Collector Row Shading: Shaded Fraction and Clear Row Spacing

Fraction of a sloped collector shaded by the row in front at a given profile angle, the angle at which shading starts and the row pitch that avoids it.

Input parameters

Unit system: SI

Parameter	Value	Unit
Collector length up the slope	2.0000	m
Collector slope	25.000	°
Row pitch (horizontal distance between the same point of adjacent rows)	4.5000	m
Profile angle of the sun	20.000	°

Calculated results

Parameter	Value	Unit
Collector height	0.84524	m
Clear ground between rows	2.6874	m
Ground cover ratio L/p	0.44444	
Profile angle below which shading starts	17.459	°
Shaded length from the bottom edge	0	m
Shaded fraction of the collector	0	%
Pitch for no shading at this profile angle	4.1349	m

Notes for this case

- Long rows on level ground; end effects ignored. For PV a small shaded strip can cut a string's output far more than its area share unless bypass diodes isolate it.

Formula and method

$$s = L - \frac{p \sin \alpha_p}{\sin(\alpha_p + \beta)}, \quad F_s = \frac{s}{L}$$

$$\tan \alpha_c = \frac{L \sin \beta}{p - L \cos \beta}, \quad p_{min} = \frac{L \sin(\alpha_p + \beta)}{\sin \alpha_p}$$

Variables

L	Collector length up the slope	m
β	Collector slope	rad
p	Row pitch (horizontal distance between the same point of adjacent rows)	m
α_p	Profile angle of the sun	rad
H	Collector height	m
$p - L \cos \beta$	Clear ground between rows	m
GCR	Ground cover ratio L/p	-
α_c	Profile angle below which shading starts	rad
s	Shaded length from the bottom edge	m

F_s	Shaded fraction of the collector	-
p_{min}	Pitch for no shading at this profile angle	m

Method and standards

Plane geometry of a shadow cast by one long row on the next.

Assumptions and limits

- Level ground, long identical rows.

Report details

Report reference	FCC-HNST-6CV8 (the same inputs always give the same reference)
Generated	23 November 2026, 17:35 UTC
Calculator	Collector Row Shading: Shaded Fraction and Clear Row Spacing
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/environmental/solar-thermal/collector-row-shading-fraction

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.