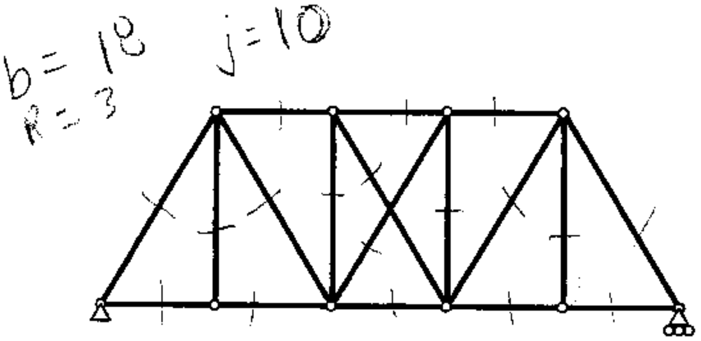
96/100

CE 461 – Structural Analysis, Fall 2006 **Name:** ______________________

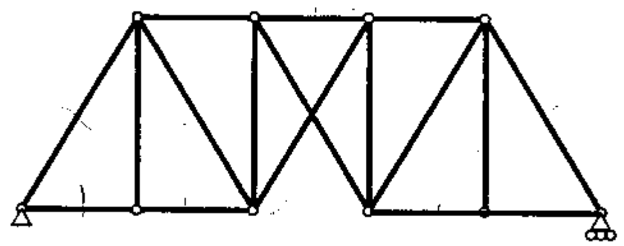
EXAM No. 1

(14) 1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.

b = 18 j = 10 R = 3 b + R 2(j)

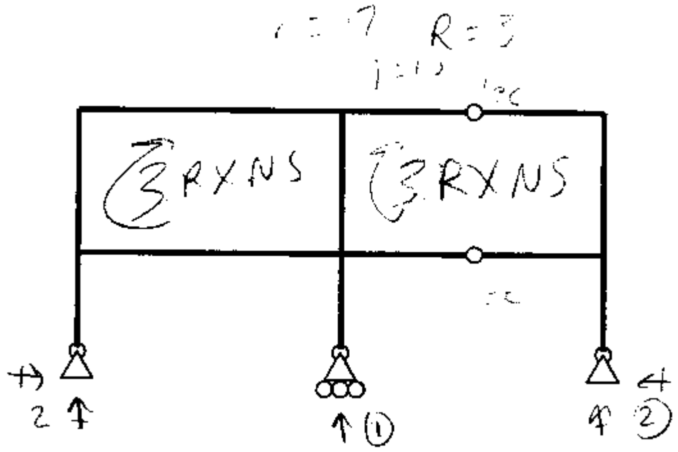


(a) 18 + 3 2(10)
21 > 20
1° INDETERMINATE IFF STABLE, STABLE ∴ 1° ✓ Indeterminant



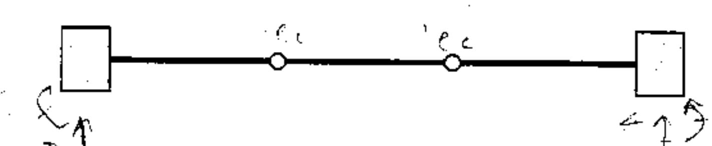
(b) 17 + 3 2(10)
20 = 20
DETERMINANT IFF STABLE
STABLE ∴ DETERMINANT ✓

b = 17 R = 3 j = 10

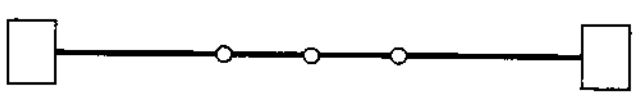


UNKNS EQUATIONS

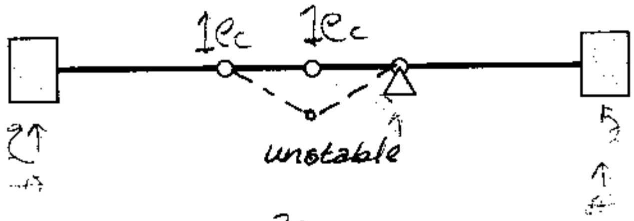
(c) 11 3Eq + 2Ec
11 > 5
6° INDETERMINANT IFF STABLE, STABLE ∴ 6° ✓ INDETERMINANT

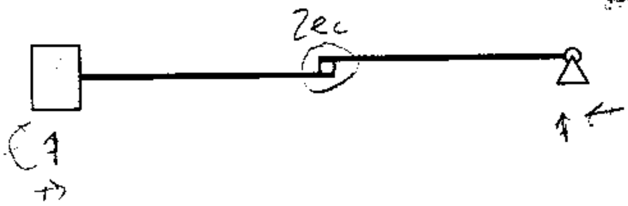


(d) 6 3Eq + 2Ec
6 > 5
1° INDETERMINANT IFF STABLE ✓
STABLE ∴ 1° INDETERMINANT



(e) UNSTABLE ✓
good

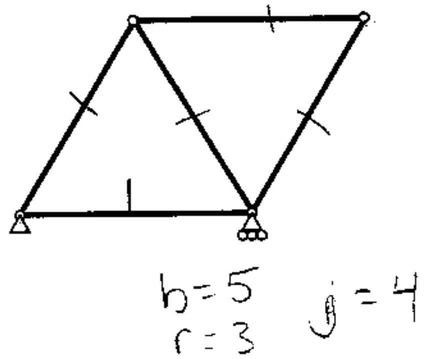




UNKNS Cond

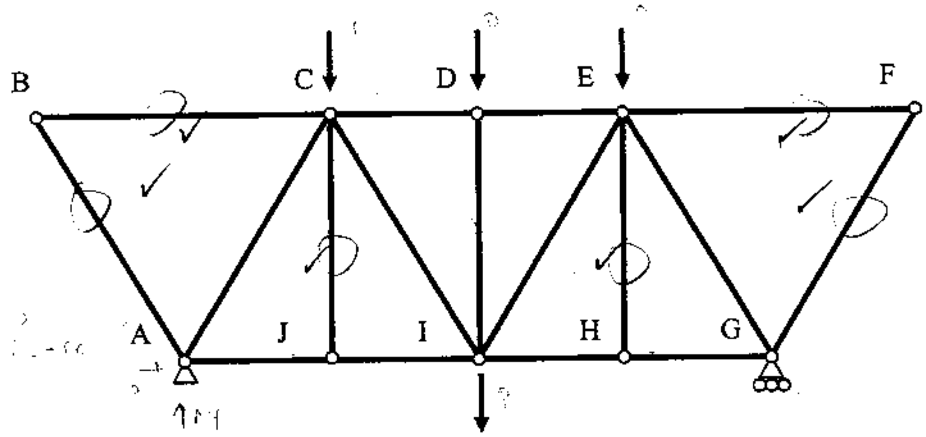
(f) 8 3Eq + 2ec
8 > 5
3° INDETERMINATE IFF STABLE
STABLE & 3° INDETERMINATE
−2

(g) 5 3Eq + 2ec
5 = 5
DETERMINATE IFF STABLE
STABLE & DETERMINATE ✓



(h) 5+3 4(2)
8 = 8
DET IFF STABLE ✓
STABLE & DETERMINANT

(9) 2. [9 pts.] Identify all zero force members in the following loaded truss:



$G_y = \frac{3}{2}P$

$A_y = 2.5P$

BC = 0

FG = 0

JC = 0

HE = 0

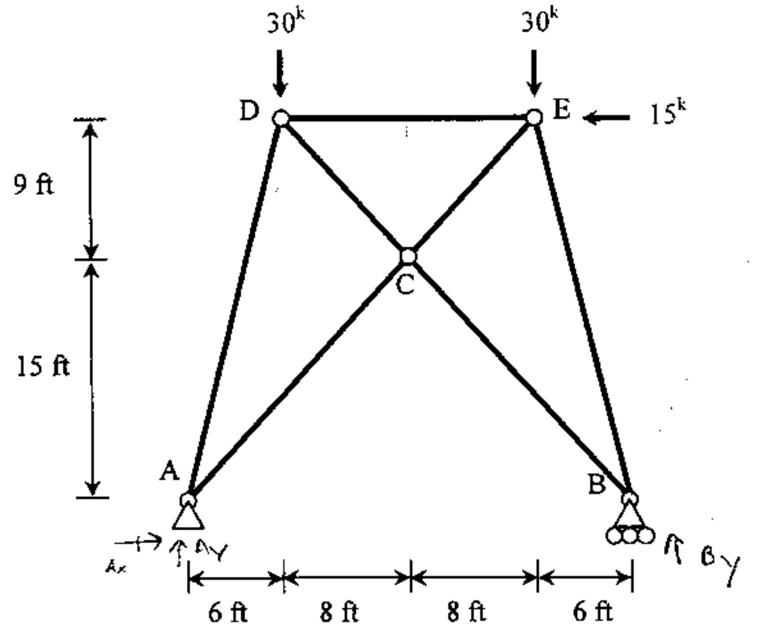
EF = 0

GF = 0

(25)

Very good!

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.



ENTIRE STRUCTURE

421

$\xrightarrow{+} \Sigma F_x = 0 = -15^k + A_x$ ✓

$A_x = 15^k$, pos $\therefore$ →

$+\uparrow \Sigma F_y = 0 = -30k - 30k + A_y + B_y$

$A_y + B_y = 60^k$

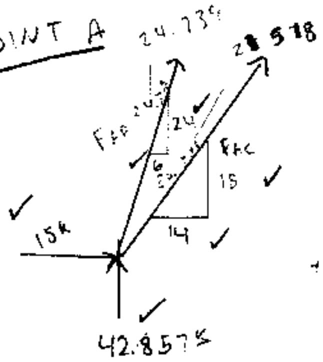
$+\circlearrowleft \Sigma M_A = 0 = -30(6ft) - 30(22ft) + B_y(28ft) + 15(24)$

$-180 - 660 + B_y(28ft) + 360$

$480 = B_y(28)$ ✓

$B_y = 17.1428^k$, pos $\therefore$ ↑, $\therefore$ $A_y = 42.857^k$, pos $\therefore$ ↑ ✓

JOINT A



$\xrightarrow{+} \Sigma F_x = 0 = 15^k + \frac{6}{24.739}(F_{AD}) + \frac{14}{20.518}(F_{AC})$

$-15 = \frac{6}{24.739}(F_{AD}) + \frac{14}{20.518}(F_{AC})$

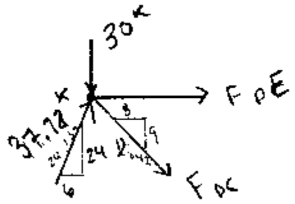
$+\uparrow \Sigma F_y = 0 = 42.857^k + \frac{24}{24.739}(F_{AD}) + \frac{15}{20.518}(F_{AC})$

$-42.857 = \frac{24}{24.739}(F_{AD}) + \frac{15}{20.518}(F_{AC})$

$F_{AD} = -37.712^k$, neg $\therefore$ compression ✓

$F_{AC} = -8.579^k$, neg $\therefore$ compression ✓

JOINT D



$\xrightarrow{+} \Sigma F_x = 0: \quad F_{DE} + \frac{6}{24.739}(37.72^K) + \frac{8}{12.042}(F_{DC})$

$-9.146 = F_{DE} + \frac{8}{12.042}(F_{DC})$

$+\uparrow \Sigma F_y = 0: -30^K + \frac{24}{24.739}(37.72) - \frac{9}{12.042}(F_{DC})$

$0 = -30 + 36.584 - \frac{9}{12.042} F_{DC}$

$-6.534 = -\frac{9}{12.042}(F_{DC})$

$\boxed{8.81^K = F_{DC}}$ ✓
pos ∴ tension

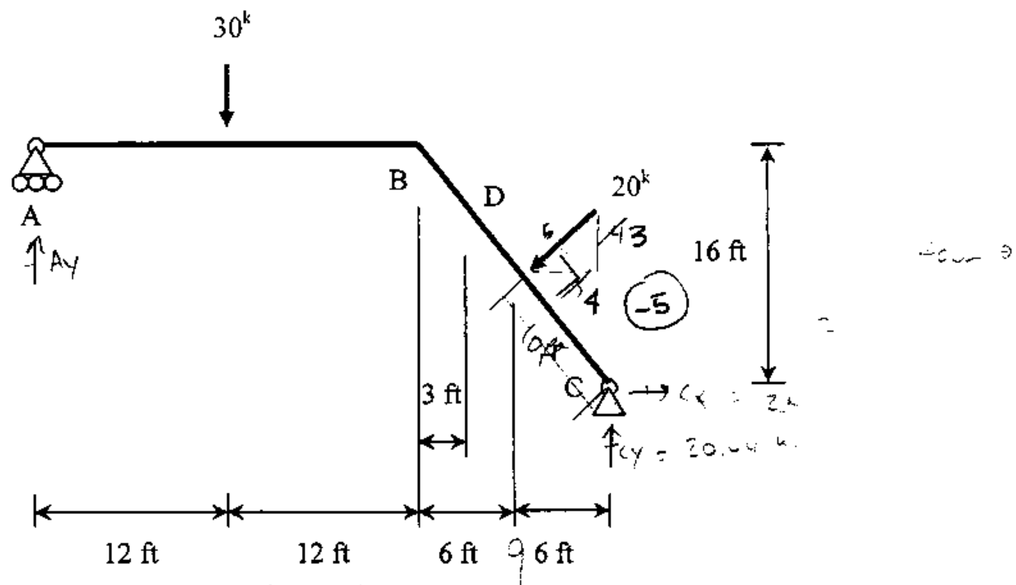
$-9.146 = F_{DE} + \frac{8}{12.042}(8.81)$

$\boxed{F_{DE} = -14.99^K}$, neg ∴ compression

✓

20

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.



ENTIRE STRUCTURE

$\xrightarrow{+} \Sigma F_x = 0 = C_x - \frac{\cancel{3}\,4}{5}(20^k)$

$C_x = 12^k$, pos ∴ → X

$+\uparrow \Sigma F_y = 0 = A_y + C_y - 30^k - \frac{4}{5}(20)$

$A_y + C_y - 30 - 16$

$A_y + C_y = 46^k$

$+\circlearrowleft \Sigma M_c = 0 = +20(10\,ft) + 30(24\,ft) - A_y(36)$

$36(A_y) = 200 + 720$

$36(A) = 920$

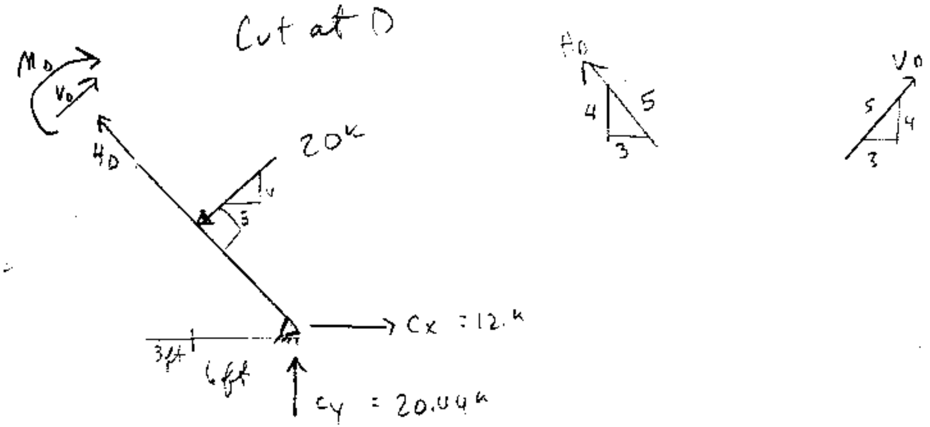
$A_y = 25.56^k$, pos ∴ ↑

$25.56 + C_y = 46^k$

$C_y = 20.44^k$ pos ∴ ↑ X

16.44^k ↑

Cut at D



$\xrightarrow{+} \Sigma F_x = 0 = 12^k - \frac{3}{5}(20^k) - \frac{3}{5}(H_D) + \frac{3}{5}(V_D)$

$12 - 12 - \frac{3}{5}(H_D) + \frac{3}{5}(V_D)$

$H_D = V_D$

$\Sigma F_y = 0 = 20.44^k - \frac{4}{5}(20) + \frac{4}{5}(H_D) + \frac{4}{5}(V_D)$

$-4.44^k = \left[\frac{4}{5}(H_D) + \frac{4}{5}(V_D)\right]\frac{5}{4}$

$-5.55 = H_D + V_D$

$-5.55 = 2H_D$ since $H_D = V_D$

$\boxed{H_D = -2.775^k, \text{ neg } \therefore \quad V_D = -2.775^k, \text{ neg } \therefore}$

$\circlearrowleft^{+} \Sigma M_c = 0 = 20^k(10ft) - M_D - V_D(15ft)$

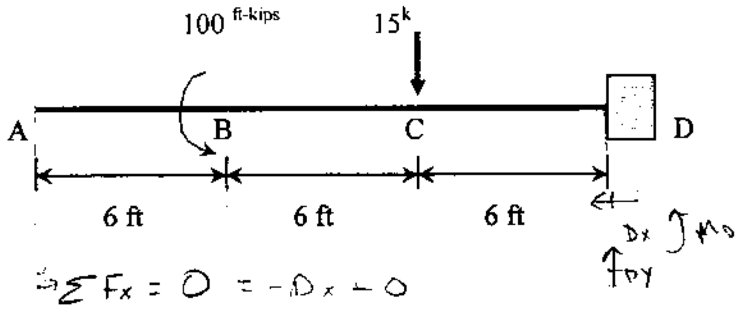
$200^{k\cdot ft} - M_D - (-2.775)(15ft)$

$200 - M_D + 41.625$

$\boxed{M_D = 241.625^{ft\text{-}k}, \text{ pos } \therefore}$

25

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.



$\xrightarrow{+} \sum F_x = 0 = -D_x + 0$

$D_x = 0$

$+\uparrow \sum F_y = 0 = D_y - 15^k$

$D_y = 15^k$, pos. ∴ ↑

$+\circlearrowleft \sum M_D = 0 = 100\,ft\text{-}kip + 15(6\,ft) - M_D$

$M_D = 190\,ft\text{-}kip$, pos ∴ ↺

A to B
0–6

$W(x) = 0$

$V(x)_{AB} = \int 0$

$V(x)_{AB} = C$

$V(0)_{AB} = 0$

∴ $V(x)_{AB} = 0$

B to C 0' → 6'

$w(x) = 0$

$V(x)_{BC} = \int w(x)$

$V(x)_{BC} = C$

$V(0)_{BC} = 0$ $C = 0$

$V(x)_{BC} = 0$

CD
0 → 6

$W(x) = 0$

$V_{CD} = \int w(x) = C$

$V(x)_{CD} = C$

$V(0)_{CD} = -15^k$

$C = -15^k$

$V(x)_{CD} = -15^k$

$M(x)_{CD} = \int V(x)_{CD} = -15x + C$

$M(0)_{CD} = -100$

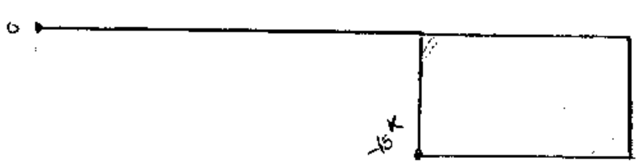
$-100 = -15(0) + C$

$M(x)_{CD} = -15x - 100$

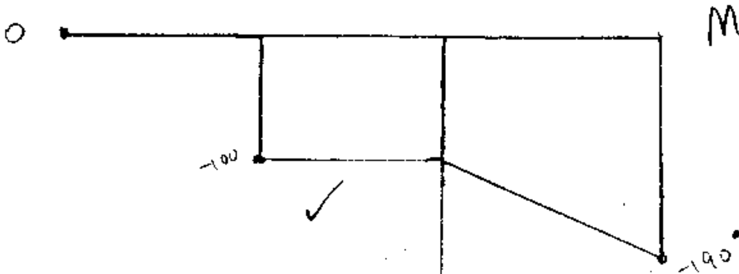
$M(6)_{CD} = -15(6) - 100$

$-90 - 100$

$M(6)_{CD} = -190$



V(x) kips



M(x) kip·ft.

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

José

+3

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 BABY!

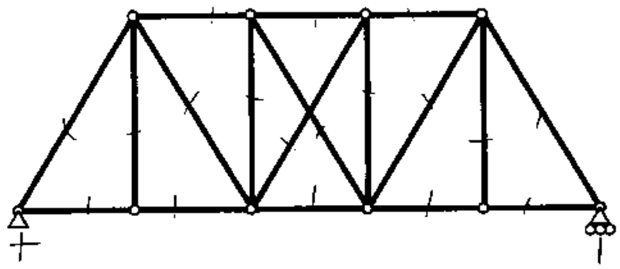
:)

93/100

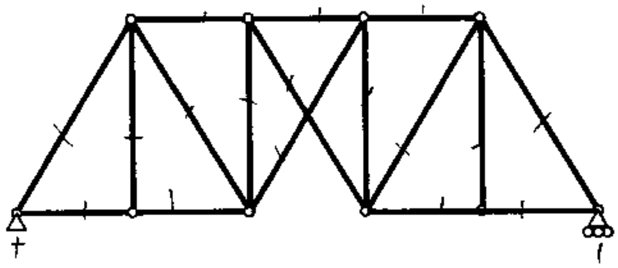
CE 461 – Structural Analysis, Fall 2006 **Name:**____________________________

EXAM No. 1

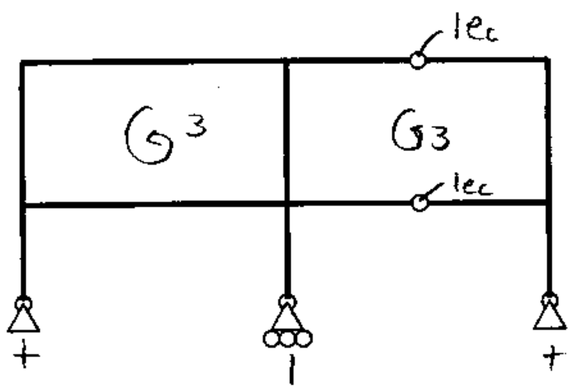
16 Excellent! 1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.



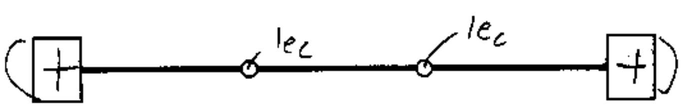
(a)
b+r   2J
18+3 > 2(10
21 > 20
STB ∴ 1° IND ✓



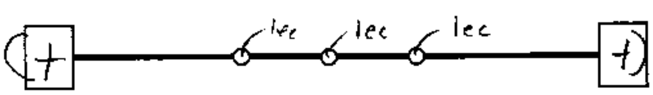
(b)
b+r   2J
17+3   2(10)
20 = 20
STB ∴ DET ✓



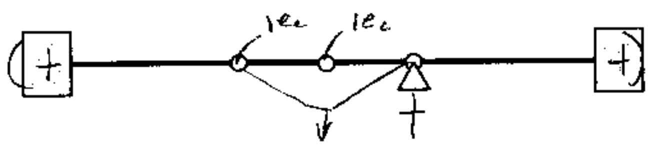
(c)
UNK   EQS
5+6 > 3+2
11 > 5
STB ∴ 6° IND ✓



(d)
UNK   EQS
6 > 3+2
STB ∴ 1° IND ✓



(e)
unstable
3pins in a line ✓

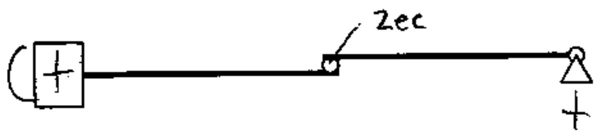


(f) UNK EQ

8 > 3+2

IND EFF STB

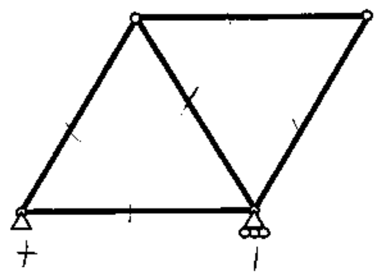
$\boxed{\text{UNSTB}}$ ✓



(g) UNK EQS

5 = 3+2

$\boxed{\text{STB} \therefore \text{DET}}$ ✓



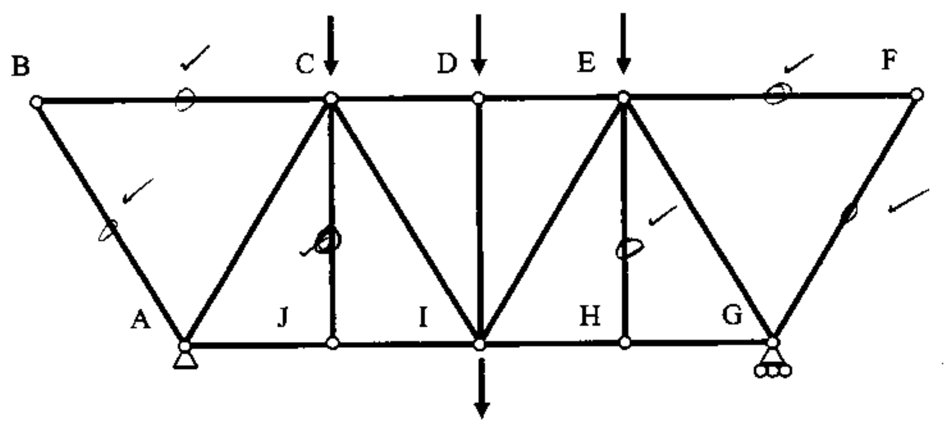
(h) b+r 2J

5+3 = 2(4)

$\boxed{\text{STB} \therefore \text{DET}}$ ✓

(9) 2. [9 pts.] Identify all zero force members in the following loaded truss:

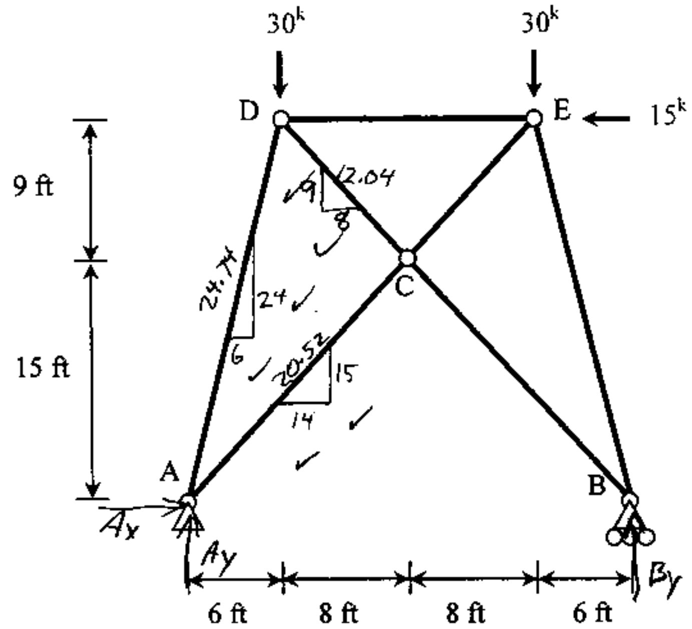
Good!



Members $\overline{CJ}$, $\overline{EH}$, $\overline{BC}$, $\overline{AB}$, $\overline{EF}$, & $\overline{GF}$

20

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.



$\circlearrowleft^+ \Sigma M_A = 0$

$B_y(28) - 30(22) - 30(6) + 15(24) = 0$

$B_y = \frac{(480)}{(28)} = \underline{17.14^k}$ ✓

$\Sigma F_y = 0$

$A_y + 17.14 - 30 - 30 = 0$

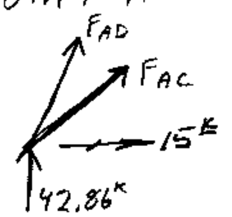
$\underline{A_y = 42.86^k}$ ✓

$\Sigma F_x = 0$

$A_x - 15 = 0$

$\underline{A_x = 15^k}$ ✓

Joint A



(-5)

$\Sigma F_y = 0$

$42.86 + F_{AD}\left(\frac{24}{24.74}\right) + F_{AC}\left(\frac{15}{20.52}\right) = 0$

$F_{AD}\left(\frac{24}{24.74}\right) + F_{AC}\left(\frac{15}{20.52}\right) = -42.86$

$\Sigma F_x = 0$

$F_{AD}\left(\frac{6}{24.74}\right) + F_{AC}\left(\frac{14}{20.52}\right) + 15 = 0$

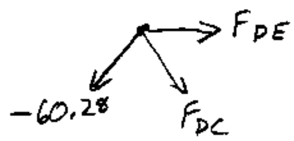
$F_{AD} = -F_{AC}(2.81)$

$-F_{AC}(2.81)\left(\frac{24}{24.74}\right) + F_{AC}\left(\frac{15}{20.52}\right) = -42.86$

$\boxed{F_{AC} = 21.45^k, \text{pos} \therefore (T)}$

$\therefore \boxed{F_{AD} = -60.28^k, \text{Neg} \therefore (C)}$

Joint D



$\Sigma F_y = 0$

$-(-60.28)\left(\frac{24}{24.74}\right) - F_{DC}\left(\frac{9}{12.04}\right) = 0$

$\boxed{F_{DC} = 78.22^k, \text{pos} \therefore (T)}$

$\Sigma F_x = 0$

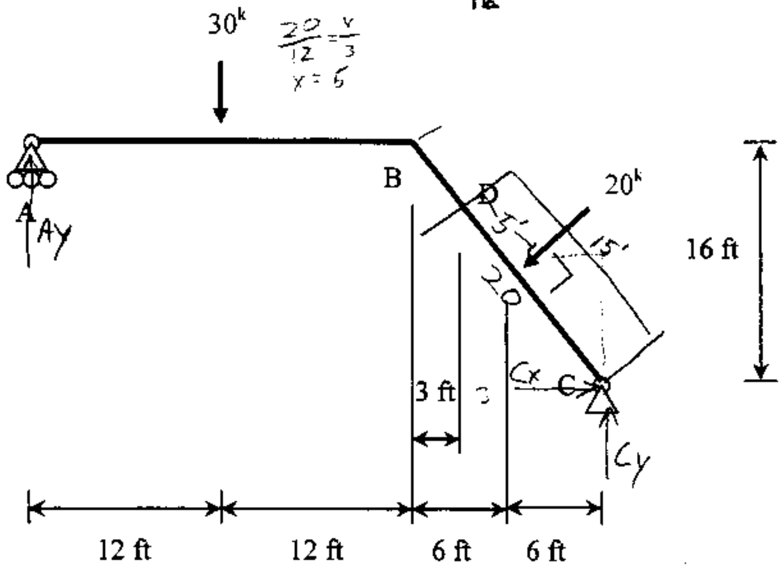
$-(-60.28)\left(\frac{6}{24.74}\right) + 78.22\left(\frac{8}{12.04}\right) + F_{DE} = 0$

$\boxed{F_{DE} = -37.36^k, \text{Neg} \therefore (C)}$

20

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.

$\frac{16}{12} = \frac{x}{6} \quad x = 8$



$\circlearrowleft + \sum M_C = 0$

$30(24) + 20(\frac{12}{20})(6) + 20(\frac{16}{20})(8) - A_y(36$

$\underline{A_y = 25.6^k}$ ✓

$\sum F_y = 0$

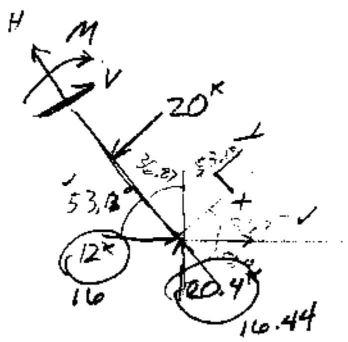
$25.6 - 30 - 20(\frac{16}{20}) + C_y = 0$ 12

$C_y = \underline{20.4^k}$ 16.44^k

$\sum F_x = 0$ -2.5

$C_x - 20(\frac{12}{20}) = 0$ 16

$C_x = 12^k$ 16^k



$\sum F_y = 0$

$V - 20 + 12(\sin(36.87)) + 20.4(\cos 36.87) = 0$ (cos, sin)

$\boxed{V = -3.52^k}$ x -2.5

$\sum F_x = 0$

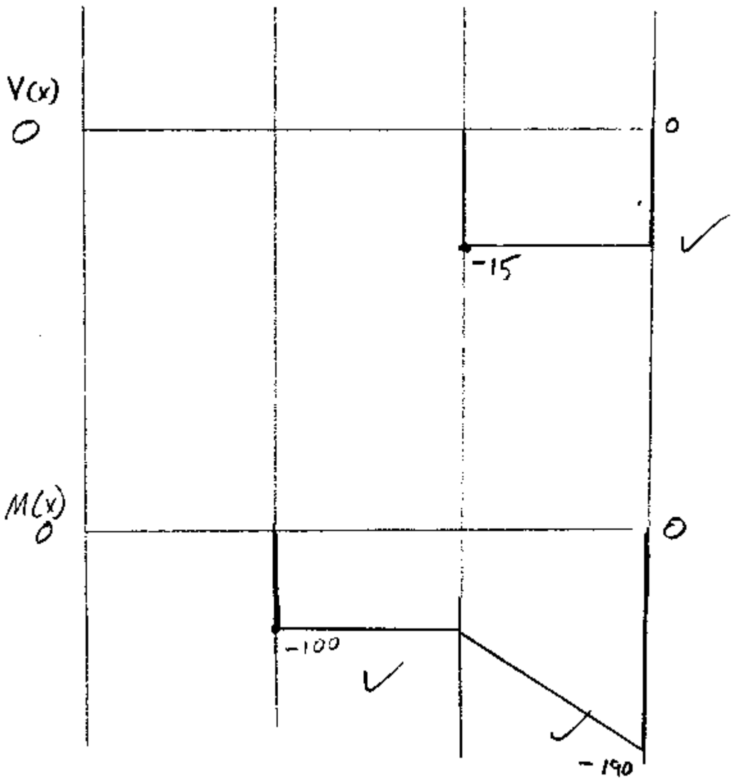
$-H + 12(\cos \ldots) - 20.4(\sin(36.87)) = 0$

$\boxed{H = -2.64^k}$

$\circlearrowright + \sum M_D = 0$

$M_D + 20(5) - 12(\sin(36.87))(15) - 20.4(\cos(36.87))15 =$

$\boxed{M_D = 252.7^{k\cdot ft}}$



$\omega = 0$

$V(x) = 0$

$M(x) = -100$

$\overline{CD}$ 0–6

$\omega = 0$

$V(x) = -15$

$M(x) = -15x - 100$

$-100 - 15(6) = M_D$

$M_D = 190$

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?

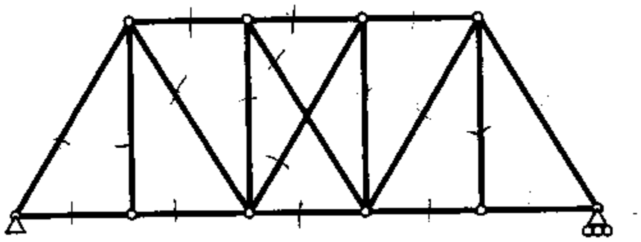
~~You Can't Do that,~~

96/100

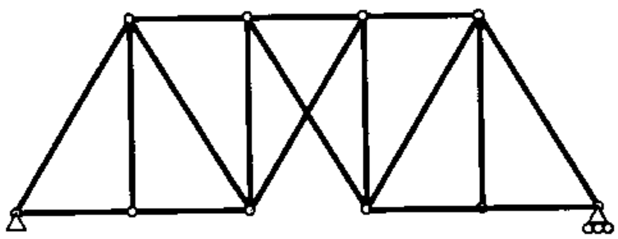
CE 461 – Structural Analysis, Fall 2006
EXAM No. 1

Name ______________________

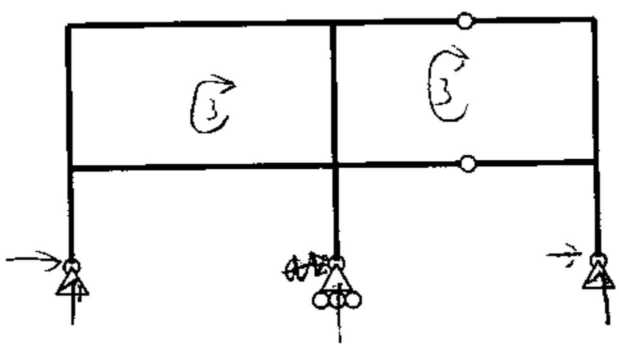
(12) 1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.



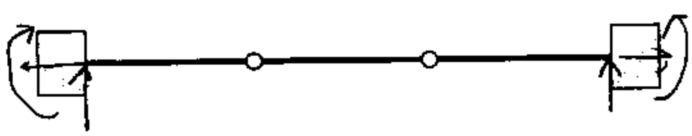
(a) $\frac{b+r}{18+3} > \frac{2j}{20}$
Structure is stable
∴ Indeterminate to 1° ✓



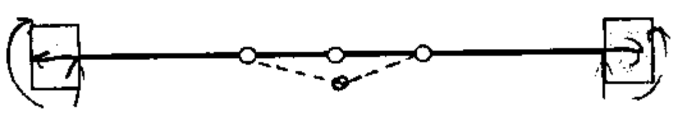
(b) $\frac{b+r}{17+3} = \frac{2j}{2(10)}$
Stable
∴ Determinate ✓



(c) unknowns: $5+3+3 = 11$ Equations: $3e_c + 2e_c = 5$
Stable
∴ Indeterminate to 6° ✓

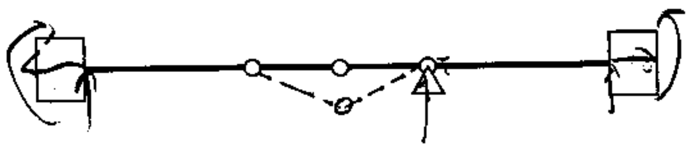


(d) unknowns: 6 equations: $3e_e + 2e_c$
Stable
∴ Indeterminate to 1° ✓



(e) unknowns: 6 eq: $4e_c + 3e_c$
Stable
∴ Determinate x UNSTABLE

-2



(f) unknowns 8   eqn $3e_e + 2e_c$

Stable

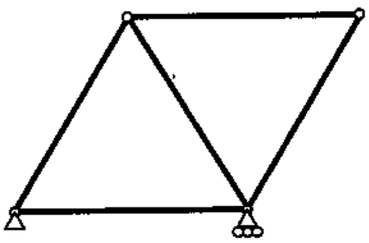
∴ Indeterminate to 3° ✗

unstable -2

(g) unknowns 5   eqn $3e_e + 2e_c$ (roller)

Stable

∴ Determinate ✓



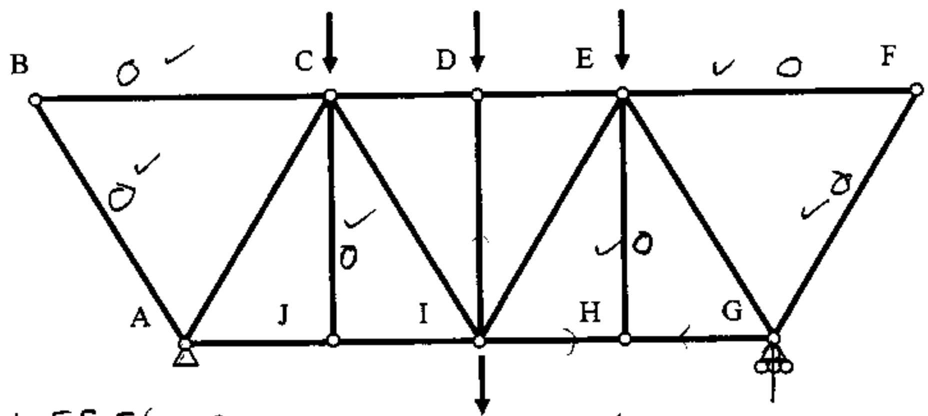
(h) $b+r = 2j$

$5+3 = 2(4)$

Stable

∴ Determinate ✓

(9) 2. [9 pts.] Identify all zero force members in the following loaded truss:

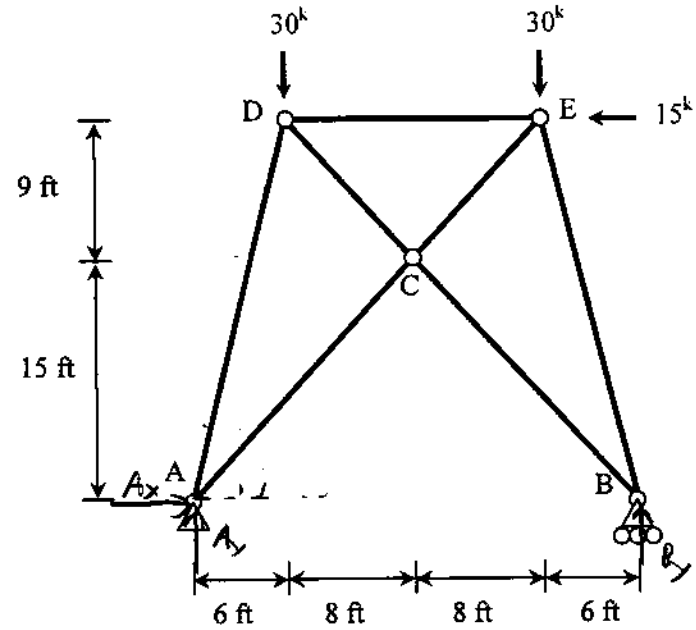


BC, BA, EF, EG = 0 - 2 bars to an unloaded joint

CJ, EH = 0 - 1 non collinear bar to an unloaded joint

25

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

$\Sigma F_x = 0$

$A_x = 15\ K$ ✓

$\Sigma M_A = 0$

$B_y \cdot 28ft + 15k \cdot 24ft - 30k \cdot 22ft - 30\ K \cdot 6ft = 0$

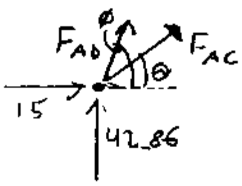
$B_y = 17.14\ kip$ ✓

$\Sigma F_y = 0$

$17.14\ kip + A_y - 30 - 30 = 0$

$A_y = 42.86\ kip$ ✓

Joint A



$\theta = \tan^{-1}\left(\frac{15}{14}\right) = 46.97°$

$\phi = \tan^{-1}\left(\frac{24}{6}\right) = 75.96°$

$\Sigma F_x = 0$

$15 + F_{AC}\cos 46.97° + F_{AD}\cos 75.96 = 0$

$\Sigma F_y = 0$

$42.86 + F_{AC}\sin 46.97° + F_{AD}\sin 75.96 = 0$

Solve w/ matrix

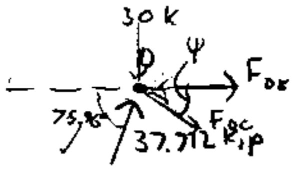
$$\begin{bmatrix} 0.7311 & 0.97014 \\ 0.6823 & 0.2425 \end{bmatrix} \quad \begin{matrix} -42.86 \\ -15 \end{matrix}$$

$$\begin{bmatrix} 0.7311 & 0.97014 \\ 0 & -0.6629 \end{bmatrix} \quad \begin{matrix} -42.86 \\ 25 \end{matrix}$$

∴ $F_{AC} = -8.581\ kip$ ∴ Comp. ✓

$F_{AD} = -37.712\ kip$ ∴ Comp ✓

Joint D



$\psi = \tan^{-1}\left(\frac{9}{8}\right) = 48.366°$

$\Sigma F_y = 0$

$37.712 \sin(75.96) - 30 - F_{DC} \sin(48.366) = 0$

$\underline{F_{DC} = 9.10 \text{ kip } (T)}$

$\Sigma F_x = 0$

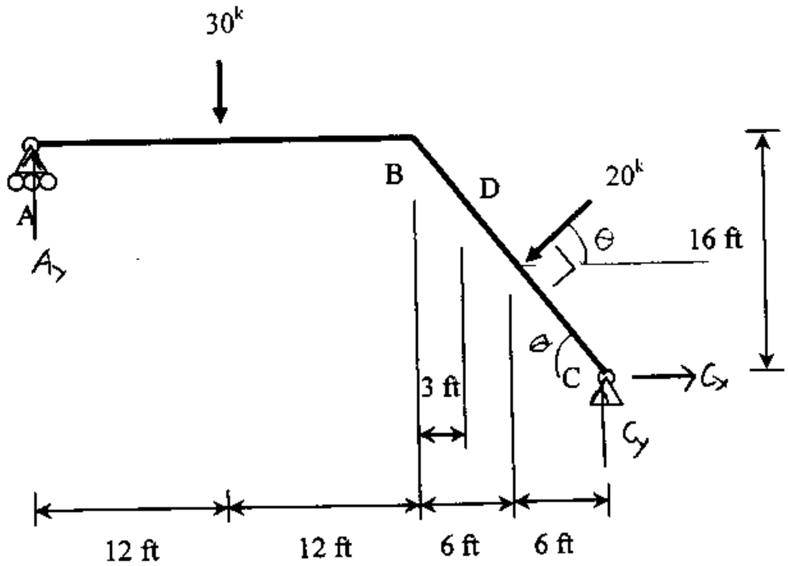
$37.712 \cos(75.96) + 9.1 \cos(48.366) + F_{DE} = 0$

$\underline{F_{DE} = -15.19 \text{ kip } \therefore (C)}$

Summary

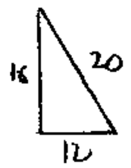
$F_{AC} = 8.58 \text{ kip } (C)$
$F_{AD} = 37.71 \text{ kip } (C)$
$F_{DC} = 9.1 \text{ kip } (T)$
$F_{DE} = 15.19 \text{ kip } (C)$

(22) 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.

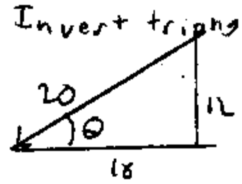


Angle:

$\sqrt{12^2+16^2} = 20$



Invert triangle for 20^k load



Overall rxn:

$\Sigma F_x = 0$

$C_x - 20\cos\theta = 0$

$C_x - \frac{16}{20} \cdot 20 = 0$

$C_x = 16$ kip ✓

$\Sigma M_C = 0$ $\quad 20^k$ load is ½ way up the 20 ft member BC ∴ $d_{F+C} = 10$ ft

$-A_y \cdot 36\text{ft} + 30\text{k} \cdot 24\text{ft} + 20\text{k} \cdot 10\text{ft} = 0$

$A_y = 25.556$ kip ✓

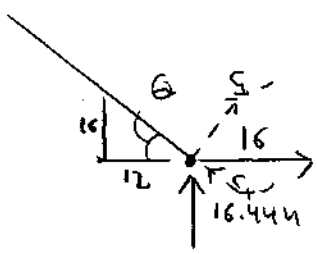
$\Sigma F_y = 0$

$A_y - 30 - \frac{12}{20} \cdot 20 + C_y = 0$

$C_y = +16.444$ kip ✓

Break bar BC at D

Create local coordinate x' along axis of bar BC



$C_x' = 16 \cdot \cos\theta - 16.444 \cos(90-\theta)$

$= 16 \cdot \frac{12}{20} - 16.444 \cdot \frac{16}{20}$

$C_x' = -3.556$ kip ✓

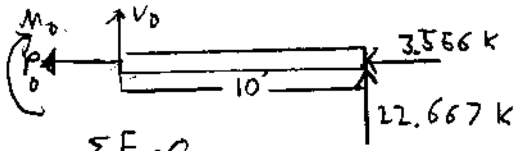
$C_y' = 16\sin\theta + 16.444\sin(90-\theta)$

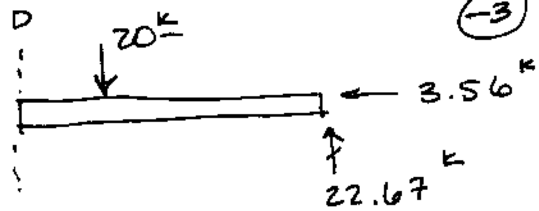
$C_y' = 16 \cdot \frac{16}{20} + 16.444\left(\frac{12}{20}\right)$

$C_y' = 22.667$ kip ✓

Break at D — ACK! Pt D is left of the 20^k load by another $5'$ ... oops

(-3)





$\Sigma F_x = 0$

$-3.556 - P_D = 0$

$P_D = -3.556$ kip $\therefore \longrightarrow$ (C)

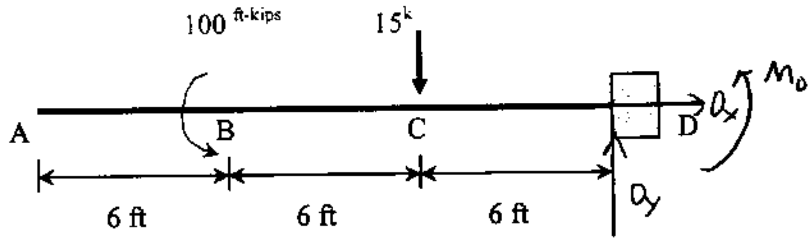
$\Sigma F_y = 0$

$22.667 + V = 0$

$V = -22.667$ kip $\therefore \downarrow$

25

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

$\Sigma F_x = 0;\ \underline{D_x = 0}$

$\Sigma F_y = 0$

$-15 + D_y = 0$

$\underline{D_y = 15\ k}$

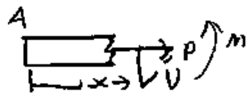
$\Sigma M_D = 0$

$100\ ft \cdot kip + 15\ k \cdot 6\ ft + M_D = 0$

$M_D = -190\ ft\text{-}kip,\ \therefore$ [CW]

Break Beam

$0 < x < 6\ ft$

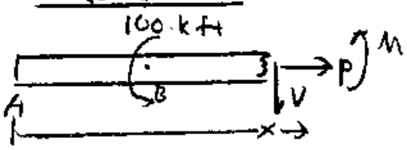


$\Sigma F_x = 0;\ P = 0$

$\Sigma F_y = 0;\ V = 0$

$\Sigma M_A = 0;\ M = 0$

$6 < x < 12\ ft$



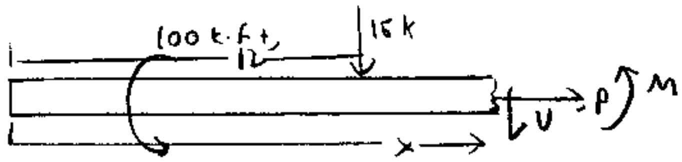
$\Sigma F_x = 0;\ P = 0 \qquad \Sigma F_y = 0;\ V = 0$

$\Sigma M_A = 0$

$100 + M = 0$

$\underline{M = -100\ ft \cdot kip}$

$12 < x < 18$ ft



$\Sigma F_x = 0$: $P = 0$

$\Sigma F_y = 0$

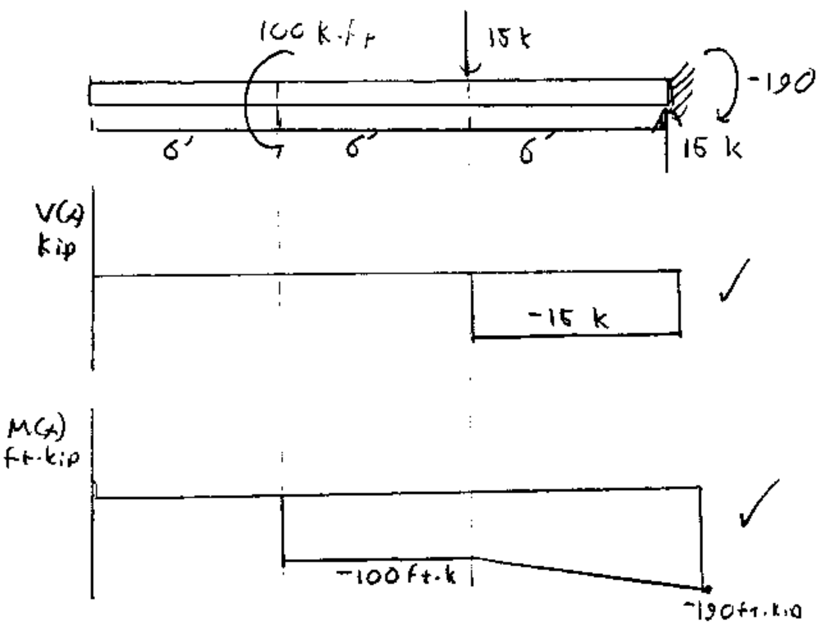
$-15 - V = 0$

$V = -15$ kip

$\Sigma M_A = 0$

$100 + M - 15\text{ k}\cdot 12\text{ ft} + 15\text{ k}\cdot x = 0$

$M = 80 - 15x$



Bonus A (3 pts.) – What was the most common name given to boys born in Texas from 1998-2003? José

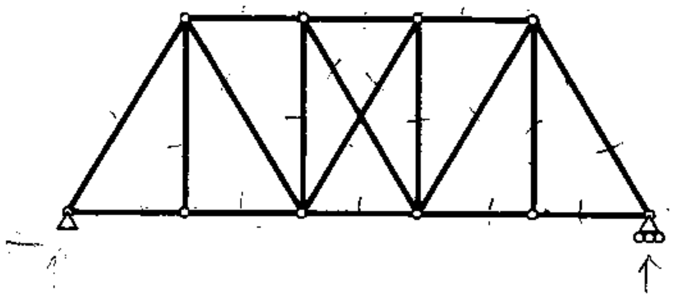
x3

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

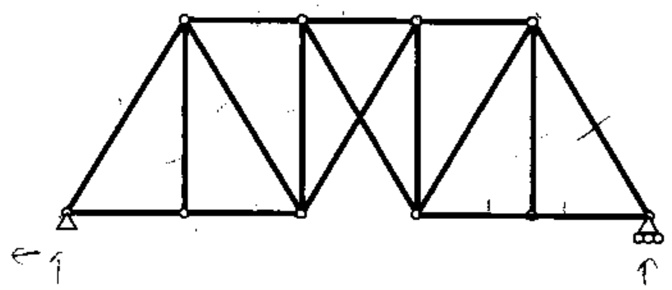
63/100

CE 461 – Structural Analysis, Fall 2006 **Name:**____________________
EXAM No. 1

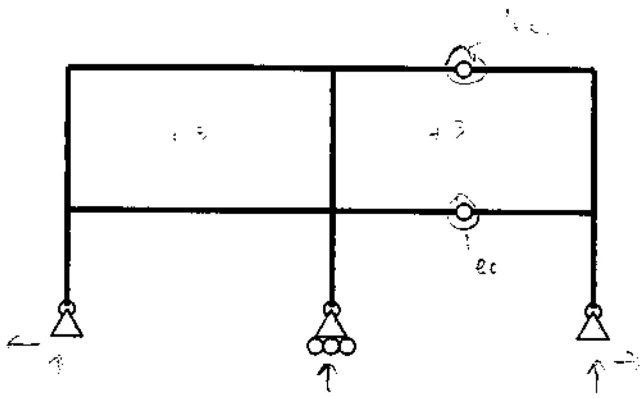
(12) 1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.



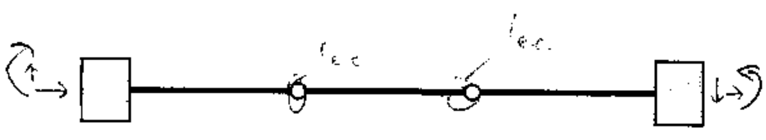
(a)
b = 18
r 3
j: 10
18+3 > 10(2)
21 > 20
Indeterminate iff stable, stable
∴ Indeterminate to 1° ✓



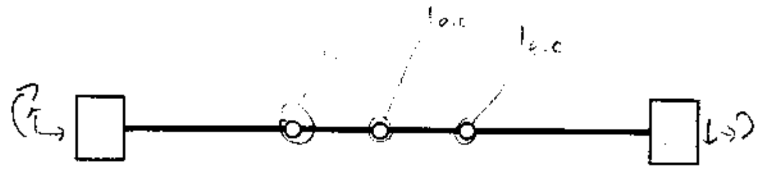
(b)
b=17, r=3, j=10
17+3 = 10(2)
Determinate iff stable
Stable ∴
Determinate ✓



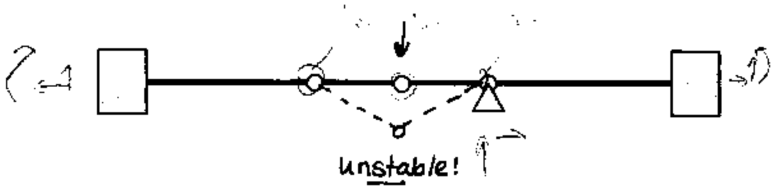
(c)
Unknowns Eq.
5+3+3 3+2e.c.
11 > 5
Indeterminate iff stable
Stable ∴
Indeterminate to 6° ✓



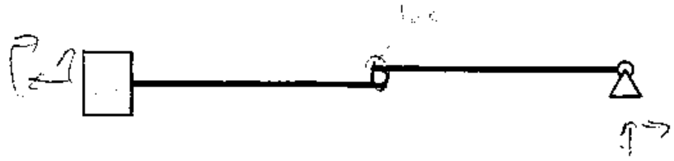
(d)
Unknowns Eq
6 3+2
6>5
Indeterminate iff stable, stable
Indeterminate to 1° ✓



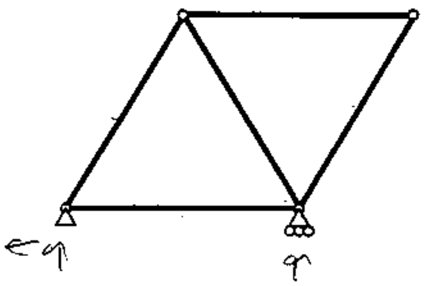
(e)
Unknowns Eq.
6 3+3
6=6
Determinate iff stable
Unstable ✓



(f) Unknowns Eq. 5 > 3
Indeterminate iff stable
Indeterminate to 2° ✗ −2

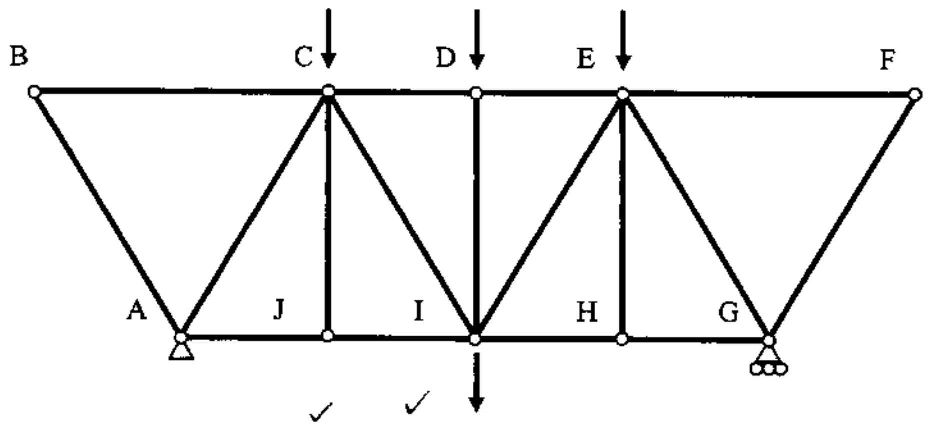


(g) Unknowns Eq.
5 > 4 Indeterminate iff stable
Indeterminate to ~~1°~~ 2° ✗ −2



(h) b = 5, r = 3, j = 4
8 = 8
Determinate iff stable
Determinate ✓

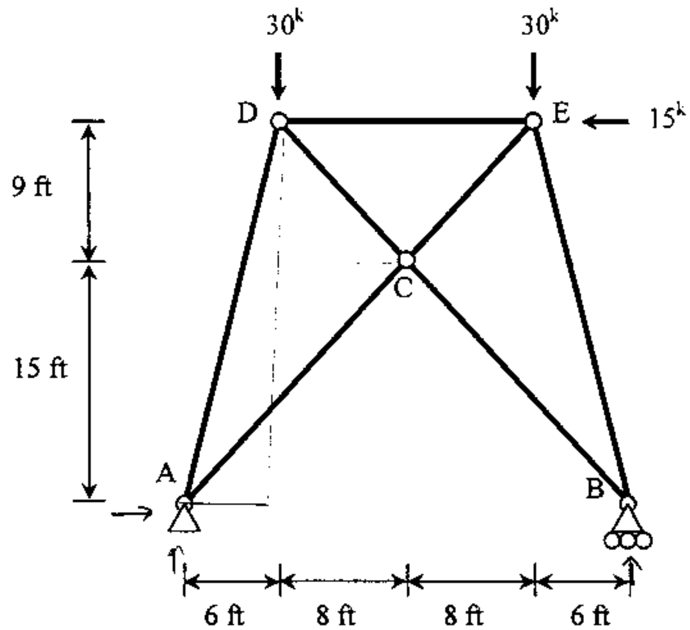
③ 2. [9 pts.] Identify all zero force members in the following loaded truss:



✓ ✓
CJ, EH AB, BC, EG, FG

Very good!

(25) 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.



$\circlearrowleft + \Sigma M_A = 0 = 30(6) + 30(22) - 15(24) - B_Y(28)$

$B_Y = 17.14$ ✓

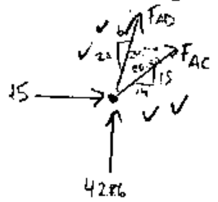
$\uparrow + \Sigma F_y = 0 = -30 - 30 + 17.14 + A_Y$

$A_Y = 42.86$ ✓

$\xrightarrow{+} \Sigma F_x = 0 = -15 + A_x$

$A_x = 15$ ✓

Joint A



$+\uparrow \Sigma F_y: 0 = 42.86 + \frac{24}{24.74} F_{AD} + \frac{15}{20.52} F_{AC}$

$0.970 F_{AD} + 0.731 F_{AC} = -42.86$

$\xrightarrow{+} \Sigma F_x: 0 = 15 + \frac{6}{24.74} F_{AD} + \frac{14}{20.52} F_{AC}$

$0.243 F_{AD} + 0.682 F_{AC} = -15$

$\boxed{F_{AD} = -37.75k \text{ neg } \therefore \text{ Compressive} \quad F_{AC} = -8.54k \text{ neg } \therefore \text{ Compressive}}$

F_{AD} F_{AC} 24.74, 20.52

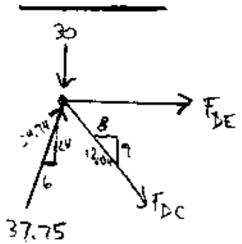
$F_{AD} = -44.19 - 0.754 F_{AC}$

$-10.74 - 0.183 F_{AC} + .682 F_{AC} = -15$

$0.499 F_{AC} = -4.26$

$.970 F_{AD} + (.731)(-8.54) = -42.86$

Joint D



$+\uparrow \Sigma F_y: 0 = -30 + 37.75 \frac{24}{24.74} - F_{DC} \frac{9}{12.04}$

$-30 + 36.62 - 0.748 F_{DC}$

$\boxed{F_{DC} = 8.85 \text{ pos } \therefore \text{ Tensile}}$

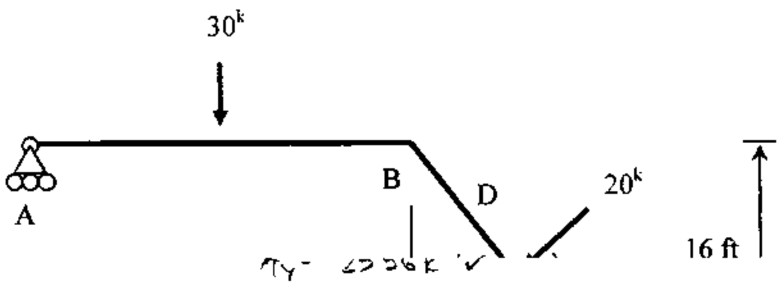
$\xrightarrow{+} \Sigma F_x: 0 = F_{DE} + \frac{6}{24.74}(37.75) + \frac{8}{12.04}(8.85)$

$F_{DE} + 9.16 + 5.88$

$\boxed{F_{DE} = -15.04 \text{ neg } \therefore \text{ Compressive}}$

13

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.



$\Sigma F_y = 0 = -30 + 25.56 + C_y - 16$

$C_y = 20.44$ ✗

$C_x = ?$ (-5)

x = 34.07

Segment DC

where from? (-2)

$\frac{16}{12} = \frac{x}{9}$

x = 12

25.55 ✗

34.07 ✗ (-5)

$+\uparrow \Sigma F_y = 0 = V_D - 20 + 34.07$

$\boxed{N_D = -25.55k \text{ neg } \therefore \rightarrow}$ ✗

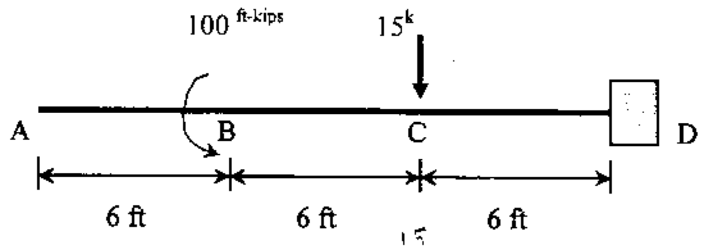
x = 25.55

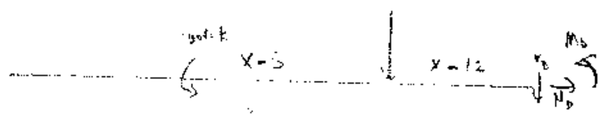
$\circlearrowleft + \Sigma M_D = 0 = M_D + 20(5) - 34.07(15)$

$\boxed{M_D = 411.05 \text{ ft·k pos. } \therefore \circlearrowright}$ ✗

10

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.





$+\uparrow \Sigma F_y = 0 = -V_D - 15$

$V_D = -15$ neg ∴ ↑

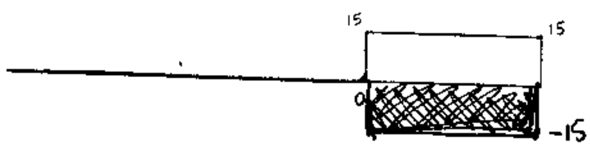
$\rightarrow \Sigma F_x = 0 = N_D$

$\circlearrowleft \Sigma M_D = 0 = -M_D - 15(x-12) - 100$

$M_D = -15x + 180 - 100$

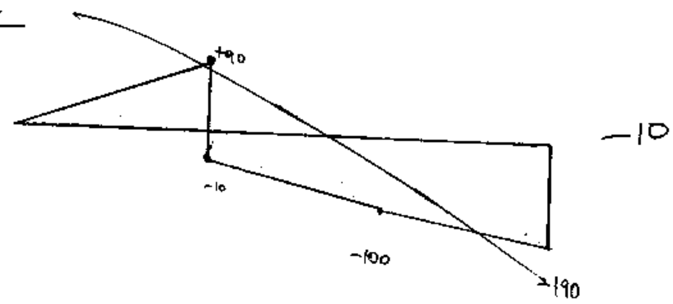
$M_D = -15x + 80$

SHEAR



-5

Moment



$M_@ 18 \rightarrow -15(18)+80 = -190$

$M_@ 12 \rightarrow -15(12)+80 = -100$

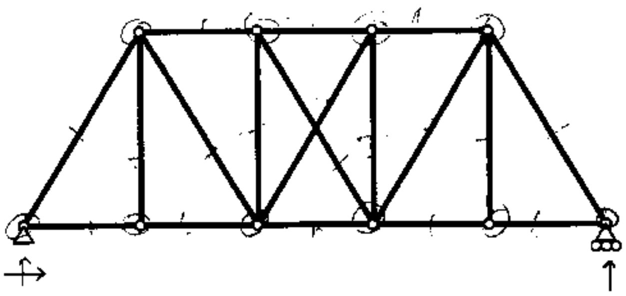
$M_@ 6 \rightarrow -15(6)+80 = -10$

$-10 + 100 = 90$

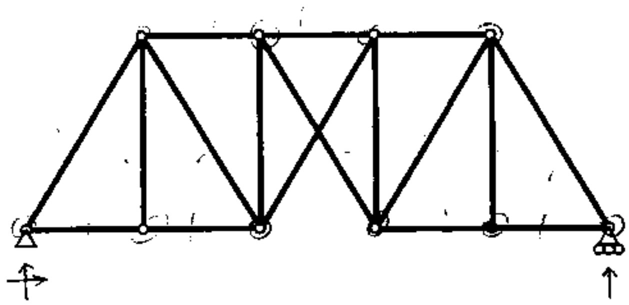
95.5 / 100

CE 461 – Structural Analysis, Fall 2006 **Name:**____________________________
EXAM No. 1

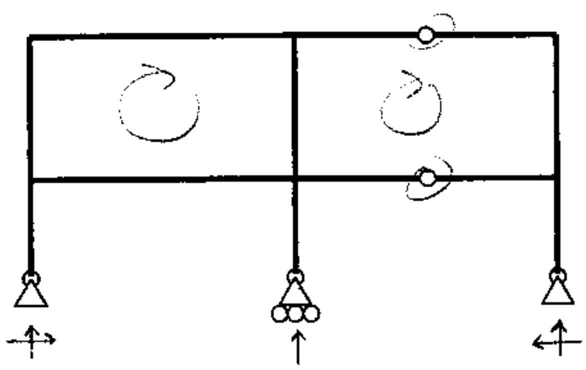
(12) 1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.



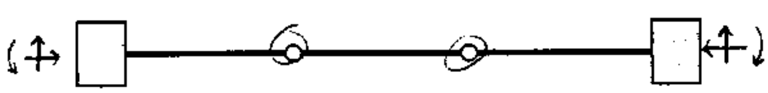
(a)
UNKS: 18+3 — EQNS: 2(10)
21 > 20
1° INDET IFF STABLE
STABLE ∴ 1° INDET ✓



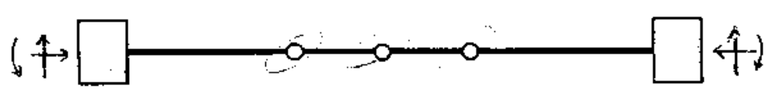
(b)
UNKS: 17+3 — EQNS: 2(10)
20 = 20
DET IFF STABLE
STABLE ∴ DET ✓



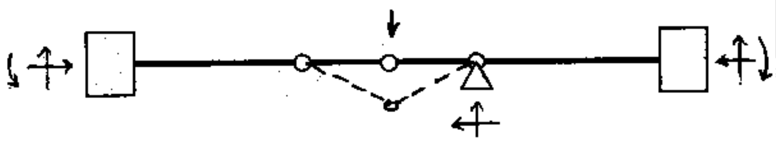
(c)
UNKS: 5+6 — EQNS: 3+2
11 > 5
6° INDET IFF STABLE ✓
STABLE ∴ 6° INDET



(d)
UNKS: 6 — EQNS: 3+2
6 > 5
1° INDET IFF STABLE
STABLE ∴ 1° INDET ✓

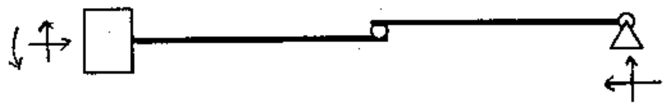


(e)
UNKS: 6 — EQNS: 3+3
6 = 6
DET IFF STABLE
UNSTABLE ✓

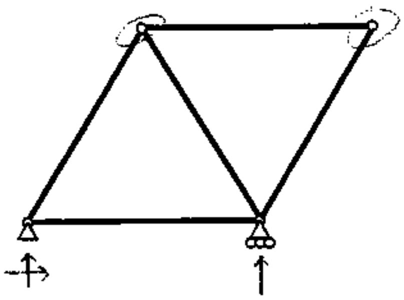


(f)
UNKS — EQNS
$3+2$ ∴ UNSTABLE
$8 > 5$
3° INDET IF STABLE
STABLE ∴ 3° INDET ✗

−2



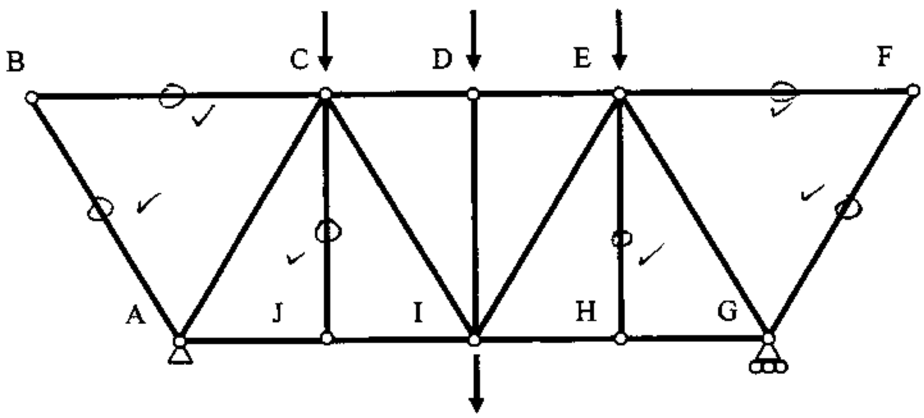
(g)
UNKS — EQNS
5 — $3+2$
$5 = 5$
DET IFF STABLE
STABLE ∴ DET ✓



(h)
UNKS — EQNS
3 — $3+2$
$3 < 5$
UNSTABLE ✗

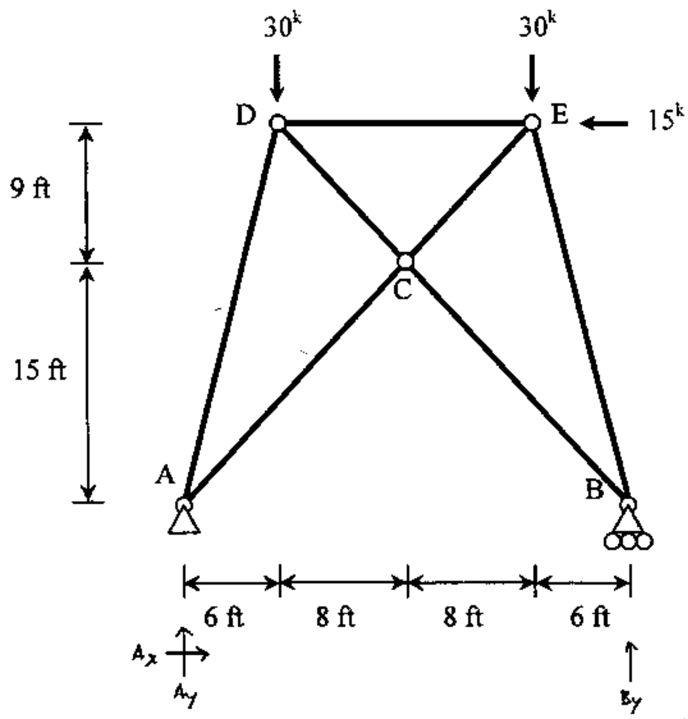
−2

(9) 2. [9 pts.] Identify all zero force members in the following loaded truss:



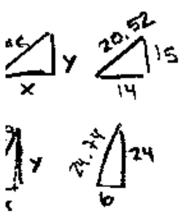
ZERO FORCE MEMBERS
AB
BC
CJ
EH
EF
GF

21.5 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.



$\circlearrowleft + \Sigma M_A = 0 = -(30^k)(6ft) - (30^k)(22ft) + (15^k)(24ft) + (B_y)(28ft)$

$\therefore B_y = 17.14^k$, pos $\therefore \uparrow$ ✓



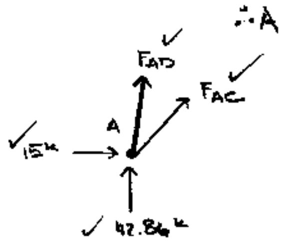
$\rightarrow + \Sigma F_x = 0 = A_x - 15^k$

$\therefore A_x = 15^k$, pos $\therefore \rightarrow$ ✓

$\uparrow + \Sigma F_y = 0 = A_y - 30^k - 30^k + B_y$

$= A_y - 60^k + 17.14^k$

$\therefore A_y = 42.86^k$, pos $\therefore \uparrow$ ✓



$\rightarrow + \Sigma F_x = 0 = 15^k + F_{AD}\left(\frac{6}{24.74}\right) + F_{AC}\left(\frac{14}{20.52}\right)$

$F_{AD} = \left(-15^k - F_{AC}\left(\frac{14}{20.52}\right)\right)\left(\frac{24.74}{6}\right)$

$\uparrow + \Sigma F_y = 0 = 42.86^k + F_{AD}\left(\frac{24}{24.74}\right) + F_{AC}\left(\frac{15}{20.52}\right)$

$0 = 42.86^k + \left(-15^k - F_{AC}\left(\frac{14}{20.52}\right)\right)\left(\frac{24.74}{6}\right) + F_{AC}\left(\frac{15}{20.52}\right)$

$0 = 42.86^k - 61.85^k - 2.813 F_{AC} + 0.731 F_{AC}$ $\Rightarrow$

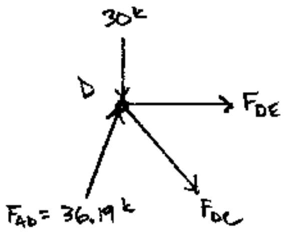
$$\boxed{\therefore\ F_{AC} = -9.12^k,\ \text{NEG}\ \therefore \swarrow\ (\text{COMP})}$$

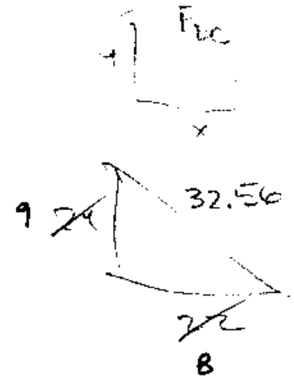
8.58^k C

$$F_{AD} = \left(-15^k - F_{AC}\left(\tfrac{14}{20.52}\right)\right)\left(\tfrac{-24.74}{6}\right)$$ MATH (-1)

$$\boxed{\therefore\ F_{AD} = -36.19^k,\ \text{NEG}\ \therefore \downarrow\ (\text{COMP})}$$

37.72^k





2.5

$$\uparrow + \sum F_y = 0 = 36.19^k\left(\tfrac{24}{24.74}\right) - 30^k - F_{DC}\left(\tfrac{24}{32.56}\right)$$

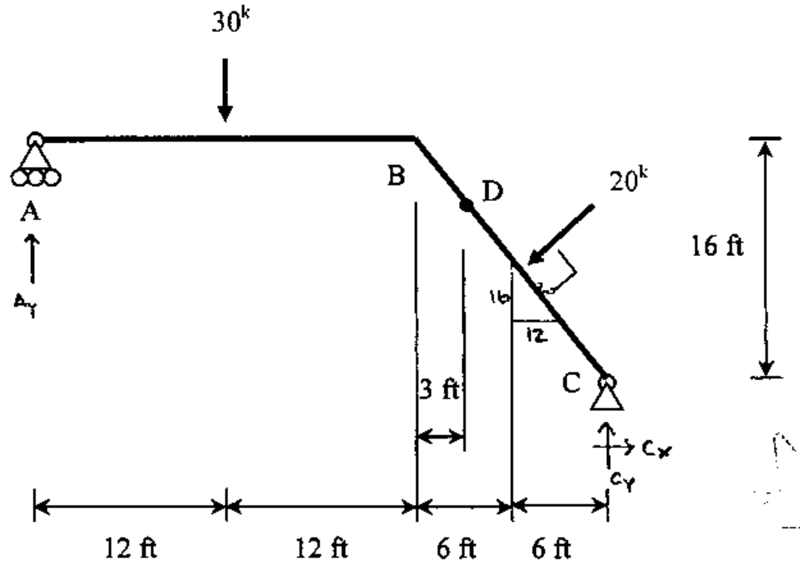
$$\boxed{\therefore\ F_{DC} = 6.93^k,\ \text{POS}\ \therefore \searrow\ (\text{TEN})}$$

$$\rightarrow + \sum F_x = 0 = 36.19^k\left(\tfrac{6}{24.74}\right) + F_{DE} + 6.93\left(\tfrac{22}{32.56}\right)$$

$$\boxed{\therefore\ F_{DE} = -13.46^k,\ \text{NEG}\ \therefore \leftarrow\ (\text{COMP})}$$

(25) 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.

Wonderful!!



$\frac{h}{6} = \frac{20}{12}$

$\rightarrow + \Sigma F_x = 0 = C_x - (20^k)(16/20)$

$C_x = 16^k$ ✓

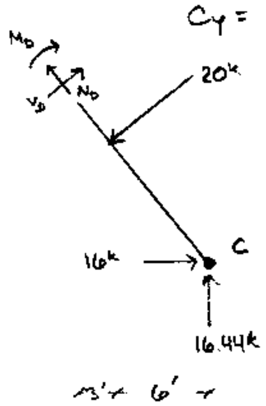
$\circlearrowleft + \Sigma M_C = 0 = (20^k)(10\ ft) + (30^k)(24\ ft) - (A_y)(36\ ft)$

$A_y = 25.56^k$ ✓

$\uparrow + \Sigma F_y = 0 = A_y - 30^k - 20^k(12/20) + C_y$

$= 25.56^k - 30^k - 20^k(12/20) + C_y$

$C_y = 16.44^k$ ✓



$\Sigma F_x = 0 = (V_D)(8/10) - N_D(6/10) - (20^k)(8/10) + 16^k$

$N_D = [0.8 V_D - 16^k + 16^k](10/6)$

$N_D = 4/3\, V_D$

$\Sigma F_y = 0 = (V_D)(6/10) + N_D(8/10) - (20^k)(6/10) + 16.44^k$

$= (V_D)(6/10) + (4/3 V_D)(8/10) - 12^k + 16.44^k$

$\boxed{\therefore V_D = -2.66^k,\ \text{NEG} \therefore}$ ✓

$N_D = 4/3\, V_D = 4/3\,(-2.66^k)$

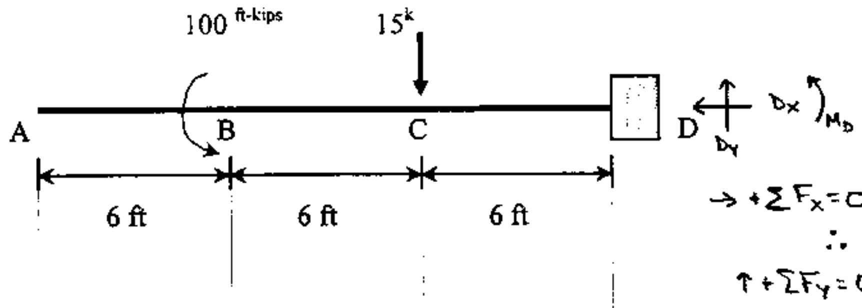
$\boxed{\therefore N_D = -3.55^k,\ \text{NEG} \therefore}$ ✓

$\Rightarrow$

$\circlearrowleft + \Sigma M_D = 0 = -M_D - (20^k)(5ft) + (16.44^k)(9ft) + (16^k)(12ft)$

$\boxed{\therefore M_D = 239.96 \text{ k-ft}, \text{ pos } \therefore \curvearrowright}$ ✓

(25) 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.



$\rightarrow + \Sigma F_x = 0 = -D_x$

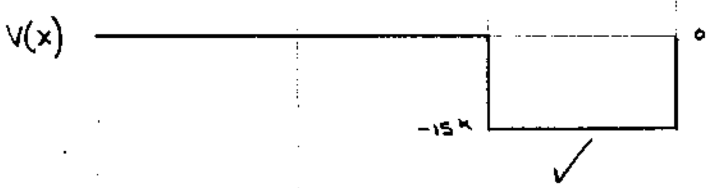
$\therefore D_x = 0$

$\uparrow + \Sigma F_y = 0 = D_y - 15^k$

$\therefore D_y = 15^k$

$\circlearrowleft + \Sigma M_D = 0 = M_D + (15^k)(6ft) + 100^{k \cdot ft}$

$\therefore M_D = -190^{k \cdot ft}$, NEG $\therefore \circlearrowright$



AB

$\omega(x) = 0$

$V(x) = \int -\omega(x)\,dx$

$= \int 0\,dx$

$V(x) = C_1$

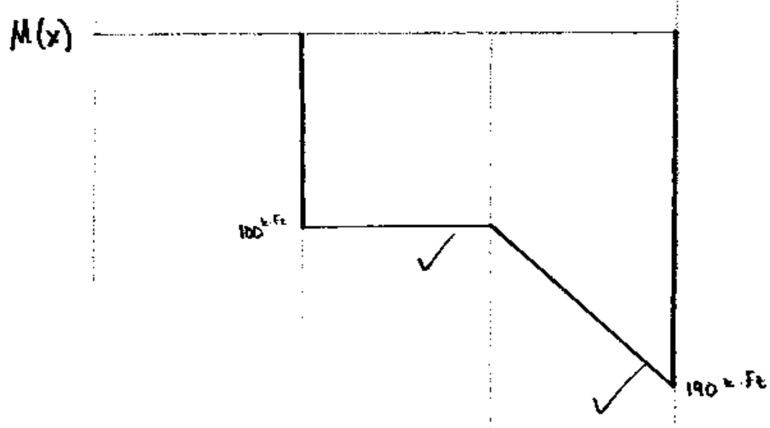
$V(0) = 0 = C_1 \quad \therefore C_1 = 0$

$V(x) = 0$

$M(x) = \int V(x)dx = \int 0 dx$

$M(x) = C_2$

$M(0) = 0 = C_2 \quad \therefore C_2 = 0$



BC

$\omega(x) = 0$

$V(x) = \int -\omega(x)\,dx$

$= \int 0\,dx$

$V(x) = C_3$

$V(0) = 0 = C_3 \quad \therefore C_3 = 0$

$V(x) = 0$

$M(x) = \int V(x)dx = \int 0 dx$

$M(x) = C_4$

$M(0) = -100 = C_4 \quad \therefore C_4 = -100$

CD

$\omega(x) = 0$

$V(x) = \int -\omega(x)dx$

$= \int 0 dx$

$V(x) = C_5$

$V(0) = -15 = C_5 \quad \therefore C_5 = -15$

$V(x) = -15$

$M(x) = \int V(x)dx = \int -15\,dx$

$M(x) = -15x + C_6$

$M(0) = -100 = -15(0) + C_6 \quad \therefore C_6 = -100$

$M(x) = -15x - 100$

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

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?

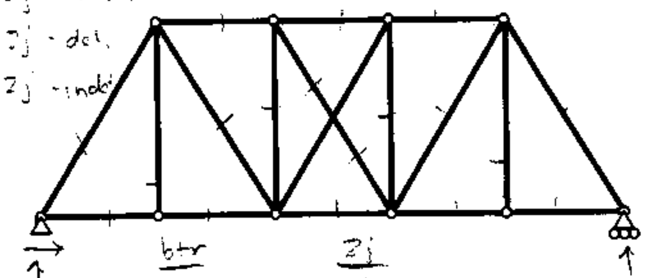
86.5/100 89/100 CRD 9/18

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

Name:__________
9/11/06

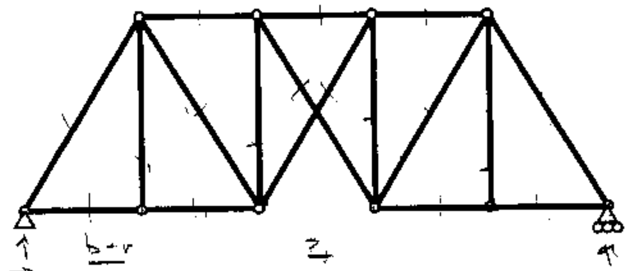
(12) 1. [16 pts.] Label the following structures as determinate, indeterminate, or unstable. If the structure is indeterminate, indicate the degree of indeterminacy.

$b+r < 2j$ - unst.
$b+r = 2j$ - det.
$b+r > 2j$ - indet.



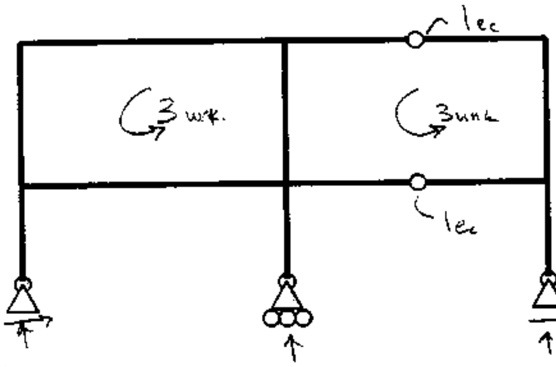
$b+r$ $2j$
$18+3 = 21 > 20 = 2(10)$

(a) Stable ∴ indeterminate - 1° ✓



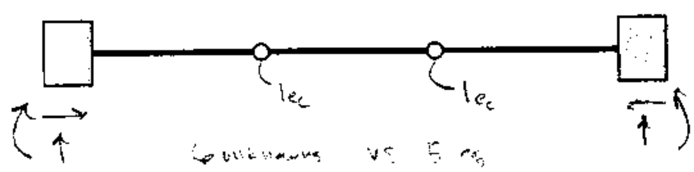
$b+r$ $2j$
$17+3 = 20 = 20 = 2(10)$

(b) Stable ∴ determinate ✓



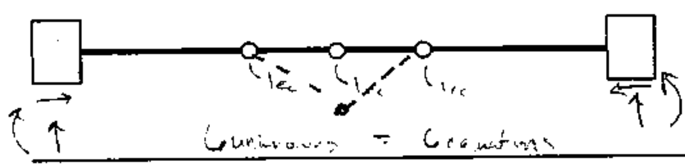
unknowns = 2+1+2+3+3 = 11   eqs = 3+2 = 5

(c) Stable ∴ indeterminate 6° ✓



6 unknowns vs 5 eqs

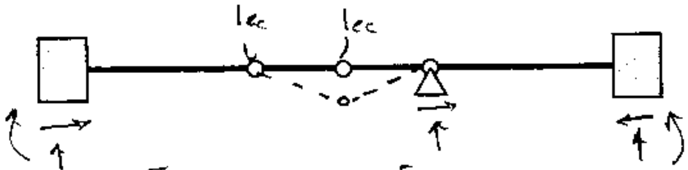
(d) Stable ∴ indeterminate 1° ✓



6 unknowns = 6 equations

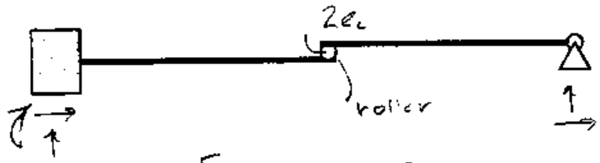
(e) UN-Stable ∴ determinate ✗ -2

as good as ground   as good as ground



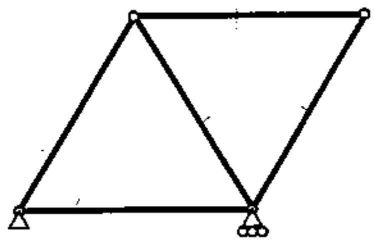
8 unknowsn vs 5 eq.

(f) ws- Stable ∴ indeterminate 3° -2



5 unknowns = 5 equations

(g) Stable ∴ determinate ✓

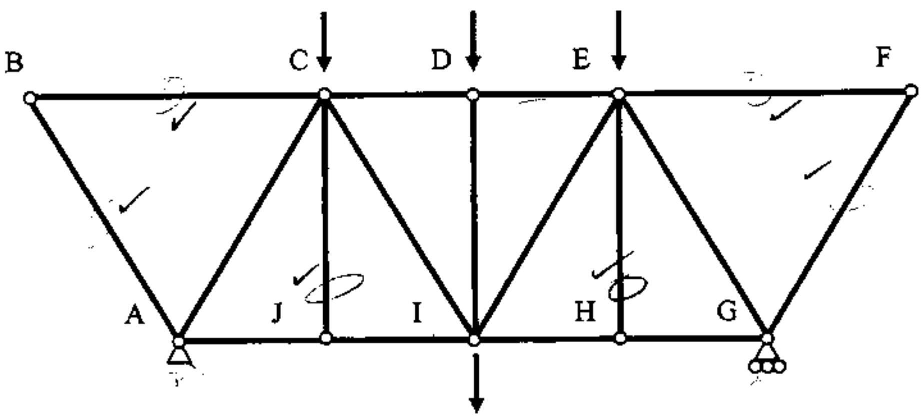


b+r 2j

5+3=8 = 8 = 2(4)

(h) stable ∴ determinate. ✓

(9) 2. [9 pts.] Identify all zero force members in the following loaded truss:

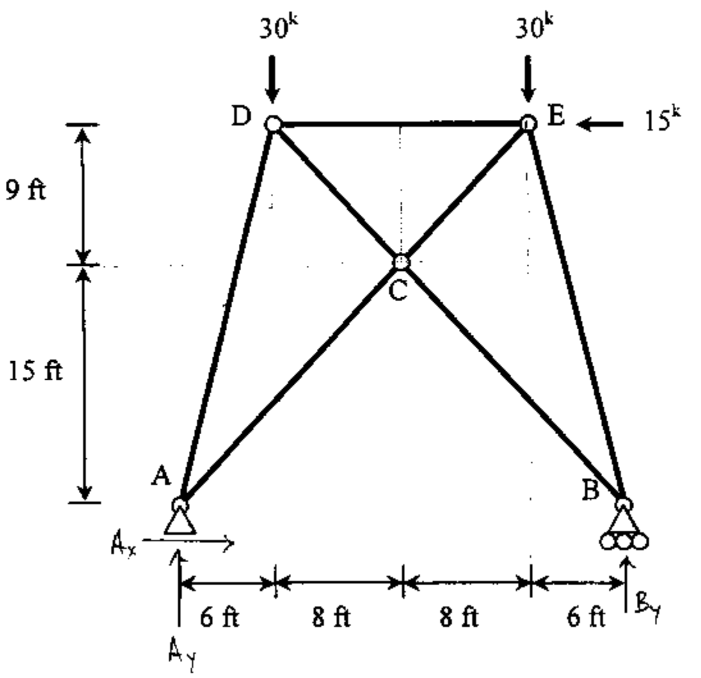


Zero Force Members: JC, HE, BC, EF, AB, FG

25

22.5

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

b+r   2j

7+3=10   2(5)=10

Stable ∴ determinate

Solve for external reactions

$\Sigma M_A = 0 = -30(6) - 30(22) + 15(24) + B_y(28)$

$B_y = 17.14^k$ ✓

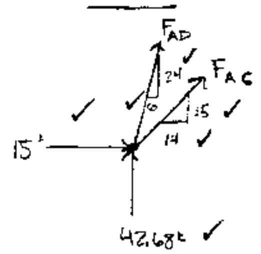
$\Sigma F_y = 0 = -30 - 30 + 17.14 + A_y$

$A_y = 42.86^k$ ✓

$\Sigma F_x = 0 = -15 + A_x$

$A_x = 15^k$ ✓

Joint A



$\sqrt{6^2+24^2} = 24.74$

$\sqrt{14^2+15^2} = 20.52$

$\Sigma F_x = 0 = 15 + \frac{6}{24.74} F_{AD} + \frac{14}{20.52} F_{AC}$

$0 = 15 + 0.2425 F_{AD} + 0.6823 F_{AC} \quad \Rightarrow \quad F_{AC} = -21.98 - 0.3554 F_{AD} \qquad (1)$

$\Sigma F_y = 0 = 42.68 + \frac{24}{24.74} F_{AD} + \frac{15}{20.52} F_{AC} \qquad (2)$

(1) → (2) $\quad 0 = 42.68 + 0.97 F_{AD} + 0.731(-21.98 - 0.3554 F_{AD})$

$-26.61 = 0.710 F_{AD}$

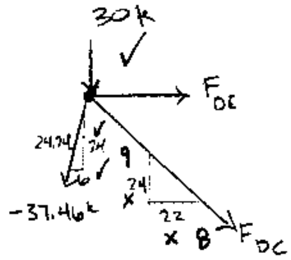
Solving using calculator

$\boxed{F_{AD} = -37.46^k \text{ or } 37.46^k \text{ in Compression}}$

$\boxed{F_{AC} = -8.67^k \text{ or } 8.67^k \text{ in Compression}}$

Joint D

$\sqrt{22^2+24^2} = 32.56$



-2.5

+2.5

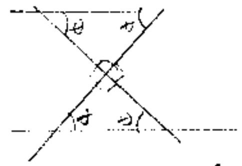
CRB
09/18/06

$\Sigma F_y = 0 = -30 - \left(-37.46\left(\frac{24}{24.74}\right)\right) - \frac{24}{32.56} F_{DC}$

$\boxed{F_{DC} = 8.6^k \text{ in Tension}}$

$\Sigma F_x = 0 = -\frac{6}{24.74}(-37.46) + F_{DE} + \frac{22}{32.56}(8.6)$

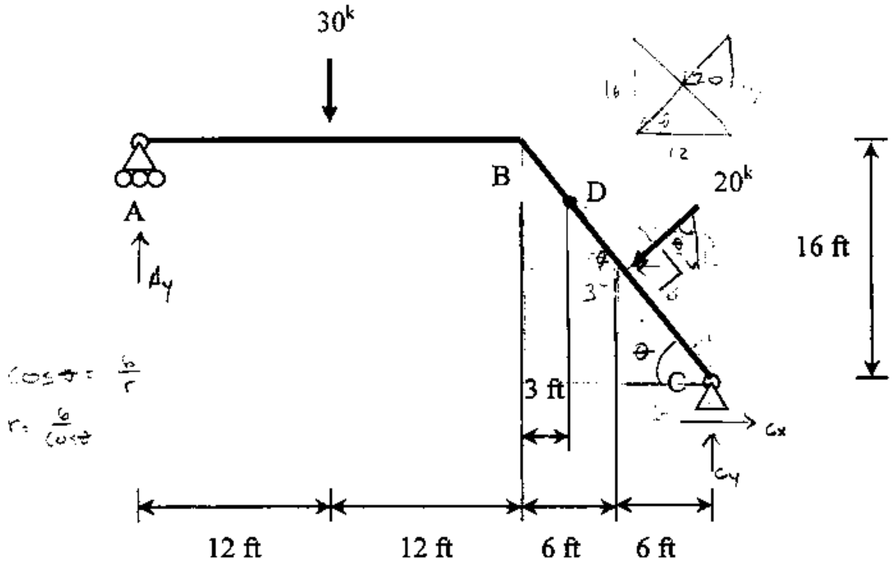
$\boxed{F_{DE} = -14.9^k \text{ or } 14.9^k \text{ in Compression}}$



18

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.

$\theta = \tan^{-1}\frac{16}{12} = 53.13°$



Stability:

3 unknowns = 3 equations

Stable ∴ determinate

$\Sigma M_C = 0 = +30(12) + 20\left(\frac{6}{\cos\theta}\right) - A_y(36)$

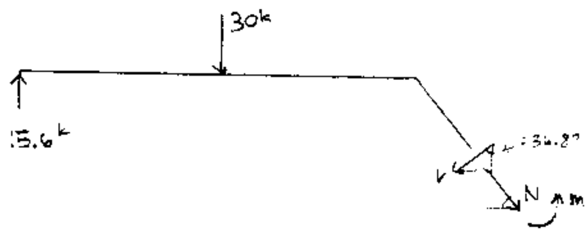
$A_y = 15.6^k$ × 25.56^k

$\Sigma F_y = 0 = 15.6 - 30 - 20(\cos\theta) + C_y$

$C_y = 26.4^k$ × 16.44^k

-5

$\Sigma F_x = 0 = C_x - 20(\sin 53.13) = 16$ ✓



-2

$\Sigma F_x = 0 = -V\sin\cancel{36.87°}\,53.13 + N\cos 53.13$

$0 = -0.60V + 0.60N$

$.8V = .6N$

$V = 0.75N$ (1)

$\Sigma F_y = 0 = 15.6 - 30 - V\cos 53.13 - N\sin 53.13$

$0.6V + 0.8N = -14.4$ (2)

(1) → (2) $0.6(.75N) + 0.8N = -14.4$

$\boxed{N = -11.52^k \text{ or } 11.52^k}$ ×

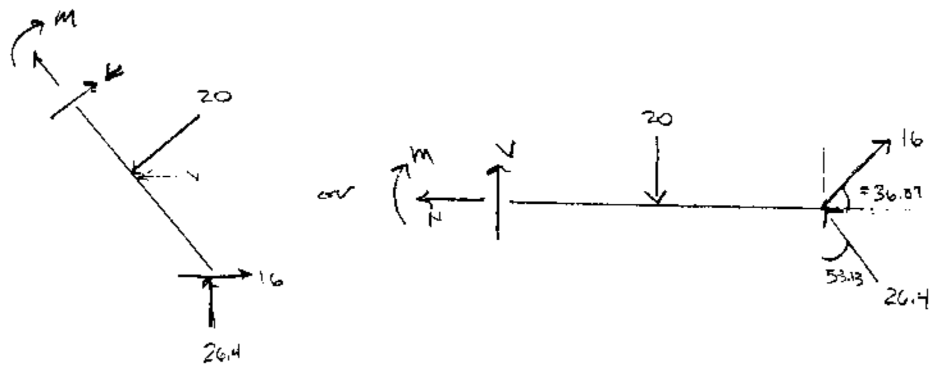
$V = 0.75(-11.52)$

$\boxed{V = -8.64^k \text{ or } 8.64^k}$ ×

$\Sigma M_D = 0 = M + 30(15) - 15.6(27)$

$\boxed{M = -28.8 \text{ ft·kips or } 28.8 \text{ ft·kips}}$

Check



$\Sigma F_x = 0 = -N + 16(\cos 36.87) - 26.4(\sin 53.13)$

$N = -8.3^k$ or $8.3^k \rightarrow$

$\Sigma F_y = 0 = V - 20 + 26.4(\cos 53.13) + 16(\sin 36.87)$

$V = -5.44^k$ or $5.44^k \downarrow$

$\Sigma M_D = 0 = M + 20\left(\frac{3}{\cos 53.13}\right) - 16\sin(36.87) - 26.4(\cos 53.13)$

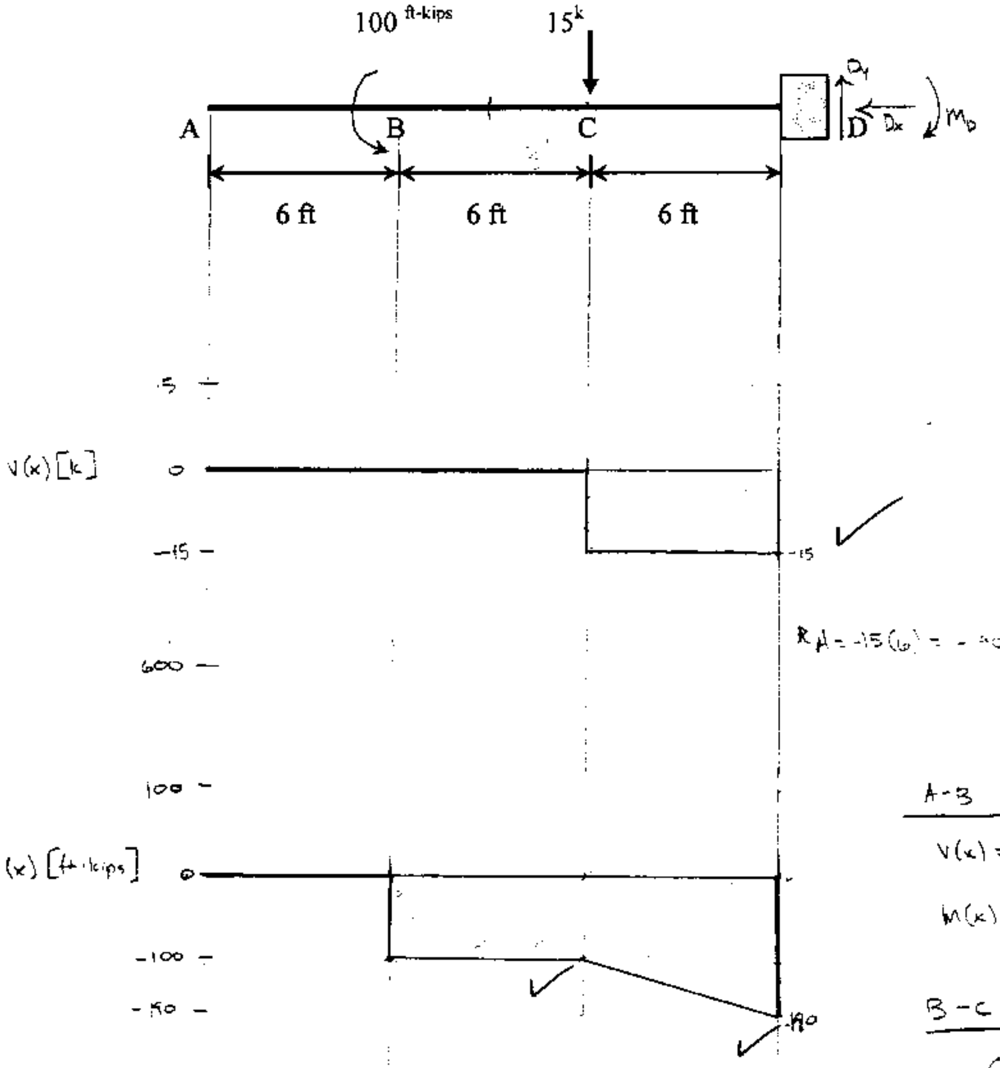
$M = -74.6$ ft.kip or 74.6 ft.kip

clockwise +

cc −

25

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.



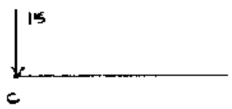
$\Sigma F_x = 0 = D_x$

$\Sigma F_y = 0 = -15 + D_y$

$D_y = 15^k$

$\Sigma M_D = M_D - 100\text{ ft kips} - 15(6)$

$M_D = 190$ ft kips



$R_A = -15(6) = -90$

A-B 0'-6'

$V(x) = \int w(x) = 0$

$M(x) = \int V(x) = 0$

B-C (0'-6')

$V(x) = \int -w(x) = 0$

$M(x) =$

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

Juan

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 shorts" hehe!!