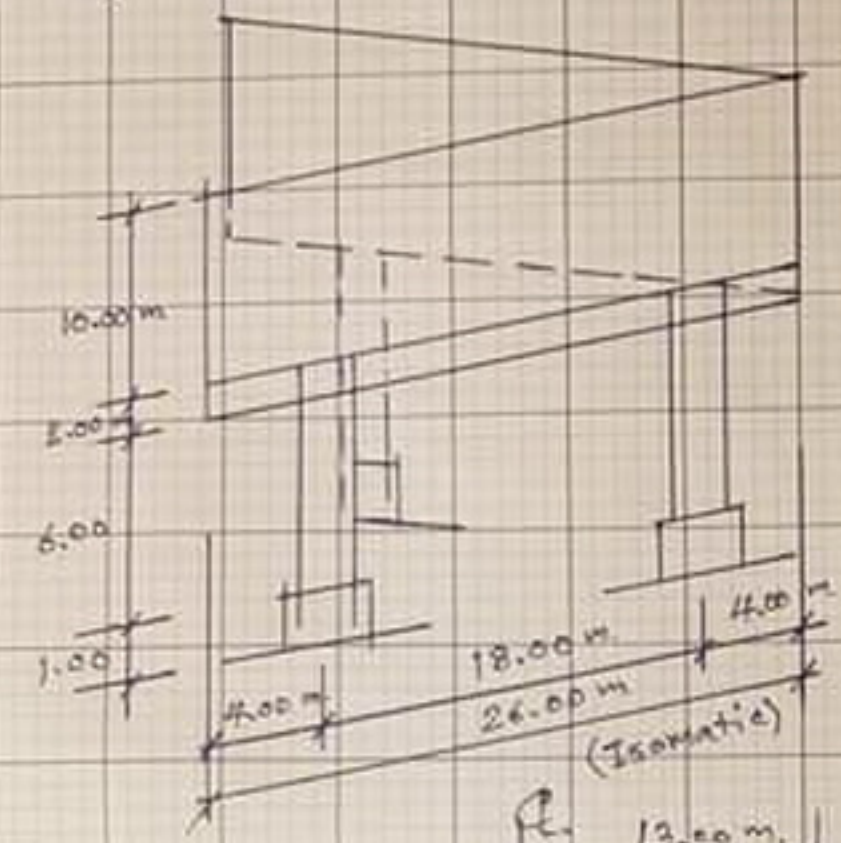
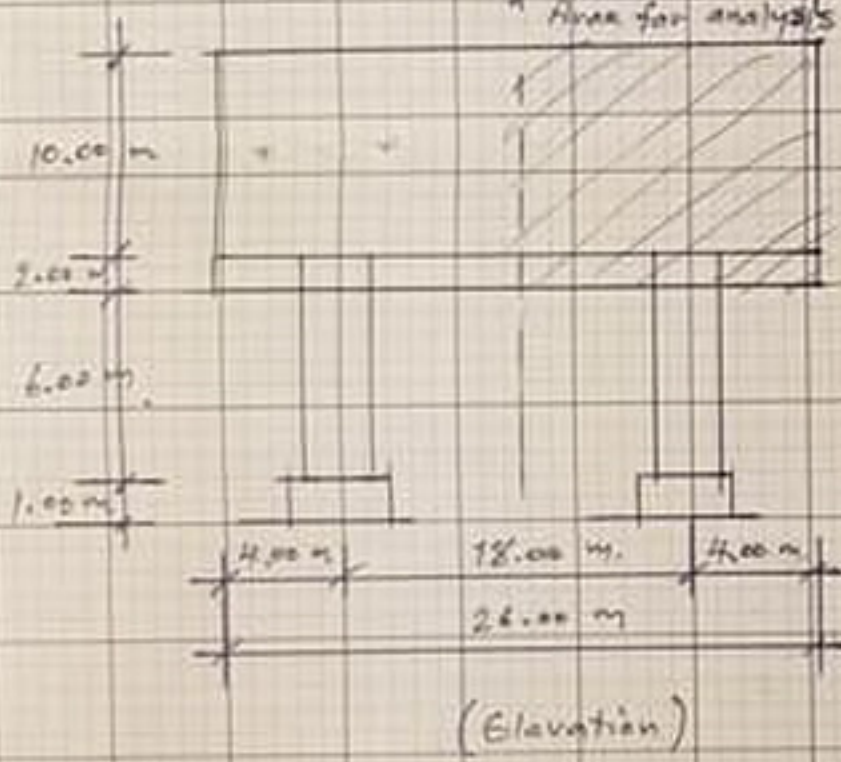
Design steel structure





Design windload $1.20(120) = 144\ kg/m^2$

Load 1, space truss, Try $80\ kg./m^2$

$= 80\left(\frac{26.00}{2}\right) \times 12.00 = 12,480\ kg.$

Load 2, Column, Assume-steel $\phi 0.80\ m$

$-1.5\ cm.\ thk.$

$-$ Fill concrete $3\ m.$

$= \left[\pi \times 0.8 \times 0.015 \times 10.50(7,850)\right] + 3 \times \left(\frac{\pi \times 0.8^2}{4}\right) \times 2,400$

$= 3,107 + 3,418 = 6,725\ kg.$

Load 3. Footing, Assume $3.00 \times 3.00 \times 1.20$

$= 3.00 \times 3.00 \times 1.20 \times 2,400$

$= 25,920\ kg$

Axial load $= 12,480 + 6,725 + 25,920$

$= 45,125\ kg.$

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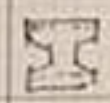
Pile for reaction

Spedification I - 0.30x0.30 , PC wire 5-ϕ 5mm Top & Bottom



Anchorage , Tension by PC wire

1-30x30 x 20.00 m

Cross section , A = 600 cm^2

unit weight = 1114 kg/m

Section Modulus = 4,065 cm^3

Perimeter = 1149 cm.

= (5x0.196x1,700x0.7)x2

= 23,324 kg.

Tension by friction of skin pile (15m.)

= (1.89x600x6.00) + (1.149x800x4.00)

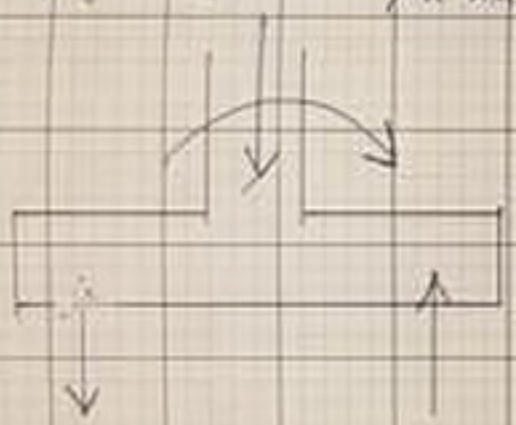
= 16,092 kg.

Pile safe load used 30 tons. → by supplier.

Supply Load 1. by wind load / x Axial load.

Compression = 136,487 + [(45,125+25,920)/2]

= 163,730 kg.



2 side add. spaceframe 12,480 kg

Σ = 163,730 + 12,480

= 176,210 kg.

Tension = (318,989/2.80)

= 113,925 kg.

Gravity Resist. ⇒ Not prominent (F.S)

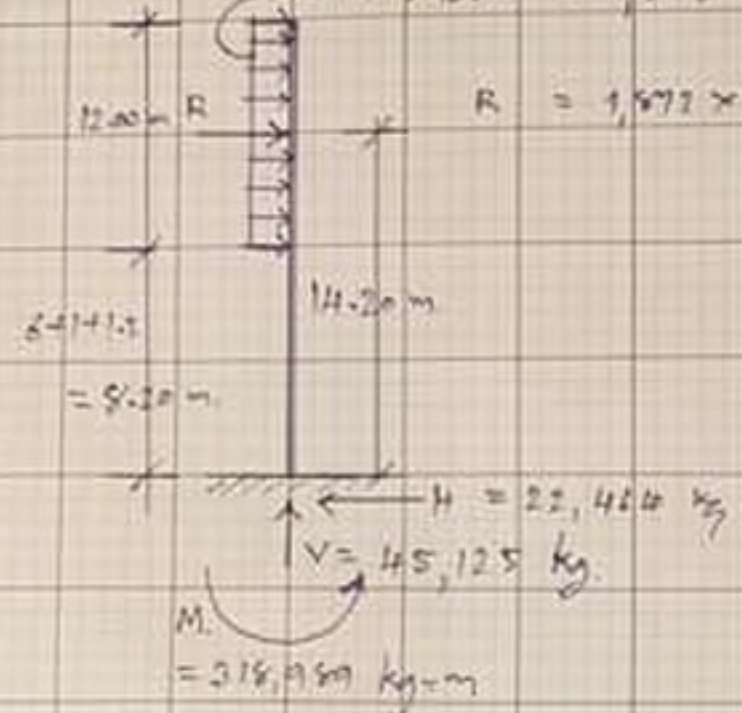
Select quantity of pile , by tension = 113,925/16,092

= 7 piles.

by compression = 176,210/30,000

= 6 piles

Wind pressure section



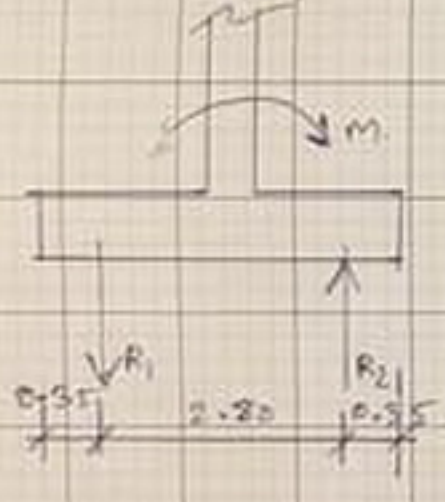
Reaction, H = 22,464 kg

V = 45,125 kg

M_{max} = 22,464 × 14.20 m.

= 318,989 kg-m.

Design Footing.



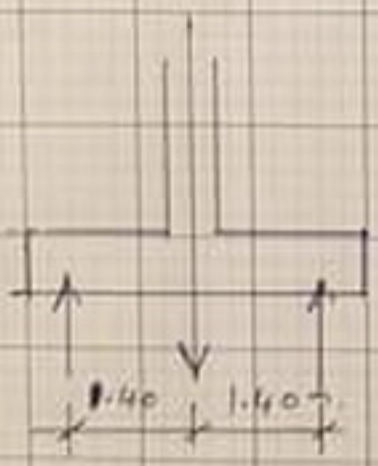
P = 45,125 kg , M = 318,989 kg-m

R_1 = (45,125/2) − (318,989/2.80)

= 91,362 kg. (↓)

R_2 = (45,125/2) + (318,989/2.8)

= 136,487 kg.



Gravity resist. wind load

M_{resist} = (45,125 − 25,920 + 35,280) × 1.40

= 76,279 kg.-m.

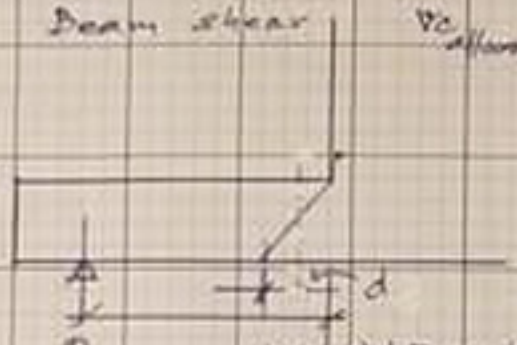
Assume Footing size 3.50×3.50×1.20 m.

W = 3.5×3.5×1.20×2400

= 35,280 kg

Check shear in footing.

Beam shear $V_{c\,allowable} = 0.29\sqrt{f_c'} = 0.29\sqrt{240} = 4.49$ ksc



$$V_c = \frac{V}{b \cdot d}$$

$$= \frac{8 \times 30,000}{3.70 \times 1.05 \times 10,000}$$

by point P, Critical load (not present), $= 6.18$ ksc > 4.49 ksc

$$V' = (8 \times 30,000) - (4.49 \times 3.70 \times 1.05 \times 10,000)$$

$$= 65,564 \text{ kg}$$

Temperature bars, $A_s = 0.002 \times 100 \times 105 = 21$ cm^2.

used DB20 m.m @ 0.15 m.

Try leg bars DB20 mm @0.15, Resist $V' = A_s \times f_s \times d \times b$

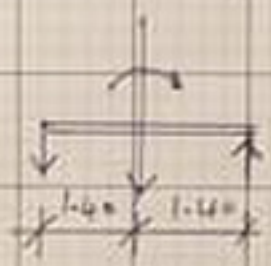
$$= (\frac{1}{0.15} \times 2 \times 3.141) \times$$

$$1,700 \times 1.05 \times 3.70$$

$$= 276,596 \text{ kg}$$

Re-bars by $-M$, $= 91,362 \times 1.40$

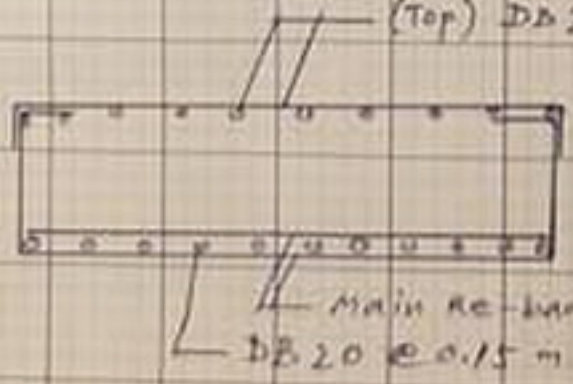
$$= 127,907 \text{ kg.-m}$$

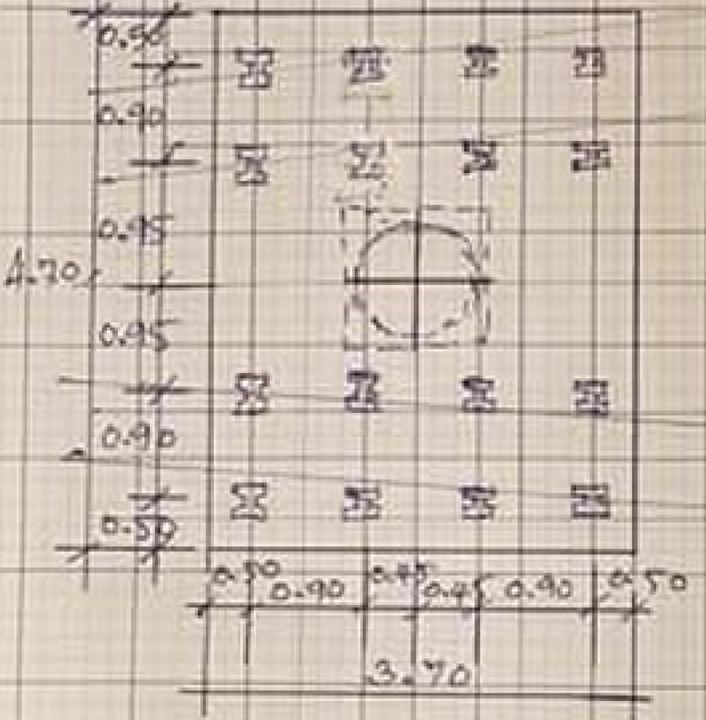


$$-A_s = \frac{127,907}{1,700 \times (1.05 - 0.10)}$$

$$= 79.20 \text{ cm}^2$$

used DB 20 mm @ 0.15 m #





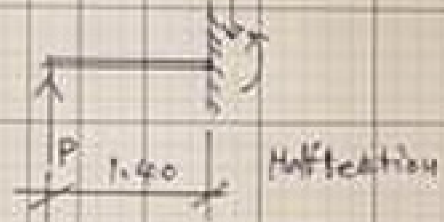
Footing composition

Present 4.70×3.70 m

$= 17.39\ m^2$ (Assume $12.25\ m^2$)

Diff. W. = 50,083 − 35,280 = 14,803 kg

used Piles 8 No. (one reaction)



Analysis, $M = (8\times30{,}000)\times1.40$

$= 336{,}000$ kg-m

$V = 8\times30{,}000 = 240{,}000$ kg

R.C. Footing, $d_{req} = \sqrt{\dfrac{M}{RB}}$

$= \sqrt{\dfrac{336{,}000\times10^2}{12.911\times3.70\times10^2}}$

$= 84.5$ cm.

Try $d = 110$ cm, $D = 120$ cm, $MR = Rbd^2 =$

$= 12.911\times3.70\times110^2$

$= 569{,}071$ kg-m.

WSD. $A_{s_t} = \dfrac{336{,}000}{1{,}700\times0.895\times1.10}$

$= 200\ cm^2$

(Main Re-bar 2 Layers) $A_s = \dfrac{336{,}000}{1{,}700\times0.895\times(1.10-0.05)}$

$= 210.32\ cm^2$

used 2 Layers DB 25 @ 0.08 m — Main Re-bar

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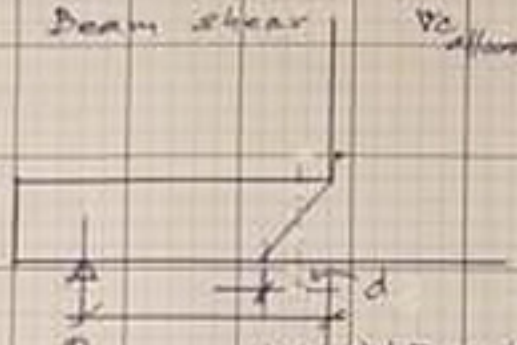
Check shear in footing.

Beam shear $V_{c\,allowable} = 0.29\sqrt{f_c'} = 0.29\sqrt{240} = 4.49$ ksc



$$V_c = \frac{V}{b \cdot d}$$

$$= \frac{8 \times 30,000}{3.70 \times 1.05 \times 10,000}$$

by point P, Critical load (not present), $= 6.18$ ksc > 4.49 ksc

$$V' = (8 \times 30,000) - (4.49 \times 3.70 \times 1.05 \times 10,000)$$

$$= 65,564 \text{ kg}$$

Temperature bars, $A_s = 0.002 \times 100 \times 105 = 21$ cm^2.

used DB20 m.m @ 0.15 m.

Try leg bars DB20 mm @0.15, Resist $V' = A_s \times f_s \times d \times b$

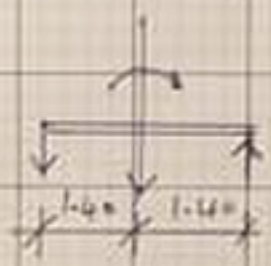
$$= (\frac{1}{0.15} \times 2 \times 3.141) \times$$

$$1,700 \times 1.05 \times 3.70$$

$$= 276,596 \text{ kg}$$

Re-bars by $-M$, $= 91,362 \times 1.40$

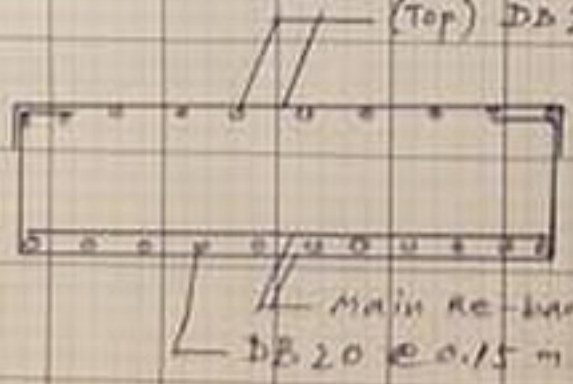
$$= 127,907 \text{ kg.-m}$$

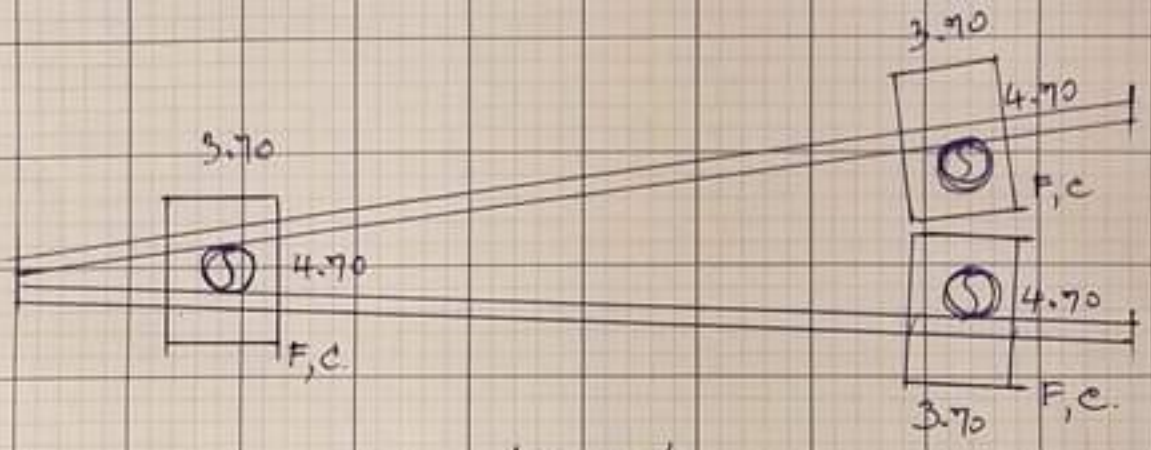


$$-A_s = \frac{127,907}{1,700 \times (1.05 - 0.10)}$$

$$= 79.20 \text{ cm}^2$$

used DB 20 mm @ 0.15 m #





Lay-out

ผู้ตรวจสอบ 17/2/66

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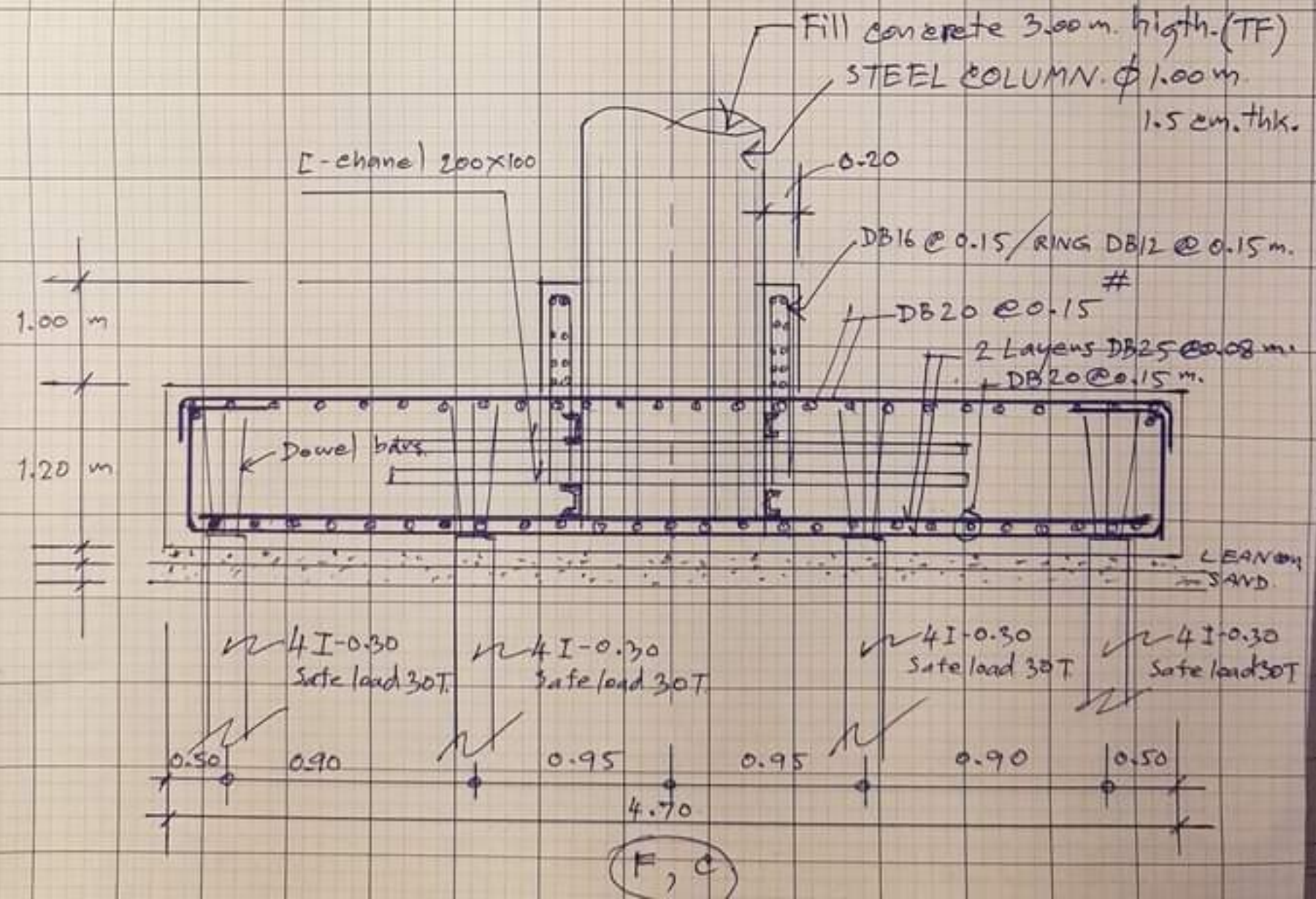
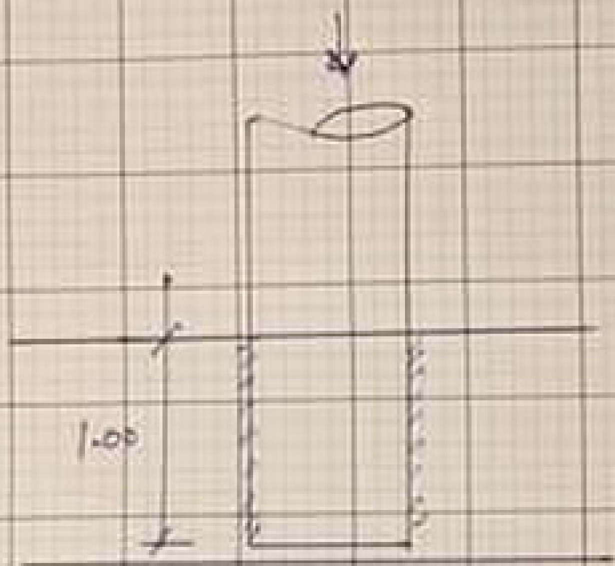
SEE STEEL DETAIL



Steel column, ϕ 80 cm, 1.5 cm

Check Bond, $u = \frac{V}{\Sigma o \cdot j \cdot d}$, $u = \frac{T}{\Sigma o \cdot L}$



Column ϕ 0.80 m, $\Sigma o = \pi d \times L$

Anchorage 1.00 m (L), $= \pi (0.80 \times 100) \times 1.00 \times 100$

$= 25,128$

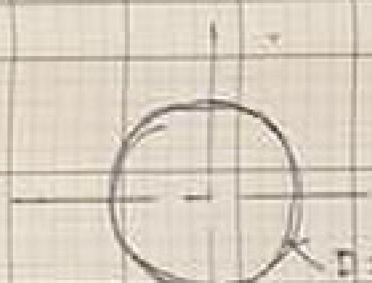
$u = \frac{(12,480 + 12,480 + 6,725)}{25,128}$

$= 1.26$ ksc.

Check stress, $\sigma = \frac{Mc}{I}$, $M_{at\ \pi} = 22,464 \times (7.00 + 6.00)$

$= \frac{292,032 \times 100 \times 40}{284,995}$, $= 292,032$ kg.-m.

$= 4,099$ ksc. ⇒ Adjust.



D = 0.80, t = 1.5 cm

$I = \frac{2}{3} m R^2$, $= \frac{\pi}{64}(D^4 - d^4) = \frac{\pi}{64}(80^4 - 77^4) = 284,995\ cm^4$.

Fill concrete, $I_c = \frac{\pi}{64} D^4 = \frac{\pi}{64}(77^4) = 1,725,245\ cm^4$

N convert $\frac{E_c}{E_s} = \frac{200,000}{2,000,000} = 0.10$

composite section Steel pipe + concret fill, $I = 284,995 + (1,725,245 \times 0.10)$

$= 457,520\ cm^4$

Re check $\sigma = \frac{Mc}{I} = \frac{292,032 \times 100 \times 40}{457,520} = 2,553$ ksc. (Re-design)

$f_{b\ allowable} = 0.6\ f_y$

$= 0.6 \times 2,520$

$= 1,512$ ksc.

[illegible] 7/1/66

[illegible]

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$D = 1.00$, $t = 1.5$ cm

$I = \frac{\pi}{64}(D^4 - d^4) = \frac{\pi}{64}(100^4 - 97^4) = 562,961$ cm^4

Fill concrete, $I_c = \frac{\pi}{64} D^4 = \frac{\pi}{64}(97^4) = 4,344,851$ cm^4

convert, $N = \frac{E_c}{E_s} = \frac{200,000}{2,000,000} = 0.10$

composite section by steel pipe + concrete fill, $I = 562,961 + (4,344,851 \times 0.10)$

$= 997,446$ cm^4

check stress by Moment. , $\sigma = \frac{Mc}{I}$

$= \frac{292,032 \times 100 \times 50}{997,446}$

$= 1,464$ ksc.

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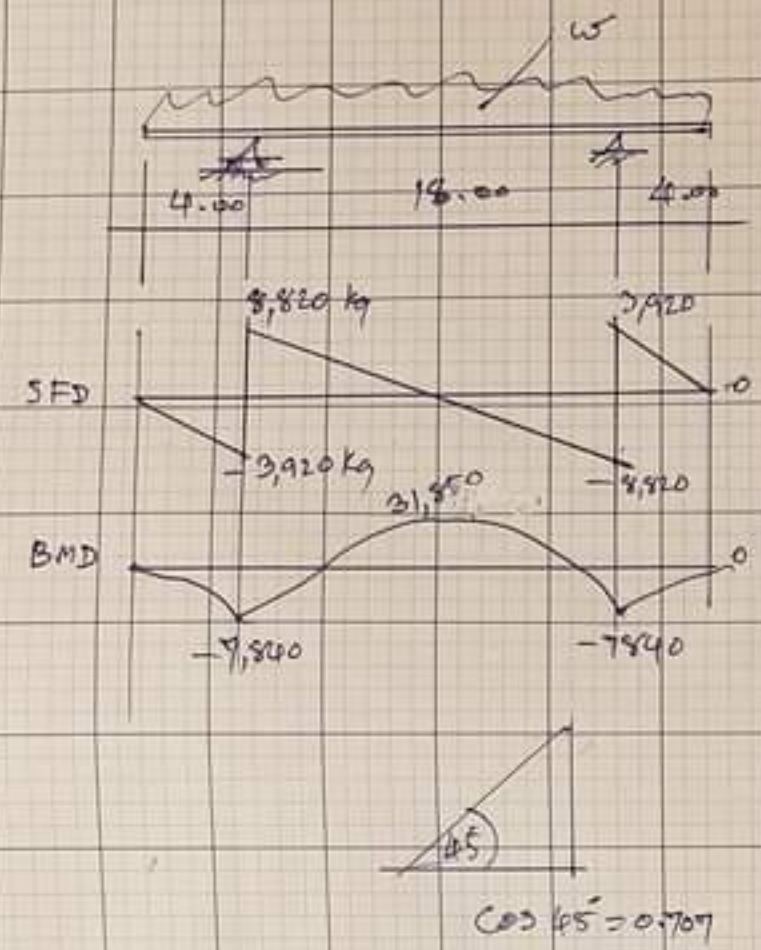
SPACE TRUSS GURDER



$\cos 45 = 0.707$

$w = (10 \times 50) + (60 \times 8) = 980$ kg./m

$V = \frac{(26.00 \times 980)}{2} = 12,740$ kg.

$M_{max} = 31,850$ kg.-m.

$A_s = \frac{31,850}{0.5(2,520) \times 2.00} = 12.63$ cm²

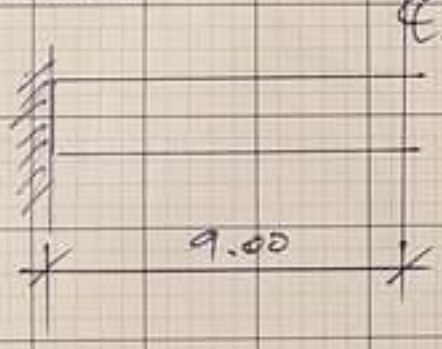
Upper chord & Lower chord $= \frac{12.63}{2}$

$= 6.315$ cm²

$\text{Diagonal} = \frac{12,740}{2(0.5 \times 2,520) \times 0.707}$

$= 7.15$ cm²

Torsion



$M = \frac{1}{2} \times 14,400 = 7,200$ kg.-m/m.

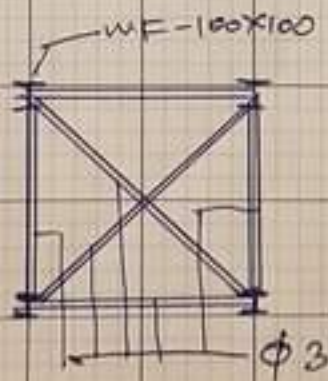
at 2.00 from support $T_{org} = 7,200 \times 7.00$

$= 50,400$ kg-m

$\text{Add } A_s = \frac{50,400}{4 \times (1.414) \times 0.5(2,520)}$

$= 7.07$ cm²

Main Chord, $A_{req} = 7.07 + 6.315 = 13.4$ cm²



used WF-100×100

Daigonal used PIPE ϕ3", 4.5 m.m.

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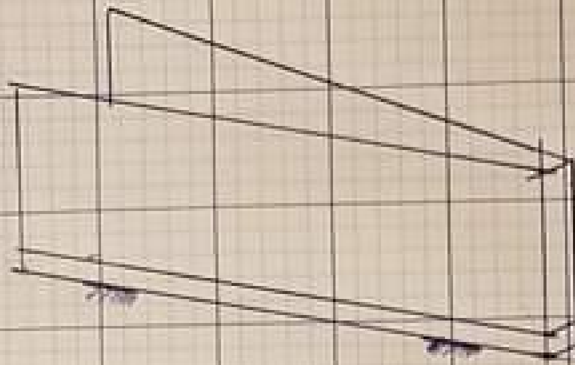
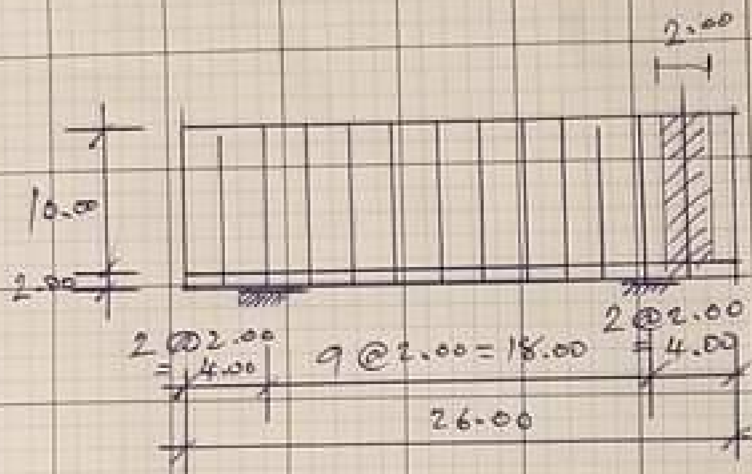
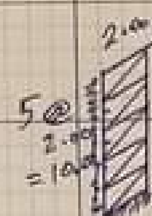


SPACE TRUSS

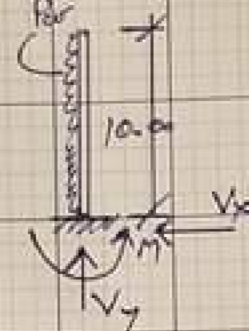
Wind pressure $1.20(120) = 144\ kg/m^2$

Free standing 10.00 m.





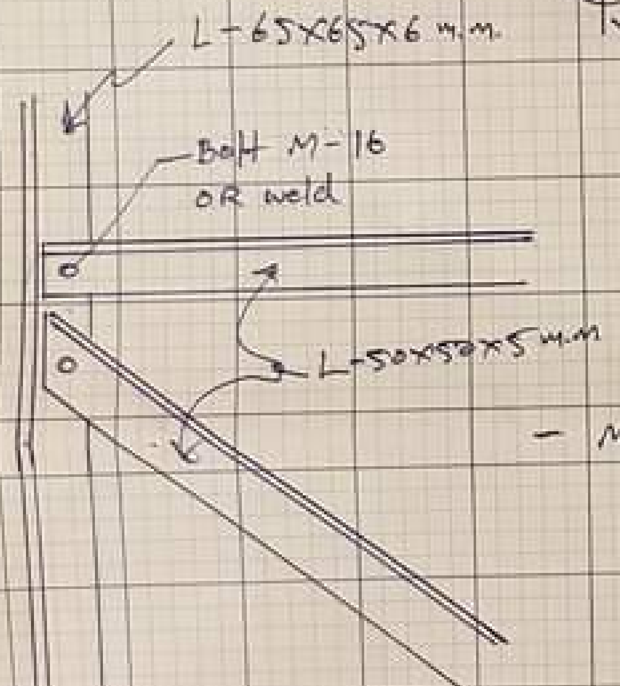
$P_w = 144 \times 2.00 = 288\ kg/m$



analysis

$M = \frac{1}{2} \times P_w \times 10.00^2$

$= 14,400\ kg\text{-}m$



$A_{st} = A_{sc} = \frac{14,400}{0.5(2,520) \times 2.00} = 5.71\ cm^2$

$\text{Compression} = \frac{14,400}{2} = 7,200\ kg.$

Select Bolt M16, $f_v = 2,000$ ksc.

– Main chord, L65×65×6 mm, $A_s = 7.80\ cm^2$

$V = P_w \times 10 = 288 \times 10$

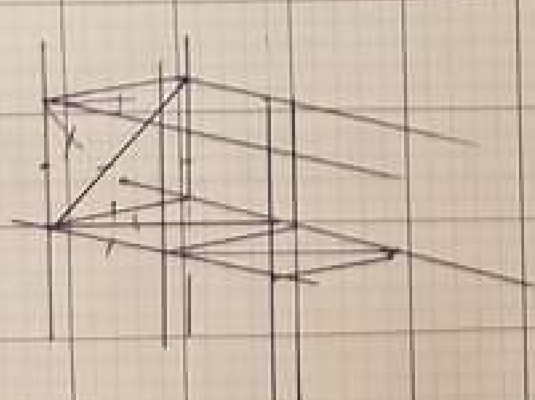
$= 2,880\ kg$

Cos 45 = 0.707

– Diagonal, $A_s = \frac{2,880}{0.5(2,520) \times 0.707} = 3.23\ cm^2$

L 50×50×5 mm, $A_s = 5.0\ cm^2$

unit weight per sq.m. $= 10 \times (6 \times 0.785) = 47.1$ say $= 50$ kg.



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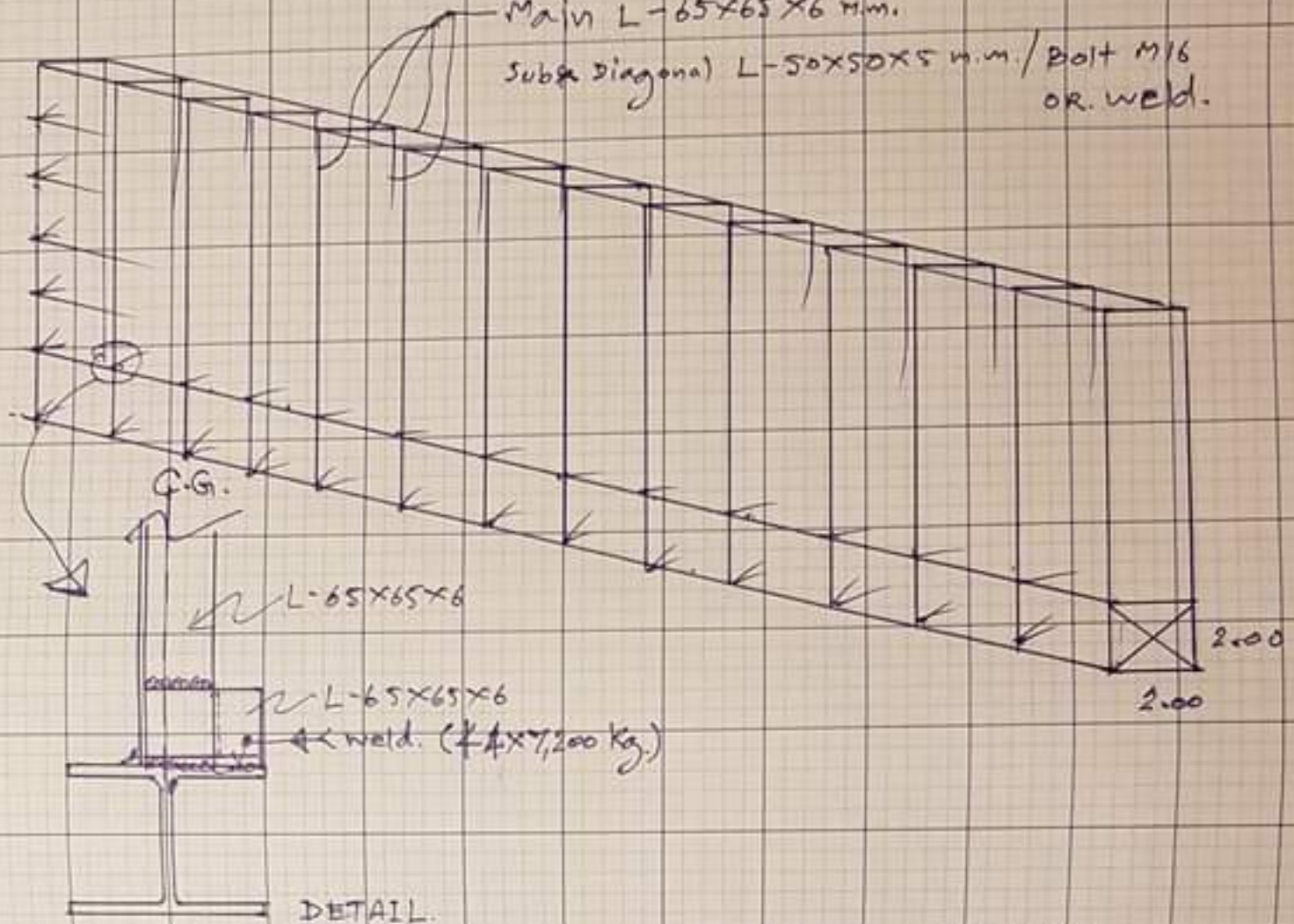
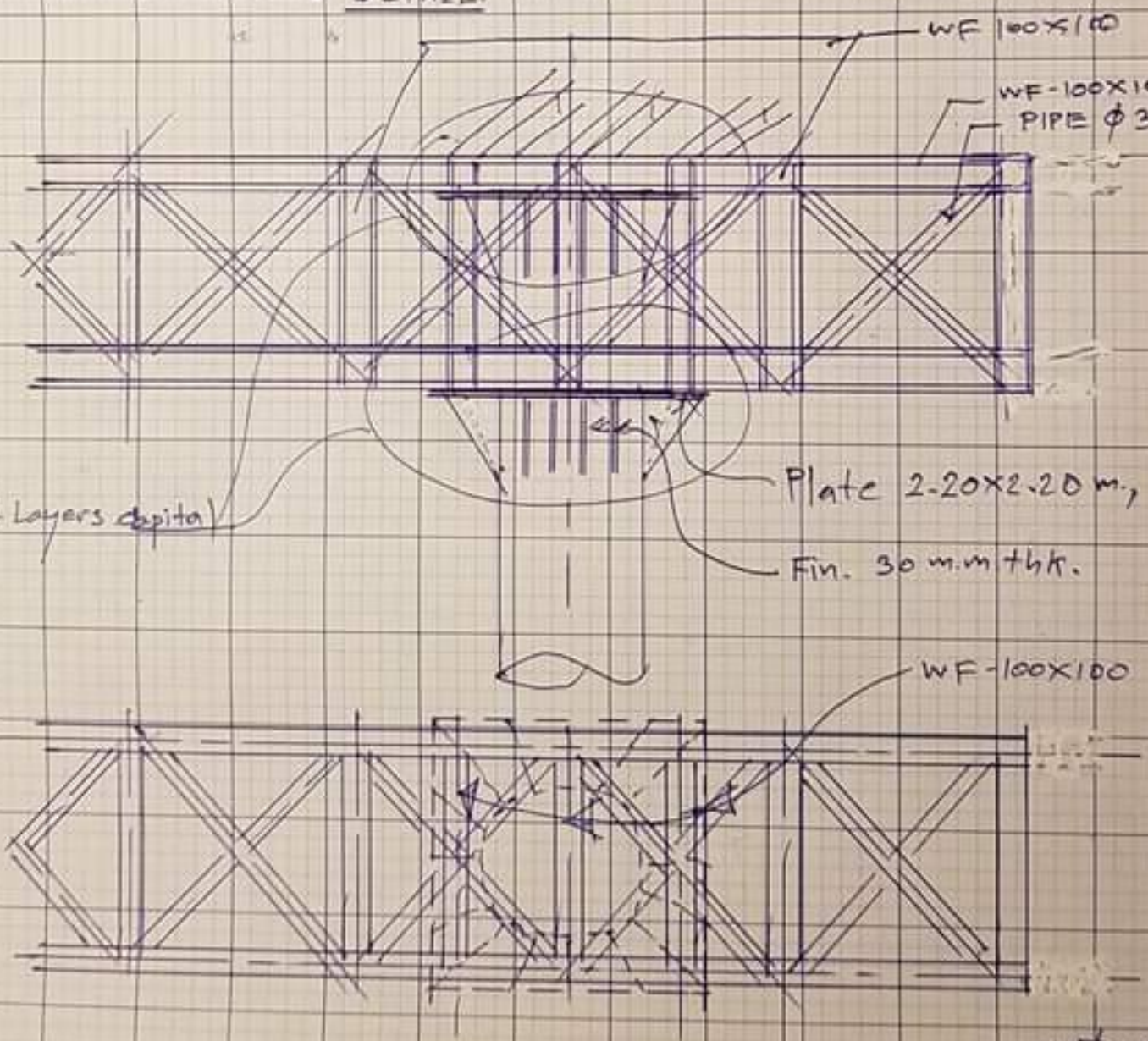


DETAIL.



Capital column

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