Important Load and Strength Characteristics Formulas PDF

Formulas

Examples

with Units

List of 13
Important Load and Strength Characteristics Formulas

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

Formula

$$P = P_1' \cdot n$$

Example with Units

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

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2) Number of Bolts given Primary Shear Force Formula

Formula

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

Example with Units

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

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

Formula

$$P_i = \delta_c \cdot k$$

Example with Units

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

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4) Pre Load in Bolt given Elongation of Bolt Formula

Formula

$$P_i = \delta_b \cdot k_b'$$

Example with Units

$$15850\,\text{N} = 0.05\,\text{mm} \cdot 3.17\text{E+}5\,\text{N/mm}$$

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5) Pre Load in Bolt given Wrench Torque Formula

Formula

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

Example with Units

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

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

Formula

$$P_b = P_i + \Delta P$$

Example with Units

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

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

Formula

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

Example with Units

$$318086.2562\,\text{N/mm} = \frac{3.1416 \cdot 15\,\text{mm}^2 \cdot 207000\,\text{N/mm}^2}{4 \cdot 115\,\text{mm}}$$

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

Formula

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

Example with Units

$$9952.5655\,\text{N} = 88\,\text{N/mm}^2 \cdot \frac{3.1416}{4} \cdot 12\,\text{mm}^2$$

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9) Tensile Force on Bolt in Shear Formula

Formula

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

Example with Units

$$9997.8045\,\text{N} = 3.1416 \cdot 12\,\text{mm} \cdot 6\,\text{mm} \cdot \frac{132.6\,\text{N/mm}^2}{3}$$

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10) Tensile Force on Bolt in Tension Formula

Formula

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

Example with Units

$$10009.1142\,\text{N} = \frac{3.1416}{4} \cdot 12\,\text{mm}^2 \cdot \frac{265.5\,\text{N/mm}^2}{3}$$

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

Formula

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

Example with Units

$$115.3941\,\text{mm} = \frac{3.1416 \cdot 15\,\text{mm}^2 \cdot 207000\,\text{N/mm}^2}{4 \cdot 3.17\text{E+}5\,\text{N/mm}}$$

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12) Wrench Torque Required to Create Required Pre Load Formula

Formula

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

Example with Units

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

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

Formula

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

Example with Units

$$206293.1005\,\text{N/mm}^2 = \frac{3.17\text{E+}5\,\text{N/mm} \cdot 115\,\text{mm} \cdot 4}{15\,\text{mm}^2 \cdot 3.1416}$$

Variables used in list of Load and Strength Characteristics Formulas above

- 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 in list of Load and Strength Characteristics Formulas above

- constant(s): **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 ➡

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