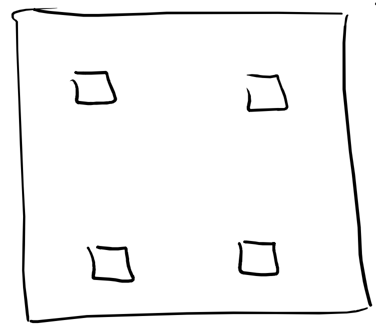
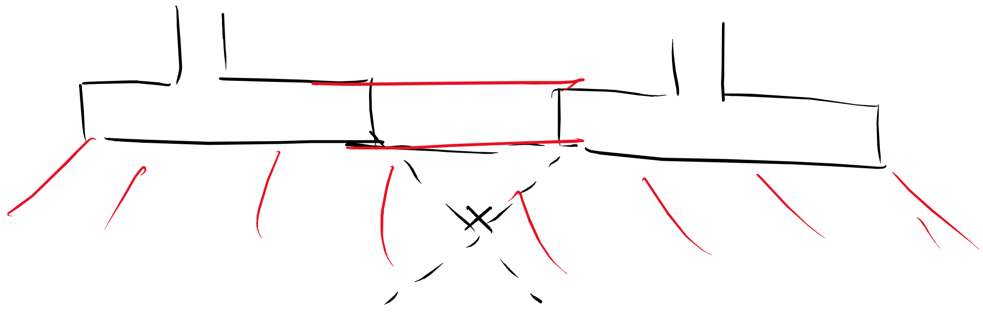
Mat Foundation

- if $\frac{\Sigma P}{q_{all}} > 60\%$ of Building Area.



- if $\frac{\Sigma P}{q_{all}} < 50$ → Isolated or Combined or Strap.

- $\frac{\Sigma P}{q_{all}} > 100\%$ → Piles.

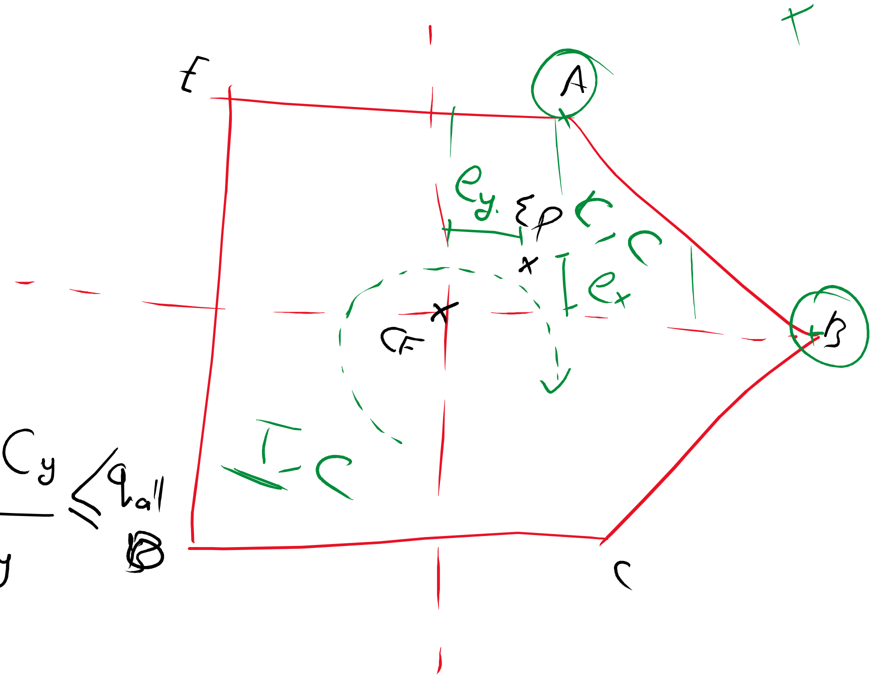


→ eccentricity → moment

Center of Load $\neq$ Center of Mat

Cases

1. M_x
2. M_y
3. M_y and M_x



$$\sigma_{max} = \frac{\Sigma P}{A} + \frac{M_x C_x}{I_x} + \frac{M_y C_y}{I_y} \leq q_{all}$$

$M_x = P \times e_x$

$M_y = P \times e_y$

(1) $\sigma_{max} \rightarrow$ at A or B
(at the quarter where (P) found.

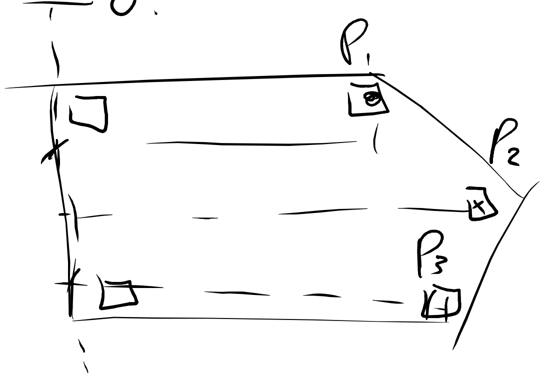
(2) σ_{min} is at the farther distance from P $\rightarrow$ at D

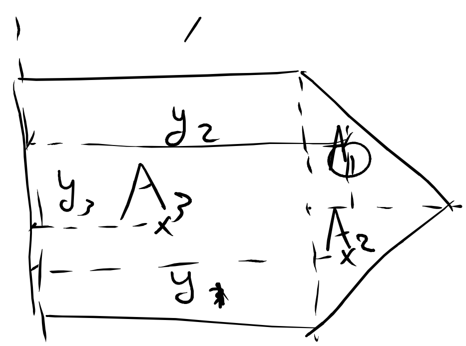
$\sigma_{min} \geq 0$

$\sigma_{max} \leq q_{all}$

$$y_p = \frac{\sum P_i \times y_i}{\sum P_i} \quad , \quad y_G = \frac{\sum A_i \times y_i}{\sum A_i}$$

Load LR y.   foot RL y





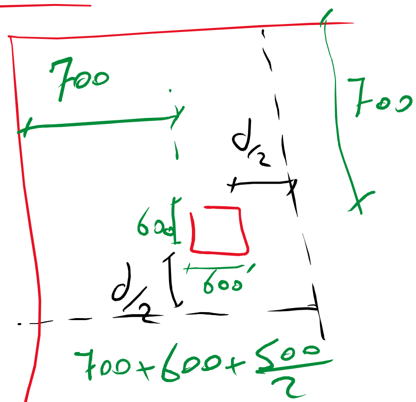
$$X_p = \frac{\sum P_i \times X_i}{\sum P_i} \quad , \quad X_G = \frac{\sum A_i \times X_i}{\sum A_i}$$

thickness

① mostly thickness controled by Punching.

interior or edge or corner $d = 500$ mm.

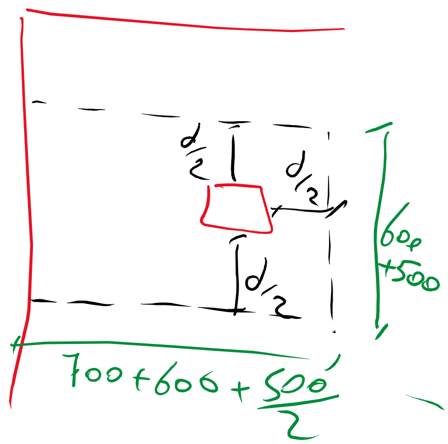
Corner



$b_o = \left(600 + \frac{500}{2} + 700\right) \times 2$

$= 3100$ mm

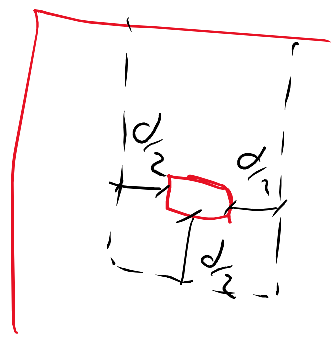
edge



$b_o = 1550 \times 2 + 600 + 500$

$= 4200$ mm

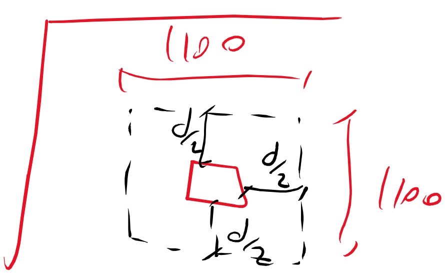
edge.



$b_o = 1550 \times 2 + 600 + 500$

$= 4200$

interior



$b_o = 1100 \times 2 + 1100 \times 2$

$= 4400$ mm

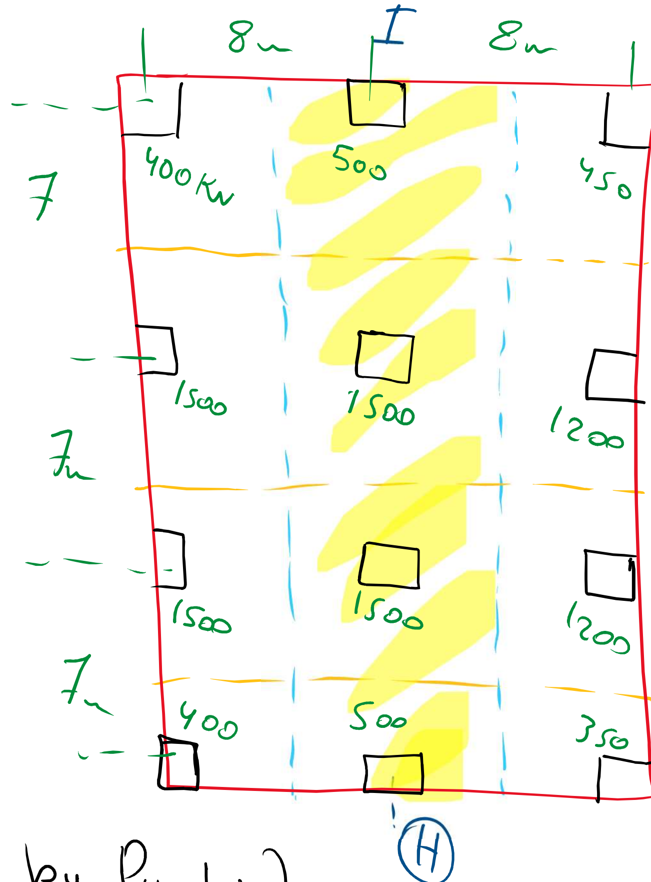
$b_o \downarrow \quad \phi V_c \downarrow$

Critical Case at the lowest b_o ⟶ at Corner Case

Design the mat foundation shown

f'_c : 20 MPa | q_{all} : 60 kN/m²

f_y : 420 MPa | all Columns 50x50 cm



Ultimate load factor 1.4

Loads given are service loads

① thickness (hint: Controled by Punching)

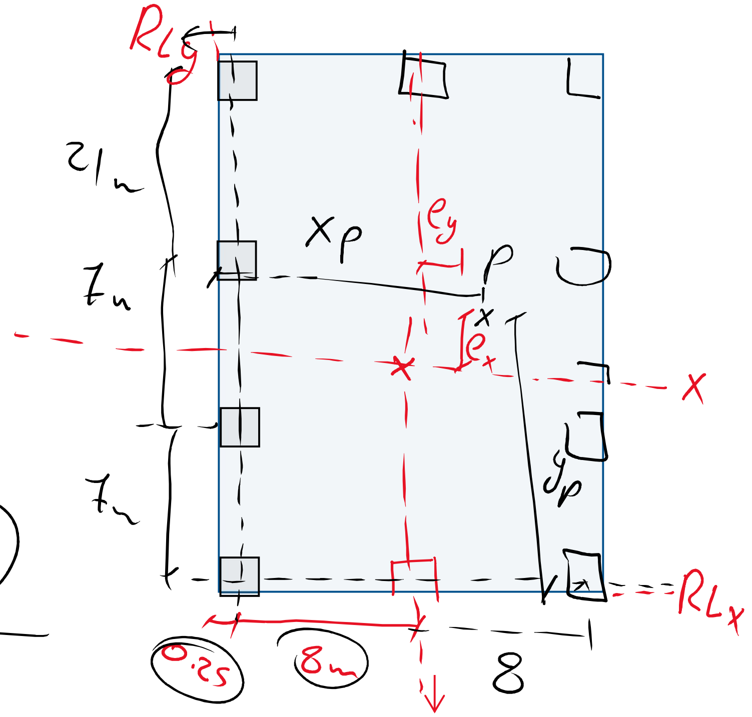
② Draw SFD, BMD for strip H-I

Solution

$$\sigma_{max} = \frac{P}{A} + \frac{M_x C_x}{I_x} + \frac{M_y C_y}{I_y} \leq q_{all} : 60 \text{ kN/m}^2$$

ⓐ Center of load and Center of footing

$$X_p = \frac{\sum P_i x_i}{\sum P_i}$$



$$= \frac{(400+1500+1500+400)\times 0 + (500+1500+1500+500)\times 8 + (450+1200+1200+350)\times 16}{\sum P_i = 11000\ \text{kN}}$$

$$X_p = 7.56\ \text{m}$$

$$X_f = \frac{16}{2} = 8\ \text{m}$$

$$y_p = \frac{(4200 \times 7\text{m} \ ② + (4200 \times 14) \ ③ + 1350 \times 21\text{m})}{11000}$$

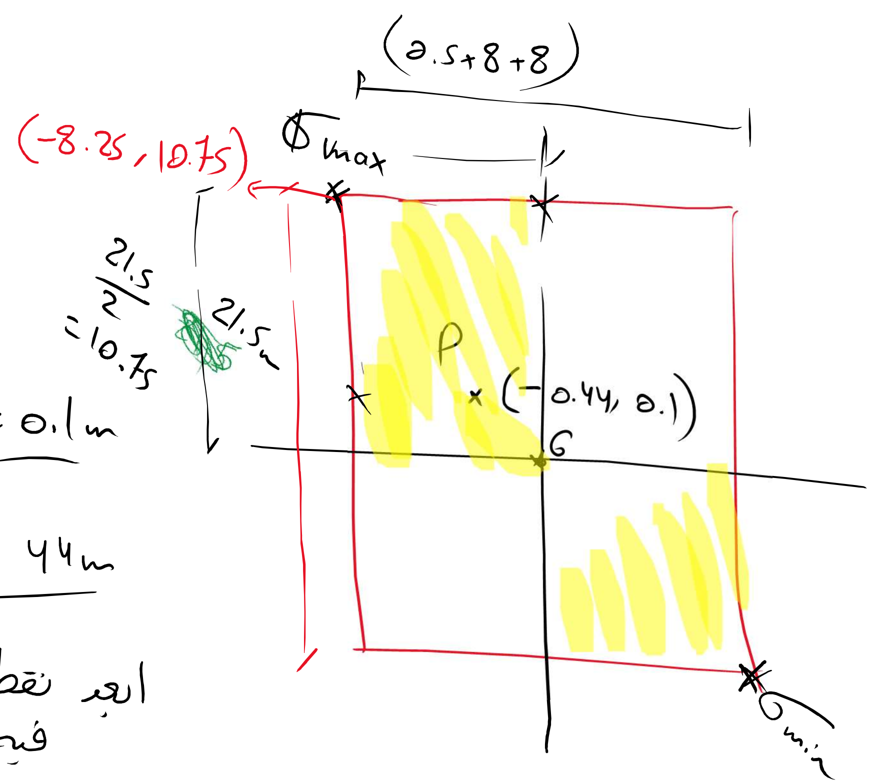
$$y_p = 10.6\ \text{m}$$

$$y_f = \frac{21}{2} = 10.5\ \text{m}$$

$$e_x = y_p - y_f = 10.6 - 10.5\text{m} = 0.1\ \text{m}$$

$$e_y = X_p - X_f = 7.56 - 8\text{m} = -0.44\ \text{m}$$

ابعد نقطه من الحمل في الربع الذي يتواجد فيه الحمل



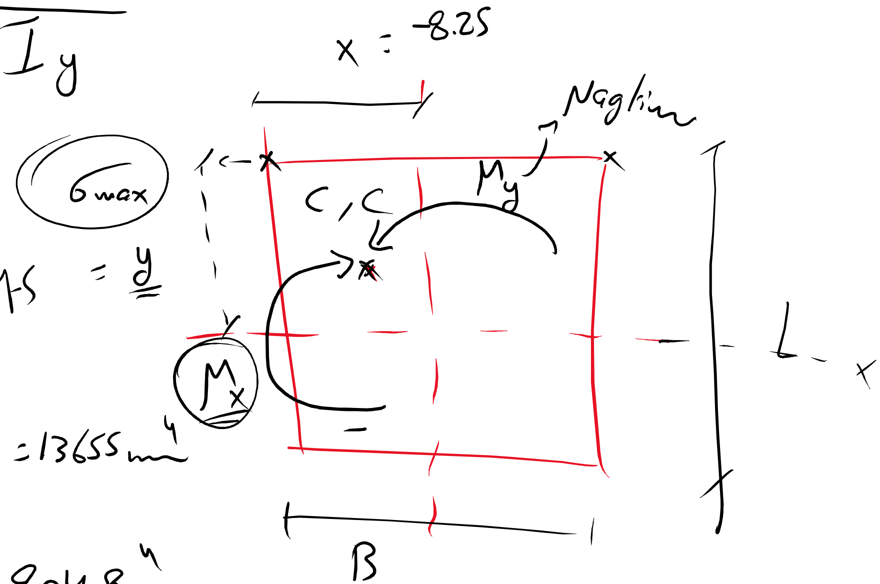
$\sigma_{max} \leq q_{all} = 60\ kN/m^2$

Servic

$$\sigma_{max} = \frac{P}{A} + \frac{M_x \times \overset{y}{C_x}}{I_x} + \frac{M_y\ \overset{x}{C_y}}{I_y}$$

$M_x = P \times e_x$

$M_y = P \times e_y$



$$I_x = \frac{L^3 \times B}{12} = \frac{21.5^3 \times 16.5}{12} = 13655\ m^4$$

$$I_y = \frac{B^3 \times L}{12} = \frac{16.5^3 \times 12.5}{12} = 8048\ m^4$$