Specific Energy and Alternate Depths in a Rectangular Channel

Specific energy at a depth, the alternate depth with the same energy, critical depth and minimum energy, and the Froude numbers in a rectangular channel.

Method: Specific energy and alternate depths

Input parameters

Unit system: SI

Parameter	Value	Unit
Discharge	12.000	m^3/s
Channel width	4.0000	m
Known depth	0.60000	m

Calculated results

Parameter	Value	Unit
Discharge per unit width	3.0000	$m^3/(s·m)$
Specific energy y + $q^2/(2gy^2)$	1.8746	m
Critical depth	0.97179	m
Minimum specific energy 1.5 y_c	1.4577	m
Alternate depth with the same energy	1.7194	m
Froude number at y_1	2.0613	
Froude number at y_2	0.42490	

Notes for this case

- Rectangular channel, uniform velocity: subcritical and supercritical alternate depths share the same specific energy; at critical depth the energy is a minimum.

Formula and method

$$E = y + \frac{q^2}{2gy^2}, \quad y_c = \left(\frac{q^2}{g}\right)^{1/3}, \quad E_{min} = \frac{3}{2} y_c, \quad Fr = \frac{q}{y\sqrt{gy}}$$

Variables

Q	Discharge	m^3/s
b	Channel width	m
y_1	Known depth	m
q	Discharge per unit width	$m^3/(s·m)$
E	Specific energy y + $q^2/(2gy^2)$	m
y_c	Critical depth	m
E_{min}	Minimum specific energy 1.5 y_c	m
y_2	Alternate depth with the same energy	m
Fr_1	Froude number at y_1	-
Fr_2	Froude number at y_2	-

Method and standards

Specific energy concept.

Assumptions and limits

- Rectangular channel, hydrostatic pressure, uniform velocity.

References

Specific energy and alternate depths

Report details

Report reference	FCC-1GZP-EK54 (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/civil/hydraulics/specific-energy-alternate-depths

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.