Fillet Weld Group under Eccentric Load: Throat Shear Stress

Primary and secondary throat shear and the resultant at the critical point of a fillet weld group under an eccentric load, by the treat-the-weld-as-a-line method.

Method: Weld group treated as lines: direct and torsional throat shear

Input parameters

Unit system: SI

Parameter	Value	Unit
Weld pattern	Two horizontal lines b, spaced d	
Horizontal dimension	100.00	mm
Vertical dimension	150.00	mm
Fillet leg size	8.0000	mm
Vertical load	40.000	kN
Eccentricity of the load from the weld group centroid	200.00	mm
Allowable throat shear stress	110.00	MPa

Calculated results

Parameter	Value	Unit
Throat area 0.707 h × total length	1,131.2	mm²
Unit polar moment of the weld lines	129,167	cm⁴
Primary (direct) shear	35.361	MPa
Secondary (torsional) shear at the farthest point	98.706	MPa
Resultant shear at the critical point	121.92	MPa
Factor of safety on the allowable	0.90221	

Notes for this case

- Elastic vector method: direct shear F/A on the throat plus torsional shear Mr/J, with J = 0.707h J_u; the resultant is checked at the corner farthest from the centroid on the load side. Weld returns and end effects are ignored.

Formula and method

$$J_u = \frac{d(3b^2+d^2)}{6}\ \text{(two vertical)},\quad \frac{b(3d^2+b^2)}{6}\ \text{(two horizontal)},\quad \frac{(b+d)^3}{6}\ \text{(box)}$$

One further formula is shown on the calculator page: https://calc.firecad.com/mechanical/machine-design/eccentric-weld-group

Variables

$\mathrm{pattern}$	Weld pattern	-
b	Horizontal dimension	m
d	Vertical dimension	m
h	Fillet leg size	m
F	Vertical load	N
e	Eccentricity of the load from the weld group centroid	m
τ_{allow}	Allowable throat shear stress	Pa
A	Throat area 0.707 h × total length	m²
J_u	Unit polar moment of the weld lines	m⁴
\tau'	Primary (direct) shear	Pa

\tau''	Secondary (torsional) shear at the farthest point	Pa
τ	Resultant shear at the critical point	Pa
n	Factor of safety on the allowable	-

Method and standards

Elastic analysis of eccentrically loaded weld groups.

Assumptions and limits

- Elastic, rigid connected parts, uniform weld size, load in the plane of the group.

References

Weld group treated as lines: direct and torsional throat shear

Report details

Report reference	FCC-4FDF-JTA6 (the same inputs always give the same reference)
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Release checks	4 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/machine-design/eccentric-weld-group

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.