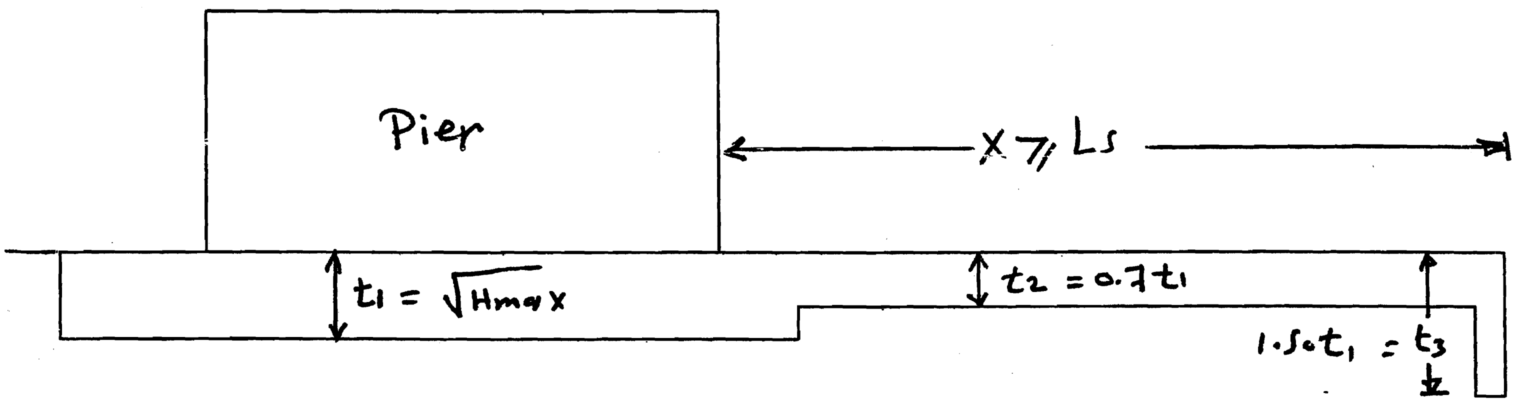
بسم الله الذى لايضر مع اسمه شئ فى الأرض ولا فى السماء وهو السميع العليم

REGULATORS

Design of Floor

Dims of Floor according of scour & Percolation



∴ $y_{d.s} =$ ✓

∴ $y_{u.s} = y_{d.s} + H_{up\,all}$ or $[U.S.W.L - b.L]$

∴ $H_{max} = y_{u.s}$

∴ $L_s = 2.1\ C_B \sqrt{\dfrac{H_{max}}{3.90}} =$ ✓

∴ $L_{P\,req} = C_B * H_{max} =$ ✓

∴ $L_{P\,ac} = \Sigma H + \Sigma V =$ ✓ مجموع المسافات الأفقية والرأسية.

$L_{P\,ac} > L_{P\,req}$ or ?

اذا لم يتحقق الشرط السابق :-

① نكبر المسافة خلف Pier

أو ② " " أمام Pier

أو ③ نضع ترجة أمام Pier

ملاحظات عند التصميم

١- يتم عمل الفرشة Floor بحيث تتحمل أحمال المنطقة

٢- يتم الحسابات على أساس أن سمك الفرشة Rigit بمعنى

أن الاجهادات تتوزع بانتظام تحت الفرشة

٣- عند تصميم الفرشة (Floor) وحساب الأحمال يتم أخذ قطاع

عرضه ١,٠٠م تحت الكوبري ← الأسوأ

٤- في الطبيعة دائماً الفرشة خرسانة مسلحة ولكن البغلة

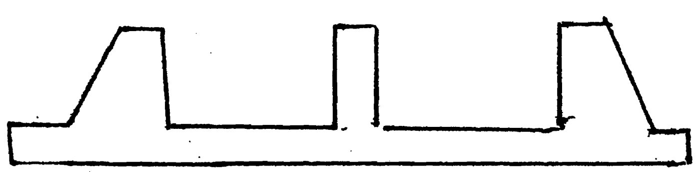
والحوائط عمله خرسانة عادية

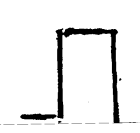
٥- تصميم الفرشة يتم على خطوتين

.. check of soil stress

.. Calculate (t, As)

٦- شكل الحوائط





Check of soil stress

.. الأحمال الرأسية فقط هي التي تسبب اجهادات على التربة

لذلك

$$\delta = \frac{\sum \text{val load}}{B\ (\text{عرض الفرشة الكلي})}$$

.. علينا أخذ نصف المنشأ فقط للتحميل

$$\delta = \frac{\sum \text{val load}\ (\text{لنصف المنشأ})}{B\ (\tfrac{1}{2}\ \text{العرض})}$$

.. الحمل = مساحة * 1.0 (عرض الشريحة) * الكثافة

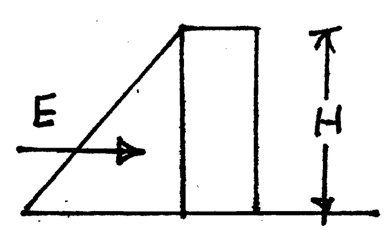
(مساحة * 1.0 = الحجم)

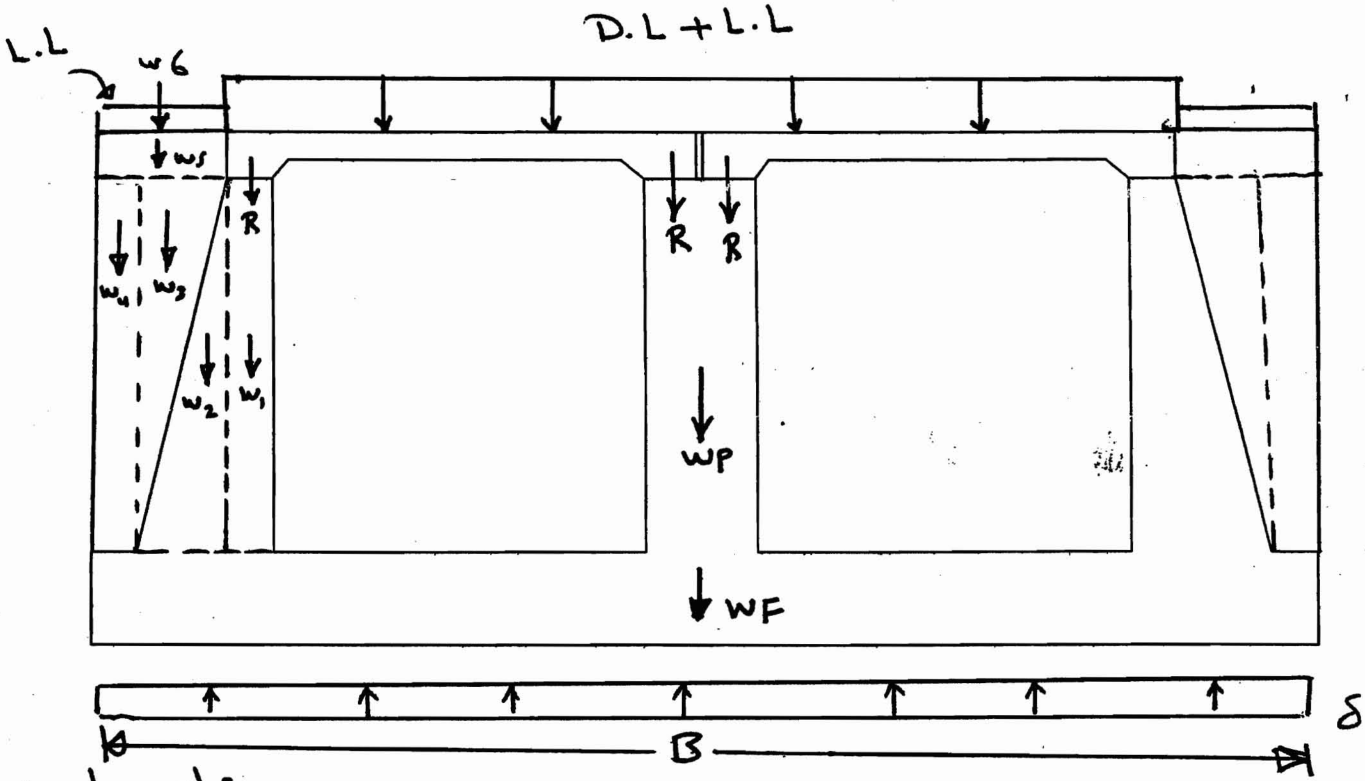
.. $\gamma_e = 1.80$, $\phi = 30^\circ$ إذا لم تعطى

$$K_a = \frac{1 - \sin\phi}{1 + \sin\phi}$$

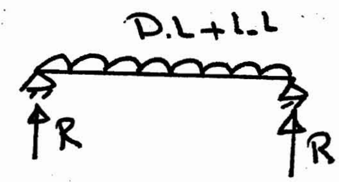
تركيز مثلث التراب

$$E = 0.5\,\gamma H^2 K_a = \checkmark$$





1- Loads



*- $R = (D.L + L.L) \frac{S + R}{2}$

*- $W_{1-2} = Area * 1.0 * \gamma_{R.C \text{ or } P.C}$

*- $W_{3-5} = Area * 1.0 * \gamma_e$

*- $W6 = L.L * \checkmark = t$

*- $WF = B * t_f * 1.0 * \gamma_{R.C} = \checkmark$ ton

*- $Wp = A_p * 1.0 * \gamma_{p.c \text{ or } R.c}$

2- check of soil stress

$$\delta = \frac{\Sigma \text{ val load}}{B}$$

Calculate t, As

steps

1- loads

2- $\delta = \frac{\Sigma \text{ v}^{al} \text{ load}}{B} = \checkmark \; t/m'$

3- Location of Zero shear

.. يتم التصميم على أقصى عزم M_{max} الذي يوجد عند Zero shear

.. قوة القص تؤثر رأسيا على الفرشة لذلك لحساب مكان Z.sh

يتم عمل معادلة $\Sigma y = 0.0$ (مجموع الأحمال الرأسية = 0.0) ⇐ $X = \checkmark$

.. اذا كان عدد الفتحات فردي (1-3-...) يكون مكان Z.shear في

المنتصف بدون حسابات أما اذا كان زوجي يتم حسابه

في الفتحة القريبة من منتصف المنشأ $\overset{n}{4} \rightarrow 2$ (في الفتحة الثانية)

4- Calculate (M, N)

$$m_{max} = \checkmark$$

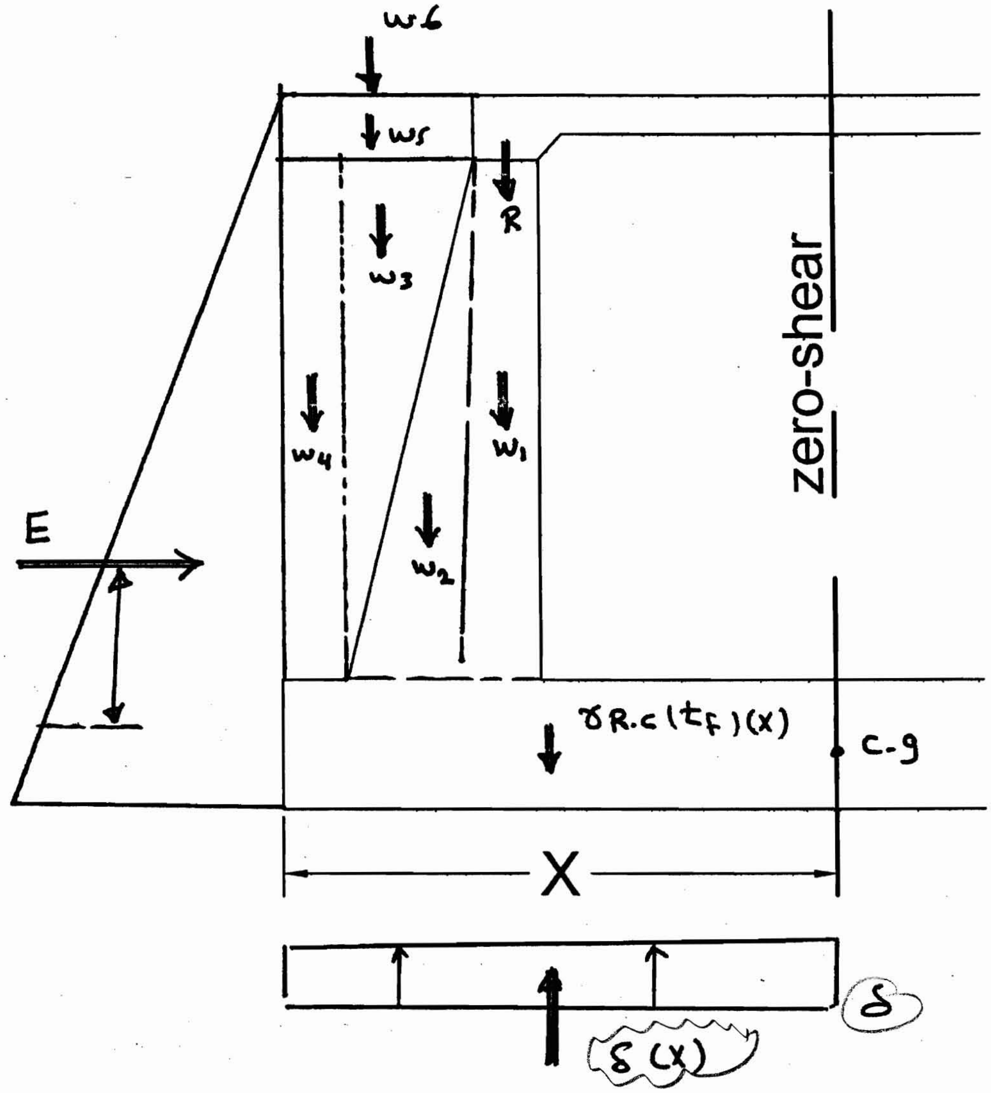
$$N = E$$

5- design

$$d = K_1 \sqrt{\frac{m}{b}}$$

التسليح

$$As = \frac{m}{K_2 d} \quad \not< As_{min} = \frac{0.2}{100} Ac$$



3- Location of Zero shear

$$\Sigma y = 0.0$$

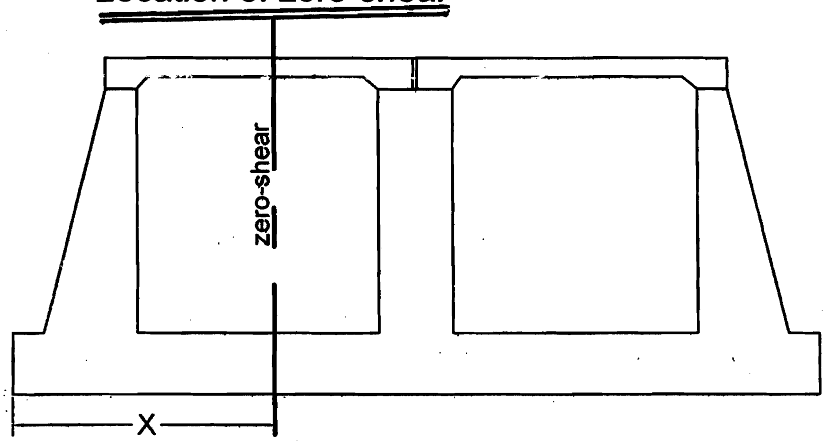
$$R + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + \gamma_{R.c}(t_f)(X) = \delta(X)$$

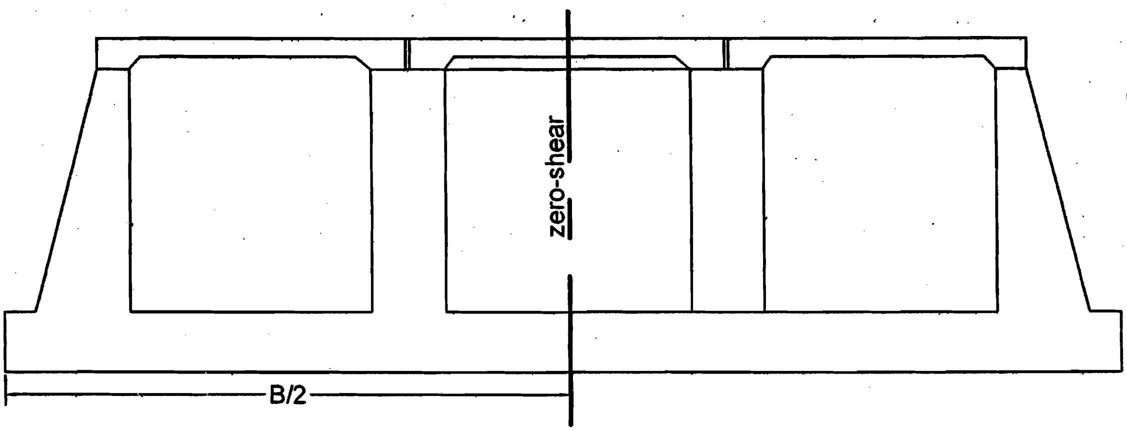
$$X = \checkmark$$

4- Calculate straining action (M, N)

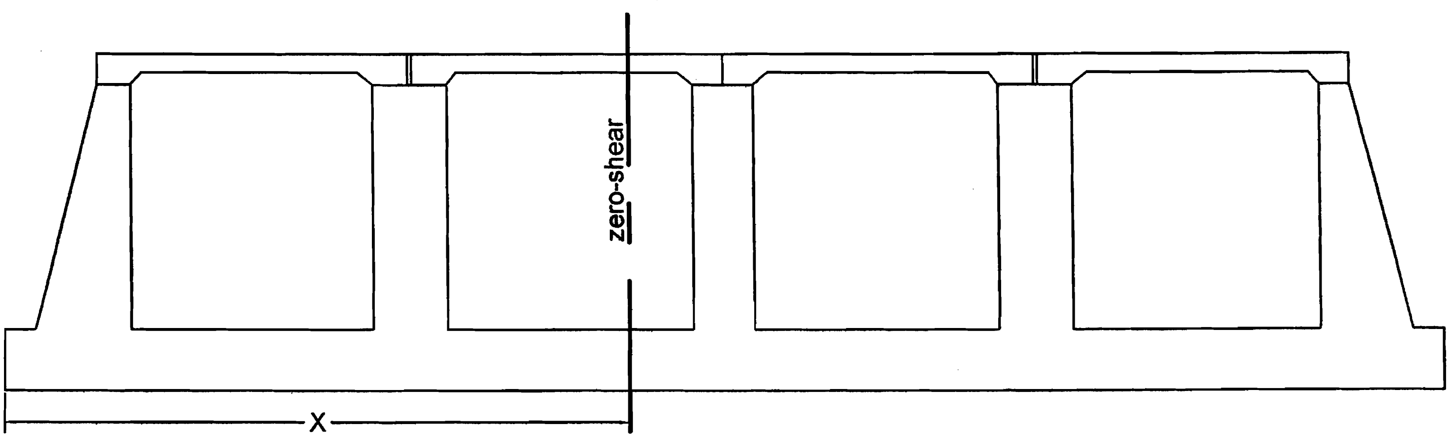
العزم = القوة * المسافة العمودية

Location of zero-shear





مع غير حسابات
في المنتصف
N ← فردي

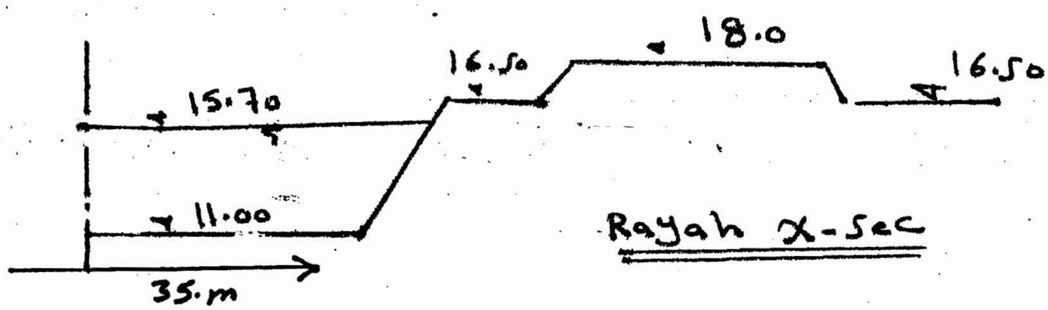


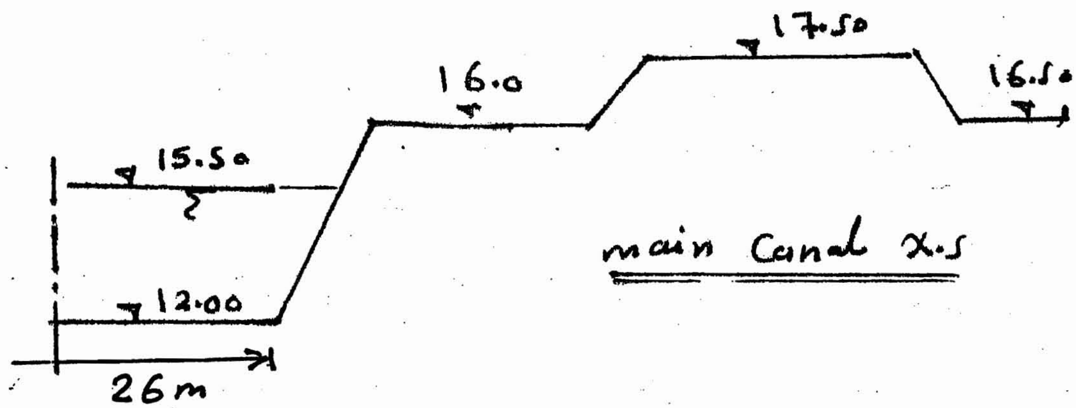
مع الأخرى: يتم إيجاد مكانه Z.shear في حالة N ⟸ عدد زوجي

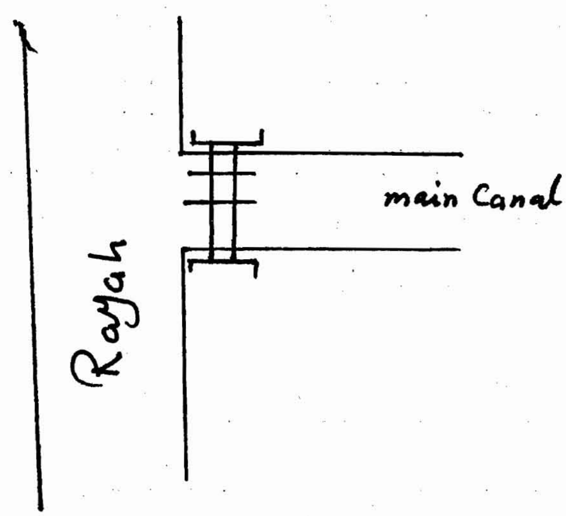
Example (1)

A reinforced concrete head regulator without approach channel is to be constructed to feed a main canal from rayah as shown in figures. The regulator consists of three vents with 6.0 spans for each. The bridge width over regulator is 12 m and has two sidewalk of 1.5 m each. The width of piers is 1.20 m and the upper level of piers is (17.20). the equivalent LL and DL on the bridge is 2.0t/m^2 and 1.50 t/m^2 respectively. The soil properties at the regulator site are: φ=30,γ_{bulk}=1.65t/m3, and the soil bearing capacity =1.35kg/cm^2,k1=0.313&k2=1218)

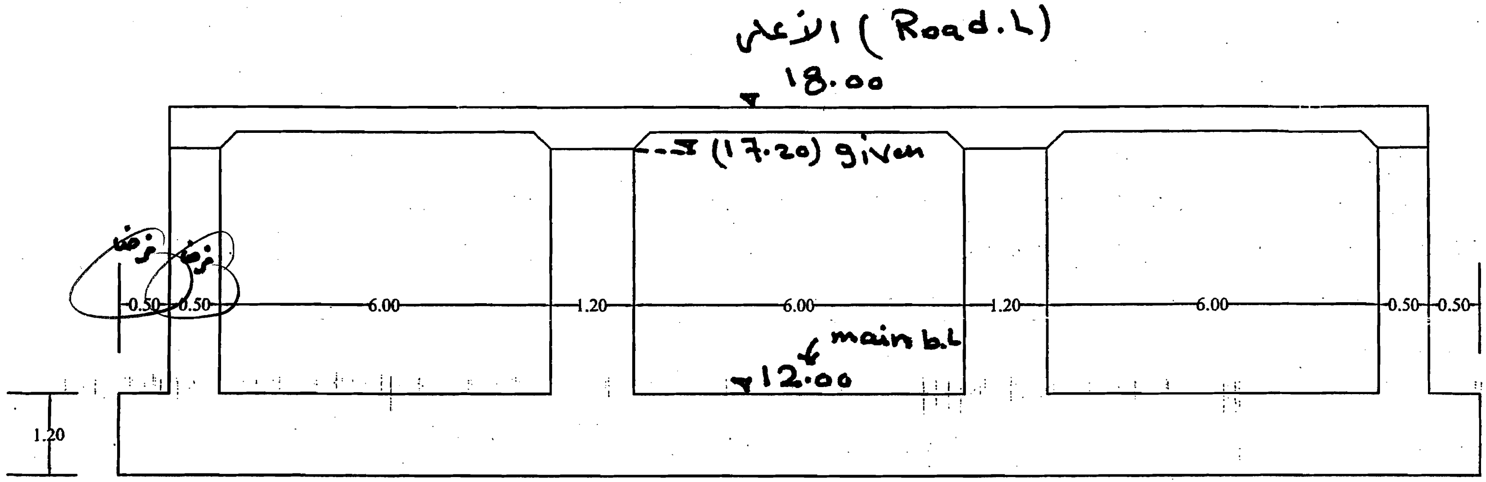
It is required to give a complete design for R.C. floor (t_f=1.20m)







given :-



خطوات الحل :-

١- حساب الأحمال

٢- حساب الاجهادات على التربة

٣- إيجاد مكان أقصى عزم [Zero shear ≡ M max]

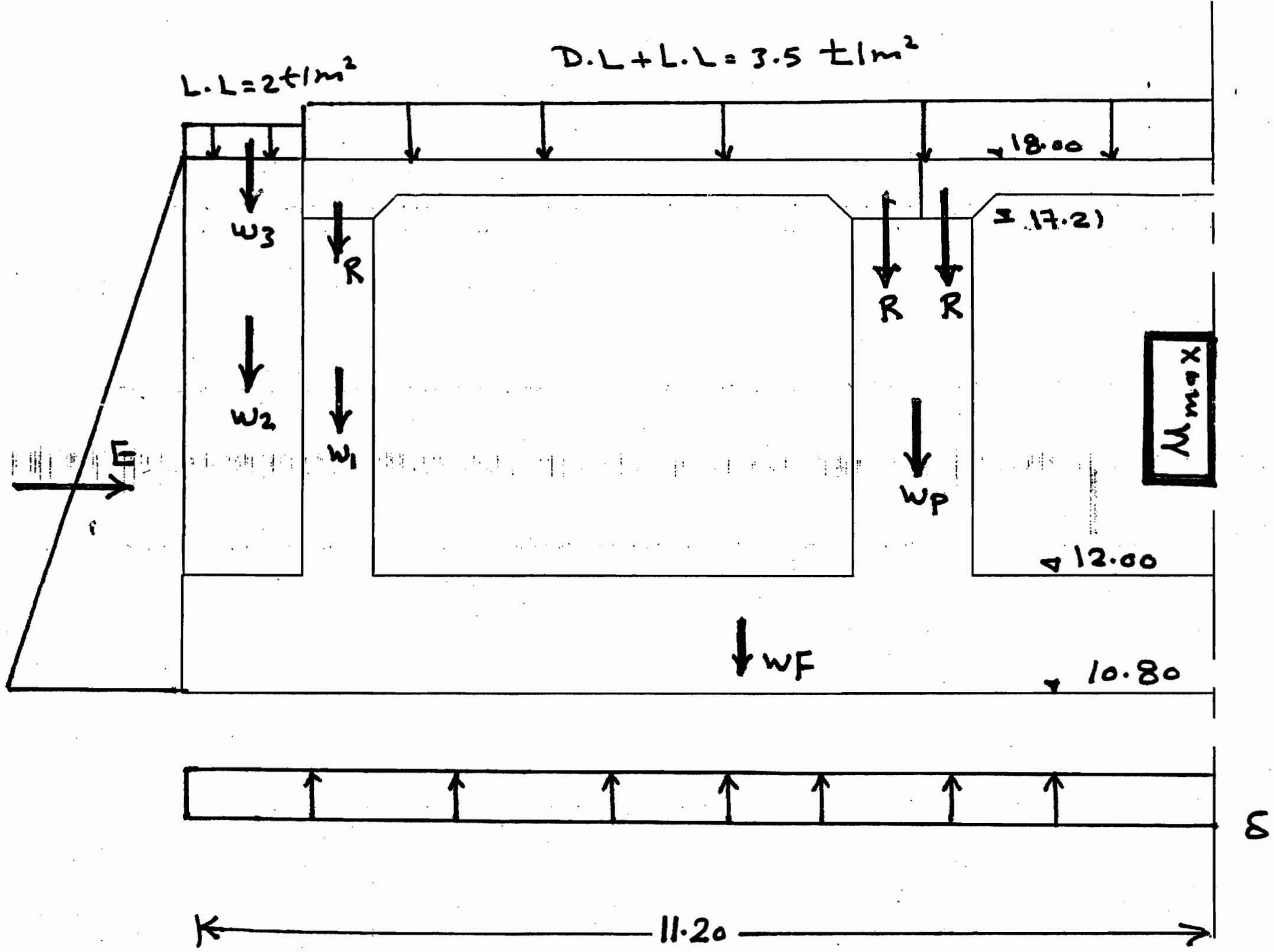
٤- إيجاد M , N

٥- التصميم (t , As)

٦- رسم التسليح

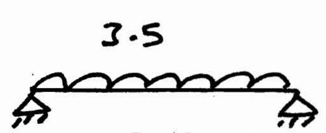
ملاحظة :-

بصفة عامة علينا أخذ $\frac{1}{2}$ إنشاءات عند حساب δ



لأن عدد الفتحات فردي ← تكون M_{max} في المنتصف

1-Loads



- $R = \frac{3.5 * 7.2}{2.0} = 12.60$ t
- $W_P = 5.20 * 1.20 * 1.0 * 2.50 = 15.60$ t
- $W_F = 11.20 * 1.20 * 1.0 * 2.50 = 33.6$ t
- $W_1 = 5.20 * 0.5 * 1.0 * 2.50 = 6.50$ t
- $W_2 = 6.0 * 0.50 * 1.0 * 1.65 = 4.95$ t
- $W_3 = 2 * 0.5 * 1.0 = 1.0$ t

… 7.2^2 * 1/2 = 14.25 t

2-Check Of Stresses

لأحمال الرأسية فقط

$$\delta = \frac{3R + W_P + W_F + W_1 + W_2 + W_3}{11.20}$$

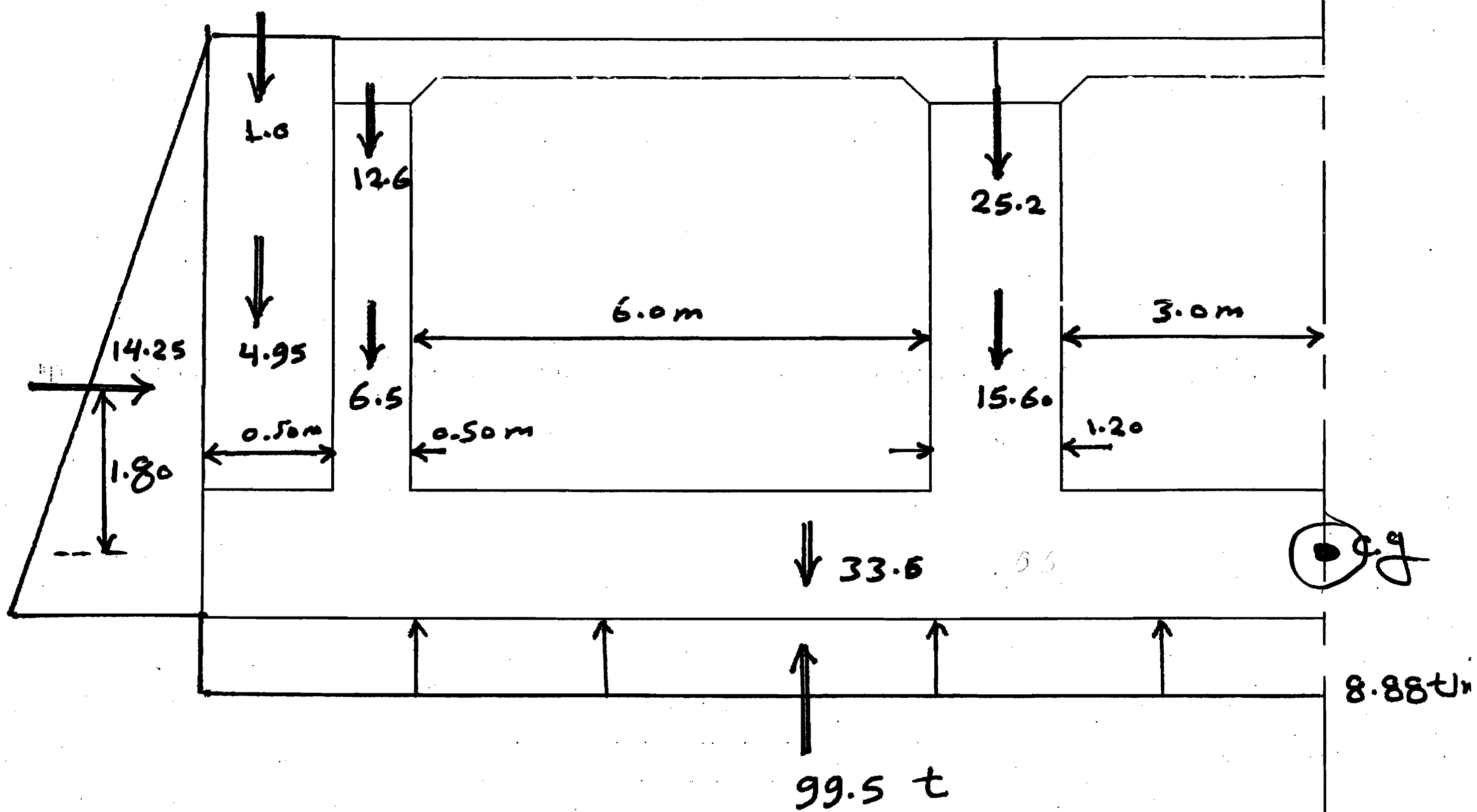
$$= \frac{3 * 12.60 + 15.60 + 33.60 + 6.50 + 4.95 + 1.0}{11.20}$$

$$\delta = 8.88\ t/m^2 < 13.5\ t/m^2 \quad \text{ok}$$

$1.35\ kg/cm^2$

3-Location Of Zero Shear

مكان M_{max} في المنتصف لأنه عدد الفتحات فردي



4-Straining Action(M,N)

$$M_{max} = (25.2 + 15.60) * 3.60 + (12.6 + 6.50) * 10.45$$

$$+ (1.0 + 4.95) * 10.95 + 33.60 * \frac{11.2}{2} - 99.5 * \frac{11.2}{2}$$

$$- 14.25 * 1.80 =$$

$$M_{max} = 16.94 \ t.m/m'$$

$$N = E = 14.25 \ t/m'$$

5-Design

*- $d = K_1 \sqrt{\frac{M}{b}} = 0.313 \sqrt{16.94*1000}$

$d = 40.7\ cm \longrightarrow t_{req} = 45\ cm$

Take $t = 1.20\ m$ $d = 1.15\ m$

*- $As = \frac{M}{K_2\, d} = \frac{16.94 * 10^5}{1218 * 115} = 12.1\ cm^2$

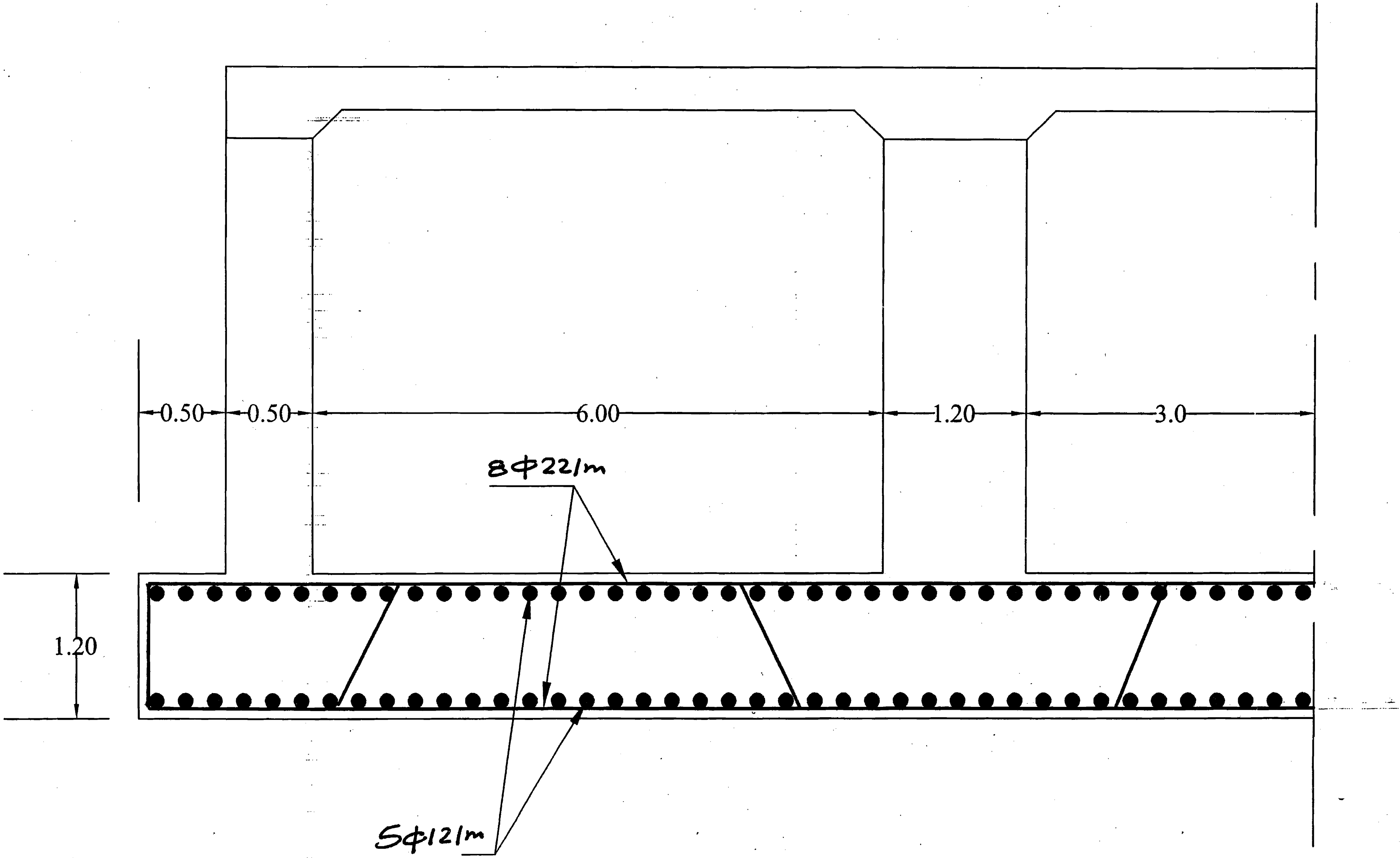
$As_{min} = \frac{0.25}{100} * \overset{b}{100} * \overset{t}{120} = 30\ cm^2$

Take $As = As_{min} = 30\ cm^2$

Select $As = 8 \Phi 22 / m'$

$As' = 5 \Phi 12 / m'$

6-Rft Details



Example (2)

Alexandria University
Faculty of Engineering
Irrigation & Hyd. Dept

Fourth year Civil Eng.
Mid-term Exam, Nov. 2003
Time allowed 1.0 hour.

Design of Irrigation Structures (II)

A) A reinforced concrete head regulator with 200 m approach channel is to be constructed to feed a main canal from a Rayah. The cross section of the main canal is given in Fig. (1). The cross section of the regulator under the bridge is given in Fig.(2). The regulator consists of two vents, each span = 4.0 m. The pier thickness is 1.0 m. The width of the bridge = 10.0 m and it has two side walks of 1.25m width each. The maximum allowable heading up is 10 cm. The maximum allowable discharge through the main canal is 16.0 m^3/sec. The equivalent Dead and Live loads of the bridge are 1.2 and 1.5 t/m^2, respectively. The soil properties at the regulator site are: $\phi = 30°$, $\gamma_{bulk} = 1.8\ t/m^3$, and the soil bearing capacity = $1.15\ kg/cm^2$.
(For the used R.C, $k_1 = 0.313$ & $k_2 = 1218$)

It is required to :.
1- **Check** the full hydraulic design of the regulator,
2- **Check** the soil stresses under the floor, and
3- **Check** the given floor thickness

B) **Draw** a Plan and Sec Elev. for the miter gate position of a symmetrical lock.

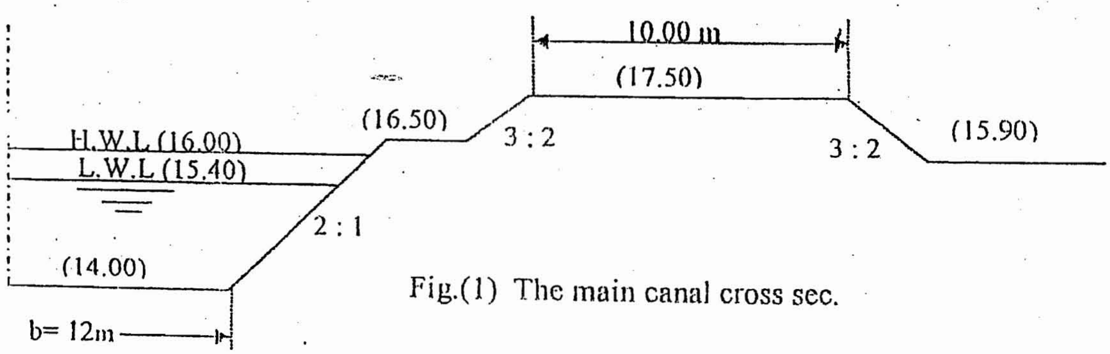


Fig.(1) The main canal cross sec.

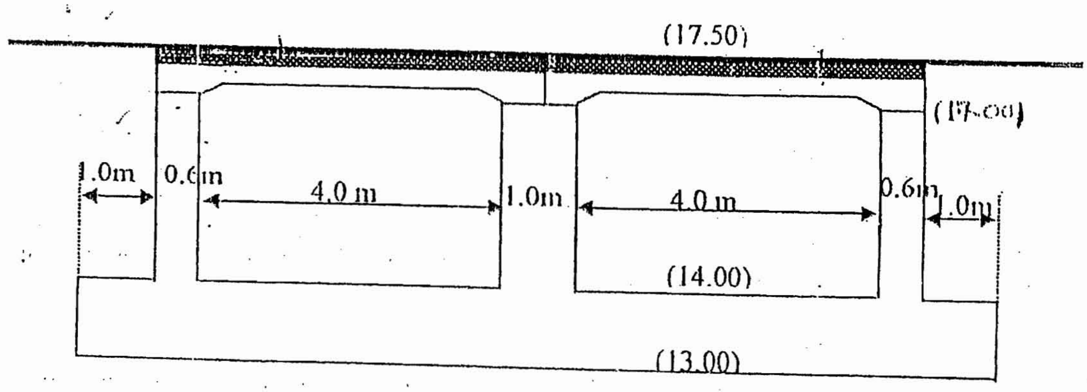
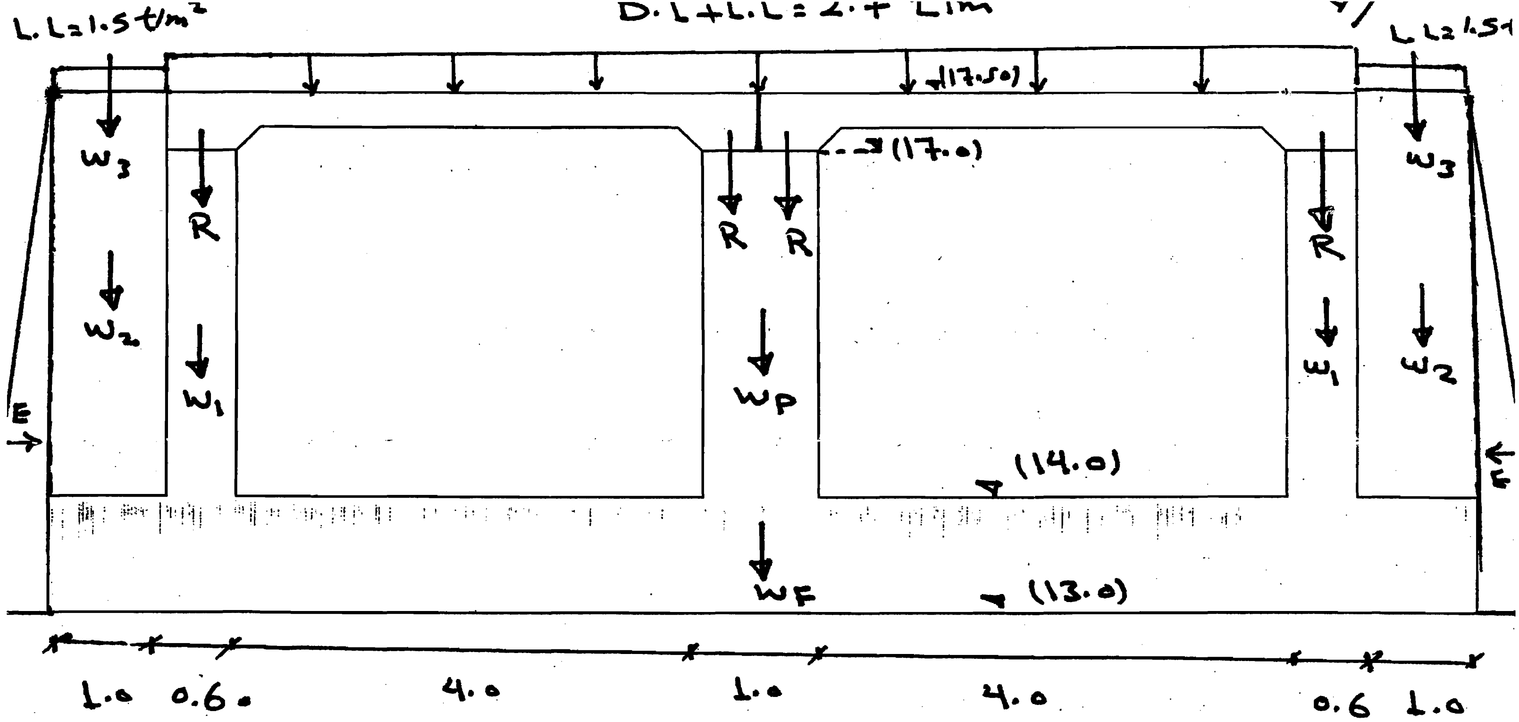


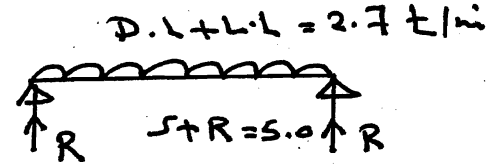
Fig.(2) The regulator cross sec under the bridge

Good luck



1-Loads بأخذ شريحة عرضها ١,٠ م

1. $R = \frac{2.7 * 5}{2.0} = \underline{6.75\ t}$



2. $W_P = H_P * R * 1.0 * \gamma_{R.C}$

$= 3 * 1.0 * 1.0 * 2.50 = \underline{7.50\ t}$

3- $W_1 = \overset{3.0}{H_P} * 0.6 * 1.0 * 2.50 = \underline{4.50\ t}$

4- $W_2 = 3.50 * 1.0 * 1.0 * \overset{\gamma_e}{1.80} = \underline{6.30\ t}$

5- $W_3 = L.L * 1.0 * 1.0 = \underline{1.50\ t}$

6- $W_F = 12.2 * \overset{1.0}{t_f} * 1.0 * \gamma_{R.C} = \underline{30.5\ t}$

7. $E = 0.5\,\gamma H^2 K_a = 0.5 * 1.80 * 4.5^2 * \frac{1}{3} = \underline{6.075\ t}$

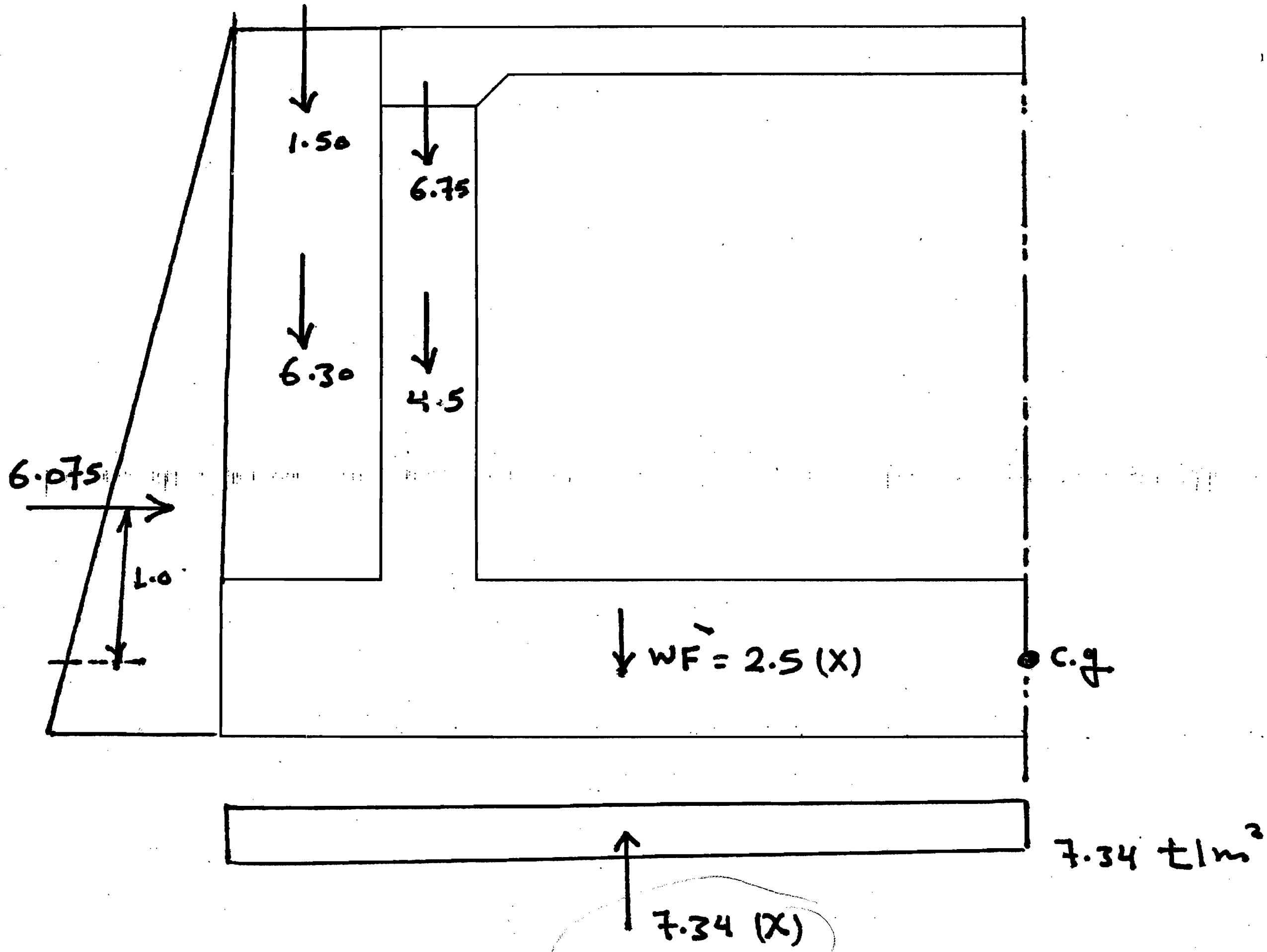
2-Check Of Stresses

$$\delta = \frac{\Sigma \text{vel load}}{B_F * 1.0} = \frac{4R + W_P + W_F + 2[w_1 + w_2 + w_3]}{12.2 * 1.0}$$

$$\delta = \frac{4 * 6.75 + 7.50 + 30.5 + 2[4.5 + 6.3 + 1.50]}{12.2 * 1.0}$$

$$\delta = 7.34 \; t/m^2 < 11.5 \; t/m^2$$

ok



3-Location Of Zero Shear

$\Sigma y = 0.0$

* - ايجاد مكان أقصى عزوم

$$1.50 + 6.75 + 6.30 + 4.50 + 2.5\,(X) = 7.34\,(X)$$

$$X = 3.94 \text{ m}$$

4-Straining Action(M,N)

$$m_{max} = 2.5 * \frac{3.94^2}{2} + (4.5 + 6.75) * (3.93 - 1.30) + (1.5 + 6.3) * (3.93 - 0.50) - 6.075 * 1.0 - 7.34 * \frac{3.94^2}{2}$$

$$m_{max} = 12.7 \text{ t.m}$$

$$N = E = 6.075 \text{ t}$$

5-Design

$$* - \quad d = K_1 \sqrt{\frac{m}{b}} = 0.313 \sqrt{\frac{12.7*10^5}{100}}$$

$$d = 35.3 \text{ Cm} \rightarrow t_{req} = 40 \text{ cm}$$

< tgiven
or

Take t = 100 cm
d = 95 Cm

$$* - \quad A_s = \frac{m}{K_2 d} = \frac{12.7*10^5}{1218*95} = 10.97 \text{ cm}^2$$

$$* - \quad A_{s\,min} = \frac{0.25}{100} A_c = \frac{0.25}{100} \overset{b}{100} * \overset{t}{100} = 25 \text{ cm}^2$$

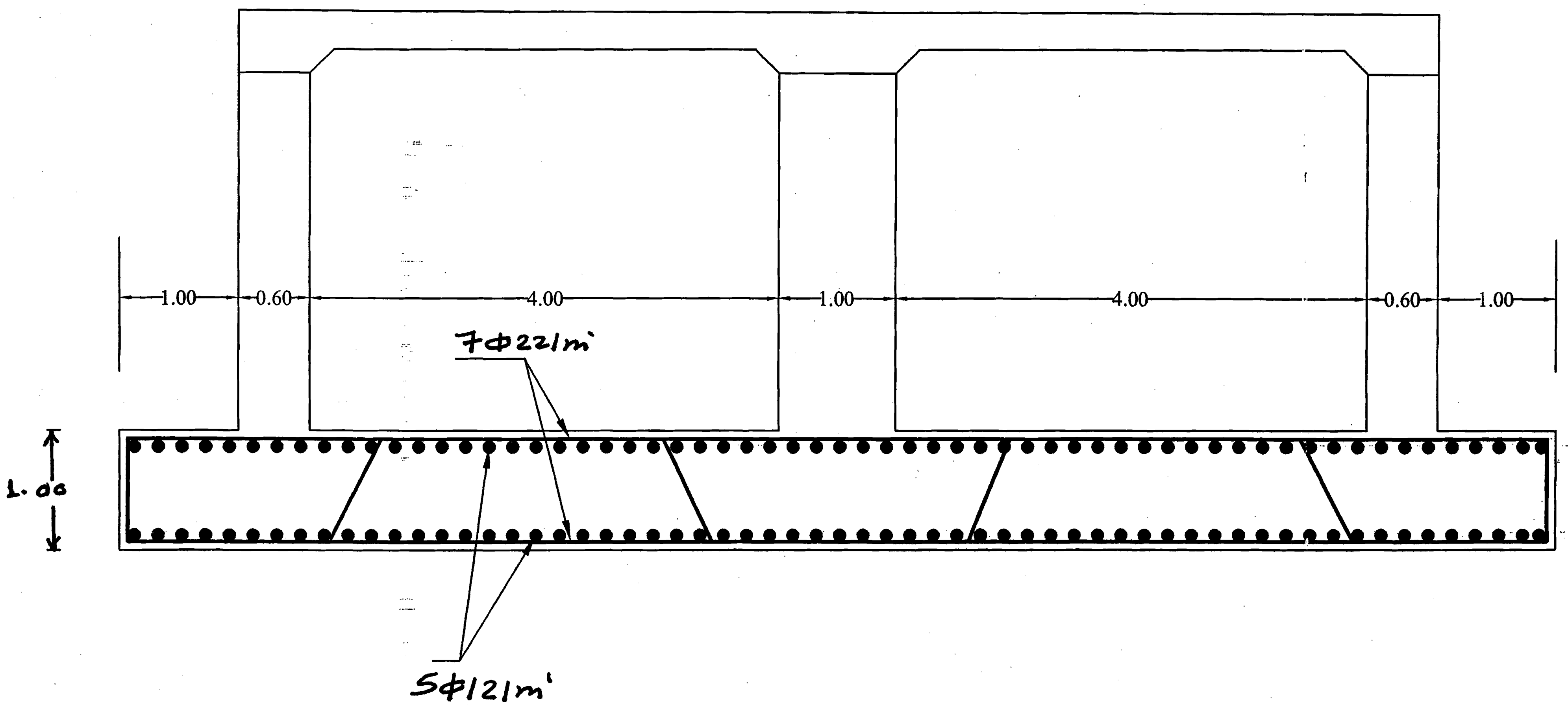
Take $A_s = A_{s\,min} = 25 \text{ cm}^2$

Select $7 \phi 22/m'$

$2500 \text{ mm}^2 = n (\frac{\pi}{4})(20)^2$

$* - A_s' = 5 \phi 12/m'$

6-Rft Details



Example (3)

IRRIGATION & HYDR. DEPT.
FOURTH YEAR CIVIL

ALEXANDRIA UNIVERSITY
FACULTY OF ENGINEERING

IRRIGATION DESIGN

MAY , 1996

TIME ALLOWED : 3 HOURS

Question No. 1

A control regulator is constructed across a main canal. The regulator consists of 4 vents, the span of each = 5.00 m. The regulator is designed for a max. allowable heading up = 10 cm. The width of the pier = 1.5 m. The equivalent total D.L. of the bridge = 1.50 t/m2. The L.L. on the bridge & the side walks = 1.0 t/m2, and 0.4 t/m2, respectively. It is required to:

واجب

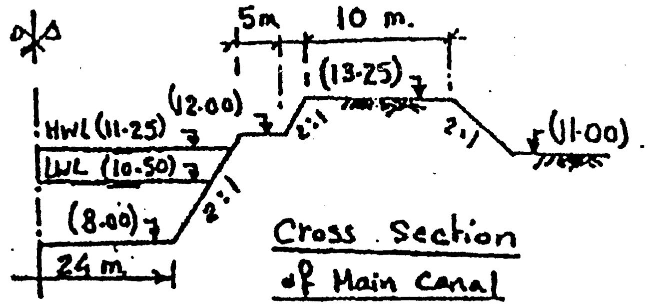
a. Calculate the maximum discharge passing through the regulator when the gates are fully opened.

b. Check the given dimensions of the pier (plain concrete), considering the case of single moment and normal forces only.

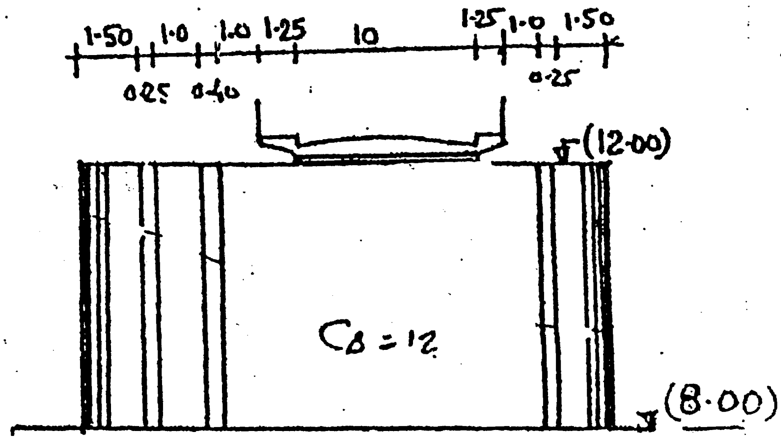
c. Calculate the required floor dimensions to overcome both the percolation and tail erosion requirements.

d. Considering 1m width under the bridge; Calculate & check the floor thickness and Rft.

e. Draw a fully dimensioned neat sketch showing the plan (H.E.R.).



Cross Section of Main Canal



Longitudinal Section of the Pier

- $\gamma_s = 1.80$ t/m³
- $\phi = 30$
- $q_{all\,soil} = 1.50$ kg/cm² - ($K_1 = 0.245$ - $K_2 = 1046$)

Required

1. Floor Dims according to Percolation & Scour

2. Design of FlooR

ملحوظة: Piers + abutment ← خرسانة عادية $\gamma = 2.2$ t/m³

FlooR ← خرسانة مسلحة $\gamma = 2.5$ t/m³

Calculate the Floor dimensions to overcome both percolation and tail erosion (scour)

$$y_{d.s} = 11.25 - 8.0 = 3.25 \text{ m}$$

$$y_{u.s} = 3.25 + 0.1 = 3.35 \text{ m} = H_{max}$$

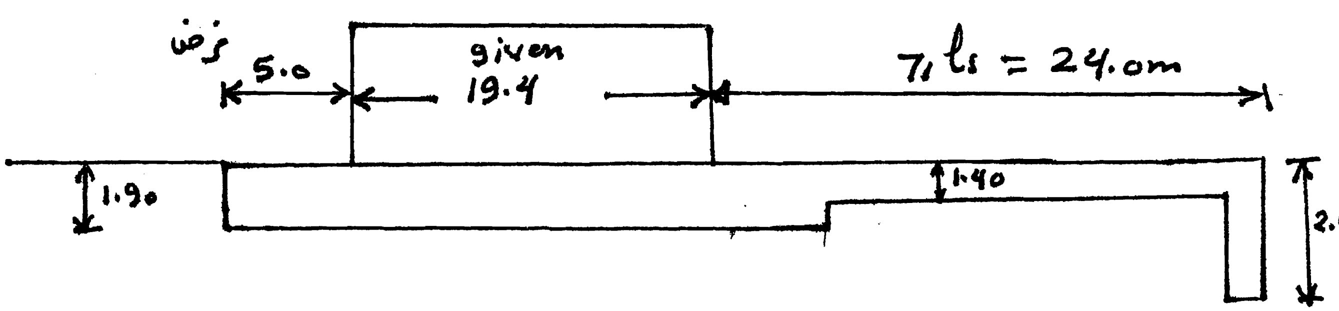
$$l_s = 2.1 \ C_B \sqrt{\frac{H_{max}}{3.90}} = 2.1 * 12 * \sqrt{\frac{3.35}{3.90}}$$

$$l_s \simeq 24.0 \text{ m}$$

$$t_1 = \sqrt{H_{max}} \simeq 1.90 \text{ m}$$

$$t_2 = 0.7 \, t_1 \simeq 1.40 \text{ m}$$

$$t_3 = 1.5 \, t_1 = 2.90 \text{ m}$$

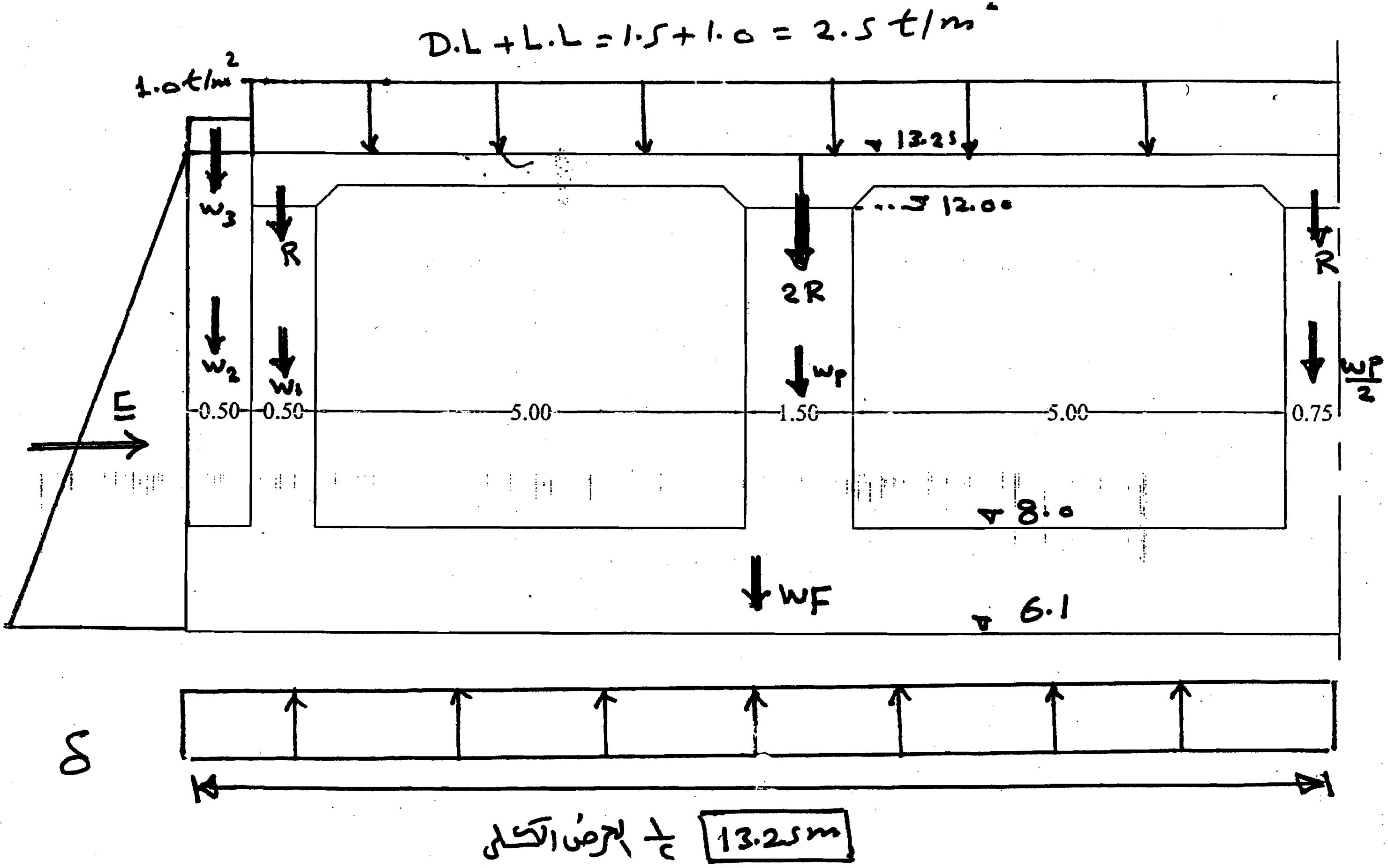


- $L_{Pac} = \Sigma H + \Sigma V = (1.9 + 0.5 + 1.5 + 2.9) + (5 + 19.4 + 24)$

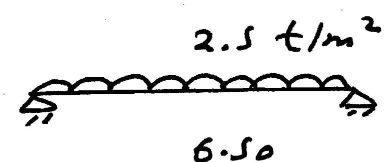
  $L_{Pac} = 55.20$ m

- $L_{Pth} = C_B * H_{max} = 12 * 3.35 = 40.2$ m

  $L_{Pac} > L_{Pth}$ OK



1-Loads



$$R = 2.5 * \frac{6.5}{2} = 8.13\ t$$

$$W_P = 1.50 * 4.0 * 1.0 * 2.2\ (\gamma_{P.C}) = 13.2\ t$$

$$W_1 = 0.5 * 4.0 * 1.0 * 2.2 = 4.4\ t$$

$$W_2 = 0.5 * 5.25 * 1.0 * 1.80 = 4.73\ t$$

$$W_3 = 0.5 * 1.0 = 0.5\ t$$

$$W_F = 13.25 * 1.90 * 1.0 * 2.50 = 62.94\ t$$

$$E = 0.5 * 1.80 * 7.15^2 * 1/3 = 15.34\ t$$

تم أخذ نصف البحرة للتحميل عند حساب δ

2-Check Of Stresses

$$\delta = \frac{1.5\,w_p + 4R + w_1 + w_2 + w_3 + w_F}{13.25}$$

$$= \frac{1.5 * 13.2 + 4 * 8.13 + 4.4 + 4.73 + 0.5 + 62.94}{13.25}$$

$$\delta = 9.43 \ t/m^2 < 15 \ t/m^2$$

$q_{all} = 1.5 \ kg/cm^2$

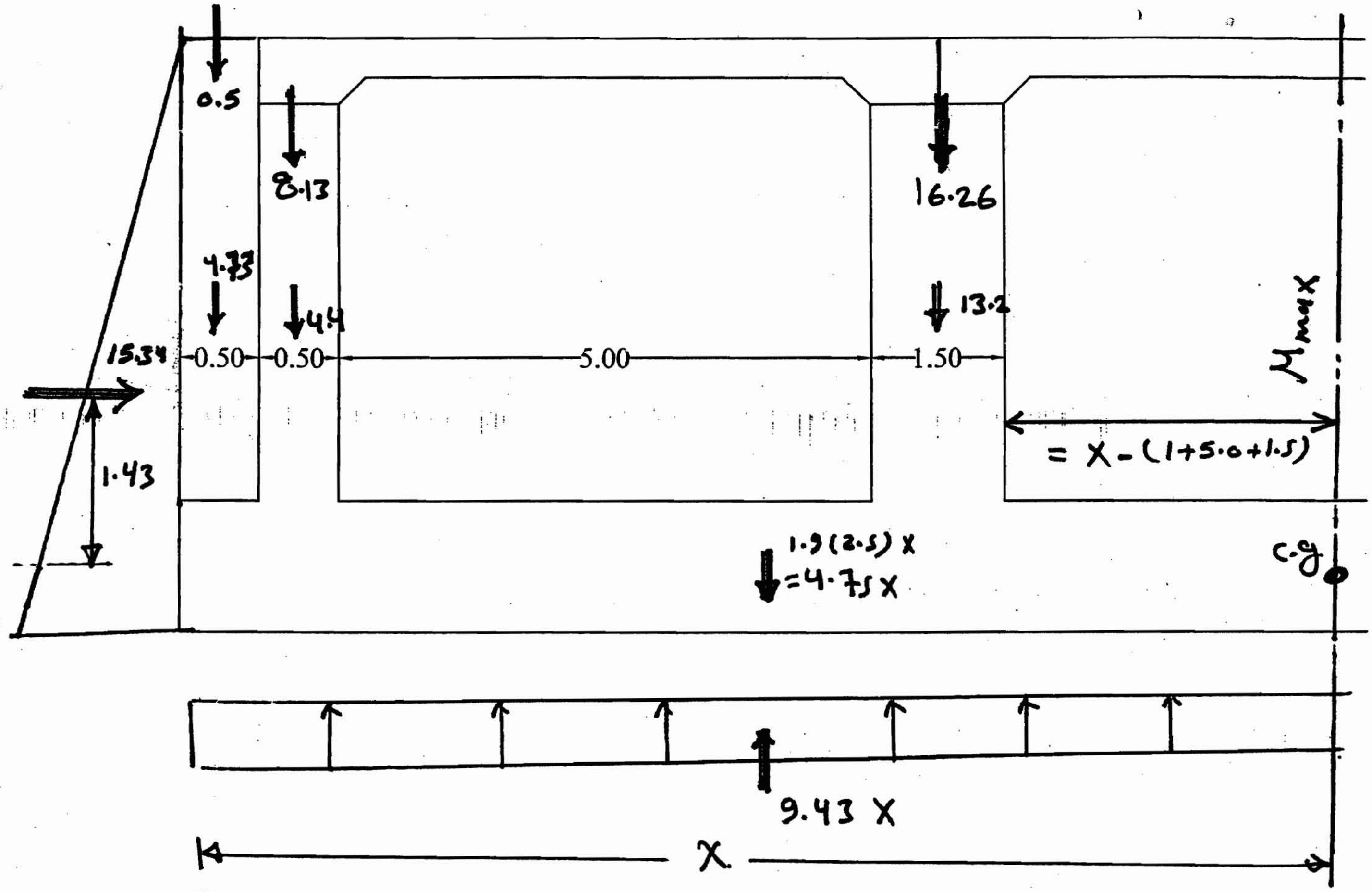
OK

3-Location Of Zero Shear

أقصى عزم يوجد بالفتحة القريبة من منتصف المنشأ

(الفتحة الثانية) $\Longleftarrow$

$\Sigma y = 0.0$



$\Sigma Y = 0.0$

$$0.5 + 4.73 + 8.13 + 4.4 + 16.26 + 13.2 + 4.75X = 9.43X$$

$$X = 10.1 \ m$$

4-Straining Action(M,N)

$$M_{max} = (16.26 + 13.2) * (3.35) + (8.13 + 4.4) * (9.35) + (0.5 + 4.73) * (9.85) + 4.75 * \frac{(10.1)^2}{2} - 9.43 * \frac{(10.1)^2}{2} - 15.34 * 1.43$$

$$M_{max} = 4.2 \ t.m$$

$$N = E = 15.34 \ t$$

5-Design

$$\therefore d = K_1 \sqrt{\frac{m}{b}} = 0.245 \sqrt{\frac{4.2 * 10^5}{100}} = 15.8 \text{ cm}$$

$$d = 15.8 \longrightarrow t_{req} = 20 \text{ cm}$$

Take $t = 190$ cm

$d = 180$ cm

$$\therefore A_s = \frac{m}{K_2 d} = \frac{4.2 * 10^5}{1046 * 180} = 2.23 \text{ cm}^2$$

$$A_{s\,min} = \frac{0.25}{100} * 100 * 190 = 47.5 \text{ cm}^2$$

$A_s = A_{s\,min} = 10 \phi 25 / m'$

• $A_s' = 5 \phi 12 / m'$

ملاحظة :. سمك الحصر (1.90) ليقل حيث ان

$\therefore LP_{ac} >> LP_{th}$

$\therefore$ t From moment صغيرة جداً

تربة $t = 1.0$ m سمك

6-Rft Details