PEMODELAN NUMERIK 2 (DUA) DIMENSI ALIRAN MELALUI PELIMPAH (SPILLWAY) DAN PEREDAM ENERGI (STILLING BASIN) DENGAN METODE VOLUME HINGGA

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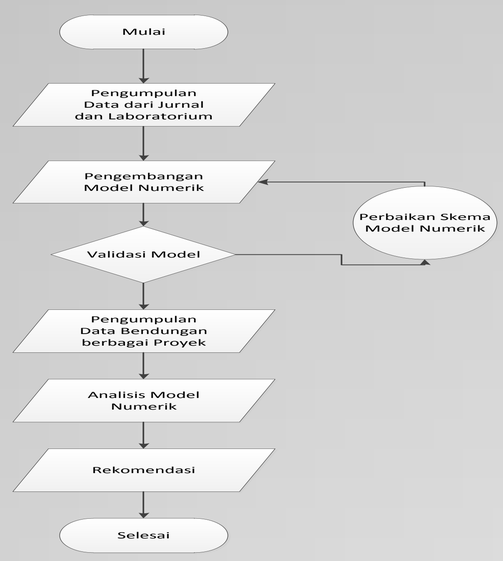
Tujuan:

- Mengembangkan model numerik berbasiskan metode volume hingga untuk mensimulasikan aliran yang melewati spillway dan peredam energi yang memberikan hasil yang akurat.
- Mendapatkan pola karakteristik aliran seperti kedalaman air dan kecepatan aliran.
- Memperoleh besaran koefisien debit mercu spillway

Metodologi:



Persamaan Matematika:

$$\frac{\partial W}{\partial t}+\frac{\partial F}{\partial x}+\frac{\partial G}{\partial y}=S$$

$$W=\begin{bmatrix}H\\uH\\vH\end{bmatrix}\quad F=\begin{bmatrix}uH\\u^2H+\frac{1}{2}gH^2\\uvH\end{bmatrix}\quad G=\begin{bmatrix}vH\\uvH\\v^2H+\frac{1}{2}gH^2\end{bmatrix}\quad S=\begin{bmatrix}0\\gH(S_x-S_{fx})\\gH(S_y-S_{fy})\end{bmatrix}$$

Pemodelan Numerik:

Diskritisasi Spasial: Metode Volume Hingga

$$A_k\frac{\partial}{\partial t}W_k+C(W_k)-D(W_k)=A_kS_k$$

$$C(W_k)=\sum_{i=1}^{N}\begin{bmatrix}Q_iH_i\\Q_iu_iH+\frac{1}{2}gH_i{}^2\Delta y_i\\Q_iv_iH_i-\frac{1}{2}gH_i{}^2\Delta x_i\end{bmatrix}$$

$$D(W_k)=D^2(W_k)-D^4(W_k)$$

$$D^2(W_k)=\sum_{i=1}^{N}\in_{ik}\frac{A_{ik}}{\Delta t_{ik}}(W_i-W_k)$$

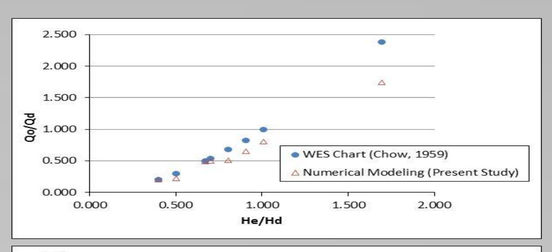
$$D^4(W_k)=\sum_{i=1}^{N}\in^{(2)}\frac{A_{ik}}{\Delta t_{ik}}(\nabla^2W_i-W_k)$$

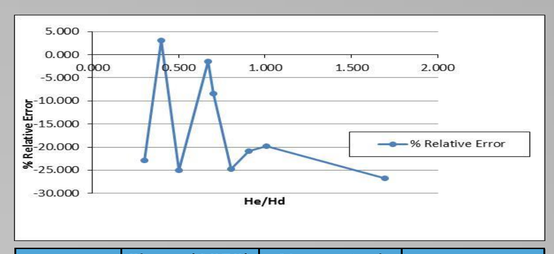
Diskritisasi Waktu: Runge Kutta 4th Order Hybrid Scheme

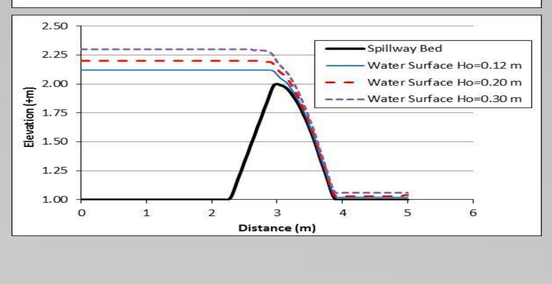
$$W_k{}^0=W_k{}^n$$
$$W_k{}^1=W_k{}^0-\alpha_1\frac{\Delta t_k}{A_k}[C(W_k{}^0)-D(W_k{}^0)]$$
$$W_k{}^2=W_k{}^0-\alpha_2\frac{\Delta t_k}{A_k}[C(W_k{}^1)-D(W_k{}^0)]$$
$$W_k{}^3=W_k{}^0-\alpha_3\frac{\Delta t_k}{A_k}[C(W_k{}^2)-D(W_k{}^0)]$$
$$W_k{}^4=W_k{}^0-\alpha_4\frac{\Delta t_k}{A_k}[C(W_k{}^3)-D(W_k{}^0)]$$
$$W_k{}^{n+1}=W_k{}^4$$

Studi Kasus:

Kasus 1: Aliran Melalui Ambang Spillway Tipe WES

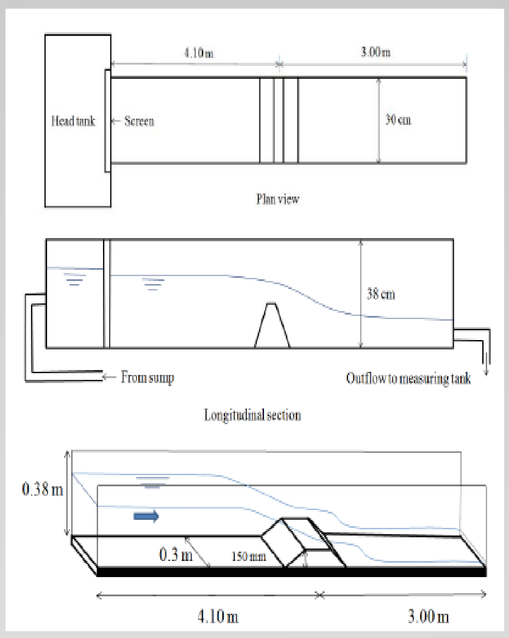




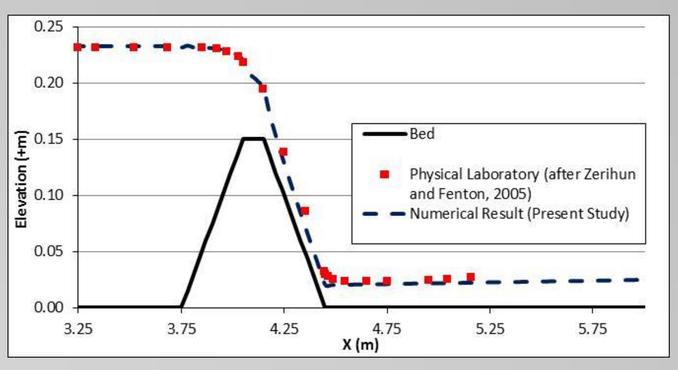


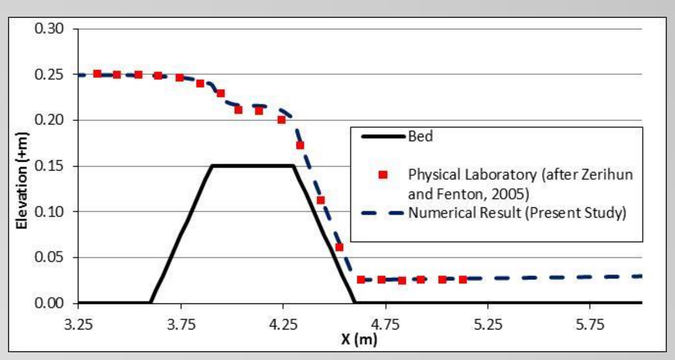
	Chow (1959)	Numerical	
He/Hd	Qo/Qd	Qo/Qd	% error
0.300	0.117	0.090	-22.870
0.401	0.202	0.208	3.099
0.501	0.302	0.226	-24.970
0.669	0.499	0.491	-1.483
0.703	0.543	0.497	-8.394
0.804	0.680	0.512	-24.713
0.906	0.829	0.655	-20.896
1.007	1.000	0.802	-19.819
1.695	2.378	1.743	-26.703

Kasus 2: Aliran Melalui Ambang Lebar

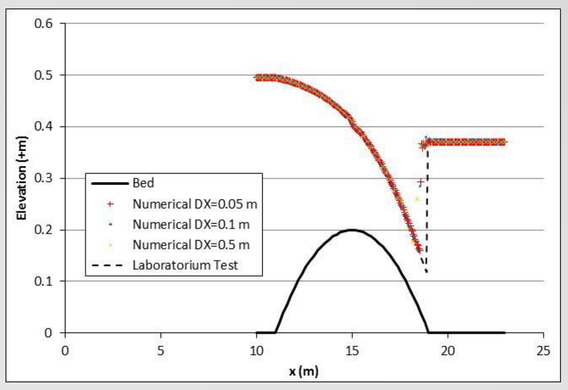


(Zerihun and Fenton, 2005)





Kasus 3: Aliran Melalui Sebuah Penghalang



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