



Ε
Μ
Π

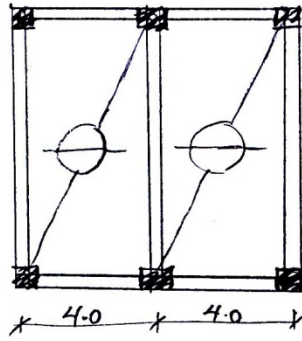
Άσκηση

Συνεχών Διέρειστων Πλακών

Π. Γιαννόπουλος

Εργαστήριο
Ωπλισμένου
Σκυροδέματος

Άσκηση Ζακάρ



C20 / S500

$h = 14 \text{ cm}$

επιβ. $g' = 1.2 \text{ kN/m}^2$

κίμος $q = 3.0$

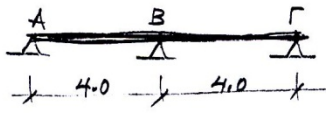
1.β. $\lambda d_{kAS} = 0.14 \times 25 = 3.5 \text{ kN/m}$

$g' =$

$g = 4.7 \text{ kN/m}$

$q =$

3.0 kN/m



στατικό
προσπολάρια

Απαιτείται από έλεγχο βελών κλίσης:

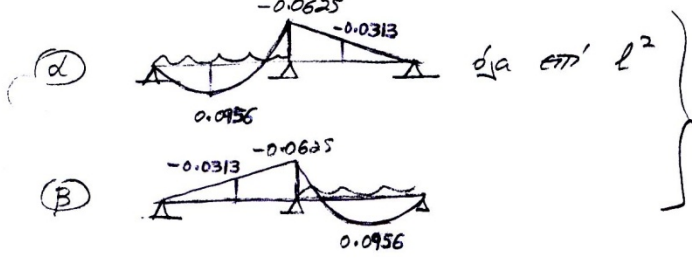
$\frac{\alpha l}{d} \leq 30$ με $\alpha = 0.80$

$c = c_{nom} = c_{min} + \Delta c_{cler}$

$= 15 + 5 = 20 \text{ mm}$

$\frac{0.8 \times 4.0}{0.116} = 27.6 < 30$

$d = h - \frac{\phi}{2} - c = 140 - \frac{8}{2} - 20 = 116 \text{ mm}$



Μορδιαίτες φορτίσεις

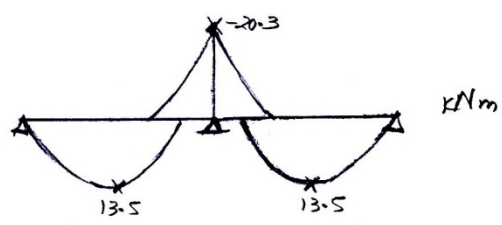
Αντίστοιχα AB, BΓ

$$\begin{cases} \max M_{AB} = [1.35(0.0956) \times 4.7 + 1.00(-0.0313) \times 4.7 + 1.50(0.0956) \times 3.0 + 0(-0.0313) \times 3.0] l^2 = 0.890 l^2 = 14.2 \text{ kNm} \\ \min M_{AB} = [1.00(0.0956) \times 4.7 + 1.35(-0.0313) \times 4.7 + 0(0.0956) \times 3.0 + 1.50(-0.0313) \times 3.0] l^2 = 0.110 l^2 = 1.8 \text{ kNm} \end{cases}$$

Στήριξη B

$$\min M_B = [1.35(-0.0625) \times 4.7 + 1.35(-0.0625) \times 4.7 + 1.50(-0.0625) \times 3.0 + 1.50(-0.0625) \times 3.0] l^2 = -1.356 l^2 = -21.7 \text{ kNm}$$

$$\max M_B = [1.00(-0.0625) \times 4.7 + 1.00(-0.0625) \times 4.7 + 0(-0.0625) \times 3.0 + 0(-0.0625) \times 3.0] l^2 = -0.508 l^2 = -9.4 \text{ kNm}$$



Με κανονική φόρτιση 1.35 παντός & 1.50 παντός:

$$M_{AB} = 0.697 l^2 = 11.2 \text{ kNm} \quad (\text{με } 1.35 \text{ παντός & } 1.50 \text{ παντός} \rightarrow M_{AB} = 0.838 l^2 = 13.4 \text{ kNm})$$

$$M_B = -1.356 l^2 = -21.7 \text{ kNm}$$

Οπλισμός

$$h = 140 \text{ mm} \quad d = 140 - \frac{8}{2} - 20 = 116 \text{ mm}$$

$$AB: \frac{M_{sd}}{bd^2} = \frac{14.2 \times 10^{-3}}{1.0 \times 0.116^2} = 1.055 \text{ MPa} \quad \frac{\pi \rho_{s, \text{REQ}}}{4 \pi} \rho = 0.260\%$$

$$\therefore A_{s1} = \rho b d = \frac{0.260}{100} \times 100 \times 11.6 = 3.02 \text{ cm}^2/\text{m} \rightarrow \phi 8/16 (= 3.14 \text{ cm}^2/\text{m})$$

$$B: M_B = -21.7 \text{ kNm} \quad M_{Bmp} \approx -19.0 \text{ kNm} \quad (h' 0.9 \times 21.7 = 19.5)$$

$$\frac{M_{sd}}{bd^2} = \frac{21.7 \times 10^{-3}}{1.0 \times 0.116^2} = 1.613 \text{ MPa} \rightarrow \rho = 0.402\%$$

$$\therefore A_{s1} = \rho b d = \frac{0.402}{100} \times 100 \times 11.6 = 4.66 \text{ cm}^2/\text{m}$$

$$\text{υποέλαμε } \phi 8/32 + \phi 8/32 = 3.14 \text{ cm}^2/\text{m}$$

$$\text{πρόσθετα} = 4.66 - 3.14 = 1.52 \text{ cm}^2/\text{m}$$

$$\rightarrow \phi 8/25 (= 2.0 \text{ cm}^2/\text{m})$$

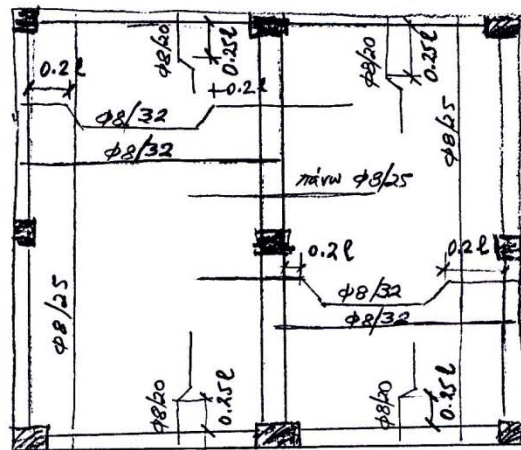
$$\min A_s = \frac{0.6 b d}{f_{yk}} = \frac{0.6 \times 100 \times 11.6}{500} = 1.39 \text{ cm}^2 \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} = 1.74 \text{ cm}^2/\text{m} \quad \therefore A_s = 3.02 > \min A_s = 1.74 \text{ cm}^2/\text{m}$$

$$= 0.0015 b d = 0.0015 \times 100 \times 11.6 = 1.74 \text{ cm}^2$$

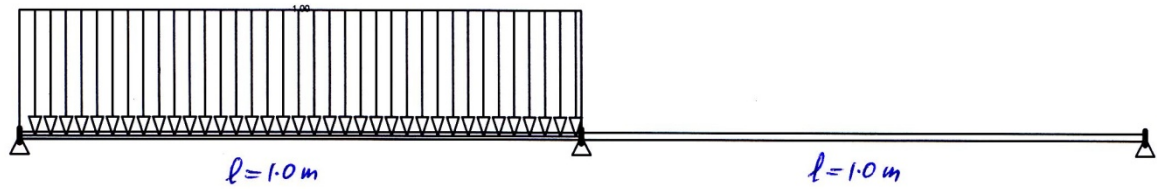
$$\max s = \frac{1.5 h}{200 \text{ mm}} = \frac{1.5 \times 14}{200} = 21 \text{ cm} \quad \left. \begin{array}{l} \\ \end{array} \right\} = 200 \text{ mm}$$

$$\Delta \text{ιατομές} \left\{ \begin{array}{l} A_s = 20\% \times 3.02 = 0.60 \text{ cm}^2/\text{m} \rightarrow \phi 8/25 (= 2.0 \text{ cm}^2/\text{m}) \\ \max s = 250 \text{ mm} \quad \& \quad \min A_{s, \text{δ}20\%} = 4 \phi 6/\text{m} \end{array} \right.$$

$$\text{Οπλισμός απόδοσης: } \left\{ \begin{array}{l} A_s = 60\% \times 3.02 = 1.81 \text{ cm}^2/\text{m} \rightarrow \phi 8/20 (= 2.5 \text{ cm}^2/\text{m}) \\ \min A_{s, \text{απόδ.}} = 5 \phi 8/\text{m} \end{array} \right.$$

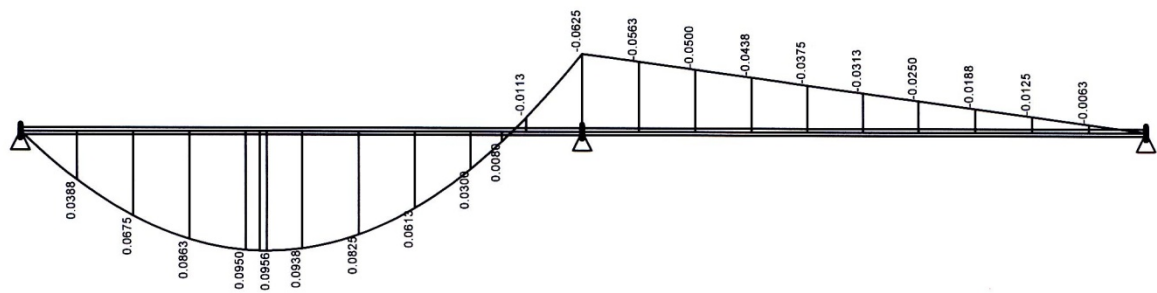


Μορδιαία Φόρτιση α



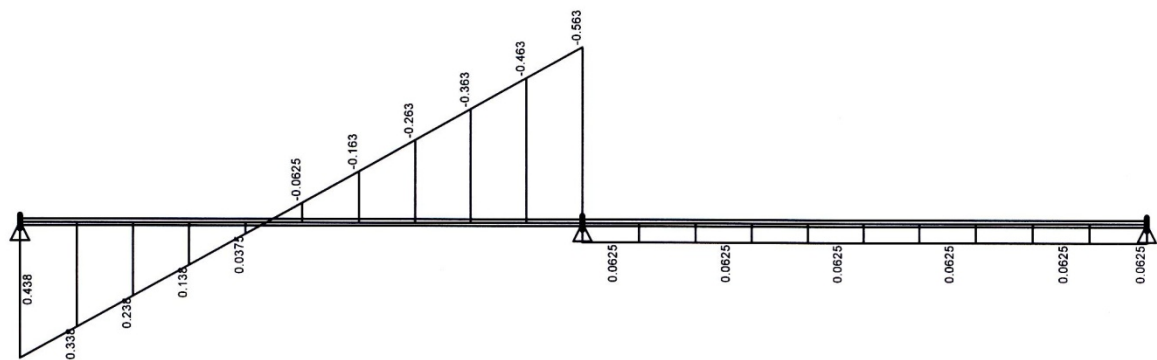
Beam line load in global Z, Loadcase 1, (1 cm 3D = UNIT) Beam line load (force) in global Z (Unit=0.500
kN/m $\rightarrow$ (Max=1.00)

M 1 : 11



Bending moment M_y of beam, Loadcase 1, 1 cm = 0.0500 kNm (Min=-0.0625) (Max=0.0957)

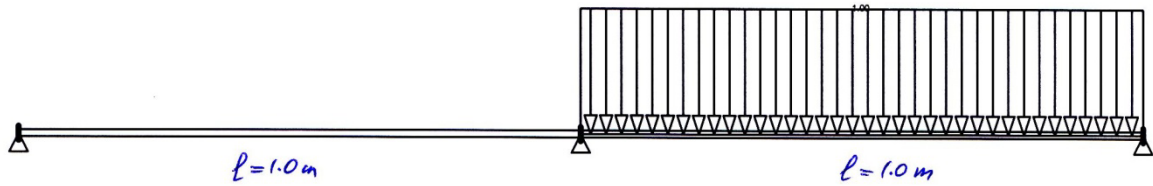
M 1 : 11



Shear force V_z of beam, Loadcase 1, 1 cm = 0.200 kN (Min=-0.562) (Max=0.438)

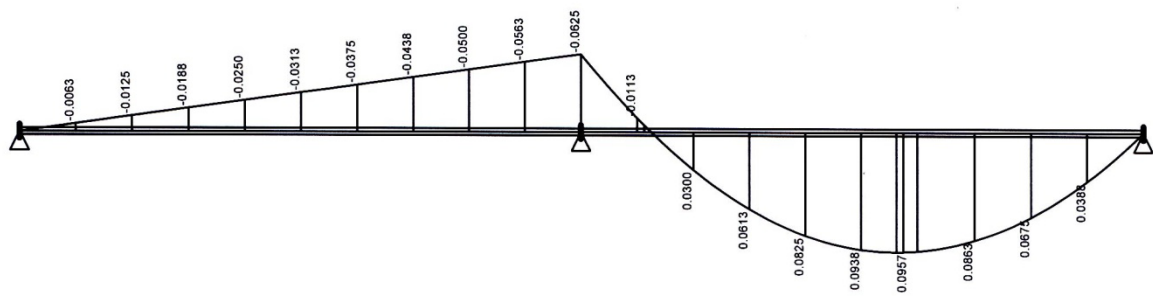
M 1 : 11

Moradiala φoption (P)



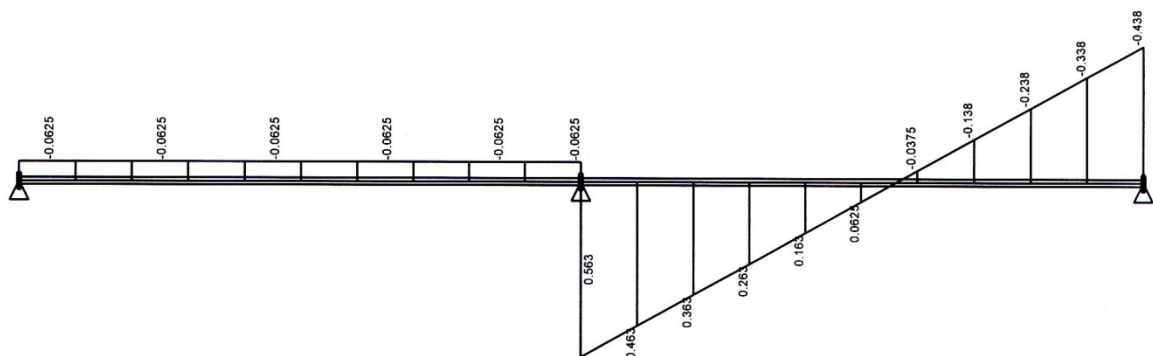
Beam line load in global Z, Loadcase 2, (1 cm 3D = UNIT) Beam line load (force) in global Z (Unit=0.500
kN/m (Max=1.00)

M 1 : 11



Bending moment M_y of beam, Loadcase 2, 1 cm = 0.0500 kNm (Min=-0.0625) (Max=0.0957)

M 1 : 11



Shear force V_z of beam, Loadcase 2, 1 cm = 0.200 kN (Min=-0.438) (Max=0.562)

M 1 : 11

Μόνημα

Α	Β	Α	Β
1.00	1.00	0	0
1.00	1.00	0	1.50
1.00	1.00	1.50	0
1.00	1.00	1.50	1.50

Κινητά

Α	Β	Α	Β
1.00	1.35	0	0
1.00	1.35	0	1.50
1.00	1.35	1.50	0
1.00	1.35	1.50	1.50

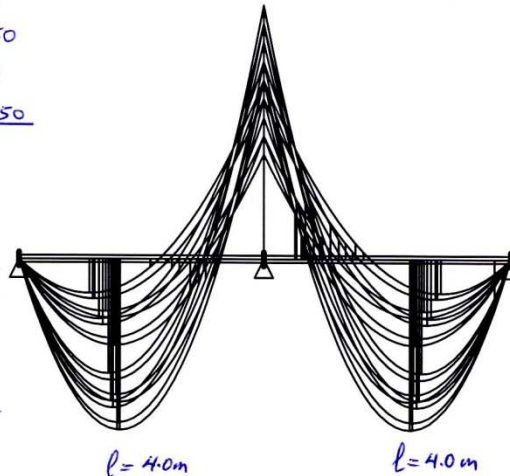
Α	Β	Α	Β
1.35	1.00	0	0
1.35	1.00	0	1.50
1.35	1.00	1.50	0
1.35	1.00	1.50	1.50

Α	Β	Α	Β
1.35	1.35	0	0
1.35	1.35	0	1.50
1.35	1.35	1.50	0
1.35	1.35	1.50	1.50

Συνδυασμοί φορτίσεων



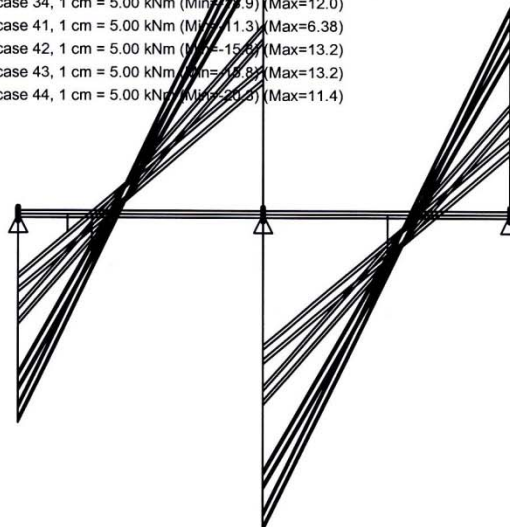
$\frac{4}{2} = 16$
περιπτώσεις
φορτίσεων



Y-X
Z

Bending moment My of beam, Loadcase 11, 1 cm = 5.00 kNm (Min=-8.40) (Max=4.73)
Bending moment My of beam, Loadcase 12, 1 cm = 5.00 kNm (Min=-12.9) (Max=11.5)
Bending moment My of beam, Loadcase 13, 1 cm = 5.00 kNm (Min=-12.9) (Max=11.5)
Bending moment My of beam, Loadcase 14, 1 cm = 5.00 kNm (Min=-17.4) (Max=9.79)
Bending moment My of beam, Loadcase 21, 1 cm = 5.00 kNm (Min=-9.87) (Max=6.94)
Bending moment My of beam, Loadcase 22, 1 cm = 5.00 kNm (Min=-14.4) (Max=13.8)
Bending moment My of beam, Loadcase 23, 1 cm = 5.00 kNm (Min=-14.4) (Max=11.0)
Bending moment My of beam, Loadcase 24, 1 cm = 5.00 kNm (Min=-18.9) (Max=12.0)
Bending moment My of beam, Loadcase 31, 1 cm = 5.00 kNm (Min=-9.87) (Max=6.94)
Bending moment My of beam, Loadcase 32, 1 cm = 5.00 kNm (Min=-14.4) (Max=11.0)
Bending moment My of beam, Loadcase 33, 1 cm = 5.00 kNm (Min=-14.4) (Max=13.8)
Bending moment My of beam, Loadcase 34, 1 cm = 5.00 kNm (Min=-18.9) (Max=12.0)
Bending moment My of beam, Loadcase 41, 1 cm = 5.00 kNm (Min=-11.3) (Max=6.38)
Bending moment My of beam, Loadcase 42, 1 cm = 5.00 kNm (Min=-15.8) (Max=13.2)
Bending moment My of beam, Loadcase 43, 1 cm = 5.00 kNm (Min=-18.9) (Max=13.2)
Bending moment My of beam, Loadcase 44, 1 cm = 5.00 kNm (Min=-20.6) (Max=11.4)

M 1 : 100



Y-X
Z

Shear force Vz of beam, Loadcase 11, 1 cm = 5.00 kN (Min=-10.5) (Max=10.5)
Shear force Vz of beam, Loadcase 12, 1 cm = 5.00 kN (Min=-14.2) (Max=20.6)
Shear force Vz of beam, Loadcase 13, 1 cm = 5.00 kN (Min=-20.6) (Max=14.2)
Shear force Vz of beam, Loadcase 14, 1 cm = 5.00 kN (Min=-21.8) (Max=21.8)
Shear force Vz of beam, Loadcase 21, 1 cm = 5.00 kN (Min=-10.9) (Max=13.8)

M 1 : 100



Bending moment M_y of beam, Loadcase 101 MAX- M_y , 1 cm = 5.00 kNm (Max=13.8)
Bending moment M_y of beam, Loadcase 102 MIN- M_y , 1 cm = 5.00 kNm (Min=-20.3) (Max=0)

M 1 : 100



Shear force V_z of beam, Loadcase 103 MAX-VZ, 1 cm = 5.00 kN (Max=25.4)
Shear force V_z of beam, Loadcase 104 MIN-VZ, 1 cm = 5.00 kN (Min=-25.4) (Max=0)

M 1 : 100