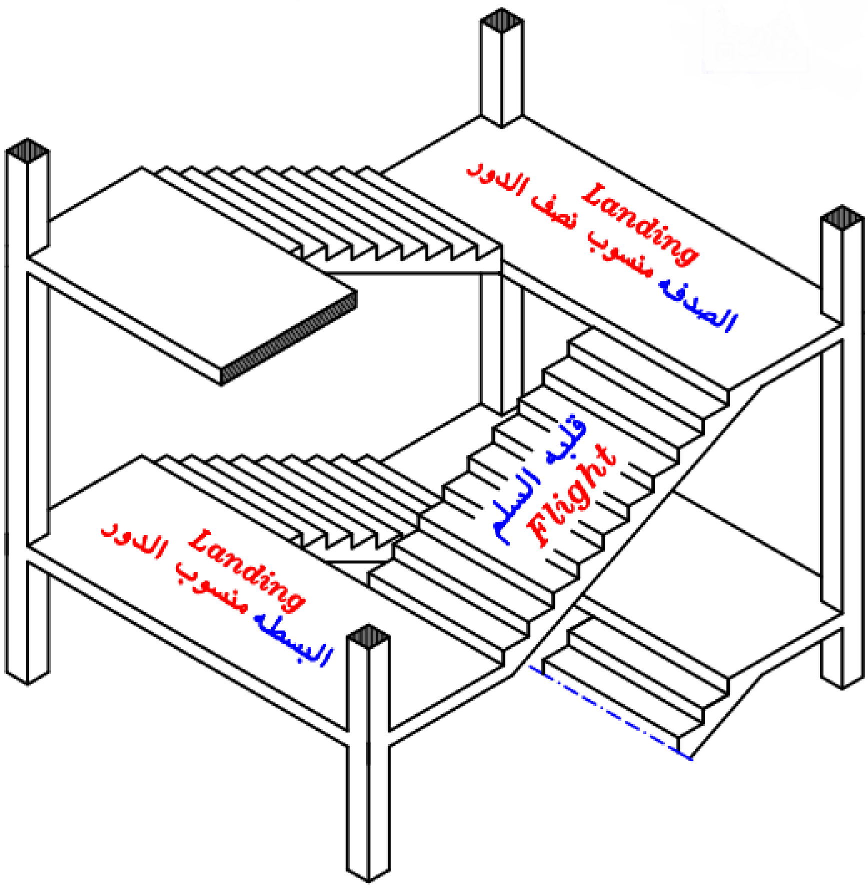
محاضرات م/ عمرو محمد طلبه لمادة

Design Of Stairs

تسألكم الدعاء

Steps of Deign STAIRS .



DESIGN OF STAIRS

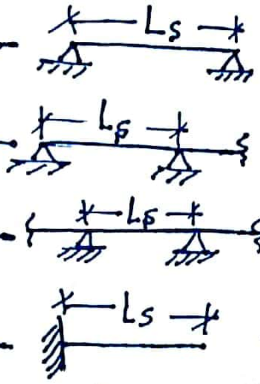
amr.tolba16@gmail.com
amr -tolba-4730a5189
amralbolbol@yahoo.com
@amrmoh95398792
01021726805 / 01100036400

* stairs *

steps of Design stairs :-

(1) Concrete Dim :- (After statical system of stairs)

* عادة تكون بلاطة السلم one way solid slab.



$t_s = \frac{L_s}{25}$

$= \frac{L_s}{30}$

$= \frac{L_s}{36}$

one way s.s

$= \frac{L_s}{10}$ (Cantliver)

L_s الطول الحقيقي الذى يسير عليه حمل.

$t_{s\,min} = 15.0\ cm$

(2) Load Calculation :- $W_s = 1.4\,D.L + 1.6\,L.L$

* D.L → $HZ = t_s \gamma_c + F.c$
  → $inc = t_{av} \gamma_c + F.c$

* LL → $HZ = l.l$
  → $inc = l.l\ \cos\theta$

W_s = → $W_{s\,hz} = 1.4[t_s \gamma_c + F.c] + 1.6\,ll$ = — t/m^2
→ $W_{s\,inc} = 1.4[t_{av} \gamma_c + F.c] + 1.6\,ll \times \cos\theta$ = — t/m^2

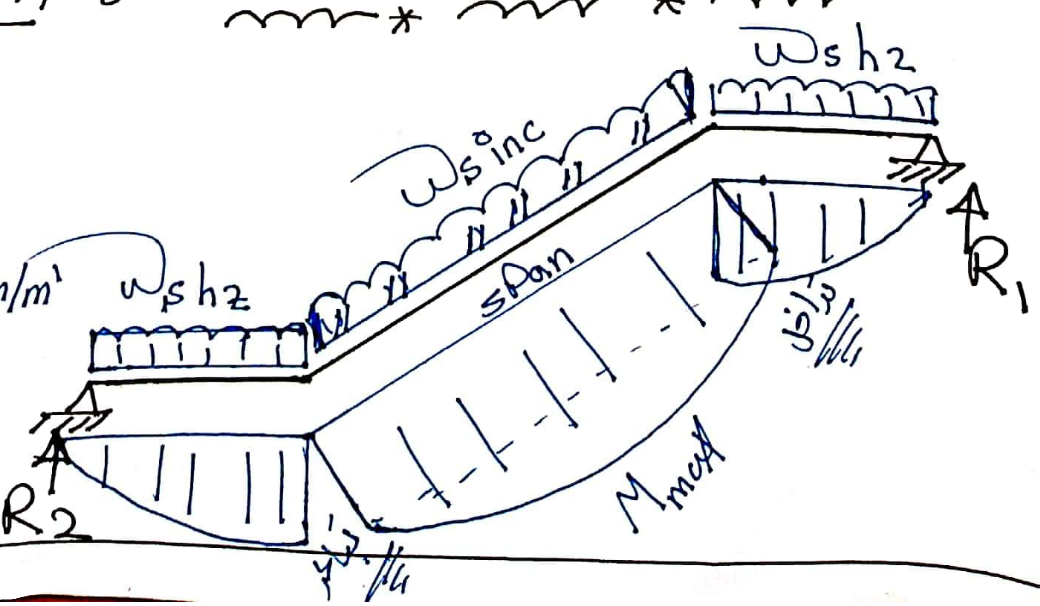
$t_{s\,av} = t_s + 7\,cm$ → * تستخدم فى حساب الأحمال فقط ولا تستخدم فى التصميم

(3) take strips :- strip 1m in load direction.

$R_1 = \ —\ ton$

$R_2 = \ —\ ton$

$M_{ult} = M_{max} = \ —\ t.m/m'$



④ Design :-

$M_{max} = ✓✓ \; t.m/m'$, $t_s = ✓ cm$, $d = ✓ cm$

$F_{cu} = ✓$, $F_y = ✓$

∴ $d = C_1 \sqrt{\dfrac{M_{ult}}{F_{cu} * b}}$

→ b عرض الشريحة $= 100 \; cm$

→ $d = t_s - cover$ → $(2-3) \; cm$

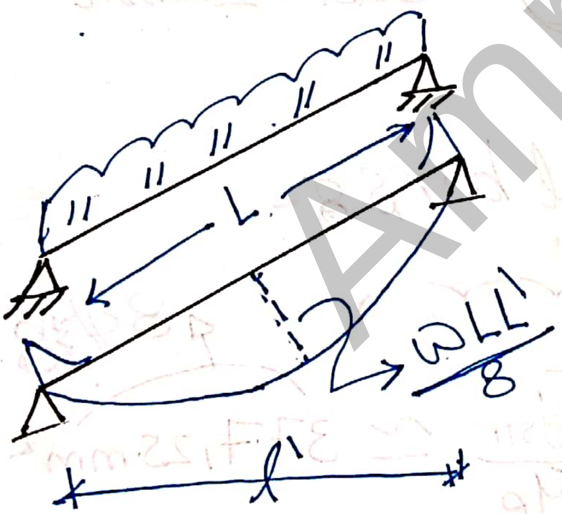
$C_1 = ✓$ From table → $J = ✓✓$

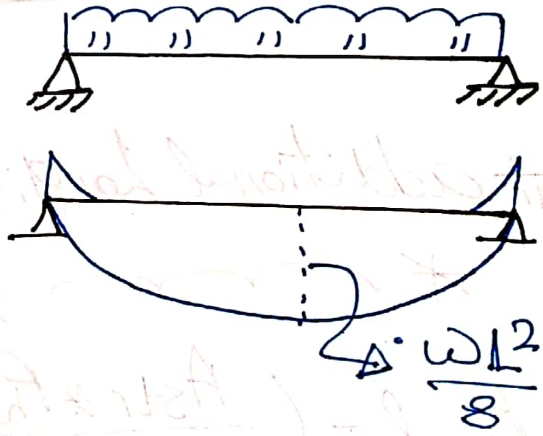
∴ $A_s = \dfrac{M_{ult}}{F_y \cdot J \cdot d} = (✓ \; cm^2/m')$ ✓✓ $> A_{s\,min}$

→ $A_{s\,min} = \dfrac{1.1}{F_y} B * d = ✓✓ > 6 \Phi 12/m'$

(B → $100 \; cm$)

⑤ Draw reinforcement :-





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* Rise (قائمة) = R = (14 → 18 cm) غالبا → 15 cm
* Going (نائمة) = G = (26 → 30 cm) غالبا → 30 cm

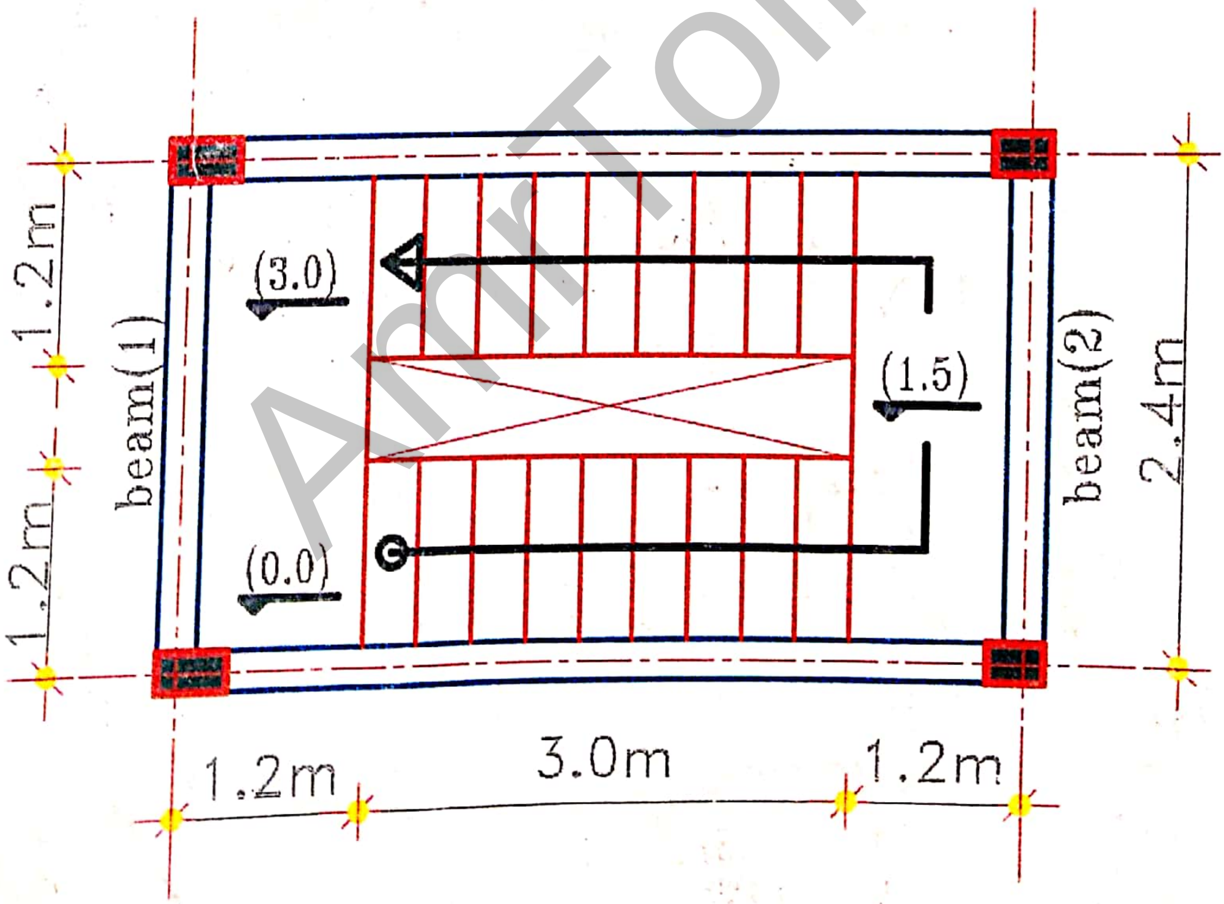
Stairs

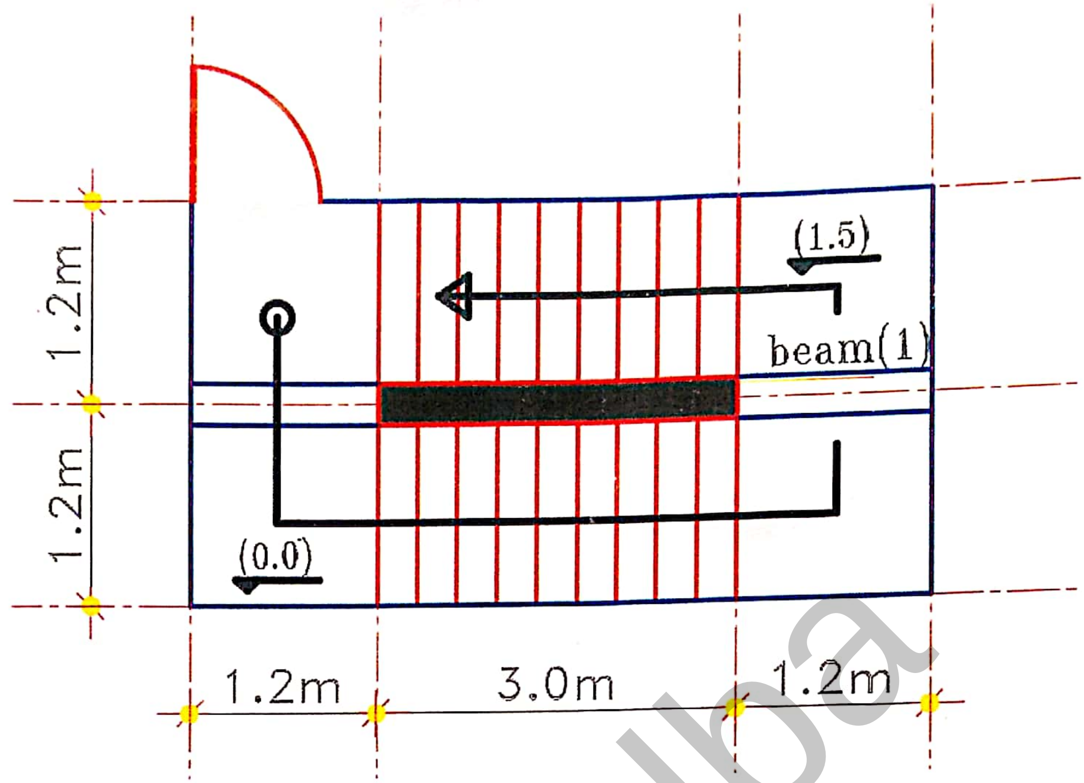
For the shown stairs.

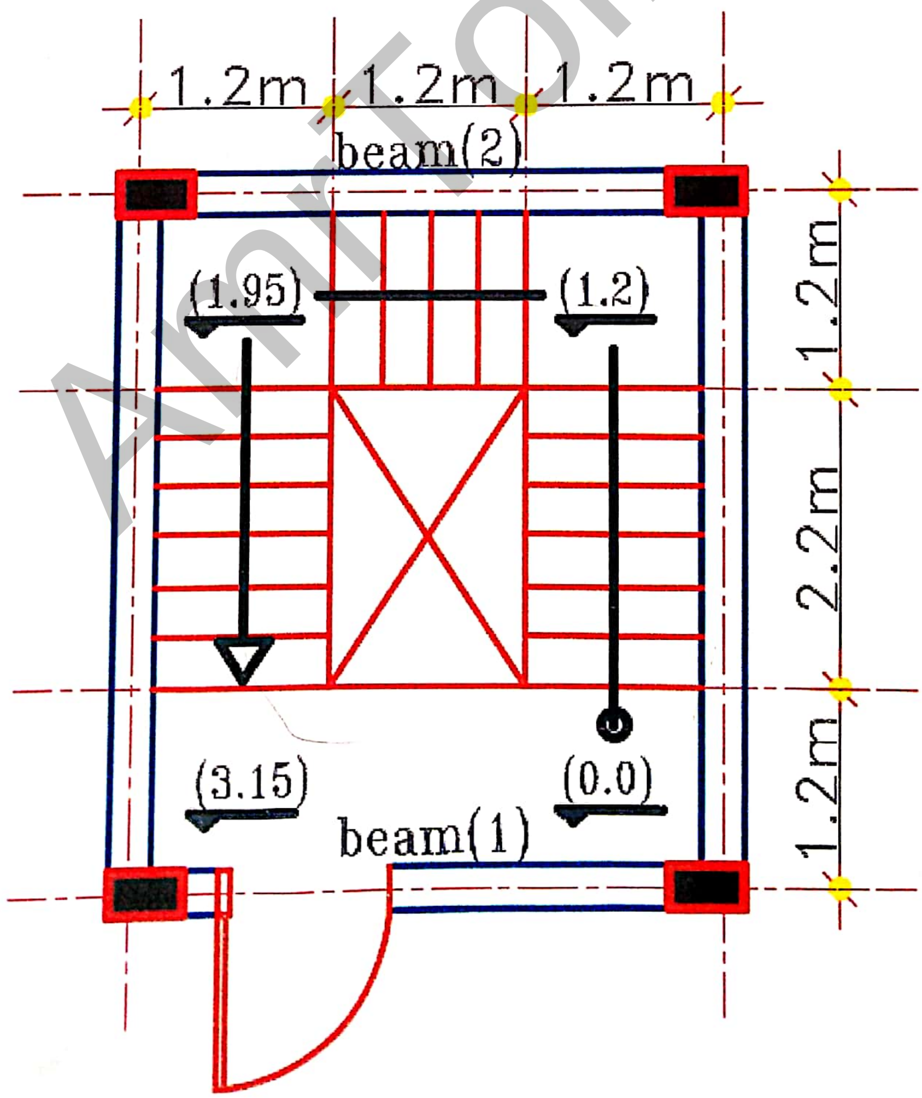
- F.c. =150 kg/m2
- L.L. =300 kg/m2
- Fcu=250 kg/cm2
- St.36/52

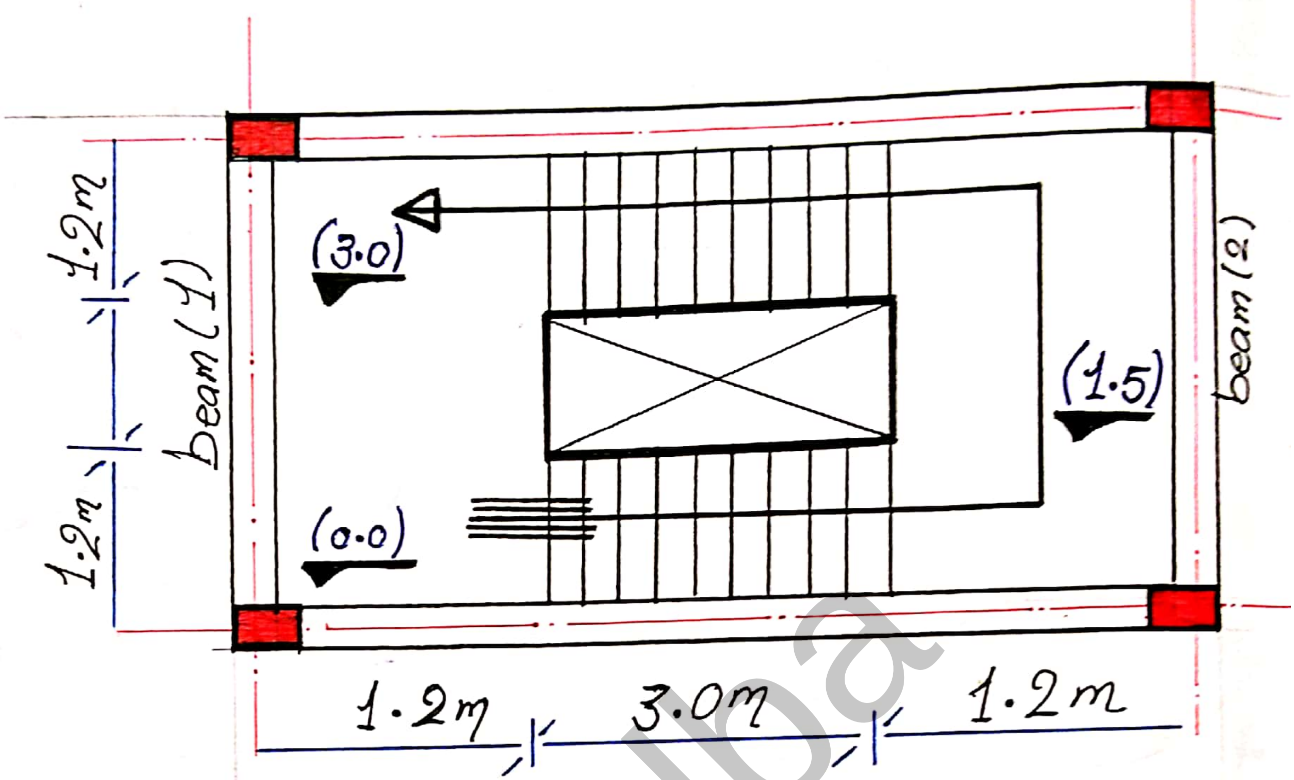
****It is required to:-**

- Design the stairs slabs and draw details of reinforcement in plan scale (1:50) and longitudinal sections.
- Design of Beams (B1-B2) and draw details of reinforcement (longitudinal and cross).




(1.5)
beam(1)
(0.0)
1.2m
1.2m
1.2m
3.0m
1.2m


1.2m
1.2m
1.2m
beam(2)
(1.95)
(1.2)
(3.15)
(0.0)
beam(1)
1.2m
2.2m
1.2m



1] Concrete Dim.s

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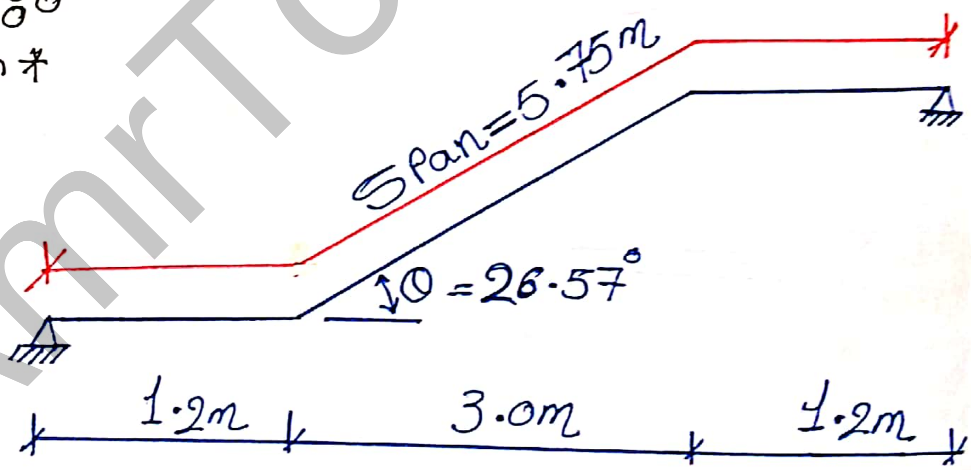


$$t_s = \frac{Span}{25}$$

$$= \frac{5750}{25}$$

$$= 230$$

$$= \boxed{240\,mm}$$

$$t_{s_{av}} = t_s + 70 = 310\,mm$$

2] load Calculation :-

$(w_{su})_{hz} = 1.4(t_s \gamma_c + F.c) + 1.6(l.l)$

$= 1.4[0.24*25+1.5]+1.6*3.0$

$w_{su_{hz}} = 15.3\ kN/m^2$

$w_{su_{Inc}} = 1.4[t_{s_{av}} \gamma_c + F.C] + 1.6\, l.l \cos\theta$

$= 1.4[0.31*25+1.5]+1.6*3.0*\cos(26.57)$

$w_{su_{In}} = 17.75\ kN/m^2$

3] take strip :-

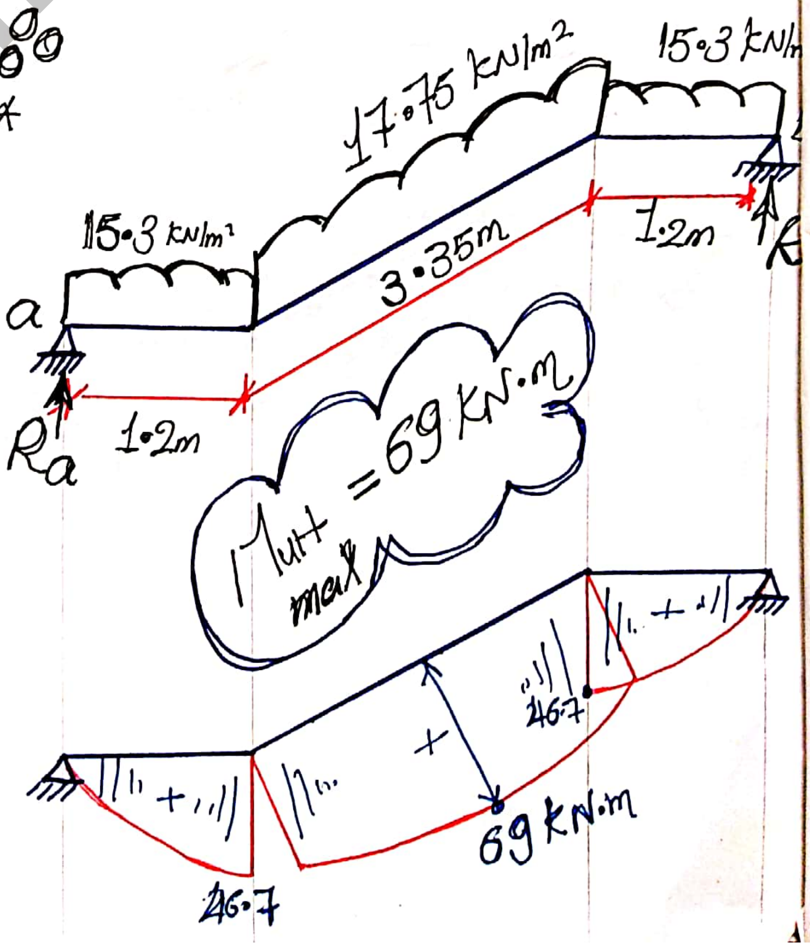
$\sum M @ a = 0.0$

$18.36*0.6+59.46*2.7$

$+18.36*4.8 = R_b*5.4$

$R_b = 48.1\ kN$

$R_a = 48.1\ kN$



4] Design Of Sections

$M_{ult max} = 69\ kN.m$

$d = 220 = C_1 \sqrt{\frac{69*10^6}{25*1000}} \Rightarrow C_1 = 4.19$ ~~J = 0.826~~ $J = 0.813$

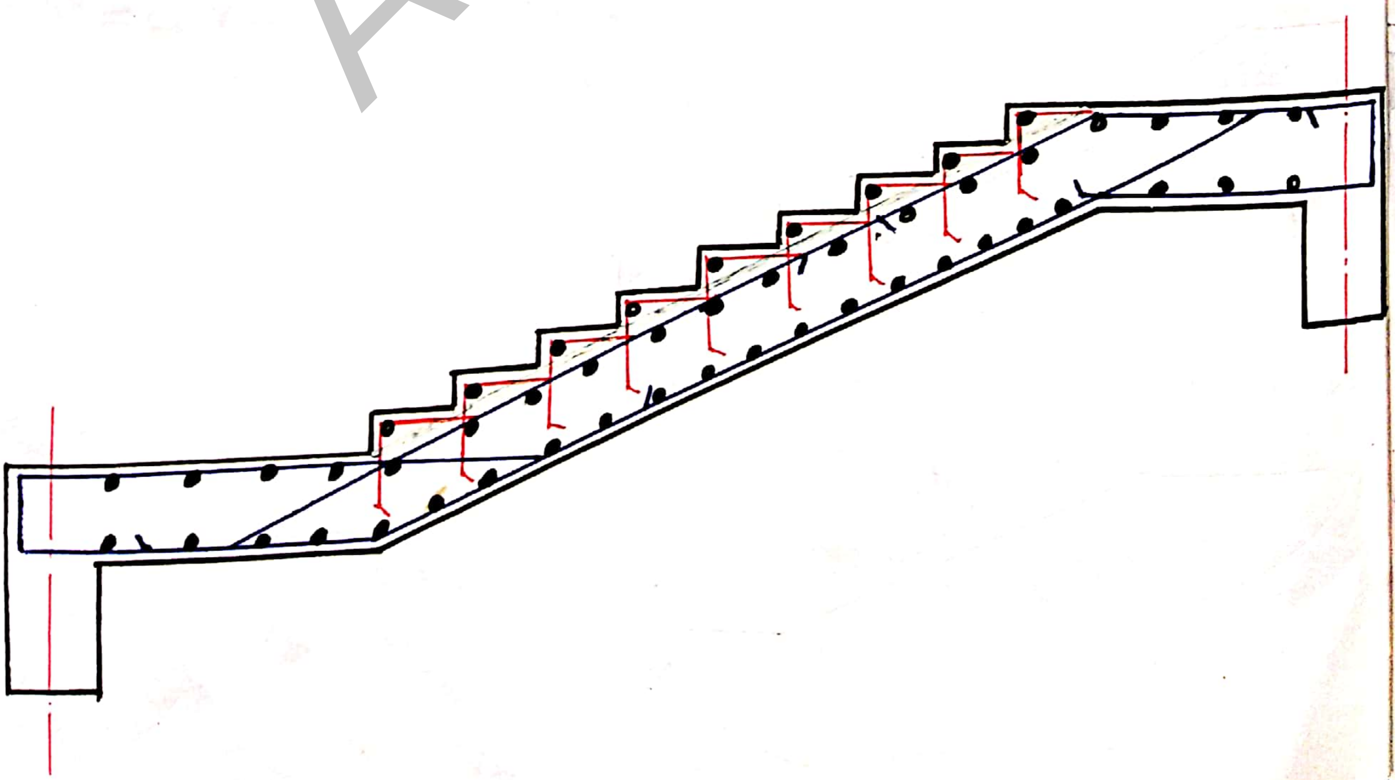
$A_S = \frac{M_{ul}*10^6}{F_y \cdot J \cdot d} = \frac{69*10^6}{360*0.813*220} = 1071.6\ mm^2$

$= 6\Phi 18/m'$

$A_{S min} = \frac{1.1}{F_y} b.d = \frac{1.1}{360} * 1000 * 220 = 672\ mm^2 < A_{req}$

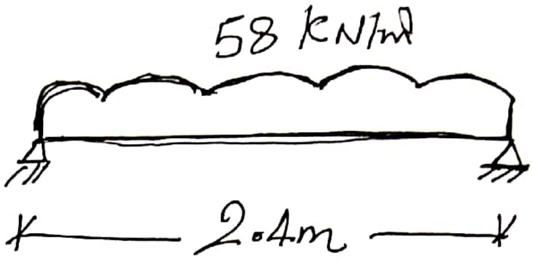
OK

Use $6\Phi 18/m'$ for all slabs



Design Of Beam :-

B_1 No torsion



<u>V.r Loads :-</u> (350 * 600)

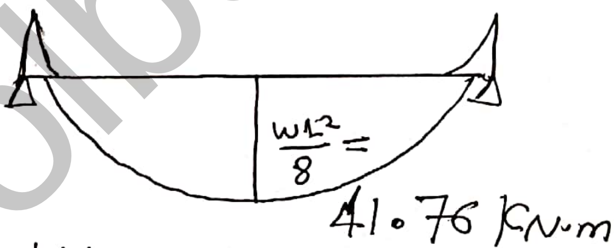
$w = o.w + wall + w_s$

$o.w = 1.4 * 25 * 0.35 * 0.6 = 7.35$ kN/m'

$wall = 2$ kN/m'

$w_s = R = 48.1$ kN/m'

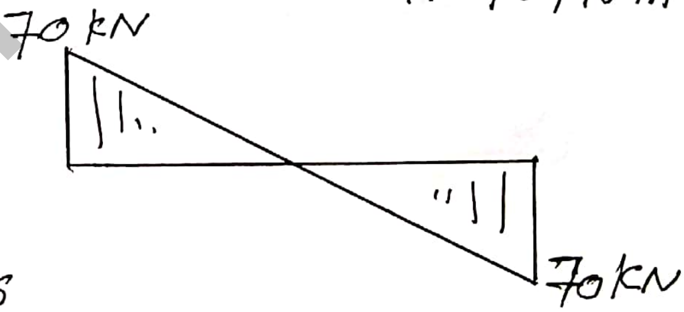
$w = 58$ KN/m'



$d = C\sqrt{\frac{M_u}{F_{cu} \cdot b}}$

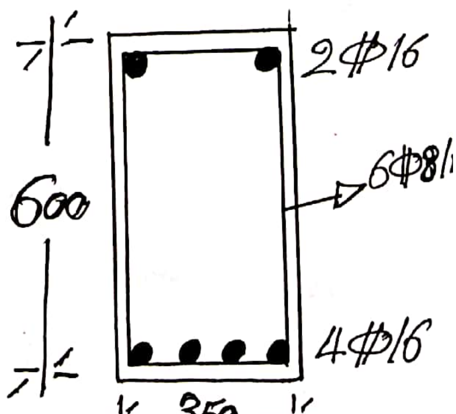
$330 = C\sqrt{\frac{42*10^6}{25*600}} \Rightarrow C = 6$

$J = 0.826$



$A_s = 236\ mm^2$

$A_{s_{min}} = 642 mm^2 = 4\Phi16$



<u>shear</u>

$q = \frac{Q}{B \cdot d} = \frac{70*10^3}{350*600} = 0.333\ N/mm^2$

$q_{cu} = 0.24\sqrt{\frac{F_{cu}}{\gamma_c}} = 0.979\ N/mm^2$

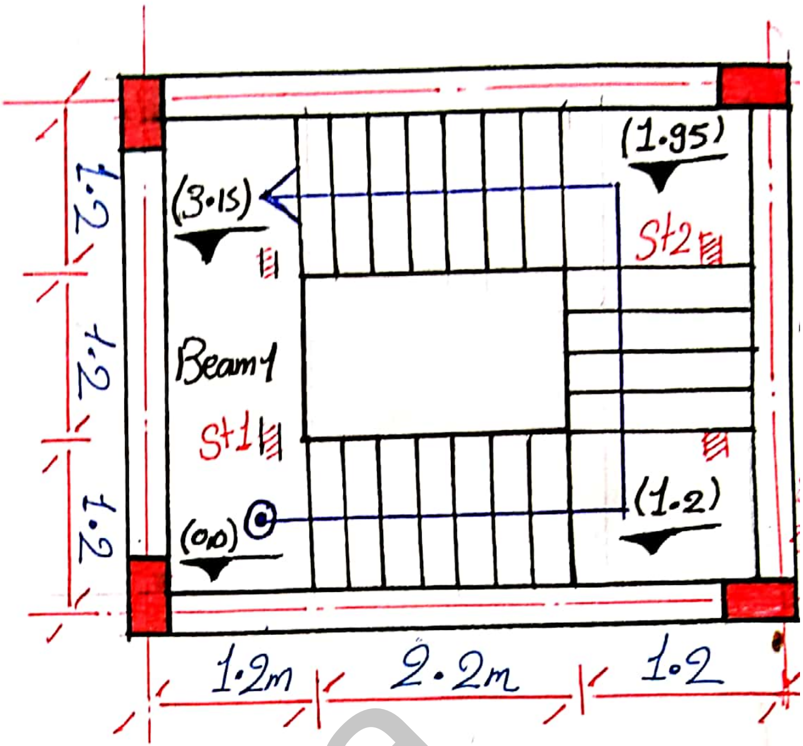
use min stirrups 5Φ8/m'

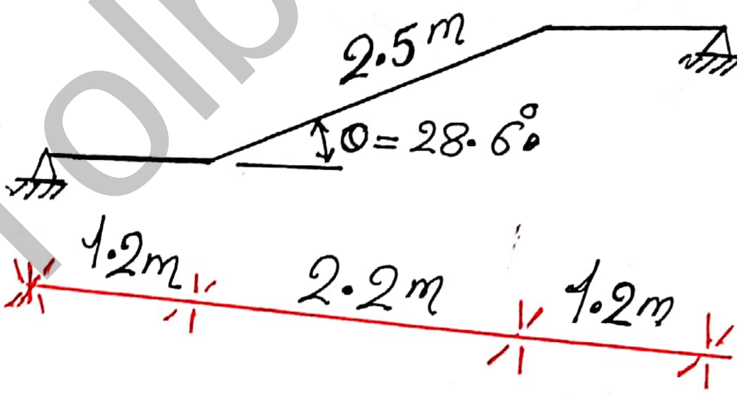
1) Concrete Dimensions

$$t_s = \frac{SPAN}{25.0} = \frac{4900}{25} \simeq 200mm$$

$t_s = 200mm$

$t_{s_{or}} = 270mm$





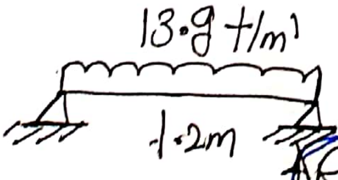
2) Load Calculation:

$$w_{su_{hz}} = 1.4*[0.2*25+1.5]+1.6*3 = 13.9 \ kN/m^2$$

$$w_{su_{In}} = 1.4[0.27*25+1.5]+1.6*3 = 15.8 \ kN/m^2$$

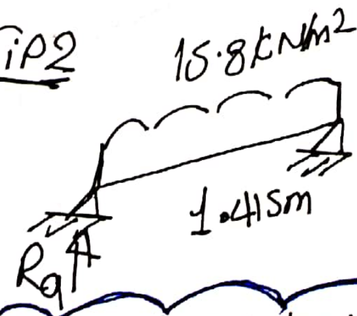
3) Strips:

strip 1



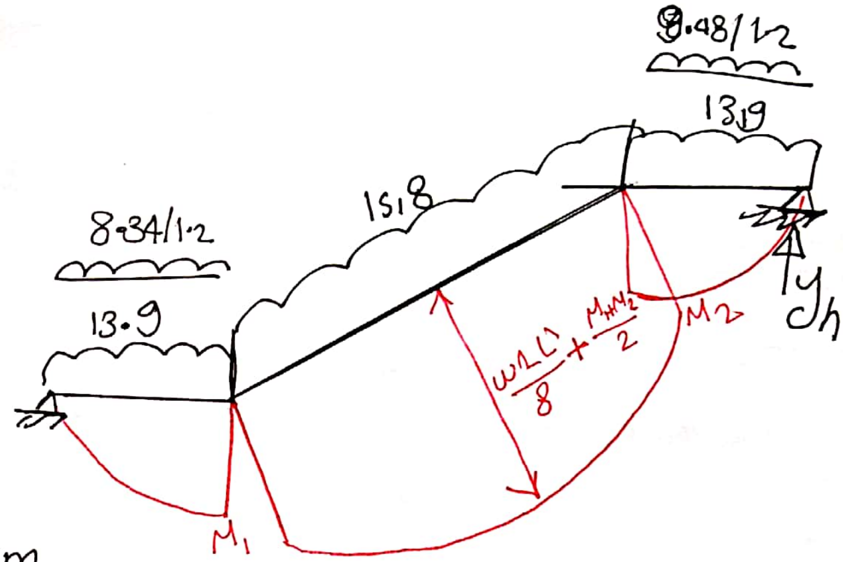
$R_b = 8.34 \ kN/m'$

strip2



$R_a = 9.48 \ kN/m'$

strip 3



$y_h = 44.5\ kN/m'$

$y_c = 43.1\ kN/m'$

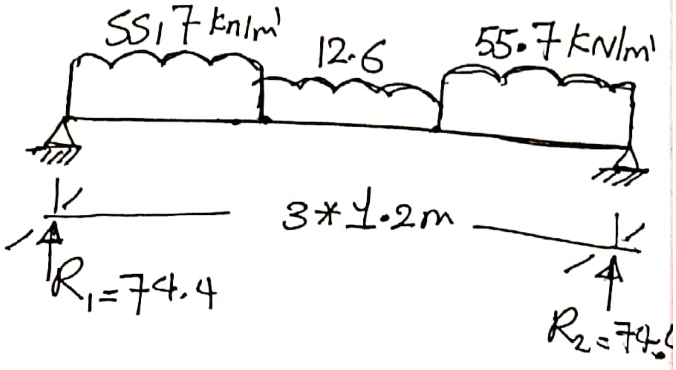
$M_{max} = 48.86\ kN.m$

$\rightarrow d = C_1 \sqrt{\frac{M_{ul}}{F_{cu} \cdot b}}$ $\rightarrow C_1 = 4.07$ $\rightarrow J = 0.808$

$A_s = \frac{M_{ult}}{F_y \cdot J \cdot d} = 933.1836\ mm^2 \simeq 10\ \Phi 12/m' \simeq 5\ \Phi 16/m'$

For Beam B_1 (300*600)

No torsion



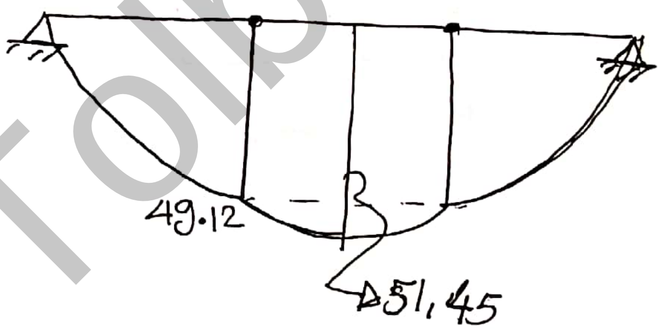
r.r Loads :-

$w_1 = o.w + wall + R$

$= 1.4 * 0.3 * 0.6 * 25 + 2 + 43.1 = 55.7 \ kN/m'$

$w_2 = o.w + wall$

$= 12.6 \ kN/m'$



$M_{max} = 51.45$

$d = C_1 \sqrt{\frac{M_u * 10^6}{F_{cu} \cdot b}}$

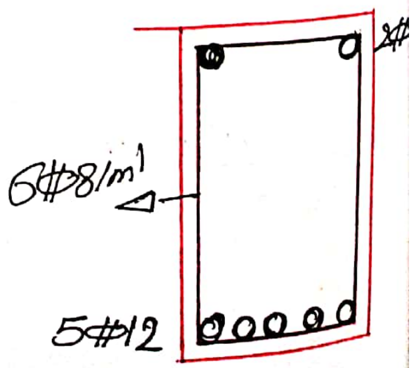
$\rightarrow 550 = C_1 \sqrt{\frac{51.45 * 10^6}{25 * 300}} \rightarrow J = 0.826$

$\rightarrow A_s = A_{s_{min}} = \frac{1.1}{F_y} b d = 505 \ mm^2 = 5\Phi12$

check shear :-

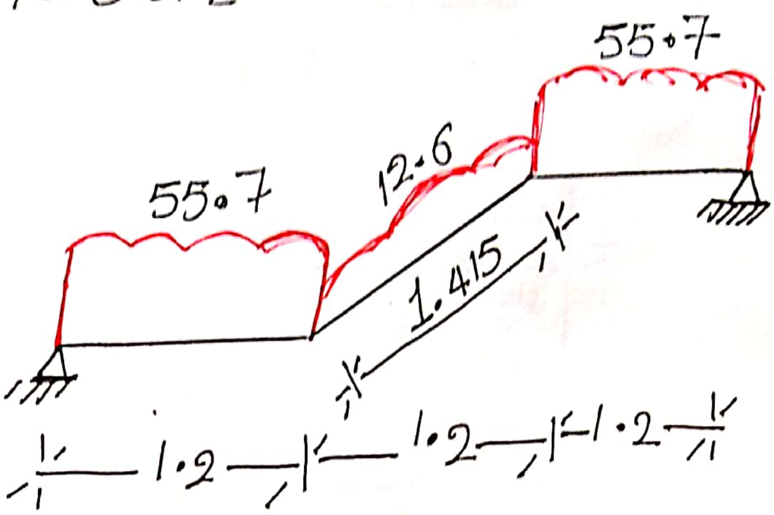
$q_1 = \frac{Q}{B \cdot d} = \frac{74.4 * 10^3}{300 * 600} = 0.45 \ N/mm^2$

$< q_{cu}$



use min. stirrups 5Φ8/m'

$\boxed{B_2}$ $(0.3*600) \rightarrow$ No torsion



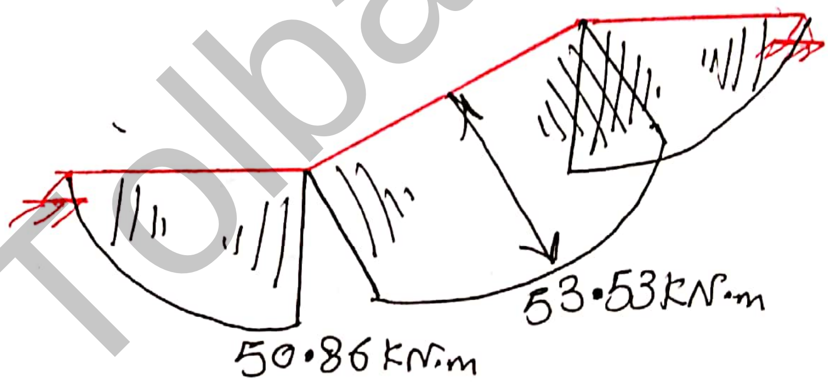
$w_1 = O.W + wall + R$

$= 55.7 \ kN/m'$

$w_2 = 12.6 \ kN/m'$

$R = \frac{\Sigma w*L}{2} = 75.8 \ kN$

$M_{max} = 53.53 \ kN.m$



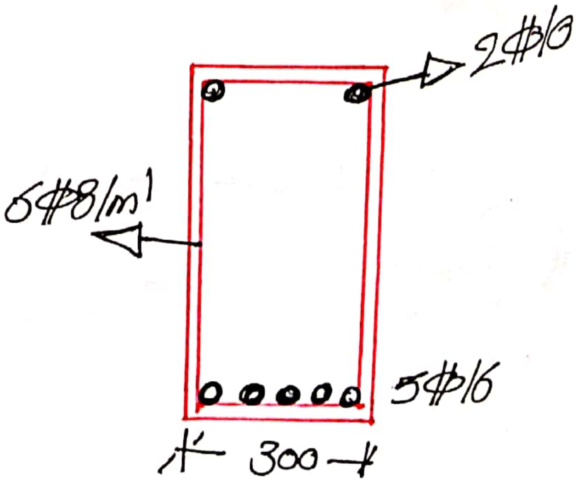
$d = C_1 \sqrt{\frac{M_u}{F_{cu} \cdot b}}$

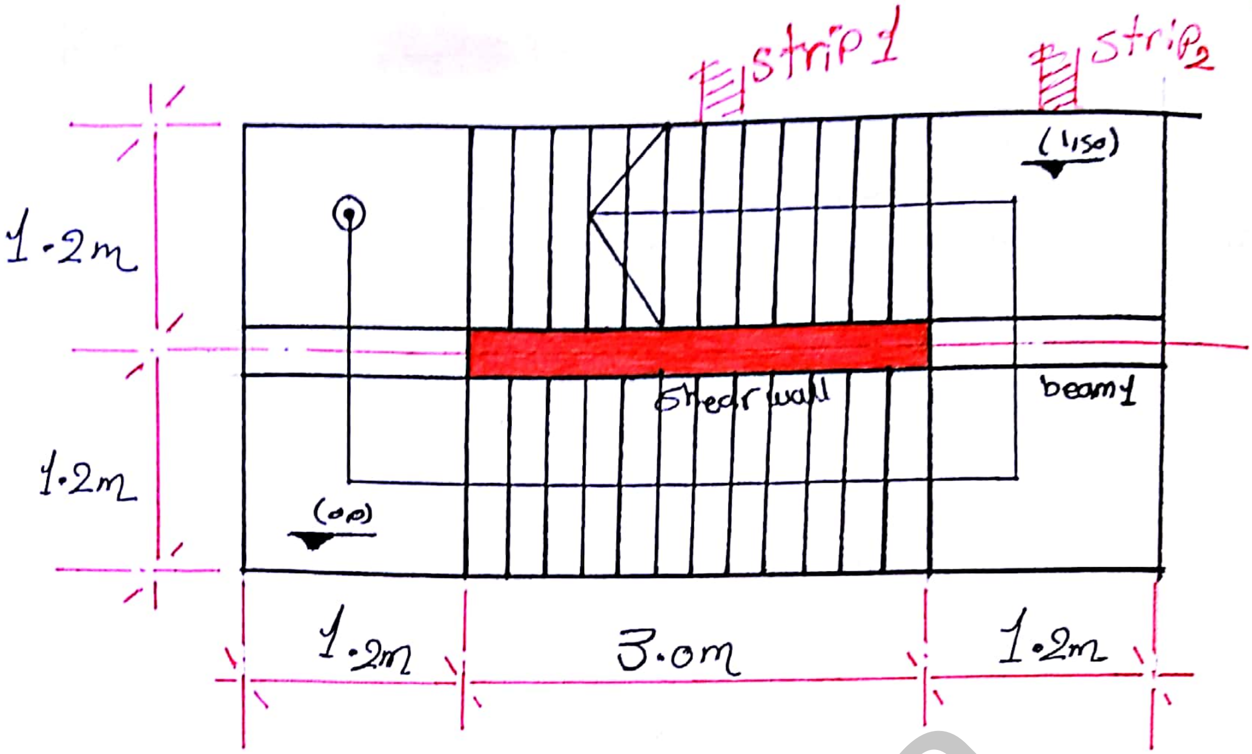
$J = 0.826$

$A_s = A_{s\,min} = 5\Phi 12$

$Q_{max} = 75.8 \ kN$

→ use min stirrups $5\Phi 8/m'$





1 Concrete Dimensions :-

$$\# \ t_s = \frac{1200}{10} = 120\,mm \simeq 150\,mm$$

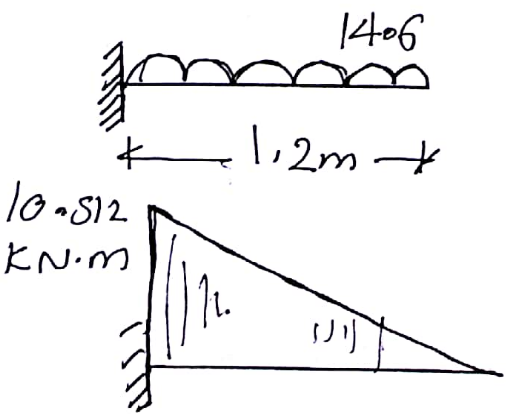
2 Load Calculation :-

$$w_{su_{hz}} = 1.4[0.15*25+1.5]+1.6*3 = 12.15\ kN/m^2$$

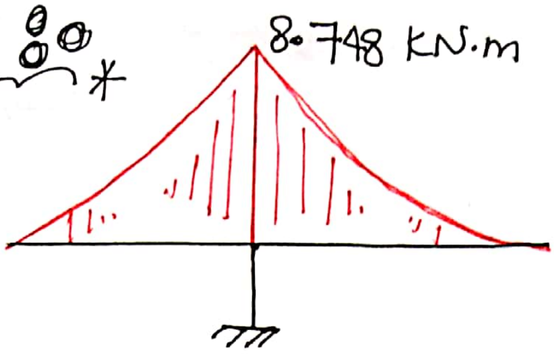
$$w_{su_{Inc}} = 1.4[0.22*25+1.5]+1.6*3*\cos(26.57^\circ) = 14.6\ kN/m^2$$

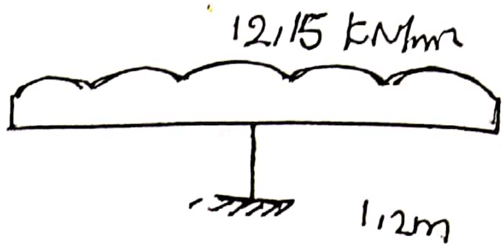
3 Strips :-

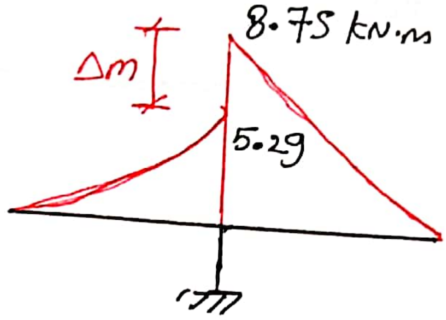
strip 1

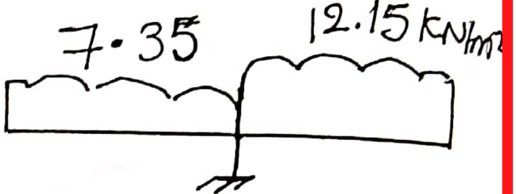


Strip 2 :









$\Delta m = 3.46\ kN.m$

→ Design slabs :

$M_{max} = 10.512\ kN.m$

$$d = C_1 \sqrt{\frac{M_{ult}}{F_{cu} \cdot b}} \longrightarrow 130 = C_1 \sqrt{\frac{10.512 * 10^6}{25 * 1000}}$$

$C_1 = 6.4 \longrightarrow J = 0.826$

$$A_s = \frac{M_{ult}}{F_y \cdot J \cdot d} = 271\ mm^2$$

$A_{s_{min}} = \frac{1.1}{F_y} b.d = 400\ mm^2 \simeq 5 \Phi 12/m$

Design of Beam (30*60)cm

$W = o.w + wall + R = 1.4*0.3*0.6*25 + 2 + 29.16 = 37.46$ kN

V.Loads

Torsion Load