Coordinate Rotation and Translation (2D)

Transforms a point between two plane grids by a rotation about the origin and a shift of origin, with an optional scale factor, and the inverse transform.

Method: Plane similarity (four-parameter Helmert) transformation

Input parameters

Unit system: SI

Parameter	Value	Unit
Point x (easting) in the old system	125.00	m
Point y (northing) in the old system	80.000	m
Rotation angle (anticlockwise positive)	30.000	°
Shift of origin in x	1,000.0	m
Shift of origin in y	2,000.0	m
Scale factor	1.0000	

Calculated results

Parameter	Value	Unit
x in the new system	1,068.3	m
y in the new system	2,131.8	m
x from the inverse transform (point treated as new)	-1,717.8	m
y from the inverse transform	-1,225.3	m
Distance of the point from the old origin	148.41	m

Notes for this case

• The forward (similarity or Helmert) transform rotates the point by θ about the old origin, scales it by s and then adds the origin shift: $x' = s(x \cos\theta - y \sin\theta) + t_x$, $y' = s(x \sin\theta + y \cos\theta) + t_y$. The inverse removes the shift, divides by s and rotates by −θ. Four parameters are fixed by two common points; with more, fit them by least squares.

Formula and method

The formula is shown on the calculator page: https://calc.firecad.com/general/geometry/coordinate-rotation-translation

Variables

x	Point x (easting) in the old system	m
y	Point y (northing) in the old system	m
θ	Rotation angle (anticlockwise positive)	rad
t_x	Shift of origin in x	m
t_y	Shift of origin in y	m
s	Scale factor	-
x'	x in the new system	m
y'	y in the new system	m
x_{inv}	x from the inverse transform (point treated as new)	m
y_{inv}	y from the inverse transform	m
ρ	Distance of the point from the old origin	m

Method and standards

Rotation and translation.

Assumptions and limits

- Plane, conformal transform; rotation about the old origin, then shift.

References

Plane similarity (four-parameter Helmert) transformation

Report details

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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/general/geometry/coordinate-rotation-translation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.