.1 $$

What is the "f1" end? $B$
8. Given the following indeterminate frame,

(a) (22 pts.) Solve for the member end moments using either the slope-deflection method or moment distribution method. Please begin the problem by stating which approach you have chosen.

(b) (8 pts.) Draw the shear and moment diagrams for member AD. Be sure to draw moment positive on the compression-side of the member.
9. (25 pts.) Solve for the deflection at point C in the following beam. You may choose from one of the methods listed below.

a. Conjugate Beam Method
b. Castigliano's Second Theorem (Method of Least Work)

\[ E = \text{constant} = 40 \text{ GPa} \]
\[ I = 500 \times 10^6 \text{ mm}^4 \]

[Diagram showing beam with loads and moments]

\[ \begin{align*}
\sum F_y &= -300 \left( \frac{4L}{6} \right) + -150 \left( 6 \right) + V_L = 0 \quad V_L = +3150 \\
\sum M_C &= -300 \left( \frac{9}{2} \right) \left( \frac{4L}{6} \right) + -150 \left( 6 \right) \left( L - M \right) - M = 0
\end{align*} \]

[Calculation steps and results]

\[ I = 500 \times 10^6 \text{ mm}^4 \]
\[ 1 \text{ m} \]
\[ M_L = \frac{-15300}{E} \quad 70 \times 10^8 \text{ N/m} \]

\[ -4.32 \times 10^{-4} \text{ m} \]

\[ -5.1 \times 10^{-4} \text{ m} \]

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10. (20 pts.) Draw the influence line for the force in member CF for the following determinate truss.

\[
\begin{array}{c|c|c|c|c|c|c}
\text{Load} & \text{Pos} 1 & \text{Pos} 2 & \text{Pos} 3 & \text{Pos} 4 & \text{Pos} 5 \\
\hline
A & 1 & 0 & & & \\
B & 1.75 & 1.25 & & & \\
C & 1.5 & 1.5 & & & \\
D & 1.25 & 0.75 & & & \\
E & 0 & 1 & & & \\
\end{array}
\]

\[
\begin{align*}
\text{Pos} 1: F_{FB} &= 0 \\
\text{Pos} 2: F_{PL} &= 0 \\
\text{Pos} 3: F_{CB} &= 0 \\
\text{Pos} 4: F_{IL} &= \text{Symmetric} \\
\text{Pos} 5: F_{PL} &= 0 \\
\end{align*}
\]
Extra Credit No. 1 (3 pts.)
Describe the role of the following fictional figure with regard to the slope-deflection method.

![Image of Green Giant]

Plays the role for holding FEMs

Extra Credit No. 2 (2 pts.)
What's the magic number? 😊

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