1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.

(a) $b = 10\quad j = 10$

$\Delta + \Delta > 2\Delta$

$1^\circ$ INDETERMINATE IFF
STABLE, STABLE $\implies$ $1^\circ$ Indeterminate

(b) $17 + 3 \quad \Delta + \Delta$

$7 > 2$

DETERMINATE IFF
STABLE $\implies$ Determinant

(c) $11 \quad 2E_a + 2E_c$

$11 > 5$

$6^\circ$ INDETERMINATE IFF
STABLE, STABLE $\implies$ Indeterminate

(d) $6 \quad 3E_b - 2E_c$

$6 > 5$

$6^\circ$ INDETERMINATE IFF
STABLE, $6^\circ$ Indeterminate

(e) UNSTABLE $\checkmark$
(a) \[ 2 \text{ pts.} \] Identify all zero force members in the following loaded truss:

\[
\begin{align*}
\begin{array}{c}
B C = 0 \\
D C = 0 \\
J C = 0 \\
H E = 0 \\
E F = 0 \\
G F = 0
\end{array}
\end{align*}
\]
3. [25 pts] Solve for the forces in members AD, AC, DC, and DE of the following truss. Be sure to indicate whether each force is tensile or compressive. USE THE METHOD OF JOINTS.

\[ \sum F_x = 0 = 30^k - 15^k + A_x \]
\[ A_x = 15^k, \text{ pos. } \uparrow \]
\[ \sum F_y = 0 = -30^k - 30^k + A_y + 8^k \]
\[ A_y = 17.1428^k, \text{ pos. } \uparrow \]
\[ \sum M_A = 0 = 30(2^k) - 30(22^k) + 8^k(28^k) + 15(24^k) \]
\[ = -180 - 650 + 6^k(13^k) = -360 \]
\[ = 6^k(28^k) \]
\[ A_y = 17.1428^k, \text{ pos. } \uparrow \]

\[ \sum F_x = 0 = 15^k + \frac{15^k}{24.72^k}(F_{AB}) + \frac{15^k}{26.58^k}(F_{AC}) \]
\[ = \frac{15^k}{24.72^k}(F_{AB}) + \frac{15^k}{26.58^k}(F_{AC}) \]
\[ \sum F_y = 0 = 42.857^k + \frac{7^k}{26.72^k}(F_{AB}) + \frac{15^k}{26.58^k}(F_{AC}) \]
\[ = \frac{7^k}{26.72^k}(F_{AB}) + \frac{15^k}{26.58^k}(F_{AC}) \]

\[ F_{AB} = -37.7128^k, \text{ neg. } \downarrow \text{ comp. press.} \]
\[ F_{AC} = -8.59^k, \text{ neg. } \downarrow \text{ comp. press.} \]
\[ \sum F_x = 0: \quad F_{DE} + \frac{6}{24.114} \left( 39.94 \right) + \frac{9}{12.042} \left( F_{DC} \right) - 9.146 = 0 \]

\[ \sum F_y = 0: \quad -30 + \frac{2x}{24.114} \left( 39.94 \right) - \frac{9}{12.042} \left( F_{DC} \right) = 0 \]

\[ D = 30 + 36.584 - \frac{9}{12.042} F_{DC} \]

\[ -6.584 = -\frac{9}{12.042} F_{DC} \]

\[ B. 8116 = F_{DC} \]

\[ \text{Pos. = Tension} \]

\[ -9.146 = F_{DE} - \frac{8}{12.042} \left( 8.816 \right) \]

\[ F_{DE} = -14.997, \text{ neg. = Compression} \]
4. [25 pts] Solve for internal shear, moment, and axial thrust at point D on the frame shown below. Be sure to use positive internal force convention in your analysis.

\[ \sum F_x = 0 = C_x - \frac{2}{5} (20k) \]
\[ C_x = 2k, \text{ pos } \text{ to } x \]

\[ \sum F_y = 0 = A_y + C_y - 30k - \frac{1}{5} (20) \]
\[ A_y + C_y - 30 = 16 \]
\[ A_y + C_y = 46k \]

\[ \sum M_c = 0 = -2D (20 ft) + 30 (24 ft) - A_y (36) \]
\[ 36A_y = 200 + 920 \]
\[ 36A_y = 920 \]
\[ A_y = 25.56 k, \text{ pos } \text{ to } y \]

\[ 25.56 + C_y = 20k \]
\[ C_y = 20 - 25.56 \]
\[ 14.44 \]
\[ \sum F_x = 0 = 12 - \frac{3}{8} (20) - \frac{3}{8} (H_0) + \frac{3}{8} (V_0) \]
\[ = 12 - 12 - \frac{3}{8} (H_0) + \frac{3}{8} (V_0) \]
\[ H_0 = V_0 \]
\[ \sum F_y = 0 = 20 + \frac{3}{8} (20) + \frac{3}{8} (H_0) + \frac{3}{8} (V_0) \]
\[ = 20 + \frac{3}{8} (20) + \frac{3}{8} (H_0) + \frac{3}{8} (V_0) \]
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\[ = 20 + \frac{3}{8} (20) + \frac{3}{8} (V_0) \]
5. [25 pts] Draw the shear and moment diagrams for the following loaded beam. Please show your work, whether you use a graphical or equation-based approach.
Bonus A (3 pts.) – What was the most common name given to boys born in Texas from 1998-2003?

Joseph

x^2

Bonus B (2 pts.) – What lucky phrase won a character on You Can’t Do That on Television a shower of green slime?

It's slime time!
1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.

(a) \[ b+r > 2J \]
\[ 18+3 > 2(10) \]
\[ 21 > 20 \]
STB: 1° IND

(b) \[ b+r > 2J \]
\[ 17+3 \leq 2(10) \]
\[ 20 = 20 \]
STB: DET

(c) UNK EOS
\[ 5+6 > 3+2 \]
\[ 11 > 5 \]
STB: 6° IND

(d) UNK EOS
\[ 6 \leq 3+2 \]
STB: 1° IND

(e) UNSTABLE
3 pins in a line
2. [9 pts.] Identify all zero force members in the following loaded truss:

Members $EJ, EH, BC, AB, EF, GF$
3. [25 pts] Solve for the forces in members AD, AC, DC, and DE of the following truss. Be sure to indicate whether each force is tensile or compressive. USE THE METHOD OF JOINTS.

\[ M_A = 0 \]

\[ B_y(28) - 30(28) - 30(6) + 15(24) = 0 \]

\[ B_y = \frac{450}{28} = 16.14 \text{ kN} \]

\[ \sum F_y = 0 \]

\[ A_y + 16.14 - 30 - 30 = 0 \]

\[ A_y = 42.86 \text{ kN} \]

\[ \sum F_x = 0 \]

\[ A_x = 15 \text{ kN} \]

\[ \sum F_y = 0 \]

\[ 42.86 + F_{AD} \left( \frac{12\pi}{24.74} \right) + F_{AC} \left( \frac{15}{20.57} \right) = 0 \]

\[ F_{AD} \left( \frac{12\pi}{24.74} \right) + F_{AC} \left( \frac{15}{20.57} \right) = -42.86 \]

\[ \sum F_x = 0 \]

\[ F_{AD} \left( \frac{6\pi}{24.74} \right) + F_{AC} \left( \frac{14}{20.57} \right) = 0 \]

\[ F_{AD} = -F_{AC} \left( \frac{28}{24.74} \right) \]

\[ -F_{AC} \left( 2.81 \right) + F_{AC} \left( \frac{15}{20.57} \right) = -42.86 \]

\[ F_{AC} = \frac{2.145}{\text{pos: (T)}} \]

\[ F_{AD} = -60.28 \text{ kN, neg: (C)} \]
4. [25 pts] Solve for internal shear, moment, and axial thrust at point D on the frame shown below. Be sure to use positive internal force convention in your analysis.

\[ \frac{16}{12} = \frac{x}{6} \quad x = 8 \]

\[ Q \leq M_c = 0 \]

\[ 30(2.4) + 20 \left( \frac{12}{30} \right)(6) + 20 \left( \frac{12}{30} \right)(8) - A_y(36) = 0 \]

\[ A_y = \frac{25.6}{25.6} k \]

\[ \Sigma F_y = 0 \]

\[ 25.6 - 20(150) + C_y = 0 \]

\[ C_y = 20.4 \quad 16.44 \]

\[ \Sigma F_y = 0 \]

\[ C_x = 20(150) = 0 \]

\[ C_x = 20(150) = 0 \]

\[ \Sigma M_o = 0 \]

\[ M_o = 20(5) - 12(5 \times 36.87 \times 15) - 20.4(\cos(45)) \times 15 \]

\[ M_o = 2527.7 \]

\[ H = -12(6.4 \times 36.87) = 0 \]

\[ H = -2.64 k \]
\begin{align*}
\omega &= 0 \\
M(x) &= 100 \\
U(x) &= -15 \\
-100 + 15x &= 0 \\
\Rightarrow x &= 100
\end{align*}
Bonus A (3 pts.) – What was the most common name given to boys born in Texas from 1998-2003?

Jhoza

Is this a phonetic spelling of Jose?...

+3

Bonus B (2 pts.) – What lucky phrase won a character on You Can't Do That on Television a shower of green slime?

You Can't Do That.
1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.

(a) \( \frac{6x}{18.3} > \frac{21}{20} \)
   - Structure is stable
   - Indeterminate to 1°

(b) \( \frac{6x}{12-3} = \frac{21}{2(10)} \)
   - Stable
   - Determinate

(c) \( \frac{3x}{5+3.3} = \frac{11}{3}e \)  \( + \) \( \frac{2}{6}age = 5 \)
   - Stable
   - Indeterminate to 6°

(d) \( \frac{5}{3}e - 2e \)
   - Stable
   - Indeterminate to 6°

(e) \( \frac{e}{5} + 3e \)
   - Stable
   - Determinate × Unstable
2. [9 pts.] Identify all zero force members in the following loaded truss:

\[ \begin{align*}
&\text{CG, DA, EF, FC = 0} - 2 \text{ bars to an unloaded joint} \\
&\text{CF, EH = 0} - 1 \text{ non-collinear bar to an unloaded joint}
\end{align*} \]
3. [25 pts] Solve for the forces in members AD, AC, DC, and DE of the following truss. Be sure to indicate whether each force is tensile or compressive. USE THE METHOD OF JOINTS.

**Overall**

\[ \Sigma F_x = 0 \]
\[ A_x = 15 \text{ kips} \]
\[ \Sigma F_y = 0 \]
\[ 17.14 \text{ kips} + A_y - 30 = 0 \]
\[ A_y = 12.86 \text{ kips} \]

**Joint A**

\[ F_{AB} \hat{y} \]
\[ F_{AC} \hat{x} \]
\[ 15 \]
\[ 42.86 \]

**Joint C**

\[ \theta = \tan^{-1} \left( \frac{15}{42.86} \right) = 46.97^o \]
\[ \phi = \tan^{-1} \left( \frac{15}{15} \right) = 45^o \]

\[ \Sigma F_x = 0 \]
\[ 15 + F_{AC} \cos 46.97^o + F_{AB} \cos 75.96^o = 0 \]
\[ \Sigma F_y = 0 \]
\[ 42.86 + F_{AC} \sin 46.97^o + F_{AB} \sin 75.96^o = 0 \]

Solve with matrix:

\[
\begin{bmatrix}
0.7311 & 0.97014 \\
0.6823 & 0.2425 \\
-0.7311 & 0.97014 \\
0 & -0.6629
\end{bmatrix}
\begin{bmatrix}
F_{AC} \\
F_{AB}
\end{bmatrix}
=
\begin{bmatrix}
-42.86 \\
-15 \\
-42.86 \\
2.5
\end{bmatrix}
\]

\[ F_{AC} = -8.581 \text{ kips} \text{ Comp} \]
\[ F_{AB} = -37.712 \text{ kips} \text{ Comp} \]
\[ \psi = \tan^{-1} \left( \frac{2}{3} \right) = 48.36^\circ \]

\[ 37.71 \sin(76.96) - 30 - F_{oe} \sin(48.36) = 0 \]

\[ F_{oe} = 9.10 \text{ kip (CT)} \]

\[ 37.71 \cos(76.96) + 9.1 \cos(48.36) + F_{oe} = 0 \]

\[ F_{oe} = -15.19 \text{ kip (C)} \]

**Summary**

<table>
<thead>
<tr>
<th>Force</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F_{oe} )</td>
<td>9.56 kip (C)</td>
</tr>
<tr>
<td>( F_{oe} )</td>
<td>37.71 kip (C)</td>
</tr>
<tr>
<td>( F_{oe} )</td>
<td>9.1 kip (CT)</td>
</tr>
<tr>
<td>( F_{oe} )</td>
<td>15.19 kip (C)</td>
</tr>
</tbody>
</table>
4. [25 pts] Solve for internal shear, moment, and axial thrust at point D on the frame shown below. Be sure to use positive internal force convention in your analysis.

\[ \text{Angle:} \]
\[ \sqrt{\text{H}, \text{W}^2} = 20 \]

\[ \text{Invert triangle for load} \]

\[ \begin{aligned} \Sigma F_x &= 0 \\
C_x - 20 \cos \theta &= 0 \\
C_x &= \sqrt{\text{H}, \text{W}^2} \cdot 20 = 0 \\
C_x &= 16 \text{ kip} \checkmark \\
\Sigma M_c &= 0 \\
20 \text{ kip} \cdot 16 \text{ ft} &= 0 \\
A_y \left( -3 \text{ kip} \cdot 12 \text{ kip} \cdot 16 \text{ ft} \right) + 20 \text{ kip} \cdot 10 \text{ ft} &= 0 \\
A_y &= 25.556 \text{ kip} \checkmark \\
\Sigma F_y &= 0 \\
A_y - 30 \text{ kip} \cdot 12 \text{ kip} \cdot 20 + C_y &= 0 \\
C_y &= +16.44 \text{ kip} \checkmark \\
\text{Break bar BC at 0} \\
\text{Create local coordinate system}\end{aligned} \]

\[ \begin{aligned} C_x' &= 16 \cdot \cos \theta - 16.44 \cdot \cos (90 - \theta) \\
&= 16 \cdot \frac{10}{16} - 16.44 \cdot \frac{15}{16} \\
C_x' &= -3.56 \text{ kip} \checkmark \\
C_y' &= 16 \sin \theta + 16.44 \sin (90 - \theta) \\
C_y' &= 16 \cdot \frac{10}{16} + 16.44 \left( \frac{10}{16} \right) \\
C_y' &= 27.66 \text{ kip} \checkmark \end{aligned} \]
Great and D - ACC! Pt D is left by the 720 k load by another 51... opioids.
5. [25 pts] Draw the shear and moment diagrams for the following loaded beam. Please show your work, whether you use a graphical or equation-based approach.

Overall:
\[ \sum F_x = 0; \quad 0_x = 0 \]
\[ \sum F_y = 0 \]
\[ -15 + 0_y = 0 \]
\[ 0_y = 15 \text{ kip} \]
\[ \sum M_D = 0 \]
\[ 100 \times 15 + 10 \times 6 - 6 \times 6 + M_B = 0 \]
\[ M_B = 190 \text{ ft-kip} \]

Break Theorem:
\[ 0 < x < 6 \text{ ft} \]

\[ \sum F_x = 0; \quad P = 0 \]
\[ \sum F_y = 0; \quad V = 0 \]
\[ \sum M_A = 0; \quad M = 0 \]

\[ 6 < x < 12 \text{ ft} \]

\[ \sum F_x = 0; \quad P = 0 \]
\[ \sum F_y = 0; \quad V = 0 \]
\[ \sum M_A = 0 \]
\[ 100 + M = 0 \]
\[ M = 100 \text{ kip-ft} \]
\[ 12 \leq x \leq 18 \]
Bonus A (3 pts.) – What was the most common name given to boys born in Texas from 1998-2003?  
José


Bonus B (2 pts.) – What lucky phrase won a character on *You Can't Do That on Television* a shower of green slime?
1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.

(a) \[ k = 12 \]
\[ f = 3 \]
\[ j = 10 \]
\[ i_{1} \geq 10f \]
\[ i_{1} > 0 \]
Indeterminate if stable; stable.
In determinate to 10.

(b) \[ k = 10 \]
\[ f = 3 \]
\[ j = 10 \]
\[ i_{1} = 10f \]
Determinate if stable.
Stable.
Determinate.

(c) \[ k > 5 \]
Indeterminate if stable.
Indeterminate to 6°.

(d) \[ k > 6 \]
\[ f = 3 \]
\[ j = 2 \]
\[ i_{1} \geq 5 \]
Indeterminate if stable.
Indeterminate to 10°.

(e) \[ k > 6 \]
\[ f = 3 \]
\[ j = 2 \]
Determinate if stable.
Unstable.
2. [9 pts.] Identify all zero force members in the following loaded truss:

\[ \text{AB, BC, EG, EG} \]
3. [25 pts] Solve for the forces in members AD, AC, DC, and DE of the following truss. Be sure to indicate whether each force is tensile or compressive. USE THE METHOD OF JOINTS.

\[ \pm \Delta M_A = 0 = 30(6) + 30(22) - 15(24) = B_Y \cdot 28 \]

\[ B_Y = 17.14 \text{ k} \]

\[ \pm \Delta F_Y = 0 = -30 - 30 + 17.14 + A_Y \]

\[ A_Y = 42.26 \text{ k} \]

\[ \Rightarrow \pm \Delta F_X = 0 = -14 + A_X \]

\[ A_X = 15 \text{ k} \]

\[ 42.26 = 42.26 + \frac{37.75}{24.14} F_{AC} + \frac{15}{20.56} F_{AC} \]

\[ 0.970 F_{AD} + 0.731 F_{AC} = -42.26 \]

\[ F_{AD} = -44.19 - 0.734 F_{AC} \]

\[ F_{AC} = -8.54 \text{ k} \; \text{neg} \; \text{Compressive} \]

\[ F_{DC} = 8.85 \text{ k} \; \text{pos} \; \text{Tensile} \]

\[ F_{AC} = \frac{24.14(37.75)}{15} + \frac{15}{24.14} F_{AC} \]

\[ F_{AC} = 37.75 \text{ k} \; \text{Compressive} \]

\[ F_{DE} = -5.64 \text{ k} \; \text{neg} \; \text{Compressive} \]
4. [25 pts] Solve for internal shear, moment, and axial thrust at point D on the frame shown below. Be sure to use positive internal force convention in your analysis.

\[ \sum F_y = 0: \quad -30 + 25.56 \theta + C_y = 0 \]
\[ C_y = 47.95 \times \]
\[ C_x = 20.44 \times \]

\[ \sum M_D = 0: \quad M_D + 20 \theta - 39.07 \theta = 0 \]
\[ M_D = 411.05 \text{ ft-lb positive} \times \]
5. [25 pts] Draw the shear and moment diagrams for the following loaded beam. Please show your work, whether you use a graphical or equation-based approach.

\[ F_E = 0 \rightarrow \delta_x = 15 \]
\[ \delta_B = -15 \]

\[ M_D = -15x + 120 \]
\[ M_D = -15x + 80 \]

\[ M_B = -10 \]

\[ M_{Ed} \rightarrow -15(0)(90) = 0 \]
\[ M_{E6} \rightarrow -15(0)(80) = 0 \]
\[ M_{E6} \rightarrow -10(90) = 900 \]
1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.

(a) \[ \frac{\text{links}}{\text{eqns}} = \frac{18+3}{2(10)} \]
\[ = \frac{21}{20} \]
1º INDET IFF STABLE
STABLE :: 1º INDET

(b) \[ \frac{\text{links}}{\text{eqns}} = \frac{17+8}{2(10)} \]
\[ = \frac{25}{20} \]
DET IFF STABLE
STABLE :: DET

(c) \[ \frac{\text{links}}{\text{eqns}} = \frac{5+6}{3+2} \]
\[ = \frac{11}{5} \]
6º INDET IFF STABLE
STABLE :: 6º INDET

(d) \[ \frac{\text{links}}{\text{eqns}} = \frac{6}{3+2} \]
\[ = \frac{6}{5} \]
1º INDET IFF STABLE
STABLE :: 1º INDET

(e) \[ \frac{\text{links}}{\text{eqns}} = \frac{6}{2+3} \]
\[ = \frac{6}{5} \]
DET IFF STABLE
UNSTABLE
4. [9 pts.] Identify all zero force members in the following loaded truss:

ZERO FORCE MEMBERS:
AB
BC
CJ
EH
EF
GF
21.5  B. [25 pts] Solve for the forces in members AD, AC, DC, and DE of the following truss. Be sure to indicate whether each force is tensile or compressive. USE THE METHOD OF JOINTS.

\[ \sum F_A = 0 = -30^k(10^f) - (30^k)(22^f) + (15^k)(24^f) + (B_y)(28^f) \]

\[ \therefore B_y = 17.14^k \text{ pos.} \quad \uparrow \bigcirc \]

\[ \Rightarrow \sum F_y = 0 = Ax - 15^k \]

\[ \therefore A_y = 15^k \text{, pos.} \quad \rightarrow \bigcirc \]

\[ \Rightarrow \sum F_x = 0 = A_y - 30^k - 30^k + B_y \]

\[ \Rightarrow A_y = 60^k + 17.14^k \]

\[ \therefore A_y = 47.26^k \text{, pos.} \quad \uparrow \bigcirc \]

\[ \Rightarrow \sum F_A = 0 = 15^k + F_{AD} \left( \frac{34}{24.54} \right) + F_{AC} \left( \frac{14}{20.52} \right) \]

\[ F_{AD} = (-15^k - F_{AC} \left( \frac{14}{20.52} \right)) \left( \frac{24.54}{6} \right) \bigcirc \]

\[ \Rightarrow \sum F_y = 0 = 47.26^k + F_{AD} \left( \frac{34}{24.54} \right) + F_{AC} \left( \frac{15}{20.52} \right) \]

\[ O = 47.26^k + (-15^k - F_{AC} \left( \frac{15}{20.52} \right)) \left( \frac{24.54}{6} \right) + F_{AC} \left( \frac{15}{20.52} \right) \bigcirc \]

\[ O = 42.66^k - 61.85^k - 2.813 F_{AC} + 0.731 F_{AC} \]
\[ F_{AC} = -9.12k, \text{ NEG} \] 
\[ F_{AD} = -15k - F_{AC} \left( \frac{\text{vertical}}{30} \right) \left( \frac{24.74}{32.56} \right) \] 
\[ \text{MATH} \]
\[ F_{AD} = -30.19k, \text{ NEG} \rightarrow \] (comp)

\[ 37.72^\circ \]

\[ F_{AB} = 36.19k \]

\[ 30^\circ \rightarrow F_{DC} \]

\[ 1 + \sum F_y = 0 = 36.19k \left( \frac{24}{24.74} \right) - 30k - F_{DC} \left( \frac{24}{32.56} \right) \]
\[ \therefore F_{DC} = 6.93k, \text{ POS} \rightarrow \] (ten)

\[ + \sum F_x = 0 = 36.19k \left( \frac{6}{24.74} \right) + F_{DC} + 6.93 \left( \frac{22}{32.56} \right) \]
\[ \therefore F_{DC} = -13.46k, \text{ NEG} \rightarrow \] (comp)
4. [25 pts] Solve for internal shear, moment, and axial thrust at point D on the frame shown below. Be sure to use positive internal force convention in your analysis.

\[ \Sigma F_x = 0 = C_x - (20k)(\frac{12}{20}) \]
\[ C_x = 100k \checkmark \]
\[ \Sigma M_C = 0 = (20k)(10ft) + (30k)(24ft) - (A_y)(360ft) \]
\[ A_y = 25.56k \checkmark \]
\[ \Sigma F_y = 0 = A_y - 30k - 20k(\frac{12}{20}) + C_y \]
\[ = 25.56k - 30k - 20k(\frac{12}{20}) + C_y \]
\[ C_y = 150.44k \checkmark \]

\[ \Sigma F_x = 0 = (V_b)(\frac{9}{10}) - N_D(\frac{9}{10}) - (20k)(\frac{8}{10}) + 160k \]
\[ N_b = \frac{\frac{4}{3} V_b}{16k + 160k} (\frac{9}{10}) \]
\[ N_D = \frac{4}{3} V_b \]
\[ \Sigma F_y = 0 = (V_b)(\frac{9}{10}) + N_D(\frac{8}{10}) - (20k)(\frac{8}{10}) + 160k + 160.44k \]
\[ = (V_b)(\frac{9}{10}) + (\frac{4}{3} V_b)(\frac{9}{10}) - 12k + 160.44k \]

\[ \Rightarrow V_b = -2.66k, \text{ neg. } \checkmark \]

\[ N_b = \frac{4}{3} V_b = \frac{9}{10} (-2.66k) \]
\[ \Rightarrow V_b = -3.55k, \text{ neg. } \checkmark \]
\[ 5 + \sum M_D = 0 = -M_D - (20k)(5\text{ft}) + (16.44k)(9\text{ft}) + (16k)(12\text{ft}) \]

\[ \therefore M_D = 239.96\text{ k-Ft} \quad \text{pos} \quad \checkmark \]
5. [25 pts] Draw the shear and moment diagrams for the following loaded beam. Please show your work, whether you use a graphical or equation-based approach.

\[ \Sigma F_x = 0 = -D_x \]
\[ \therefore D_x = 0 \]
\[ \Sigma F_y = 0 = D_y - 15 k \]
\[ \therefore D_y = 15 k \]
\[ \Sigma M_D = 0 = M_D + (15k)(6ft) + 100 k \cdot \text{in} \]
\[ \therefore M_D = -190 \text{ k-in}, \text{ negative} \]

\[ V(x) = \int 0 \, dx \]
\[ M(x) = \int V(x) \, dx \]

\[ \omega(x) = 0 \]
\[ v(x) = \int \omega(x) \, dx \]
\[ M(x) = \int V(x) \, dx \]

\[ C_1 = C_2 = 0 \]

\[ C_4 = -100 \]

\[ C_3 = C_5 = -15 \]

\[ C_6 = -100 \]
Bonus A (3 pts.) – What was the most common name given to boys born in Texas from 1998-2003?

José

Bonus B (2 pts.) – What lucky phrase won a character on You Can't Do That on Television a shower of green slime?
1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.

(a) Stable. Indeterminate - 1

(b) Stable. Indeterminate

(c) Stable. Indeterminate - 2

(d) Stable. Indeterminate - 1

(e) Unstable. Indeterminate

(f) Stable. Determinate

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CE 461 – Structural Analysis, Fall 2006
EXAM No. 1

Name: ________________________

9/11/06
2. [9 pts.] Identify all zero force members in the following loaded truss:

Zero Force Members: JE, HE, BC, EF, AB, FG
3. [25 pts] Solve for the forces in members AD, AC, DC, and DE of the following truss. Be sure to indicate whether each force is tensile or compressive. USE THE METHOD OF JOINTS.

Check Stability

\[ \frac{b+e}{7+3} = 10 \]

Solve for external reactions

\[ \Sigma M_A = 0 = -30(6) - 15(12) + 15(8) \]

\[ F_y = 17.14 \text{k} \checkmark \]

\[ \Sigma F_y = 0 = -30 - 30 + 17.14 + A_y \]

\[ A_y = 42.86 \text{k} \checkmark \]

\[ \Sigma F_x = 0 = -15 + A_x \]

\[ A_x = 15 \text{k} \checkmark \]

Joint A

\[ \sqrt{u^2 + v^2} = 24.74 \]

\[ \sqrt{u^2 + v^2} = 20.62 \]

\[ \Sigma F_v = 0 = 15 + \frac{u}{24.74} F_{AD} + \frac{v}{20.62} F_{AC} \]

\[ u = 15 + 0.2474 F_{AD} - 0.6828 F_{AC} \Rightarrow F_{AC} = -2.98 - 0.3554 F_{AD} \quad (1) \]

\[ \Sigma F_x = 0 = 42.48 + \frac{u}{20.62} F_{AD} - \frac{v}{20.62} F_{AC} \quad (2) \]

\[ (1) + (2) \]

\[ D = 42.48 + 0.97 F_{AD} + 0.781(-2.98 - 0.3554 F_{AD}) \]

\[ -26.64 = 0.710 F_{AD} \]

Solving using a calculator

\[ F_{AD} = -37.46 \text{k} \text{ or } 37.46 \text{k in Compression} \]

\[ F_{AC} = -8.67 \text{k} \text{ or } 8.67 \text{k in Compression} \]
Joint D

\[ \sqrt{22^2 + 24^2} = 32.56 \]

\[ ZF_y = 0 = -80 - (-37.46 \left( \frac{24}{24.74} \right)) - \frac{24}{32.56} F_{dc} \]

\[ F_{dc} = 8.6 \text{k in Tension} \]

\[ ZF_x = 0 = -\frac{24}{24.74} (-37.46) + F_{de} + \frac{23}{32.56} (3.6) \]

\[ F_{de} = -14.9 \text{k or 14.9 k in Compression} \]
4. [25 pts] Solve for internal shear, moment, and axial thrust at point D on the frame shown below. Be sure to use positive internal force convention in your analysis.

\[ \theta = \tan^{-1} \frac{16}{12} = 53.13^\circ \]

\[ \sum M_a = 0 = 30(12) + 20(\frac{16}{\cos 53.13^\circ}) - A_y(36) \]

\[ A_y = 15.67 \times 85.66 \]

\[ \sum F_y = 0 = 15.67 - 30 - 20(\cos 53.13^\circ) + c_y \]

\[ c_y = 21.44 \times 11.64 \]

\[ \sum F_x = 0 = -V \sin 53.13^\circ + N \cos 53.13^\circ \]

\[ C = 0.50V + 0.60N \]

\[ 0.87V = 0.60N \]

\[ V = 0.75N \] (1)

\[ \sum F_x = 0 = 15.67 - 30 - V \cos 53.13 - N \sin 53.13 \]

\[ 0.6V + 0.8N = -14.4 \] (2)

\[ (1) \times (1) \]

\[ 0.6(0.75N) + 0.8N = -14.4 \]

\[ N = -11.52 \text{ k or } 11.52 \text{ k} \]

\[ V = -8.64 \text{ k or } 8.64 \text{ k} \]
Check

\[
\Sigma F_x = 0 = -N + 16(\cos 30.47\degree) - 20(\sin 30.47\degree)
\]

\[
N = -8.13 \text{ kN} \quad \text{or} \quad -8.13 \text{ kN}
\]

\[
\Sigma F_y = 0 = V - 200 - 20u(\cos 30.47\degree) - 16(\sin 30.47\degree)
\]

\[
v = 5.34 \text{ kN} \quad \text{or} \quad 5.34 \text{ kN}
\]

\[
\Sigma M = 0 = M + 20(\frac{3}{2} \times 38.31) - 16 \sin (36.87\degree) - 20.4 (\cos 36.87\degree)
\]

\[
M = -74.1 \text{ kN m} \quad \text{or} \quad 74.1 \text{ kN m}
\]
5. [25 pts] Draw the shear and moment diagrams for the following loaded beam. Please show your work, whether you use a graphical or equation-based approach.
Bonus A (3 pts.) – What was the most common name given to boys born in Texas from 1998-2003?


Bonus B (2 pts.) – What lucky phrase won a character on You Can't Do That on Television a shower of green slime?

"Eat your shoes," he said.