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Design against Fluctuating Load Formulas

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List of 61 Design against Fluctuating Load Formulas

Design against Fluctuating Load

Endurance Limit Approximate Estimation in Design

1) Endurance Limit for Axial Loading

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

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2_img.jpg\)](#)

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

2) Endurance Limit given Endurance Limit for Axial Loading

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

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa_img.jpg\)](#)

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

3) Endurance Limit of Rotating Beam Specimen

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

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d_img.jpg\)](#)

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



4) Endurance Limit of Rotating Beam Specimen of Steel

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 220N/mm^2 = 0.5 \cdot 440N/mm^2$$

5) Endurance Limit of Specimen

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 176N/mm^2 = 0.4 \cdot 440N/mm^2$$

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

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

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$ex \quad 132N/mm^2 = 0.3 \cdot 440N/mm^2$$

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

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

[Open Calculator !\[\]\(aff7c69c44a5e015f18c35867ef3f5c3_img.jpg\)](#)

$$ex \quad 176N/mm^2 = 0.4 \cdot 440N/mm^2$$



9) Fatigue Stress Concentration Factor given Modifying Factor

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

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

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

11) Modifying Factor to Account for Stress Concentration

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

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

12) Reliability Factor for Fluctuating Load

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

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

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



13) Size Factor for Fluctuating Load

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

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

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

15) Surface Finish Factor of Specimen

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

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



Notch Sensitivity for Fluctuating Loads

16) Fatigue Stress Concentration Factor

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

[Open Calculator !\[\]\(950a62bbddad88d64435fd35607dfc42_img.jpg\)](#)

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

17) Fatigue Stress Concentration Factor given Notch Sensitivity Factor

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

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719_img.jpg\)](#)

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

18) Notch Sensitivity Factor

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

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7_img.jpg\)](#)

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

19) Notch Sensitivity Factor given Fatigue Stress Concentration Factor

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

[Open Calculator !\[\]\(21226b58c700e5231ab98d27101bac58_img.jpg\)](#)

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



20) Theoretical Stress for Fluctuating Load

$$\text{fx } \sigma = \sigma_o \cdot k_t$$

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5_img.jpg\)](#)

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

Soderberg and Goodman Lines

21) Goodman Line Amplitude Stress

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

[Open Calculator !\[\]\(3cb60d42b10e53f9522bb0b392c1c4cd_img.jpg\)](#)

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

22) Goodman Line Endurance Limit

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

[Open Calculator !\[\]\(0d7ca0919e6c47bbd874bfa0189fe22e_img.jpg\)](#)

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



23) Goodman Line Mean Stress [Open Calculator !\[\]\(3d8c13c92b853674f749aac6fa869926_img.jpg\)](#)

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

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

24) Goodman Line Ultimate Tensile Strength [Open Calculator !\[\]\(17acf1afa8cdf0b67c53d4865a5ed469_img.jpg\)](#)

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

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

25) Limiting Value of Mean Stress [Open Calculator !\[\]\(d8ab143e904bfa3467271eec5af75a9b_img.jpg\)](#)

$$fx \quad S_m = f_s \cdot \sigma_m$$

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

26) Limiting Value of Stress Amplitude [Open Calculator !\[\]\(2b17f17ebbacc911bb0ff784ab641779_img.jpg\)](#)

$$fx \quad S_a = f_s \cdot \sigma_a$$

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



27) Permissible Mean Stress for Fluctuating Load

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

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0_img.jpg\)](#)

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

28) Permissible Stress Amplitude for Fluctuating Load

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

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(4b7a79268f6ba26c1471d4232fffa85a_img.jpg\)](#)

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



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

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

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010_img.jpg\)](#)

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

32) Soderberg Line Amplitude Stress

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

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd_img.jpg\)](#)

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



33) Soderberg Line Endurance Limit

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb_img.jpg\)](#)

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

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

34) Soderberg Line Mean stress

[Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1_img.jpg\)](#)

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

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

35) Soderberg Line Tensile Yield Strength

[Open Calculator !\[\]\(4fe57c3593bf1b21d272ae7ac8dfaf77_img.jpg\)](#)

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

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



Stress Concentration Factors in Design

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

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

[Open Calculator !\[\]\(23d9fc146e83b5c3013cfa32c784f8d5_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a_img.jpg\)](#)

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

38) Highest Value of Actual Stress near Discontinuity

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

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a_img.jpg\)](#)

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



39) Mean Stress for Fluctuating Load [Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff_img.jpg\)](#)

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

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

40) Ratio of Torsional Strength of Shaft with Keyway to without Keyway [Open Calculator !\[\]\(830769b31eeeaca920791081939ff8ba_img.jpg\)](#)

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

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

41) Theoretical Stress Concentration Factor [Open Calculator !\[\]\(47734e4656765d20df4fdbd5b7aff048_img.jpg\)](#)

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

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

42) Theoretical Stress Concentration Factor for Elliptical Crack [Open Calculator !\[\]\(41aea2746216b27a6939d696d8e035da_img.jpg\)](#)

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

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



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

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

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

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

Flat Plate against Fluctuating Loads

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

$$\text{fx } P = \sigma_o \cdot d_o \cdot t$$

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(21226b58c700e5231ab98d27101bac58_img.jpg\)](#)

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



47) Nominal Tensile Stress in Flat Plate with Shoulder Fillet

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2_img.jpg\)](#)

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



Rectangular Plate against Fluctuating Loads

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

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

[Open Calculator !\[\]\(96cc62f861fdd6e50510c0224a756dff_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(f95dab70c751fda7d824b8b03650f7aa_img.jpg\)](#)

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

52) Nominal Tensile Stress in Rectangular Plate with Transverse Hole

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

[Open Calculator !\[\]\(e9474ce1d70442456f8fe9c393ea149c_img.jpg\)](#)

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



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

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

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1_img.jpg\)](#)

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

Round Shaft against Fluctuating Loads

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

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

[Open Calculator !\[\]\(95b425611cbd2b8716a140cf67c81822_img.jpg\)](#)

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



56) Nominal Bending Stress in Round Shaft with Shoulder Fillet

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

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a_img.jpg\)](#)

$$\text{ex } 24.45179 \text{ N/mm}^2 = \frac{32 \cdot 14000 \text{ N*mm}}{\pi \cdot (18 \text{ mm})^3}$$

57) Nominal Tensile Stress in Round Shaft with Shoulder Fillet

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

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010_img.jpg\)](#)

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

58) Nominal Torsional Stress in Round Shaft with Shoulder Fillet

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

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd_img.jpg\)](#)

$$\text{ex } 24.88843 \text{ N/mm}^2 = \frac{16 \cdot 28500 \text{ N*mm}}{\pi \cdot (18 \text{ mm})^3}$$



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

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

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

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

$$\text{fx } (M_{tt}) = \frac{\tau_o \cdot \pi \cdot d_{\text{small}}^3}{16}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

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



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 Reliability 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)
- $M_{t,t}$ 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)
- **S_{en}** Endurance Limit of Notched Specimen (Newton per Square Millimeter)
- **S_{enf}** 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)
- **σ_{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)
- $\sigma_{\min}$ 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)
- $\sigma_{a\max}$ 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 



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