EAH 225 HYDRAULICS - TEST

Date : 31st March 2009

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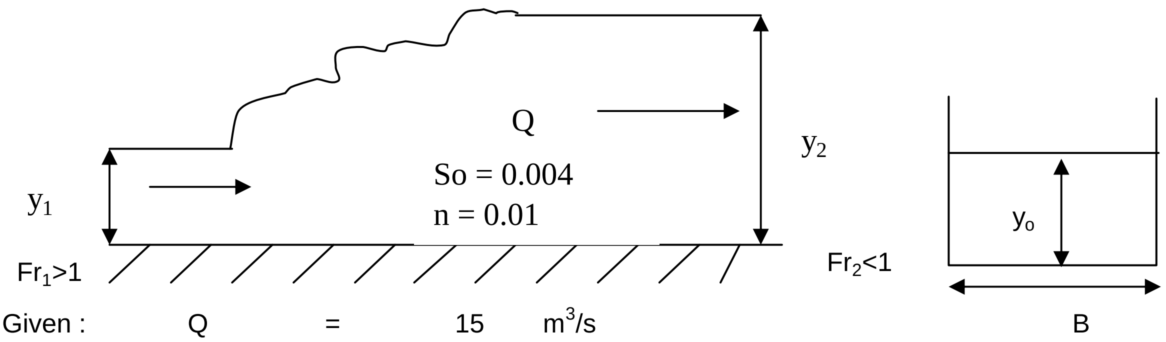


Given :	Q	=	15	m^3/s
	S_o	=	0.004	
	B	=	3.0	m
	n	=	0.01	

(a) Determine the state of flow, y_1

Manning equation:

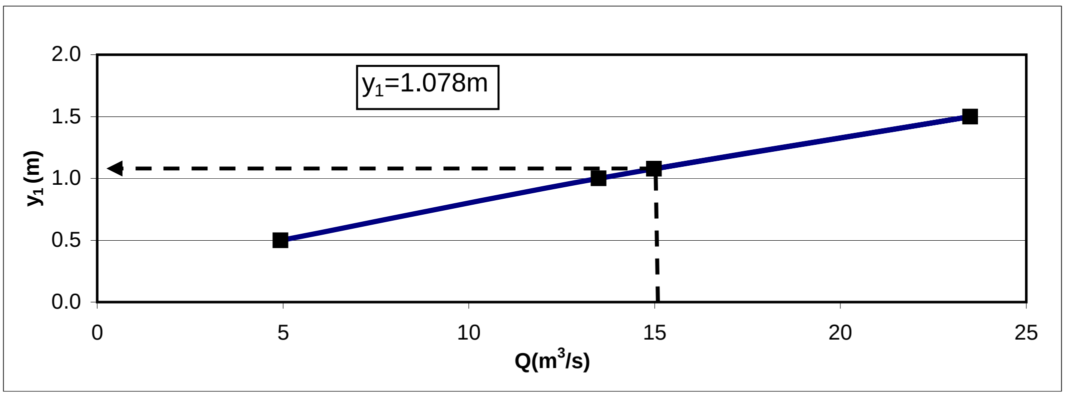
$$V_1 = (1/n)R_2^{2/3}S_o^{1/2}$$
$$= (1/0.01)R_2^{2/3}(0.004)^{1/2}$$
$$= 6.325\ R_2^{2/3}$$

$$A_1 = By_1$$
$$= 3y_1$$

$$P_1 = B+2y_1$$
$$= 3+2y_1$$

y_1 (m)	A_1 (m^2)	P_1 (m)	R (m)	V_1 m/s	Q (m^3/s)
0.5	1.5	4.0	0.375	3.289	4.93
1.0	3.0	5.0	0.600	4.499	13.50
1.5	4.5	6.0	0.750	5.221	23.49
1.078	3.2	5.2	0.627	4.634	14.99

Check (1.078) — OK (14.99)



Check :

$$Fr_1 = \frac{V_1}{\sqrt{gy_1}}$$

$$= \frac{4.634}{\sqrt{(10)(1.078)}}$$

= 1.411471 (>1) "Supercritical"

(b) Determine the state of flow for downstream of hydraulic jump, y_2

Hydraulic jump formula :

$$y_2 = \frac{y_1}{2}\left[\sqrt{1+8Fr_1^{\ 2}} - 1\right]$$

$$y_2 = \frac{1.078}{2}\left[\sqrt{1+8(1.411471)^2} - 1\right]$$

= 1.679 m

Check : V_2 = $(Q/(A_2)$ = 2.977434 m/s

$$Fr_2 = \frac{V_2}{\sqrt{gy_2}}$$

$$= \frac{2.9774}{\sqrt{(10)(1.679)}}$$

= 0.726571 (<1) "Subcritical"

(c) Estimate the energy head loss through the jump

$$h_f = E_{S1} - E_{S2} = \left(y_1 + \frac{V_1^{\ 2}}{2g}\right) - \left(y_2 + \frac{V_2^{\ 2}}{2g}\right)$$

$$E_{S1} = 1.078 + \frac{4.634^2}{2(10)}$$ = 2.15

$$E_{S2} = 1.679 + \frac{2.9774^2}{2(10)}$$ = 2.12

h_f = 2.15 - 2.93 = 0.03

2 Design a retangular concrete channel

Given:	**Q**	=	**20**	**m^3/s**			
	n	=	0.013				
	S_o	=	0.001				
Assume:	**B**	=	**3.0**	**m**			
	D	=	**3.0**	**m**			**(Bankfull flow)**
	A	=	B x D		=	3 x 3	
					=	9	m^2
	P	=	B + 2 D		=	3 + 2(3)	
					=	9	m
	R	=	A/P		=	1	
	V	=	$\frac{1}{n} R^{2/3} S_o^{1/2}$				
		=	**2.43**	**m/s**			
	Q	=	VA				
	Q	**=**	**21.89**	**m^3/s**	**(> 20 m^3/s)**		
Check:	**V_{min}**	=	0.6	m/s			
	V_{max}	=	4	m/s			
	V	**=**	**2.43**	**m/s**	**OK**		