Notch Root Stress and Strain by Neuber's Rule

Local stress and strain at a yielding notch root from K_t, nominal stress and the cyclic Ramberg–Osgood curve, by Neuber's rule.

Method: Neuber (1961) rule with the Ramberg–Osgood cyclic curve (Dowling, Mechanical Behavior of Materials, 4th ed. (Pearson, 2013), ch. 14)

Input parameters

Unit system: SI

Parameter	Value	Unit
Elastic stress concentration factor	2.5000	
Nominal stress	200.00	MPa
Elastic modulus	200.00	GPa
Cyclic strength coefficient	1,200.0	MPa
Cyclic strain-hardening exponent	0.15000	

Calculated results

Parameter	Value	Unit
Notch root stress	418.61	MPa
Notch root strain	0.002986	
Stress concentration (actual)	2.0931	
Strain concentration	2.9861	

Notes for this case

• Neuber's rule σε = (K_tS)²/E with the cyclic stress–strain curve ε = σ/E + (σ/K')^(1/n'). Use K_f (fatigue notch factor) instead of K_t for fatigue life when notch sensitivity is low. Nominal stress assumed elastic.

Formula and method

$$\sigma\varepsilon = \frac{(K_t S)^2}{E}, \quad \varepsilon = \frac{\sigma}{E} + \left(\frac{\sigma}{K'}\right)^{1/n'}$$

Variables

K_t	Elastic stress concentration factor	-
S	Nominal stress	Pa
E	Elastic modulus	Pa
K'	Cyclic strength coefficient	Pa
n'	Cyclic strain-hardening exponent	-
σ	Notch root stress	Pa
ε	Notch root strain	-
K_σ	Stress concentration (actual)	-
K_ε	Strain concentration	-

Method and standards

Neuber's rule.

Assumptions and limits

- Elastic nominal section; uniaxial. A warning appears when S exceeds the cyclic 0.2 % offset yield strength K'(0.002)^n'.

References

• Neuber (1961) rule with the Ramberg–Osgood cyclic curve (Dowling, Mechanical Behavior of Materials, 4th ed. (Pearson, 2013), ch. 14)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/materials/properties/neuber-notch-stress

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.