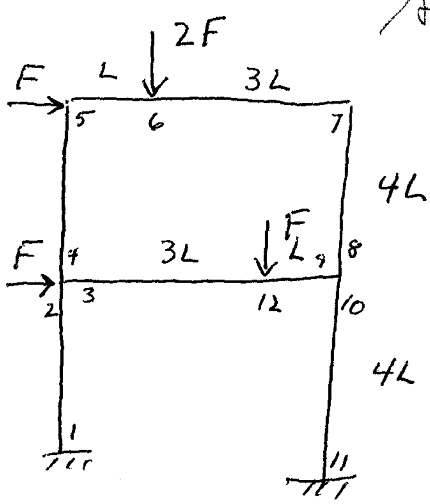
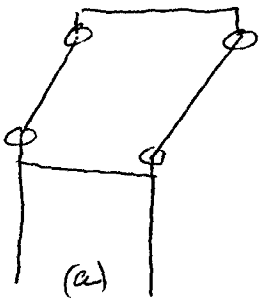
Solution Assgn 6

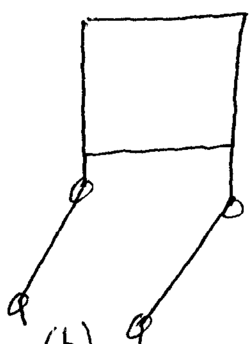




(a)

$$F(4L\theta) = M_o\theta(4)$$

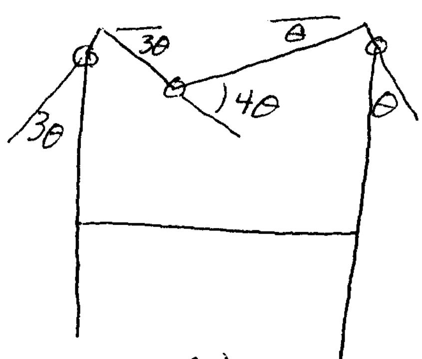
$$f^+ = 1$$



(b)

$$2F(4L\theta) = M_o\theta(4\times2)$$

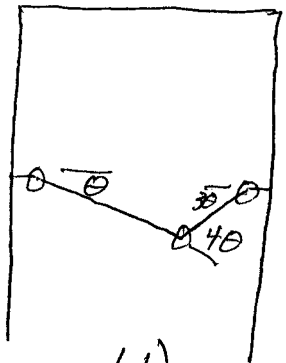
$$f^+ = 1$$



(c)

$$2F(3L\theta) = M_o\theta(3+4+1)$$

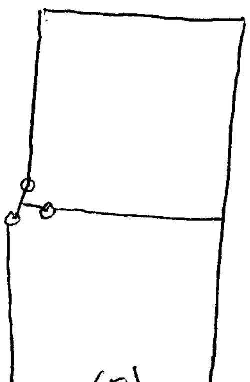
$$f^+ = \frac{4}{3}$$



(d)

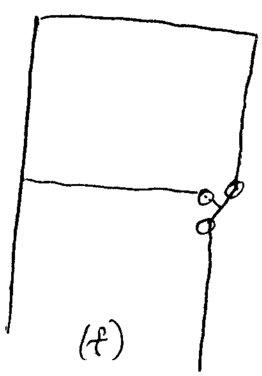
$$F(3L\theta) = 2M_0\theta(1+4+3)$$

$$f^+ = 16/3$$



(e)

(rotations exaggerated)

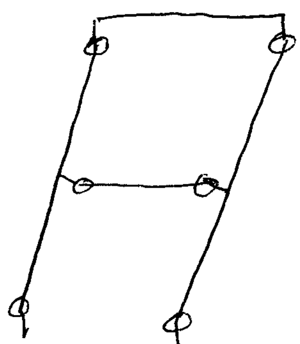


(f)

" "

(g) = (a) + (b) with no savings will also result in $f = 1$

(h) = (a) + (b) + (e) + (f) has savings, so will be better

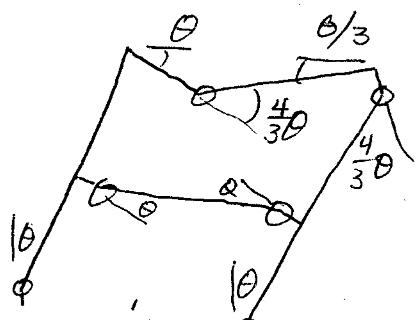


$$FL\theta(4+8) = M_0\theta(2+2+1+1+2+2)$$

$$f^+ = \frac{5}{6}$$

(h)

best panel is (h), best beam (c) : (i)

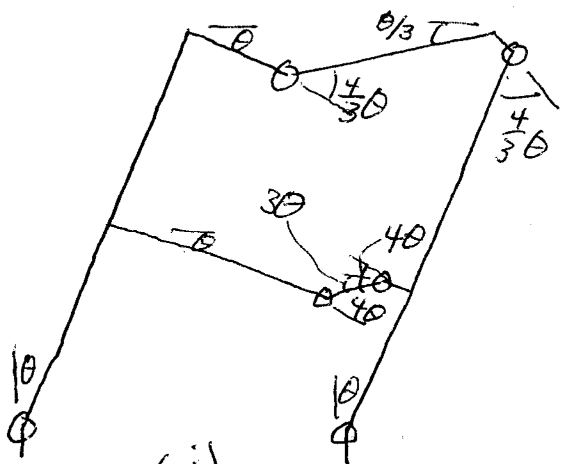


$$FL\theta(4+8+2) = M_0\theta\left(2+2+\tfrac{4}{3}+\tfrac{4}{3}+2+2\right)$$

$$f^+ = \frac{16}{21}$$

(i)

a mechanism involving the lower beam is unlikely since for (d) $f^+ = 16/3$ (very high)
but to make sure, consider (i) + (d) : (j)



(j)

$$FL\theta(4+8+2+3) =$$

$$= M_0\theta\left(2+\frac{4}{3}+\frac{4}{3}+8+8+2\right)$$

$$f^+ = \frac{4}{3}$$

(i) is best with $f^+ = 16/21$

To see if (i) is SA use virt work

(a) $-m_4 + m_5 - m_7 + m_8 = 4f = \frac{64}{21}$ ①

(b) $-m_1 + m_2 - m_{10} + m_{11} = 8f = \frac{128}{21}$ ②

(c) $-3m_5 + 4m_6 - m_7 = 6f = \frac{96}{21}$ ③

(d) $-m_3 + 4m_{12} - 3m_9 = 3f = \frac{48}{21}$ ④

(e) $-m_2 + m_3 + m_4 = 0$ ⑤

(f) $-m_8 - m_9 + m_{10} = 0$ ⑥

from (i) $m_1 = -2$

$m_3 = 2$

$m_6 = 1$

$m_7 = -1$

$m_9 = -2$

$m_{11} = 2$

from ④ $-2 + 4m_{12} + 6 = \frac{48}{21}$

$m_{12} = -\frac{3}{7}$ ok $(-2 < m_{12} < 2)$

from ③ $-3m_5 + 4 + 1 = \frac{96}{21}$

$m_5 = \frac{1}{7}$ ok

from ①

$-m_4 + \frac{1}{7} + 1 + m_8 = \frac{64}{21}$

$m_8 = m_4 + \frac{40}{21}$

from ⑤

$-m_2 + 2 + m_4 = 0$

$m_2 = m_4 + 2$

from ②

$$2 + (m_4 + 2) - m_{10} + 2 = \frac{128}{21}$$

$$m_{10} = m_4 - \frac{2}{21}$$

from ⑥

$$-\left(+m_4 + \frac{40}{21}\right) + 2 + \left(m_4 - \frac{2}{21}\right) \equiv 0 \quad \text{ok}$$

if:

$\lvert m_8 \rvert \leq 1$	$\lvert m_2 \rvert \leq 2$	$\lvert m_{10} \rvert \leq 2$
$-1 \leq m_4 + \frac{40}{21} < 1$	$-2 \leq m_4 + 2 \leq 2$	$-2 \leq m_4 - \frac{2}{21} \leq 2$
$-\frac{61}{21} \leq m_4 \leq -\frac{19}{21}$	$-4 \leq m_4 \leq 0$	$-\frac{40}{21} \leq m_4 \leq \frac{44}{21}$

also $\lvert m_4 \rvert < 1$

$$\therefore \quad \left.\begin{matrix} -61/21 \\ -84/21 \\ -40/21 \\ \rightarrow -1 \end{matrix}\right\} \leq m_4 \leq \left\{\begin{matrix} -19/21 \leftarrow \\ 0 \\ 44/21 \\ 1 \end{matrix}\right.$$

all conditions satisfied if $-1 \leq m_4 \leq -19/21$

$\therefore$ $\exists$ at least one SAF assoc. with (i)

$$\therefore \quad f^{\circ} = \frac{16}{21}$$