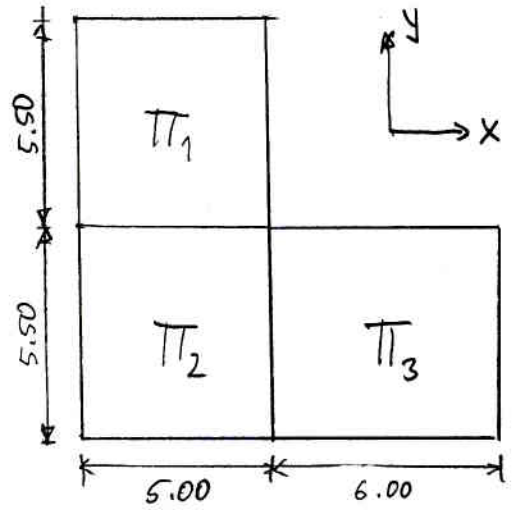
ΤΡΕΙΣ ΣΥΝΕΧΕΙΣ ΠΛΑΚΕΣ



Π_1 : mind = 0.8 × 5.50/30 = 14.67 cm

Π_2 : mind = 0.8 × 5.0/30 = 13.33 cm

Π_3 : mind = 0.8 × 6.0/30 = 16.0 cm

$\rightsquigarrow h = 0.20\,m$

$g = 5.0\ kN/m^2$

$p = 5,0\ kN/m^2$

Επίλυση κατά Markus

Π_1 (πρ. 2')

$\varepsilon' = \frac{l_x}{l_y} = \frac{5.00}{5.50} = 0.91 \rightsquigarrow k_y = 0.631 \quad k_x = 0,369$

$\nu_y = 0.643 \quad \nu_x = 0.747$

Π_2

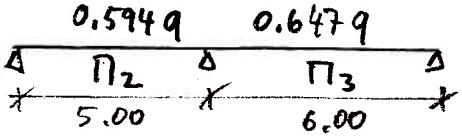
$\varepsilon = \frac{l_y}{l_x} = \frac{5,50}{5,00} = 1.10 \rightsquigarrow k_x = 0.594 \quad k_y = 0.406$

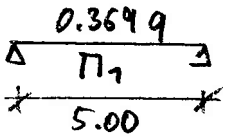
$\nu_x = 0.77 \quad \nu_y = 0,77$

Π_3

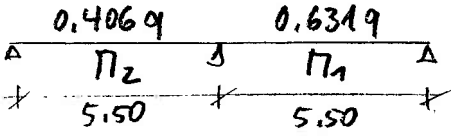
$\varepsilon = \frac{l_y}{l_x} = \frac{5.50}{6.00} = 0.92 \rightsquigarrow k_x = 0,647 \quad k_y = 0.353$

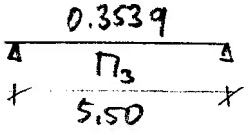
$\nu_x = 0.646 \quad \nu_y = 0.750$





Τομείς κατά x





Τομείς κατά y

Π. Γιαννόπουλος

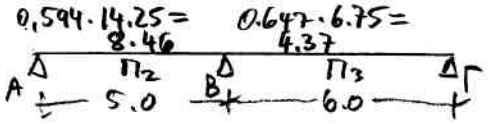
Συνολικό φορτίο (μόνιμο + κινητό)

$1.35g + 1.5p = 1.35 \times 5.0 + 1.5 \times 5.0 = 14.25\ kN/m$

Μόνιμο φορτίο

$1.35g = 1.35 \times 5.0 = 6.75\ kN/m$

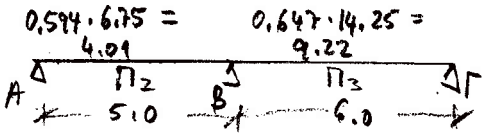
Max ανοίγματος Π_2 κατά x-x



$$M_B = -0.0568 \cdot q_1 l_1^2 - 0.0682 \cdot q_2 \cdot l_2^2 = -22.74\ kNm$$

$$\boxed{\max M_{AB}} = 0 + \left(q_1 \frac{l_1}{2} + \frac{M_B - 0}{l_1}\right)^2 \frac{1}{2q_1} = 16.29\ kNm \times Y_x\,(=0.77) = 12.54\ kNm$$

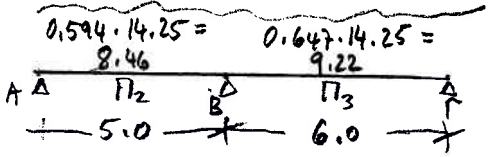
Max ανοίγματος Π_3 κατα x-x



$$M_B = -0.0568 \cdot 4.01 \cdot 5.0^2 - 0.0682 \cdot 922 \cdot 6.0^2 = -28.33\ kNm$$

$$\boxed{\max M_{B\Gamma}} = M_B + \left(q_2 \frac{l^2}{2} + \frac{0 - M_B}{l_2}\right)^2 \cdot \frac{1}{2q_2} = 28.53\ kNm \times Y_x\,(=0.646) = 18.43\ kNm$$

Min Π_2-Π_3 κατα x-x

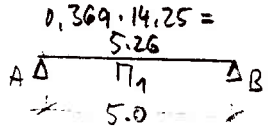


$M_{AB} = 11.95\ kNm$

$M_{B\Gamma} = 25.97\ kNm$

$$\boxed{\min M_B} = -34.65\ kNm$$

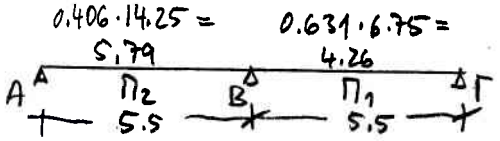
Max ανοίγματος Π_1 κατά x-x



$$\boxed{\max M_{AB}} = \frac{5.26 \cdot 5.0^2}{8} = 16.43\ kNm \times V_x\,(=0.747) = 12.27\ kNm$$

Π. Γιαννόπουλος

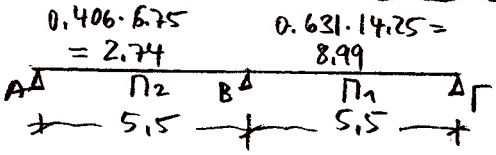
Max ανοίγματος Π_2 κατά y-y



$$M_B = -0.0568 \cdot q_1 \cdot l_1^2 - 0.0682\, q_2\, l_2^2 = -18.74 \text{ kNm}$$

$$\boxed{\max M_{AB}} = 0 + \left(q_1 \frac{l_1}{2} + \frac{M_B - 0}{l_1}\right)^2 \frac{1}{2q_1} = 13.53 \text{ kNm} \times \nu_y (=0.77) = 10.42 \text{ kNm}$$

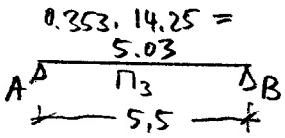
Max ανοίγματος Π_1 κατά y-y



$$M_B = -0.0568 \cdot 2.74 \cdot 5.5^2 - 0.0682 \cdot 8.99 \cdot 5.5^2 = -23.25 \text{ kNm}$$

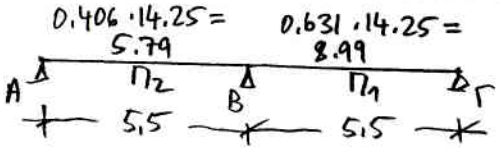
$$\boxed{\max M_{B\Gamma}} = M_B + \left(\frac{q_2 l^2}{2} + \frac{0 - M_B}{l_2}\right)^2 \frac{1}{2q_2} = 23.36 \text{ kNm} \times \nu_y (=0.643) = 15.02 \text{ kNm}$$

Max ανοίγματος Π_3 κατά y-y

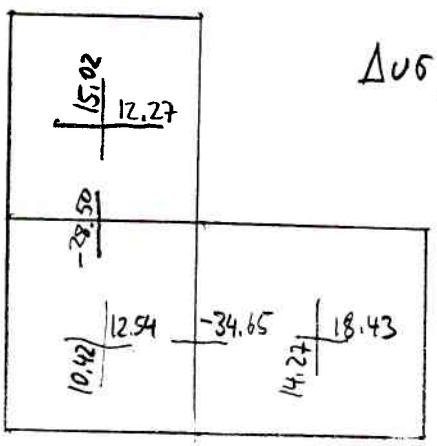


$$\boxed{\max M_{AB}} = \frac{5.03 \cdot 5.5^2}{8} = 19.02 \cdot \nu_y (=0.75) = 14.27 \text{ kNm}$$

Min οπλισέως Π_2-Π_1 κατά y-y



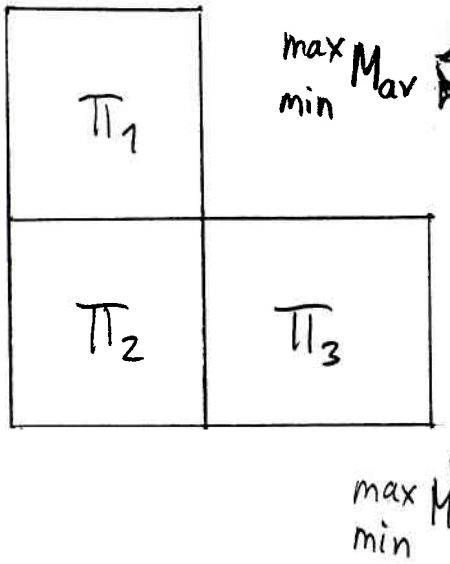
$$\boxed{\min M_B} = -0.0568 \cdot 5.79 \cdot 5.5^2 - 0.0682 \cdot 8.99 \cdot 5.5^2 = -28.50 \text{ kNm}$$



Δυσμενείς κατά Markus

Π. Γιαννόπουλος

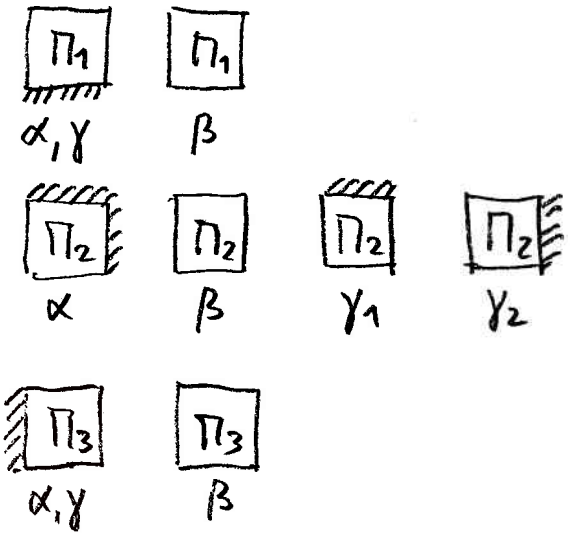
Κατά Czerny



α) παδοχική φόρτιση $g+\frac{p}{2}$ με πλακώσεις περιμετρικά όπου υπάρχει συνέχεια, αλλιώς ό,τι όριο υπάρχει

β) φόρτιση $\pm p/2$ με απλές στηρίξεις περιμετρικά

γ) ανά μια κοινή πλευρά πάκτωση (επειδή όπου δε-λούμε να υπο-λογίσουμε και οι υπόλοιπες απλές στηρίξεις και φόρτιση $\pm p/2$ τη ροπή στήριξης)

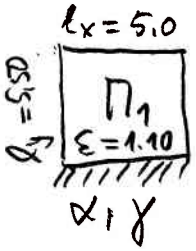


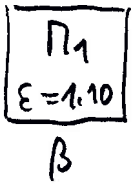
$l_x = l_{min} \qquad \varepsilon = \frac{l_y}{l_x}$

$M = \frac{q \cdot l_{min}^2}{k}$

$g' = 1.35g + 1.50\frac{p}{2} = 10.50\ kN/m^2$

$g'' = \pm 1.50\frac{p}{2} = \pm 3.75\ kN/m^2$





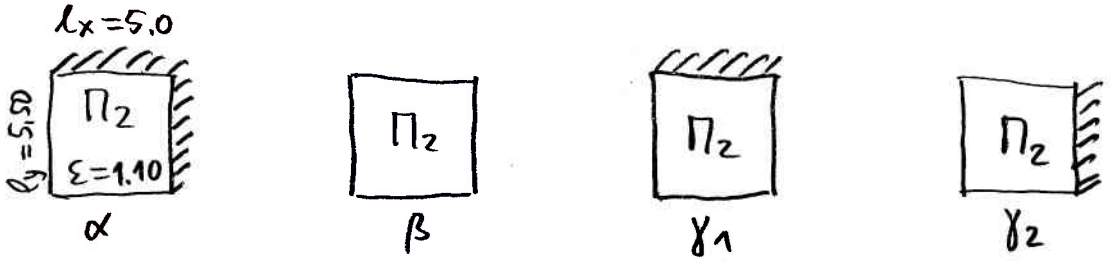
$m_{xm} = 31.9$

$m_{ymax} = 28.8$

$m_{yerm} = 10.9$

$m_{xm} = 22.4$

$m_{ymax} = 27.9$

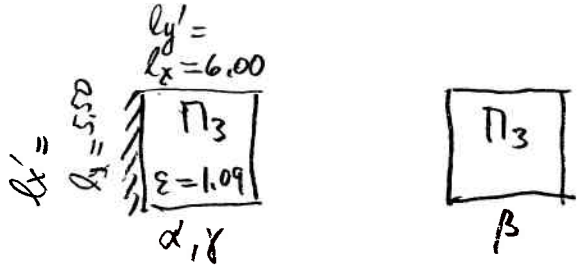


$m_{x_m} = 35.1$ $\quad m_{xm} = 22.4$ $\quad m_{y_{erm}} = 10.9$ $\quad m_{x_{erm}} = 10.9$

$m_{x_{erm}} = 12.7$ $\quad m_{y_{max}} = 27.9$

$m_{y_{max}} = 42.0$

$m_{y_{erm}} = 13.6$



$m_{y'_{max}} = m_{x_{max}} = 28.8$ $\quad m_{y_m} = 22.9 = m_{x'_m}$

$m_{y'_{erm}} = m_{x_{erm}} = 10.8$ $\quad m_{x_{max}} = 27.8 = m_{y'_{max}}$

$m_{x'_m} = m_{y_m} = 32.8$

Π_1 $\max/\min M_{xm} = \frac{g' \cdot l_{1x}^2}{k'_x} \pm \frac{g'' l_{1x}^2}{k''_x}$ (για α) ± β)

$= \frac{10.5 \cdot 5.0^2}{31.9} \pm \frac{3.75 \cdot 5.0^2}{22.4} = 8.23 \pm 4.19 = 12.42/4.04$ kN m

$\max/\min M_{ym} = \frac{g' \cdot l_{1x}^2}{k'_y\,(=28.8)} \pm \frac{g'' \cdot l_{1x}^2}{k''_y\,(=27.9)} = 9.11 \pm 3.36 = 12.47/5.75$ kNm

Π_2 $\max/\min M_{xm} = \frac{10.5 \cdot 5.0^2}{35.1} \pm \frac{3.75 \cdot 5.0^2}{22.4} = 7.48 \pm 4.19 = 11.67/3.29$ kNm

$\max/\min M_{ym} = \frac{262.5}{42.0} \pm \frac{93.75}{27.9} = 6.25 \pm 3.36 = 9.61/2.89$ kNm

Π_3 $\max/\min M_{xm} = \frac{10,5 \cdot 5,5^2}{28.8} \pm \frac{3.75 \cdot 5,5^2}{27.8} = 11.03 \pm 4.08 = 15,11/6.95$ kNm

$\max/\min M_{ym} = \frac{10,5 \cdot 5,5^2}{32.8} \pm \frac{3.75 \cdot 5,5^2}{22.9} = 9.68 \pm 4.95 = 14.63/4.73$ kNm

Π. Παπαδόπουλος

Π2-Π3 $\min/\max M_{2-3} = -0,5\left[\frac{g' l_{2x}^2}{k'_{x\,em}} + \frac{g' l_{3y}^2}{k'_{x\,em}}\right] \mp 0,5\left[\frac{g'' l_{2x}^2}{k''_{x\,em}} + \frac{g'' l_{3y}^2}{k''_{x\,em}}\right]$

($a_{n2} + a_{n3}$; $\gamma_{2n2} + \gamma_{n3}$)

$= -0,5\left[\frac{10,5 \cdot 5,0^2}{12.7} + \frac{10,5 \cdot 5,5^2}{10.8}\right] \mp 0,5\left[\frac{3.75 \cdot 5,0^2}{10.9} + \frac{3.75 \cdot 5,5^2}{10.8}\right]$

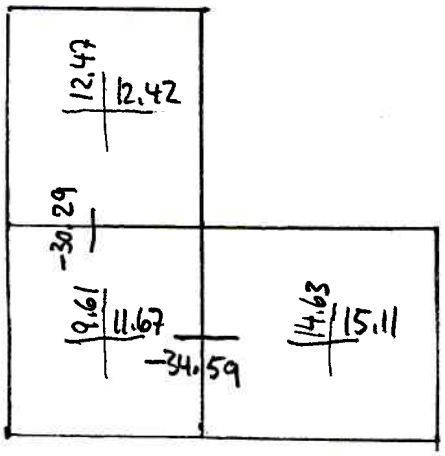
$= -25.04 \mp 9.55 = -34.59 / -15.49$ kNm

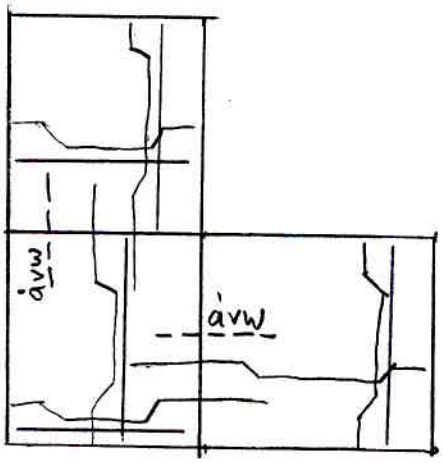
Π1-Π2 $\min/\max M_{1/2} = -0,5\left[\frac{10.5 \cdot 5,0^2}{10.9} + \frac{10.5 \cdot 5,0^2}{13.6}\right] \mp \left[\frac{3.75 \cdot 5,0^2}{10.9} + \frac{3.75 \cdot 5,0^2}{10.9}\right]$

($a_{n1} + a_{n2}$; $\gamma_{n1} + \gamma_{1n2}$)

$= -21.69 \mp 8.6 = -30,29 / -13.09$ kNm

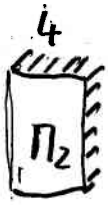
$\min/\max M_{2-3} = \frac{1}{2}\left[-(a_{n2} \mp \gamma_{2n2}) - (a_{n3} \mp \gamma_{n3})\right] =$



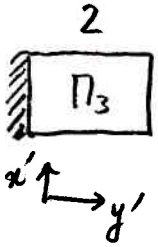


Κατά Pieper-Hartens

$\frac{l_y}{l_x} = \frac{5.50}{5.0} = 1.10 \rightsquigarrow f_x = 26.3 \quad f_y = 29.2 \quad S_y = 10.9$



$\frac{l_y}{l_x} = \frac{5.50}{5.0} = 1.10 \rightsquigarrow f_x = 27.3 \quad f_y = 34.1 \quad S_x = 12.7 \quad S_y = 13.6$



$\frac{l_y'}{l_x'} = \frac{6.0}{5.5} = 1.09 \approx 1.1 \rightsquigarrow f_x' = f_y = 27.0 \quad f_y' = f_x = 29.2 \quad S_y' = S_x = 11.0$

$m_{fx} = q\frac{l_x^2}{f_x} \qquad m_{sx_0} = q\frac{l_x^2}{S_x}$

$m_{fy} = q\frac{l_x^2}{f_y} \qquad m_{sy_0} = q\frac{l_x^2}{S_y}$ όπου $l_x = l_{min}$

Έλεγχος ισχύος της μεθόδου $\frac{\text{μικτό } p}{\text{ολικό } q} < \frac{2}{3}$

$1.5 \times 5.0 < \frac{2}{3}(1.35 \cdot 5.0 + 1.50 \cdot 5.0)$

$7.5 < 9.5 \qquad$ o.k.

Π. Γιαννόπουλος

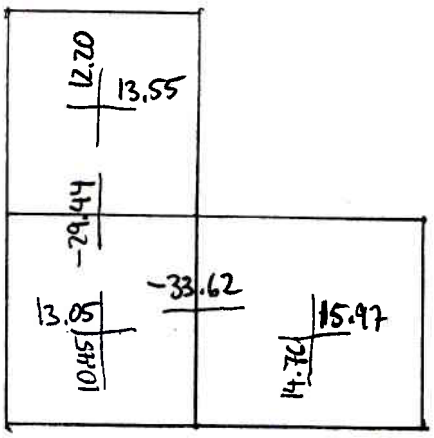
Ροπές αναγμάτων

Πi	είδος στήριξης	l_x ή l_y'	l_y ή l_x'	$\varepsilon = l_y/l_x$ ή $\varepsilon' = l_y'/l_x'$	f_x ή f_y'	f_y ή f_x'	s_x ή s_y'	s_y ή s_x'	m_{fx}	m_{fy}	m_{sxo}	m_{syo}
Π_1	2	5.0	5,5	1.10	26.3	29.2		10.9	13.55	12.20		-32.68
Π_2	4	5.0	5.5	1.10	27.3	34.1	12.7	13.6	13.05	10.45	-28.05	-26.19
Π_3	2	l_y' 6.0	l_x' 5.5	1.09	27.0	29.2	11.0		15.97	14.76	-39.19	

Ροπές στηρίξεως

Στήριξη i-j	m_{soi}	m_{soj}	$\frac{m_{soi}+m_{soj}}{2}$	$0.75 \min m_{soi}$	min ms [1] $(l_i/l_j < 5)$
2-3	-28.05	-39.19	-33.62	-29.39	-33.62
2-1	-26.19	-32.68	-29.44	-24.51	-29.44

1) όταν $l_i/l_j > 5$
$\min(m_{soi}, m_{soj})$



Π. Γιαννόπουλος