مادة الخرسانة المسلحة أ

الحل النموذجي لإمتحان الفصل الدراسي الأول الفرقة الثانية ـ قسم عمارة

٢٠١٦ـ٢٠١٧

دكتور المادة

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SHOUBRA FACULTY OF ENGINEERING
CIVIL ENGINEERING DEPARTEMENT
SECOND YEAR ARCHITECTURE
Code: CVE242

Final 1st Term Exam
Tuesday 03/01/2017
Reinforced Concrete Structure (A)
Duration: 3.0 hours
No. of questions: 1

| Total Mark: 60 Marks | Closed Book Exam | The Exam consists of one page |

*Systematic arrangement of calculations and clear neat sketches are essential.
*Complete detail drawings of concrete dimensions and steel reinforcement are essential.
*(Any missing data should be reasonably assumed according to Egyptian Code of Practice.
* For all of the following problems: fcu = 30 MPa, fy = 360 MPa.

QUESTION 1:   (60 Marks)   [ILO's: a3, a4, a5, a6, b2, b4, b6]

The structural system of the building shown in Figure below is subjected to:
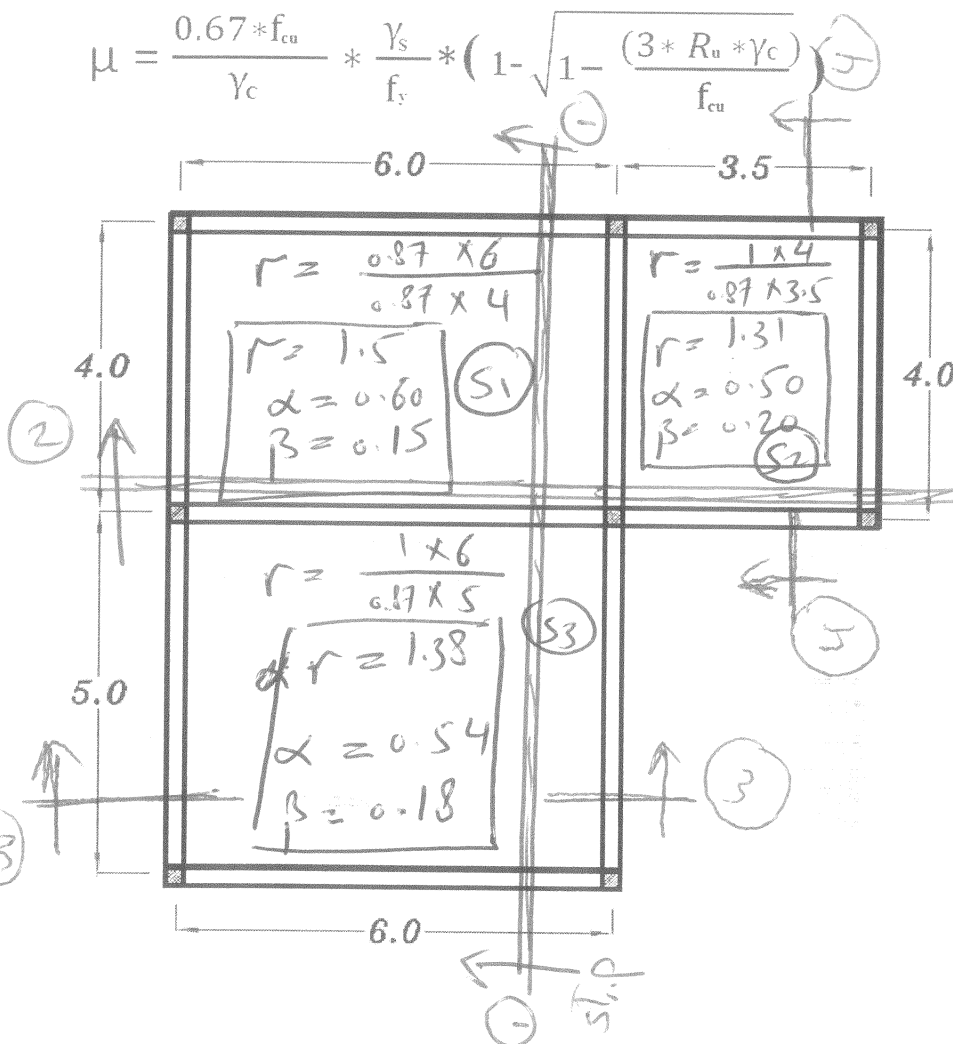
* Story height   = 3.0 m
* Live load on the slabs   = 2.0 KN/m^2
* Flooring Cover   = 1.5 KN/m^2
* γ_{wall} = 18 KN/m^3
* Thickness of walls   = 250 mm (assume walls on all beams)
* All beams section (b x t) = 250 mm x 700 mm

It is required to:
a) Design all slabs for thickness and steel reinforcement. (30 Marks)
b) Draw to a reasonable scale a plan showing reinforcement details and thickness of slabs. (30 Marks)

$$\mu = \frac{0.67 * f_{cu}}{\gamma_c} * \frac{\gamma_s}{f_y} * \left(1 - \sqrt{1 - \frac{(3 * R_u * \gamma_c)}{f_{cu}}}\right)$$

• since r < 2 for All slab
∴ the slabs are two way.

$$\alpha = 0.5r - 0.15$$
$$\beta = \frac{0.35}{r^2}$$

S1: $r = \frac{0.87 \times 6}{0.87 \times 4}$ $r = 1.5$ $\alpha = 0.60$ $\beta = 0.15$

S2: $r = \frac{1 \times 4}{0.87 \times 3.5}$ $r = 1.31$ $\alpha = 0.50$ $\beta = 0.20$

S3: $r = \frac{1 \times 6}{0.87 \times 5}$ $r = 1.38$ $\alpha = 0.54$ $\beta = 0.18$

6.0   3.5
4.0   4.0
5.0   6.0

Final Term Solution ⊙ —

Given:- $f_{cu} = 30 \, MPa$

$\quad\quad\quad f_y = 360 \, MPa$

$L.L = 2 \, kN/m^2$, $F.C = 1.5 \, kN/m^2$

30

Design

* **For slab (S1):-**

$r = 1.5$
$\alpha = 0.60$
$\beta = 0.15$

$$t_s = \frac{L_s}{40} = \frac{4000}{40}$$

$$\boxed{t_s = 100 \, mm}$$

$D.L = 0.1 + 25 + 1.5$

$L.L = 2$

$$W_u = 1.5 \, (4+2) = \underline{\underline{9 \, kN/m^2}}$$

* **For slab (S2):-**

$r = 1.31$
$\alpha = 0.50$
$\beta = 0.20$

$$t_s = \frac{L_s}{40} = \frac{3500}{40}$$

$$= 87.50 \quad \therefore \boxed{t_s = 100 \, mm}$$

$$\therefore \boxed{W_u = 9 \, kN/m^2}$$

①

* **for slab (S3) :-**

$$t_s = \frac{l_s}{40} = \frac{5000}{40}$$

$$\boxed{\begin{array}{l} r = 1.38 \\ \alpha = 0.54 \\ \beta = 0.18 \end{array}}$$

$$= 125 \, m \simeq 140 \, mm$$

$$\therefore D.l = 0.14 * 25 + 1.5 = 5$$

$$L.L = 2$$

$$W_u = 1.5 (5 + 2) = \underline{\underline{10.5 \, kN/m^2}}$$

Strip ① — ① :-

0.54 * 10.5 kN/m²   0.6 * 9 kN/m²

Sec ① :-

$$M_u = \frac{0.54 * 10.5 * 5^2}{10}$$

$$\boxed{M_u = 14.20 \, kN \cdot m}$$

5m   4m

$$\frac{wl^2}{24} = \frac{0.54*10.5*5^2}{24}$$ $$\frac{wl^2}{8} = \frac{0.54(\frac{10.5+9}{2})+(\frac{5+4}{2})^2}{8} = \boxed{14}$$

① $$\frac{0.6*9*4^2}{24} = \frac{wl^2}{24}$$ ②

$$\| + \|$$ ③ $$\| + \|$$

Sec ② :-

$$M_u = \frac{0.6*9*4^2}{10} = \boxed{\begin{array}{c} 8.64 \\ kN\sim \end{array}}$$ $$\frac{wl^2}{10} = \frac{0.54*10.5*5^2}{10} = \boxed{14.20}$$ $$\frac{wl^2}{10} = \frac{0.6*9*4^2}{10} = \boxed{8.64}$$

Sec ③ $$M_u = \frac{0.54*(\frac{10.5+9}{2})+(\frac{5+4}{2})^2}{8} = \boxed{14.01 \, kN\sim}$$ ②

Design of sections :-

Sec ① :- $t = 120 mm$
$b = 1000 mm$

- $M_u = 14.20 kN·m$

- $R_u = \dfrac{14.20 \times 10^6}{1000 \times (105)^2} = 1.28$

- $\mu = 0.0043 \quad > \quad \mu_{min} = 0.0015 \quad o.k$

$A_s = \mu bd = 0.0043 \times 1000 \times 105$

$$\boxed{A_s = 457.45 \ mm^2/m} \quad 6 \, \phi \, 10/m$$

Sec ② : $M_u = 8.64 kN·m$

$t = 100 mm$
$b = 1000 mm$

- $R_u = \dfrac{8.64 \times 10^6}{1000 \times (85)^2} = 1.19$

$\mu = 0.0040 \quad > \quad \mu_{min} = 0.0015$

$\therefore A_s = 0.004 \times 1000 \times 85 = 342.44 \ mm^2/m$

$$\boxed{A_s = 342.44 \ mm^2/m} \quad 5 \, \phi \, 10/m \quad ③$$

Sec ③ :- $t = 100$

$b = 1000$

- $M_u = 14 \ kN \cdot m$

- $R_u = \dfrac{14 * 10^6}{1000 * (85)^2} = 1.94$

- $\mu = 0.0067 > \mu_{min} = 0.0015$ 0.1C
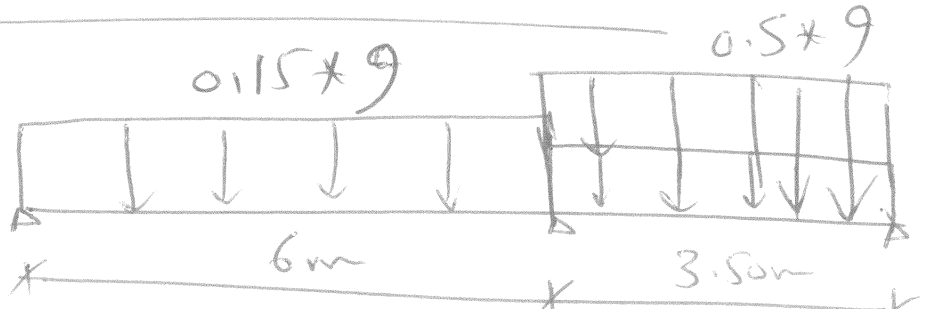
- $A_s = \mu \cdot b \cdot d = 0.0067 * 1000 * 85$

$$\boxed{A_s = 574.06 \ mm^2 / m}$$

$6\phi 12 / m$

strip ② :-

Sec ④ :

$M_u = \boxed{4.86 \ m}$

Sec ⑤ :-

$M_u = \boxed{5.51 \ m}$
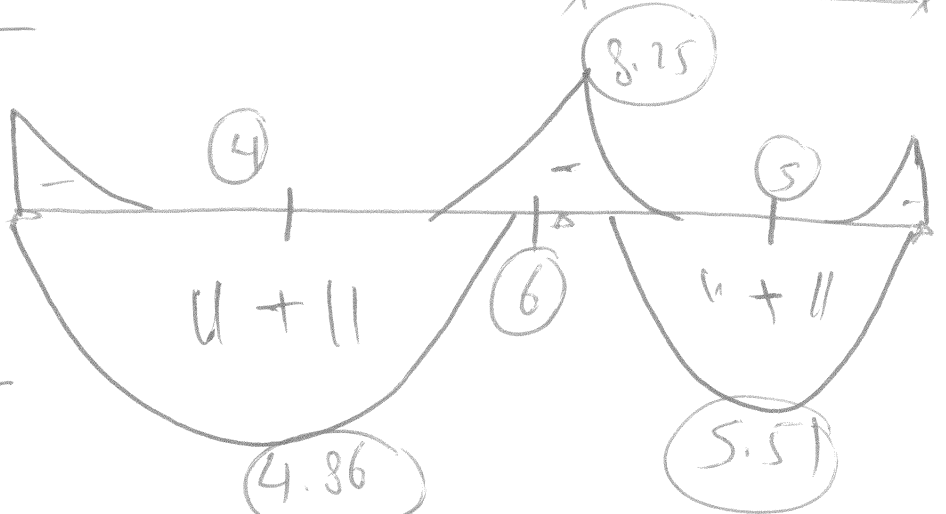
Sec ⑥ :-

$\boxed{M_u = 8.25 \ m}$

④

Design of Section

- **Sec ④ :** $t = 100 \, mm$

  $b = 1000 \, mm$

- $M_u = 4.86 \, m$

- $R_u = \dfrac{4.86 \times 10^6}{1000 \times (75)^2} = 0.864$

- $\mu = 0.0029 > \mu_{min} = 0.0015$

  $A_s = 0.0029 \times 1000 \times 75 = 215 \, mm^2/m$

  $\boxed{A_s = 215 \, mm^2/m}$ use $5\phi 8/m$

Sec ⑤ : $t = 100 \, mm$

  $b = 1000 \, mm$

- $M_u = 5.51 \, m$

- $R_u = \dfrac{5.51 \times 10^6}{1000 \times (85)^2} = 0.76$

- $\mu = 0.0025 > 0.0015$

  $\boxed{A_s = 214.47 \, mm^2/m}$ use $5\phi 8/m$

<u>Sec ⑥:</u> $t = 100$ ~
$b = 1000$ ~

. $M_u = 8.25$ ~

. $R_u = \dfrac{8.25 \times 10^6}{1000 \times (85)^2} = 1.14$

. $\mu = 0.005 > 0.0015$

$$\boxed{A_s = 425 \text{ m}^2/\text{m}} \qquad 6\,\phi 10/\text{m}$$

<u>Strip ③ :-</u>

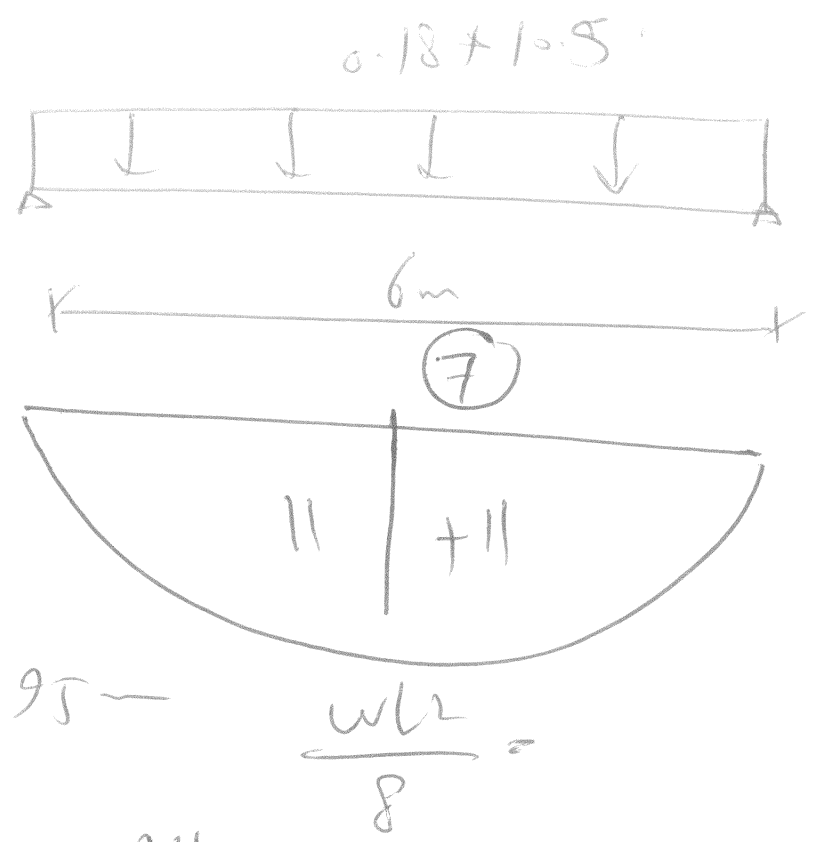$M_u = \dfrac{wL^2}{8}$

$M_u = 8.51$ ~

. $b = 1000$

. $t = 120$ ~ $d = 95$ ~

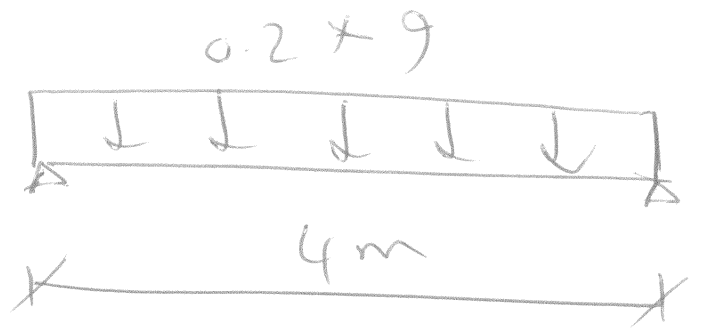. $R_u = \dfrac{8.51 \times 10^6}{1000 \times (95)^2} = 0.94$

. $\mu = 0.0031 > 0.0015$

$$\boxed{A_s = 298 \text{ m}^2/\text{m}} \qquad 5\,\phi 10/\text{m}$$

$0.18 + 1.5$
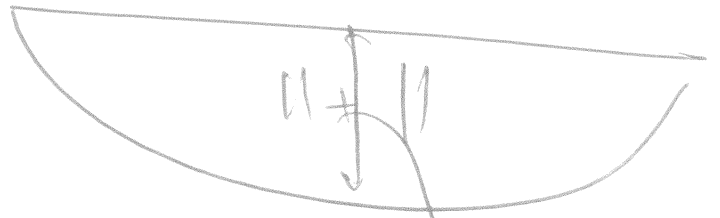

$6\,m$

⑦

$\dfrac{wL^2}{8} =$

⑥

* Strip ④ :-

$$M_u = \frac{wL^2}{8} = 3.6 \text{ m}$$

0.2 * 9

4 m

. b = 1000
. $t_s = 100$ d = 75

$$R_u = \frac{3.6 * 10^6}{1000 * (75)^2} = 0.64$$

$$\frac{wL^2}{8} = 3.6$$

$$\mu = 0.00159 > 0.0015$$

$$\boxed{(A_s = 119 \quad \sim^2/\sim}$$

S 98/m

⑦

30 — Detail