Most Economical Channel Section (Rectangular and Trapezoidal)

Depth, bed width, area and velocity of the best hydraulic rectangular or trapezoidal channel for a flow and bed slope by Manning's equation.

Method: Best hydraulic section with Manning's equation (Chow, Open-Channel Hydraulics (McGraw-Hill, 1959), ch. 7)

Input parameters

Unit system: SI

Parameter	Value	Unit
Discharge	18,000	m³/h
Manning's n	0.015000	
Bed slope	5.0000e-04	
Side slope H:V (0 = rectangular)	0	

Calculated results

Parameter	Value	Unit
Flow depth	1.4437	m
Bed width	2.8873	m
Flow area	4.1683	m²
Mean velocity	1.1995	m/s
Hydraulic radius	0.72183	m

Notes for this case

• Best hydraulic section: least wetted perimeter for the area (b = 2y for rectangles; for trapezoids b = 2y(√(1 + z²) − z) and R = y/2). The best of all trapezoids has z = 1/√3 (half hexagon). Check velocity against scour and silting limits; excavation cost may favour wider, shallower channels.

Formula and method

$$R = \frac{y}{2}, \quad b = 2y\left(\sqrt{1+z^2} - z\right), \quad Q = \frac{1}{n} A R^{2/3} S^{1/2}$$

Variables

Q	Discharge	m³/s
n	Manning's n	-
S	Bed slope	-
z	Side slope H:V (0 = rectangular)	-
y	Flow depth	m
b	Bed width	m
A	Flow area	m²
v	Mean velocity	m/s
R	Hydraulic radius	m

Method and standards

Best hydraulic section.

Assumptions and limits

- Uniform flow.

References

- Best hydraulic section with Manning's equation (Chow, Open-Channel Hydraulics (McGraw-Hill, 1959), ch. 7)

Report details

Report reference	FCC-K894-CYY3 (the same inputs always give the same reference)
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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/economical-channel-section

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.