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Load and Strength Characteristics Formulas

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List of 13 Load and Strength Characteristics Formulas

Load and Strength Characteristics

1) Imaginary Force at Center of Gravity of Bolted Joint given Primary Shear Force

Open Calculator

fx $P = (P_1') \cdot n$

ex $12000\text{N} = 3000\text{N} \cdot 4$

2) Number of Bolts given Primary Shear Force

Open Calculator

fx $n = \frac{P}{P_1'}$

ex $4 = \frac{12000\text{N}}{3000\text{N}}$

3) Pre Load in Bolt given Amount of Compression in Parts Joined by Bolt

Open Calculator

fx $P_i = \delta_c \cdot k$

ex $16500\text{N} = 11\text{mm} \cdot 1500\text{N/mm}$

4) Pre Load in Bolt given Elongation of Bolt

Open Calculator

fx $$P_i = \delta_b \cdot (k_b')$$

ex $$15850\text{N} = 0.05\text{mm} \cdot 3.17\text{E}\hat{}5\text{N/mm}$$

5) Pre Load in Bolt given Wrench Torque

Open Calculator

fx $$P_i = \frac{M_t}{0.2 \cdot d}$$

ex $$16500\text{N} = \frac{49500\text{N*mm}}{0.2 \cdot 15\text{mm}}$$

6) Resultant Load on Bolt given Pre Load and External Load

Open Calculator

fx $$P_b = P_i + \Delta P$$

ex $$19000\text{N} = 16500\text{N} + 2500\text{N}$$

7) Stiffness of Bolt given Thickness of Parts Joined by Bolt

Open Calculator

fx $$(k_b') = \frac{\pi \cdot d^2 \cdot E}{4 \cdot l}$$

ex $$318086.3\text{N/mm} = \frac{\pi \cdot (15\text{mm})^2 \cdot 207000\text{N/mm}^2}{4 \cdot 115\text{mm}}$$

8) Tensile Force on Bolt given Maximum Tensile Stress in Bolt

Open Calculator

$$P_{tb} = \sigma t_{max} \cdot \frac{\pi}{4} \cdot d_c^2$$

$$9952.566\text{N} = 88\text{N/mm}^2 \cdot \frac{\pi}{4} \cdot (12\text{mm})^2$$

9) Tensile Force on Bolt in Shear

Open Calculator

$$P_{tb} = \pi \cdot d_c \cdot h \cdot \frac{S_{sy}}{f_s}$$

$$9997.804\text{N} = \pi \cdot 12\text{mm} \cdot 6\text{mm} \cdot \frac{132.6\text{N/mm}^2}{3}$$

10) Tensile Force on Bolt in Tension

Open Calculator

$$P_{tb} = \frac{\pi}{4} \cdot d_c^2 \cdot \frac{S_{yt}}{f_s}$$

$$10009.11\text{N} = \frac{\pi}{4} \cdot (12\text{mm})^2 \cdot \frac{265.5\text{N/mm}^2}{3}$$

11) Thickness of Parts Held Together by Bolt given Stiffness of Bolt

Open Calculator

$$l = \frac{\pi \cdot d^2 \cdot E}{4 \cdot (k_b')}$$

$$115.3941\text{mm} = \frac{\pi \cdot (15\text{mm})^2 \cdot 207000\text{N/mm}^2}{4 \cdot 3.17\text{E}\hat{}5\text{N/mm}}$$

12) Wrench Torque Required to Create Required Pre Load

Open Calculator

fx $$M_t = 0.2 \cdot P_i \cdot d$$

ex $$49500\text{N*mm} = 0.2 \cdot 16500\text{N} \cdot 15\text{mm}$$

13) Young's Modulus of Bolt given Stiffness of Bolt

Open Calculator

fx $$E = \frac{(k_b') \cdot l \cdot 4}{d^2 \cdot \pi}$$

ex $$206293.1\text{N/mm}^2 = \frac{3.17\text{E}\hat{}5\text{N/mm} \cdot 115\text{mm} \cdot 4}{(15\text{mm})^2 \cdot \pi}$$

Variables Used

- ΔP Load due to External Force on Bolt *(Newton)*
- d Nominal Bolt Diameter *(Millimeter)*
- d_c Core Diameter of Bolt *(Millimeter)*
- δ_b Elongation of Bolt *(Millimeter)*
- E Modulus of Elasticity of Bolt *(Newton per Square Millimeter)*
- f_s Factor of Safety of Bolted Joint
- h Height of Nut *(Millimeter)*
- k Combined Stiffness of Bolt *(Newton per Millimeter)*
- k_b' Stiffness of Bolt *(Newton per Millimeter)*
- l Total Thickness of Parts Held Together by Bolt *(Millimeter)*
- M_t Wrench Torque for Bolt Tightening *(Newton Millimeter)*
- n Number of Bolts in Bolted Joint
- P Imaginary Force on Bolt *(Newton)*
- P_1' Primary Shear Force on Bolt *(Newton)*
- P_b Resultant Load on Bolt *(Newton)*
- P_i Pre Load in Bolt *(Newton)*
- P_{tb} Tensile Force in Bolt *(Newton)*
- S_{sy} Shear Yield Strength of Bolt *(Newton per Square Millimeter)*
- S_{yt} Tensile Yield Strength of Bolt *(Newton per Square Millimeter)*
- δ_c Amount of Compression of Bolted Joint *(Millimeter)*
- σt_{max} Maximum Tensile Stress in Bolt *(Newton per Square Millimeter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- 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: **Stiffness Constant** in Newton per Millimeter (N/mm)
  Stiffness Constant Unit Conversion
- Measurement: **Stress** in Newton per Square Millimeter (N/mm²)
  Stress Unit Conversion

Check other formula lists

- **Joint Analysis Formulas**
- **Load and Strength Characteristics Formulas**

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