Strain Gauge Rosette: Principal Strains and Stresses

Principal strains, principal stresses, maximum shear and principal direction from a rectangular (0-45-90) or delta (0-60-120) strain gauge rosette.

Method: Strain transformation and Hooke's law in plane stress

Input parameters

Unit system: SI

Parameter	Value	Unit
Rosette type	Rectangular 0°/45°/90°	
Strain on gauge a (0°)	650.00	με
Strain on gauge b (45° or 60°)	280.00	με
Strain on gauge c (90° or 120°)	-120.00	με
Elastic modulus	200.00	GPa
Poisson's ratio	0.30000	

Calculated results

Parameter	Value	Unit
Major principal strain	650.29	με
Minor principal strain	-120.29	με
Maximum in-plane shear strain	770.58	με
Angle from gauge a to the major principal axis (anticlockwise)	1.1156	°
Major principal stress	134.99	MPa
Minor principal stress	16.439	MPa
Maximum in-plane shear stress	59.276	MPa
Von Mises stress (plane stress)	127.57	MPa

Notes for this case

- Plane stress at a free surface, linear elastic isotropic material. Gauges a, b and c are read anticlockwise; enter tensile strain positive and correct the readings for transverse sensitivity first.

Formula and method

$$\text{rectangular}: \ \gamma_{xy} = 2\varepsilon_b - \varepsilon_a - \varepsilon_c, \quad \text{delta}: \ \varepsilon_y = \frac{2\varepsilon_b + 2\varepsilon_c - \varepsilon_a}{3}, \ \gamma_{xy} = \frac{2(\varepsilon_b - \varepsilon_c)}{\sqrt{3}}$$

$$\varepsilon_{1,2} = \frac{\varepsilon_x + \varepsilon_y}{2} \pm \sqrt{\left(\frac{\varepsilon_x - \varepsilon_y}{2}\right)^2 + \left(\frac{\gamma_{xy}}{2}\right)^2}, \quad \sigma_1 = \frac{E(\varepsilon_1 + \nu\varepsilon_2)}{1 - \nu^2}$$

Variables

rosette	Rosette type	-
ε_a	Strain on gauge a (0°)	-
ε_b	Strain on gauge b (45° or 60°)	-
ε_c	Strain on gauge c (90° or 120°)	-
E	Elastic modulus	Pa
ν	Poisson's ratio	-
ε_1	Major principal strain	-
ε_2	Minor principal strain	-

γ_{max}	Maximum in-plane shear strain	-
θ_p	Angle from gauge a to the major principal axis (anticlockwise)	rad
σ_1	Major principal stress	Pa
σ_2	Minor principal stress	Pa
τ_{max}	Maximum in-plane shear stress	Pa
σ_{vM}	Von Mises stress (plane stress)	Pa

Method and standards

Strain transformation and plane-stress Hooke's law.

Assumptions and limits

- Plane stress, elastic isotropic material, small strains.

References

Strain transformation and Hooke's law in plane stress

Report details

Report reference	FCC-46DM-YHFM (the same inputs always give the same reference)
Generated	23 November 2026, 18:18 UTC
Calculator	Strain Gauge Rosette: Principal Strains and Stresses
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/mechanical/strength-of-materials/strain-rosette

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Reopens the calculator with the inputs of this report.