Buckling Verification

Sample document with complete example values. It shows the report the purchased export produces for YOUR input - it is not itself a report for any part.

Project: Sample project Part/Position: no real part Prepared by: Sample, not released

Overall assessment: OK - the buckling safety reaches S_req = 4, the compression check is satisfied.

Inputs

Euler case	Case 2: pinned / pinned (β = 1)
Free member length L	1,500 mm
Compressive force F	7,000 N
Cross-section	Round bar, d = 30 mm
Young's modulus E	210,000 N/mm²
Reference value R_e or σ_cB (compression check)	235 N/mm²
Limit slenderness λ_g	105
Tetmajer coefficients (a; b; c)	310; −1.14; 0
Required buckling safety S_req	4

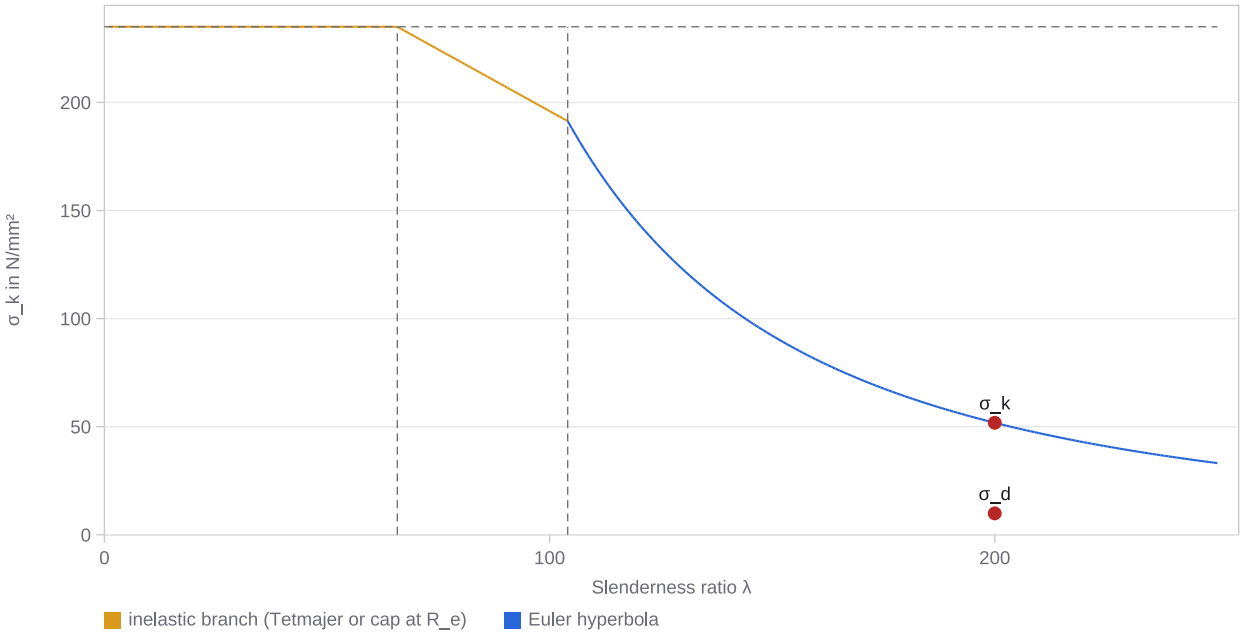
Cross-section and slenderness

Area A	706.86 mm²
Second moment of area I_min	39,761 mm⁴
Radius of gyration i	7.5 mm
Effective length l_k = β·L	1,500 mm
Slenderness ratio λ	200
Crushing limit λ_0	65.8
Range	elastic (Euler)
Buckling stress σ_k	51.82 N/mm²
Critical buckling load F_k	36,626 N
Allowable force F_all = F_k/4	9,157 N
Compressive stress σ_d = F/A	9.9 N/mm²

Verifications

Criterion	Value	Limit	Status
Buckling safety S = F_k/F	5.23	4	● OK
Compression check S = R_e/σ_d	23.73	1.5	● OK

Buckling stress curve σ_k(λ)



About the chart

The curve is a material property: it states which buckling stress σ_k is still carried at which slenderness ratio λ. Left of the switching point the inelastic branch applies, right of it the Euler hyperbola. The horizontal dashed line is the yield strength R_e, where the curve is capped. Of the two dashed verticals the left one marks the crushing limit λ_0 - left of it the curve is capped and buckling does not govern -, the right one the switching point from which Euler is used. The switching point is the intersection of the two curves and does not always coincide with the tabulated λ_g. Both dots sit at this member's slenderness ratio: σ_k on the curve is the stress that can be carried, σ_d below it the applied compressive stress. Their ratio σ_k/σ_d is the buckling safety S = F_k/F.

Calculation basis

Buckling verification for straight, centrically loaded compression members: the end conditions give the effective length l_k = β·L, and with the radius of gyration i = √(I_min/A) the slenderness ratio λ = l_k/i. In the elastic range the Euler hyperbola σ_k = π²·E/λ² applies, in the inelastic range the Tetmajer line or parabola; the buckling stress is capped at the yield strength R_e. The switch is made at the INTERSECTION of the two curves rather than at the tabulated λ_g: λ_g = π·√(E/σ_P) and the Tetmajer coefficients come from different sources and do not meet everywhere (for the line 335 − 0.62·λ the intersection lies at 85.8 while the tables state 85, 88 or 89). No buckling stress can exceed the Euler hyperbola, because in the inelastic range σ_k = π²·T_K/λ² applies with the buckling modulus T_K < E (Dubbel, 22nd ed., printed page C 40, eq. (8), after Engesser and v. Kármán). The buckling safety is S = F_k/F with F_k = σ_k·A. In addition, the compressive stress σ_d = F/A is checked against R_e.

Model: ideal straight member with constant cross-section under static compression, centric or with a given eccentricity e; imperfections are covered globally by the buckling safety factor. No torsional or lateral-torsional buckling of open thin-walled sections, no transverse load. Sizing tool for machine and fixture design - structural members must be verified per EN 1993-1-1 (buckling curves); do not mix the two concepts. Use the spring calculator for compression springs and the beam calculator for members under transverse load.

About this sample

All values on these pages come from a freely chosen example calculation and belong to no real part. The purchased export contains the same sections with your input, your header data (project, part, prepared by) and as searchable text. Pricing and scope: maschinenbaurechner.de/en/pricing