Solar Position at Noon, Incidence on a Tilted Panel and Suggested Tilt

Solar declination for a day, noon sun altitude, noon incidence angle on a tilted equator-facing panel, and the tilt facing the noon sun.

Method: Cooper's declination δ = 23.45° sin(360(284 + n)/365) and solar-noon geometry (Duffie and Beckman, Solar Engineering of Thermal Processes)

Input parameters

Unit system: SI

Parameter	Value	Unit
Latitude (north positive)	18.999	°
Day of the year	172.00	
Panel tilt from horizontal	18.999	°

Calculated results

Parameter	Value	Unit
Solar declination	23.450	°
Sun altitude at solar noon	85.549	°
Incidence angle on the panel at noon	23.450	°
Beam factor cos θ	0.91741	
Tilt facing the noon sun on this day	4.4505	°

Notes for this case

• Cooper's declination formula; panel faces the equator. For fixed panels, tilt near the latitude maximises annual yield; flatter favours summer, steeper winter.

Formula and method

$$\delta = 23.45° \sin\left(360° \frac{284+n}{365}\right), \quad \alpha_n = 90° - |\varphi - \delta|, \quad \theta_i = |\varphi - \beta - \delta| \ \text{(northern hemisphere, noon)}$$

$$\theta_i = |\varphi + \beta - \delta| \ \text{(southern hemisphere, panel facing north, noon)}, \quad \beta_{noon} = |\varphi - \delta|$$

Variables

φ	Latitude (north positive)	rad
n	Day of the year	-
β	Panel tilt from horizontal	rad
δ	Solar declination	rad
α_n	Sun altitude at solar noon	rad
θ_i	Incidence angle on the panel at noon	rad
$\cos\theta_i$	Beam factor cos θ	-
β_{noon}	Tilt facing the noon sun on this day	rad

Method and standards

Solar geometry.

Assumptions and limits

- Solar noon; equator-facing panel (south-facing in the northern hemisphere, north-facing in the southern, with latitude negative).
- Latitude must lie between −90° and 90° and tilt between 0° and 90°.

References

• Cooper's declination δ = 23.45° sin(360(284 + n)/365) and solar-noon geometry (Duffie and Beckman, Solar Engineering of

Thermal Processes)

Report details

Report reference	FCC-JZGB-PRJW (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/electrical/solar-pv/solar-incidence-tilt

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.