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Stress Concentration Factors in Design Formulas

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List of 26 Stress Concentration Factors in Design Formulas

Stress Concentration Factors in Design

Rectangular Plate against Fluctuating Loads

1) 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 $$35\text{mm} = 70\text{mm} - \frac{8750\text{N}}{10\text{mm} \cdot 25\text{N/mm}^2}$$

2) Highest Value of Actual Stress near Discontinuity

Open Calculator

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

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

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

Open Calculator

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

ex $$8747.5\text{N} = 25\text{N/mm}^2 \cdot (70\text{mm} - 35.01\text{mm}) \cdot 10\text{mm}$$

4) Nominal Tensile Stress in Rectangular Plate with Transverse Hole

Open Calculator

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

$$25.00714\text{N/mm}^2 = \frac{8750\text{N}}{(70\text{mm} - 35.01\text{mm}) \cdot 10\text{mm}}$$

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

Open Calculator

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

$$10.00286\text{mm} = \frac{8750\text{N}}{(70\text{mm} - 35.01\text{mm}) \cdot 25\text{N/mm}^2}$$

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

Open Calculator

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

$$70.01\text{mm} = \frac{8750\text{N}}{10\text{mm} \cdot 25\text{N/mm}^2} + 35.01\text{mm}$$

Round Shaft against Fluctuating Loads

7) 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 $$23089.1\text{N*mm} = \frac{25\text{N/mm²} \cdot \pi \cdot (21.11004\text{mm})^3}{32}$$

8) 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 $$45\text{mm} = \frac{0.2 \cdot 5\text{mm} + 1.1 \cdot 4\text{mm}}{1 - 0.88}$$

9) 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 $$4\text{mm} = \frac{45\text{mm}}{1.1} \cdot \left(1 - 0.88 - 0.2 \cdot \frac{5\text{mm}}{45\text{mm}}\right)$$

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10) 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 $$25\text{N/mm²} = \frac{32 \cdot 23089.1\text{N*mm}}{\pi \cdot (21.11004\text{mm})^3}$$

11) Nominal Tensile Stress in Round Shaft with Shoulder Fillet

Open Calculator

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

ex $$25\text{N/mm²} = \frac{4 \cdot 8750\text{N}}{\pi \cdot (21.11004\text{mm})^2}$$

12) Nominal Torsional Stress in Round Shaft with Shoulder Fillet

Open Calculator

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

ex $$20\text{N/mm²} = \frac{16 \cdot 36942.57\text{N*mm}}{\pi \cdot (21.11004\text{mm})^3}$$

13) 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 $$0.88 = 1 - 0.2 \cdot \frac{5\text{mm}}{45\text{mm}} - 1.1 \cdot \frac{4\text{mm}}{45\text{mm}}$$

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

Open Calculator

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

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

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

Open Calculator

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

ex $$8749.999\text{N} = \frac{25\text{N/mm}^2 \cdot \pi \cdot (21.11004\text{mm})^2}{4}$$

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

Open Calculator

fx $$M_t = \frac{\tau_o \cdot \pi \cdot d_{small}^3}{16}$$

ex $$36942.57\text{N*mm} = \frac{20\text{N/mm}^2 \cdot \pi \cdot (21.11004\text{mm})^3}{16}$$

17) 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

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

Open Calculator

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

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

19) 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 $$30\text{mm} = 15\text{mm} \cdot (3 - 1)$$

20) Mean Stress for Fluctuating Load

Open Calculator

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

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

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

Open Calculator

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

$$15\text{mm} = \frac{30\text{mm}}{3 - 1}$$

22) Nominal Tensile Stress in Flat Plate with Shoulder Fillet

Open Calculator

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

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

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

Open Calculator

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

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

24) Theoretical Stress Concentration Factor

Open Calculator

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

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

25) Theoretical Stress Concentration Factor for Elliptical Crack

Open Calculator

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

ex $$3 = 1 + \frac{30 \text{mm}}{15 \text{mm}}$$

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

Open Calculator

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

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

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
- 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)*
- h Height of Shaft Keyway *(Millimeter)*
- k_f Fatigue Stress Concentration Factor
- k_t Theoretical Stress Concentration Factor
- M_b Bending Moment on Round Shaft *(Newton Millimeter)*
- M_t Torsional Moment on Round Shaft *(Newton Millimeter)*
- P Load on Flat Plate *(Newton)*
- t Thickness of Plate *(Millimeter)*
- w Width of Plate *(Millimeter)*
- σ_m Mean Stress for Fluctuating Load *(Newton per Square Millimeter)*
- σ_{max} Maximum Stress at Crack Tip *(Newton per Square Millimeter)*
- σ_{min} Minimum Stress at Crack Tip *(Newton per Square Millimeter)*
- σ_o Nominal Stress *(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)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- 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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- **Soderberg and Goodman Lines Formulas**
- **Stress Concentration Factors in Design Formulas**

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