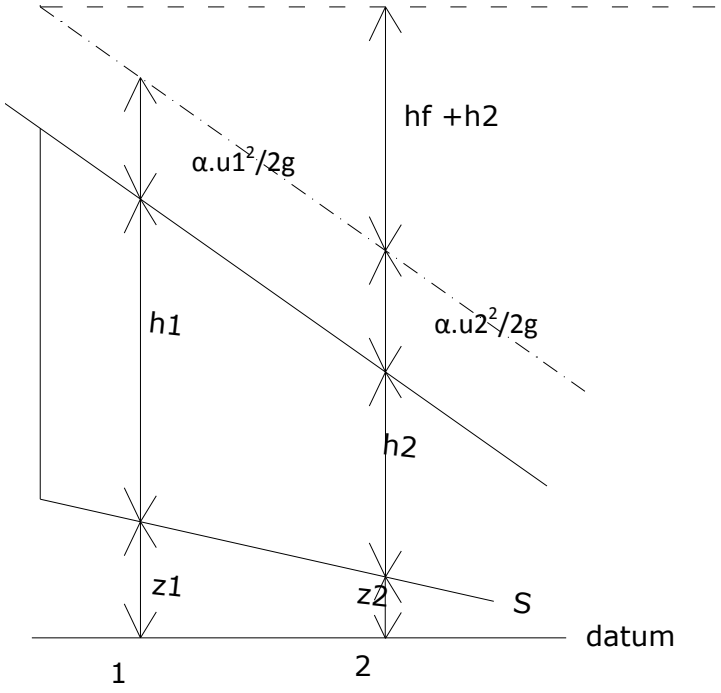
METODA STANDARD STEP

- Dapat digunakan untuk saluran alam (misal = sungai) dimana luas tampang berubah dan non-prasmatis
- Kehilanagn energy pada saluran adalah kehilangan energy karena gesekan dasar dank arena perubahan bentuk tampang
- Prinsip: penggunaan persamaan energy
  Persamaan energy antara tampang 1 dan 2



$Z_1 + h_1 + \alpha.u_1^2/2g = Z_2 + h_2 + \alpha.u_2^2/2g + hf + he$

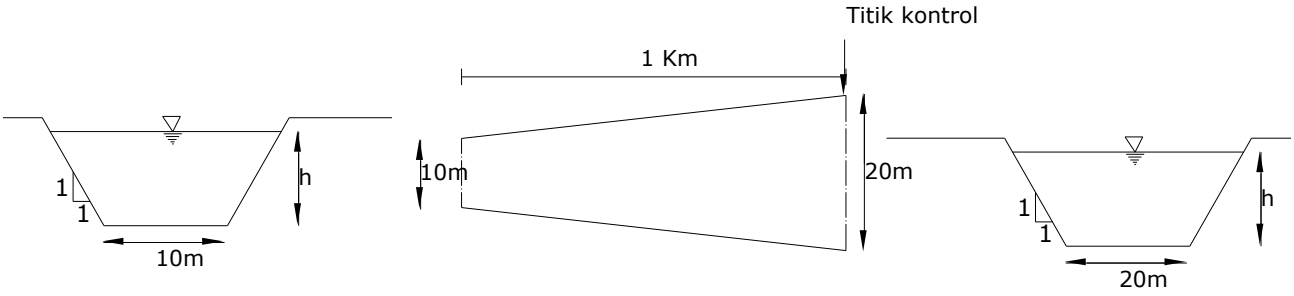
hf = kehilangan energy akibat gesekan dasar

$hf = (Sf1 + Sf2/2).\Delta x$

he = kehilangan energy akibat perubahan tampang

$he = k\, I(U_1^2 - U_2^2)/2.gI$, k = koefisien kehilangan energy

contoh



Pada tampang 2 : h = 5,0 m

$Q = 100\ m^3/s$

S o = 0,001 ; k = 0,4 → dasar saluran lurus

n = 0,018

hitung: - kedalaman aliran pada jarak 1,0 : 0,8 : 0,6: 0,4 : dan 0,2 km dari ujung hilir

solusi

tampang control = ujung hilir dimana kondisi alirn diketahui

pada ujung hulu (tampang 1)

$A = (10 + h)h$

$P = (10 + 2h\sqrt{2}$ } R = A/P

Kedalaman air normal

$Q = A.1/n.\ R^{2/3}.\ So^{1/2}$

$100 = ((10 + H).H)/0{,}018)\ .[\ (10+H).H)/(10 + 2H\sqrt{2}))]^{2/3}.(0{,}001)^{1/2}$

Dengan coba-coba, H = 2,80 m

$Fr = u/\sqrt{g.D} = 100/(12{,}8.2{,}8).(1/(9{,}8.(12{,}8.2{,}8)/10+2.1.2{,}8)) = 0{,}588 < 1$

Aliran subkritis

Berarti h > H > hcr → kurva M_1

- Kehilangan energy
    a. Akibat perubahan tampang

he = k $I(U_1^2 – U_2^2)/2.gI$ = 0,4 $I(U_1^2 – U_2^2)/2.gI$

akibat gesekan

hf =$[Sf_1 + Sf_2/2].\Delta X \rightarrow Sf = Q^2.n^2/A^2/R^{4/3}$

- Pada jarak X = 0 (tampang control)

B = 20 m; Z = 0; h = 5,0 m

A = (20+1,5).5 = 125 m^2; P = (20 +2,5√2) = 34,14 m

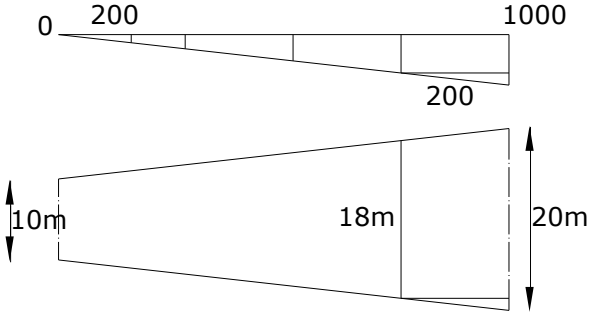
U = 100/125 = 0,8 m/s R = 125/34,14 = 3,66 m

$E_2 = Z + h + U^2/2g + hf + he$

= 0 + 5 +$(0,8^2/2.9,81)$ +hf + he = 5,033 +he +hf

$Sf_2 = (100^2. 0,018^2/125^2.3,66^{4/3}) = 3,69.10^{-5}$

He2 = 0 (anggapan sementara)



- Pada X =200 m (Δx = 200 m)

B = 20 –(200/1000).10 = 18

Z = So.Δx = 0,001 x 200 = 0,2 m

H → ditentukan dengan coba – coba

misal

h = 4,9 m → coba, dasarnya kurva M_1

A = 112,21 m^2

U = 100 / 112,21 = 0,891 m/s

P = (18 + 2.4,9.√2) = 31,86 m

R = A/P = 3,52 m

$E_1 = Z_1 + h + u^2/2g \rightarrow Z_1$ = So.Δx = 0,001 x 200 = 0,2

= 0,2 + 4,9 + $(0,891^2)/(2.9,81)$ = 5,141 m

$Sf1 = (100^2 .0,018^2)/ (112,21^2 .3,52^{4/3}) = 4,26.10^{-5}$

hf_{0-200m} = Sf x Δx = $4,26.10^{-5}$ x 200 = 0,0085 m

$he = 0,4\ I(0,8^2 – 0,891^2)/2.9,81I = 0,0031$ m

$E_2 = Z_2 + h + u^2/2g + he + hf = 0 + 5 + (0,8^2/2.9,81) + 0,0085 + 0,0031 = 5,044$ m

$E_1 \neq E_2 \rightarrow 5,141 \neq 5,044 \rightarrow$ coba h yang lain

Misal h =4,81 m

$A = 109,72\ m^2$; u = 0,911 ; R = 3,47 m

$E_1 = Z_1 + h + u^2/2g$

$= 0,2 + 4,81 + (0,911^2)/(2.9,81) = 5,052$ m

$Sf_2 = (100^2 .0,018^2)/ (109,72^2 .3,47^{4/3}) = 5,14.10^{-5}$

$Sf\ \square = (3,69.10^{-5} + 5,14.10^{-5})/2 = 4,42.10^{-5}$

$hf = Sf\ \square x\ \Delta x = 4,42.10^{-5} \times 200 = 0,00883$ m

$he = 0,4\ I(0,8^2 – 0,911^2)/2.9,81I = 0,0039$ m

$E_2 = Z_2 + h + u^2/2g + he + hf = 0 + 5 + (0,8^2/2.9,81) + 0,0039 + 0,00883 = 5,045$ m

$E_1 \approx E_2$ ……**Ok**

METODE STANDARD STEP

Q= 100
m3/s
n= 0,018
S0 = 0,01

Jarak	ΔX	b	z	h	A	u	E1	P	R	Sf	Sf	hf	he	E2
(m)	(m)	(m)	(m)	(m)	(m^2)	(m/s)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
0	200	20	0	5	125	0.8	34.14	34.14	3.661	0.0000367	-	-	-	-
200	200	18	0.2	4.8	109.7	0.911	31.6	31.6	3.472	0.0000512	0.000044	0.0088	0.0039	5.045
400	200	16	0.4	4.6	95.3	1.05	29.07	29.07	3.277	0.0000733	0.0000623	0.0125	0.0055	5.07
600	200	14	0.6	4.4	81.6	1.225	26.53	26.53	3.077	0.000109	0.000091	0.0182	0.0081	5.102
800	200	12	0.8	4.2	68.9	1.452	23.99	23.99	2.87	0.000168	0.000138	0.0276	0.0124	5.146
1000	200	10	1	4.1	56.9	1.757	21.46	21.46	2.652	0.000273	0.00022	0.044	0.02	5.211

Q= 25m3/s b= 10 m
n= 0,025
S0 = 0,001

y	A	P	R	V	Es	ΔEs	If	Io - If	ΔX	X
(m)	(m^2)	(m)	(m)	(m)	(m)	(m)	(m/s)	(m)	(m)	(m)
2.00	20.0	14.0	1.429	1.25	2.08	0	0	0	-	0
1.95	19.5	13.90	1.403	1.282	2.034	0.0459	0.00063	0.00037	123.95	123.95
1.90	19.0	13.80	1.377	1.315	1.988	0.0455	0.00068	0.00032	142.13	266.07
1.85	18.5	13.70	1.350	1.351	1.943	0.0452	0.000735	0.000265	170.32	436.39
1.80	18.0	13.60	1.324	1.389	1.898	0.0448	0.000796	0.000204	219.73	656.13
1.75	17.5	13.50	1.296	1.429	1.854	0.0443	0.000865	0.000135	328.28	984.4
1.70	17.0	13.40	1.269	1.471	1.81	0.0438	0.000942	0.000058	756.86	1741.27
1.69	16.9	13.38	1.263	1.479	1.802	0.0087	0.000993	0.000007	1223.09	2964.36