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

LOCKS

Part(1)

Contents

1-Drawing

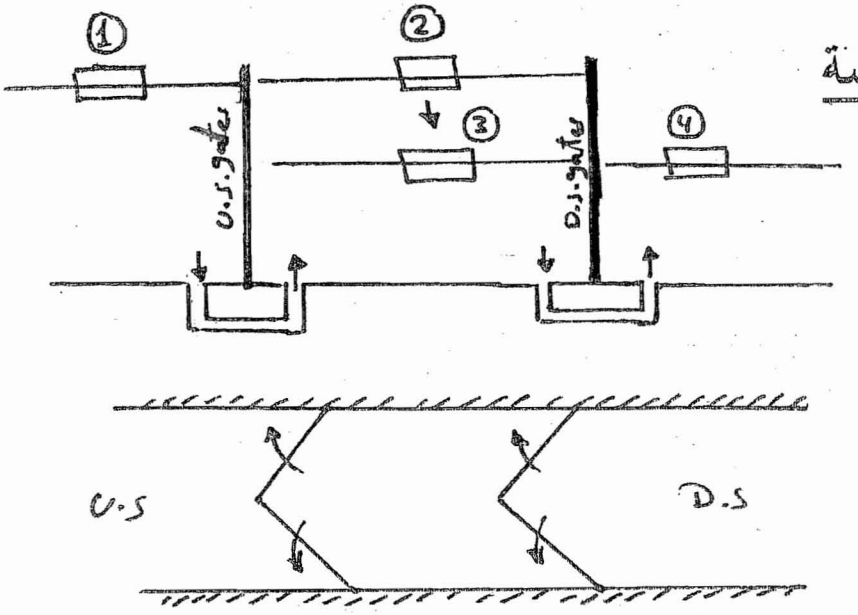
2- Hydraulic design for side culvert

3-Structural design for land walls (P.C. or R.C.)

الهدف من الاهوسة

يتم عمل الهاويس (LOCK) في المجاري الملاحية والتي يوجد بها تغير مفاجئ لسطح المياه > 3.0 م أو يتم عمله في حالة عمل ترعة تربط بين مجريين ملاحيين بينهم فرق في منسوب المياه > 3.0 م

نظرية عمل الاهوسة



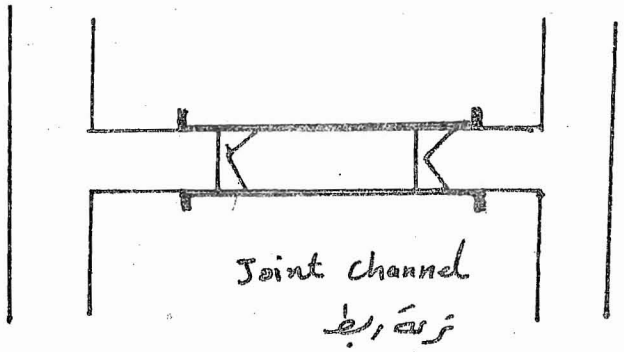
ملاحظة: ① يتم فتح البوابات سواء في U.S أو D.S عندما يكون منسوب المياه قبل وبعد البوابات متساوي فيتم الفتح

② يتم جعل منسوب المياه قبل وبعد البوابات متساوي عن طريق side culvert

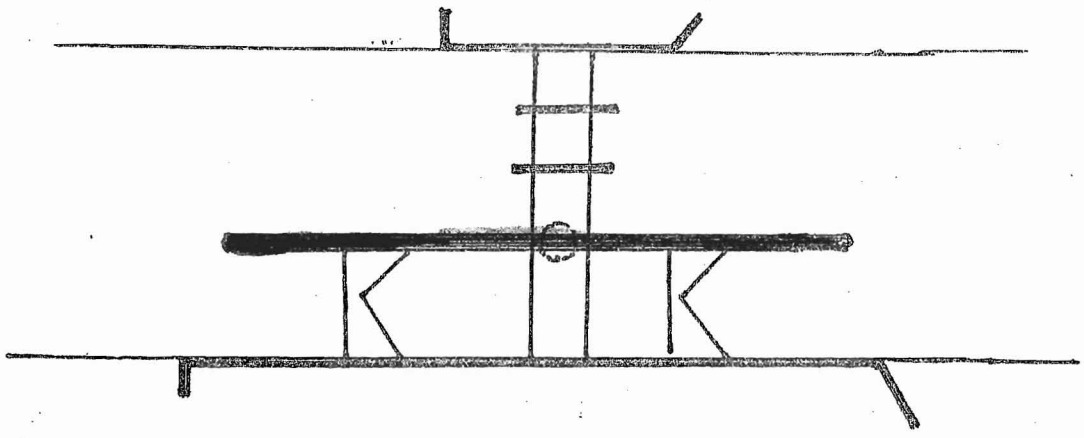
③ side culvert عبارة عن فتحات يتم عملها على جانبي

انواع الاهوسة

A- symmetrical lock



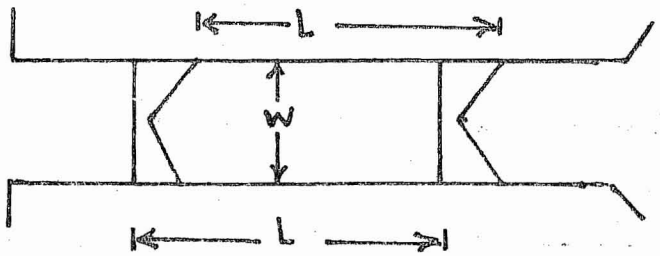
B- Un symmetrical lock



.. الكوبرى عكس يكون ← وسط حجرة الصاويس
← قبل الصاويس
← بعد الصاويس

ثلاث إحتمالات

أبعاد حجرة الهاويس



W → lock chamber width (16~20)

L → lock chamber length (116~120)

.. يتم تحديد أبعاد حجرة الصادين بناءً على أبعاد أكبر مركب ستمر خلال المجرى الملاحي (الصادين)

.. L تقاس بين نقطتين متماثلتين

المكونات الرئيسية للهاويس

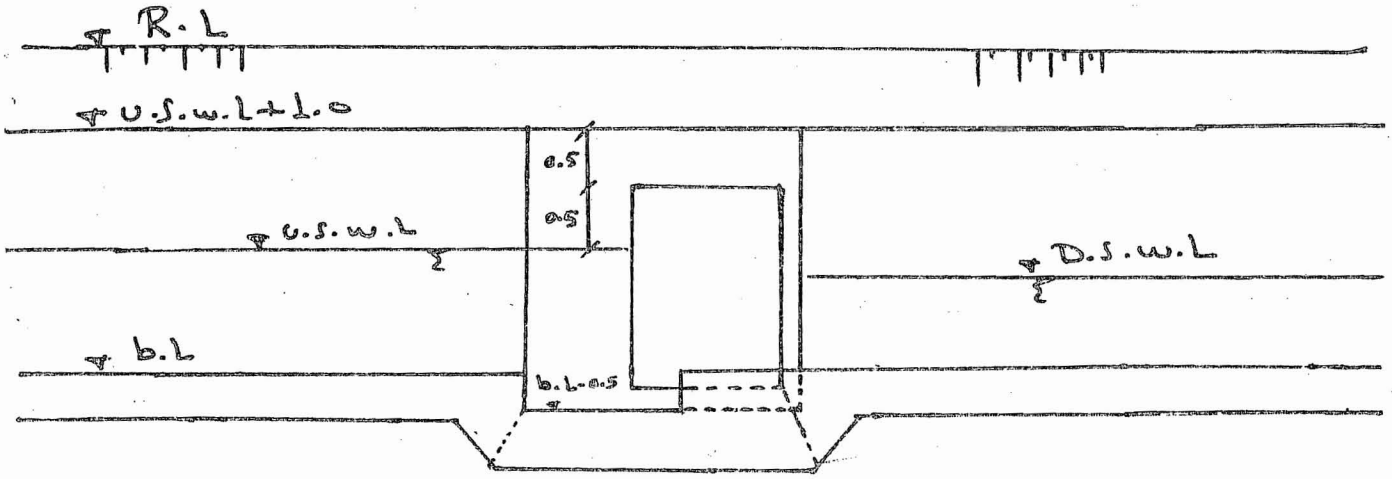
* 1- miter gate البوابات
2- swing bridge الكوبري المتحرك
* 3- land wall
*- 4- side Culvert
*- 5- Guide Pier
*- 6- Floor

المطلوب معرفتة فى الهاويس

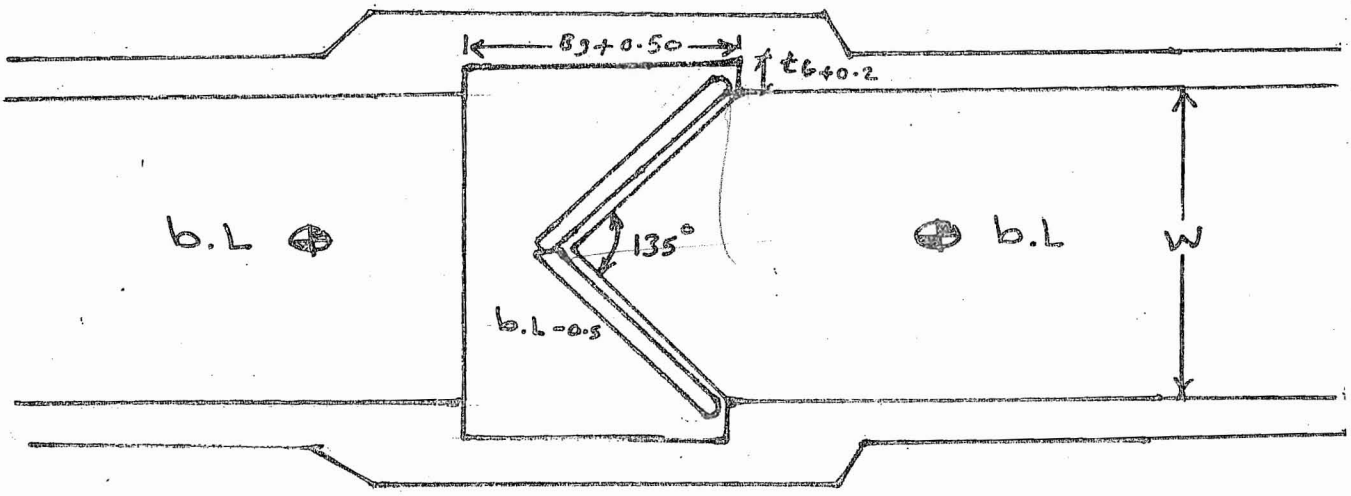
١- [illegible] (حفظ)
٢- التصميم الهيدروليكي لـ side Culvert
٣- التصميم الانشائي لكل من

land wall
Guide Pier
FlooR.

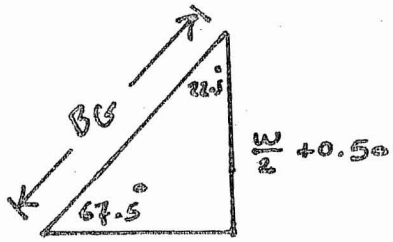
Miter Gate



ELE



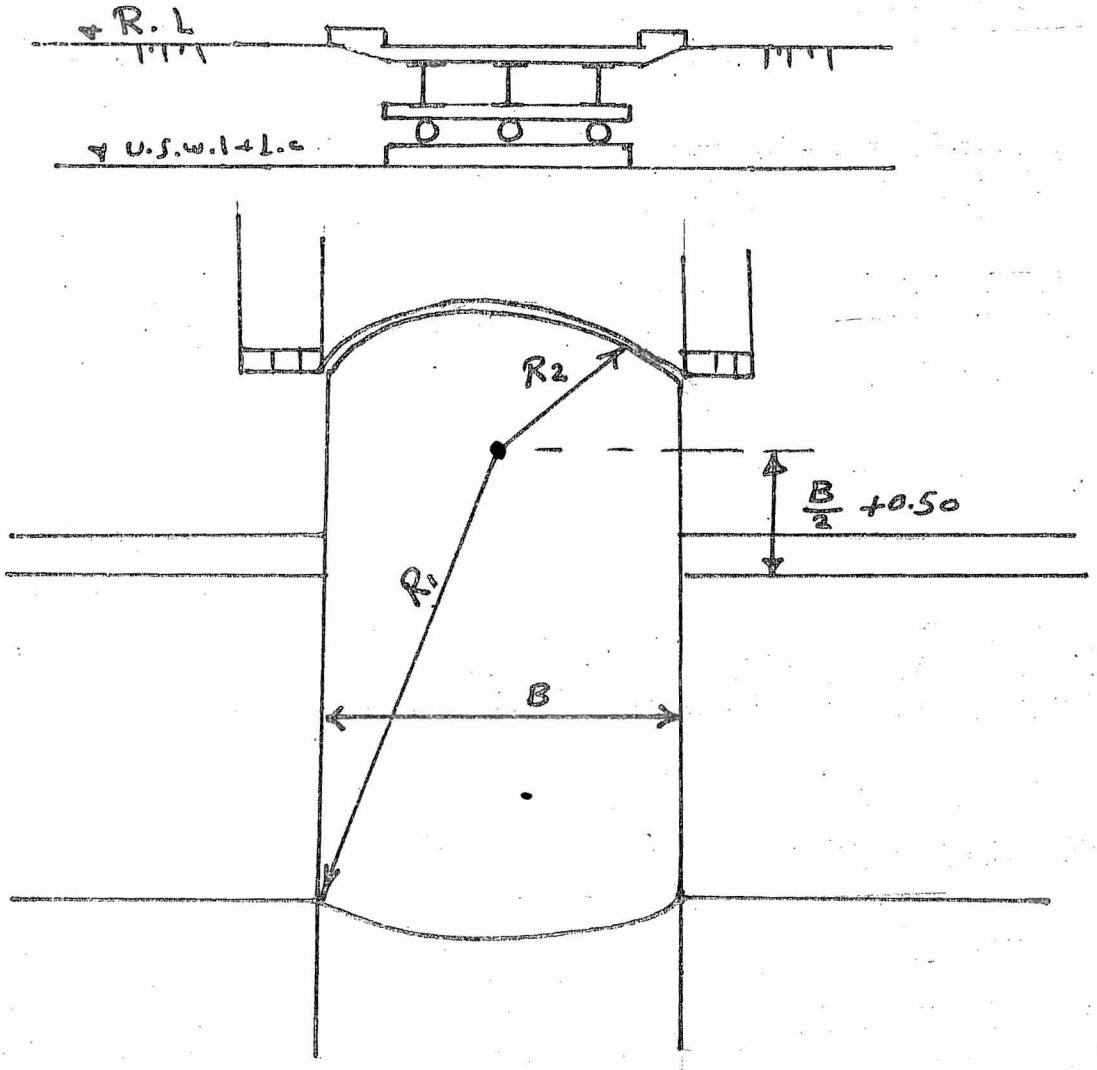
Dims of miter gate



* - $BG = \dfrac{W/2 + 0.50}{\cos 22.5^{\circ}}$

* - $tG = \dfrac{W}{20}$

Swing Bridge



Dims of swing bridge

* - R_1 ⟶ نصف قطر السكة

* - $R_2 = \frac{3}{8} R_1$

* - B ⟶ عرض الكوبرى

Examble

A reinforced concrete navigation symmetrical lock is to be constructed across a joint channel between two navigable canals, as shown in fig. (1). The cross sections of the canals and the joint channel are recorded in the following table. The lock chamber dimensions are 16* 116 m. The cross section of the lock chamber is given in fig. (2). The side culvert dimensions are 1.0*1.5 m.

Cross Section	Bed		Water Level,m	Berm		Road		Side Slopes
	Level,m	Width,m		Level,m	Width,m	Level,m	Width,m	
Nav. Canal (1)	13.00	40	17.80	(18.50)	5	20.00	12	2 :1
Nav. Canal (2)	13.00	35	16.50	(17.00)	5	18.50	10	2 :1
Joint Channel	(13.00)	25	(17.80) 16.50	18.50 17.00	5	20.00 18.50	10	2 :1

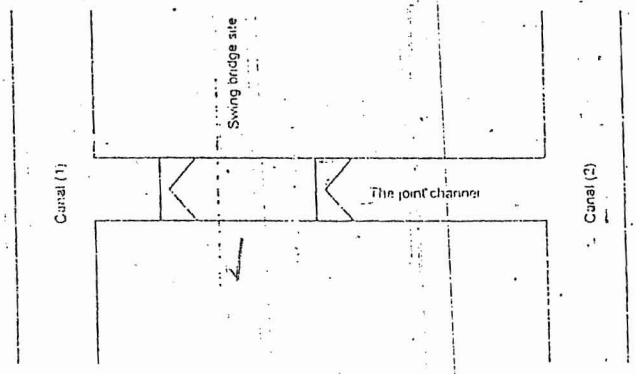


Fig. (1) Layout of the lock

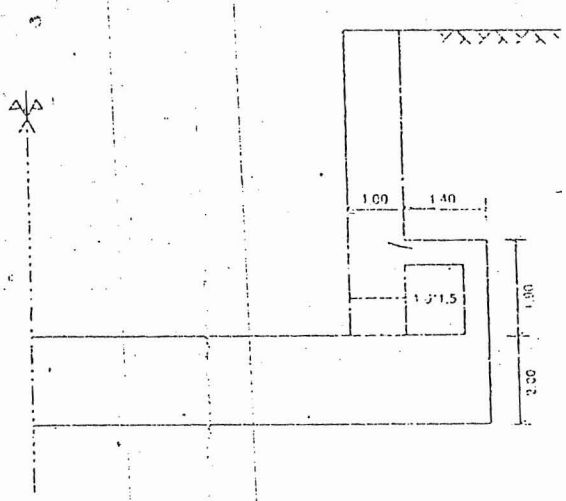


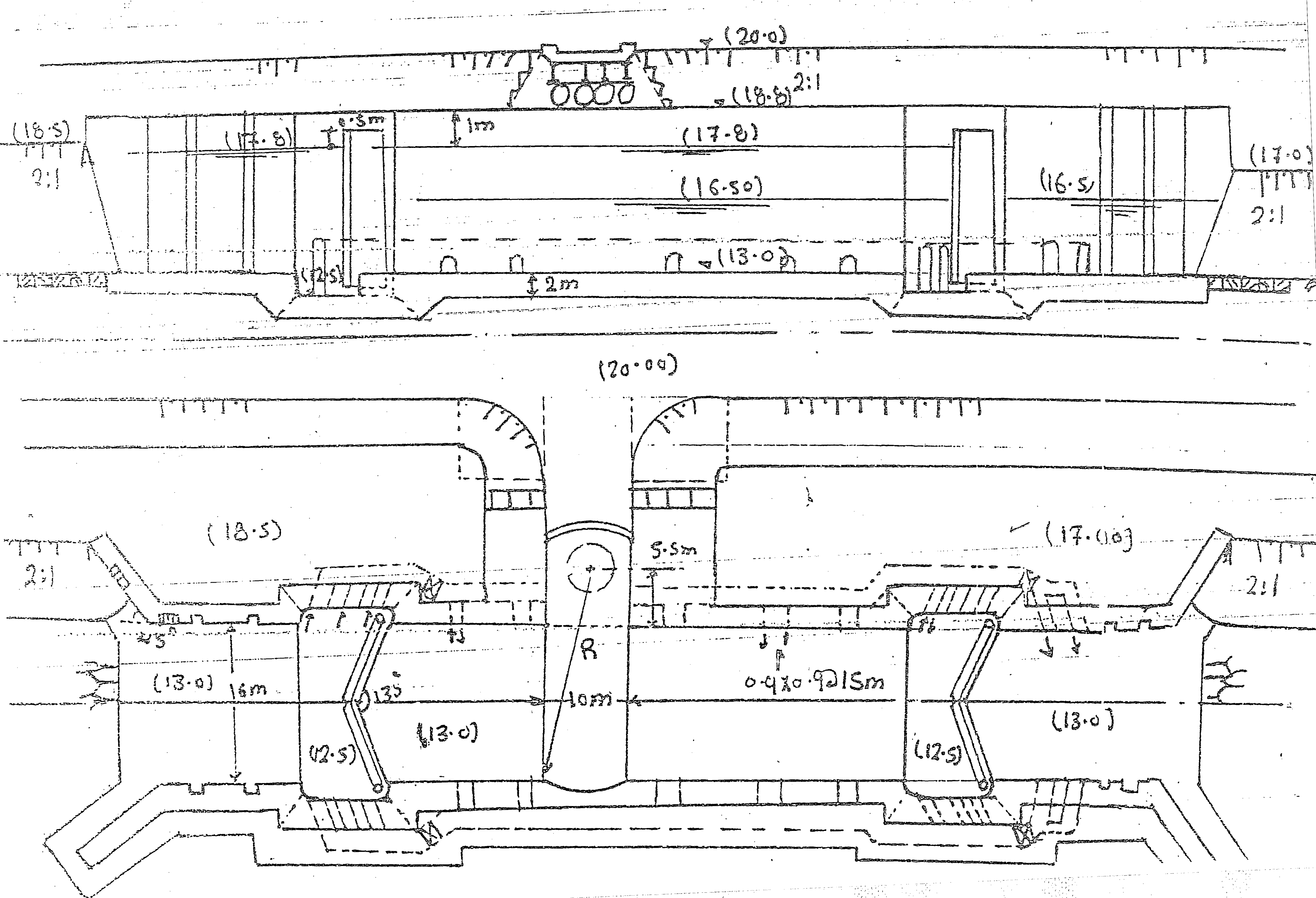
Fig. (2) Lock chamber cross section

It is required to:

Draw, to scale, each of the following:

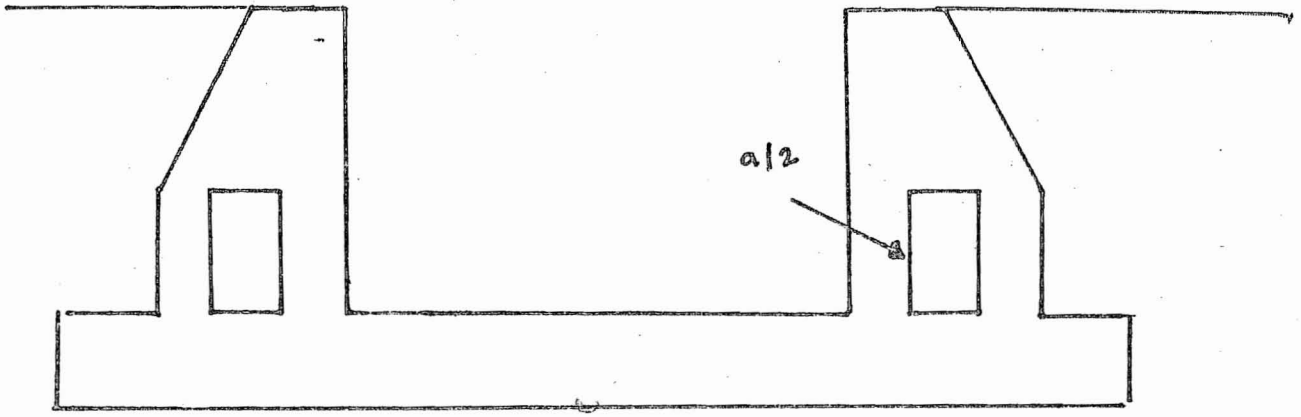
i- Plan(H.E.R.)

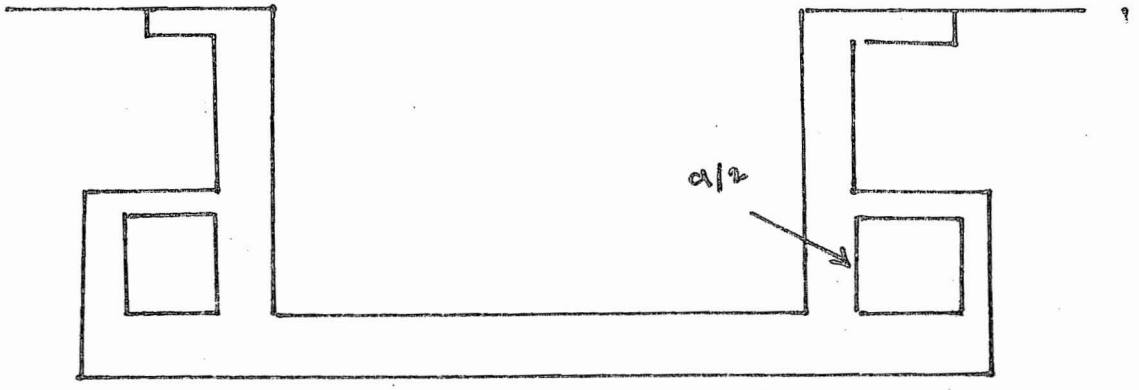
ii- Longitudinal section through the lock chamber

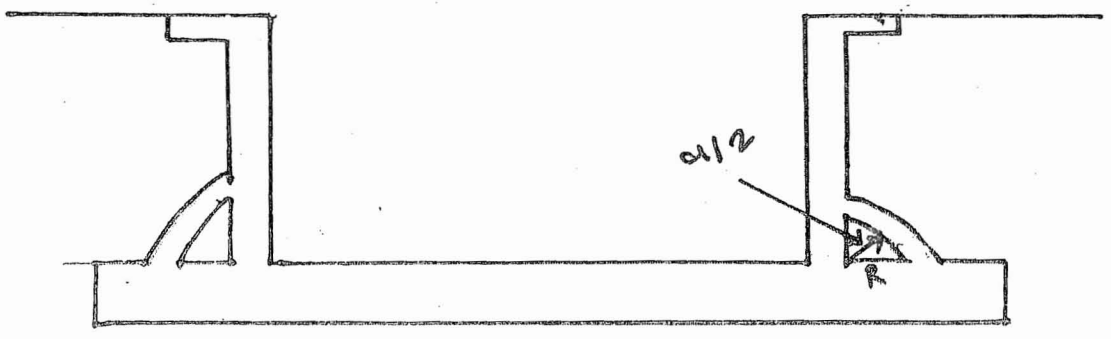

(20·0)
(18·8)
2:1
(18·5)
(17·8)
0·3m
1m
(17·8)
(16·50)
(16·5)
(17·0)
2:1
(12·5)
(13·0)
2m
(20·00)
(18·5)
5·5m
(17·0)
2:1
(13·0)
6m
135°
(12·5)
(13·0)
R
10m
15m
(12·5)
(13·0)

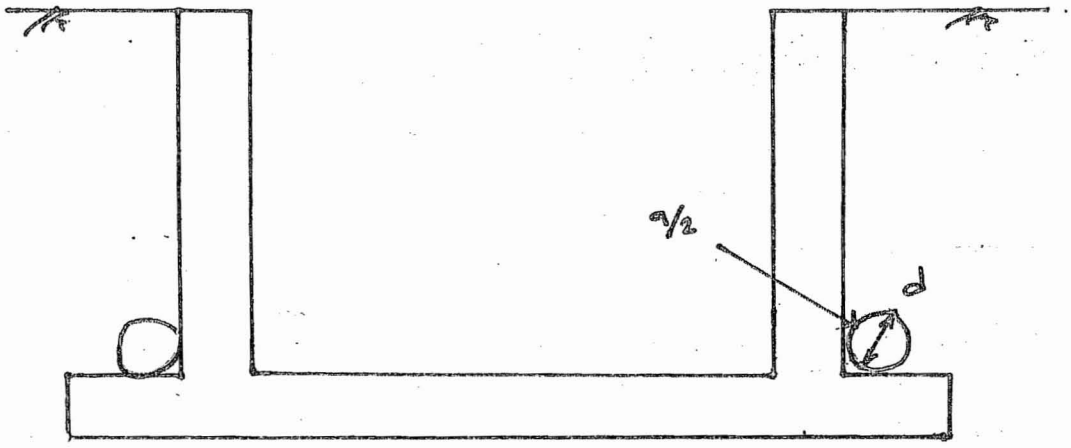
Hydraulic Design Of Side Culver

A-Position And Shapes Of Side Culvert









b-Hydraulic Design

$$q = \frac{2 \times L \times W \sqrt{H}}{Cd \times T \times \sqrt{2g}} = \checkmark \ m^2$$

∴ $q = \checkmark \ m^2$ المساحة الكلية

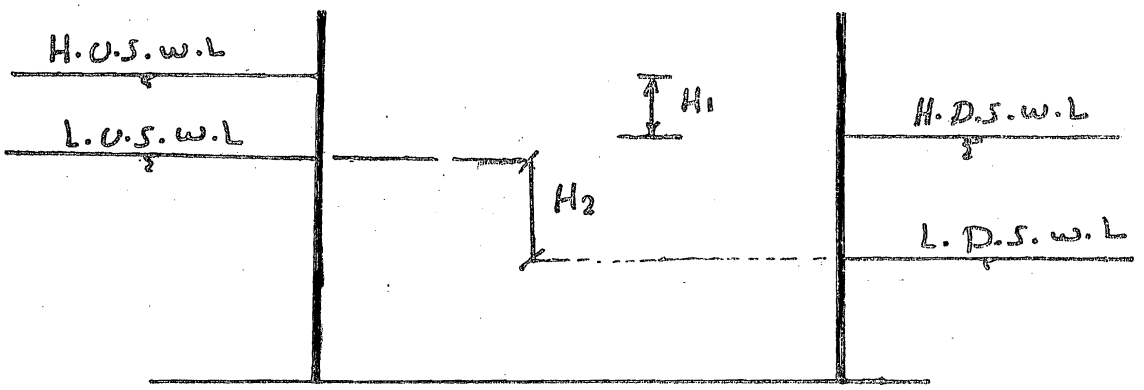
∴ $L = \checkmark \ m$ طول الحاجز

∴ $W = \checkmark \ m$ عرض الحاجز

∴ $H =$ H.U.S.W.L − H.D.S.W.L
L.U.S.W.L − L.D.S.W.L ← نأخذ الأكبر

∴ $Cd = 0.62$ ثابت.

∴ $T = \checkmark \ sec$ زمن الفتح الكهربي



- $H = \max [H_1 \text{ ، } H_2]$

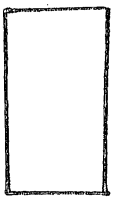
- عندما يكون معطى منسوب واحد فقط في الأمام والخلف

$H =$ U.S.W.L - D.S.W.L

- يجب معرفة التصريف بالثانية $T = 1$ sec

time of filling & empting the box

- في حالة side culvert مستطيل



$$q = \frac{2 \times L \times w \times \sqrt{H}}{Cd \times T \times \sqrt{2g}}$$

$$q = \frac{2 \times 120 \times 20 \times \sqrt{(11.25 - 8.0)}}{0.62 \times (12 \times 60) \times \sqrt{19.62}}$$

$$q = 4.38 \ m^2$$

Case U) □ □

$q = 4.38 \longrightarrow \frac{q}{2} = 2.19 = b * h$

$2.19 = b * h$

ass $b = 1.0 \longrightarrow h = 2.19 = 2.20m$

$b = 1.0m$
$h = 2.20m$

OR

ass $h = 1.80 \longrightarrow b = 1.22m$

$\rightarrow b = 1.25$

التقريب لـ 5cm بالزيادة

$b = 1.25m$
$h = 1.80m$

Examble-

given

- symmetrical lock
- W X L = 20 X 120 m
- T = 12 min
- U.S.W.L = 11.25
- D.S.W.L = 8.0

Required

Design a filling & emptying opening for each of the following shapes

Case (1)

Case (2)

Case (3)

Case (2) 

$$\frac{q}{2} = 2.19 = \frac{\pi r^2}{4}$$

$$r = 1.67 \longrightarrow r = 1.70 \text{ mm}$$

ليس له min مثل الحالة السابقة

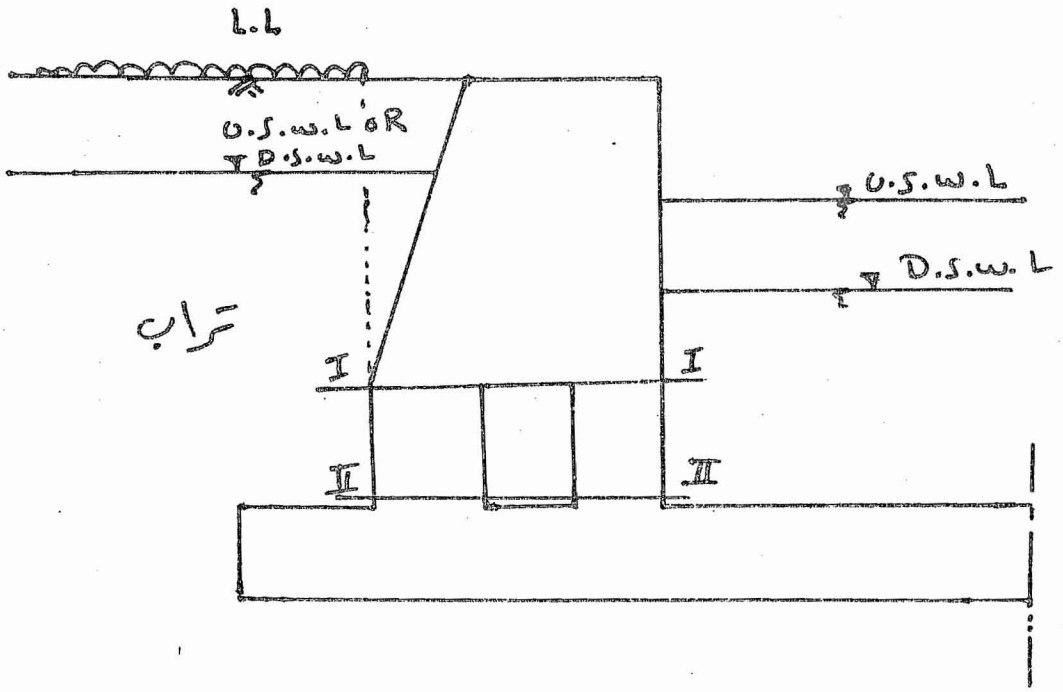
Case(3) 

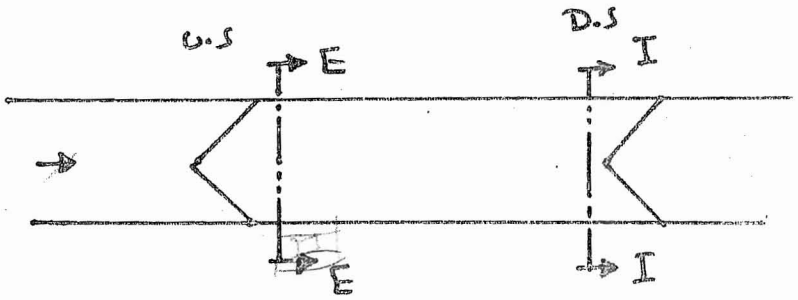
$$\frac{q}{2} = 2.19 = \frac{\pi D^2}{4.0}$$

$$D = 1.67 \longrightarrow D = 1.70 \text{mm}$$

Structural Design Of Land Wall

الشكل العام للحائط





• منسوب المياه ناحية التراب تختلف حسب مكان القطاع

E-E ← منسوب المياه O.S

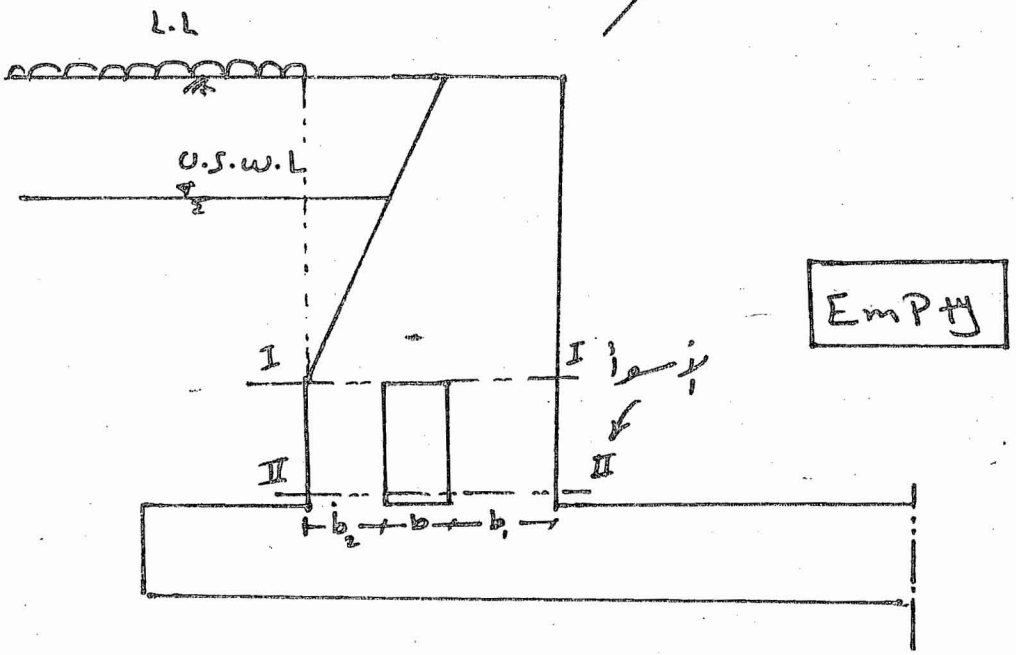
I-I ← منسوب المياه D.S

الفرض

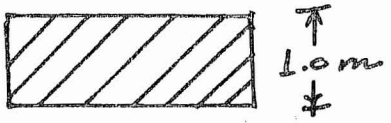
التراب لابد أنه يكون موجود فيسبب لزوم على الحائط

ضغم ليقاوم زيادة العزم ← لذلك حالة التحميل الأسوأ ←

B = 1.0 m



القطاع I - I

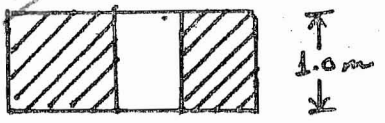


Plan

Solid

القطاع II - II

Plan

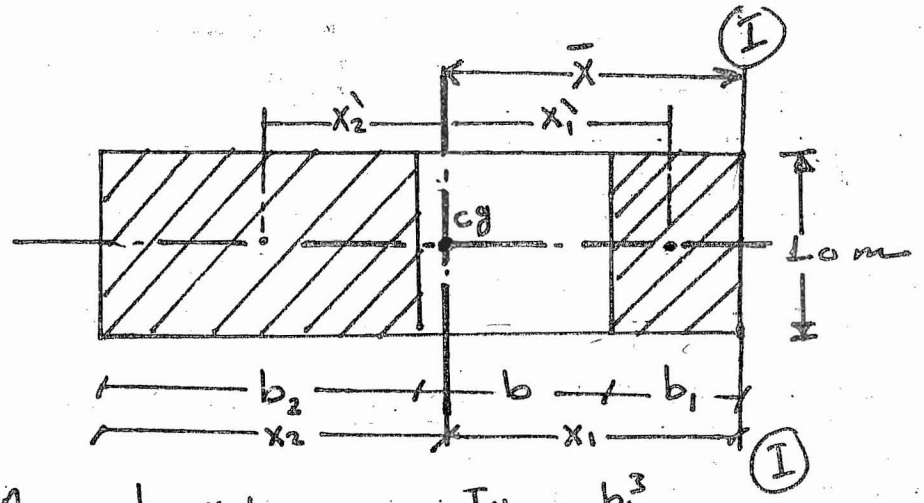


مفرغ

* الأسود القطاع المفرغ Hollow section

* يتم وضع L.L في حالة وجودة بحيث يسبب عزوم فقط

القطاعات المفرغة Hollow Section



$A_1 = b_1 \times 1.0$, $I_{y_1} = \frac{b_1^3}{12}$

$A_2 = b_2 * 1.0$, $I_{y_2} = \frac{b_2^3}{12}$

$A = A_1 + A_2$

* لمعرفة c.g القطاع لابد من أخذ عزوم حسابات

Σ moment of Area @ I-I

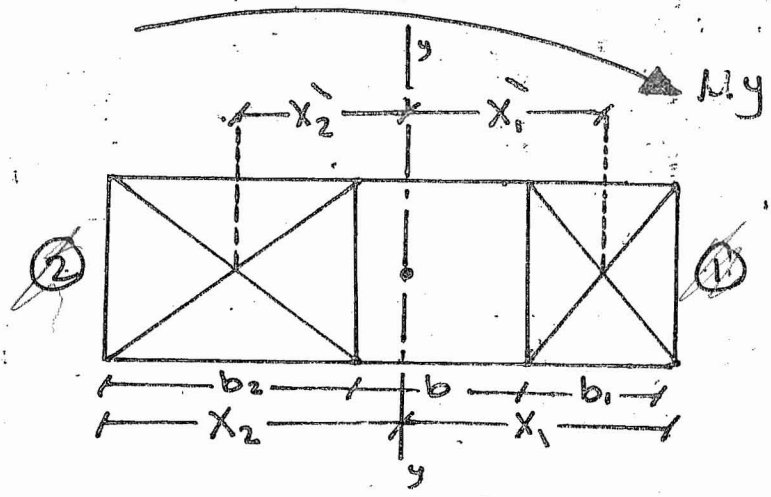
$$A_1 \left(\frac{b_1}{2}\right) + A_2 \left[b_1 + b + \frac{b_2}{2}\right] = A \bar{x}$$

$\bar{x} = r$

* لحساب I_y للقطاع ككل

$$I_y = I_{y_1} + A_1 (x_1')^2 + I_{y_2} + A_2 (x_2')^2$$

* - في حالة التأكد من الإجهادات في حالة الجسر العادية



$$X_1 = X_1' + \frac{b_1}{2}$$

$$X_2 = X_2' + \frac{b_2}{2}$$

$$F_{1,2} = \frac{-N}{A} \pm \frac{my}{Iy} X_{1,2}$$

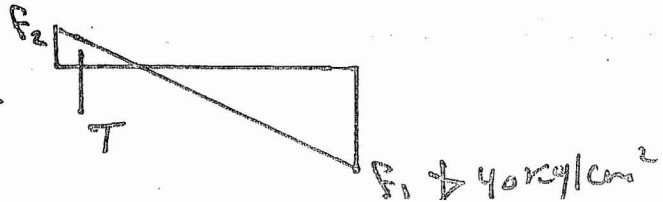
$$A = A_1 + A_2$$

$Iy = \leftarrow$ للمقطع كله

f_1 (comP) $\not>$ 40 kg/cm²

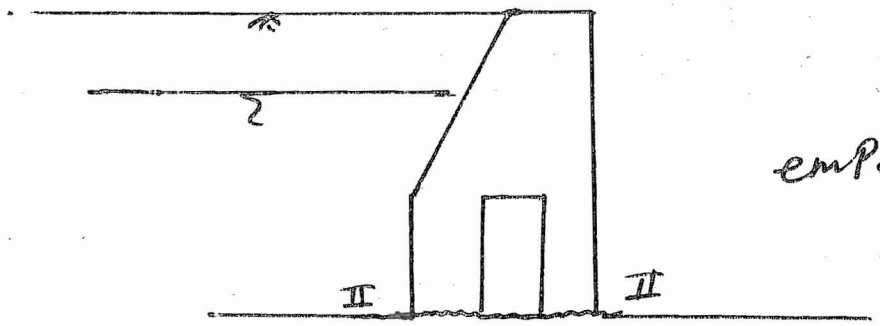
$T = \leftarrow$

$As = \frac{T}{f_s} = \leftarrow cm^2$



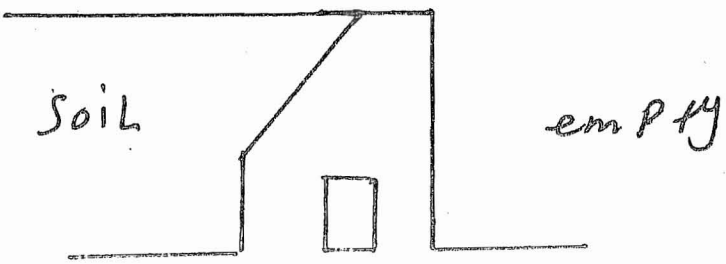
ملاحظات مهمة جدا فى الامتحانات

١- يتم التصميم على حالة التحميل الأسوأ عند قطاع (II-II) إذا لم يعطى حالة معينة لقطاع معين

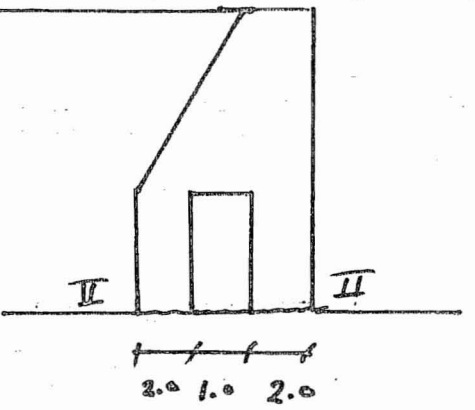


٢- عكس يعطى حالة ويطلب عمل check عند قطاع معين فلابد أن نلتزم بذلك

٣- عكس يطلب عمل Just after Construction check جعن ← مافيش مياه



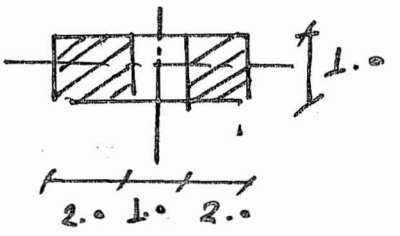
٤- ممكن للتحصيل من الإمكان كيدوم القطاع (II - II) متماثل



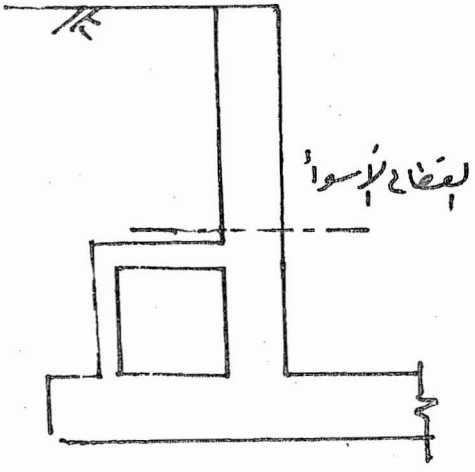
$A = 2.0 * 1.0 * 2.0 = 4.0$

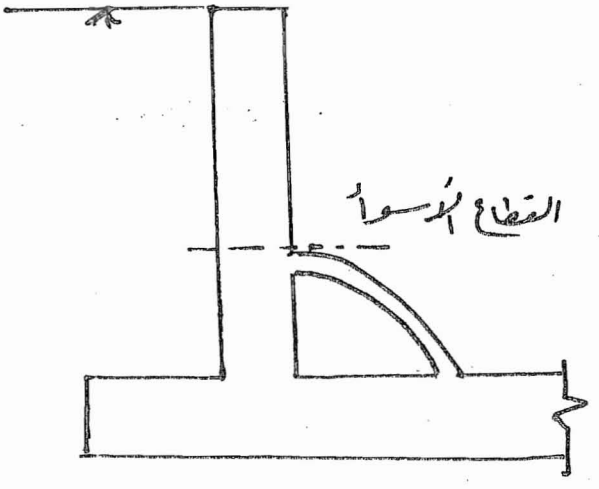
$I_y =$  $-$ 

$I_y = \frac{1*5^3}{12} - \frac{1*1^3}{12} =$



٥- لو ni side culvert خارج الحائط يكون القطاع الأسوأ دائما أعلى side culv.





Examble

For the shown plain and reinforced concrete cross sections of a symmetrical lock, the following data is given:

- Width and length of the lock chamber are 20, 120 m respectively,
- Time of filling and emptying the Lock chamber is 10 minutes, and
- Soil properties: γ_e= 1.80 t/m^3, φ= 30°.

It is required to:

1- Calculate the dimensions of the side culvert shown in fig. (1).
2- Design the land wall in figures (1),

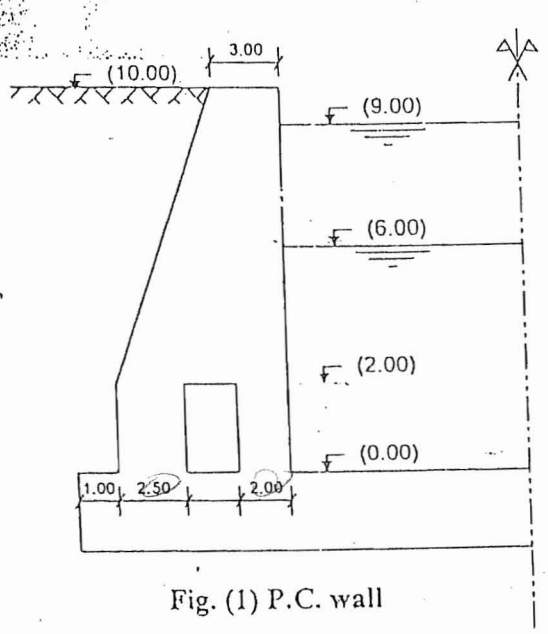


Fig. (1) P.C. wall

given

L= 120 m
w= 20 m
T= 10 min = 600 sec
H= 9.0 - 6 = 3.0 m

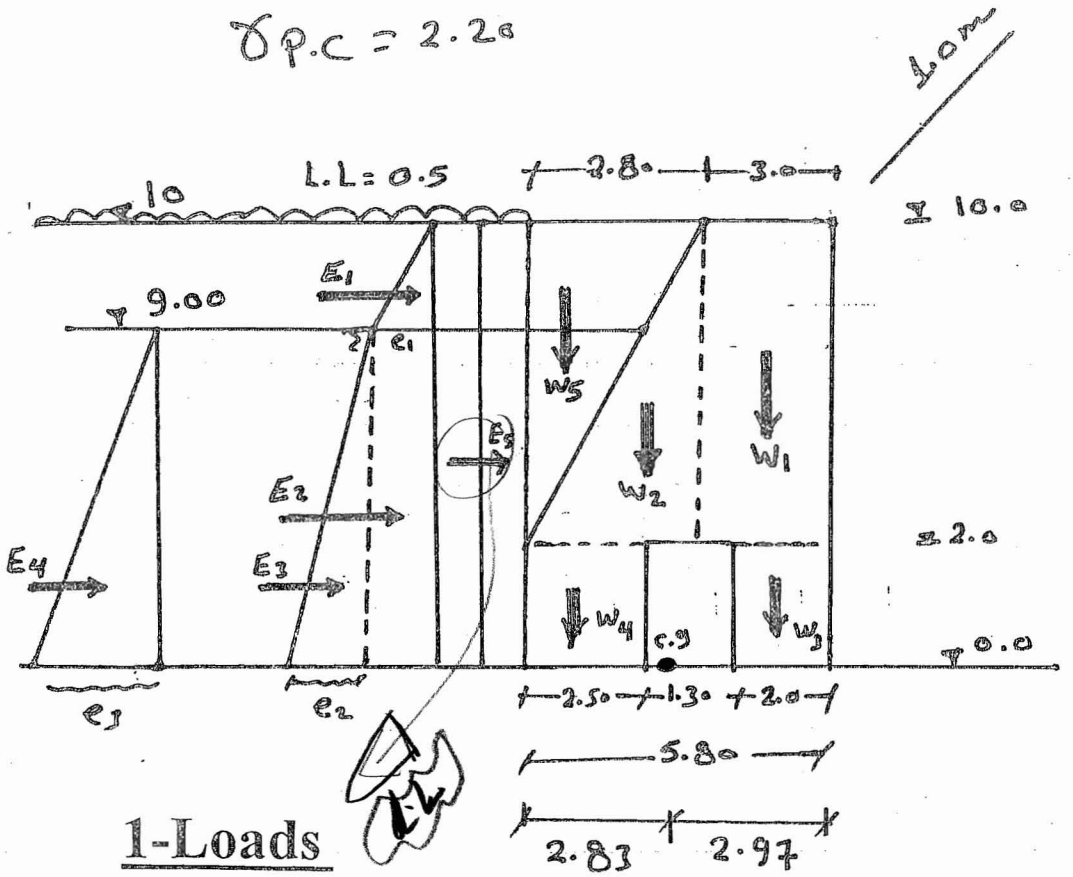
$$q = \frac{2 L W \sqrt{H}}{C_d T \sqrt{2g}} = \frac{2 * 120 * 20 \sqrt{3.0}}{0.62 * 600 * \sqrt{19.62}}$$

$$q = 5.05 \ m^2$$

$$\frac{q}{2} = 2.52 = b * h = b * 2.0$$

$$b = 1.26 \longrightarrow 1.30 \ m$$

$\gamma_{R.C} = 2.20$



1-Loads

*- $W_1 = 3 * 8.0 * 1.0 * 2.2 = 52.80$ ton

*- $W_2 = 0.5 * 2.80 * 8 * 2.20 * 1.0 = 24.64$ ton

*- $W_3 = 2 * 2 * 1 * 2.20 = 8.8$ ton

*- $W_4 = 2.50 * 2 * 1.0 * 2.2 = 11$ ton

*- $W_5 = 0.5 * 2.80 * 8 * 1 * 1.8 = 20.16$ ton

$e_1 = \gamma h_1 K_a = 1.80 * 1.0 * \frac{1}{3} = 0.6$ t/m²

$e_2 = \gamma_{sub} * h_2 * K_a = 1.0 * 9.0 * \frac{1}{3} = 3.0$ t/m²

$e_3 = \gamma_w h_2 = 9.0$ t/m²

* $E_1 = 0.5\, e_1\, h_1\,(1) = 0.5 * 0.60 * 1.0 = \underline{0.30 \text{ ton}}$

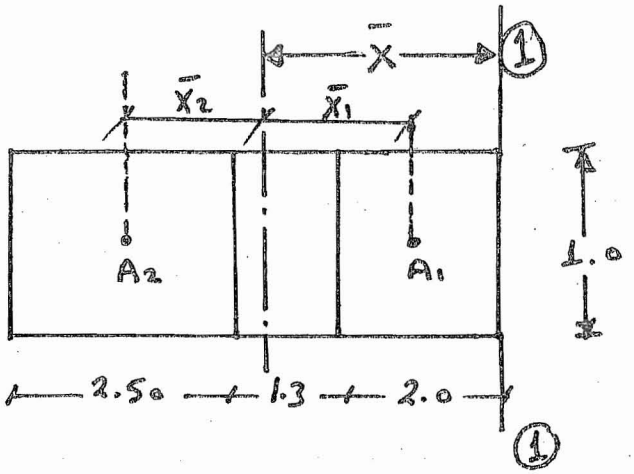
* $E_2 = e_1 * h_2 = 0.60 * 9.0 = \underline{5.40 \text{ ton}}$

* $E_3 = 0.5 * e_2 * h_2 = 0.5 * 3 * 9.0 = \underline{13.50 \text{ ton}}$

* $E_4 = 0.5 * e_3 * h_2 = 0.5 * 9.0 * 9.0 = \underline{40.50 \text{ ton}}$

* $E_5 = L.L * Ka\,(h_1 + h_2) = 0.5 * \frac{1}{3} * 10 = \underline{1.67 \text{ ton}}$

2-Properties Of Sec



$A_1 = 2\ m^2$, $I_{y_1} = \frac{2^3}{12} = 0.67\ m^4$

$A_2 = 2.50\ m^2$, $I_{y_2} = \frac{2.5^3}{12} = 1.30\ m^4$

$A = 4.50\ m^2$

* إيجاد مكان c.g ← Σ m of area @ 1-1

$$A_1 (1) + 2.50\ (4.55) = A\ (\bar{X})$$

$$2 + 2.5\ (4.55) = 4.5\ \bar{X}$$

$$\bar{X} = 2.97\ m$$

* حساب Iy للمقطع ككل

$\bar{X}_1 = 2.97 - 1.0 = 1.97\ m$

$\bar{X}_2 = 2.83 - 1.25 = 1.58\ m$

$$I_y = 0.67 + 2 * 1.97^2 + 1.30 + 2.50 * 1.58^2$$

$$I_y = 15.97\ m^4$$

3-Straining Action(M&N)

$$M = W_1 * (2.97 - \tfrac{3}{2}) + W_3 * (2.97 - \tfrac{2}{2})$$
$$+ E_1 * (9 + \tfrac{1}{3}) + E_2 (4.50) + E_3 (3.0)$$
$$+ E_4 (3.0) + E_5 (5.0) - W_2 (2.83 - 2.8\tfrac{2}{3})$$
$$- W_4 (2.83 - \tfrac{2.5}{2}) - W_5 (2.83 - 2.8\tfrac{1}{3})$$

$$= 52.80 * 1.47 + 8.8 * 1.97 + 0.30 * 9.33$$
$$+ 5.40 * 4.50 + 13.50 * 3.0 + 40.5 * 3.0$$
$$+ 1.67 * 5.0 - 24.64 * 0.96 - 11 * 1.58$$
$$- 20.16 * 1.897$$

$$M = 213.1 \ t.m$$

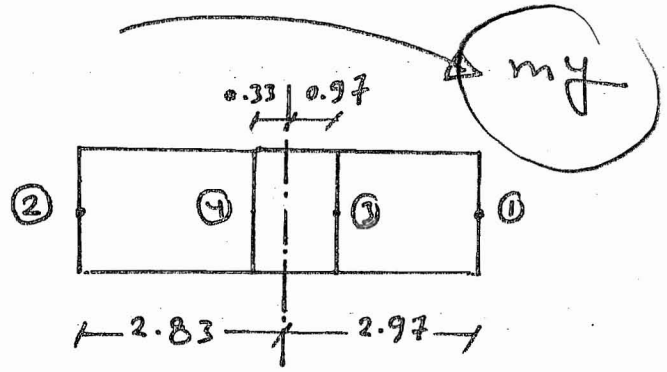
$$N = \Sigma W = 117.4 \ t$$

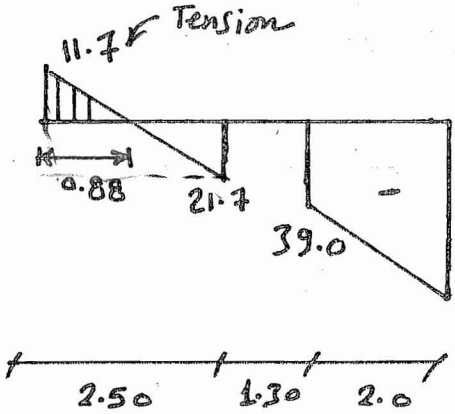
4- Check Of Stresses

$$F_{1,2,3,4} = -\frac{N}{A} \pm \frac{my}{Iy} X = -\frac{117.4}{4.50} \pm \frac{213.1}{15.97} X$$

$$F_{1,2,3,4} = -26.1 \pm 13.34\ X$$

Point	X	F t/m²
1	2.97	-65.7
2	2.83	+11.7
3	0.97	-39.0
4	0.33	-21.7



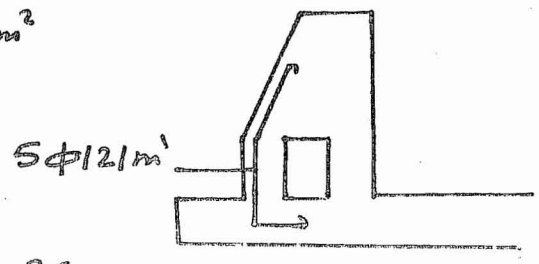


$65.7 < 400\ t/m^2$ OK

$$T = 0.5 * 0.88 * 11.70 = 5.15\ ton$$

$$A_s = \frac{T}{f_s} = \frac{5.15}{1.0} = 5.15\ cm^2 \rightarrow 5\phi 12/m'$$

$1.0\ t/cm^2$



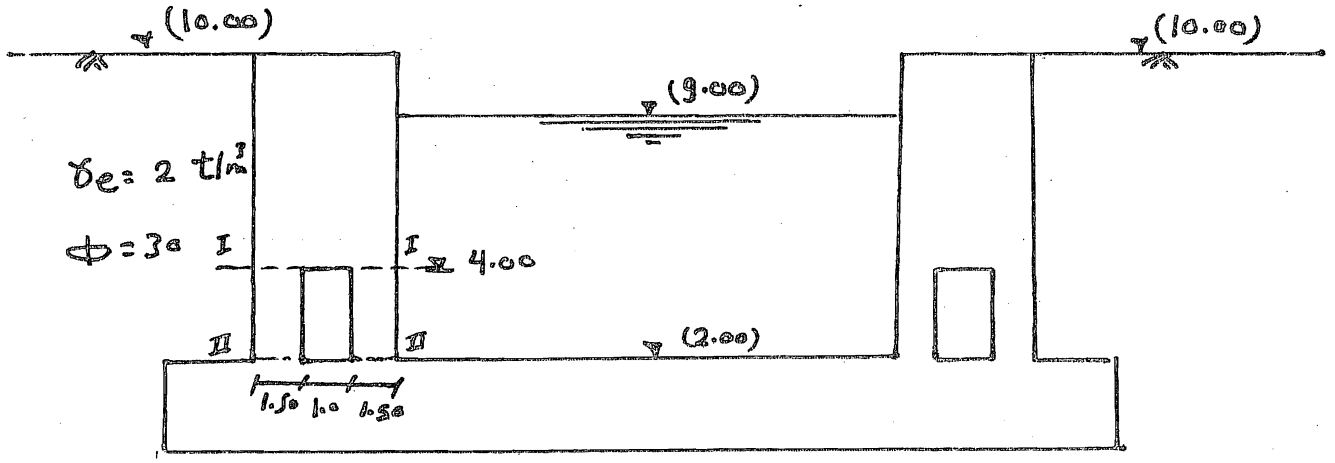
Exam(2002)

For the shown P.C symmetrical lock

you are required to :

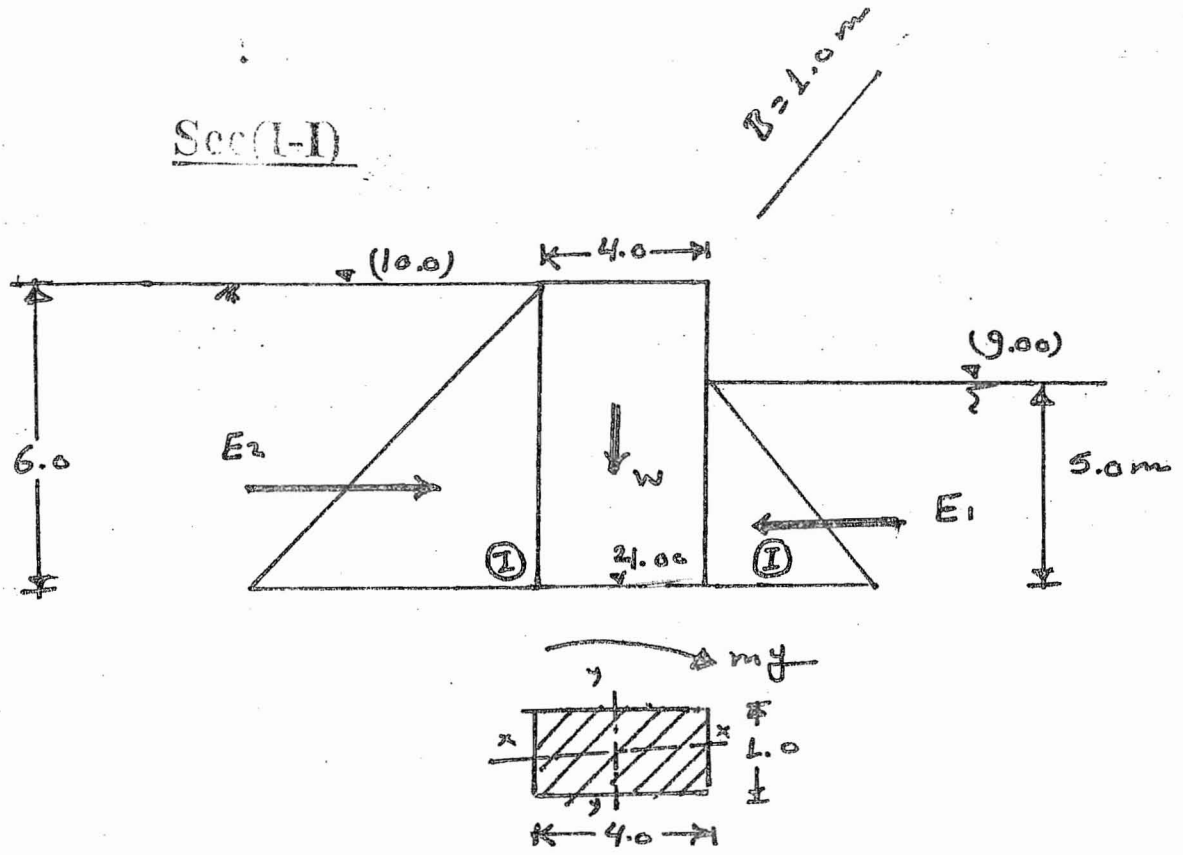
A- check stress on sec (I-I)

B- check stress on sec (II-II)



ملاحظة : مطلوب تصميم الحائط الساند لحالة التحميل المعطاه

Sec(1-1)



1- Loads

$$w = 4 * 6.0 * 1.0 * 2.20 = \underline{52.8\ t}$$

$$E_1 = 0.5 * \overset{\gamma_w}{1} * 5^2 = \underline{12.5\ t}$$

$$E_2 = 0.5 * \overset{\gamma_s}{2} * 6^2 * \tfrac{1}{3} = \underline{12\ t}$$

2-Properties Of Sec

$$A = 4 * 1.0 = 4.0\ m^2$$

$$I_y = \frac{1 * 4^3}{12} = 5.33\ m^4$$

3-Straining Action(M&N)

$$M = E_2\,(2) - E_1\left(\frac{5}{3}\right) =$$

$$= 12 * 2 - 12.5 * \frac{5}{3}$$

$$M = 3.17 \text{ t.m}$$

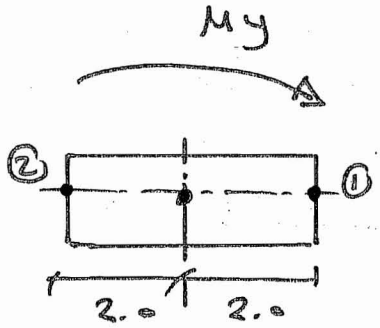
$$N = W = 52.8 \text{ t}$$

4- Check of Stresses

$$F = -\frac{N}{A} \pm \frac{My}{I_y}\,x$$

$$F = -\frac{52.8}{4} \pm \frac{3.17}{5.33}(X)$$

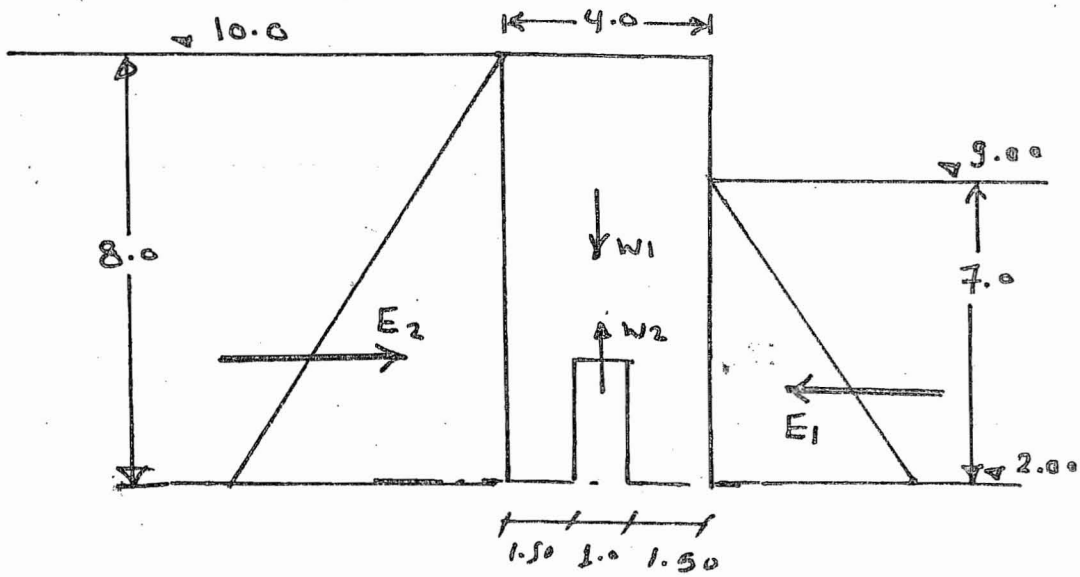
$$F = -13.2 \pm 0.6\,X$$



$F_1 = -13.2 - 0.6 * 2 = -14.4 \text{ t/m}^2 < 400 \text{ t/m}^2$ OK

$F_2 = -13.2 + 0.6 * 2 = -12 \text{ t/m}^2 < 400 \text{ t/m}^2$ OK

Sec(II-II)



1-Loads

$W_1 = 4 * 8.0 * 1.0 * 2.20 =$ 70.4 ton

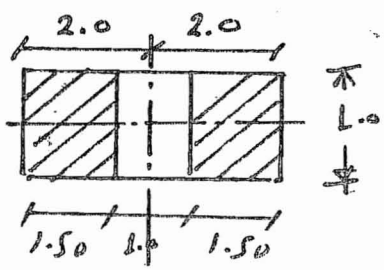
$W_2 = 1 * 2.0 * 1.0 * 2.20 =$ 4.40 ton

$E_1 = 0.5 * \gamma_w^{1} * 7^2 =$ 24.50 ton

$E_2 = 0.5 * \gamma_s^{2} * 8^2 * \frac{1}{3} =$ 21.33 ton

2-Properties of Sec

العضو متماثل ← c.g تأثير المنشأ



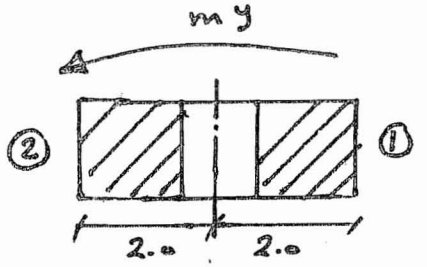
$A = 1 * 4 - 1 * 1 =$ 3.0 m^2

$I_y = \frac{1 * 4^3}{12} - \frac{1 * 1^3}{12} =$ 5.25 m^4 العضو متماثل

3-Straining Action(M&N)

$$M = E_2\left(\frac{8}{3}\right) - E_1\left(\frac{7}{3}\right)$$

$$= 21.33\left(\frac{8}{3}\right) - 24.50\left(\frac{7}{3}\right) = -0.29$$



$M = 0.29$ t.m

$N = W_1 - W_2 = 66$ ton

4- Check of Stresses

$$F_{1,2} = \frac{-N}{A} \pm \frac{my}{Iy} x.$$

$$= \frac{-66}{3} \pm \frac{0.29}{5.25} * 2.0$$

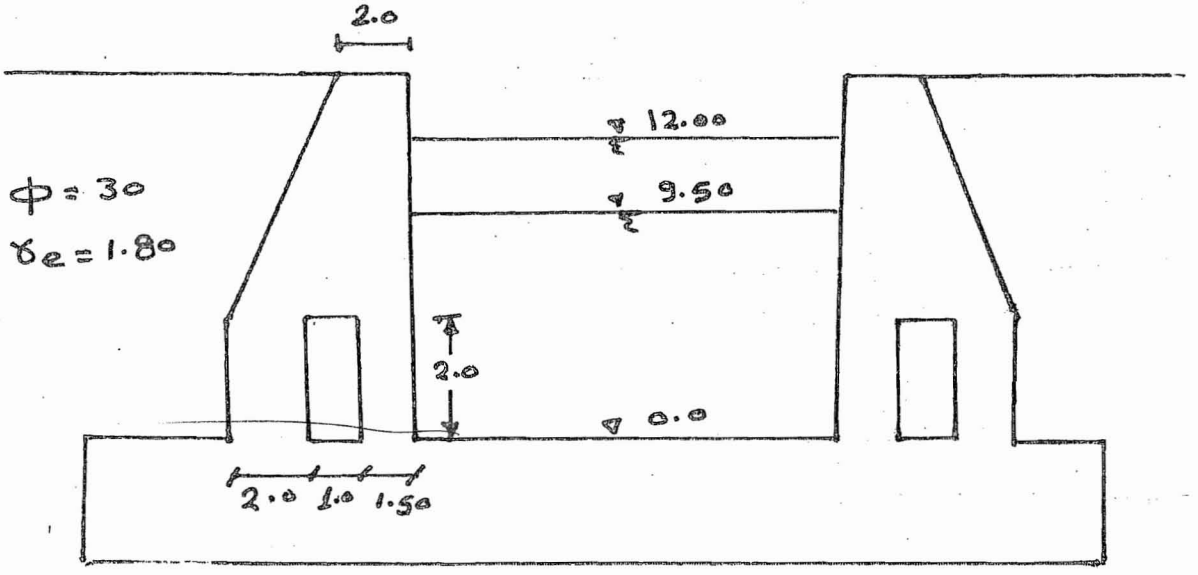
$f_1 = -21.90$

$f_2 = -22.1 < 400\ t/m^2$ OK

Exam فكرة

Examble

For the case of Just after Construction, and L.L = 1.50 t/m². It's required to design the Following Plain Concrete land wall.

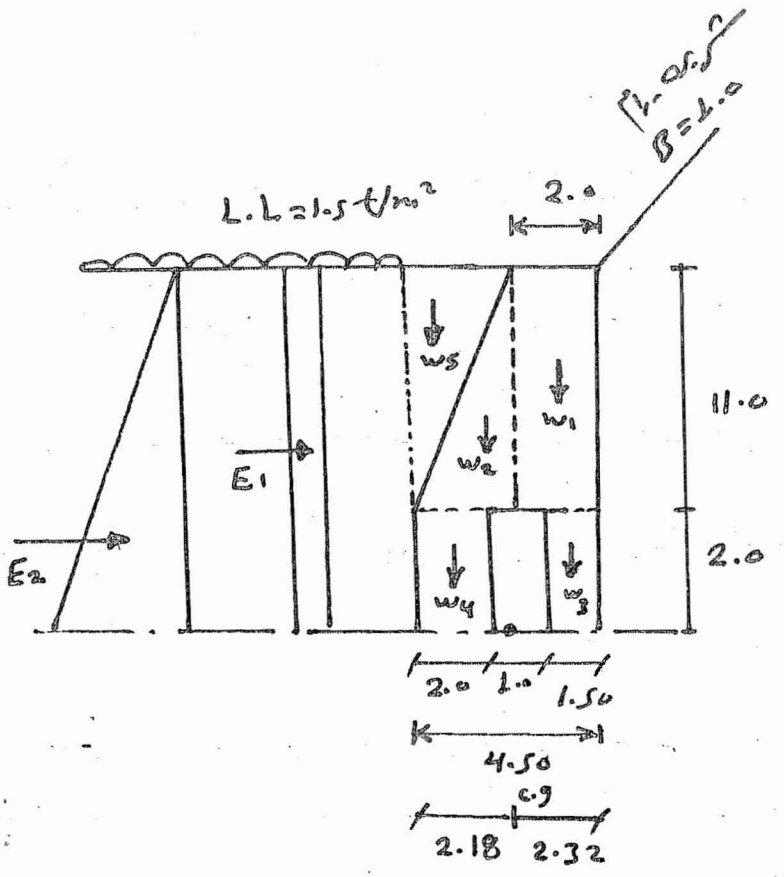


ملاحظات

① غير معطى المنسوب العلوى land wall ← فيؤخذ أعلى

من منسوب أرض مياه + 1.0 ⇐ 13.0 ▽

② مطلوب تصميم لحالة Just after Cons. ← لاتوجد مياه



1- Loads

$W_1 = 2 * 11 * 2.20 = 48.4$ ton

$W_2 = 0.5 * 2.50 * 11 * 2.20 = 30.25$ ton

$W_3 = 1.50 * 2.0 * 2.2 = 6.60$ ton

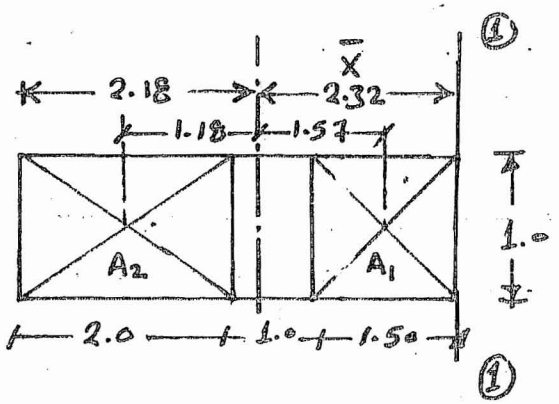
$W_4 = 2.0 * 2.0 * 2.20 = 8.8$ ton

$W_5 = 0.5 * 2.50 * 11 * 1.80 = 24.75$ ton

$E_1 = {}^{L.L}1.50 * 13 * {}^{Ka}\frac{1}{3} = 6.5$ ton

$E_2 = 0.5 * 1.8 * 13^2 * \frac{1}{3} = 50.7$ ton

2-Properties Of Sec (II-II)



$A_1 = 1.50\ m^2$, $I_{y_1} = \frac{1*1.5^3}{12} = 0.28\ m^4$

$A_2 = 2.0\ m^2$, $I_{y_2} = \frac{1*2^3}{12} = 0.67\ m^4$

$A = 3.50\ m^4$

ΣM of Area @ 1-1 ⇐ ايجاد مكان c.g (المركز) ..

$$1.50 * \frac{1.50}{2} + 2 * 3.50 = 3.50 \times \bar{X}$$

$$\bar{X} = 2.32\ m$$

ايجاد Iy للمركز ..

$$Iy = 0.28 + 1.50 * 1.57^2 + 0.67 + 2 * 1.18^2$$

$$Iy = 7.43\ m^4$$

3-Straining Action(M&N)

$\therefore N = \Sigma w = 118.8$ ton.

$\therefore M_{cg} = 48.4*(2.32-1.0) + 6.6*(2.32-0.75)$

$- 30.25*(2.18-\frac{2}{3}2.50) - 8.8*(2.18-1)$

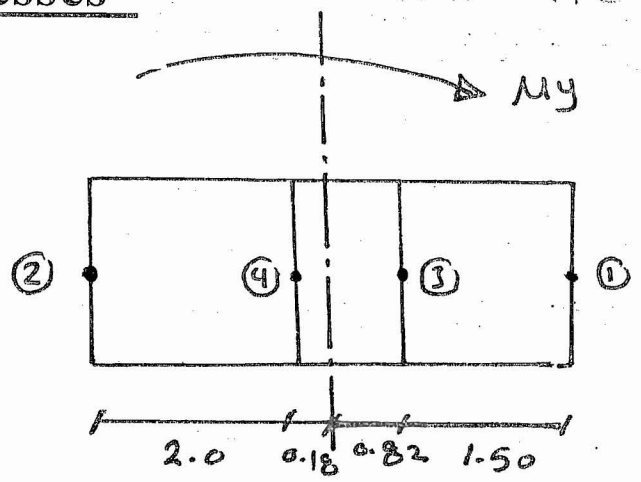
$- 24.75*(2.18-\frac{1}{3}2.50) + 6.50*\frac{13}{2}$

$+ 50.70\ \frac{13}{3} = 276.96$

$M = 276.96$ t.m

$N = 118.8$

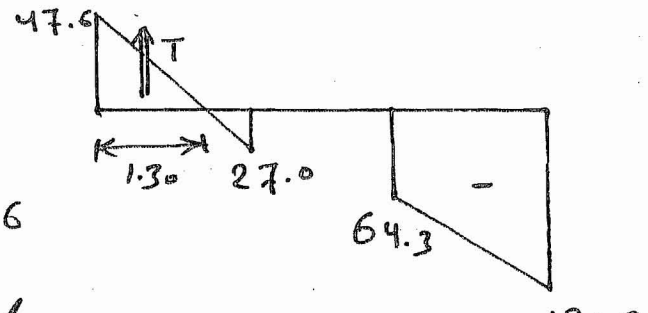
4- Check Of Stresses



$$f = \frac{-N}{A} \pm \frac{My}{Iy} x = -\frac{118}{3.50} \pm \frac{276.96}{7.43} x$$

$$f = -33.71 \pm 37.28\ x$$

Point	x	f	
1	2.32	$-120.2\ t/m^2$	$< 400\ t/m^2$ Comp OK
2	2.18	$+47.6\ t/m^2$	tension → N.G
3	0.82	$-64.3\ t/m^2$	$< 400\ t/m^2$ OK
4	0.18	$-27.0\ t/m^2$	$< 400\ t/m^2$ OK



- $T = 0.5 * 1.30 * 47.6$

$T = 30.94$ ton

- $As = \frac{T}{fs} = \frac{30.94}{1.0} = 30.94\ cm^2$

$9\ \phi 22/m'$

Examble-: design of the land wall.

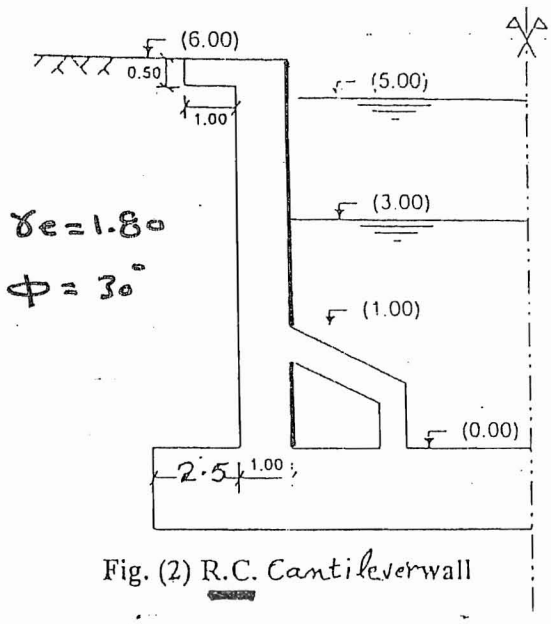
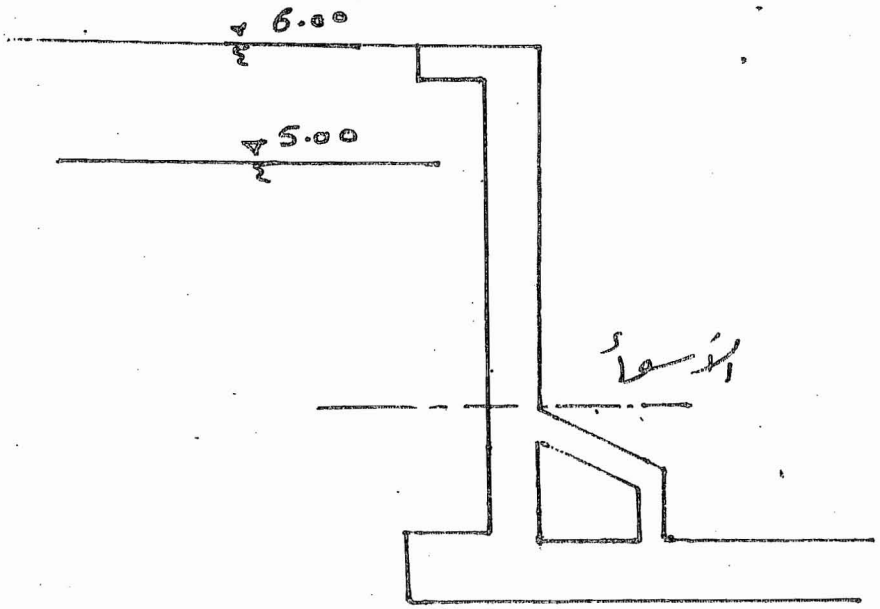


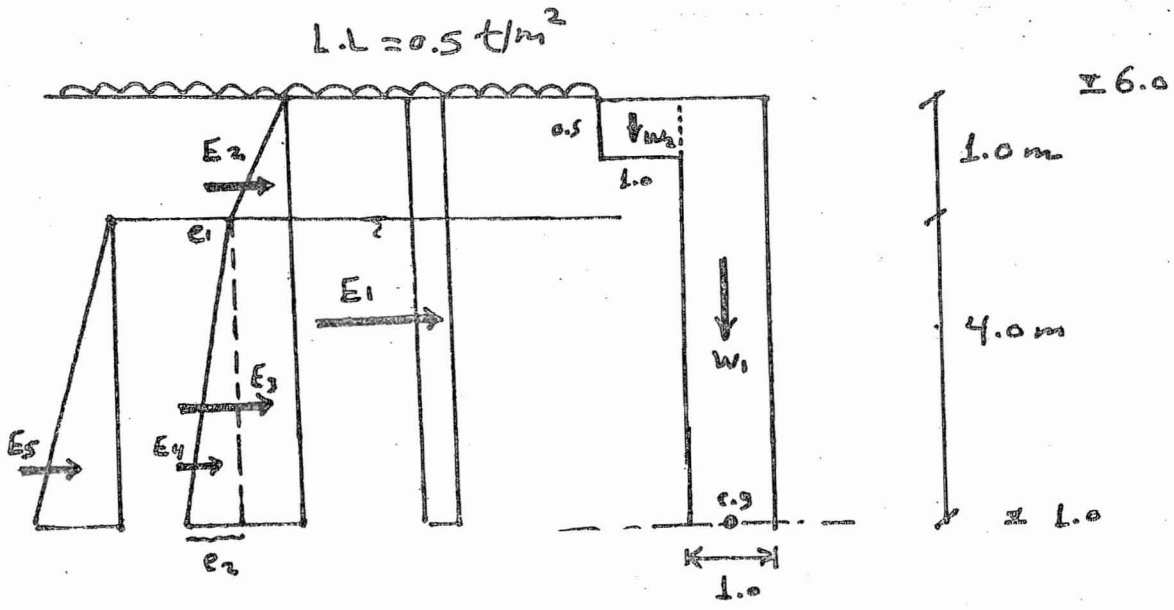
Fig. (2) R.C. Cantileverwall

$K_1 = 0.245$

$K_2 = 1.046$

ملاحظة لم يرد حالة التحميل ← تقنا, الأسوأ





1- Loads

$$e_1 = \gamma h_1 K_a = 1.80 * 1 * \tfrac{1}{3} = 0.6 \ t/m^2$$

$$e_2 = \gamma_{sub} h_2 K_a = 1.0 * 4 * \tfrac{1}{3} = 1.33 \ t/m^2$$

* - $W_1 = 1 * 5 * 2.50 = \underline{12.50 \text{ ton}}$ ($\gamma_{R.C}$)

* - $W_2 = 1 * 0.5 * 2.50 = \underline{1.25 \text{ ton}}$

* - $E_1 = 0.5 * 5 * \tfrac{1}{3} = \underline{0.83 \text{ ton}}$

* - $E_2 = 0.5 * 0.60 * 1.0 = \underline{0.30 \text{ ton}}$

* - $E_3 = 0.6 * 4.0 = \underline{2.40 \text{ ton}}$

* - $E_4 = 0.5 * 1.33 * 4.0 = \underline{2.66 \text{ ton}}$

* - $E_5 = 0.5 * 1.0 * 4^2 = \underline{8 \text{ ton}}$ (γ_w)

2-Straining Action(M&N)

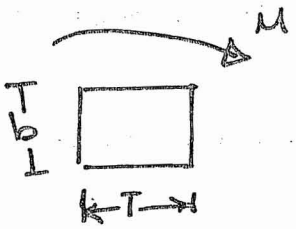
$$M_{c.g} = E_1 * 2.5 + E_2 * 4.33 + E_3 * 2.0 + E_4 * 1.33$$
$$+ E_5 * 1.33 - w_2 * 1.0 .$$

$$M_{c.g} = 0.83 * 2.50 + 0.30 * 4.33 + 2.40 * 2.0$$
$$+ 2.66 * 1.33 + 8 * 1.33 - 1.25 * 1.0$$

$$M = 21.1 \text{ t.m}$$

$$N = w_1 + w_2 = 13.75 \text{ ton}$$

3. design



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

$$= 0.245 \sqrt{\frac{21.1 * 10^5}{100}} = 35.6 \text{ cm}$$

$T \simeq 40$ cm

Take $T = T_{given} = 1.0$ m

$d = 0.95$ m.

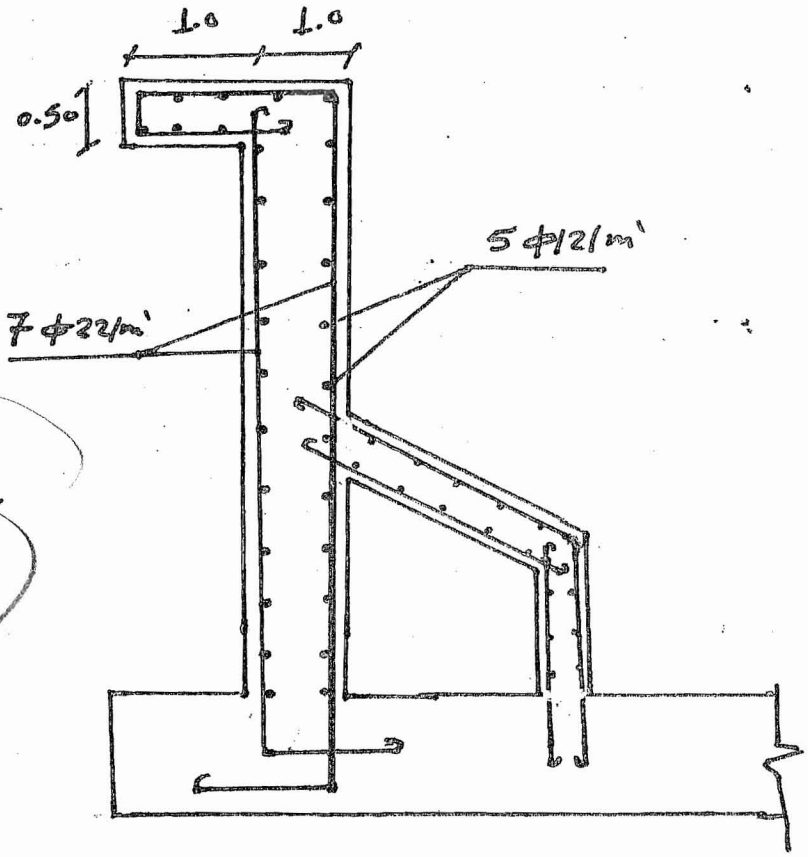
$$\therefore A_s = \frac{m}{K_2 d} = \frac{21.1 * 10^5}{1046 * 95}$$

$$A_s = 21.2 \ Cm^2$$

$$A_{s\,min} = \frac{0.25}{100} * 100 * 100 = 25 Cm^2$$

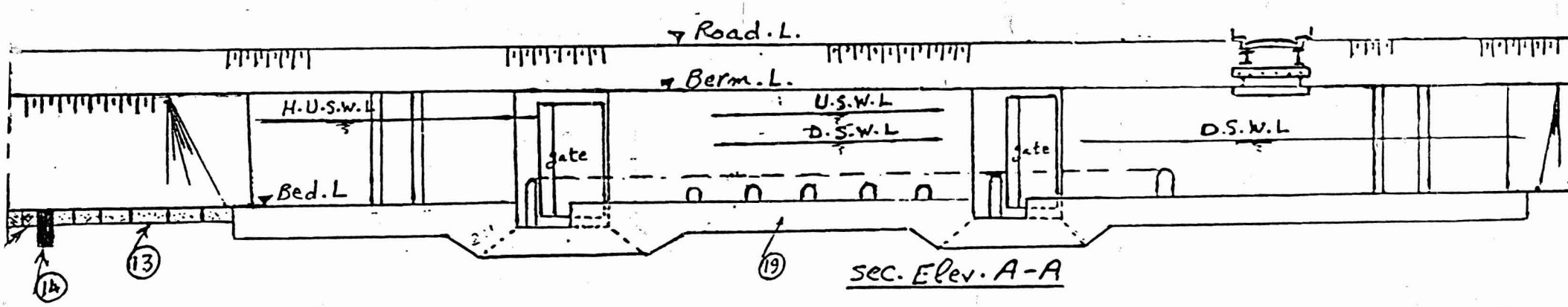
(b = 100, T = 100)

$$A_s = A_{s\,min} = 25 Cm^2 = 7\phi 22/m'$$

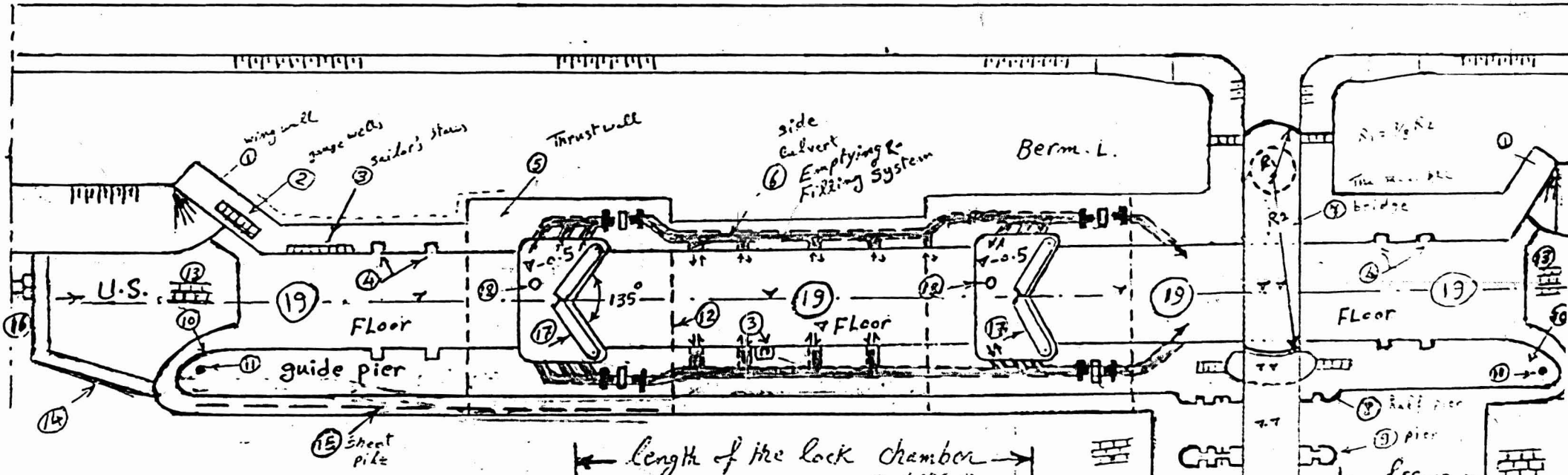


غير معطاة بالمحاضرة للزمن

Unsymmetrical Lock



sec. Elev. A-A



PLAN (H.E.R.)

(10) U.S & D.S noses of the guide pier
(11) U.S & D.S Capstan wheel
(12) The Construction joints through the lock
(13) The U.S & D.S Precast Concrete blocks
(14) A Confinement plain Concrete blocks
(15) sheet piles
(16) pitching in morter in both U.S & D.S sides

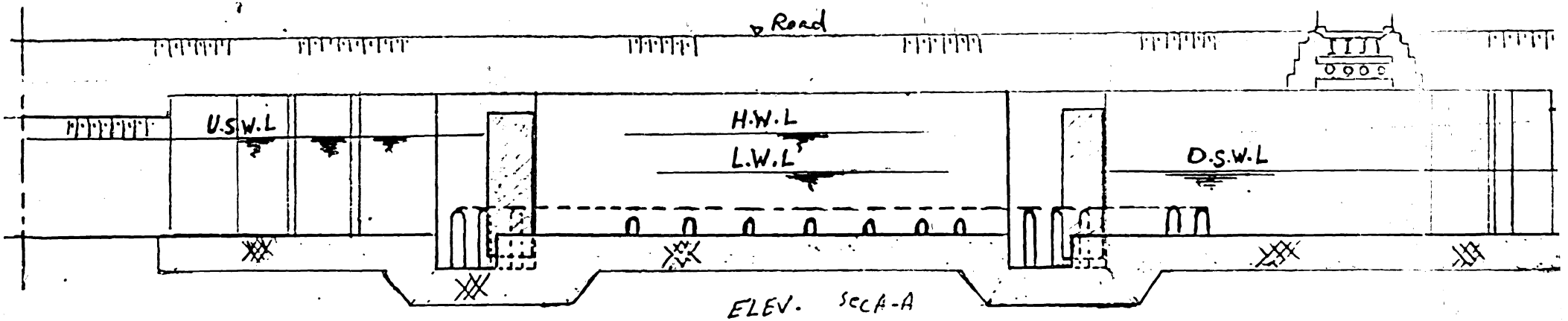
(17) Lock gates
(18) Sump
(19) Floor

(7) bridge
(8) half pier
(9) pier

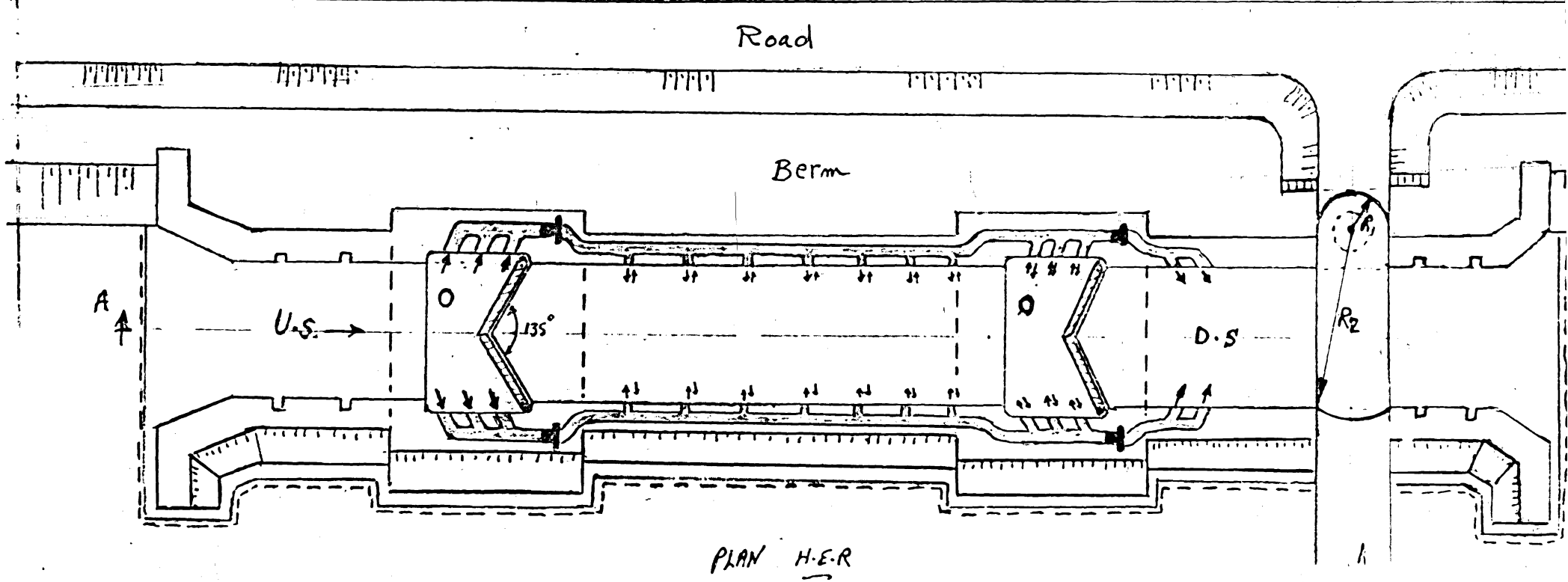
(4) Emergency gates grooves
(5) Thrust wall
(6) side Culvert

(1) wing walls
(2) gauge wall
(3) sailor's stairs

symmetrical lock



ELEV. SECA-A



PLAN H.E.R