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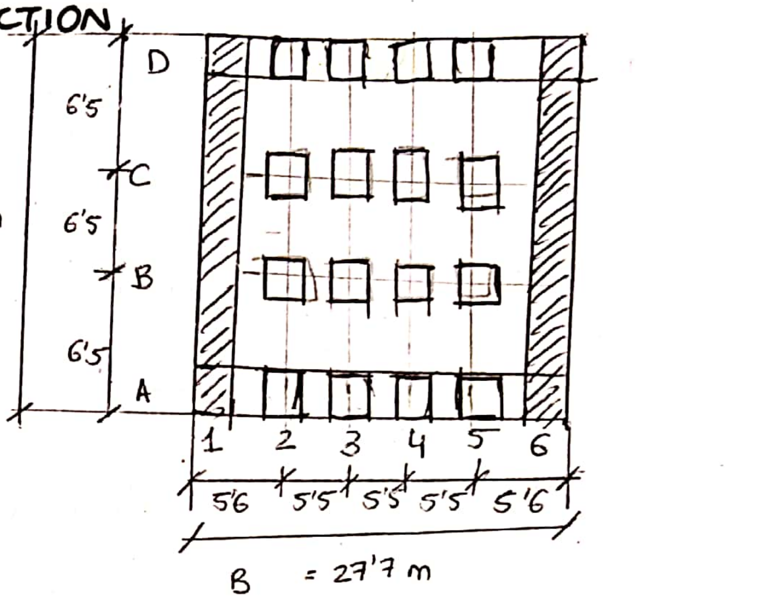
4th TASK. RC STIFFENING WALLS IN THE STRUCTURE FROM 3th TASK IN LONGITUDINAL DIRECTION

T = IV
W = I
nº of floors = 7
h = 3'9 m
n×h = 27'3 m



1. WIND LOAD

P_v = 1'25 Kg/m3 (density of air)

For wind load area W = I
↳ V_b = 22'5 m/s

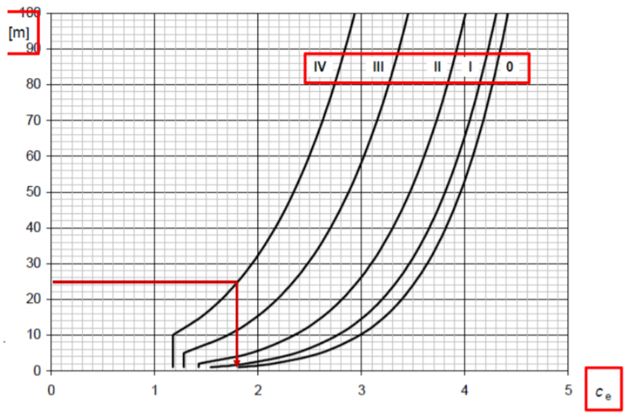
C_{pe} = 1'3 (External preassure coeffict).

Characteristic value (w_k) : $w_k = q_b \cdot C_e(z) \cdot C_{pe}$

$$q_b = \frac{1}{2} P_v \cdot V_b^2$$

$$q_b = \frac{1}{2} \cdot 1'25 \cdot 22'5^2 = 316 \ N/m^2 = 0'316 \ KN/m^2$$

$C_e(z)$ = 1'9 for a z = 27'3 m and T.C = IV



$$w_k = 0'316 \cdot 1'3 \cdot 1'9 = 0'78 \ KN/m^2$$

γ_Q = partial factor

$\gamma_Q = 1'5$

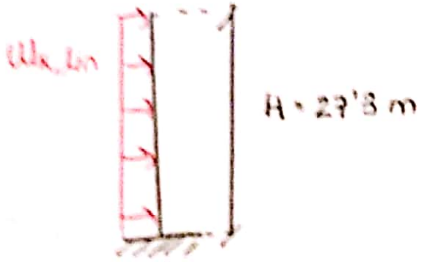
$W_d = \gamma_Q \cdot W_K$

$W_d = 1'5 \cdot 0'78$

$W_d = 1'17 \ KN/m^2$

We need linear load in KN/m:

$W_{K,lin} = W_K \cdot B = 0'78 \cdot 27'7 = 21'61 \ KN/m$



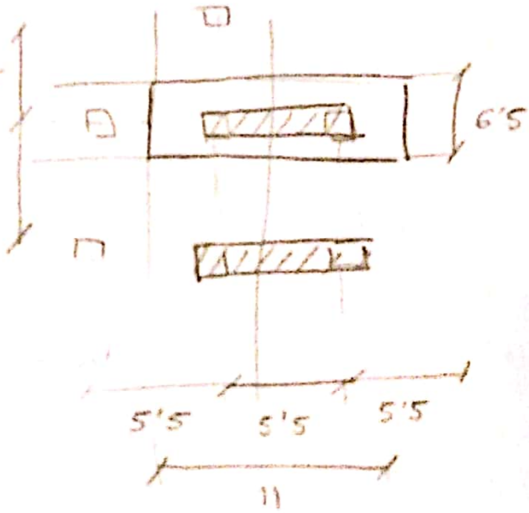
2. VERTICAL LOADS

I estimate 2 walls of lenght = 5'5 m and thickness 250 mm.

MINIMUM VERTICAL LOAD

The tributing area:

$A_{trib} = 6'5 \cdot 11 = 71'5 \ m^2$



From TASK 3, the slab load = 10'13 KN/m²

nº of floors = 7

$R_{min} = 7 \cdot 71'5 \cdot 10'13$

$R_{min} = 5070 \ KN$

MAXIMUM VERTICAL LOAD

From TASK 3: the desing load:

$f_d = 15'97 \ KN/m^2$

$R_{max} = 7 \cdot 71'5 \cdot 15'97$

$R_{max} = 7993 \ KN$

So the con...

C_1: Charact... vertical load

$C_1 = 21'6$ ... $\simeq 5660$ KN

C_2: Desing ... vertical load

$C_2 = 1'17$ ... $3 \simeq 8878$ KN

C_3: Desing wind load + minimum vertical load

$C_3 = 1'17 \frac{KN}{m^2} \cdot 27'7 \cdot 27'3 + 5070 \simeq 5955$ KN

This does not make sense. You can't sum horizontal and vertical loads.
Delete this part.
But as you have not used these numbers in further calculation, the rest of the task is correct.

C1 will be use.

3. DESING OF GEOMETRY OF THE WALLS

The total bending moment in the foot of all stiffening walls is:

$$M_w = \frac{1}{2} \cdot w_{k,lin} \cdot H^2$$

$$M_w = \frac{1}{2} \cdot 21'61 \cdot 27'3^2 \approx 8053 \text{ KN}\cdot\text{m}$$

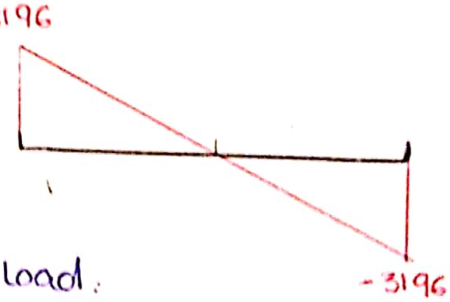
And the stress from the characteristic wind load;

m = 2 = nº of stiffening walls.

$$\sigma_w = \pm \frac{1}{m} \cdot \frac{M_w}{W} \quad ; \quad W = \frac{t \cdot L^2}{6} = \text{section modulus of one wall}$$

$$W = \frac{0'25 \cdot 5'5^2}{6} = 1'26 \text{ m}^3$$

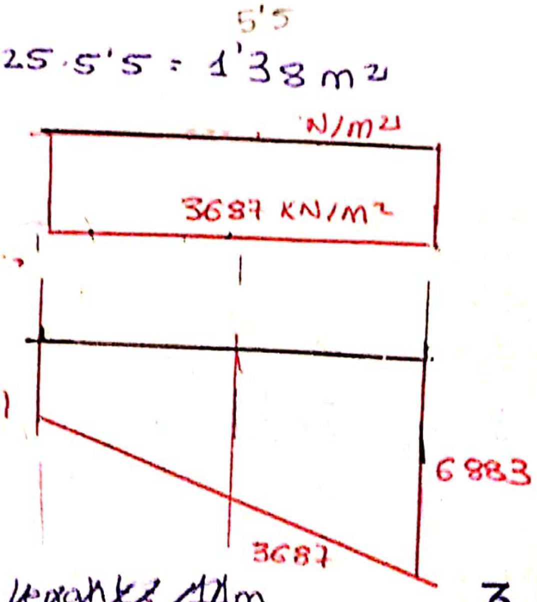
$$\sigma_w = \pm \frac{1}{2} \cdot \frac{8053 \text{ [KN m]}}{1'26 \text{ [m}^3\text{]}} \cong \pm 3196 \text{ KN/m}^2$$



Stress from the minimum vertical load:

$$\sigma_N = \frac{R_{MIN}}{A} \; ; \; A = t \cdot L = 0'25 \cdot 5'5 = 1'38 \text{ m}^2$$

$$\sigma_N = \frac{5070}{1'38} = 3657 \text{ KN/m}^2$$



Tension is avoid from C1, so the estimated geometry is corrected:

2 walls of $L = 5'5$m and thickness of 250 mm

~~2 walls of lenght 11m~~

4. DESING OF REINFORCEMENT

C2: $M_w = \frac{1}{2} \cdot w_d \, H^2 = \frac{1}{2} \cdot 1'17 \frac{KN}{m^2} \cdot 27'7m \cdot 27'3^2$

$M_w = 12077 \; KN \cdot m$

$\sigma_w = \pm \frac{1}{2} \cdot \frac{12077}{1'26} = \pm 4792'5$

$\sigma_N = \frac{7993}{1'38} = 5813$

→ No tension

C3: σ_w = same as in C2 → $\sigma_w = \pm 4792'5$

σ_N = same as is C1 → $\sigma_N = 3687$

↳ Tension

↓

REINFORCEMENT

VERTICAL REINFORCEMENT

$0'002 \cdot a_c \leq a_{s,v} \leq 0'04 \cdot a_c$

$S_v \leq \min(3t \, ; 400) \, mm = (3 \cdot 250 \, ; \, 400) = 750 \, mm$

$a_c = 250 \cdot 1000 = 25e^4 \; mm^2$

$500 \leq a_{sv} \leq 10000 \; mm^2$

$a_{sv} = 500 \; mm^2$

$\phi 8$ a 200 mm → $a_{sv} = 2 \cdot 251 \; mm^2/m$

HORIZONTAL REINFORCEMENT

$a_{s,H} \geq \max(0'25 \cdot a_{s,v} \, ; \, 0'001 \cdot a_c)$

$S_H \leq 400 mm$

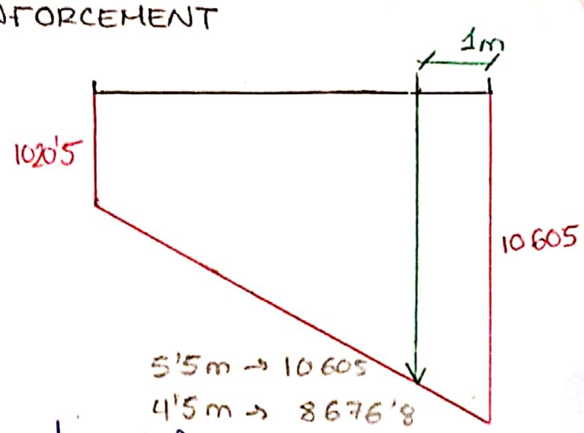
$a_{sH} \geq \max(0'25 \cdot 500 \, ; \, 0'001 \cdot 25e^4)$

$a_{sH} \geq \max(125 \, ; \, 250) \; mm^2$

$a_{sH} = 250 \; mm^2$

$\phi 8$ a 400 mm → $a_{sH} = 2 \cdot 126 \; mm^2/m$

COMPRESSED REINFORCEMENT



$N = \sigma_{\phi} \cdot t \cdot 1m$

$N = 8677 \cdot 0'25 \cdot 1$

$N = 2169'3$ KN

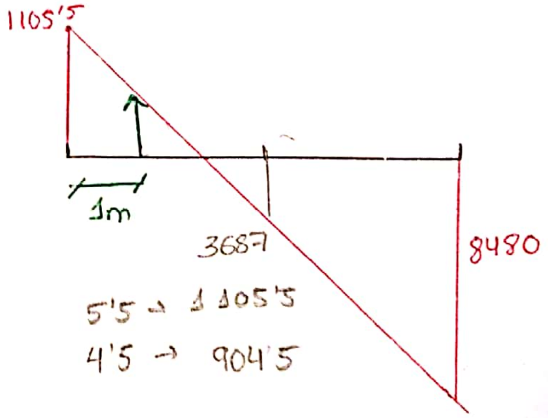
- $\sigma_s = 400 MPa$
- $f_{cd} = 16'67$ MPa for C 25/30

The required area of vertical reinforcement is:

$$a_{s,req,v} = \frac{N - 0'8 \cdot a_c \cdot f_{cd}}{\sigma_s}$$

$$a_{s,req,v} = \frac{2169'3 - 0'8 \cdot 0'25 \cdot 1 \cdot 16'67e^3}{400\,e^3} = -0'0029 < 1 \checkmark$$

TENSILE REINFORCEMENT



$N = 904'5 \cdot 0'25 \cdot 1$

$N = 226'13$ KN

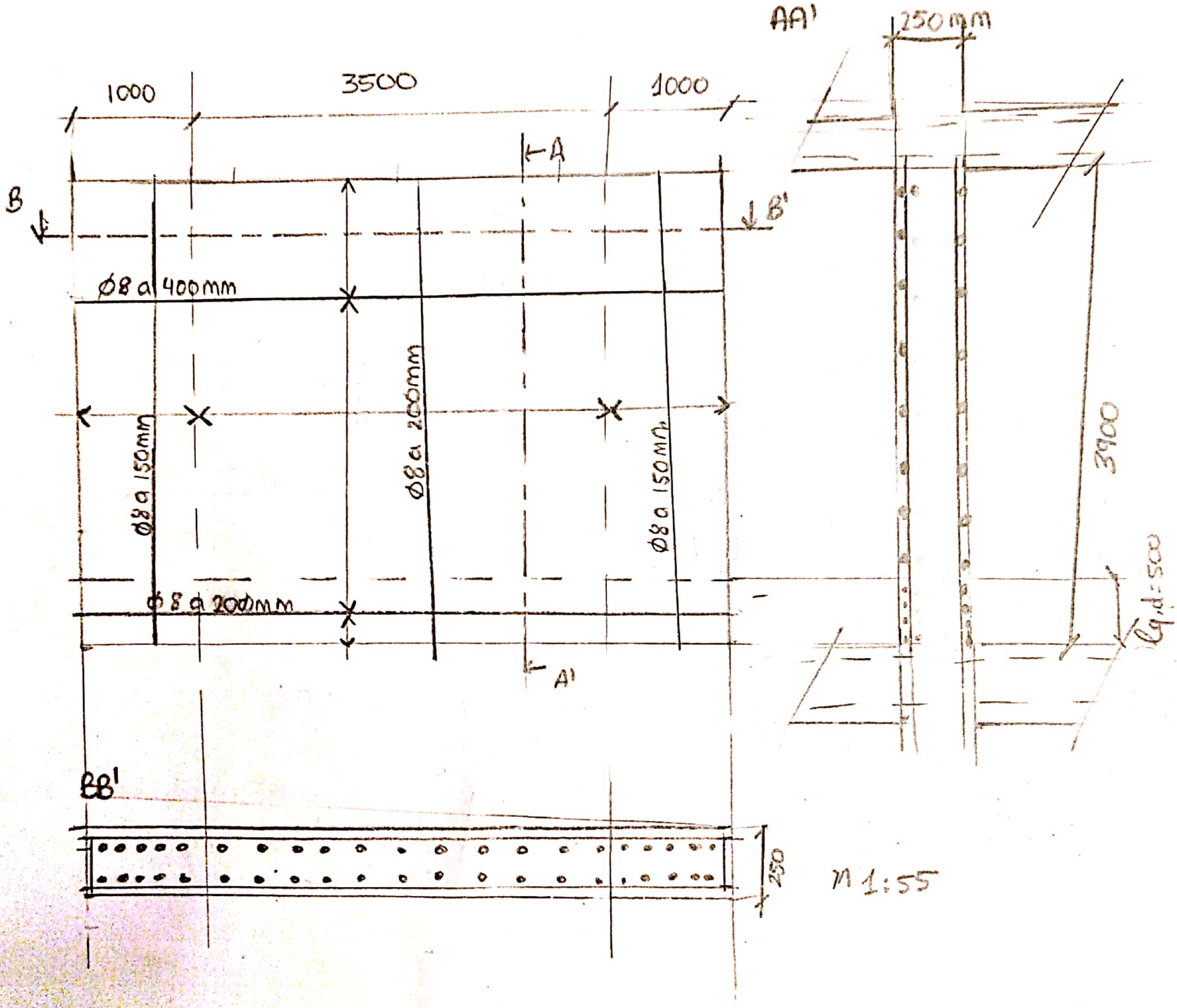
- $f_{yd} = 434'78$ MPa for B500S

$$a_{s,req,v} = \frac{N}{f_{yd}} = \frac{226'13}{434'78e3}$$

$a_{s,req,v} = 0'00052\ m^2 = 520\ mm^2$

$a_{s,req,v} = 520\ mm^2 > a_{s,v} = 500\ mm^2$

So, $\phi 8$ a 150 mm → $a_{sv} = 2.335\ mm^2/m$
and $\phi 8$ a 400 mm → $a_{sH} = 2.126\ mm^2/m$



AA'
250 mm
1000
3500
1000
A
B
B'
Ø8 a 400mm
Ø8 a 200mm
Ø8 a 150mm
Ø8 a 150mm
3900
Ø8 a 200mm
A'
BB'
250
M 1:55