Cross-Flow (Banki) Turbine Runner Diameter and Width

Jet velocity, runner diameter for a speed and the runner width for the flow of a cross-flow (Banki–Michell) turbine, with shaft power at an efficiency.

Method: Banki–Michell velocity relations

Input parameters

Unit system: SI

Parameter	Value	Unit
Design flow	1,800.0	m³/h
Net head	20.000	m
Runner speed	500.00	rpm
Nozzle entry angle	16.000	°
Nozzle velocity coefficient	0.98000	
Jet thickness as a fraction of runner diameter	10.000	%
Turbine efficiency	78.000	%

Calculated results

Parameter	Value	Unit
Jet velocity	19.410	m/s
Optimum peripheral speed	9.3288	m/s
Runner outer diameter	356.34	mm
Runner width (jet width)	722.93	mm
Shaft power	76.492	kW

Notes for this case

• C_1 = C_v√(2gH); best efficiency near u = ½C_1cosα_1, so D = 2u/ω. The jet, of thickness k_jD and width B, carries Q = C_1k_jDB. Cross-flow turbines suit 5–100 m heads and wide flow ranges (part-gate sections keep efficiency); efficiencies of 70–80 % are typical.

Formula and method

$$C_1 = C_v\sqrt{2gH}, \quad u = \frac{1}{2}C_1\cos\alpha_1, \quad D = \frac{2u}{\omega}, \quad B = \frac{Q}{C_1 k_j D}$$

Variables

Q	Design flow	m³/s
H	Net head	m
N	Runner speed	rad/s
α_1	Nozzle entry angle	rad
C_v	Nozzle velocity coefficient	-
k_j	Jet thickness as a fraction of runner diameter	-
η	Turbine efficiency	-
C_1	Jet velocity	m/s
u	Optimum peripheral speed	m/s
D	Runner outer diameter	m
B	Runner width (jet width)	m
P	Shaft power	W

Method and standards

Cross-flow turbine.

Assumptions and limits

- Free jet; simple velocity triangle at entry.

References

Banki–Michell velocity relations

Report details

Report reference	FCC-J7HT-MTCS (the same inputs always give the same reference)
Generated	23 November 2026, 17:42 UTC
Calculator	Cross-Flow (Banki) Turbine Runner Diameter and Width
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/boilers-power-plant/hydro-power/crossflow-turbine-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.