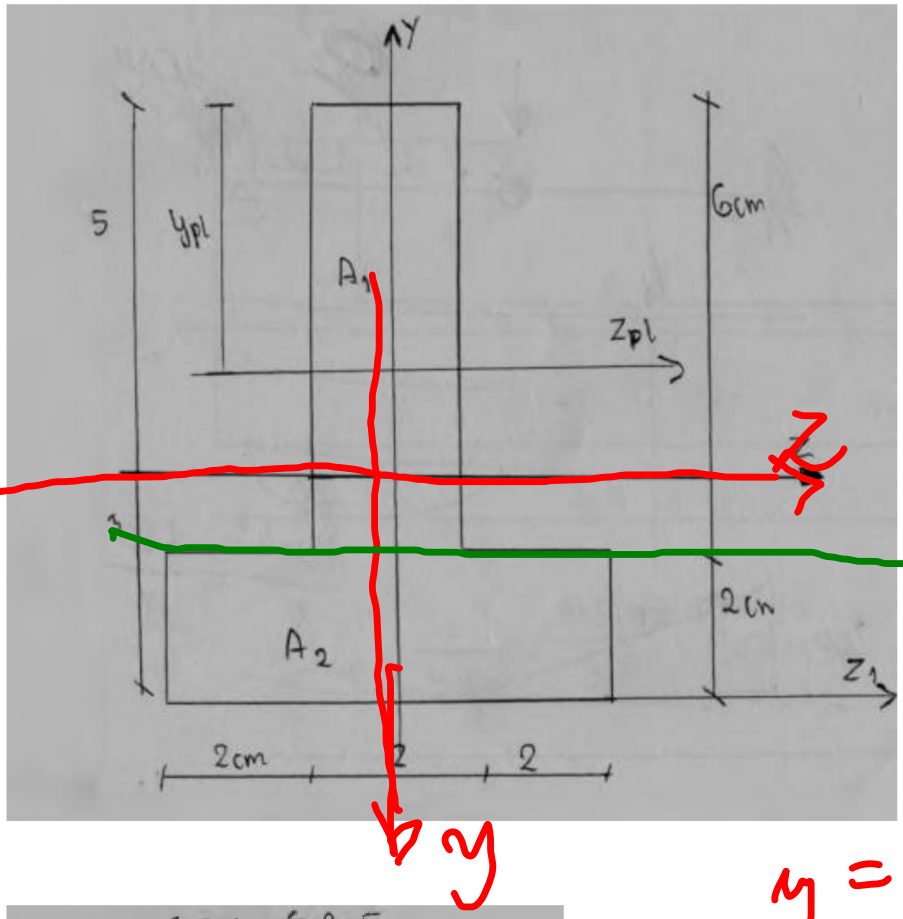
PRZYKŁAD1



$$y = \frac{6 \cdot 2 \cdot 1 + 6 \cdot 2 \cdot 5}{12 + 12} = 3\,cm$$

$$W_{sp} = \frac{136\,cm^4}{5\,cm} = 27{,}2\,cm^3$$

$A_1 = A_2 = 12\,cm^2$

$y_{pl} \cdot 2 = 12\,cm^2$

$y_{pl} = 6\,cm$

$$W_{pl} = |S_{z_{pl}^1}| + |S_{z_{pl}^2}|$$

$$W_{pl} = 2 \cdot 6 \cdot 3 + 6 \cdot 2 \cdot 1 = 48\,cm^3$$

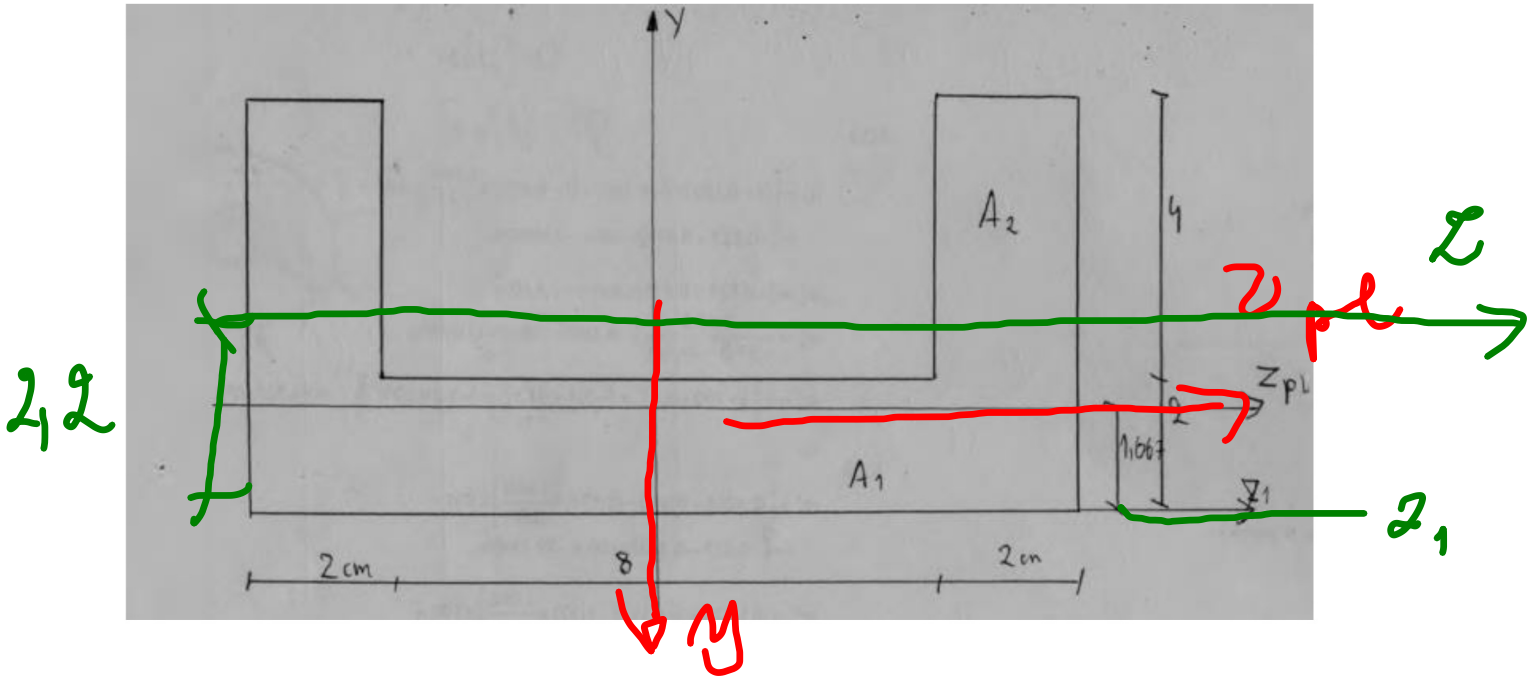
$$z = \left|\frac{W_{pl} - W_{sp}}{W_{sp}}\right| \cdot 100\%$$

$z = 76{,}5\%$

$$y = \frac{S_{z_1}}{A}$$

$$W_{sp} = \frac{J_z}{y_{max}}$$

PRZYKŁAD 2

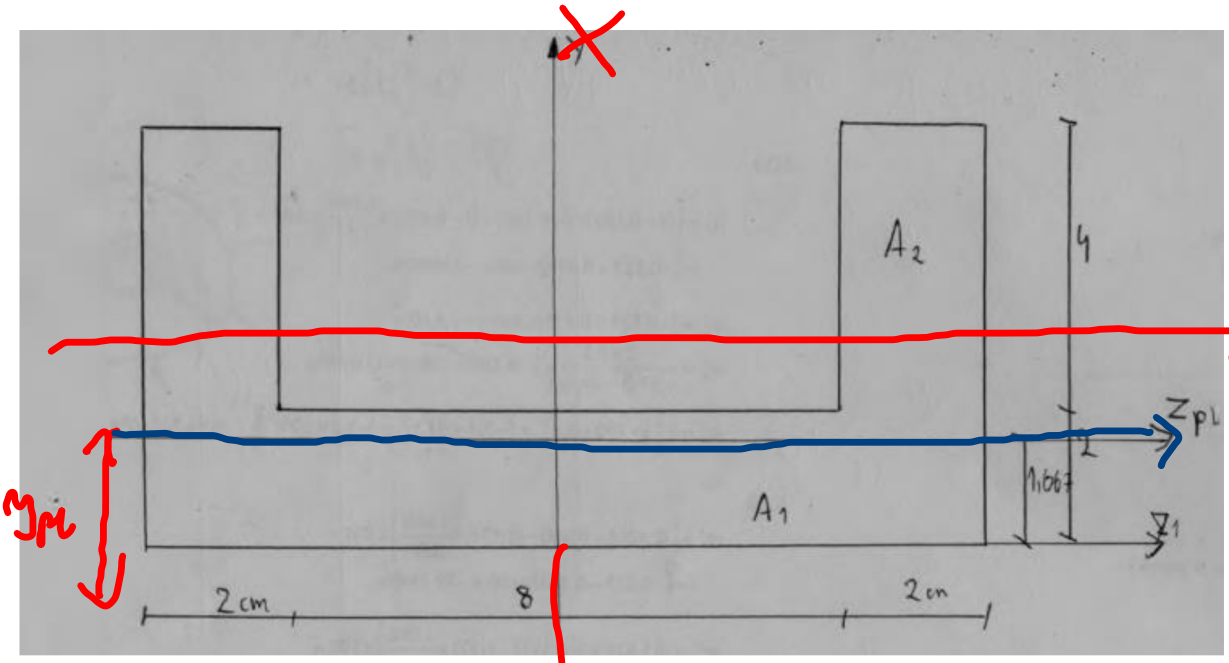


$$y = \frac{S_{z1}}{A} = \frac{12 \cdot 2 \cdot 1 + 2 \cdot 2 \cdot 4}{12 \cdot 2 + 2 \cdot 4} = 2{,}2$$

$$J_z = \frac{12 \cdot 6^3}{12} + 12 \cdot 6 \cdot 0{,}8^2 - \left(\frac{8 \cdot 4^3}{12} + 8 \cdot 4 \cdot 1{,}8^2\right)$$

$$= 115{,}733 \text{ cm}^3$$

$$W_{sp} = \frac{J_z}{y_{max}} = \frac{115{,}33}{3{,}8} = 30{,}456 \text{ cm}^3$$



$A_1 = A_2 = 20\,cm^2$

$y_{pl} \cdot 12\,cm = 20\,cm^2$

$y_{pl} = \frac{20}{12} = 1{,}667\,cm$

$A = 40\,cm^2$

$W_{pl} = |S_{z_{pl}}| + |S^2_{z_{pl}}| = 12 \cdot 1{,}667 \cdot 0{,}8335 + 2 \cdot 2 \cdot 4\,(2 + 0{,}333) + 12 \cdot 0{,}333 \cdot 0{,}1667 = 54{,}667\,cm^3$

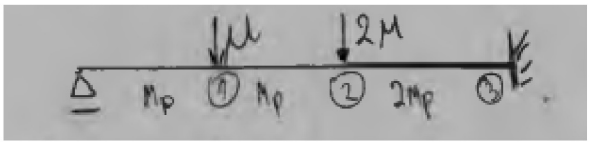
$20 = 12 \cdot y_{pl}$

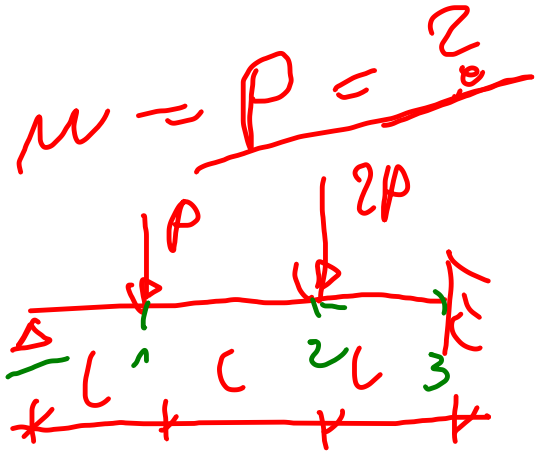
$z = \left| \frac{W_{pl} - W_{sp}}{W_{sp}} \right| = 79{,}4\,\%$

$M_{sp} = R_e \cdot W_{sp}$

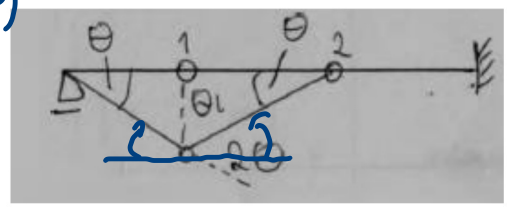
$M_{pl} = R_e\, W_{pl}$

PRZYKŁAD 3





(1,2)



$2\Theta \cdot M_p + \Theta M_p = \Theta l \cdot \mu$

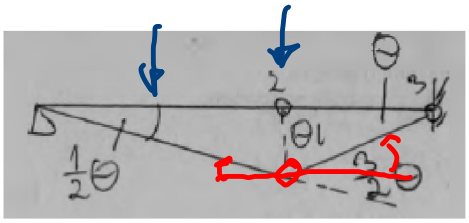
$\mu = 3\frac{M_p}{l}$

n = 2

z mechanizmu stopi się

$M_p = P(\mu)$

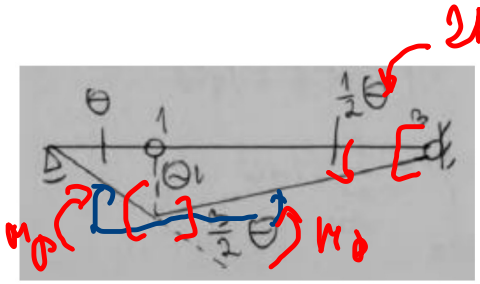
(2,3)



$\frac{3}{2}\Theta \cdot M_p + \Theta \cdot 2M_p = \Theta l \cdot 2\mu + \frac{\Theta l}{2} \cdot \mu$

$\mu = \frac{7}{5}\frac{M_p}{l}$

(1,3)

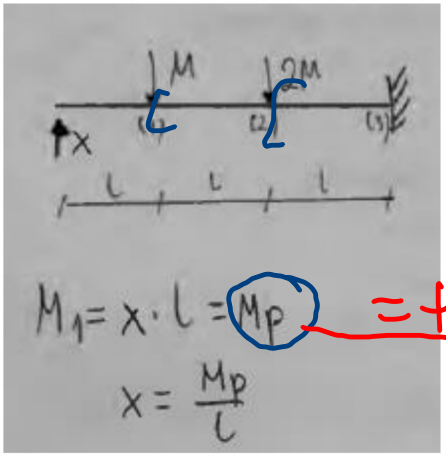


$\frac{3}{2}\Theta \cdot M_p + \frac{1}{2}\Theta \cdot 2M_p = \Theta l \cdot \mu + \frac{\Theta l}{2} \cdot 2\mu$

$\mu = \frac{5}{4}\frac{M_p}{l} = \mu_{min}$

$\frac{5}{4}\frac{M_p}{l}$) $\frac{7}{5}\frac{M_p}{l}$) $\frac{3M_p}{l}$

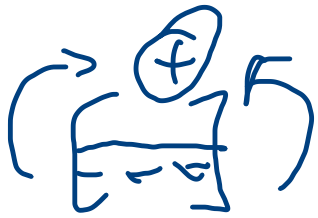
1,3



$M_1 = x \cdot l = M_p \Rightarrow +M_p$

$x = \frac{M_p}{l}$

$M_2 = x \cdot 2l - \mu \cdot l$



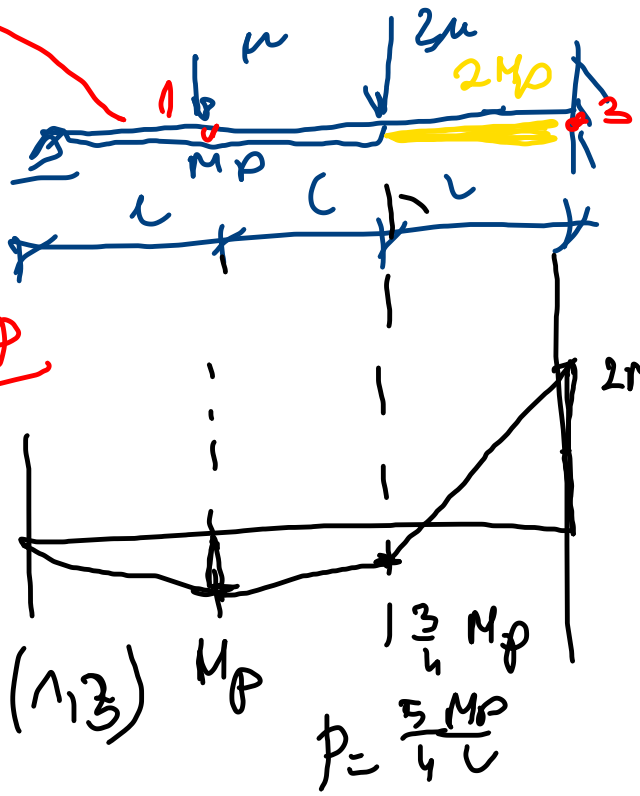
$M_3 = 3xl - 2\mu l - 2\mu l = -2M_p$

$3M_p - 4\mu l = -2M_p$

$4\mu = 5\frac{M_p}{l}$

$\mu = \frac{5}{4}\frac{M_p}{l}$

$-2M_p$

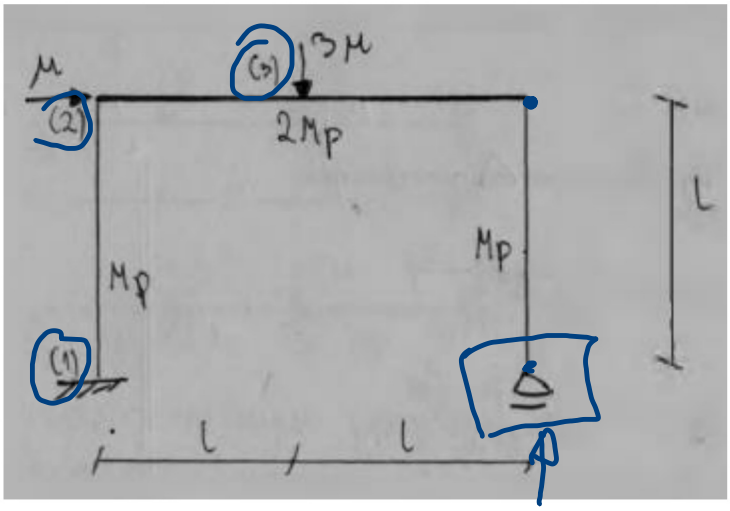


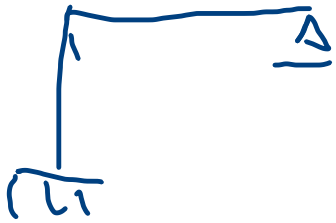
$M_2 = x \cdot 2l - \mu \cdot l$

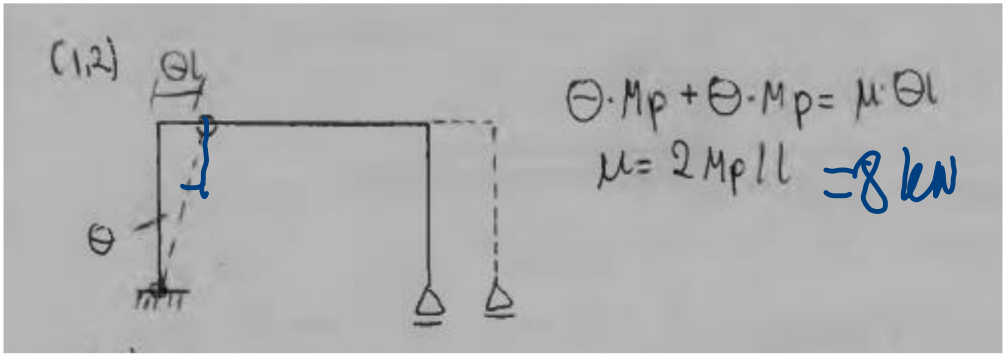
$M_2 = 2M_p - \frac{5}{4}M_p$

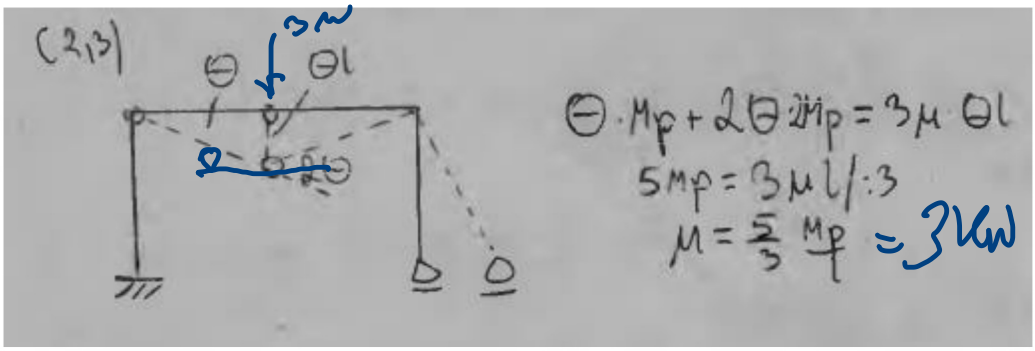
$M_2 = \frac{3}{4}M_p$

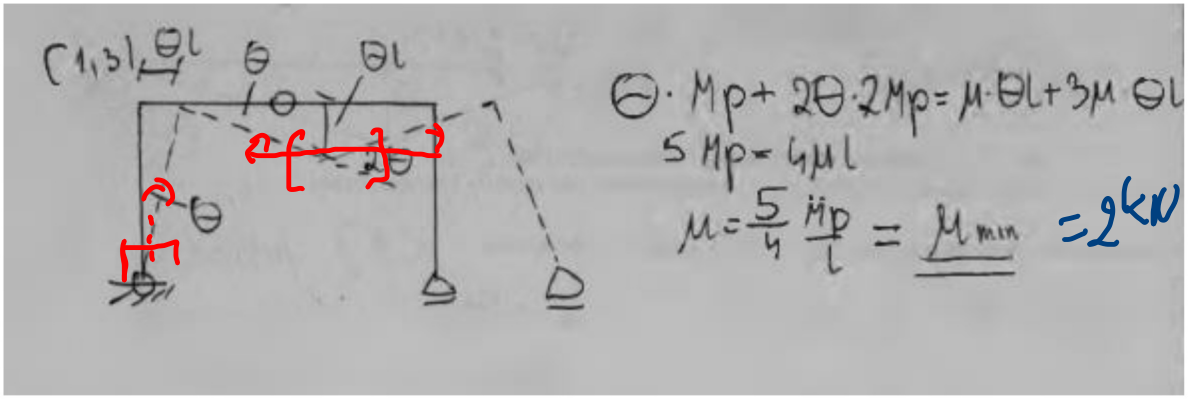
PRZYKŁAD 4


μ
(3)
3μ
(2)
2Mp
L
Mp
Mp
(1)
l
l

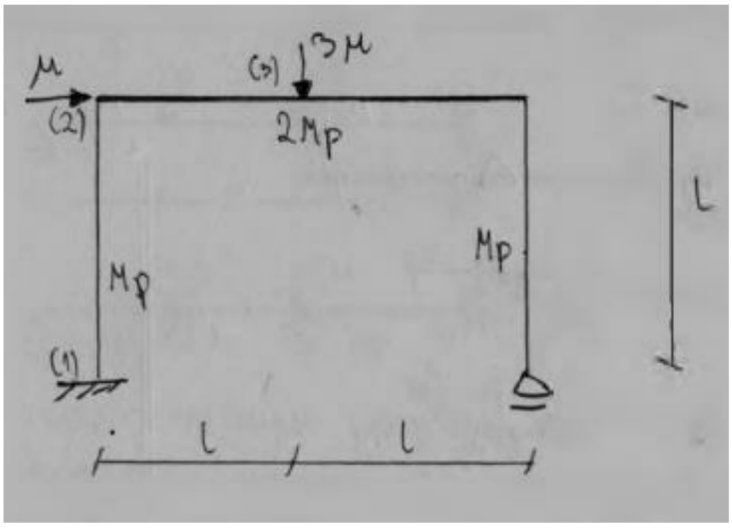


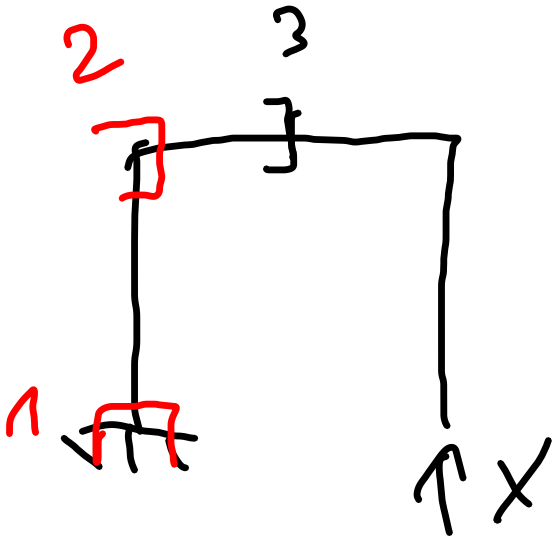

(1,2)
Θl
Θ
Θ·Mp + Θ·Mp = μ·Θl
μ = 2Mp/l = 8 kN


(2,3)
Θ
3μ
Θl
Θ·Mp + 2Θ·2Mp = 3μ·Θl
5Mp = 3μl /:3
μ = 5/3 Mp/l = 3 kN


(1,3)
Θl
Θ
Θl
Θ
Θ·Mp + 2Θ·2Mp = μ·Θl + 3μ·Θl
5Mp = 4μl
μ = 5/4 Mp/l = μmin = 2 kN

1,3





$M_3 = x \cdot l = 2Mp$

$x = 2\frac{Mp}{l}$

$M_1 = x \cdot 2l - 3\mu \cdot l - \mu \cdot l = -Mp$

$2 \cdot 2Mp - 4\mu l = -Mp$

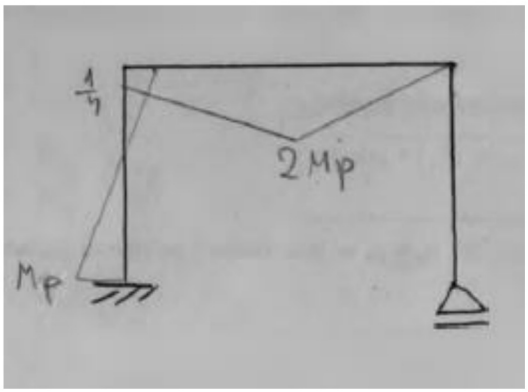
$4\mu = 5Mp \,/\, l$

$\mu = \frac{5}{4}\frac{Mp}{l}$

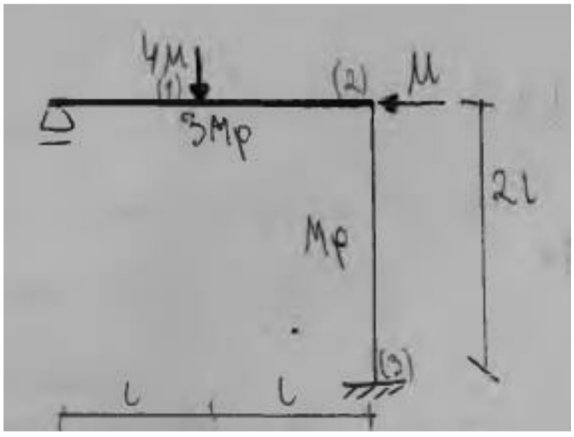
$M_2 = 2x - 3\mu l$

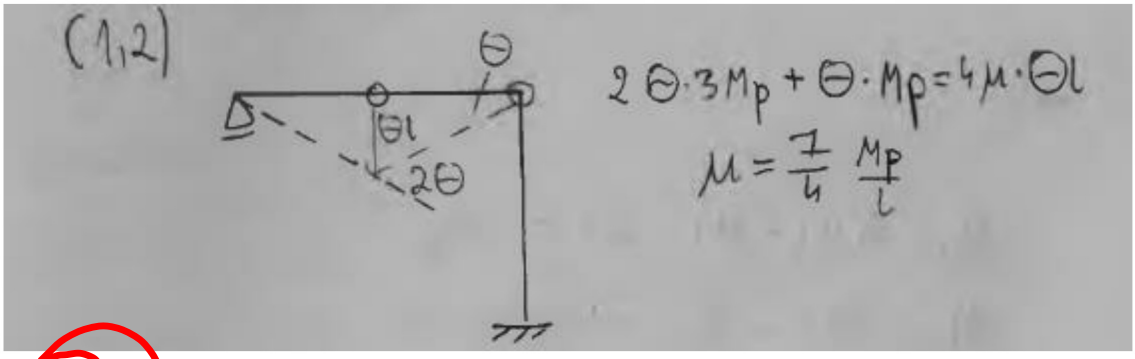
$M_2 = 4Mp - \frac{15}{4}Mp$

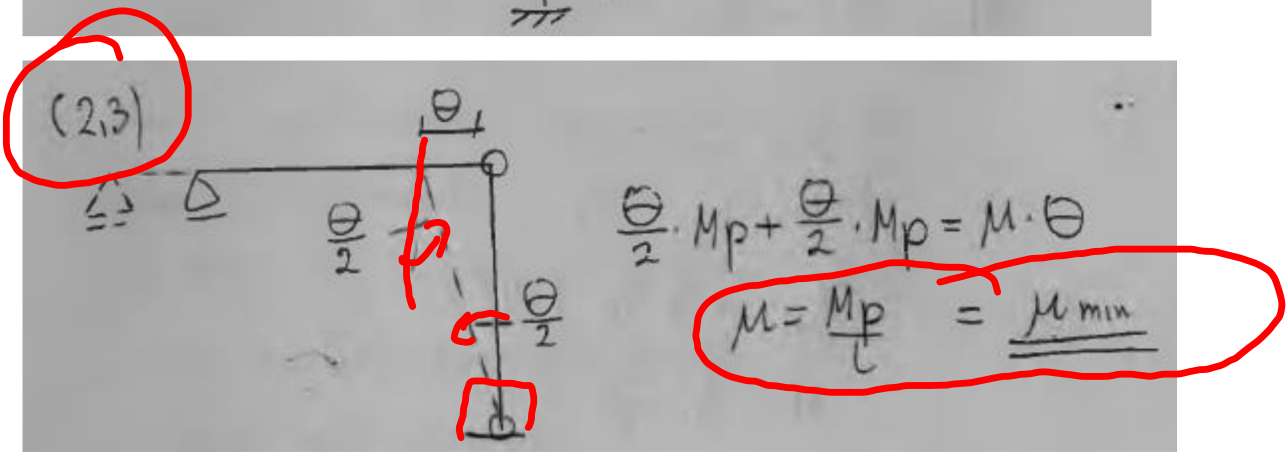
$M_2 = \frac{1}{4}Mp$

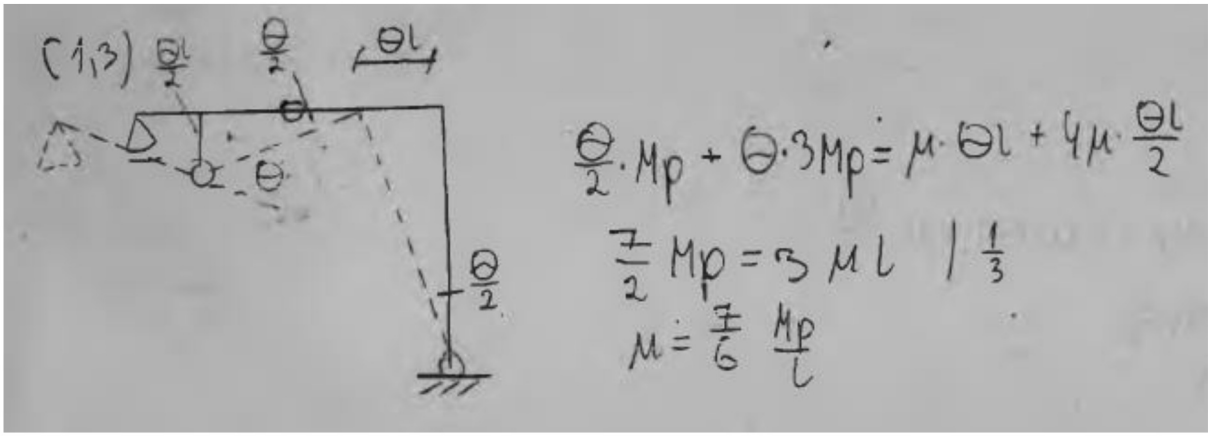


PRZYKŁAD 5

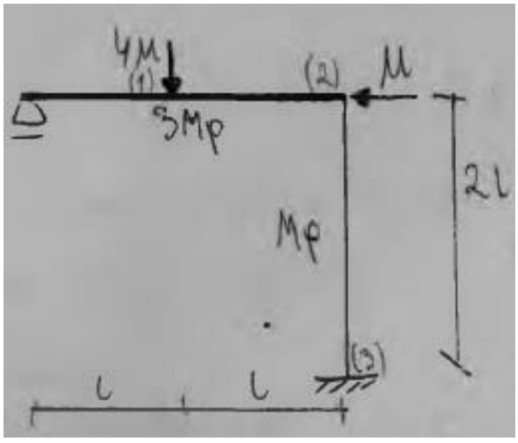

4M
(1)
(2)
M
3Mp
Mp
2l
(3)
l
l

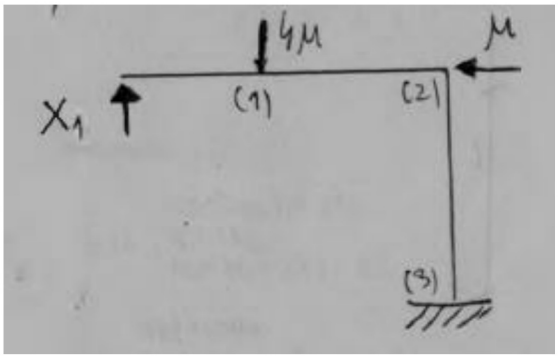

(1,2)
Θ
Θl
2Θ
2Θ·3Mp + Θ·Mp = 4μ·Θl
μ = 7/4 Mp/l


(2,3)
Θ
Θ/2
Θ/2
Θ/2·Mp + Θ/2·Mp = μ·Θ
μ = Mp/l = μ min


(1,3)
Θl/2
Θ/2
Θl
Θ
Θ/2
Θ/2·Mp + Θ·3Mp = μ·Θl + 4μ·Θl/2
7/2 Mp = 3 μ l | 1/3
μ = 7/6 Mp/l

(2,3)





MPMS

M_2

M_3

$M_2 = x \cdot 2l - 4M \cdot l = Mp$

$M_3 = x \cdot 2l - 4M \cdot l - 2M \cdot l = -Mp$

$$\begin{cases} 2x - 4M = Mp/l \\ -2x + 6M = Mp/l \end{cases} +$$

$$\Rightarrow 2x - 4\frac{Mp}{l} = \frac{Mp}{l}$$

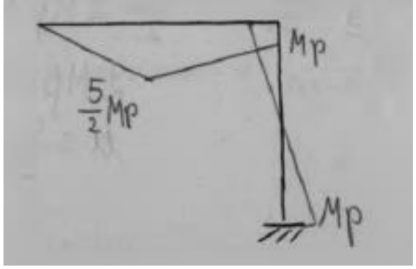
$$2x = 5\frac{Mp}{l}$$

$$x = \frac{5}{2}\frac{Mp}{l}$$

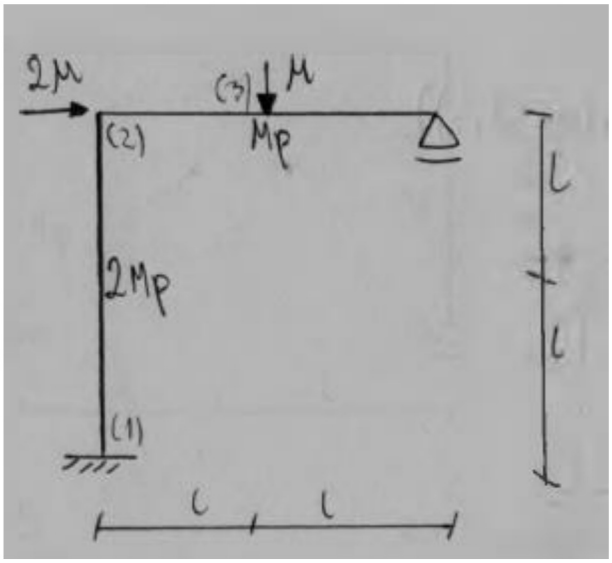
$$2M = 2Mp/l$$

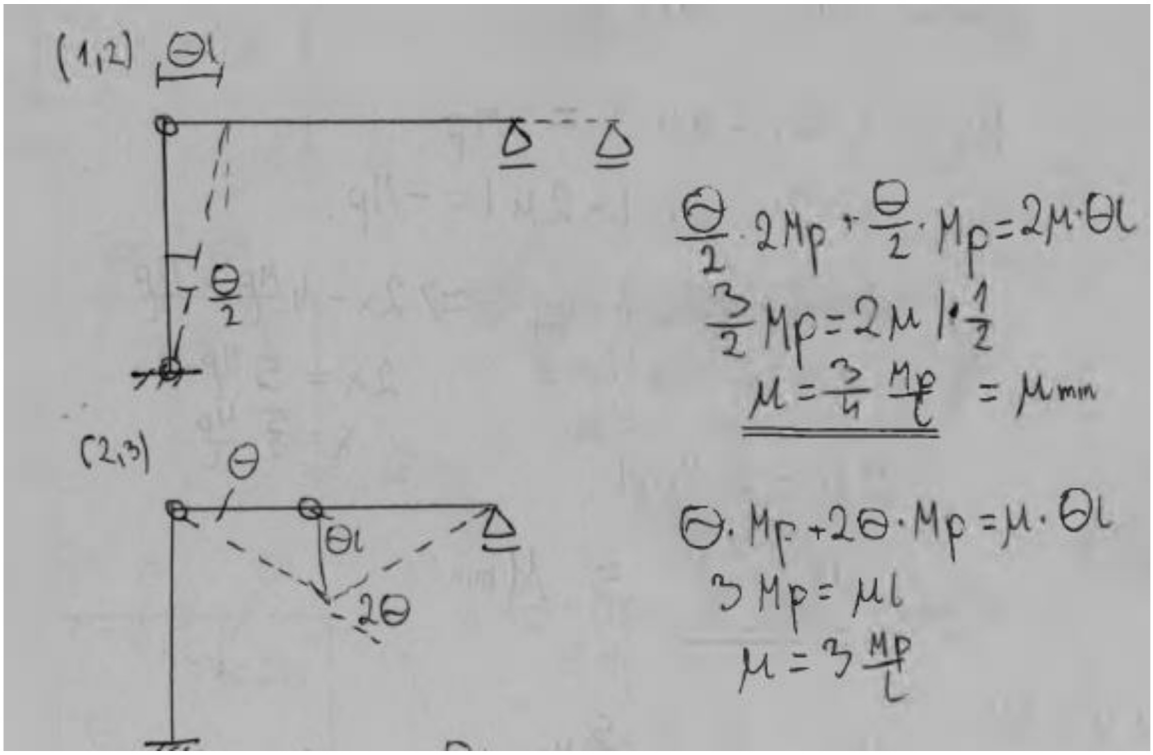
$$M = \frac{Mp}{l} = M_{min}$$

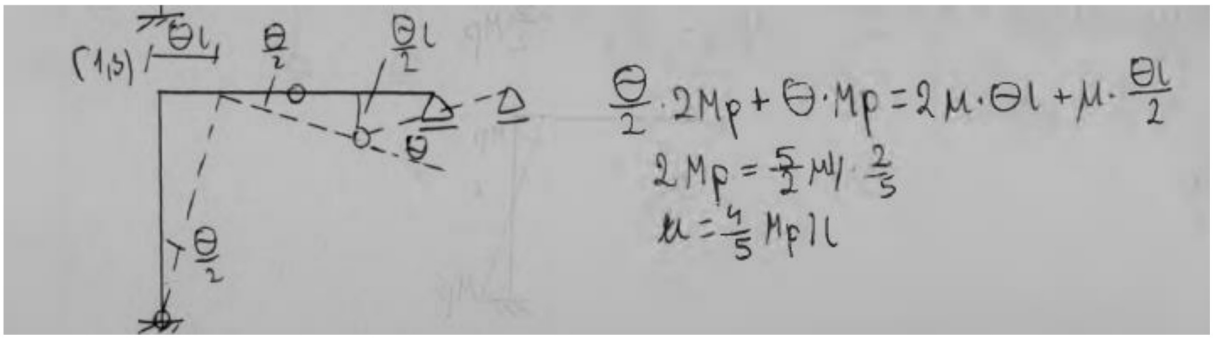
$M_1 = x \cdot l = \frac{5}{2}Mp$

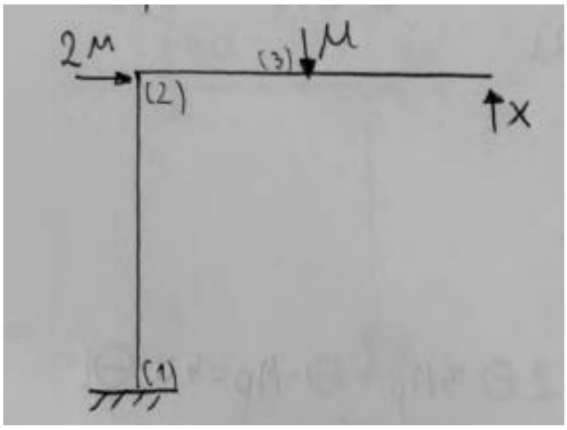


PRZYKŁAD 6


2μ
(3)
μ
(2)
Mp
2Mp
(1)
l
l
l
l
l


(1,2)
Θl
Θ/2
(Θ/2)·2Mp + (Θ/2)·Mp = 2μ·Θl
3/2 Mp = 2μ | ·1/2
μ = 3/4 Mp/l = μmin
(2,3)
Θ
Θl
2Θ
Θ·Mp + 2Θ·Mp = μ·Θl
3Mp = μl
μ = 3 Mp/l


(1,3)
Θl
Θ/2
Θl/2
Θ
Θ/2
(Θ/2)·2Mp + Θ·Mp = 2μ·Θl + μ·Θl/2
2Mp = 5/2 μl | ·2/5
μ = 4/5 Mp/l



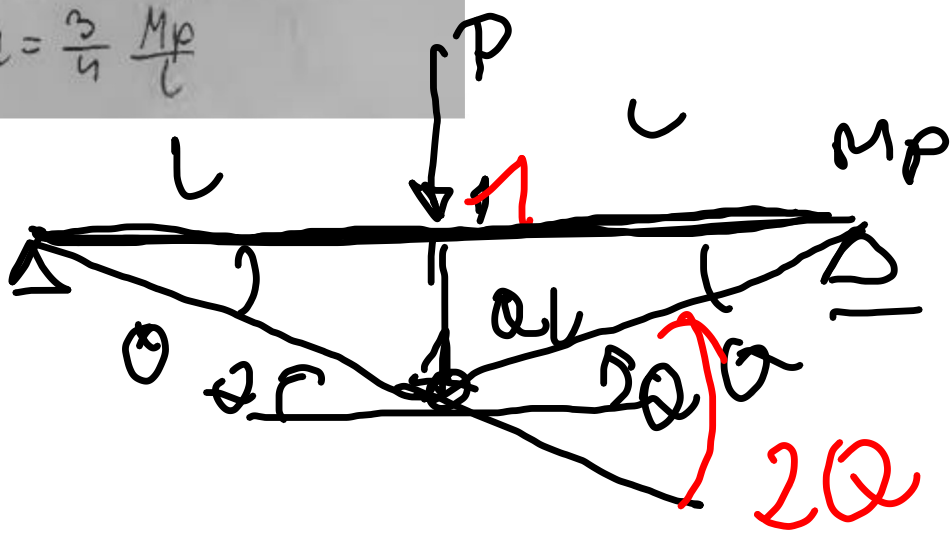
$$M_1 = 4\mu l + \mu l - 2x = 2M_p$$

$$M_2 = \mu l - 2x = -M_p$$

$$\begin{cases} 5\mu l - 2x = 2M_p \\ -\mu l + 2x = M_p \end{cases}$$

$$4\mu l = 3M_p \quad | : 4l$$

$$\mu = \frac{3}{4}\frac{M_p}{l}$$

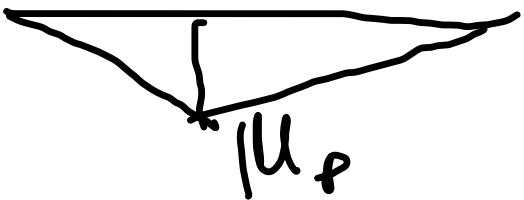


$\mu = ?$

(1)

$$2\Theta \cdot M_p = P \cdot \Theta l$$

$$P = \frac{2\Theta M_p}{\Theta l} = \frac{2M_p}{l}$$



$P = 2 < \mu$