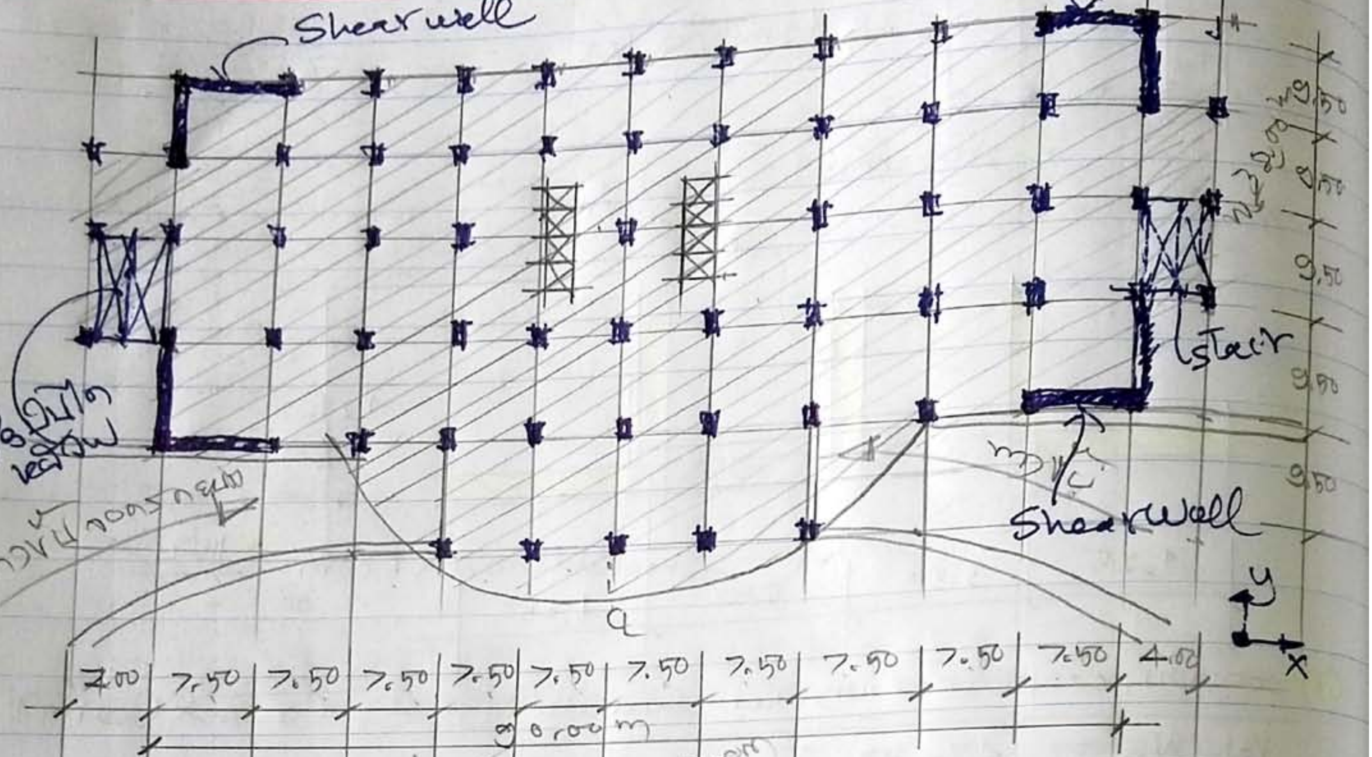
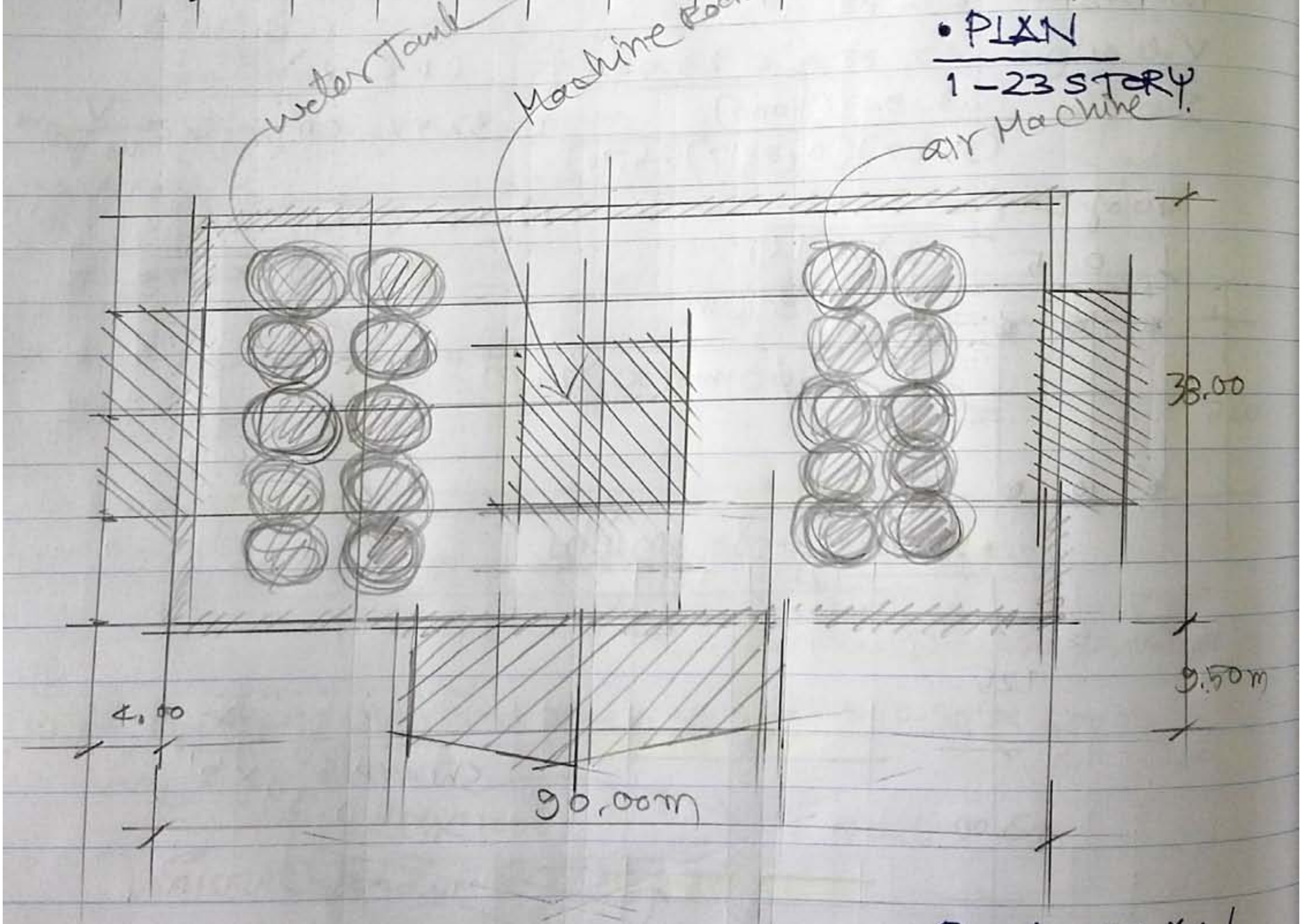
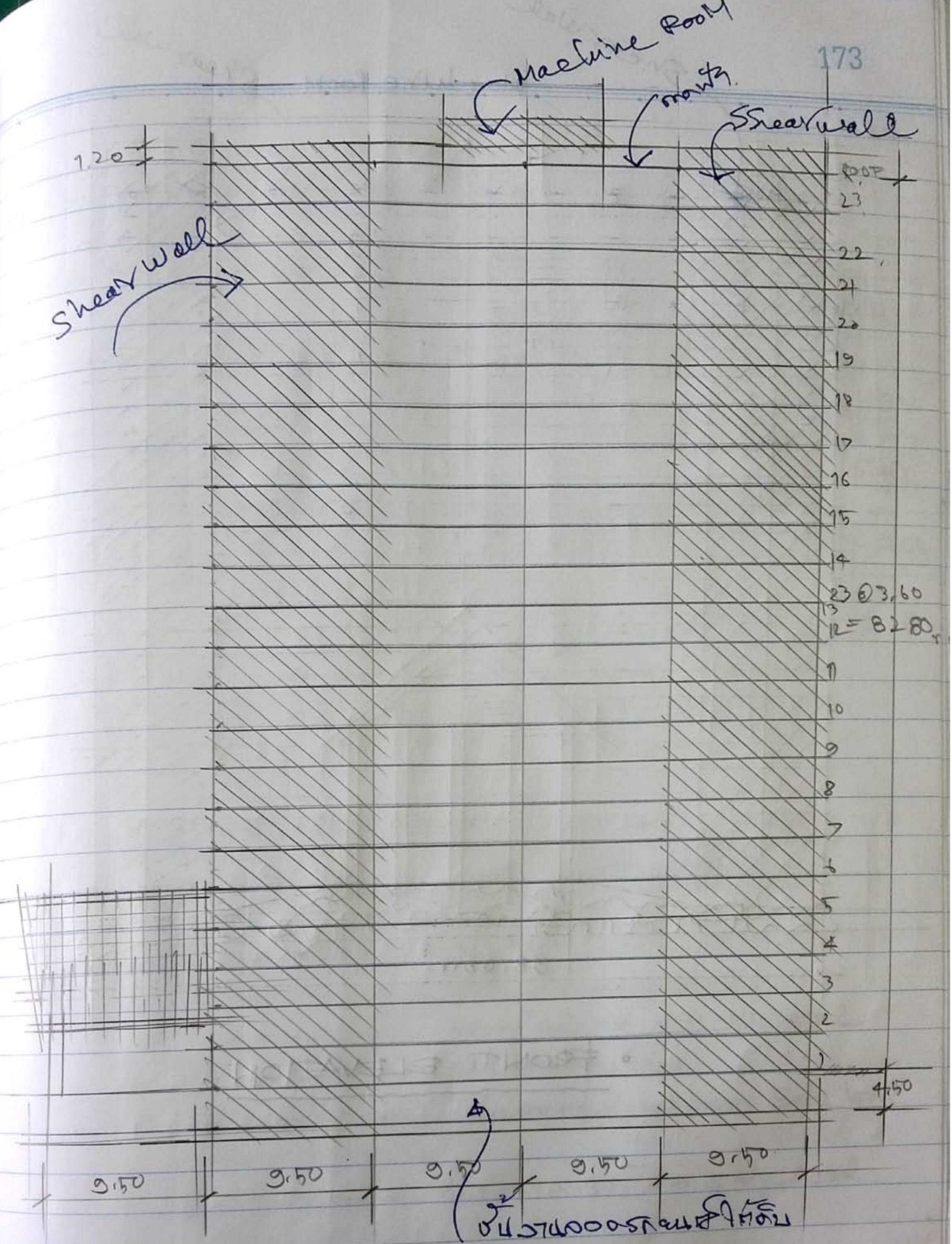
- CONCRETE DESIGN PROJECT(17) --(31 มค 67)
- อาคารชุดพักอาศัยและโรงแรม 23 ชั้น (เหนือดิน) + อาคารจอดรถใต้ดิน 7 ชั้น



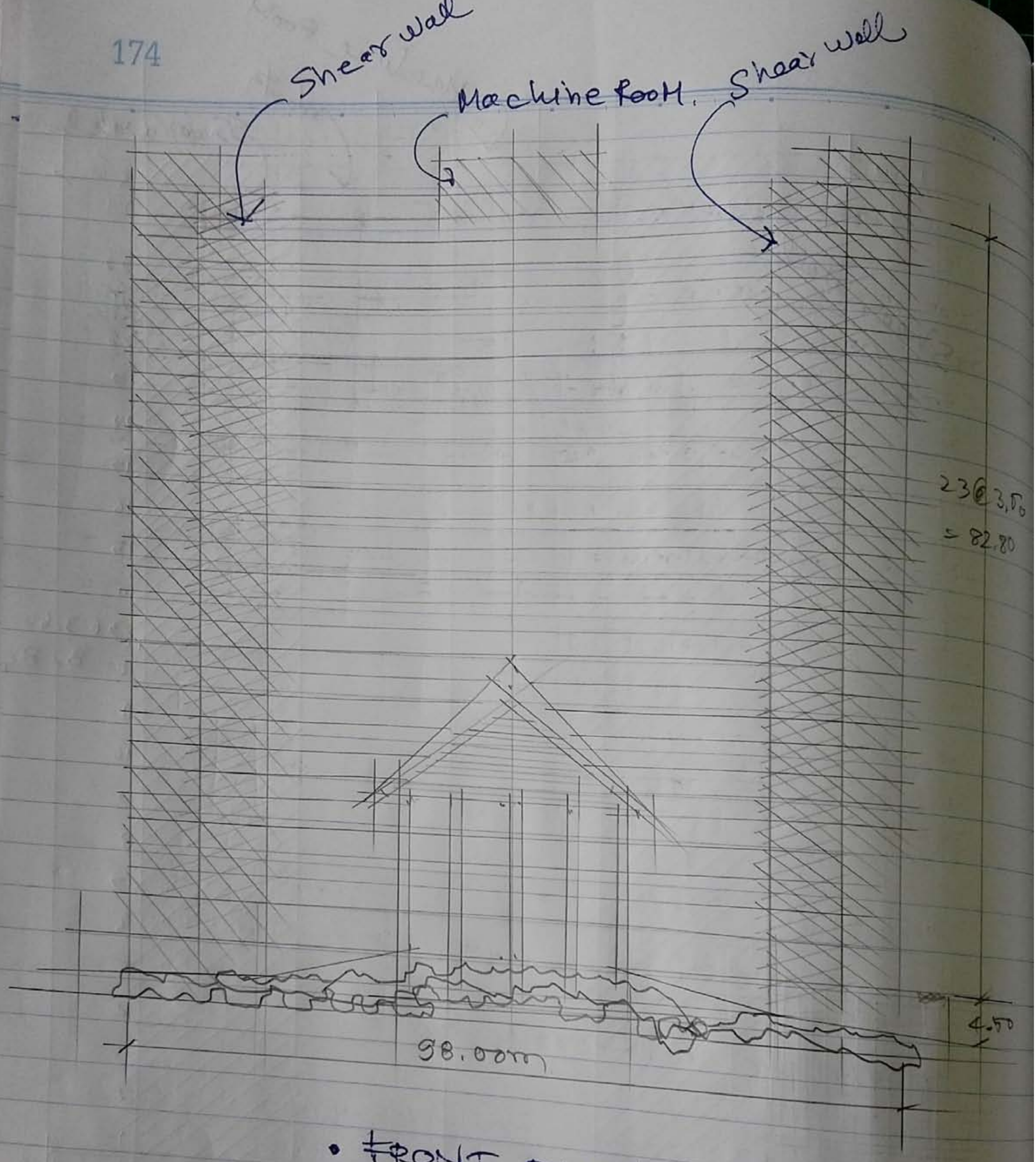
- PLAN
1-23 STORY



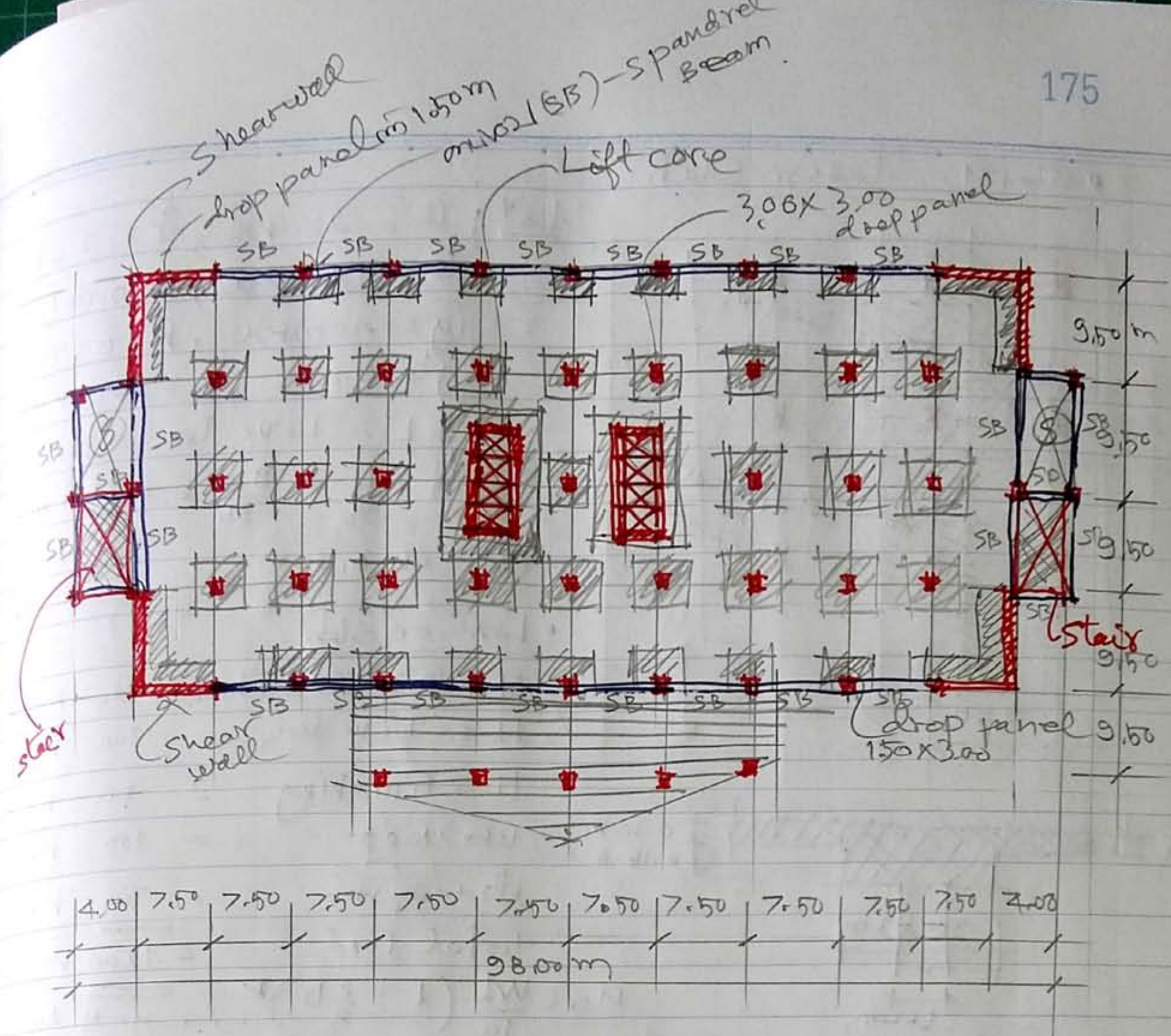
- ROOF PLAN


Machine Room
mouth
SShearwall
Shear wall
1.20
ROOF
23
22
21
20
19
18
17
16
15
14
23 @ 3.60
13
12 = 82.80
11
10
9
8
7
6
5
4
3
2
1
4.50
9.50
9.50
9.50
9.50
9.50
9.50
ชั้นวางของตรงนี้ใต้ดิน

• SIDE VIEW



• FRONT ELEVATION



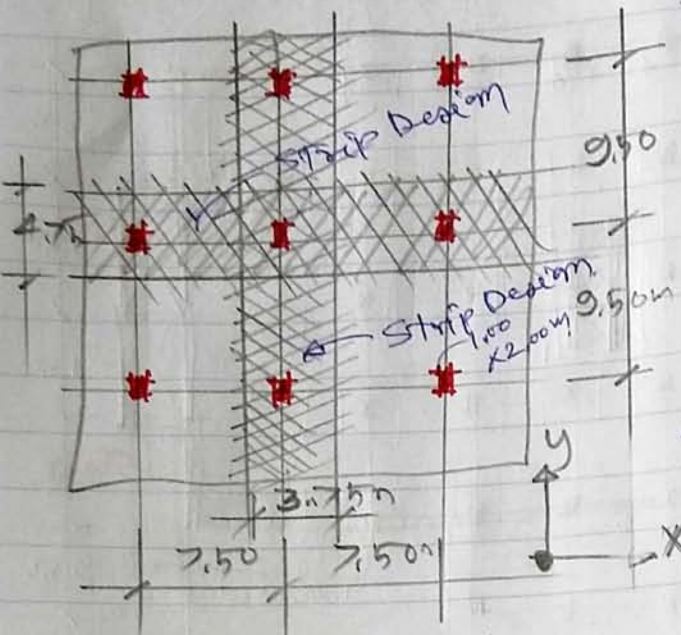
- ~~Drop~~ panel plan, Liftcore, stair spandrel Beam and Shearwall

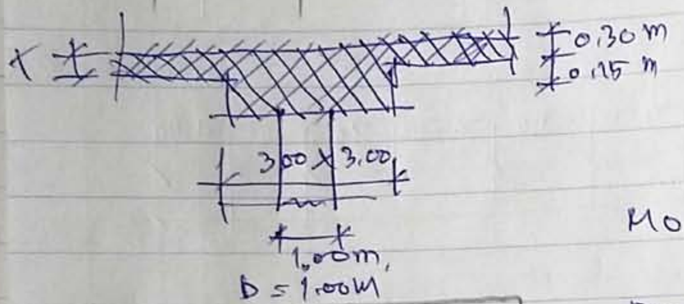
- Structural System
  1. Flat slab with drop panel
  2. Shearwall Resisting wind Load
  3. Mat Foundation on pile
     - Bored pile Ø 1.00 m × 40.00 m Safe load 400 T/pile
     - spun pile Ø 1.00 × 30.00 m safe load 300 T/pile

- ขนาดเสาที่ใช้ในโครงสร้างอาคาร.

1. ใต้ดิน, [illegible] ขนาด 1.20 × 2.00 m ถึงชั้น 12
2. ชั้น 13 – ชั้นหลังคา ขนาด 1.00 × 2.00 m
3. Shearwall หนา 0.40 m
4. Lift core หนา 0.40 m.
5. Flat slab thickness $= \frac{L}{30} = \frac{9.50}{30} = 0.316$ m
6. Drop panel 0.25 – 0.50 T = 0.45 m
7. ขนาด Drop = 0.30 L = 3.00 m. × 3.00 m.

• Step① Design Slab





Let; fc' = 280 ksc, fc = 126 ksc
fs = 1700 ksc, ρ = 0.00139
fy = 4000 ksc, K = 0.375
j = 0.875, R = 20.70 ksc
; LL = Live load = 300 kg/m²

T-min = $\frac{L}{36} = \frac{9.50}{36} = 0.263$ m

use ⇒ 0.30 m.

• **Load on Slab**

DL = (0.30)(2400)	= 720	kg/m²
LL = Live load	= 300	kg/m²
FL = Finishing	= 50	kg/m²
[illegible]	= 100	kg/m²
[illegible]	= 30	kg/m²
total Load	= 1200	kg/m²

$$M_o = \frac{WL}{10}\left(L - \frac{2}{3}D\right)^2 \;\ldots\; y\text{-}y \text{ Axis}$$

D = 1.00 m, W = 1200 kg/m², L = 9.50 m

$$M_o = \frac{(1200)(9.50)}{10}\left[9.50 - \frac{2}{3}(1)\right]^2$$

= 88944.953 kg-m ...

• Width Drop panel
= (0.30)(9.50)
= 2.85 m
= 3.00 m ...

• Column Strip

⊖M = (0.50)(88944.953) = 44472.476 kg-m
⊕M = (0.20)(88944.953) = 17788.991 kg-m

• Middle Strip

⊖M = (0.15)(88944.953) = 13341.742 kg-m
⊕M = (0.15)(88944.953) = 13341.742 kg

• Find slab thickness

$$d\text{-max} = \sqrt{\frac{(44472.476)(100)}{(20.70)(375)}} = \sqrt{572.914} = 23.90 \text{ cm}$$

Try T = 30 cm; $d = 30 - 2.5 - \frac{1.6}{2} = 26.70$ cm > 23.90 cm
⇒ T = 30 cm ... O.K.

- Depth of Drop

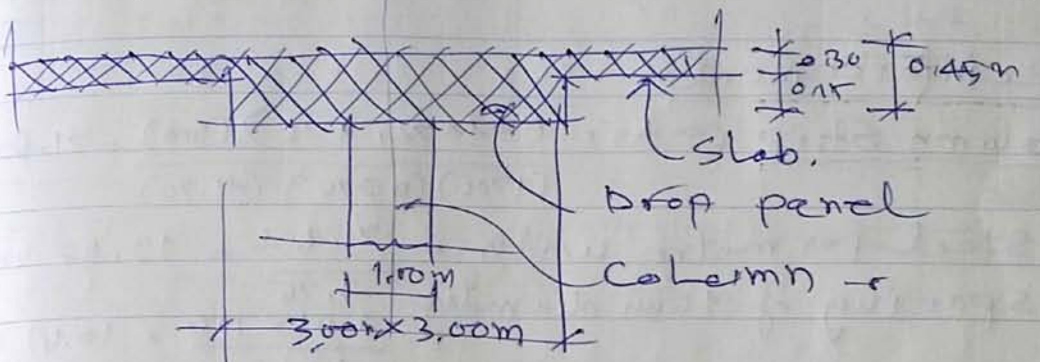
$$d_{max} = \sqrt{\frac{(44472.476)(100)}{(20.70)(300)}} = \sqrt{716.143} = 26.76 \text{ cm}$$

$T = 26.76 + 2.50 + 1.6 = 30.86$ cm

$T = 25\% - 50\%$ of (T) Thickness of Slab.

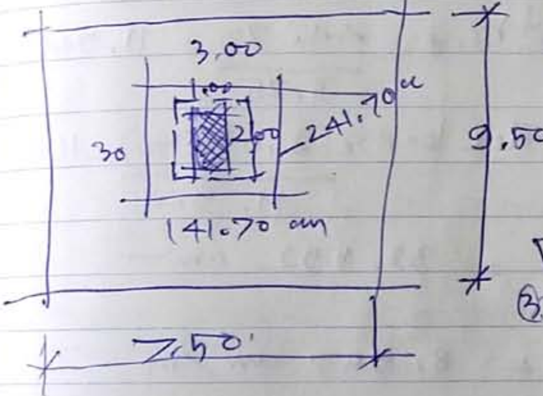
$= (0.50)(T) = (0.50)(0.30) = 0.15$ m

Drop panel thickness $= 0.30 + 0.15 = 0.45$ m



- Check punching Shear

(a) Critical section in drop



$d = 45 - 2.5 - 1.6/2 = 41.70$ cm

$b_0 = (2)(241.70) + (2)(141.70)$

$= 483.40 + 283.40$

$= 766.80$ cm

$V = (7.50)(9.50)(1.20\,T/m^2) + (3)(3)(0.840\,T/m^2) - (2.267)(1.267) \times (1.56\,T/m^2)$

$= 85.50 + 7.56 - 4.48$

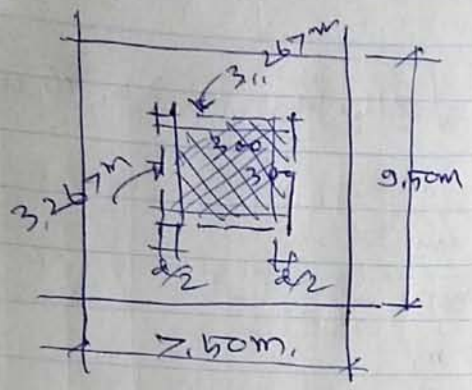
$= 88.58$ T

$$V_c = \frac{(88.58)(1000)}{(766.80)(41.70)} = 2.770 \text{ ksc}$$

$= 2.77$ ksc $<$ 8.868 ksc

- Vc control $= 0.53\sqrt{280} = 8.868$ ksc

(b) Critical Section in Slab



$d = 26.70$ cm

$b_o = (4)(326.70) = 1306.80$ cm

Load; $V = \left[(7.50)(9.50) - (3.267)^2(1.20)\right]$ Fu

$= 72.692$ T

$$V_C = \frac{(72.692)(1000)}{(1306.80)(26.70)}$$

$= 2.083$ KSC < 8.806 KSC — ok

- **Reinforcement**
- **Column Strip** ⊖ $A_s = \frac{(44472.476)(100)}{(1700)(0.875)(41.70)} = 71.696$ cm²

- Steel per metre width $= \frac{71.696}{3.75} = 19.118$ cm²/m
- spacing of 16mm diameter $= \frac{2.01 \times 100}{19.18} = 10.51$ cm.

⊕ $A_s = \frac{(17788.991)(100)}{(1700)(0.875)(26.70)} = 44.73$ cm²

- steel per metre width $= \frac{44.73}{3.75} = 11.944$ cm²/m

- spacing of 16mm diameter bar $= \frac{(2.01)(100)}{11.944} = 16.82$ cm

- **Middle strip**

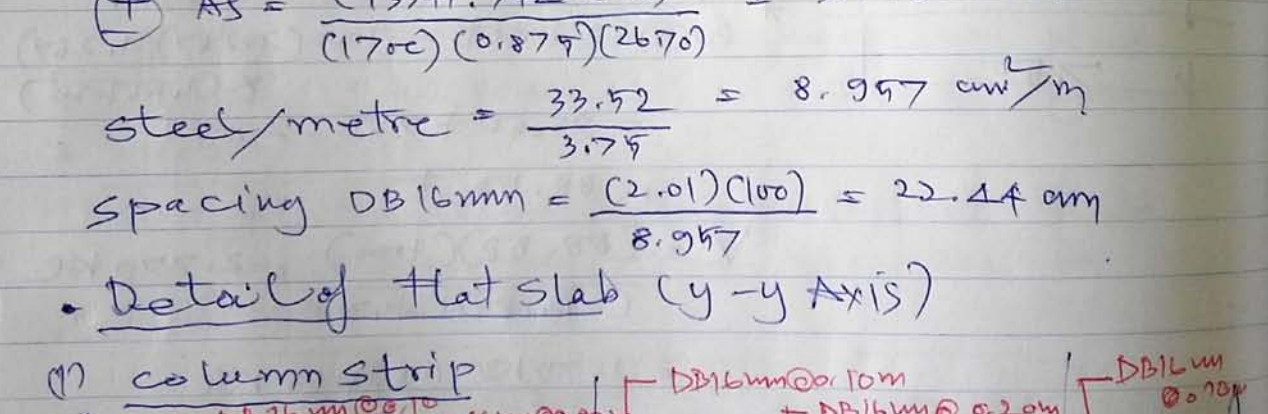
⊕ $A_s = \frac{(13341.742)(100)}{(1700)(0.875)(26.70)} = 33.592$ cm²

steel/metre $= \frac{33.52}{3.75} = 8.957$ cm²/m

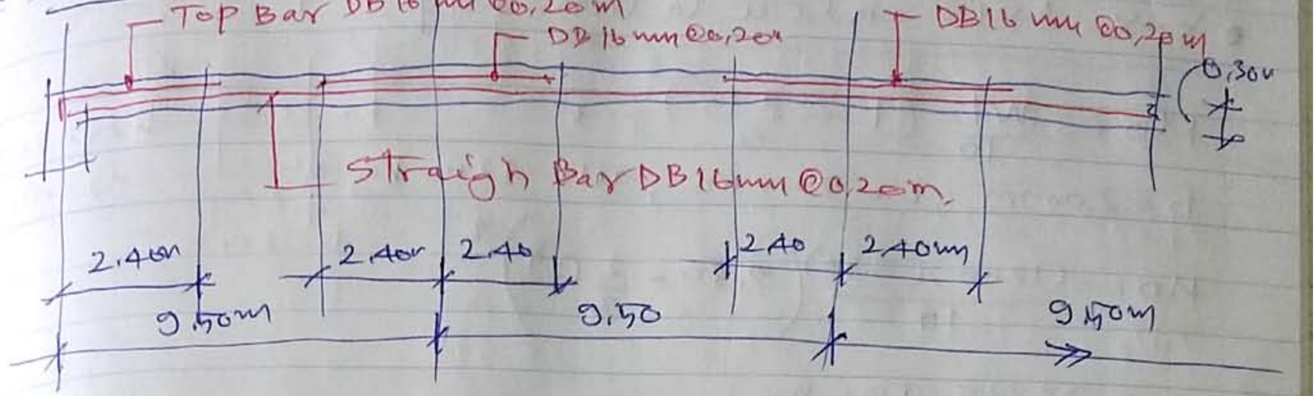
spacing DB16mm $= \frac{(2.01)(100)}{8.957} = 22.44$ cm

- **Detail of flat slab (y-y Axis)**

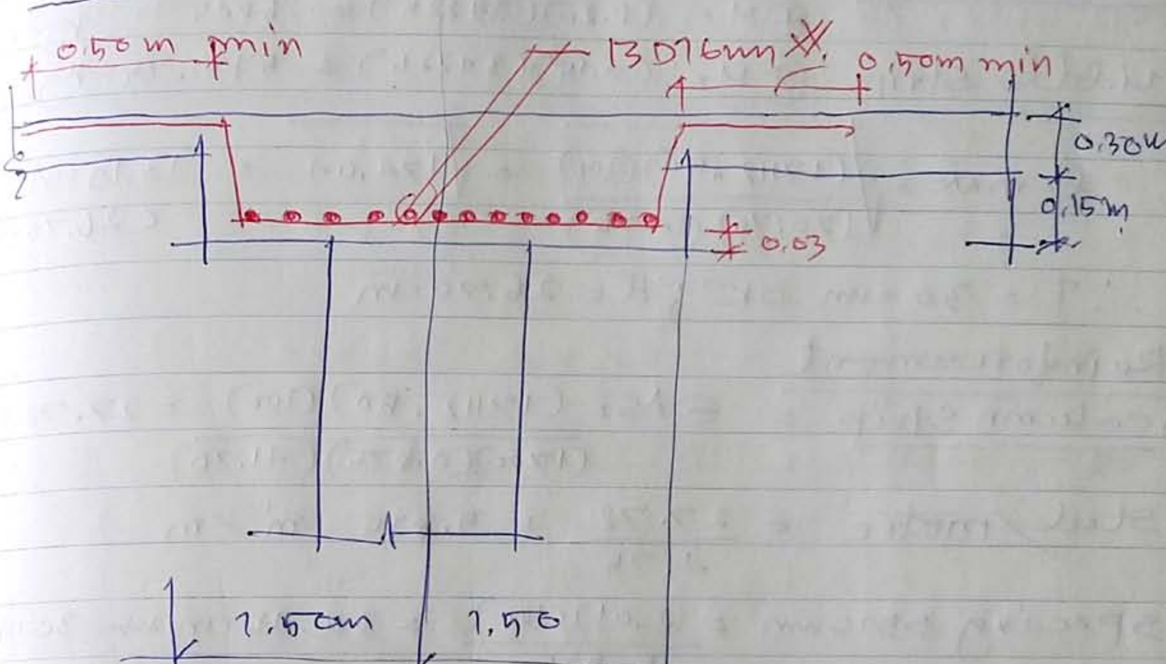
(1) column strip



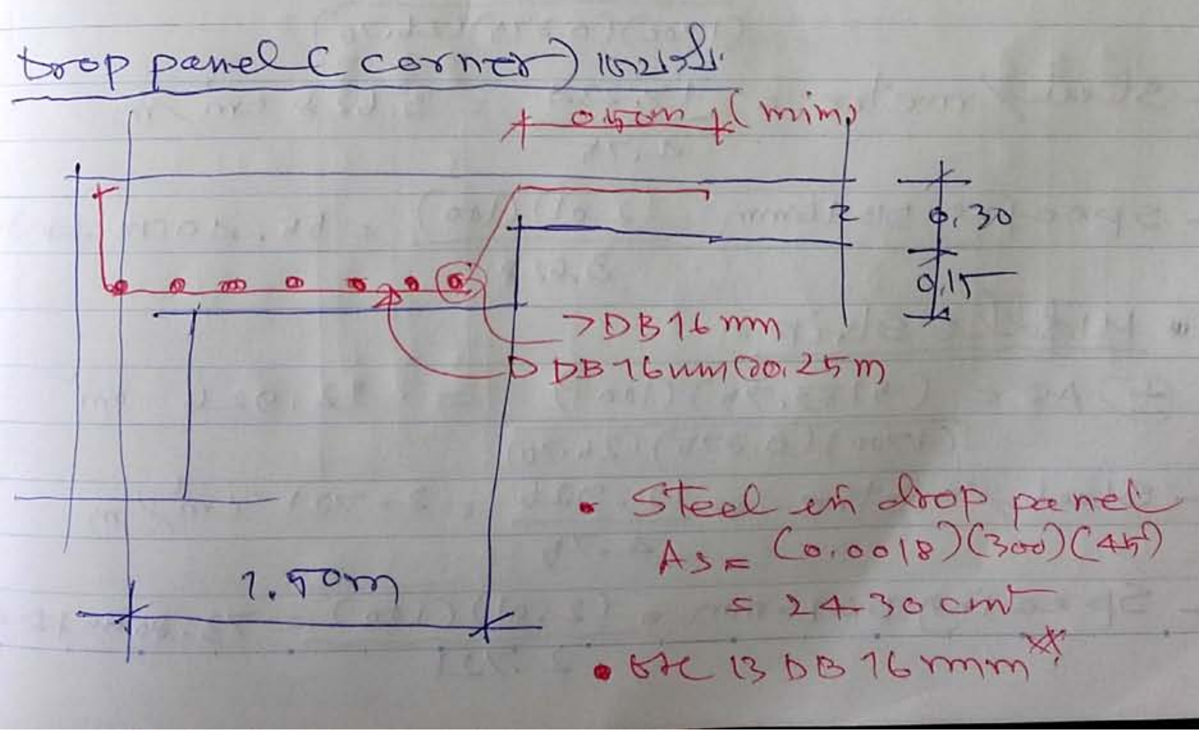
(2) Middle strip



(3) Drop panel



④ Drop panel (corner) [illegible]

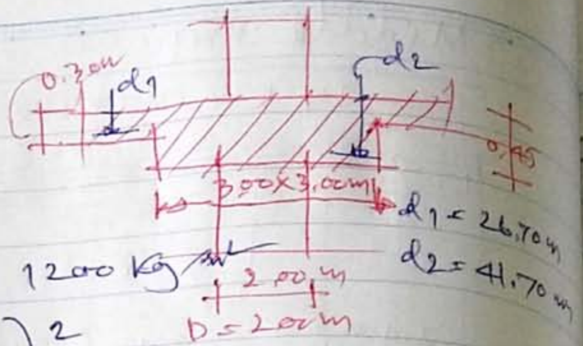


- Steel in drop panel

$$A_s = (0.0018)(300)(45)$$
$$= 24.30 \text{ cm}^2$$

- ใช้ 13 DB 16 mm**

- Design Slab continute
- X-X Axis calculation



$M_o = \frac{WL}{10}\left(L - \frac{2}{3}D\right)^2$ ⟶

$D = 2.00\ m$, $L = 7.50\ m$, $W = 1200\ Kg/m^2$

$M_o = \frac{(1200)(7.50)}{10}\left(7.50 - \frac{2}{3}(2)\right)^2$

$= 34225\ Kg-m$

- Column Strip ⊖$M = (0.50)(34225) = 17112.50\ Kg-m$

  ⊕$M = (0.20)(34225) = 6845\ Kg-m$

- Middle strip ±$M = (0.15)(34225) = 5133.75\ Kg-m$

$d\text{-max} = \sqrt{\frac{(17112.50)(100)}{(20.70)(475)}} = \sqrt{174.04} = 13.19\ cm < 26.70\ cm$

$\therefore T = 30\ cm$ OK ; $d = 26.70\ cm$

- Reinforcement
- Column Strip = ⊖$AS = \frac{(17112.50)(100)}{(1700)(0.875)(41.70)} = 27.72\ cm^2$

- Steel/metre $= \frac{27.72}{4.75} = 5.835\ cm^2/m$

- Spacing DB16mm $= \frac{(2.01)(100)}{5.835} = 34.45\ cm$ # 30 cm

⊕$AS = \frac{(6845)(100)}{(1700)(0.875)(26.70)} = 17.234\ cm^2$

- steel/metre $= \frac{17.234}{4.75} = 3.628\ cm^2/m$

- spacing DB16mm $= \frac{(2.01)(100)}{3.628} = 55.40\ cm$ # 30 cm

- Middle Strip

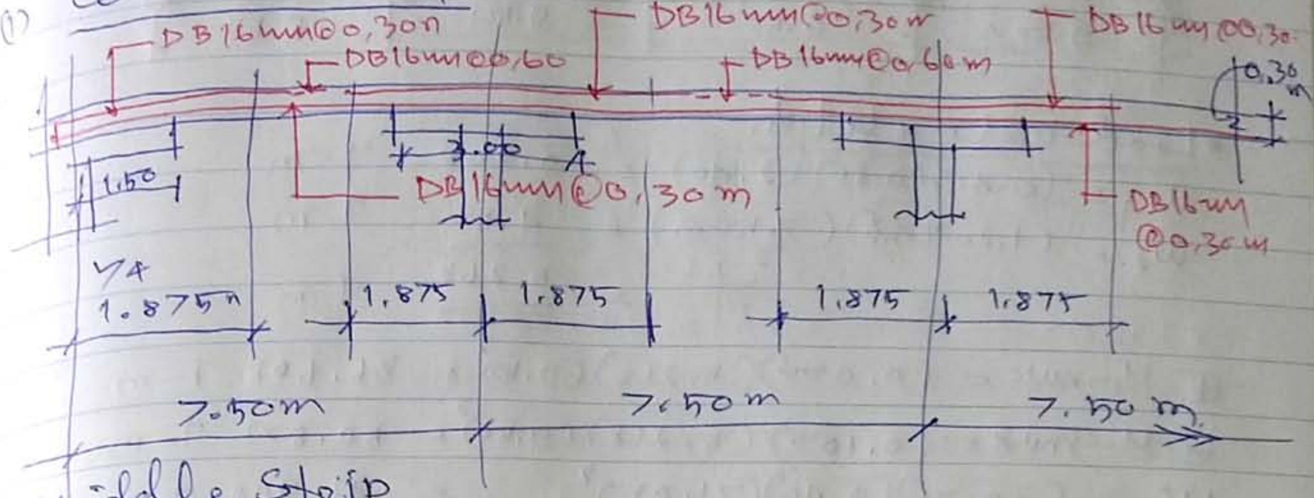
±$AS = \frac{(5133.75)(100)}{(1700)(0.875)(26.70)} = 12.926\ cm^2$

- Steel/metre $= \frac{12.926}{4.75} = 2.721\ cm^2/m$

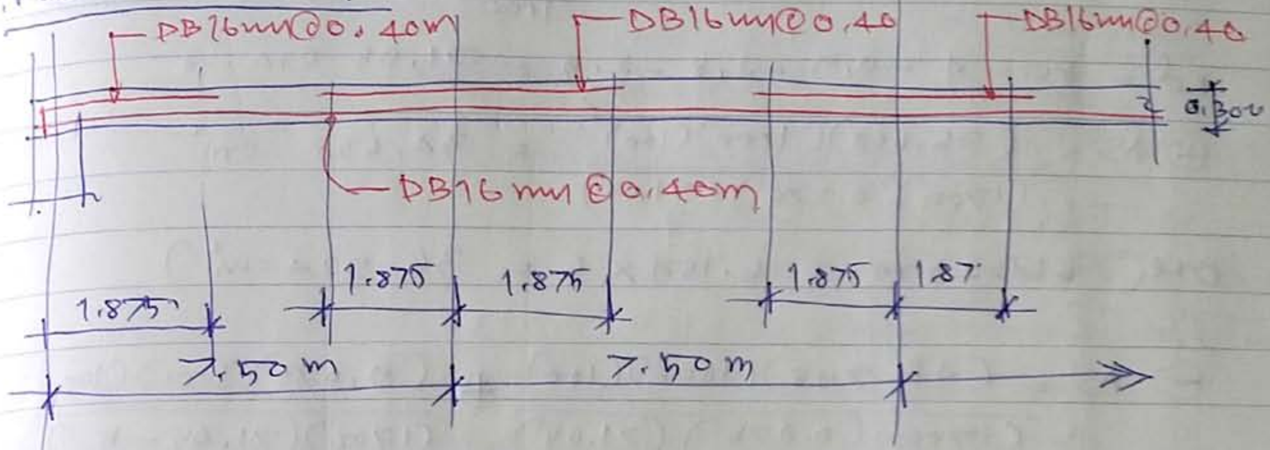
- Spacing DB16mm $= \frac{(2.01)(100)}{2.721} = 73.86\ cm$ # 40 cm

• Detail of Flat Slab (x-x Axis)

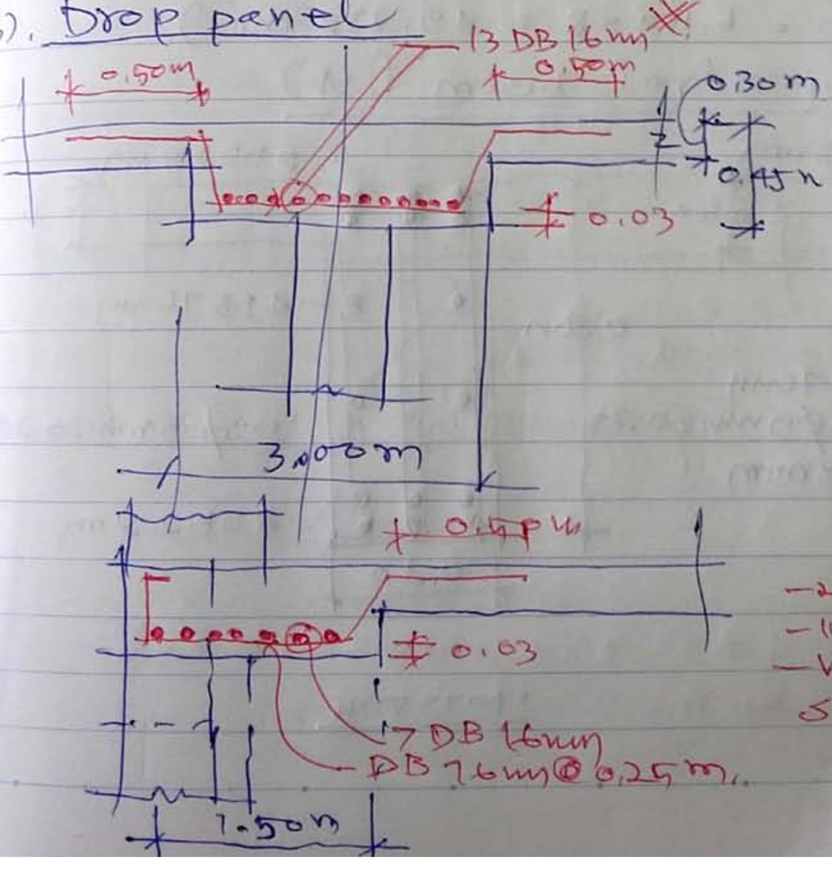
(1) Column Strip



(2) Middle Strip

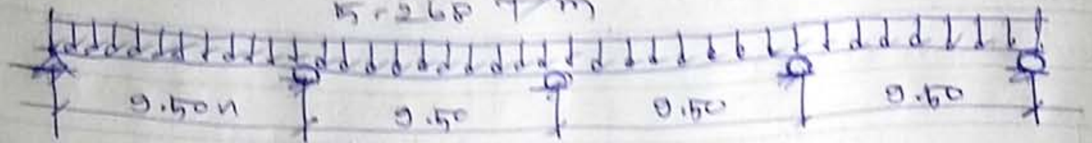


(3). Drop panel



- [illegible]
- [illegible]
- Vou Left Over Shear wall

- **Design Spendrel Beem (SB)** (Ass Section 0.40×0.80)



- **Lood calculation**

$w_1 = (0.40)(0.80)(2.40) = 0.768$ T/m

$w_2 = (1.20\ \text{T/m}^2)(\frac{7.50\text{m}}{2}) = \underline{4.50}$ T/m

$\sum = \underline{\underline{5.268}}$ T/m

⊕ M-max = $(0.077)(5.268)(9.50)^2 = 36.608$ T-m

⊖ M-max = $(0.107)(5.268)(9.50)^2 = 50.871$ T-m

MC = $(20.70)(0.40)(71.05)^2 / 1000 = 41.798$ T-m

- $d = 80 - 4 - 0.9 - 2.8 - \frac{2.5}{2} = 71.05$ cm →

⊕ $AS = \frac{(36.608)(1000)(100)}{(1700)(0.875)(71.05)} = 34.638\ \text{cm}^2$

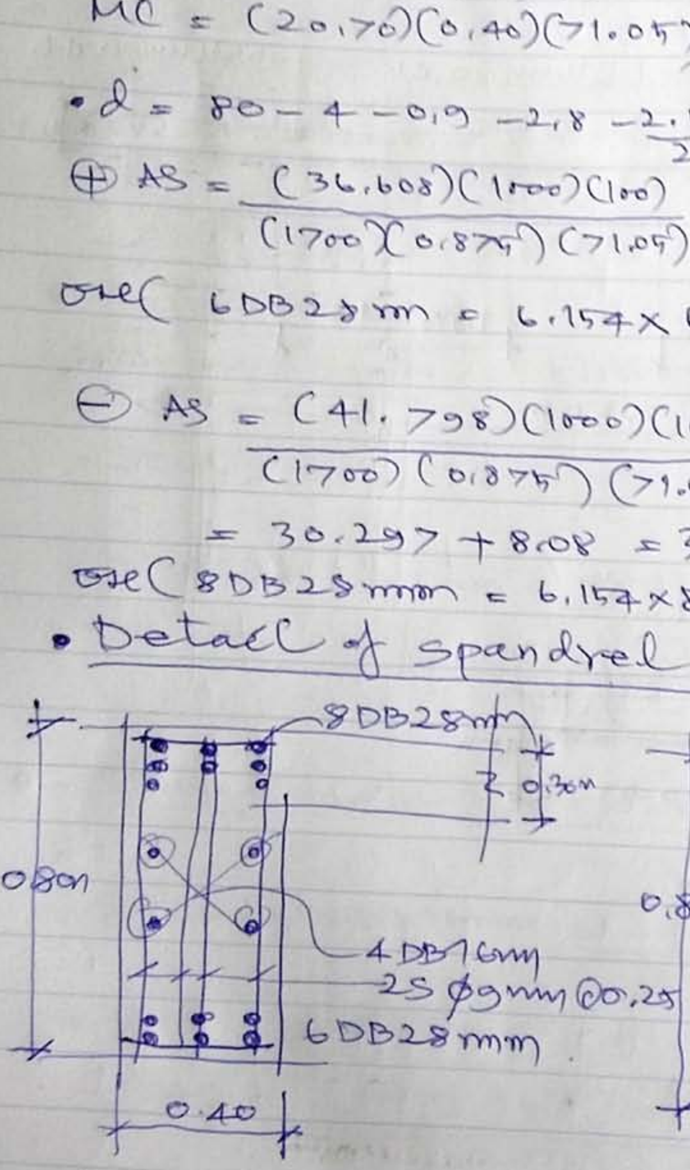
Use(6DB28mm = 6.154×6 = 36.924 cm²)

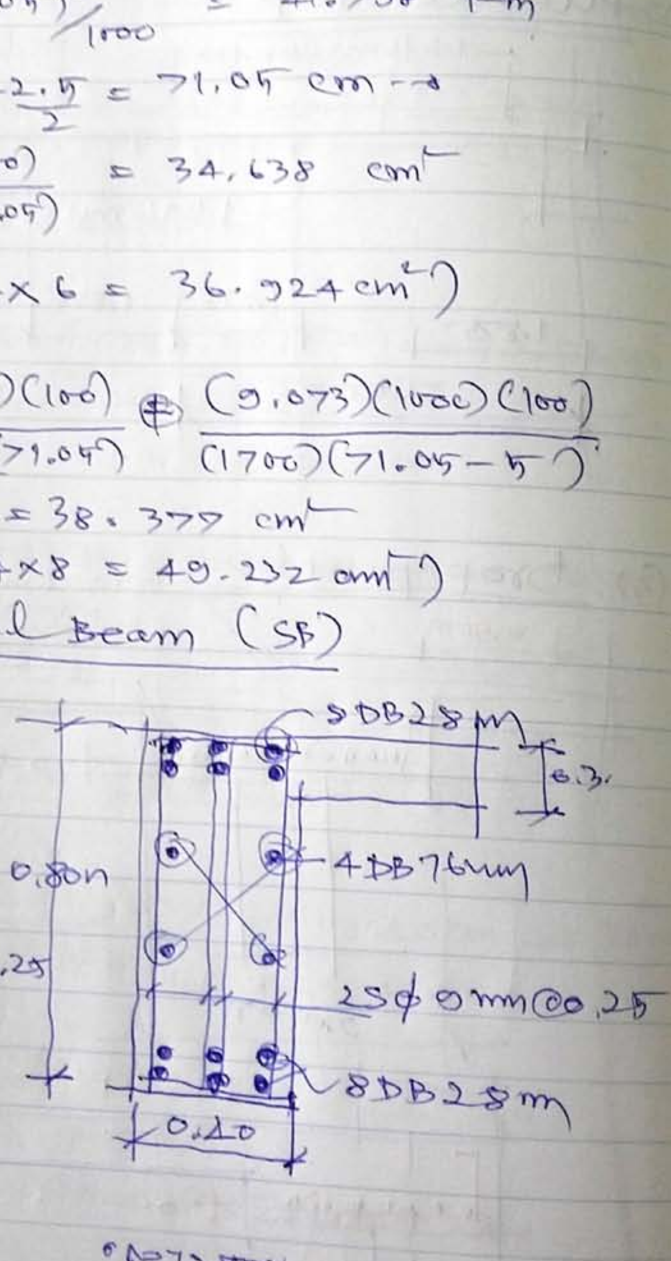
⊖ $AS = \frac{(41.798)(1000)(100)}{(1700)(0.875)(71.05)} \oplus \frac{(9.073)(1000)(100)}{(1700)(71.05-5)}$

$= 30.297 + 8.08 = 38.377\ \text{cm}^2$

Use(8DB28mm = 6.154×8 = 49.232 cm²)

- **Detail of spandrel Beam (SB)**



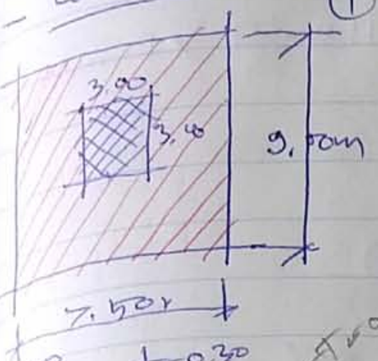


- ຫົວເສົາ

- ກາງຄານ.

• Step ② Design column,

- Load calculation



① $w_1 = (3)(3)(1.560\ T/m^2) = 14.04\ T$

$w_2 = (62.25)(1.20\ T/m^2) = 74.70\ T$

$\sum load = 88.74\ T$ → Tributary Area $(7.50 \times 9.50\ m^2)$

(DL + LL + FL)

• drop t = 0.30 T = 0.45

1200 − 720 + 1080
= 1560 Kg/m²
= 1.56 T/m² − load

• Slab

A = (7.5)(9.50) − 9
= 62.25 m²
Load = 1200 Kg/m²

② นน อาคาร/ชั้น

นน เสา h = 3.50m ① = (14.40)(19 ต้น) = 273.60 T   (T/ต้น)

② = (14.40 T/ต้น)(32) = 460.80 T

③ นน พื้น ชั้น = (3724 m² + 152 m²)(1.20 T/m²)
slab   drop

= 5367.24 T

① + ② + ③ Σ load = 6101.64 T

∴ นน อาคารทั้งหมด = 24 × 6101.64   (ชั้น)
≃ 146439.36 T

(ยังไม่รวม นน ฐานราก) [illegible]
[illegible])

• น้ำหนักของเสาต้นริม / ชั้น = $\frac{1}{2}(88.74)$ = 44.37 T ⇒ 45 T.

• น้ำหนักของเสาต้นใน / ชั้น = 88.74 T = 90 T.

• $P_C = (0.2125)(280)(100)(200)/1000 = 1190\ T$

• $P_C = (0.2125)(280)(120)(200)/1000 = 1428\ T$

• (1) ออกแบบเสา C1 → 1.00 × 2.00 เมตร ; เสาชั้นที่ 13 − Roof

P-max = 270 T

PC = 1190 T > P-max ; Try $P_g = 1.50\%$

$P_g = \frac{A_s}{A_g}$; $A_s = (0.015)(100)(200) = 300\ cm^2$

• ใช้ 40DB32 mm ; $A_s = 8.04 \times 40 = 321.60\ cm^2$

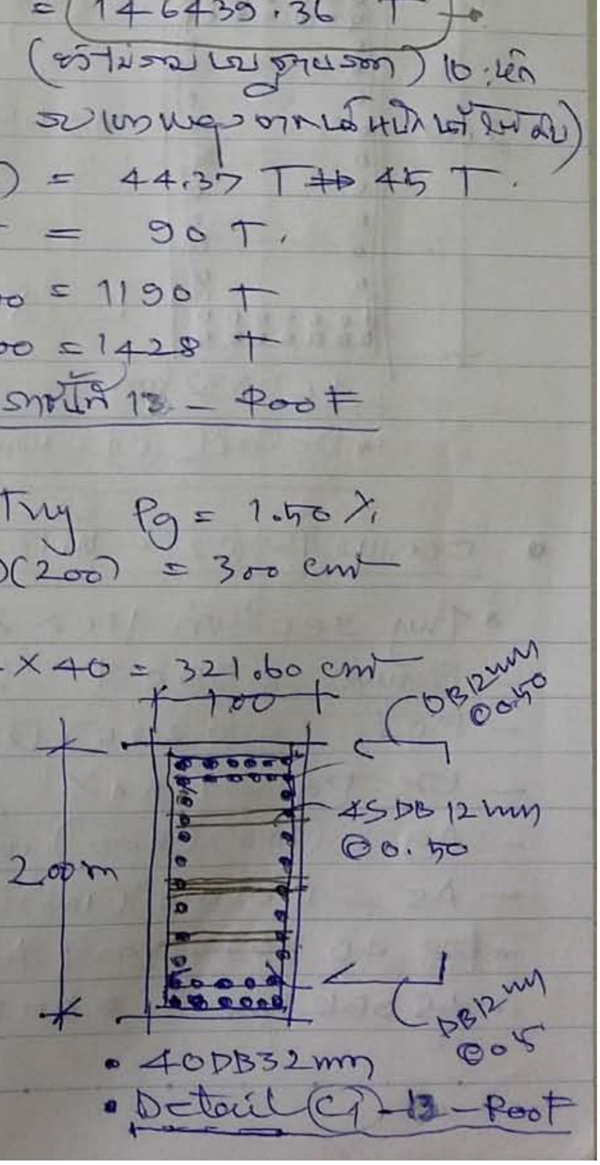
• Code เหล็กปลอก ใช้ DB12 mm

S = (16)(3.2) = 51.20 cm

S = (48)(1.20) = 57.60 cm

S = ด้านแคบสุด = 100 cm.

∴ ใช้ 4S ϕ12 mm @ 0.50 m



- (2) ออกแบบเสา ⓒ1 (ริม) – ชั้นสอง – ชั้นที่ ⑫ ; Try Section 1,00 × 2,00 ม.
  - P-max = 1080 T

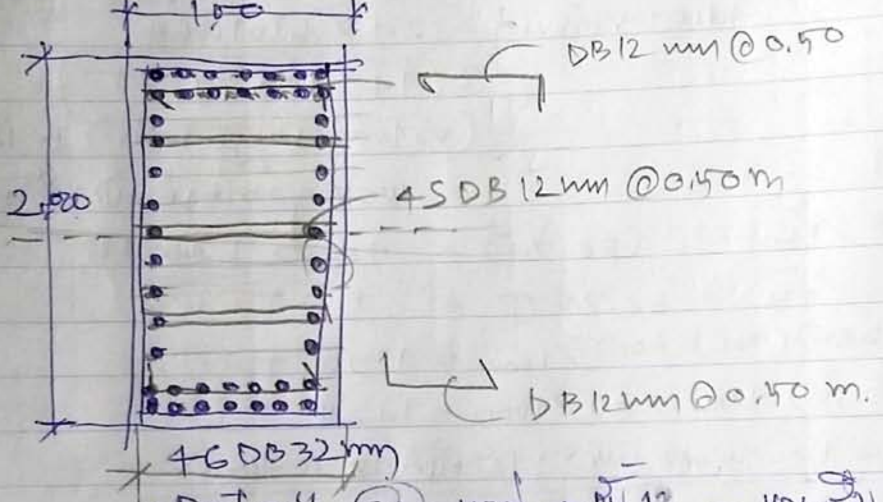
    PC = (0.2125)(280)(100)(200)/1000 = 1190 T > P-max

    Try Pg = 1.80%

    $P_g = \frac{A_s}{A_g}$; As = Pg · Ag

    = (0.018)(100)(200)

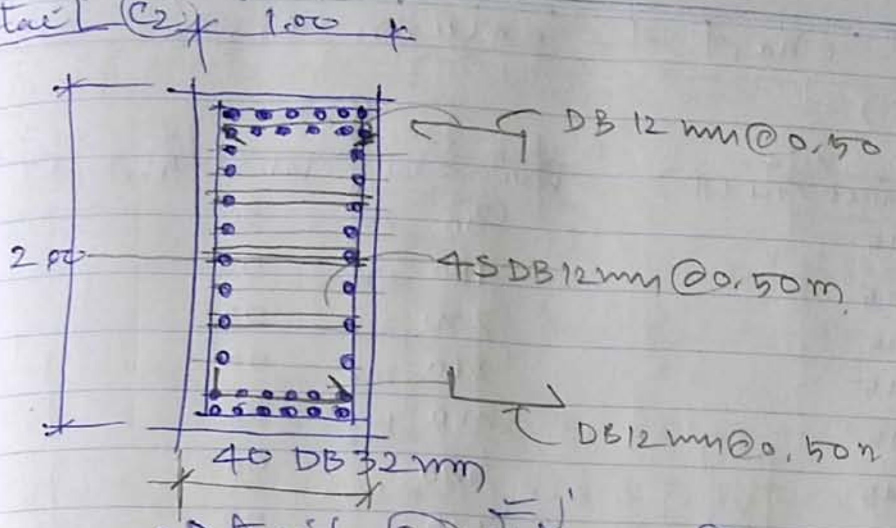
    = 360 cm²
  - ใช้ 46 DB 32 mm ; As = 46 × 8.04 = 369.84 cm²
  - Stirup spacing (DB 12 mm stirup)
    - (16)(3.2) = 51.20 cm
    - (48)(1.2) = 57.60 cm
    - ด้านแคบสุด = 100 cm
  - ใช้ 4S DB 12 mm @ 0.50 m



- Detail ⓒ1 – ชั้นสอง → ชั้น 13 – แนวริม

- ออกแบบเสา ⓒ2 – ชั้น 13 – หลังคา (Roof (เสาริมหลังคา)
  - Try section 1.00 × 2.00 ม.
  - P-max = 990 T ; Ag = 1.00 × 2.00 m²
  - PC = (0.2125)(280)(100)(200)/1000 = 1190 T > 990 T
  - ใช้ Pg = 1.50% ; $P_g = \frac{A_s}{A_g}$ →
  - Ag = (100)(200) cm²
  - As = (0.015)(100)(200) = 300 cm²
  - ใช้ 40 DB32 mm ; As = 8.04 × 40 = 321.60 cm²
  - 4S DB12 mm @ 0.50 m.

• Detail C2



• Detail C2 ชั้นที่ 13 – หลังคา (Roof)

• ออกแบบ C2 ชั้นฐานราก ถึง ชั้นที่ 12 : Try Section 1.20 x 2.00 m.

- P_max = 2160 T

- $P_C = (0.2125)(280)(120)(200)/1000 = 1428$ T.

- $P_S = 2160 - 1428 = 732$ T.

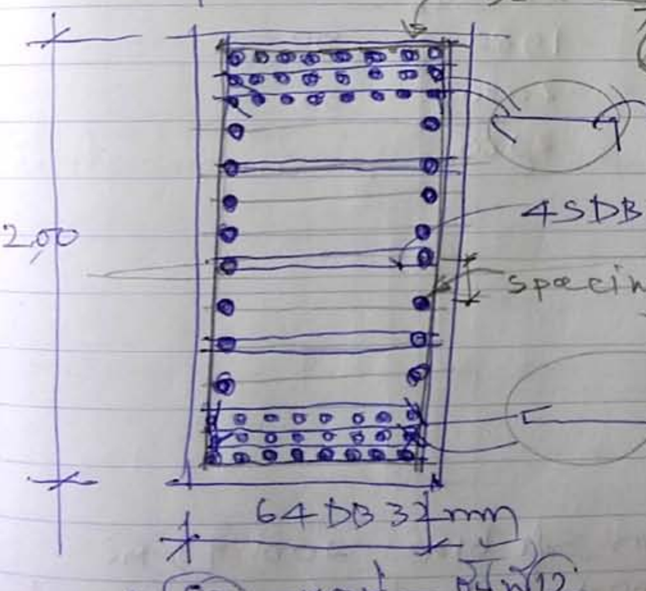
- $A_S = \dfrac{(732)(1000)}{(0.85)(1700)} = 506.57$ cm²

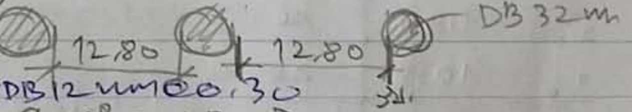
, ใช้ 64 DB 32 mm : $A_S = 514.56$ cm²

$P_g = \dfrac{A_S}{A_g} = \dfrac{514.56}{(120)(200)} = 0.021 < 0.04$ ...ok.

- Detail C2 - ชั้นฐานราก - ชั้นที่ 12

$S = \dfrac{(120 - 8 - 3.2\times 7)}{7} = 12.80$ cm ≤ 15 cm





DB12mm@0.30

(6×8 = 48
64-48 = 16) -ต.

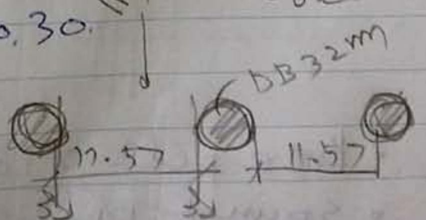
4SDB12mm@0.30m.

spacing ของเหล็กยืน $= \dfrac{(200 - 8 - 13\times 3.2)}{13}$

= 11.57 cm

≤ 15 cm ..ok

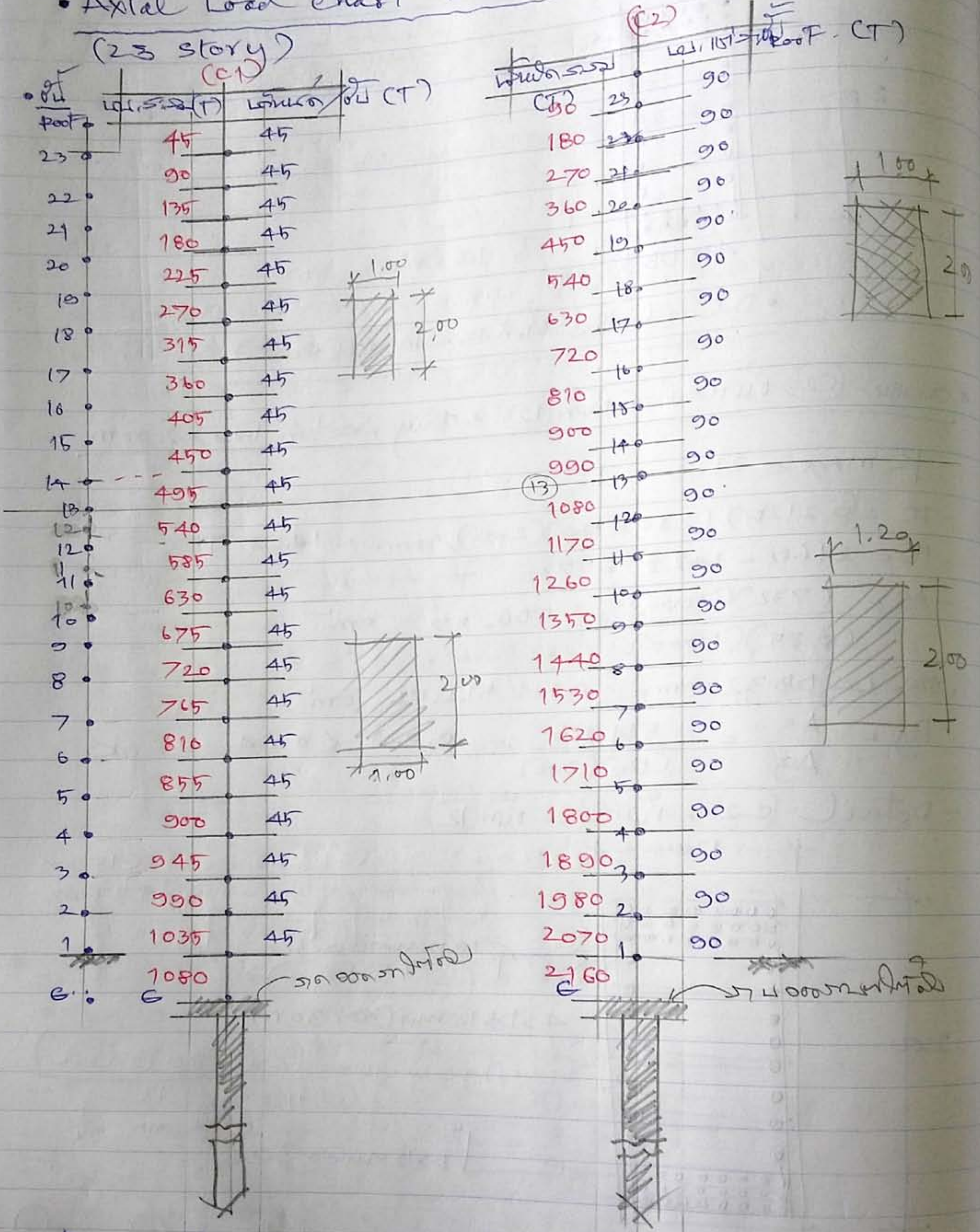
DB12mm@0.30.



• C2 - ฐานราก - ชั้นที่ 12

- Axial Load chart to column C1, C2

(23 story)



(C1)

ชั้น	นน.รวม (T)	เพิ่มแต่ละชั้น (T)
roof		
23	45	45
22	90	45
21	135	45
20	180	45
19	225	45
18	270	45
17	315	45
16	360	45
15	405	45
14	450	45
13	495	45
12	540	45
11	585	45
10	630	45
9	675	45
8	720	45
7	765	45
6	810	45
5	855	45
4	900	45
3	945	45
2	990	45
1	1035	45
G	1080	

(C2)

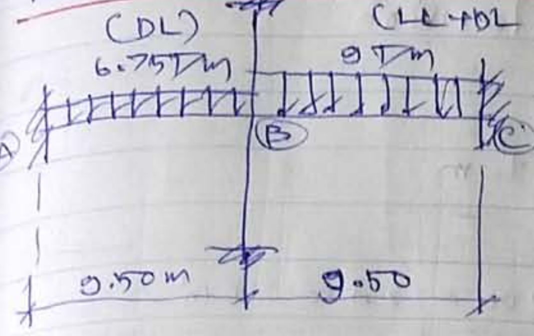
ชั้น	เพิ่มขึ้นรวม (T)	นน. แต่ละชั้น (T)
roof		
23	90	90
22	180	90
21	270	90
20	360	90
19	450	90
18	540	90
17	630	90
16	720	90
15	810	90
14	900	90
13	990	90
12	1080	90
11	1170	90
10	1260	90
9	1350	90
8	1440	90
7	1530	90
6	1620	90
5	1710	90
4	1800	90
3	1890	90
2	1980	90
1	2070	90
G	2160	

- Bore pile Ø1.00 × 40.00 m Safe load 400 T/ต้น
- Spund pile Ø1.00 × 30.00 m Safe load 300 T/ต้น

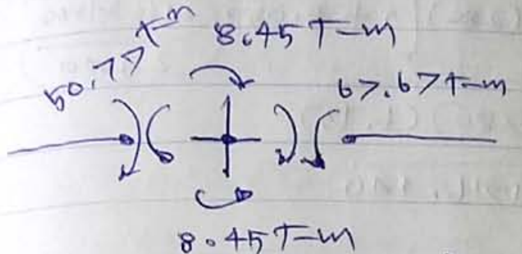
(8 พค 57)

- ออกแบบเสารับแรงอัดตามแนวแกน แรงเฉือนและโมเมนต์ดัด

① หาโมเมนต์ดัดในเสาเนื่องจาก gravity load โดยประมาณ



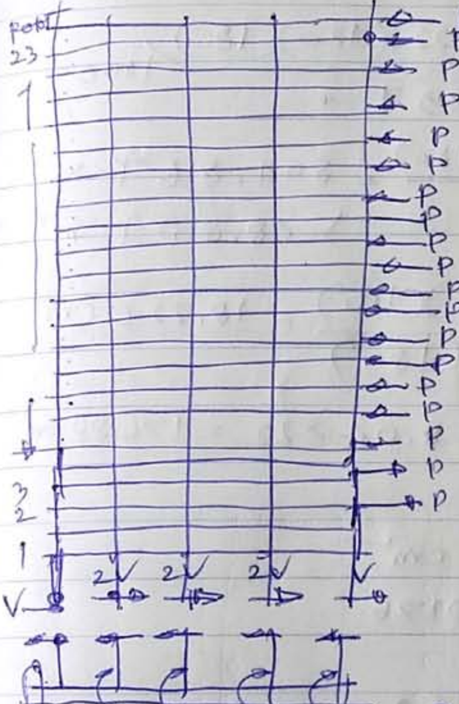
$$FEM_{AB} = -\frac{WL^2}{12} = -(6.75)(9.50)^2/12$$
$$= -50.77 \ T\text{-}m$$
$$FEM_{BA} = +50.77 \ T\text{-}m$$
$$FEM_{BC} = -(9)(9.50)^2/12$$
$$= -67.67 \ T\text{-}m$$
$$FEM_{CB} = +67.67 \ T\text{-}m$$

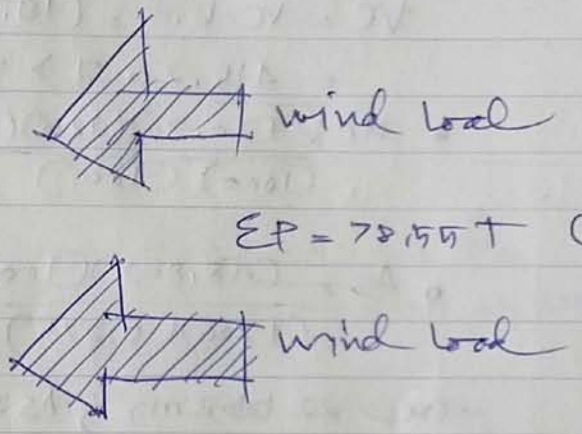


$$M = (67.67 - 50.77)/2 = 8.45 \ T\text{-}m$$

(เสา)
[illegible]

② หาโมเมนต์ดัดในเสาเนื่องจากแรงลม (Wind Load) โดยวิธี Portal



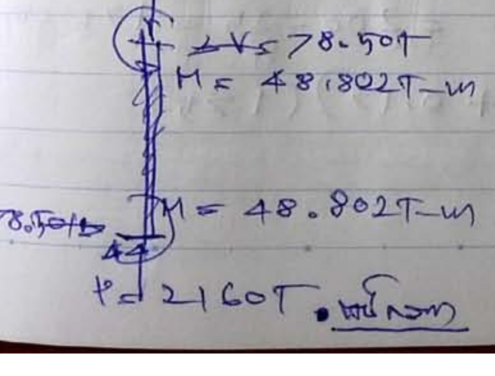


$\Sigma P = 78.55 \ T$ (1 Bay)

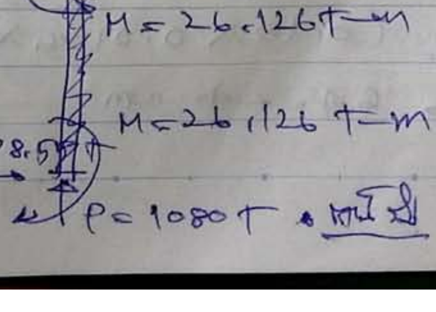
$$8V = 78.55 \ T$$
$$V = \frac{78.55}{8} = 9.82 \ T$$
$$2V = 19.64 \ T$$

- M ที่เสาแถวริม = $9.82 \times 1.8 = 17.676 \ T\text{-}m$
- M ที่เสาแถวกลาง = $19.64 \times 1.8 = 35.352 \ T\text{-}m$

③ แรงลม + gravity load $= \left(\begin{array}{l} 8.45 + 35.352 = 48.802 \ T\text{-}m \\ 8.45 + 17.676 = 26.126 \ T\text{-}m \end{array}\right)$

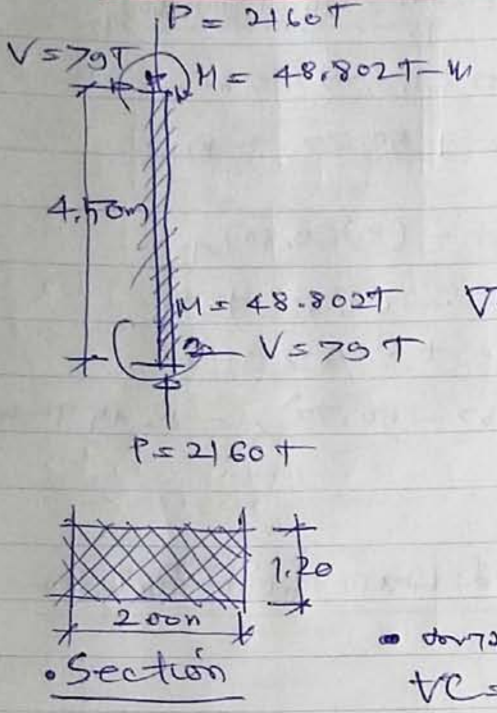


• เสากลาง



• เสาริม

- ตรวจสอบหน้าตัดเสา และ ปริมาณเหล็กเสริมเสา (C2) ชั้นล่างสุด เนื่องจาก แรงตามแนวแกน, แรงเฉือน และโมเมนต์ดัด



• Section

$P = 2160$ T

$M = 48.802$ t-m

$V = 79$ t

$A_g = 120 \times 200 = 24000$ cm^2

$V_C = 0.464\sqrt{(280)\left[1 + 0.057\left(\frac{2160 \times 1000}{24000}\right)\right.}$

$= 0.464\sqrt{(280)(6.13)}$

$= 0.464\sqrt{1716.140}$

$= 19.222$ KSC

- ความลึกประสิทธิผล ; $d = (0.90)(200) = 180$ cm

$V_C = v_c \cdot b \cdot d = (19.222)(120)(180)/1000$

$= 415.20$ T $>$ 79 T

- $M_C = \frac{(20.70)(120)(180)}{(1000)(100)} = 804.816$ T-m > 48.802 T-m

- $A_S = \frac{(48.802)(1000)(100)}{(1700)(0.875)(180)} = 18.226$ cm^2

· ใช้ 22 DB32mm ; $A_S = 8.04 \times 22 = 176.88$ cm^2

- ตรวจสอบพฤติกรรมใต้หน้าตัดของเสา

$A_{st} = (44)(8.04) = 353.76$ cm^2

$P_g = \frac{A_s}{A_g} = \frac{353.76}{24000} = 0.0176$

$m = \frac{f_y}{0.85 f_c'} = \frac{4000}{(0.85)(280)} = 16.81$

$I = \frac{bh^3}{12} = \frac{(120)(200)^3}{12} = 80 \times 10^6$ cm^3

$h = 200$ cm ; $d' = 25$, $h - d' = 200 - 25 = 175$ cm

$e_b = (0.67 \times \overset{P_g}{0.0176} \times \overset{m}{16.81} + 0.17)\overset{h-d'}{(175)}$

$= 64.44$ cm

e จริง $= \frac{M}{P} = \frac{(48.802)(100)}{2160} = 2.259$ cm < 64.44 cm

- ตรวจหน่วยแรงตามแนวแกนร่วมกับหน่วยแรงดัด แบบ ทิศทางเดียว โดยใช้สมการ

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1 \quad --*$$

$$F_a = (0.34)(1 + P_g \cdot m) f_c'$$
$$= (0.34)(1 + 0.0176 \times 16.87)(280)$$
$$= 123.365 \text{ KSC}$$

$$f_a = \frac{P}{A} = \frac{(2160)(1000)}{24000} = 90 \text{ KSC}$$

$$F_b = (0.45)(f_c') = (0.45)(280) = 126 \text{ KSC}$$

$$f_b = \frac{MC}{I} = \frac{(44.802)(1000)(100)(100)}{80 \times 10^6} = 6.11 \text{ KSC}$$

- แทนค่าในสูตร $\frac{f_a}{F_a} + \frac{f_b}{F_b} = \frac{90}{123.40} + \frac{6.11}{126} = 0.729 + 0.048$

$$= 0.78 < 1.00 \text{ — ok.}$$

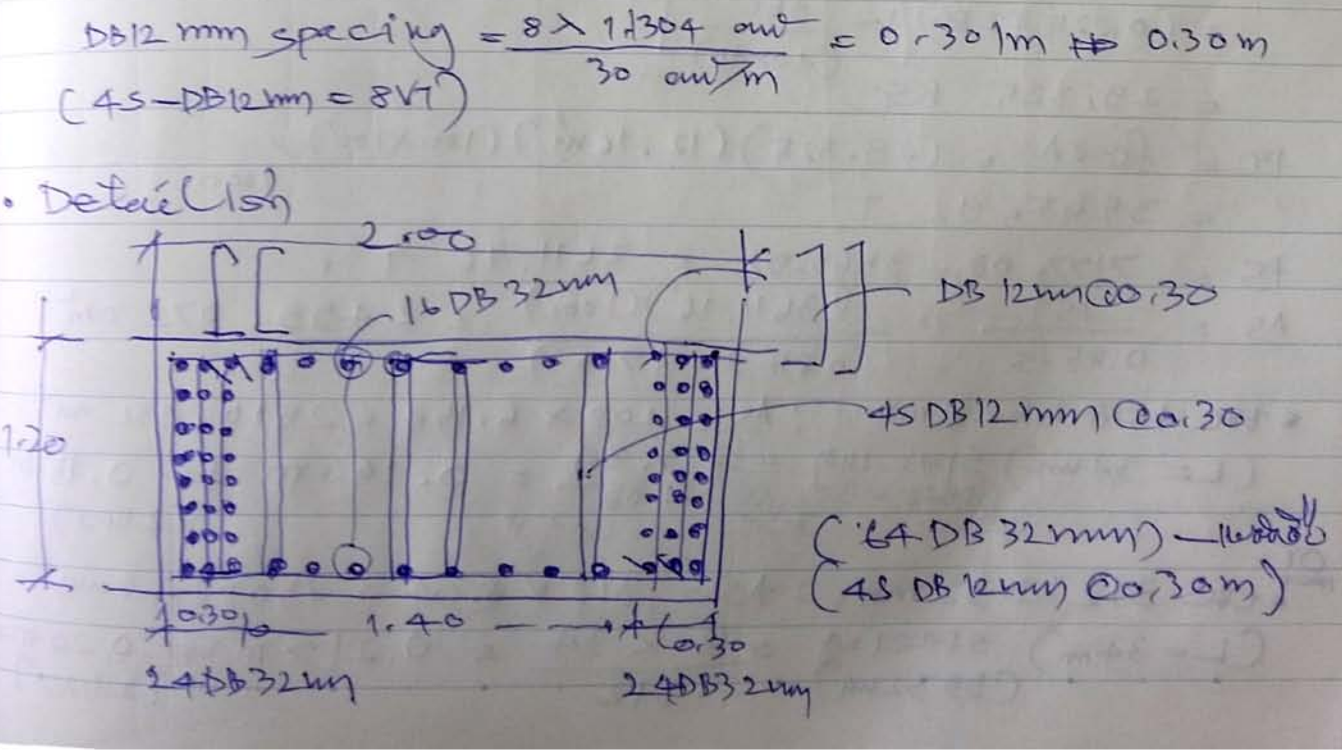
- เหล็กเสริมผนัง
  - Vsteel $= (0.0015)(100)(120) = 18$ cm²/m

    DB32 spacing $= \frac{8.04 \text{ cm}^2}{18 \text{ cm}^2/\text{m}} = 0.44$ m ⇒ ใช้ > $\boxed{\text{CODE } 15 \text{ cm}}$
  - Hsteel $= (0.0025)(100)(120) = 30$ cm²/m

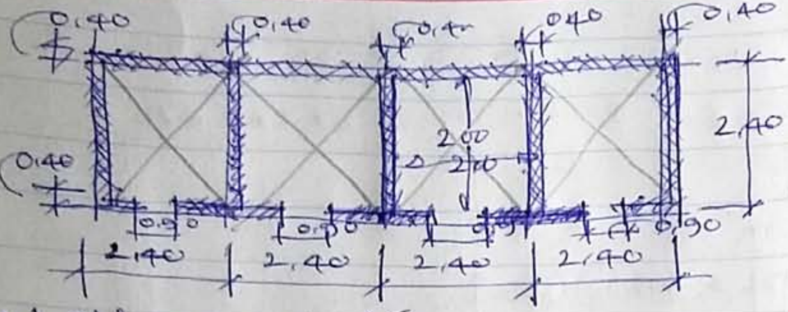
    DB12 mm spacing $= \frac{8 \times 1.1304 \text{ cm}^2}{30 \text{ cm}^2/\text{m}} = 0.301$ m ⇒ 0.30 m

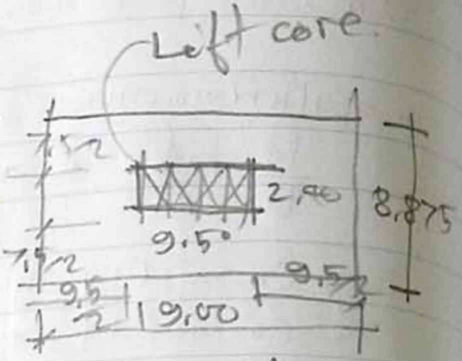
    (4S-DB12mm = 8ขา)

- Detailเสา



- Step ③ Design Lift core





- Lift core section

- Tributary Area

- Tributary Area : $A = (9.90)(19) - (9.50)(2.40)$
  $= 165.30\ m^2$
- (Area พื้น 23ชั้น × นน./ม²) $= (165.30\ m^2)(24)(1.20\ T/m^2)$
  $= \boxed{4760.64\ T}$ จากพื้น --- ⓦ1
- นน. Lift core $= \left[(2.80\times5)+(10\times2)-(4\times0.90)\right](0.40m)$
  ∴ L = 34 m ∴ $\times 2.40 \times 3.60 \times 23$ ชั้น
  $= (12.16\ m^2)(2.40\times3.60\times23$ ชั้น$)$
  $= \boxed{2416.44\ T}$ จากผนัง Lift --- ⓦ2

∴ Total Load $= W_1 + W_2 = 4760.64 + 2416.44$
$= \boxed{7177.08\ T}$

- $f_c = 0.225 f_c' \left[1 - \frac{h}{40t}\right]^3$; h = 360 cm , t = 40 cm

$= (0.225)(280)\left[1 - \frac{360}{(40\times40)}\right]^3$

$= 29.325$ ksc

$P_C = f_c \cdot A = (29.325)(12.16\ m^2)(100\times100)/1000$

$= 3565.92\ T$

$P_S = 7177.08 - 3565.92 = 3611.16\ T$

$A_S = \frac{P_S}{0.85 f_s} = \frac{(3611.16)(1000)}{(0.85)(1700)} = 2499.072\ cm^2$

- Use 408 DB 28 mm : $A_S = 408 \times 6.154 = 2510.832\ cm^2$
  (L = 34 m) Spacing (DB28 m) $= \frac{②\times34}{408} = 0.166\ m$ ⇒ 0.15 m (2 แถว)
  ~~2150~~ ([illegible])

or

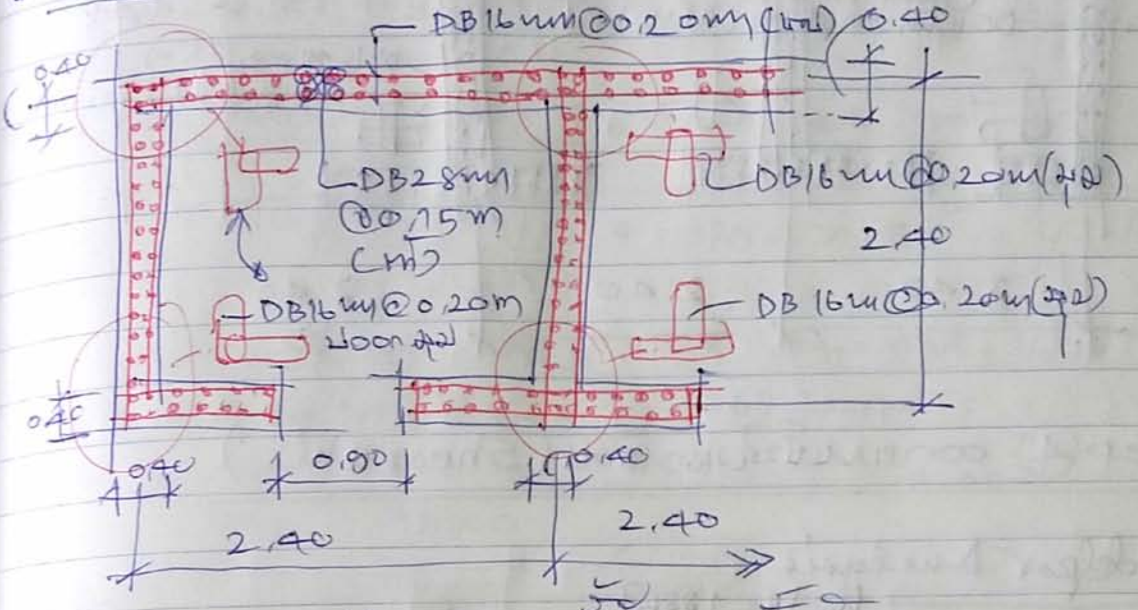
- Use 312 DB 32 mm : $A_S = 312 \times 8.04 = 2508.48\ cm^2$
  (L = 34 m) spacing (DB32 mm) $= \frac{②\times34}{312} = 0.217\ m$ ⇒ 0.20 m (2 แถว)

- CODE ; $As_{min} = (0,0025)(100)(40) = 10\ cm^2/m < \frac{2499,072}{34} = 73,50\ cm^2/m$

- $ASb = (0,0025)(100)(40) = 10\ cm^2/m$

  [DB16mm spacing $= \frac{2,01\ cm^2}{10\ cm^2/m} = 0,201\ m \Rightarrow 0,20\ m$

- Detail Lift core ชั้นใต้ดิน – ชั้นที่ ⑫



- Design Lift core ชั้น B – ชั้นที่ 10

$P_{max} = 7177.08/2 = 3588.54$ Tons

$PC = 3565.92$ T

$PS = 3588.54 - 3565.92 = 22.62$ T

$AS = \frac{(22.62)(1000)}{(0.85)(1700)} = 15.654\ cm^2/34m$

$As_{min} = (0,0025)(100)(40) = 10\ cm^2/m$

- ใช้ DB25mm spacing $= \frac{4.906\ cm^2}{10\ cm^2/m} = 0.491\ m \Rightarrow 0,30\ m$ →

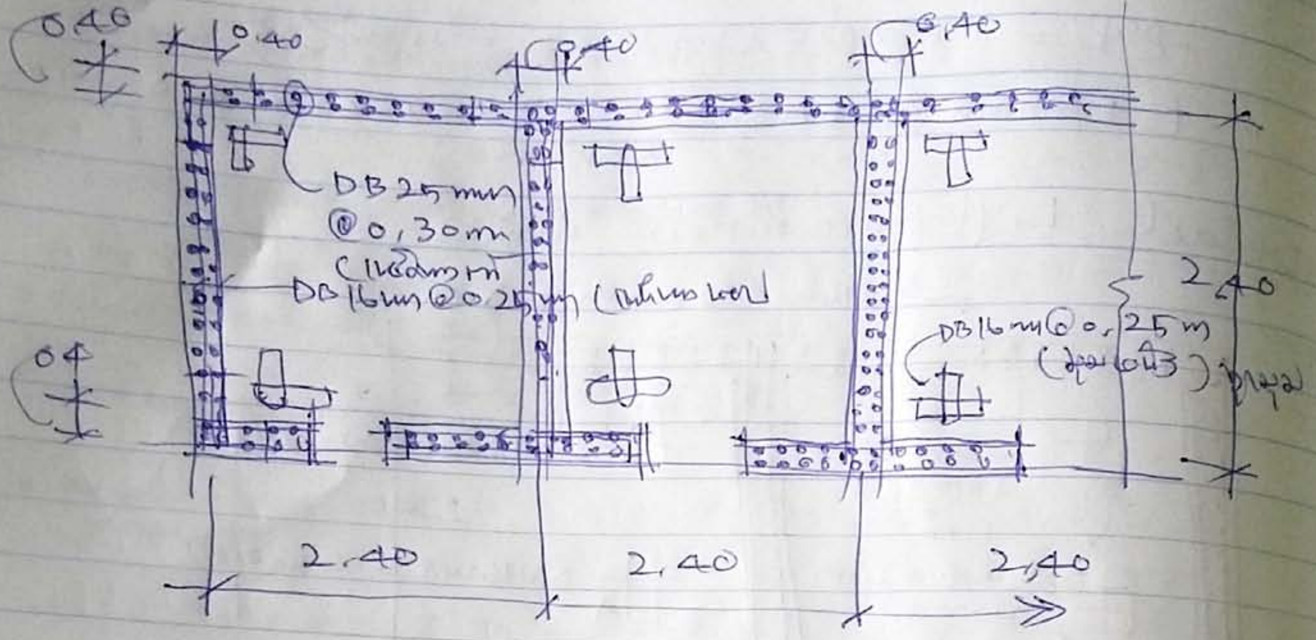
$Asb = (0.0025)(2.40)(40) = 24,00\ cm^2$

- ใช้ 12DB16mm ; $AS = 2,01 \times 12 = 24.12\ cm^2/2.40m$

$Asb/m = 24.10/2.40 = 10.05\ cm^2/m$

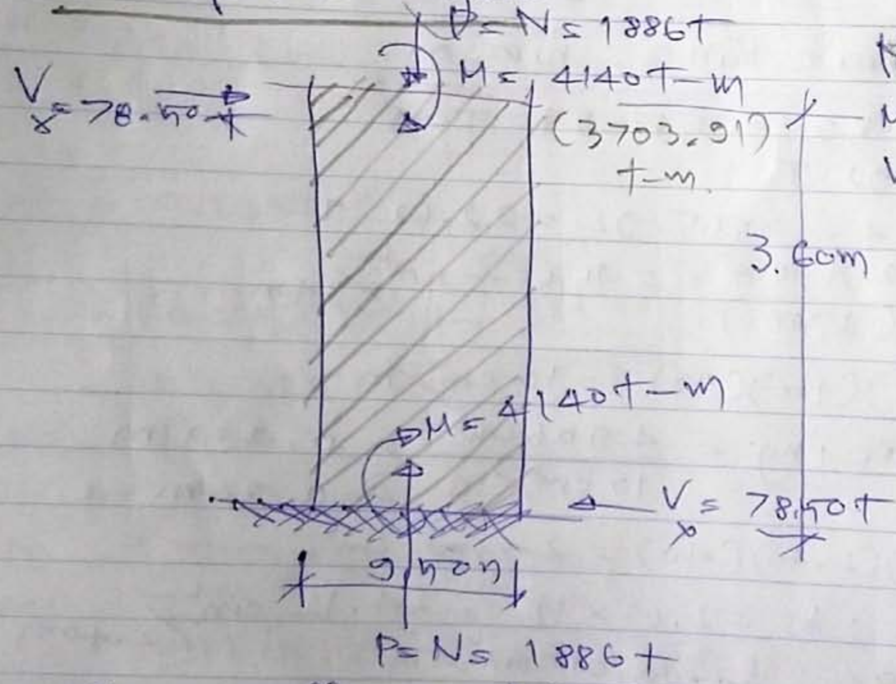
spacing DB16mm $= \frac{② \times 2.01\ cm^2}{10.05} = 0,40\ m \Rightarrow 0,25\ m$ →

- Detail Lift core ຊັ້ນ (13) - RooF



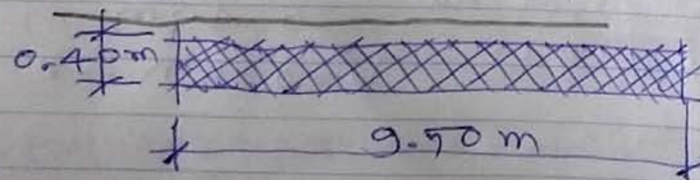
- Step ④ ອອກແບບ[illegible] (Shear wall)

- Model for Analysis



N_x = P = 1886 T
M = 4140 T-m
V_x = 78.50 T

- Shear wall section



A_g = (40)(950)
= 38000 cm^2
I = 2857.916×10^6 cm^4

$vc = 0.464\sqrt{(fc')\left[1 + 0.057\frac{N}{Ag}\right]}$ --- ⟶

$= 0.464\sqrt{(280)\left[1 + (0.057)\frac{(1886 \times 1000)}{(38000)}\right]}$

$= 15.192$ KSC

$Vc = vc.b.d = (15.192)(40)(0.90 \times 950)/1000$

$= 544.464\ T > 78.55\ T$

$MC = \frac{(20.70)(40)(855)^2}{(100)(1000)} = 6052.877\ T\text{-}m > 4140\ T\text{-}m$

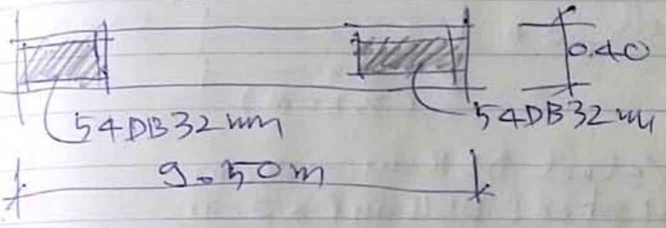
$As = \frac{(4140)(1000)(100)}{(1700)[0.60 \times 950]} = 427.244\ cm^2$ -→

$As = \frac{(4140)(1000)(100)}{(1700)(0.875)(855)} = 325.57\ cm^2$

. ใช้ 54DB32mm ; $As = 54 \times 8.04 = 434.16\ cm^2$

. $Ast = (54 \times 2)A = 108 \times 8.04 = 868.32\ cm^2$

. $Pg = \frac{As}{Ag} = \frac{868.32}{38000} = 0.0228 < 0.004$



$m = \frac{Fy}{(0.85)(280)} = \frac{4000}{(0.85)(280)} = 16.81$

$I = \frac{bh^3}{12} = \frac{(40)(950)^3}{12} = 2857.916 \times 10^6\ cm^4$

$h = 950\ cm$; $d' = 25\ cm$; $h - d' = 950 - 25 = 925\ cm$

$eb = (0.67 \times 0.0228 \times 16.81 + 0.17)(925) = 394.78\ cm$

$e = \frac{(4140)(100)}{1886} \frac{T\text{-}cm}{T} = 219.51\ cm < 394.78\ cm$

[illegible] -→

ใช้สูตร $\boxed{\frac{fa}{Fa} + \frac{fb}{Fb} \leq 1}$ --→

. $Fa = (0.34)(1 + Pg \cdot m)fc' = (0.34)(1 + 0.0228 \times 16.81) \times 280$

$= 131.687$ KSC --→

- $f_a = \frac{P}{A} = \frac{(1886)(1000)}{38000} = 40.631$ ksc
- $F_b = (0.45)f_c' = (0.45)(280) = 126$ ksc
- $f_b = \frac{MC}{I} = \frac{(4140)(1000)(100)(475)}{(2857.916 \times 10^6)} = 68.808$ ksc.
- แทนค่า $\frac{f_a}{F_a} + \frac{f_b}{F_b} = \frac{40.631}{131.687} + \frac{68.808}{126} = 0.376 + 0.546$

$= 0.922 < 1.00$ -- ok.

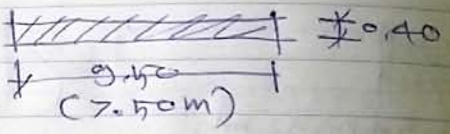
- เหล็กเสริมพื้น
- Vsteel = $(0.0015)(100)(40) = 6\ cm^2/m$

spacing DB16mm = $\frac{2.01\ cm^2}{6\ cm^2/m} = 0.335\ m \Rightarrow 0.30\ m$

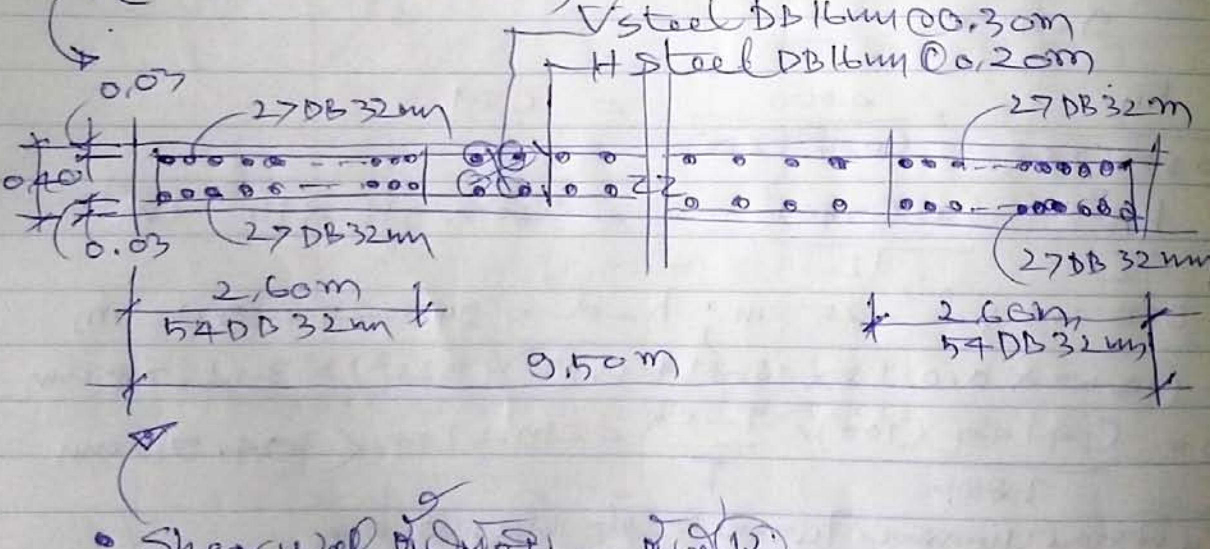
- Hsteel = $(0.0025)(100)(40) = 10\ cm^2/m$

spacing DB16mm = $\frac{2.01\ cm^2}{10\ cm^2/m} = 0.20\ m \Rightarrow 0.20\ m$

- <u>Detail Shearwall</u> →

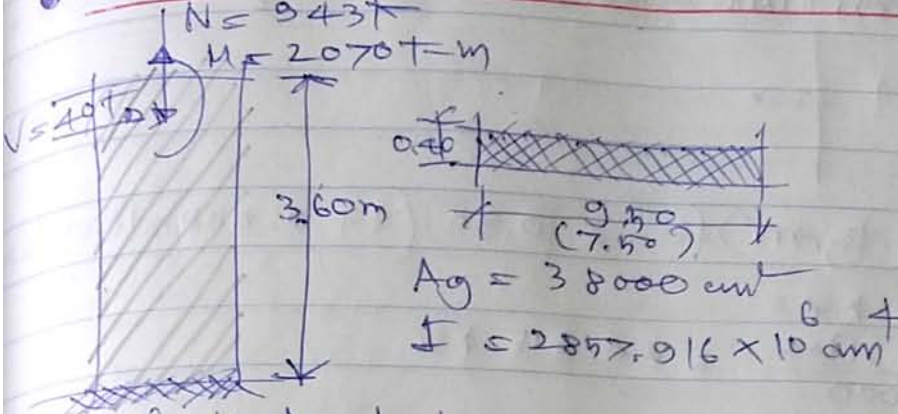


- (ชั้นใต้ดิน – ชั้น 10 [illegible])
- (ชั้นใต้ดิน – ชั้นที่ 12)



- Shearwall ชั้นใต้ดิน – ชั้นที่ ⑫

- Design Shear wall ชั้น 13 – Roof



$A_g = 38000\ cm^2$

$I = 2857.916 \times 10^6\ cm^4$

- Model for Analysis

$vc = 0.464\sqrt{(280)\left[1 + (0.057)\left(\overset{2.4145}{\frac{943 \times 1000}{38000}}\right)\right]}$

$= 0.464\sqrt{676.06}$

$= 12.064$ ksc

$Vc = vc \cdot b \cdot d = (12.064)(40)(0.90 \times 950)/1000$

$= 412.607\ T > 40\ T$

$Mc = \frac{(20.70)(40)(855)^2}{(1000)(100)} = 6052.877\ T\text{-}m > 2070\ T\text{-}m$

$As = \frac{(2070)(1000)(100)}{(1700)(0.60 \times 950)} = 213.622\ cm^2$

$As = \frac{(2070)(1000)(100)}{(1700)(0.875)(855)} = 162.75\ cm^2$

- Use 28 DB 32 mm ; $As = 28 \times 8.04 = 225.12\ cm^2$
- $Ast = 2 \times 28 \times 8.04 = 450.24\ cm^2$
- $Pg = \frac{450.24}{38000} = 0.0118 - (0.04)$

$m = \frac{fy}{(0.85)f'c} = \frac{4000}{(0.85)(280)} = 16.81$

$I = \frac{bh^3}{12} = \frac{40 \times 950^3}{12} = 2857.916 \times 10^6\ cm^4$

$h = 950\ cm$; $d' = 25\ cm$; $h - d' = 950 - 25 = 925\ cm$

$eb = (0.67 \times 0.0118 \times 16.81 + 0.17)(925) = 280.18\ cm$

$eo = \frac{M}{P} = \frac{(2070)(100)}{943}\ \left(\frac{T\text{-}cm}{T}\right) = 219.51\ cm < 280.18\ cm \rightarrow ok$

- ดังนั้นพิจารณาสภาวะของในกรณีรับแรงอัดและแรงดัด โดยใช้สูตร

$$\boxed{\frac{fa}{Fa} + \frac{fb}{Fb} \le 1}$$

- $Fa = (0.34)(1 + P_g \cdot m) fc' = (0.34)(1 + 0.0118 \times 16.81)(280)$

  $= 114.084$ KSC

- $fa = \frac{P}{A} = \frac{(943)(1000)}{38000} = 24.815$ KSC

- $Fb = 0.45 fc' = (0.45)(280) = 126$ KSC

- $fb = \frac{MC}{I} = \frac{(2070)(1000)(100)(475)}{2857.916 \times 10^6} = 34.404$ KSC

- แทนค่า $\frac{fa}{Fa} + \frac{fb}{Fb} = \frac{24.815}{114.084} + \frac{34.404}{126} = 0.217 + 0.273$

  $= 0.490 < 1.00$ ... OK.

- <u>เหล็กเสริมอื่น</u>

Vsteel = (0.0015)(100)(40) = 6 cm²/m

use DB16mm @0.30 m ...

H-steel = (0.0025)(100)(40) = 10 cm²/m

use DB16mm @0.20 m ...

- <u>Detail</u> (Shearwall ชั้น 13 – Roof)