NOV. 2008

RC II معلومات - اساسيه حول

① $U = 1.2D + 1.6L$

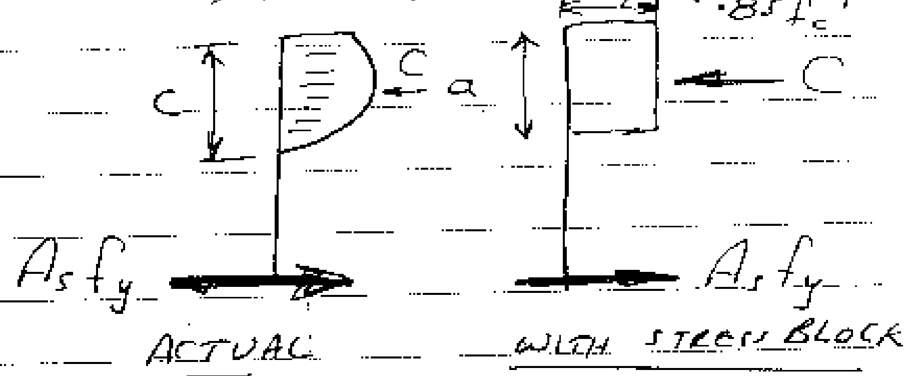
Dead Load — Live Load

② β_1 : Per ACI 318M-08

(i) $\beta_1 = 0.85$ for $f_c' \leq 28 N/mm^2$

(ii) $\beta_1 = 0.65$ " $f_c' \geq 56$ "

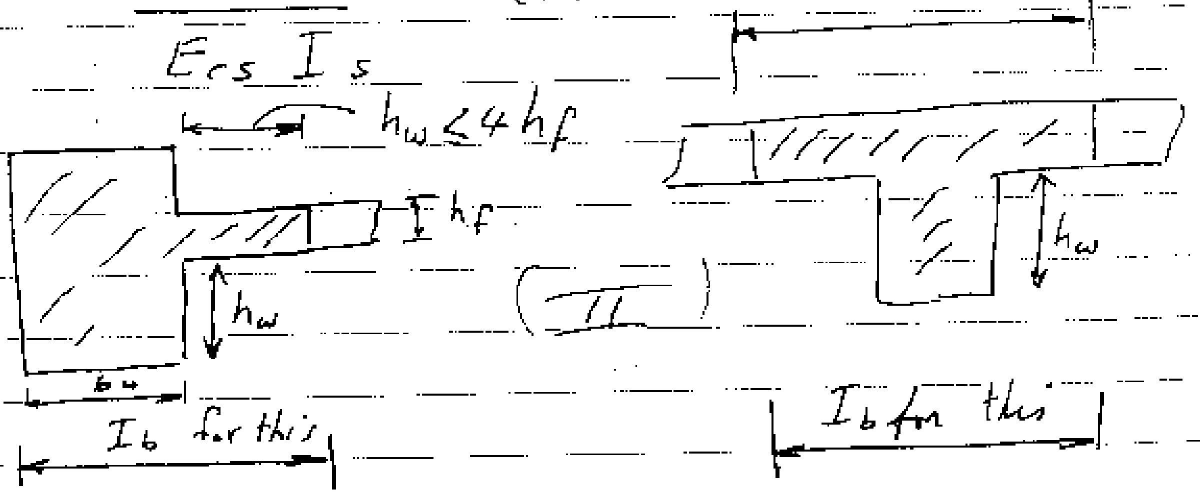
(iii) $\beta_1 = 0.85 - (0.05/7)(f_c' - 28)$ for $28 < f_c' < 56 N/mm^2$



③ DIRECT DESIGN METHOD (DDM)

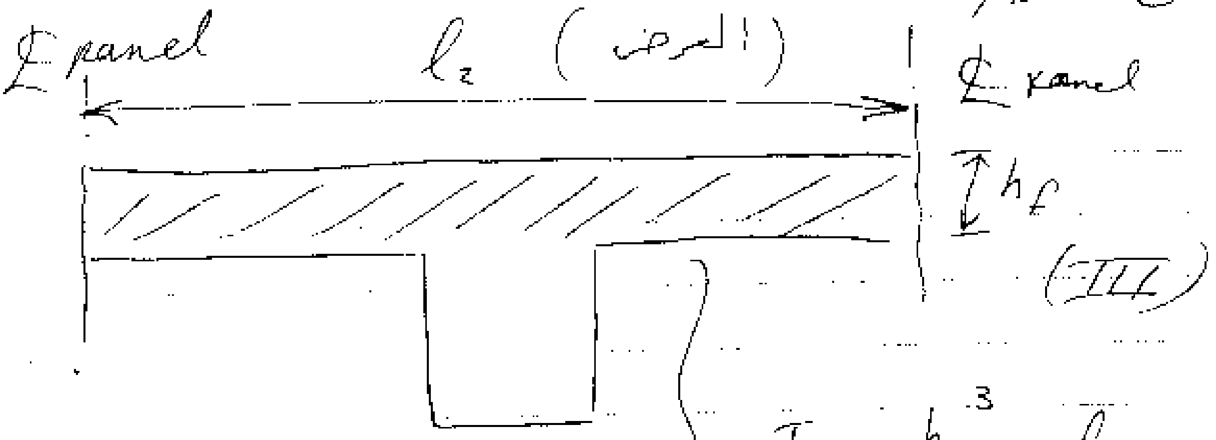
$\alpha = \dfrac{E_{cb} I_b}{E_{cs} I_s}$ (I)

$(b_w + 2h_w) \leq b_w + 8h_f$



2/NOV 08

(2)



(III)

$$I_s = \left(\frac{h_f^3}{12}\right) l_2$$

"STATIC" MOMENT "M_o"

$$M_o = \frac{W_u \, l_2 \, l_n^2}{8} \qquad \text{(IV)}$$

M_o — static moment

W_u — factored load $= 1.2D + 1.6L$

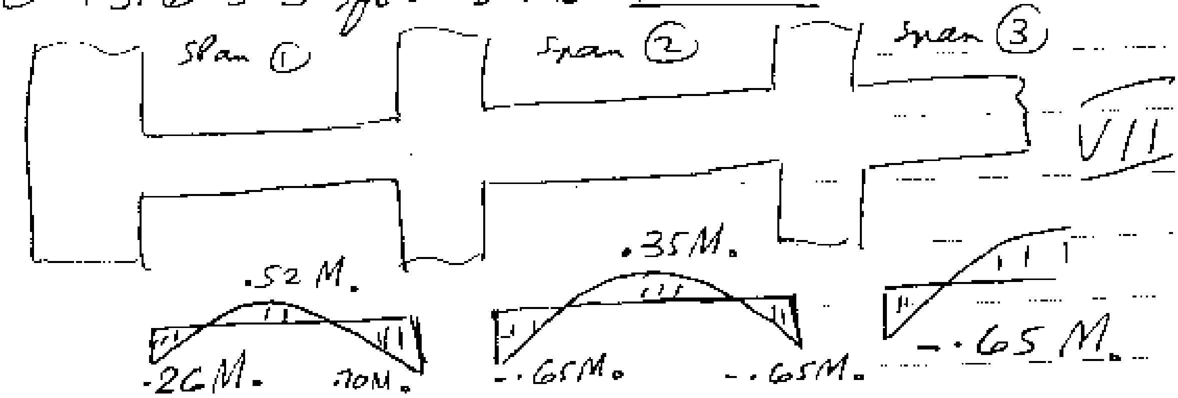
l_2 — العرض

l_n — clear span in direction ∥ l_1

$l_n \geq$ CLEAR SPAN
$l_n \geq 0.65\, l_1$] (V)

Per ACI 13.6.3.3 (داخلية) INTERIOR SPAN
$-$VE MOMENT $0.65\, M_o$
$+$VE " $0.35\, M_o$] (VI)

APPLYING 13.6.3.3 for SLAB "WITHOUT" BEAMS



(VII)

3

SLAB THICKNESS h

1. SLABS WITHOUT BEAMS (FLAT PLATE & FLAT SLAB)

Table 9.5(c): $h_{,min}$ of SLABS without interior beams:

Yield strength f_y, N/mm^2	WITHOUT DROP PANELS			WITH DROP PANELS		
	Exterior Panels*		Interior Panels	Exterior Panels*		Interior Panels
	WITHOUT Edge Beam	WITH Edge Beam (+)		WITHOUT Edge Beam	WITH Edge Beam (+)	
300	$l_n/33$	$l_n/36$	$l_n/36$	$l_n/36$	$l_n/40$	$l_n/40$
420	$l_n/30$	$l_n/33$	$l_n/33$	$l_n/33$	$l_n/36$	$l_n/36$
520	$l_n/28$	$l_n/31$	$l_n/31$	$l_n/31$	$l_n/34$	$l_n/34$

Notes:
1. Use linear interpolation, where necessary
2. [*] Drop panels per 13.3.7.1 and 13.3.7.2
3. [+] Edge beams should have $\alpha_{edge\,beam} \geq 0.8$
4. $h_{SLAB} \geq 120\,mm$ without drop panels
   $h_{SLAB} \geq 100\,mm$ with " " per 13.3.7.1 & 13.3.7.2

$\beta = l_{n\text{-}LONG} / l_{n\text{-}SHORT}$

2. SLABS WITH BEAMS (2-WAY SLABS)

2.1 When $\alpha_m \leq 0.2$ apply Table 9.5(c) + Note 4 above

2.2 $0.2 \leq \alpha_m \leq 2$, apply Eq. (I):

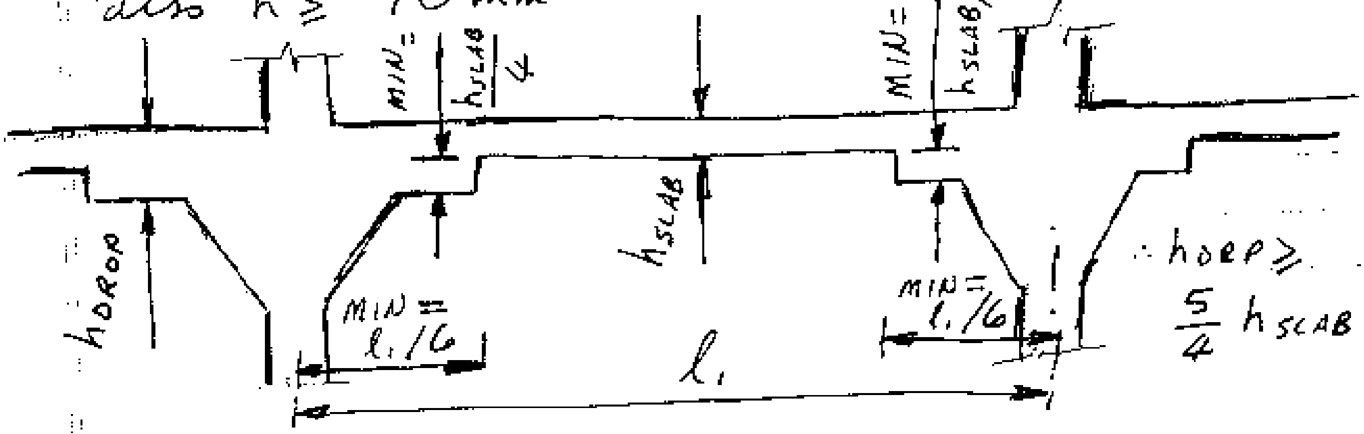
$$h_{,min} = l_n (0.8 + f_y/1500) / [36 + 5\beta(\alpha_m - 0.2)] \quad (I)$$

also $h \geq 120\,mm$

2.3 When $\alpha_m > 2$ apply Eq. (II):

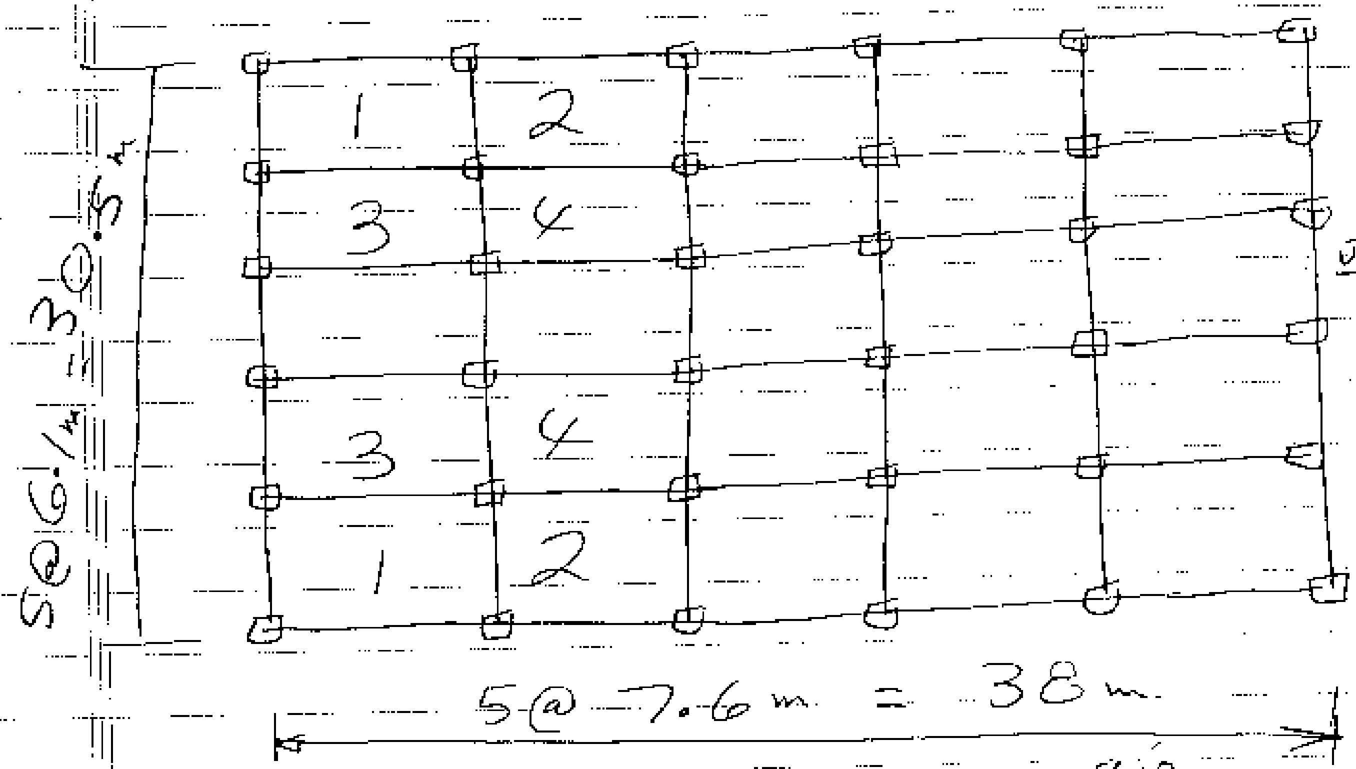
$$h_{,min} = l_n (0.8 + f_y/1500) / (36 + 9\beta) \quad (II)$$

also $h \geq 90\,mm$



(4)

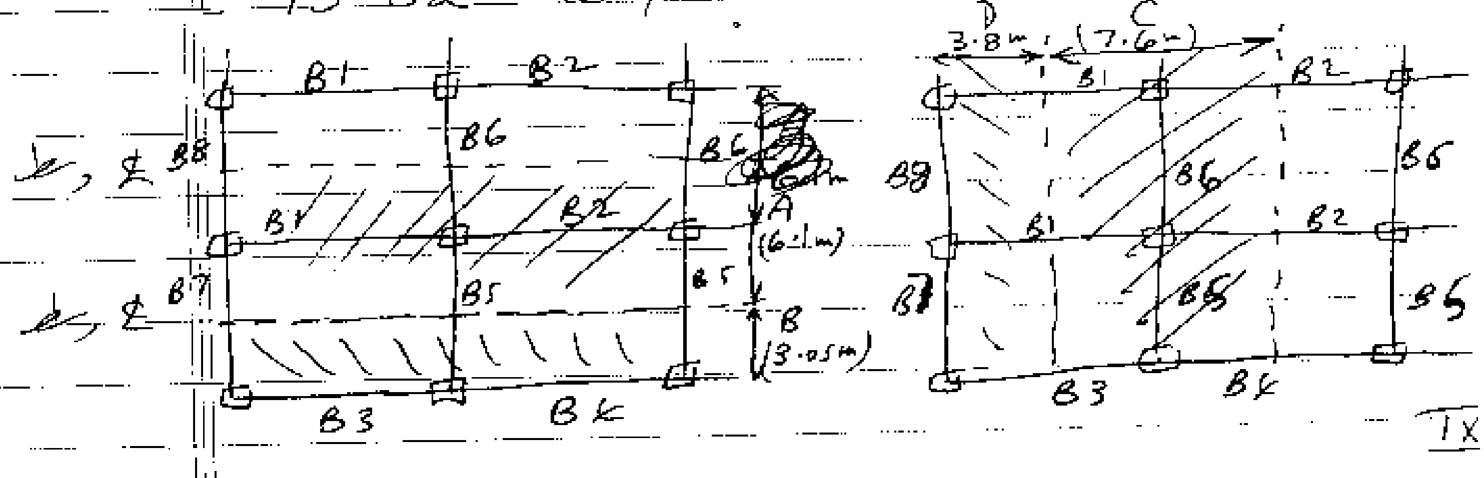
FIRST EXAMPLE:



$f'_c = 20.7\ N/mm^2$; $f_y = 276\ N/mm^2$; SERVICE L $= 6.61\ kN/m^2$, storey height = 3.7m ; slab h = 165 mm ; long beams: h = 710 mm & b_w = 355 mm ; short beams: h = 610 mm & b_w = 305 mm ; ALL columns are 380 x 380 mm

$W_u = 1.2D + 1.6L = 1.2 \times .165 \times 24 + 1.6 \times 6.61$

$= 15.32\ kN/m^2$ Factored Load



5

4/NOV 08

FR. A $M_o = w_u l_2 l_n^2/8 = 15.32 \times 6.1 \times 7.295^2/8 = 622$ kNm

FR. B $M_o = 311$ kNm

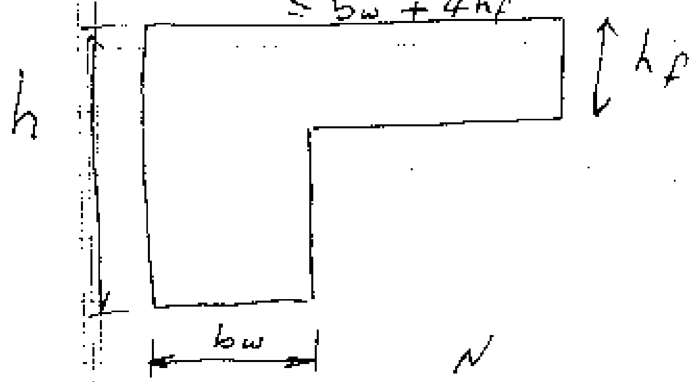
FR C $M_o = 15.32 \times 7.6 \times 5.765^2/8 = 480$ kNm

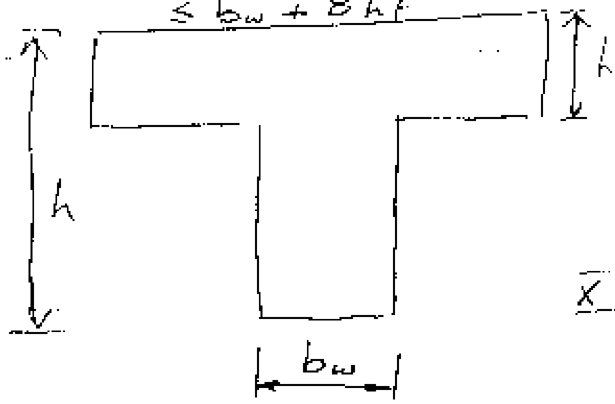
FR D $M_o = 260$ kNm

X

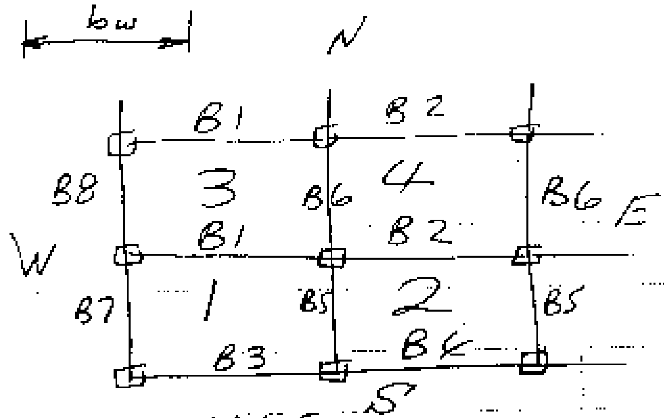
$b \le b_w + h - h_f$
$\le b_w + 4h_f$

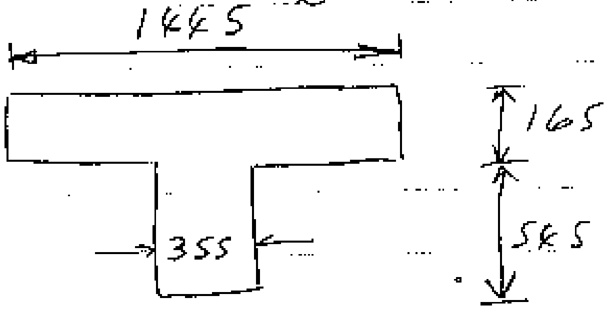
$b \le b_w + 2h - 2h_f$
$\le b_w + 8h_f$



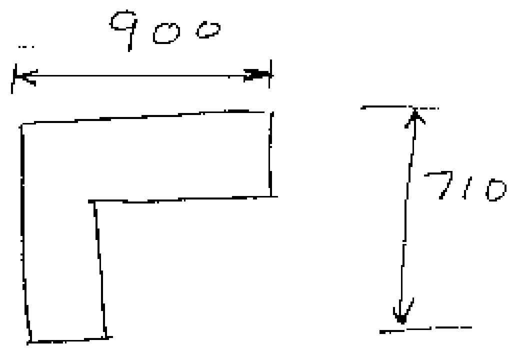


X



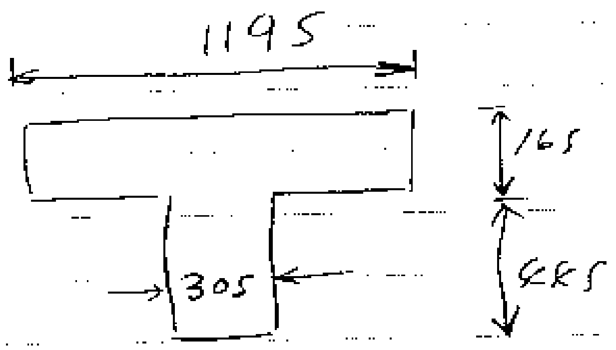


B1-B2

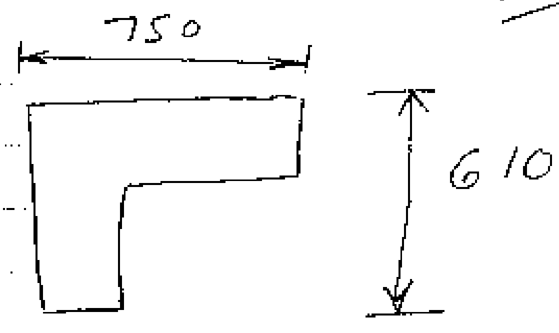


B3-B4

XI



B5-B6



B7-B8

5/ NOV 08

6

B1- B2

$I_b = 1.88 \times 10^{10}\ mm^4$; $I_s = 2.283 \times 10^{9}\ mm^4$

$\alpha = E_{cb} I_b / (E_{cs} I_s) = 8.23$

B3- B4

$I_b = 1.57 \times 10^{10}\ mm^4$; $I_s = 1.14 \times 10^{9}\ mm^4$

$\alpha = 13.8$

B5-B6

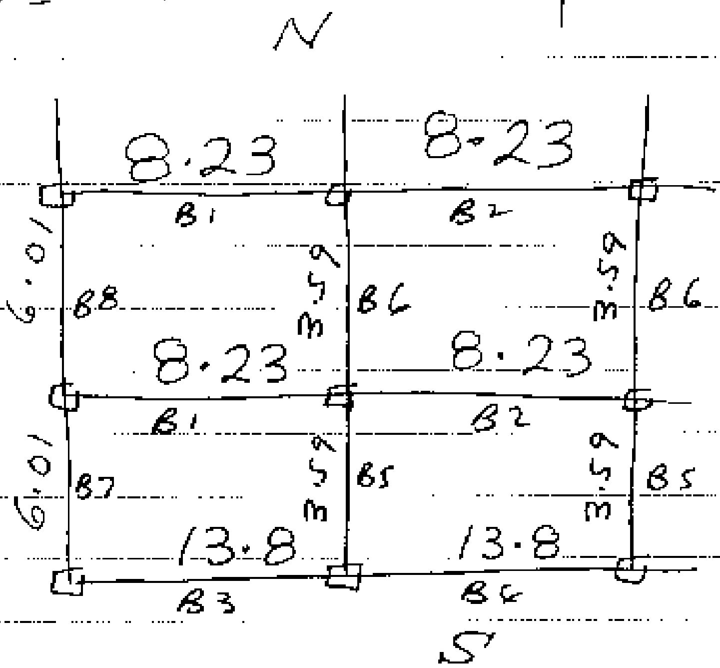
$I_b = 1.06 \times 10^{10}\ mm^4$; $I_s = 2.845 \times 10^{9}\ mm^4$

$\alpha = 3.59$

B7- B8

$I_b = 8.53 \times 10^{9}\ mm^4$ | $\alpha = 6.01$

$I_s = 1.42 \times 10^{9}\ mm^4$



Ib3
α
XIII

7

SA / NOV 08

13.6.3.3 In an end span, total factored static moment, M_o, shall be distributed as follows:

	(1)	(2)	(3)	(4)	(5)
	Exterior edge unrestrained	Slab with beams between all supports	Slab without beams between interior supports		Exterior edge fully restrained
			Without edge beam	With edge beam	
Interior -ve factored moment	0.75	0.70	0.70	0.70	0.65
+VE factored moment	0.63	0.57	0.52	0.50	0.35
Exterior -VE factored moment	0	0.16	0.26	0.30	0.65

5B/NOV 08

13.6.4.1 Column strips shall be proportioned to resist the following portions in percent of interior negative factored moments:

l_2/l_1	0.5	1.0	2.0
$(\alpha_1 l_2/l_1) = 0$	75	75	75
$(\alpha_1 l_2/l_1) \geq 1.0$	90	75	45

13.6.4.2 Column strips shall be proportioned to resist the following portions in percent of exterior negative factored moments:

l_2/l_1		0.5	1.0	2.0
$(\alpha_1 l_2/l_1) = 0$	$\beta_t = 0$	100	100	100
	$\beta_t \geq 2.5$	75	75	75
$(\alpha_1 l_2/l_1) \geq 1.0$	$\beta_t = 0$	100	100	100
	$\beta_t \geq 2.5$	90	75	45

9

SC /NOV 08

13.6.4.4 Column strips shall be proportioned to resist the following portions in percent of positive factored moments:

l_2/l_1	0.5	1.0	2.0
$(\alpha_1 l_2/l_1)=0$	60	60	60
$(\alpha_1 l_2/l_1)\geq 1.0$	90	75	45

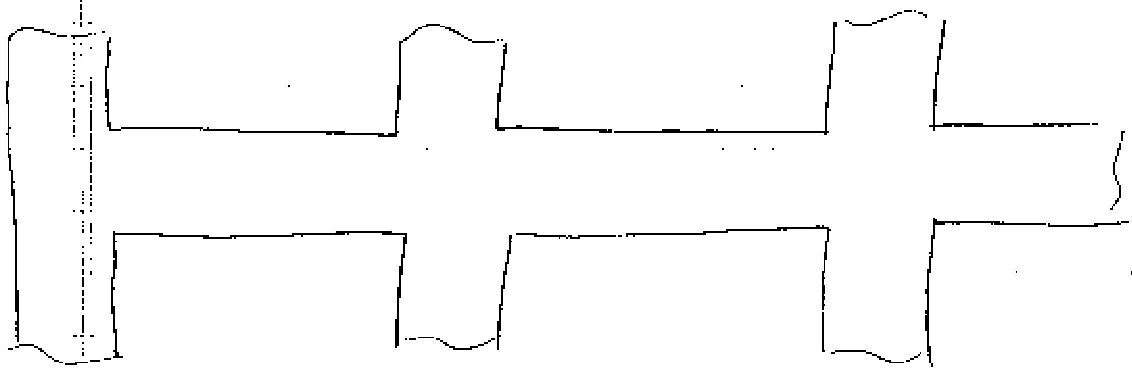
(10)

6/NOV 08

LONGITUDINAL FRAME MOMENTS 13.6.3.2 & 13.6.3.3

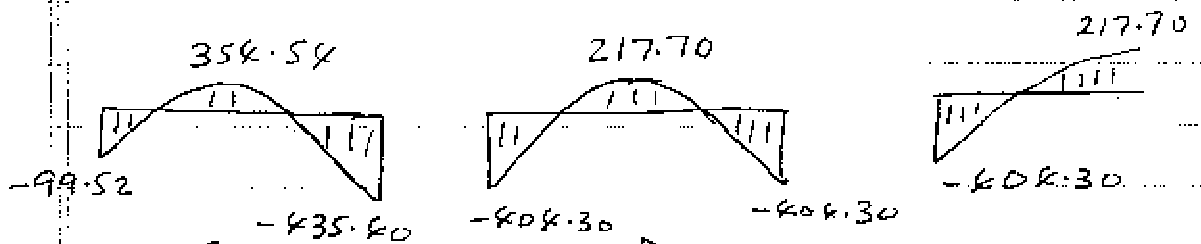
FRAME A $M_o = 622$ kNm

		A	B (A/2)
M− @ EXERIOR SUPPORT:	.16 × 622	= 99.52 kNm	49.76
M+ IN " SPAN:	.57 × 622	= 354.54 "	177.27
M− @ 1st INTERIOR SUPPORT:	.7 × 622	= 435.40 "	217.7
M− @ TYPICAL " " :	.65 × 622	= 404.30 "	202.15
M+ IN " INTERIOR SPAN:	.35 × 622	= 217.7 "	108.85



FR. A

XIV

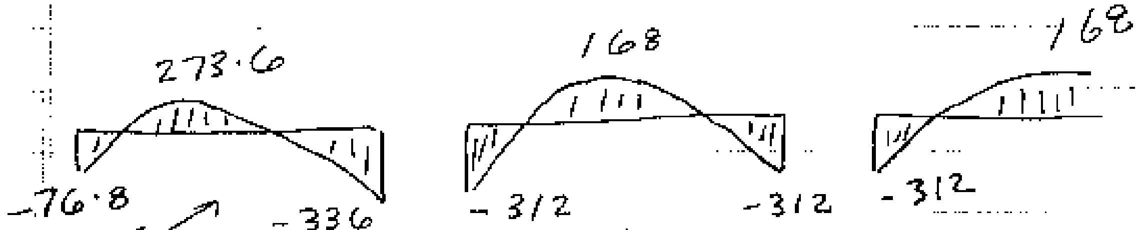


FR. A

XIV

CHECK: $354.54 + \frac{435.40 + 99.52}{2}$
$= 622 = M_o$, OK

check $217.7 + 404.30 = 622 = M_o$, OK

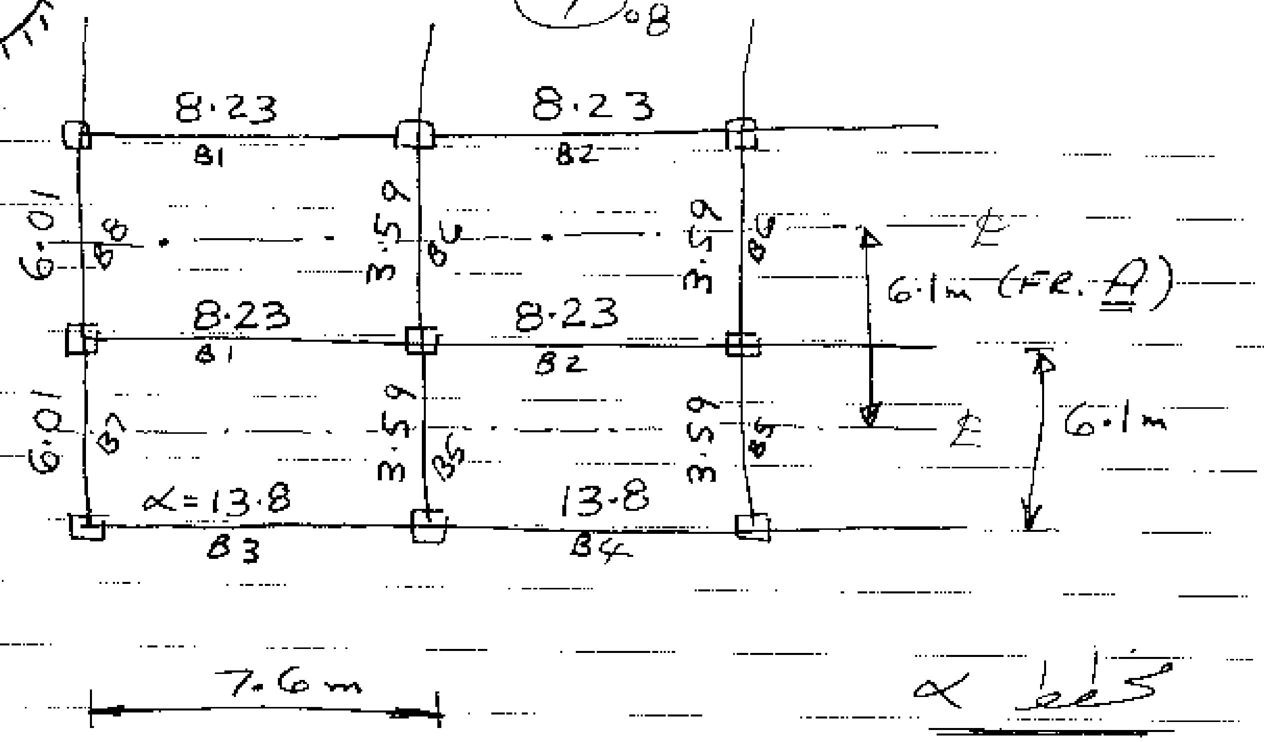


FR C

CHECK $273.6 + \frac{336 + 76.8}{2}$
$= 480 = M_o$, OK

check $168 + 312 = 480$ kNm, OK

(7).8



For frame A : M_o = 622 kNm

LONGITUDINAL MOMENTS FRAME A [see ACI code 13.6.3.2 & 13.6.3.3

M_- @ EXTERIOR SUPPORT = .16 × 622 = 99.52 kNm

M_+ IN " SPAN = .57 × " = 354.54 "

M_- @ FIRST INTERIOR SUPPORT = .70 × " = 435.40 "

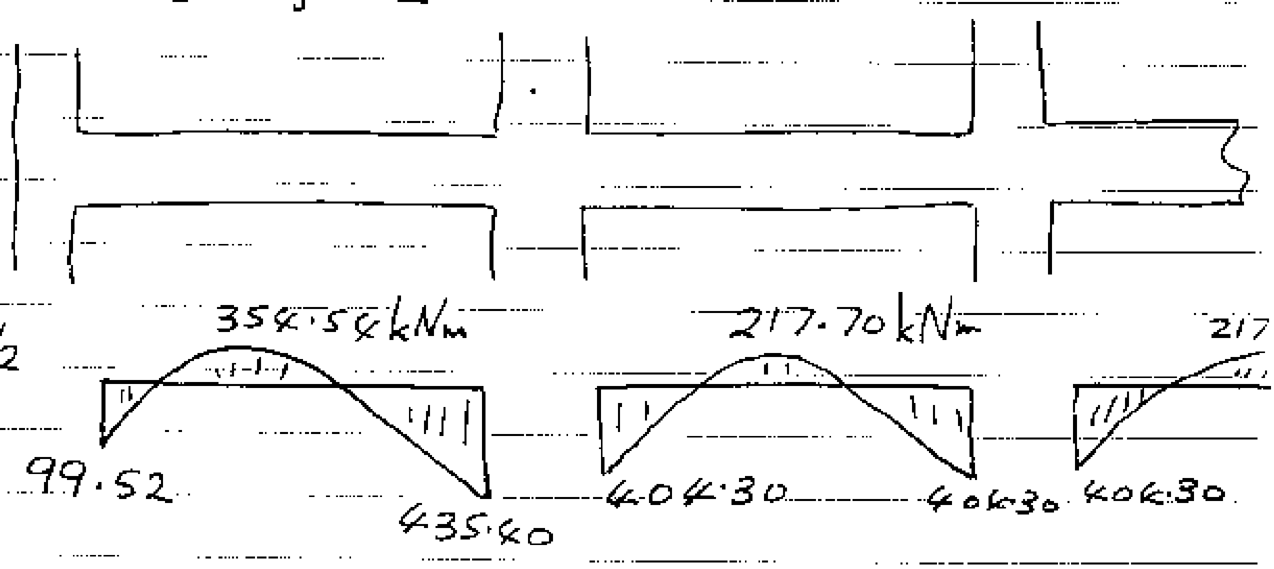
M_- @ TYPICAL " " = .65 × " = 404.30 "

M_+ IN " " SPAN = .35 × " = 217.70 "

see diagram

Esu (?)

FR B = FRA/2



SUMMARY OF TORSIONAL CONSTANT C (mm^4)

	LONG SPAN (E-W)	SHORT SPAN (N-S)
EDGE BEAM	7.913×10^9	4.463×10^9
INTERIOR BEAM	8.573×10^9	4.974×10^9

(FR. A) فيما يلي بداية التوزيع العرضي

(a) NEGATIVE MOMENT @ FACE OF EXTERIOR SUPPORT (

$\ell_2/\ell_1 = 0.8$; $\alpha_1 = 8.23$; $\alpha_1 \ell_2/\ell_1 = 6.61$;

$C = 4.463\times10^9 mm^4$ ($\perp$ SPAN OF FRAME A) ← [BENDING يكون اللي عمودي على ال]

$I_s = bh^3/12 = 6100\times165^3/12 = 2.283\times10^9 mm^4$;

$\beta_t = C/(2 I_s) = 4.463/(2\times2.283) = 0.98$

SEE TABLE 1, USING ACI 13.6.4.2 :-

TABLE 1: LINEAR INTERPOLATION FOR COLUMN STRIP % OF EXTERIOR -VE MOM. — FR. A

		ℓ_2/ℓ_1	0.5	0.8	1.0
$\alpha_1\ell_2/\ell_1 = 6.61 > 1$ ∴	→	$\beta_t = 0$	100%	100%	100%
	→	$\beta_t = .98$	الجواب المطلوب →	81.9%	
	→	$\beta_t \geq 2.50$	75%	67.5%	75%

-76.8 kNm is divided into 3 parts

$-76.8 \times .819 = -62.9$ kNm TOTAL COLUMN STRIP

× .85 [13.6.5.1 since $\alpha_1\ell_2/\ell_1 > 1$ → -53.46 kNm TO BEAM

× .15 → -9.44 kNm TO C.S. SLAB

$-76.8 + 62.9 = -13.9$ kNm TO MIDDLE STRIP SLAB

(b) NEGATIVE MOMENTS @ EXTERIOR FACE OF FIRST INTERIOR SUPPORT & @ FACE OF TYPICAL INTERIOR SUPPORT FR. A

FOLLOW 13.6.4.1, giving Table 3:

l_2/l_1	0.50	0.80	1.0
$\frac{\alpha_1 l_2}{l_1} = 6.61 > 1, \therefore \rightarrow$	90%	(81%) الجواب	75%

$\therefore$ −435.40 & −404.30 } × .81 × .85 ; × .81 × .15 ; × .19
BEAM — CS SLAB — MS SLAB

(c) POSITIVE MOMENTS IN EXTERIOR & INTERIOR SPANS:

APPLY ACI 13.6.4.4 with $\alpha_1 l_2/l_1 >$ (جميع الحالات) → SAME AS TABLE 3 FOR FR. A:

TABLE 5 TRANSVERSE DISTRIBUTION OF LONGITUDINAL MOMENTS FOR FR. A:

TOTAL WIDTH = 6.1 m ; COLUMN STRIP = 3.05 m ; MIDDLE ST. = 3.05 m

	EXTERIOR SPAN			INTERIOR SPAN	
	EXT. −VE	+VE	INT. −VE	−VE	+VE
TOTAL M	−99.52	354.54	−635.4	−406.30	217.70
BEAM M	−78.34	244.10	299.77	−278.36	149.89
CS SLAB M	−13.82	43.08	52.9	−49.12	26.45
MS ,, M	−7.36	67.36	−82.73	−76.82	41.36

SAMPLE 10 DESIGNS FR. A # SLABS:

$d_{LONG} = 165 - 20 - 16/2 = 137$ mm

FOR +VE MS FR. A (EXTERIOR)

67.36 [TABLES] / 3.05 = 22.09 kNm/m

$A_s = M_n / [f_y (d - a/2)]$, Assume $a = 16$ mm

$\therefore A_s = \frac{22.09}{.9} \times 10^6 / (276(137-8)) = 689$ mm²/m

CHECK $a = \frac{A_s f_y}{.85 f'_c b} = \frac{689 \times 276}{.85 \times 20.7 \times 1000} = 10.8$ mm SAFE

(1) DES → Use 12 mm bars @ 160 mm spacing
$A_s = 707$ mm²/m > 689 FOR +VE MS
EXTERIOR FR. A.

CHECK MIN. STEEL: Ch 7 of code:

$A_{s,min} = .002 bh = .002 \times 1000 \times 165 = 330$ mm²/m < 689 OK

, COLUMN STRIP WIDTH EXCLUDING BEAM = $\frac{3.05 - .355}{2} = 1.3475$ m

TABLES → $\frac{43.08}{2} / 1.3475 = 16$ kNm/m, Assume $a = 10$ mm:

$A_s = \frac{(16/.9)10^6}{276(137-5)} = 488$ mm²/m

(2) DES → Use 12 mm bars @ 230 mm spacing,
$A_s = 491$ mm²/m > 488 (OK) FOR COLUMN STRIP EXTERIOR OF FR. A POSITIVE

FOR MIDDLE STRIP, INTERIOR POSITIVE

$M_u = 41.36$ (TABS) / 3.05 = 13.56 kNm/m

WITH $a = 10$ mm; $A_{s\,REQ} = \frac{(13.56/.9)10^6}{276(137-5)} = 414$ mm²/m > 330

(3) DES → Use 12 mm bars @ 270, $A_s = 419 > 414$ mm²/m for MIDDLE STRIP INTERIOR POSITIVE

FOR COLUMN STRIP, INTERIOR POSITIVE:

$\frac{26.45}{2} / 1.3475 = 9.81$ kNm/m

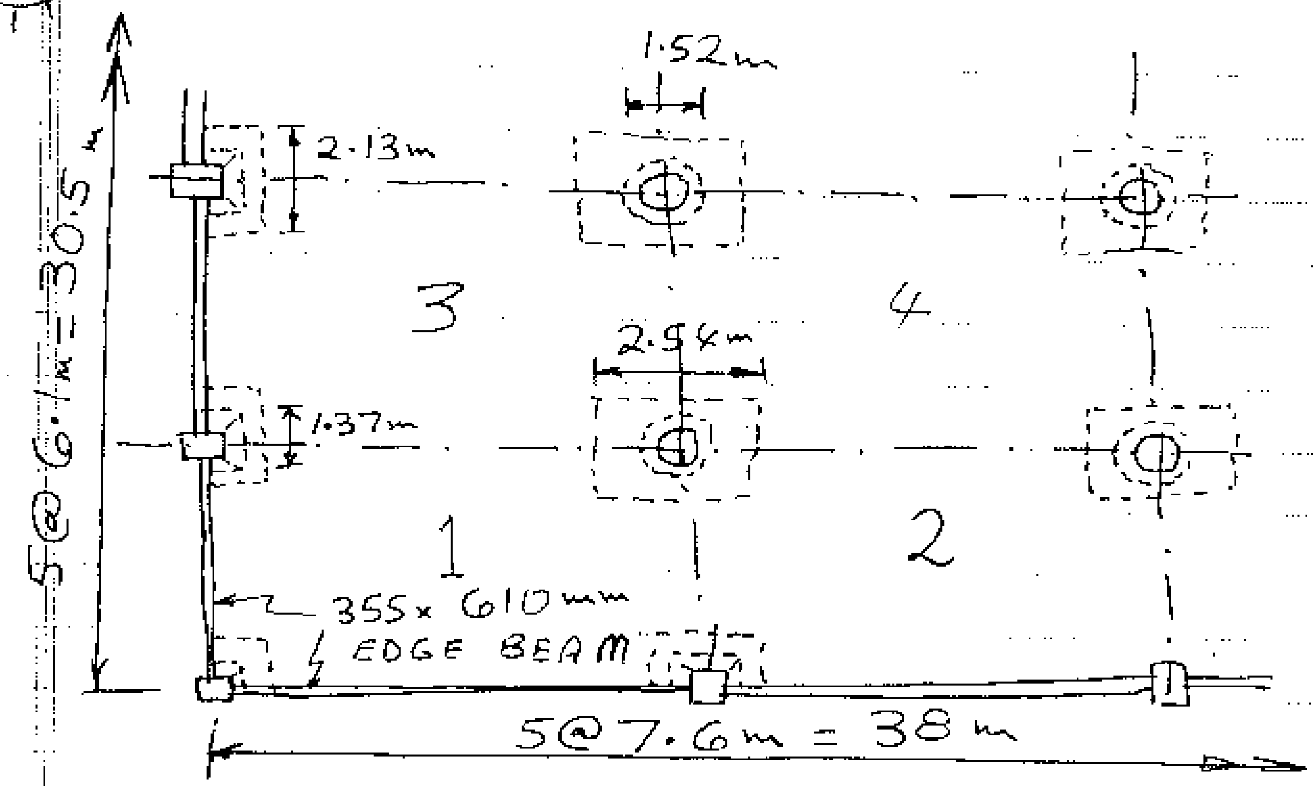
$A_{s\text{-}REQ} = \frac{(9.81/2)\,10^6}{276\,(137-4)} = 297\ mm^2/m < 330$

assuming a = 8mm — USE (330)

(4) 1 DES. Use 12 mm @ 330 spacing (max allowable spacing = 2h ← ACI code)

$A_s = 342\ mm^2/m > 330$, OK at COLUMN STRIP, INTERIOR POSITIVE.

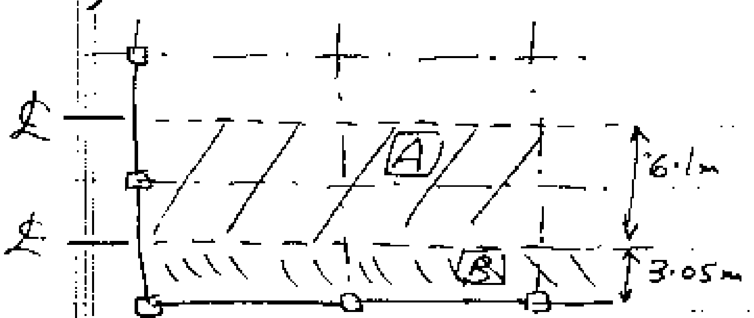
(12) 08

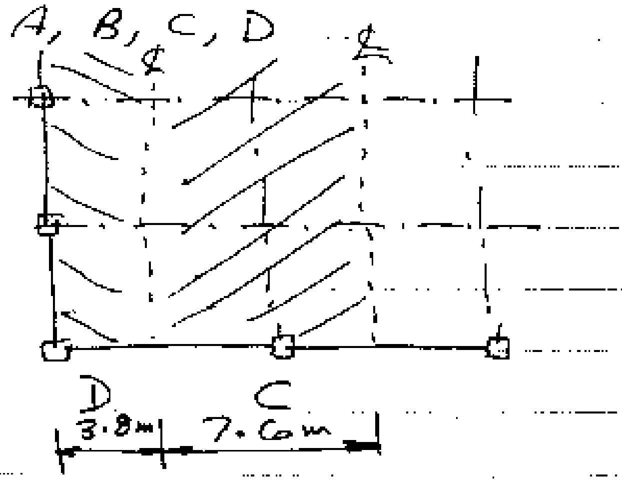


FLAT SLAB

$f'_c = 20.7$ N/mm^2; $f_y = 276$ N/mm^2; $L = 6.68$ kN/m^2; Storey height = 3.05m (MAJOR ADVANTAGE OF FLAT SLAB); EXTERIOR COLUMNS 410mm SQUARE; INTERIOR COLUMNS 460mm CIRCULAR; $h_{SLAB} = 190$ mm; $h_{DROP\ PANEL} = 265$mm

1) FIND M_o FOR FRAMES A, B, C, D





$D = .19 \times 24 = 4.56$ kN/m^2

$w_u = 1.2 \times 4.56 + 1.6 \times 6.68$

$= 16.16$ kN/m^2

Check h for slabs, etc

(1) See p. (2A) NOV 08 :–
Following (9.5)c, first line of 300 N/mm^2
(OK given f_y = 276 N/mm^2):
a. with drop panel
b. " edge beam
c. l_n = 7.6 − 1.35 = 6.25 m
d. l_n/40 = 6.25/40 = .15625 m
e. 190 mm > 156.25 mm ; ∴ OK for DEFLECTION

(2) Also p. (2A) NOV 08 :
(4/5) 190 = 237.5 mm
265 mm > 237.5 mm, ∴ OK for DROP PANEL

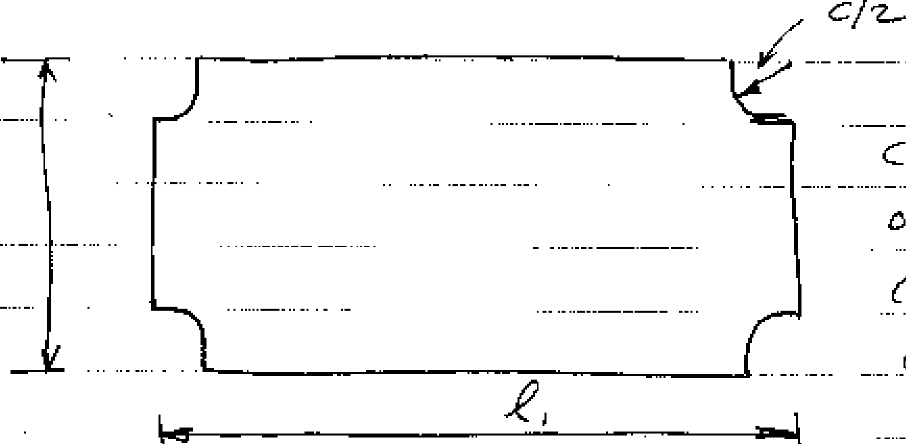
(3) Also p. (2A) NOV 08 :
7.6/6 = 1.267 m
2.54/2 = 1.27 m > 1.267, OK

Per ACI Code : FRAME A

$M_o \geq W_u l_2 l_n^2/8 = 16.16 \times 6.1 (7.6 - 1.35)^2 = 481$ kNm

Per EQ. II :

$M_o \geq W_u l_2 l_1^2 \left(1 - \frac{2c}{3l_1}\right)^2$ (II)



C = DIAMETER OF THE COLUMN CAPITAL

Also $M_o \geq 16.16 \times 6.1 \times 7.6^2 \left(1 - \frac{2 \times 1.52}{3 \times 7.6}\right)^2 = 535 > 481$

USE (الأكبر)

& B = A/2

Per ACI Code : FRAME C

$M_o \geq 16.16 \times 7.6 (6.1 - 1.35)^2 = 346$ kNm

Per EQ. II :

$M_o \geq 16.16 \times 7.6 \times 6.1^2 \left(1 - \frac{2 \times 1.52}{3 \times 6.1}\right)^2 = 397 > 366$

USE (الأكبر)

D = C/2

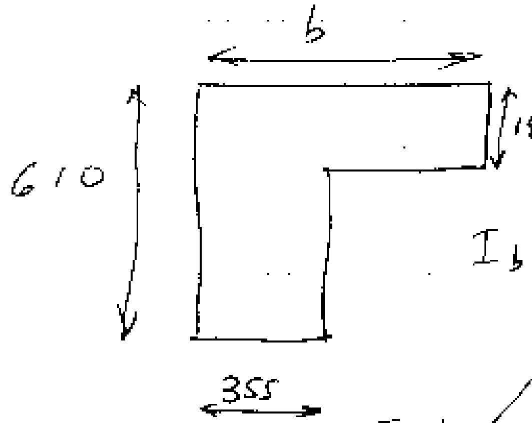
Summary

FR	M_o, kNm
A	535
B	267
C	397
D	198

(19)

(14) 0B

إيجاد خطط α



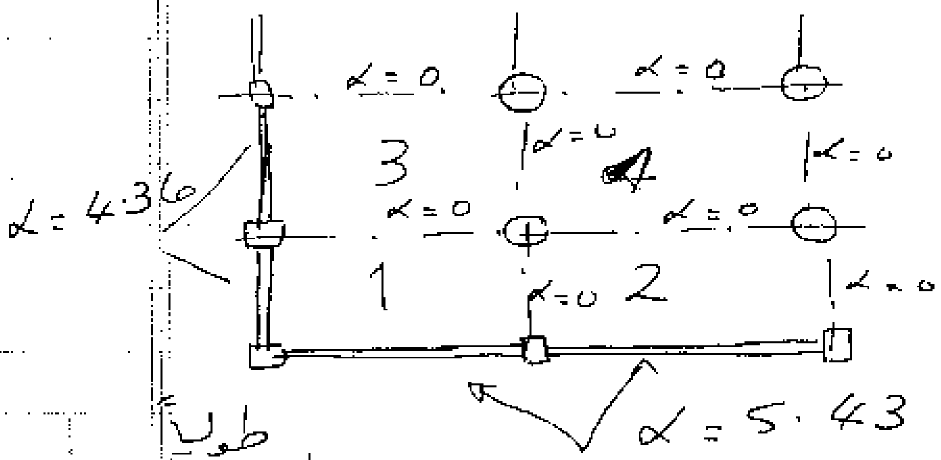
$\leq 190 \times 4 + 355 = 1115$

$\leq 610 - 190 + 355 = 775 = b$ (الأصغر)

$I_b = 9.47 \times 10^9 \ mm^4$

$\alpha_{LONG\ BEAM} = I_b / I_s = / (3050 \times 190^3/12) = 5.43$

$\alpha_{SHORT} = / (3800 \times 190^3/12) = 4.36$



α خطط

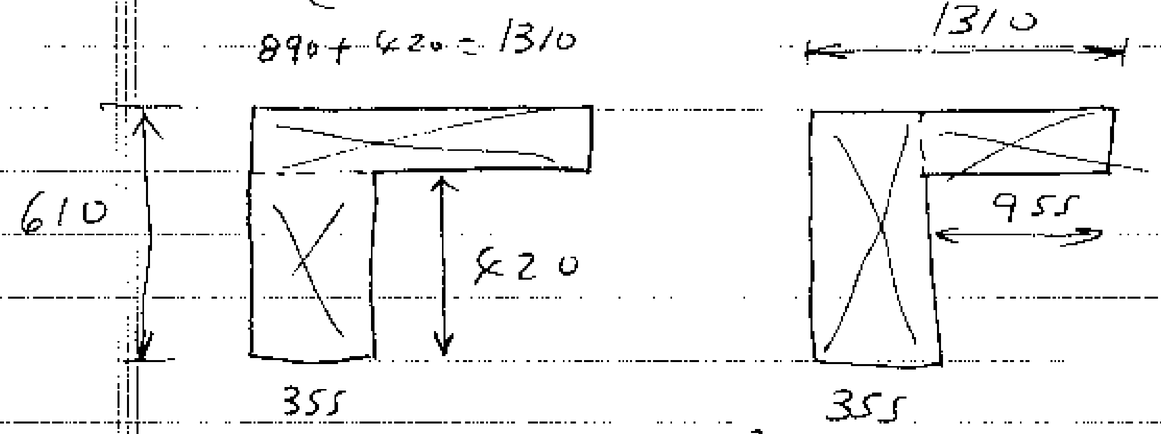
LONGITUDINAL DISTRIBUTION 13.6.3.3 & 13.6.3.2 (kNm)

FRAME	A	B	C	D
M_o	535	267	397	198
M_- @ EXTERIOR SUPP. = .3 M_o	161	80	119	59
M_+ IN " SPAN = .5 M_o	268	134	199	99
M_- @ 1st INT. SUPPORT = .7 M_o	375	187	278	139
M_- TYP. INT. " = .65 M_o	348	174	258	129
M_+ TYP. " SPAN = .35 M_o	187	93	139	69

للتوزيع العرضي ↓ (15) 08

C (TORSIONAL CONSTANT)

890 + 420 = 1310



$$C = \left(1 - .63\frac{x}{y}\right) x^3 y/3$$

اما $C_{EDGE\ BEAM} = \left(1 - \frac{.63 \times 355}{420}\right)\frac{355^3 \times 420}{3} + \left(1 - \frac{.63 \times 190}{1310}\right)\frac{190^3 \times 955}{3} = 5.669 \times 10$

او $C_{EDGE\ BEAM} = \left(1 - \frac{.63 \times 355}{610}\right)\frac{355^3 \times 610}{3} + \left(1 - \frac{.63 \times 190}{955}\right)\frac{190^3 \times 955}{3} = 7.67 \times 10^9$

↑ USE (الأكبر)

خلاصة التوزيع الطولي

(A): −161, −375, −342, −348; spans 268, 187

(C): −119, −278, −258, −258; spans 199, 146

(B): −80, −187, −174, −174; spans 136, 93

(D): −59, −139, −129, −129; spans 99, 69

I_s for β_t A & B $= 6100 \times 190^3/12 = 3.49 \times 10^9\ mm^4$

I_s for β_t C & D $= 7600 \times 190^3/12 = 4.36 \times 10^9$ "

عرضي

TABLE : TRANSVERSE DISTRIBUTION

No.	EQUIVALENT RIGID FRAME	A	B	C	D
1	TOTAL TRANSVERS WIDTH , mm	6100	3050	7600	3800
2	Col. STRIP 〃 , mm	3050	1525	3050	1525
3	HALF MIDD STR 〃 , mm	2@1525	1525	2@2275	2275
4	C , mm^4	← 7.67×10^9 →			
5	I_s , mm^4 IN β_t	← 3.49×10^9 →		← 4.34×10^9 →	
6	$\beta_t = E_{cb}C/(2E_{cs}I_s)$	← 1.10 →		← 0.88 →	
7	α_1	0	5.43	0	4.36
8	l_2/l_1	← 0.80 →		← 1.25 →	
9	$\alpha_1 l_2/l_1$	0	4.34	0	5.45
10	EXTERIOR M− % to CS	89%	91.6	91.3	88.7
11	M+ % 〃 CS	60%	81	60	67.5
12	INTERIOR M− % 〃 〃	75%	81	75	67.5

Note : 10, 11, 12 ARE BASED ON LINEAR INTERPOLATION (ACI)

SAMPLE (نموذج) TABLE FACTORED MOMENTS IN A TYPICAL COLUMN STRIP & MIDDLE STRIP (FR C)

No.		EXTERIOR SPAN			INTERIOR SPAN	
		EXTERIOR −VE	+VE	INT. −VE	−VE	+VE
1	TOTAL M : CS+MS	−119	199	−278	−258	139
2	% TO CS	91.3%	60%	75%	75%	60%
3	Mom. CS	−109	119	−209	−194	83
4	〃 MS	−10	80	−69	−64	56

Based on the latest 318M – ACI – code:
For nonprestressed slabs and footings V_c (NOMINAL) shall be the smallest of (a), (b), (c):

(a) $V_c = (1 + 2/\beta_c)\sqrt{f_c'}\,\frac{b_o d}{6}$ (11-33)

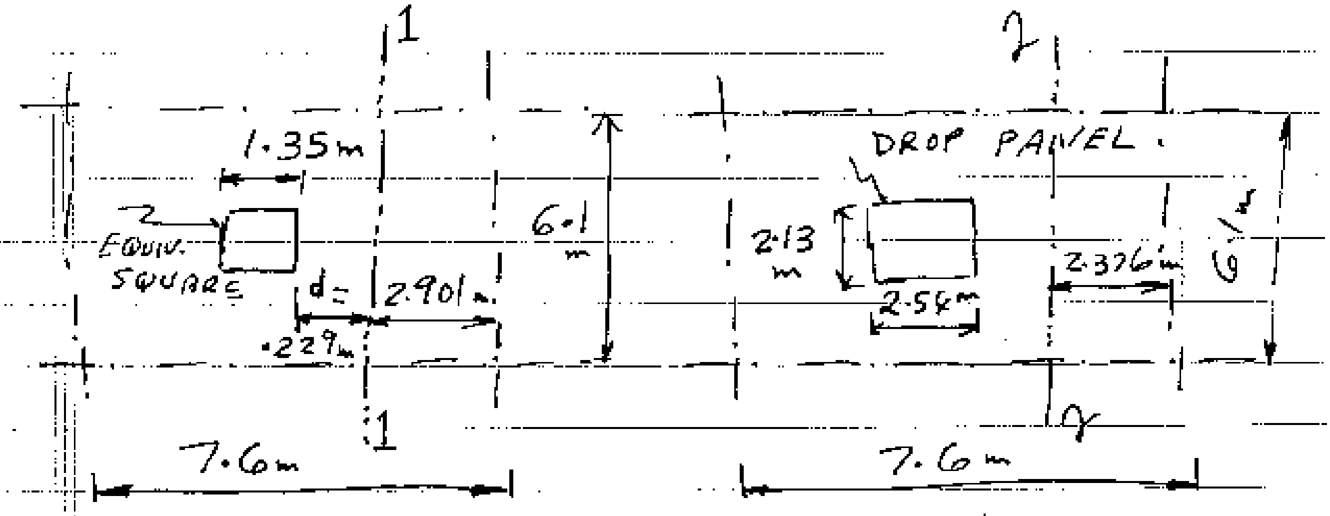
b_o = perimeter

(b) $V_c = \left(\frac{\alpha_s d}{b_o} + 2\right)\frac{\sqrt{f_c'}}{12}\,b_o d$ (11-34)

α_s = 40 for INTERIOR columns
= 30 " EDGE "
= 20 " CORNER "

(c) $V_c = \frac{\sqrt{f_c'}}{3}\,b_o d$ (11-35)

SHEAR IN THE GIVEN "FLAT SLAB" EXAMPLE



WIDE-BEAM (ONE-WAY) ACTION

Taking average d for the drop panel:
= 265 – 20 (COVER) – 16 (BAR d_b) = 229 mm

Taking average d for the slab outside the drop panel
= 190 – 20 – 16 = 154 mm

SECTION 1-1 ("BEAM" SHEAR):

$V_u = 16.16 \times 2.901 \times 6.1 = 286.0$ kN "FACTORED"

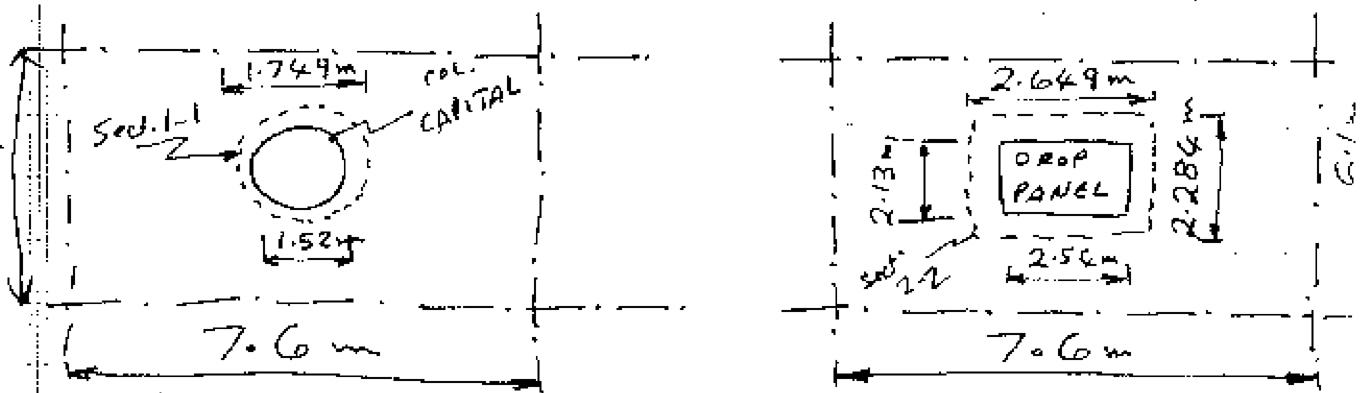
Start (conservatively) with d = 154 mm:

$V_c = \frac{\sqrt{f_c'}}{6} b_w d = \frac{\sqrt{20.7}}{6} \times 154 \times 6.1 = 712.3$ kN (NOMINAL)

$\phi V_c = .75 \times 712.3 = 534$ kN $> V_u = 286.0$ OK

By inspection Section 2-2 has a smaller V_u ($16.16 \times 6.1 \times 2.376 = 234.2$ kN $<$ 534 kN) $\therefore$ OK for "BEAM" Shear.

TWO-WAY ACTION:



@ d/2 the critical sections are 1-1 (around the column capital) and 2-2 (around the drop panel.)

Section 1-1: $V_u = 16.16\,[6.1 \times 7.6 - \pi/4 \times 1.749^2]$
$+ 1.2 \times .075 \times 24\,[2.13 \times 2.54 - \pi/4 \times 1.749^2] = 716.9$ kN (FACTORED)

$b_o = \pi \times 1.749 = 5.49$ m PERIMETER

With $\beta_c < 2$ Eq. (11-35) controls giving smaller V_c than (11-33)

$\therefore$ Between (11-33) & (11-35) $V_c = (\sqrt{f_c'}/3) b_o d$ — (I)

Eq. (11-34): $V_c = (\alpha_s d/b_o + 2)(\sqrt{f_c'}/12) b_o d$; $\alpha_s = 40$ INTERIOR column

$= (40 \times 229/5420 + 2)(\sqrt{f_c'}/12) b_o d = 18.68(\sqrt{f_c'}/12) b_o d$ (II)

(II) > (I) ; $\therefore$ Use (I): $V_c = (\sqrt{20.7}/3)\,5.49 \times 229 = 1907$ kN

$\phi V_c = .75 \times 1907 = 1430$ kN > 718 — OK

SECT. 2-2 $V_u = 16.16\,(6.1 \times 7.6 - 2.694 \times 2.284) = 649.7$ kN

Similarly to above: $V_c = (\sqrt{20.7}/3) \times 2\,(2.694 + 2.284)\,154 = 2325$ kN

$\phi V_c = .75 \times 2325 = 1744$ kN > 649.7 kN, OK