T2

IRRIGATION STRUCTURES-(I)

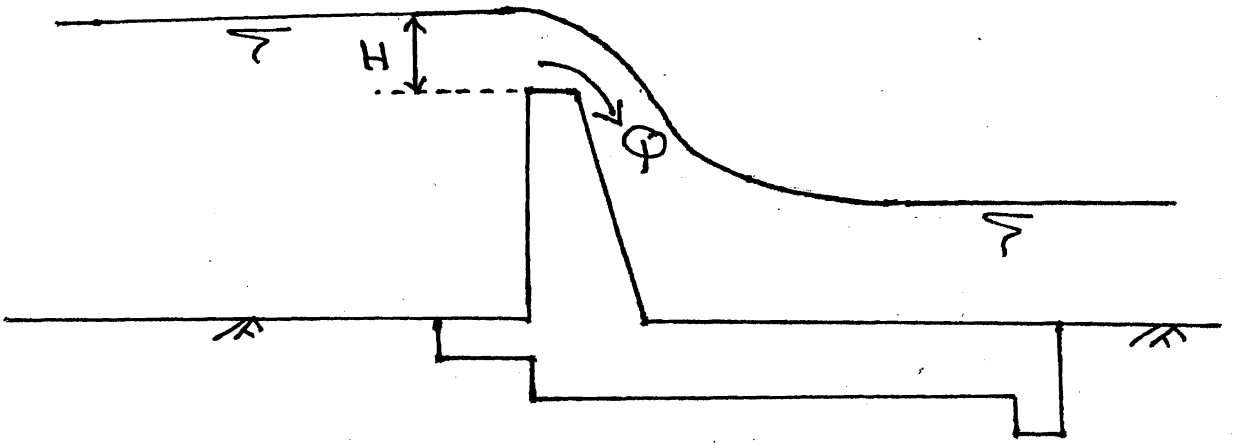
6- WEIRS

No (19)

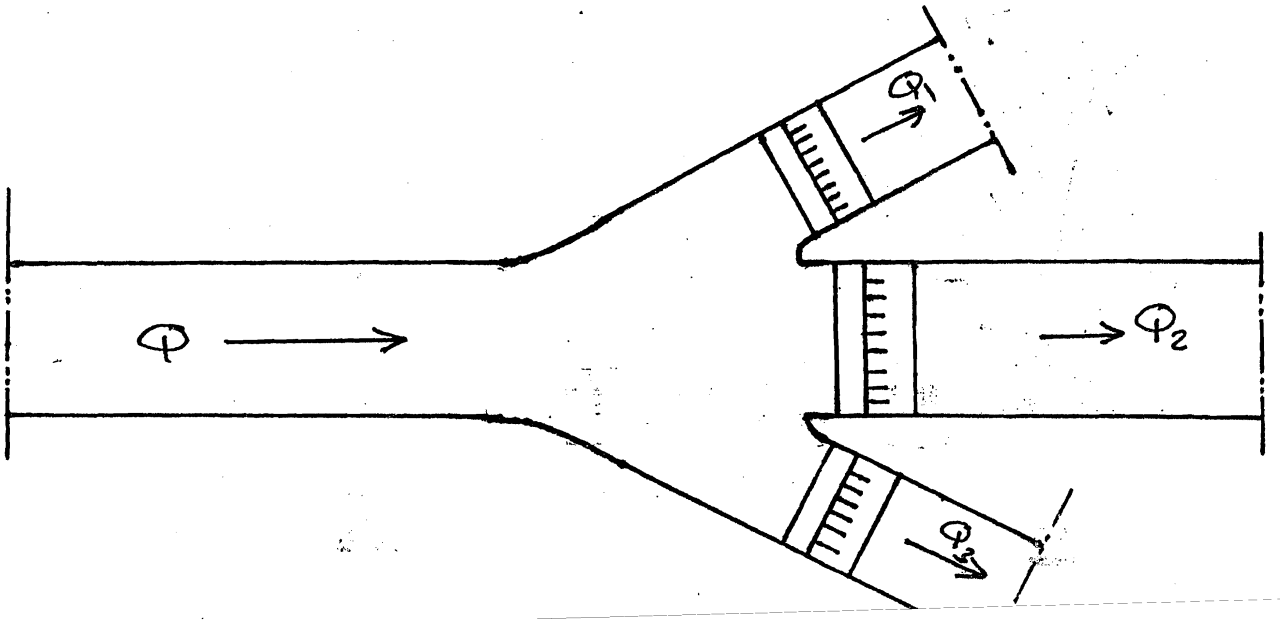
WEIRS

• Functions of weirs :- إستخدامات الصارت

1- To measure the discharges لقياس التصرفات

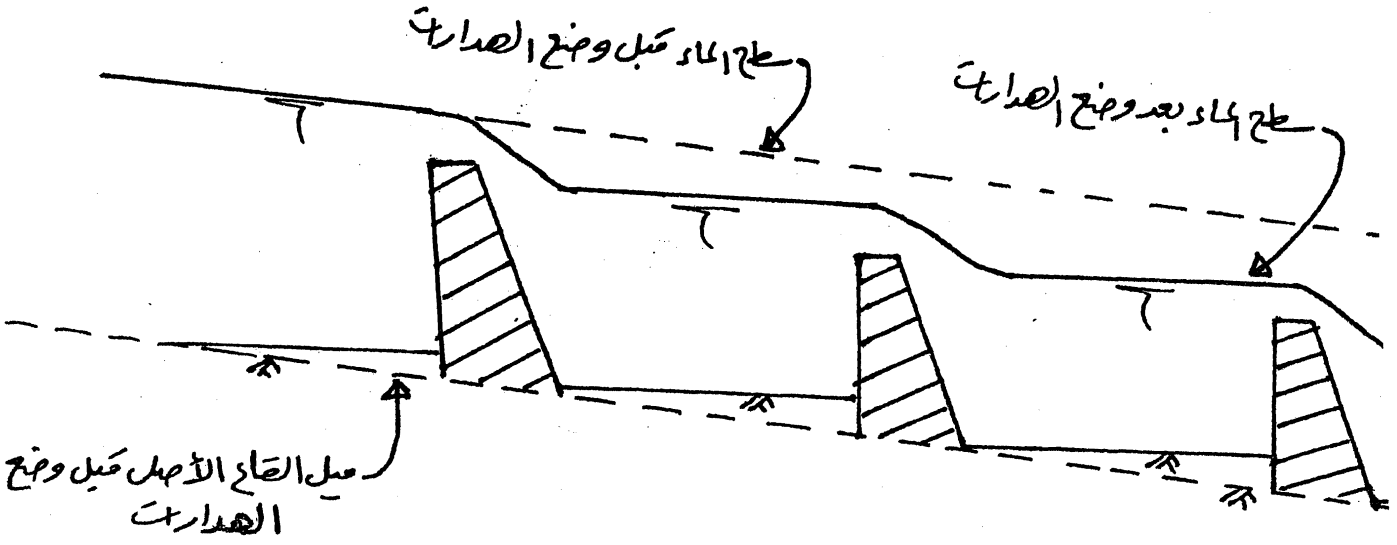


2- To Control the water distribution التحكم فى توزيع المياه



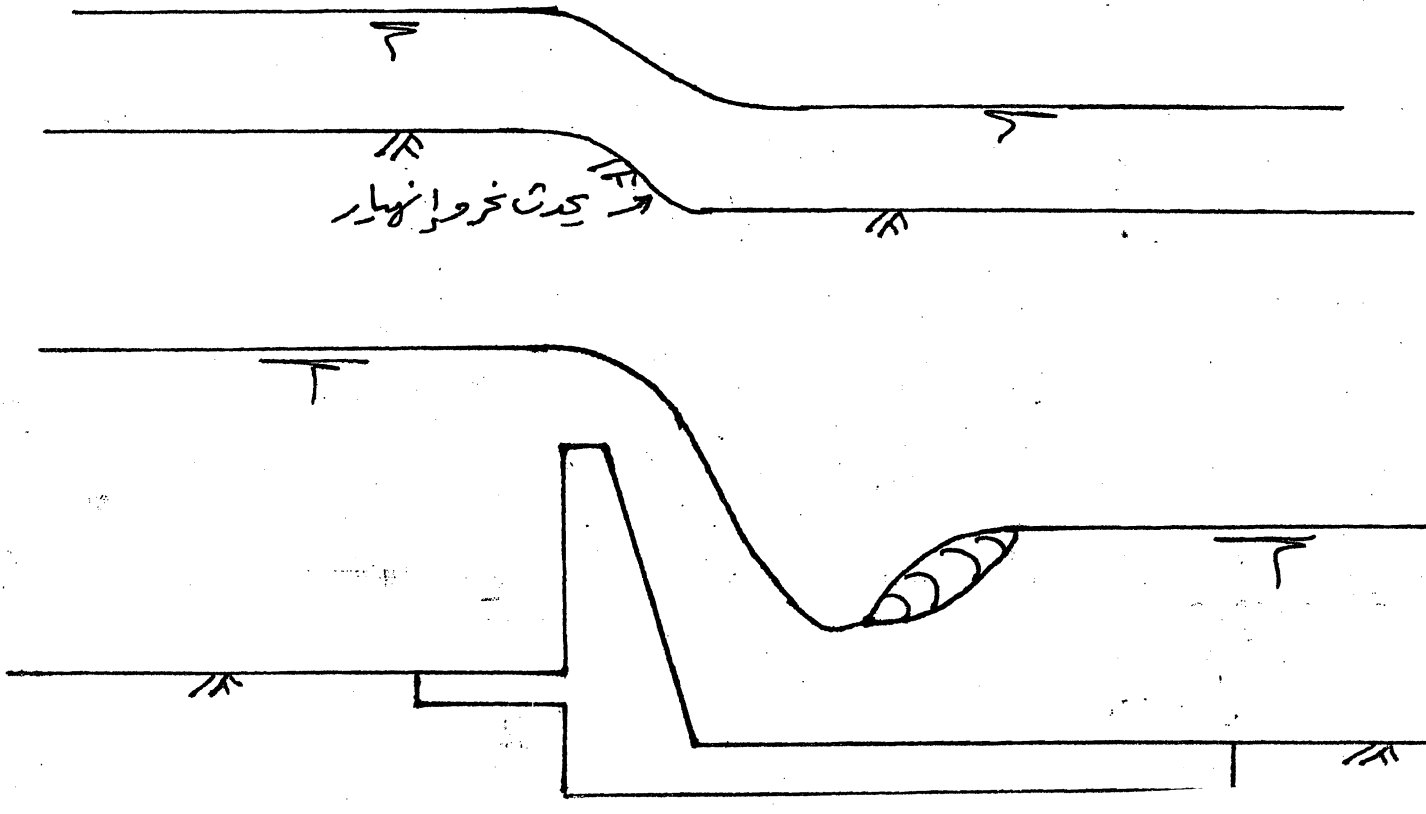
3- To reduce water surface slope in steep lan

تقليل ميل سطح الماء في الأراضي شديدة الإنحدار



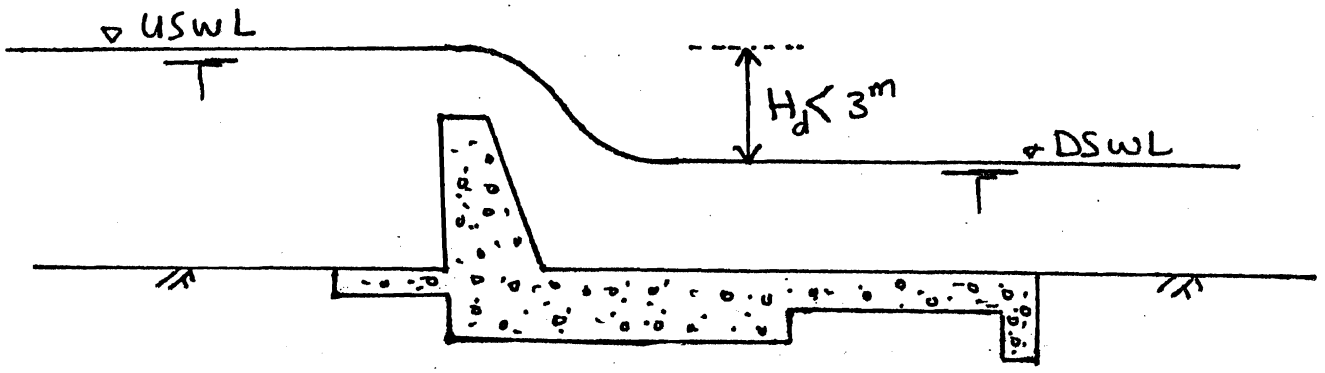
4- To Protect Canals at Canal Falls

لحماية قاع الترع عند ساقط المياه

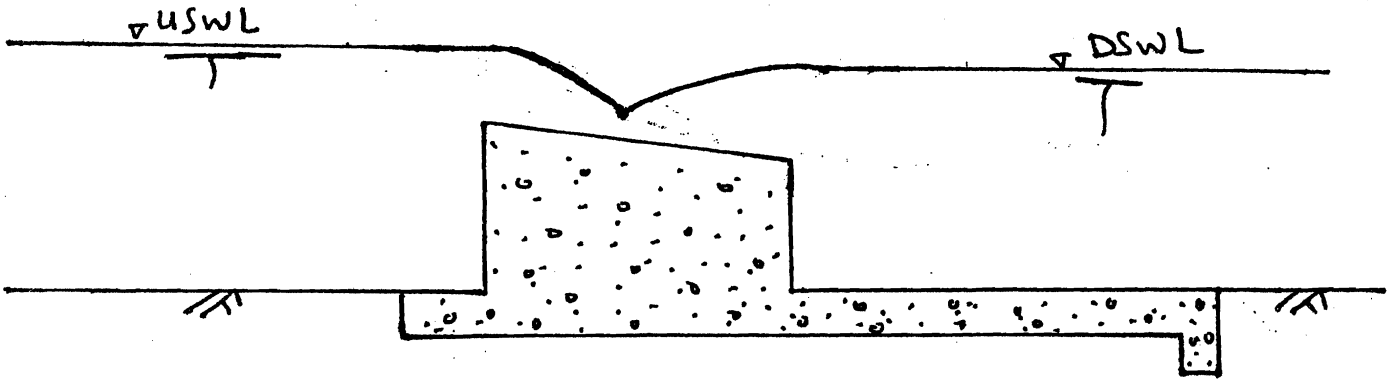


• Types of weirs

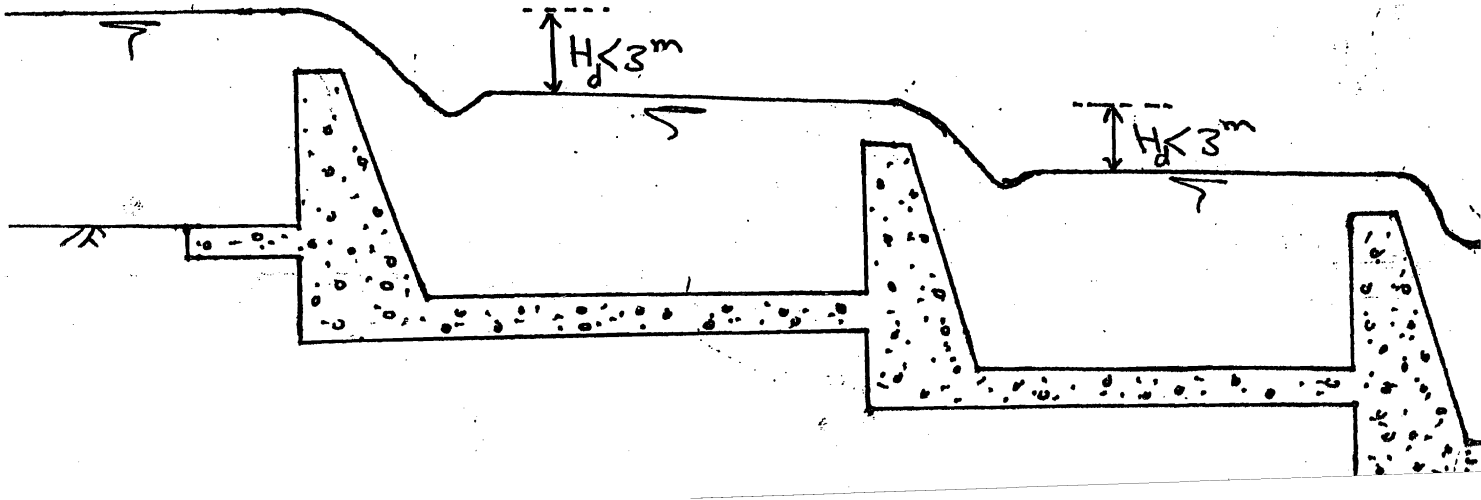
1- Clear over-fall weir (Fayum type)



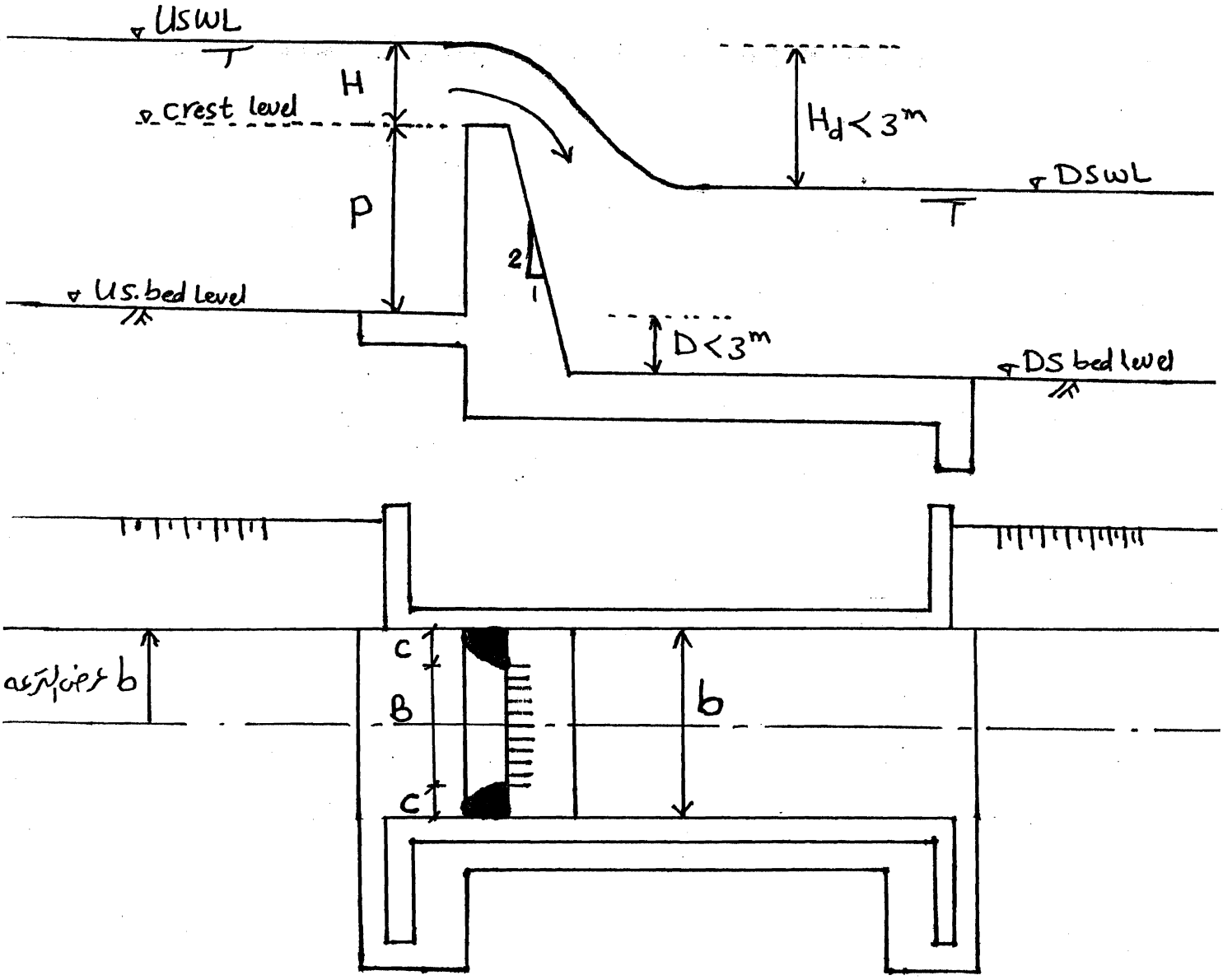
2- standing wave weir



3- stepped weir



Clear over-fall weir (Fayum type)



- H : Head on weir = USWL − ℄ crest level
- P : UP Stream sill depth = ℄ crest level − USbL
- H_d : drop in water levels = ℄ USWL − ℄ DSWL
- D : drop in bed levels = ℄ USbL − ℄ DSbL
- b : total width of weir = B + 2c
- B : effective width of weir
- c : side Column ≅ 0.5^m

خطوات التصميم

1- Hydraulic Design

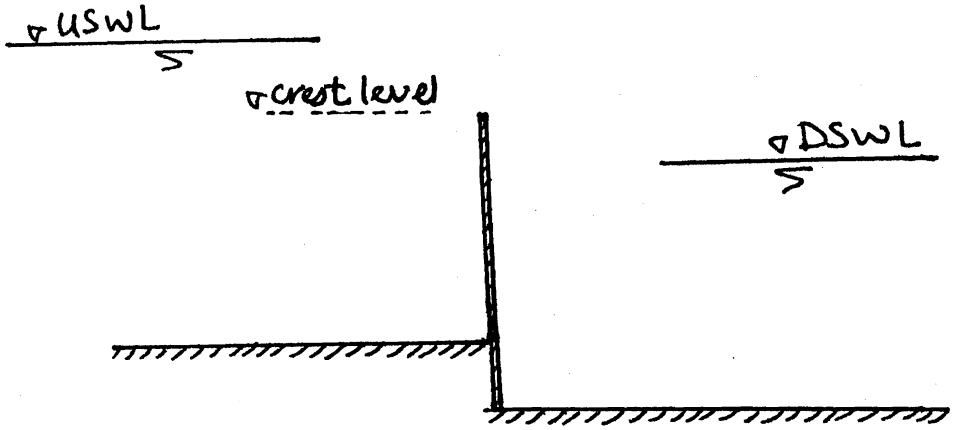
2- Structral Design

3- Drawings.

1- Hydraulic Design

Given :-

- $Q = \checkmark\ m^3/sec$ (Canal discharge)
- USWL = ✓
- DSWL = ✓



- b (Canal width)

Reqs-

- find weir dimensions (H & B)
- find crest level
- check free Condition (crest level > DSWL)

Sol:-

1- assume $b_{weir} = b_{canal}$

$$C = 0.5^m$$

$$\therefore B = b - 2C = \checkmark m$$

2- Calculate (H) from free weir equation

$$Q = \frac{2}{3} C_d B \sqrt{2g} H^{3/2}$$

$$C_d = 0.625$$

$$\therefore Q = 1.85 B H^{3/2}$$

$$\therefore H = \checkmark m$$

3-

$$\text{Crest level} = \text{USWL} - H = \checkmark m$$

4- check free Condition

$$\text{Crest level} > \text{DSWL} \quad \therefore \text{OK}$$

لو لم يتحقق الشرط نزود عرض الصدار (b) ثم نعيد الحل مرة أخرى

example :-

Given :-
- $Q = 10\ m^3/sec$
- USWL = (15.00)
- DSWL = (12.50)
- $b_{Canal} = 6.5\ m$

Req :- weir dimensions

Sol :-

assume $b_{weir} = b_{Canal} = 6.5\ m$

$$C = 0.5\ m$$

$$\therefore B = 6.5 - 2*0.5 = 5.5\ m$$

$$Q = 1.85\ B\ H^{3/2}$$

$$10 = 1.85 * 5.5 * H^{3/2}$$

$$\therefore H = 0.99\ m$$

$$\therefore \text{crest level} = 15 - 0.99 = (14.00)\ m$$

Check

$\therefore$ crest level $>$ DSWL

$\therefore$ ok fr

Example :-

Given:- Canal Data at weir site in the following

	U.S the weir	D.S the weir
High water level (H.W.L)	(14.25)	(12.85)
Low water level (L.W.L)	—	(12.35)
Bed level	(12.25)	(10.85)
Bed width	6.0	6.0
Side Slopes	2:1	2:1
Road level	(16.25)	(15.00)
Berm level	(14.75)	(13.50)

- $Q_{max} = 12\ m^3/sec$
- $Q_{min} = 7.5\ m^3/sec$

Req:-

1- Complete hydraulic design of the weir
2- Draw the Canal Cross section U.S the weir

Sol:-

$$\text{assume } b_{weir} = b_{canal} = 6^m$$

$$C = 0.5^m$$

$$\therefore B = 6 - 2*0.5 = 5^m$$

∴ معدل تصرف أقصى وأدنى ومناسيب مصرى ودنيا

∴ يوجد لنا H_{max} & H_{min}

نبدأ الكل صمام الكلام المعلوم وهو (H_{max})

$$\therefore Q_{max} = 1.85\ B\ H_{max}^{3/2}$$

$$12 = 1.85 * 5 * H_{max}^{3/2} \longrightarrow \therefore H_{max} = 1.19 = 1.2$$

$$\text{- } \Sigma \text{ crest level} = 14.25 - 1.2 = (13.05) > 12.85$$

∴ ok free

$$Q_{min} = 1.85\ B\ H_{min}^{3/2}$$

$$7.5 = 1.85 * 5 * H_{min}^{3/2} \longrightarrow \therefore H_{min} = 0.87^{m}$$

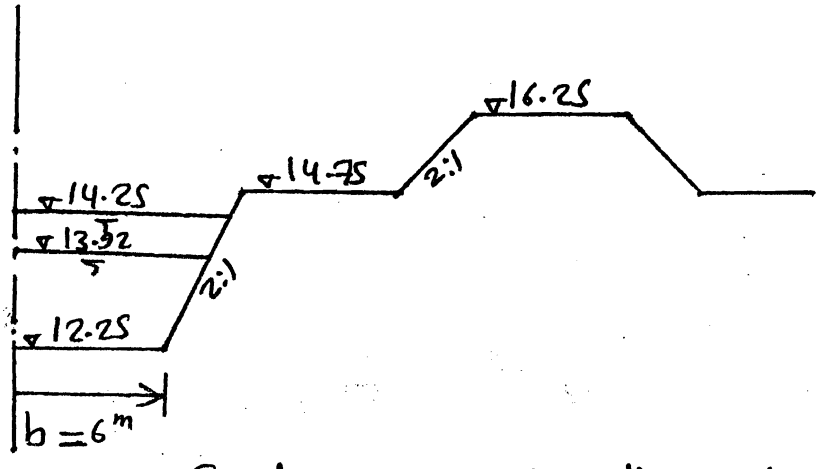
$$\therefore \Sigma \text{ US LwL} = 13.05 + 0.87 = (13.92)$$

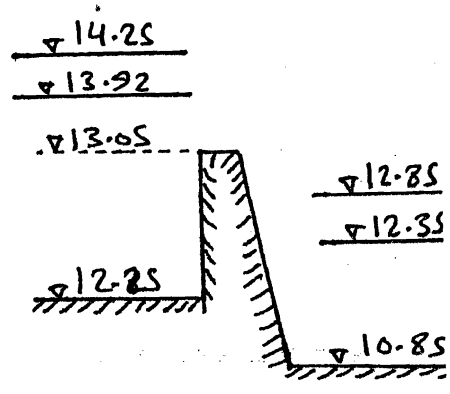
Check of drop

$H_{d1} = \Sigma$ US HWL $-\ \Sigma$ DS HwL $= 1.4 < 3$ ok

$H_{d2} = \Sigma$ USLwL $-\ \Sigma$ DSLwL $= 1.57 < 3$ ok

∴ use fayum type

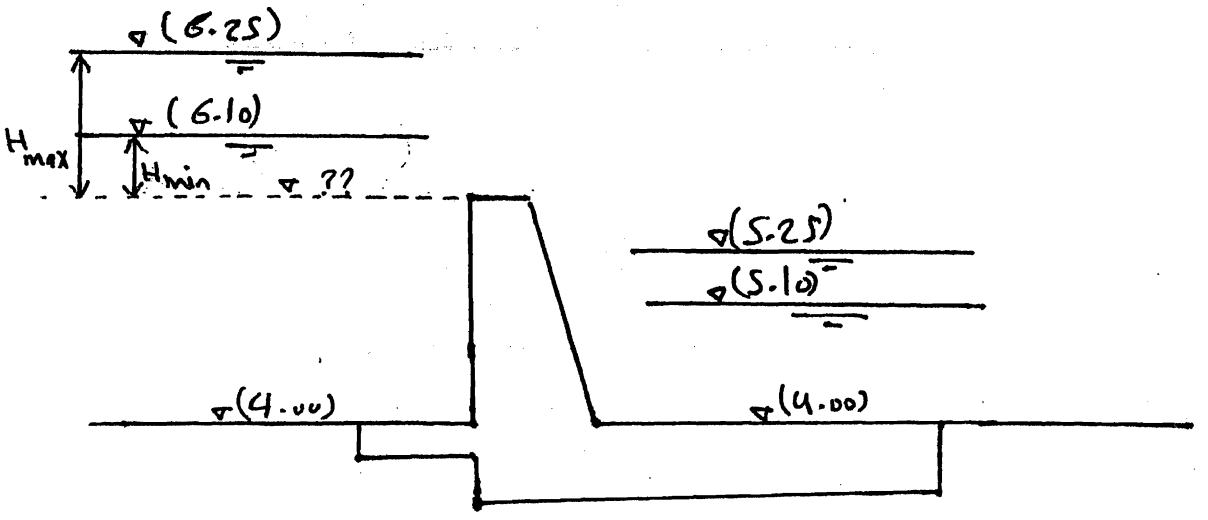




Canal cross sec U.S the weir

example

Given :-



- $Q_{max} = 3.63\ m^3/sec$
- $Q_{min} = 2.6\ m^3/sec$
- $b_{Canal} = 3.8^m$

Req :- Hydraulic design (weir dimensions)

Sol :-

عندما يكون معطى مناسيب قصوى ودنيا فنى هذه الحالة يتم إيجاد أولاً H_{max} & H_{min} ثم إيجاد عرض القناة B .

$$Q_{max} = 1.85\ B\ H_{max}^{3/2} \longrightarrow (1)$$

$$Q_{min} = 1.85\ B\ H_{min}^{3/2} \longrightarrow (2)$$

(2) على (1) بقسمة

$$\frac{Q_{max}}{Q_{min}} = \left(\frac{H_{max}}{H_{min}}\right)^{1/2}$$

$$\therefore \frac{H_{max}}{H_{min}} = \left(\frac{Q_{max}}{Q_{min}}\right)^{2/3} = \left(\frac{3.63}{2.6}\right)^{2/3} = 1.25$$

$$\therefore H_{max} = 1.25\, H_{min} \longrightarrow (1)$$

$$H_{max} - H_{min} = 6.25 - 6.1 = 0.15 \longrightarrow (2)$$

$$\therefore 1.25 H_{min} - H_{min} = 0.15$$

$$\therefore H_{min} = 0.6^{m}$$

$$\therefore H_{max} = 0.75^{m}$$

$$\therefore \text{I crest level} = 6.25 - 0.75 = (5.50)$$

$$\text{or} = 6.1 - 0.6 = \underline{(5.50) > 5.25}$$

∴ ok fre

- Find B

$$Q_{max} = 1.85\, B\, H_{max}^{3/2}$$

$$3.63 = 1.85\, B\, (0.75)^{3/2}$$

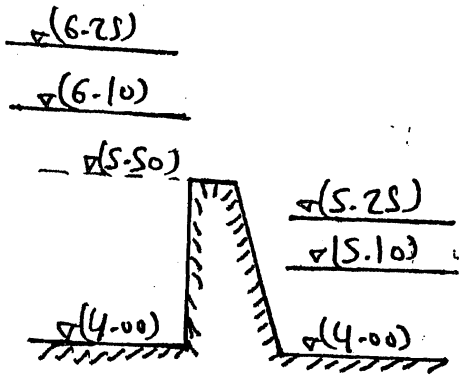
$$\therefore B = 3^{m}$$

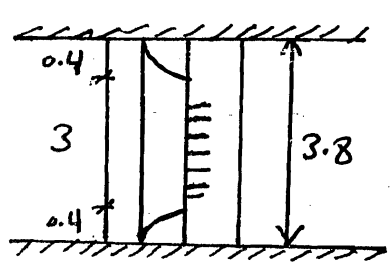
$$\therefore b_{canal} = 3.8^{m}$$

$$\therefore 3.8 = B - 2C = 3 - 2C$$

$$\therefore C = 0.4^{m} \quad (0.35 \sim 0.65)$$

∴ OK





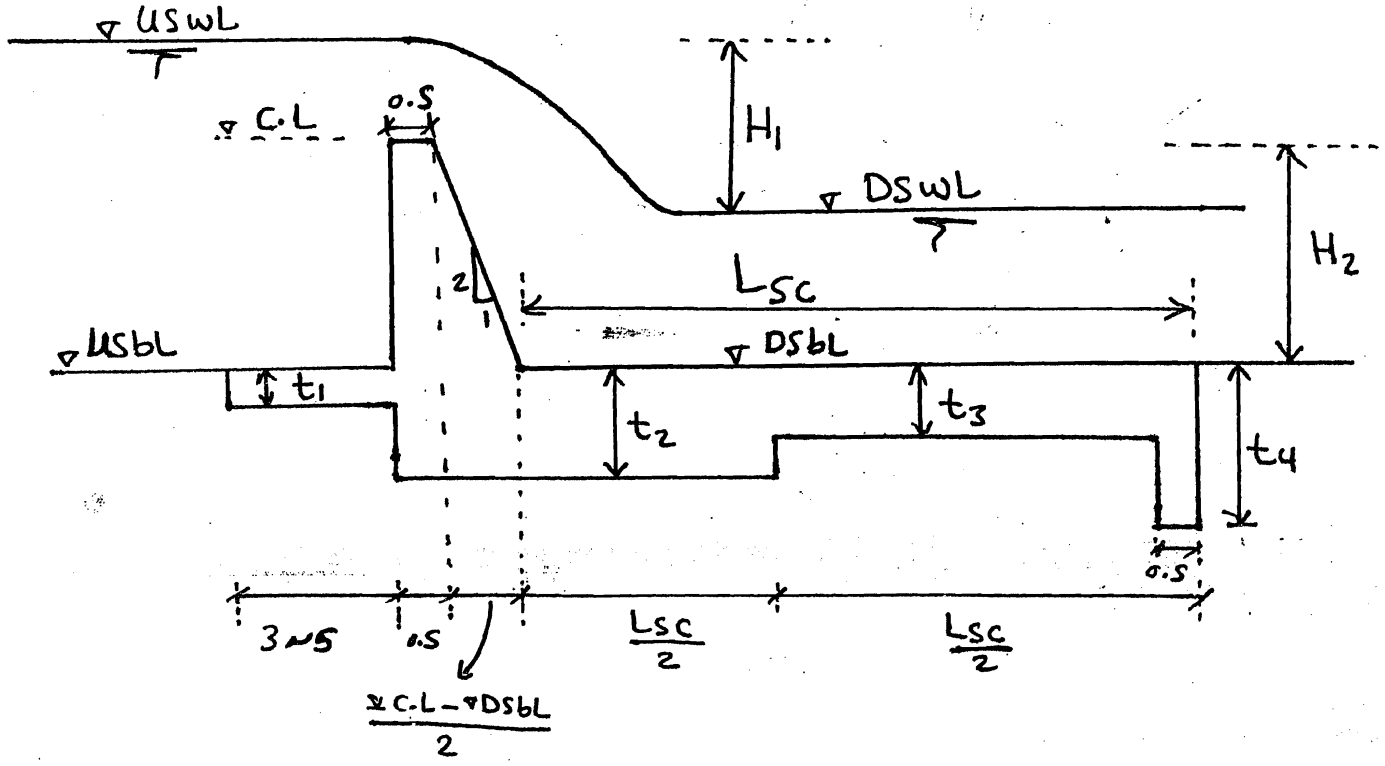
2- structural Design

1- Design of floor dimensions (Thickness and lengths for Scouring and Percolation lengths.

2- Check floor thickness against uplift

1- Design of floor dimensions

• floor thickness



- $t_1 = 0.5^m$
- $t_2 = \sqrt{H_{max}}$
- $t_3 = 0.7\, t_2$
- $t_4 = 1.5\, t_2$

- H_{max} = max of (H_1 of H_2)

• Scouring length :-

- $L_{sc} = 0.65\, C_B \sqrt{H_{max}} = \checkmark m$

• check of Percolation length

- $L_{P_{reqr}} = C_B\, H_{max}$
- $L_{P_{act}} = \Sigma L_V + \Sigma L_H$

If $L_{Pact} > L_{Preqr}$ ∴ ok

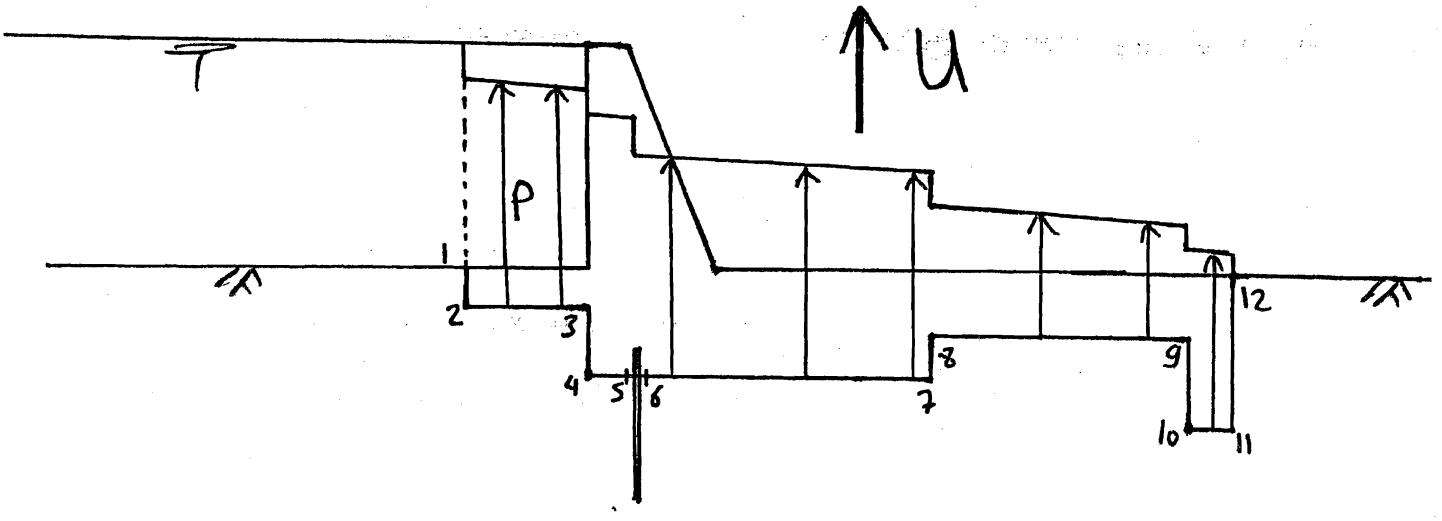
If $L_{Pact} < L_{Preqr}$ ∴ Not ok

وتستخدم Sheet Pile (d) مقدار

$$d = \frac{L_{Preq} - L_{Pact}}{2}$$

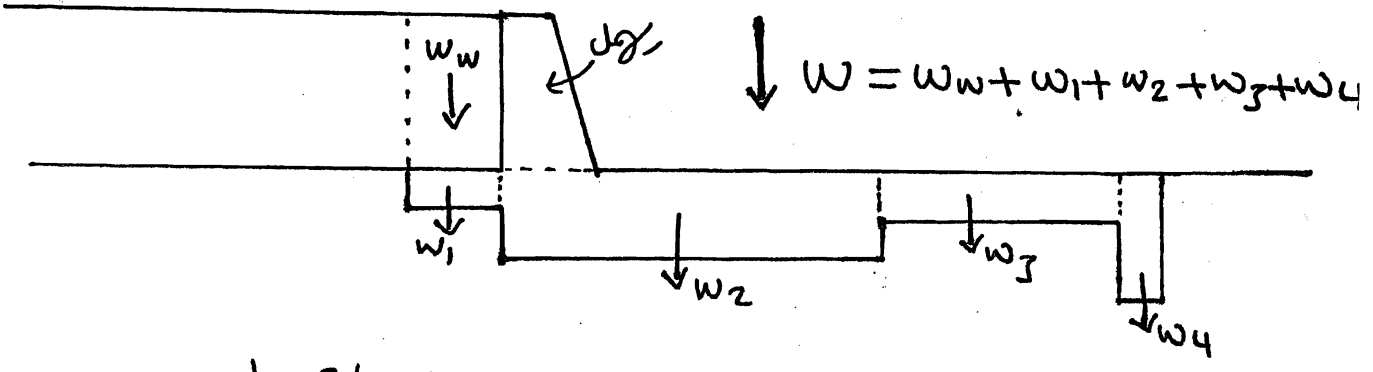
2- Check floor thickness against uplift

seepage الى



نحسب h (1 ← 12)

- $h_i = H_{max} - \frac{L_{Pi}}{C_B}$ where $C_B = \frac{L}{H}$
- $P_i = h_i \pm z_i$



Check

$$F.o.S = \frac{W}{U} = \checkmark \geq 1.25$$