calculatoratoz.com

unitsconverters.com

Design against Fluctuating Load Formulas

Calculators! Examples! Conversions!

List of 61 Design against Fluctuating Load Formulas

Design against Fluctuating Load

Endurance Limit Approximate Estimation in Design

1) Endurance Limit for Axial Loading

fx $$S_{ea} = 0.8 \cdot S_e$$

Open Calculator

ex $$40.8\mathrm{N/mm^2} = 0.8 \cdot 51\mathrm{N/mm^2}$$

2) Endurance Limit given Endurance Limit for Axial Loading

fx $$S_e = \frac{S_{ea}}{0.8}$$

Open Calculator

ex $$52.5\mathrm{N/mm^2} = \frac{42\mathrm{N/mm^2}}{0.8}$$

3) Endurance Limit of Rotating Beam Specimen

fx $$S'_e = \frac{S_e}{K_b \cdot K_d \cdot K_c \cdot K_a}$$

Open Calculator

ex $$215.5234\mathrm{N/mm^2} = \frac{51\mathrm{N/mm^2}}{0.85 \cdot 0.34 \cdot 0.89 \cdot 0.92}$$

4) Endurance Limit of Rotating Beam Specimen of Steel

fx $$S'_e = 0.5 \cdot \sigma_{ut}$$

Open Calculator

ex $$220\mathrm{N/mm^2} = 0.5 \cdot 440\mathrm{N/mm^2}$$

5) Endurance Limit of Specimen

fx $$S_e = K_a \cdot K_b \cdot K_c \cdot K_d \cdot S'_e$$

Open Calculator

ex $$52.0593\mathrm{N/mm^2} = 0.92 \cdot 0.85 \cdot 0.89 \cdot 0.34 \cdot 220\mathrm{N/mm^2}$$

6) Endurance Limit Stress of Rotating Beam Specimen of Aluminium Alloys

fx $$S'_e = 0.4 \cdot \sigma_{ut}$$

Open Calculator

ex $$176\mathrm{N/mm^2} = 0.4 \cdot 440\mathrm{N/mm^2}$$

7) Endurance Limit Stress of Rotating Beam Specimen of Cast Aluminium Alloys

fx $$S'_e = 0.3 \cdot \sigma_{ut}$$

Open Calculator

ex $$132\mathrm{N/mm^2} = 0.3 \cdot 440\mathrm{N/mm^2}$$

8) Endurance Limit Stress of Rotating Beam Specimen of Cast Iron or Steels

fx $$S'_e = 0.4 \cdot \sigma_{ut}$$

Open Calculator

ex $$176\mathrm{N/mm^2} = 0.4 \cdot 440\mathrm{N/mm^2}$$

9) Fatigue Stress Concentration Factor given Modifying Factor

Open Calculator

$$k_f = \frac{1}{K_d}$$

$$2.941176 = \frac{1}{0.34}$$

10) Modifying Factor for Fluctuating Load given Fatigue Stress Concentration Factor

Open Calculator

$$K_d = \frac{1}{k_f}$$

$$0.465116 = \frac{1}{2.15}$$

11) Modifying Factor to Account for Stress Concentration

Open Calculator

$$K_d = \frac{S_e}{S'_e \cdot K_a \cdot K_b \cdot K_c}$$

$$0.333082 = \frac{51\mathrm{N/mm^2}}{220\mathrm{N/mm^2} \cdot 0.92 \cdot 0.85 \cdot 0.89}$$

12) Reliability Factor for Fluctuating Load

Open Calculator

$$K_c = \frac{S_e}{S'_e \cdot K_d \cdot K_a \cdot K_b}$$

$$0.87189 = \frac{51\mathrm{N/mm^2}}{220\mathrm{N/mm^2} \cdot 0.34 \cdot 0.92 \cdot 0.85}$$

13) Size Factor for Fluctuating Load

Open Calculator

$$K_b = \frac{S_e}{S'_e \cdot K_d \cdot K_c \cdot K_a}$$

$$0.832704 = \frac{51 \text{N/mm}^2}{220 \text{N/mm}^2 \cdot 0.34 \cdot 0.89 \cdot 0.92}$$

14) Stress Amplitude for Fluctuating load given Maximum Stress and Minimum Stress

Open Calculator

$$\sigma_a = \frac{\sigma_{\text{max fl}} - \sigma_{\text{min fl}}}{2}$$

$$30 \text{N/mm}^2 = \frac{95 \text{N/mm}^2 - 35 \text{N/mm}^2}{2}$$

15) Surface Finish Factor of Specimen

Open Calculator

$$K_a = \frac{S_e}{S'_e \cdot K_b \cdot K_c \cdot K_d}$$

$$0.90128 = \frac{51 \text{N/mm}^2}{220 \text{N/mm}^2 \cdot 0.85 \cdot 0.89 \cdot 0.34}$$

Notch Sensitivity for Fluctuating Loads

16) Fatigue Stress Concentration Factor

Open Calculator

fx $$k_f = \frac{Se_{nf}}{Se_n}$$

ex $$2.277778 = \frac{205\text{N/mm}^2}{90\text{N/mm}^2}$$

17) Fatigue Stress Concentration Factor given Notch Sensitivity Factor

Open Calculator

fx $$k_f = 1 + q \cdot (k_t - 1)$$

ex $$2 = 1 + 0.5 \cdot (3 - 1)$$

18) Notch Sensitivity Factor

Open Calculator

fx $$q = \frac{\sigma_{an}}{\sigma_{tn}}$$

ex $$0.727273 = \frac{80\text{N/mm}^2}{110\text{N/mm}^2}$$

19) Notch Sensitivity Factor given Fatigue Stress Concentration Factor

Open Calculator

fx $$q = \frac{k_f - 1}{k_t - 1}$$

ex $$0.575 = \frac{2.15 - 1}{3 - 1}$$

20) Theoretical Stress for Fluctuating Load

Open Calculator

fx $$\sigma = \sigma_o \cdot k_t$$

ex $$75\text{N/mm}^2 = 25\text{N/mm}^2 \cdot 3$$

Soderberg and Goodman Lines

21) Goodman Line Amplitude Stress

Open Calculator

fx $$\sigma_a = S_e \cdot \left(1 - \frac{\sigma_m}{\sigma_{ut}}\right)$$

ex $$45.20455\text{N/mm}^2 = 51\text{N/mm}^2 \cdot \left(1 - \frac{50\text{N/mm}^2}{440\text{N/mm}^2}\right)$$

22) Goodman Line Endurance Limit

Open Calculator

fx $$S_e = \frac{\sigma_a}{1 - \frac{\sigma_m}{\sigma_{ut}}}$$

ex $$33.84615\text{N/mm}^2 = \frac{30\text{N/mm}^2}{1 - \frac{50\text{N/mm}^2}{440\text{N/mm}^2}}$$

23) Goodman Line Mean Stress

Open Calculator

$$\sigma_m = \sigma_{ut} \cdot \left(1 - \frac{\sigma_a}{S_e}\right)$$

$$181.1765\text{N/mm}^2 = 440\text{N/mm}^2 \cdot \left(1 - \frac{30\text{N/mm}^2}{51\text{N/mm}^2}\right)$$

24) Goodman Line Ultimate Tensile Strength

Open Calculator

$$\sigma_{ut} = \frac{\sigma_m}{1 - \frac{\sigma_a}{S_e}}$$

$$121.4286\text{N/mm}^2 = \frac{50\text{N/mm}^2}{1 - \frac{30\text{N/mm}^2}{51\text{N/mm}^2}}$$

25) Limiting Value of Mean Stress

Open Calculator

$$S_m = f_s \cdot \sigma_m$$

$$100\text{N/mm}^2 = 2 \cdot 50\text{N/mm}^2$$

26) Limiting Value of Stress Amplitude

Open Calculator

$$S_a = f_s \cdot \sigma_a$$

$$60\text{N/mm}^2 = 2 \cdot 30\text{N/mm}^2$$

27) Permissible Mean Stress for Fluctuating Load

Open Calculator

fx $$\sigma_m = \frac{S_m}{f_s}$$

ex $$28.5\text{N/mm}^2 = \frac{57\text{N/mm}^2}{2}$$

28) Permissible Stress Amplitude for Fluctuating Load

Open Calculator

fx $$\sigma_a = \frac{S_a}{f_s}$$

ex $$57\text{N/mm}^2 = \frac{114\text{N/mm}^2}{2}$$

29) Slope of Line OE in Modified Goodman Diagram given Bending Amplitude and Mean Bending Moment

Open Calculator

fx $$m = \frac{M_{ba}}{M_{bm}}$$

ex $$1.5 = \frac{1800\text{N*mm}}{1200\text{N*mm}}$$

30) Slope of Line OE in Modified Goodman Diagram given Force Amplitude and Mean Force

Open Calculator

fx $$m = \frac{P_a}{P_m}$$

ex $$0.342105 = \frac{26\text{N}}{76\text{N}}$$

31) Slope of Line OE in Modified Goodman Diagram given Stress Amplitude and Mean Stress

Open Calculator

fx $$m = \frac{\sigma_a}{\sigma_m}$$

ex $$0.6 = \frac{30\text{N/mm}^2}{50\text{N/mm}^2}$$

32) Soderberg Line Amplitude Stress

Open Calculator

fx $$\sigma_a = S_e \cdot \left(1 - \frac{\sigma_m}{\sigma_{yt}}\right)$$

ex $$21\text{N/mm}^2 = 51\text{N/mm}^2 \cdot \left(1 - \frac{50\text{N/mm}^2}{85\text{N/mm}^2}\right)$$

33) Soderberg Line Endurance Limit

Open Calculator

fx $$S_e = \frac{\sigma_a}{1 - \frac{\sigma_m}{\sigma_{yt}}}$$

ex $$72.85714 \text{N/mm}^2 = \frac{30 \text{N/mm}^2}{1 - \frac{50 \text{N/mm}^2}{85 \text{N/mm}^2}}$$

34) Soderberg Line Mean stress

Open Calculator

fx $$\sigma_m = \sigma_{yt} \cdot \left(1 - \frac{\sigma_a}{S_e}\right)$$

ex $$35 \text{N/mm}^2 = 85 \text{N/mm}^2 \cdot \left(1 - \frac{30 \text{N/mm}^2}{51 \text{N/mm}^2}\right)$$

35) Soderberg Line Tensile Yield Strength

Open Calculator

fx $$\sigma_{yt} = \frac{\sigma_m}{1 - \frac{\sigma_a}{S_e}}$$

ex $$121.4286 \text{N/mm}^2 = \frac{50 \text{N/mm}^2}{1 - \frac{30 \text{N/mm}^2}{51 \text{N/mm}^2}}$$

Stress Concentration Factors in Design

36) Diameter of Shaft given Ratio of Torsional Strength of Shaft with Keyway to without Keyway

Open Calculator

fx $$d = \frac{0.2 \cdot b_k + 1.1 \cdot h}{1 - C}$$

ex $$45\text{mm} = \frac{0.2 \cdot 5\text{mm} + 1.1 \cdot 4\text{mm}}{1 - 0.88}$$

37) Height of Shaft Keyway given Ratio of Torsional Strength of Shaft with Keyway to without Keyway

Open Calculator

fx $$h = \frac{d}{1.1} \cdot \left(1 - C - 0.2 \cdot \frac{b_k}{d}\right)$$

ex $$4\text{mm} = \frac{45\text{mm}}{1.1} \cdot \left(1 - 0.88 - 0.2 \cdot \frac{5\text{mm}}{45\text{mm}}\right)$$

38) Highest Value of Actual Stress near Discontinuity

Open Calculator

fx $$\sigma a_{max} = k_f \cdot \sigma_o$$

ex $$53.75\text{N/mm}^2 = 2.15 \cdot 25\text{N/mm}^2$$

39) Mean Stress for Fluctuating Load

Open Calculator

fx $$\sigma_m = \frac{\sigma_{max} + \sigma_{min}}{2}$$

ex $$110\text{N/mm}^2 = \frac{180\text{N/mm}^2 + 40\text{N/mm}^2}{2}$$

40) Ratio of Torsional Strength of Shaft with Keyway to without Keyway

Open Calculator

fx $$C = 1 - 0.2 \cdot \frac{b_k}{d} - 1.1 \cdot \frac{h}{d}$$

ex $$0.88 = 1 - 0.2 \cdot \frac{5\text{mm}}{45\text{mm}} - 1.1 \cdot \frac{4\text{mm}}{45\text{mm}}$$

41) Theoretical Stress Concentration Factor

Open Calculator

fx $$k_t = \frac{\sigma a_{max}}{\sigma_o}$$

ex $$2.48 = \frac{62\text{N/mm}^2}{25\text{N/mm}^2}$$

42) Theoretical Stress Concentration Factor for Elliptical Crack

Open Calculator

fx $$k_t = 1 + \frac{a_e}{b_e}$$

ex $$3.133333 = 1 + \frac{32\text{mm}}{15\text{mm}}$$

43) Width of Shaft Keyway given Ratio of Torsional Strength of Shaft with Keyway to without Keyway

Open Calculator

fx $$b_k = 5 \cdot d \cdot \left(1 - C - 1.1 \cdot \frac{h}{d}\right)$$

ex $$5\text{mm} = 5 \cdot 45\text{mm} \cdot \left(1 - 0.88 - 1.1 \cdot \frac{4\text{mm}}{45\text{mm}}\right)$$

Flat Plate against Fluctuating Loads

44) Load on Flat Plate with Shoulder Fillet given Nominal Stress

Open Calculator

fx $$P = \sigma_o \cdot d_o \cdot t$$

ex $$8750\text{N} = 25\text{N/mm}^2 \cdot 35\text{mm} \cdot 10\text{mm}$$

45) Major Axis of Elliptical Crack Hole in Flat Plate given Theoretical Stress Concentration Factor

Open Calculator

fx $$a_e = b_e \cdot (k_t - 1)$$

ex $$30\text{mm} = 15\text{mm} \cdot (3 - 1)$$

46) Minor Axis of Elliptical Crack Hole in Flat Plate given Theoretical Stress Concentration Factor

Open Calculator

fx $$b_e = \frac{a_e}{k_t - 1}$$

ex $$16\text{mm} = \frac{32\text{mm}}{3 - 1}$$

47) Nominal Tensile Stress in Flat Plate with Shoulder Fillet

Open Calculator

$$\sigma_o = \frac{P}{d_o \cdot t}$$

$$25\text{N/mm}^2 = \frac{8750\text{N}}{35\text{mm} \cdot 10\text{mm}}$$

48) Smaller Width of Flat Plate with Shoulder Fillet given Nominal stress

Open Calculator

$$d_o = \frac{P}{\sigma_o \cdot t}$$

$$35\text{mm} = \frac{8750\text{N}}{25\text{N/mm}^2 \cdot 10\text{mm}}$$

49) Thickness of Flat Plate with Shoulder Fillet given Nominal Stress

Open Calculator

$$t = \frac{P}{\sigma_o \cdot d_o}$$

$$10\text{mm} = \frac{8750\text{N}}{25\text{N/mm}^2 \cdot 35\text{mm}}$$

Rectangular Plate against Fluctuating Loads

50) Diameter of Transverse Hole of Rectangular Plate with Stress Concentration given Nominal Stress

Open Calculator

fx $$d_h = w - \frac{P}{t \cdot \sigma_o}$$

ex $$35\text{mm} = 70\text{mm} - \frac{8750\text{N}}{10\text{mm} \cdot 25\text{N/mm}^2}$$

51) Load on Rectangular Plate with Transverse Hole given Nominal Stress

Open Calculator

fx $$P = \sigma_o \cdot (w - d_h) \cdot t$$

ex $$5250\text{N} = 25\text{N/mm}^2 \cdot (70\text{mm} - 49\text{mm}) \cdot 10\text{mm}$$

52) Nominal Tensile Stress in Rectangular Plate with Transverse Hole

Open Calculator

fx $$\sigma_o = \frac{P}{(w - d_h) \cdot t}$$

ex $$41.66667\text{N/mm}^2 = \frac{8750\text{N}}{(70\text{mm} - 49\text{mm}) \cdot 10\text{mm}}$$

53) Thickness of Rectangular Plate with Transverse Hole given Nominal Stress

Open Calculator

fx $$t = \frac{P}{(w - d_h) \cdot \sigma_o}$$

ex $$16.66667\text{mm} = \frac{8750\text{N}}{(70\text{mm} - 49\text{mm}) \cdot 25\text{N/mm}^2}$$

54) Width of Rectangular Plate with Transverse Hole given Nominal Stress

Open Calculator

fx $$w = \frac{P}{t \cdot \sigma_o} + d_h$$

ex $$84\text{mm} = \frac{8750\text{N}}{10\text{mm} \cdot 25\text{N/mm}^2} + 49\text{mm}$$

Round Shaft against Fluctuating Loads

55) Bending Moment in Round Shaft with Shoulder Fillet given Nominal Stress

Open Calculator

fx $$M_b = \frac{\sigma_o \cdot \pi \cdot d_{small}^3}{32}$$

ex $$14313.88\text{N*mm} = \frac{25\text{N/mm}^2 \cdot \pi \cdot (18\text{mm})^3}{32}$$

56) Nominal Bending Stress in Round Shaft with Shoulder Fillet

Open Calculator

fx $$\sigma_o = \frac{32 \cdot M_b}{\pi \cdot d_{small}^3}$$

ex $$24.45179\text{N/mm²} = \frac{32 \cdot 14000\text{N*mm}}{\pi \cdot (18\text{mm})^3}$$

57) Nominal Tensile Stress in Round Shaft with Shoulder Fillet

Open Calculator

fx $$\sigma_o = \frac{4 \cdot P}{\pi \cdot d_{small}^2}$$

ex $$34.38533\text{N/mm²} = \frac{4 \cdot 8750\text{N}}{\pi \cdot (18\text{mm})^2}$$

58) Nominal Torsional Stress in Round Shaft with Shoulder Fillet

Open Calculator

fx $$\sigma_o = \frac{16 \cdot (M_t t)}{\pi \cdot d_{small}^3}$$

ex $$24.88843\text{N/mm²} = \frac{16 \cdot 28500\text{N*mm}}{\pi \cdot (18\text{mm})^3}$$

59) Smaller Diameter of Round Shaft with Shoulder Fillet in Tension or Compression

Open Calculator

$$d_{small} = \sqrt{\frac{4 \cdot P}{\pi \cdot \sigma_o}}$$

$$21.11004\text{mm} = \sqrt{\frac{4 \cdot 8750\text{N}}{\pi \cdot 25\text{N/mm}^2}}$$

60) Tensile Force in Round Shaft with Shoulder Fillet given Nominal Stress

Open Calculator

$$P = \frac{\sigma_o \cdot \pi \cdot d_{small}^2}{4}$$

$$6361.725\text{N} = \frac{25\text{N/mm}^2 \cdot \pi \cdot (18\text{mm})^2}{4}$$

61) Torsional Moment in Round Shaft with Shoulder Fillet given Nominal Stress

Open Calculator

$$(M_t t) = \frac{\tau_o \cdot \pi \cdot d_{small}^3}{16}$$

$$22902.21\text{N*mm} = \frac{20\text{N/mm}^2 \cdot \pi \cdot (18\text{mm})^3}{16}$$

Variables Used

- a_e Major Axis of Elliptical Crack *(Millimeter)*
- b_e Minor Axis of Elliptical Crack *(Millimeter)*
- b_k Width of Key in Round Shaft *(Millimeter)*
- C Ratio of Shaft Strength with and without Keyway
- d Diameter of Shaft with Keyway *(Millimeter)*
- d_h Diameter of Transverse Hole in Plate *(Millimeter)*
- d_o Smaller Width of Plate *(Millimeter)*
- d_{small} Smaller Diameter of Shaft with Fillet *(Millimeter)*
- f_s Design Factor of Safety
- h Height of Shaft Keyway *(Millimeter)*
- K_a Surface Finish Factor
- K_b Size Factor
- K_c Reliabilty Factor
- K_d Modifying Factor for Stress Concentration
- k_f Fatigue Stress Concentration Factor
- k_t Theoretical Stress Concentration Factor
- m Slope of modified Goodman Line
- M_b Bending Moment on Round Shaft *(Newton Millimeter)*
- M_{ba} Bending Moment Amplitude *(Newton Millimeter)*
- M_{bm} Mean Bending Moment *(Newton Millimeter)*
- M_tt Torsional moment on Round Shaft *(Newton Millimeter)*

- **P** Load on Flat Plate *(Newton)*
- **P_a** Force Amplitude for Fluctuating Stress *(Newton)*
- **P_m** Mean Force for Fluctuating Stress *(Newton)*
- **q** Notch Sensitivity Factor
- **S_a** Limiting Value of Stress Amplitude *(Newton per Square Millimeter)*
- **S_e** Endurance Limit *(Newton per Square Millimeter)*
- **S'_e** Endurance Limit of Rotating Beam Specimen *(Newton per Square Millimeter)*
- **S_{ea}** Endurance Limit for Axial Loading *(Newton per Square Millimeter)*
- **S_m** Limiting Value of Mean Stress *(Newton per Square Millimeter)*
- **Se_n** Endurance Limit of Notched Specimen *(Newton per Square Millimeter)*
- **Se_{nf}** Endurance Limit of Notch Free Specimen *(Newton per Square Millimeter)*
- **t** Thickness of Plate *(Millimeter)*
- **w** Width of Plate *(Millimeter)*
- **σ** Theoretical Stress *(Newton per Square Millimeter)*
- **σ_a** Stress Amplitude for Fluctuating Load *(Newton per Square Millimeter)*
- **σ_{an}** Increase of Actual Stress over Nominal Stress *(Newton per Square Millimeter)*
- **σ_m** Mean Stress for Fluctuating Load *(Newton per Square Millimeter)*
- **$\sigma_{max\ fl}$** Maximum Stress Value for Fluctuating Load *(Newton per Square Millimeter)*
- **σ_{max}** Maximum Stress at Crack Tip *(Newton per Square Millimeter)*

- **$\sigma_{min\ fl}$** Minimum Stress Value for Fluctuating Load *(Newton per Square Millimeter)*
- **σ_{min}** Minimum Stress at Crack Tip *(Newton per Square Millimeter)*
- **σ_{o}** Nominal Stress *(Newton per Square Millimeter)*
- **σ_{tn}** Increase of Theoretical Stress over Nominal Stress *(Newton per Square Millimeter)*
- **σ_{ut}** Ultimate Tensile strength *(Newton per Square Millimeter)*
- **σ_{yt}** Tensile Yield Strength for Fluctuating load *(Newton per Square Millimeter)*
- **σa_{max}** Highest Value of Actual Stress near Discontinuity *(Newton per Square Millimeter)*
- **τ_{o}** Nominal Torsional Stress for Fluctuating Load *(Newton per Square Millimeter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Torque** in Newton Millimeter (N*mm)
  Torque Unit Conversion
- Measurement: **Stress** in Newton per Square Millimeter (N/mm²)
  Stress Unit Conversion

Check other formula lists

- Design against Fluctuating Load Formulas
- Design of Bevel Gear Formulas
- Design of Chain Drives Formulas
- Design of Cotter Joint Formulas
- Design of Coupling Formulas
- Design of Flywheel Formulas
- Design of Friction Clutches Formulas
- Design of Helical Gears Formulas
- Design of Keys Formulas
- Design of Knuckle Joint Formulas
- Design of Lever Formulas
- Design of Pressure Vessels Formulas
- Design of Shafts Formulas
- Design of Threaded Fasteners Formulas
- Power Screws Formulas
- Threaded Joints Formulas

Feel free to SHARE this document with your friends!

PDF Available in

English Spanish French German Russian Italian Portuguese Polish Dutch

12/14/2023 | 6:41:27 AM UTC *Please leave your feedback here...*