Hydraulic Jump: Sequent Depth and Energy Loss

Depth after a hydraulic jump in a rectangular channel from the upstream depth and velocity (Bélanger), with the energy lost and the upstream Froude number.

Method: Momentum balance across a jump (Bélanger); Chow; Open-Channel Hydraulics

Input parameters

Unit system: SI

Parameter	Value	Unit
Depth before the jump	0.30000	m
Velocity before the jump	6.0000	m/s
Water density (for the power lost)	998.00	kg/m³
Channel width (for the power lost)	2.0000	m

Calculated results

Parameter	Value	Unit
Froude number before the jump	3.4981	
Depth after the jump	1.3417	m
Head lost $(y_2 - y_1)^3/(4\, y_1\, y_2)$	0.70205	m
Power dissipated	24.735	kW

Notes for this case

- Power with the water density entered. Horizontal rectangular channel, friction in the jump neglected.

Formula and method

$$Fr_1 = \frac{v_1}{\sqrt{g y_1}}, \quad \frac{y_2}{y_1} = \frac{1}{2}\left(\sqrt{1 + 8 Fr_1^2} - 1\right), \quad \Delta E = \frac{(y_2 - y_1)^3}{4 y_1 y_2}, \quad P_L = \rho g\, v_1 y_1 b\, \Delta E$$

Variables

y_1	Depth before the jump	m
v_1	Velocity before the jump	m/s
ρ	Water density (for the power lost)	kg/m³
b	Channel width (for the power lost)	m
Fr_1	Froude number before the jump	-
y_2	Depth after the jump	m
ΔE	Head lost $(y_2 - y_1)^3/(4\, y_1\, y_2)$	m
P_L	Power dissipated	W

Method and standards

Momentum across the jump.

Assumptions and limits

- Horizontal, rectangular.

References

- Momentum balance across a jump (Bélanger); Chow
- Open-Channel Hydraulics

Report details

Report reference	FCC-XYJN-NG6Z (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/fluid-mechanics/hydraulic-jump

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.