Important Threaded Bolted Joints Formulas PDF

Formulas
Examples
with Units

List of 34
Important Threaded Bolted Joints Formulas

1) Bolt Dimensions Formulas

1.1) Core Diameter of Bolt given Maximum Tensile Stress in Bolt Formula

Evaluate Formula

Formula

$$d_c = \sqrt{\frac{P_{tb}}{\left(\frac{\pi}{4}\right) \cdot \sigma t_{max}}}$$

Example with Units

$$12.0225\,\text{mm} = \sqrt{\frac{9990\,\text{N}}{\left(\frac{3.1416}{4}\right) \cdot 88\,\text{N/mm}^2}}$$

1.2) Core Diameter of Bolt given Shear Area of Nut Formula

Evaluate Formula

Formula

$$d_c = \frac{A}{\pi \cdot h}$$

Example with Units

$$11.9897\,\text{mm} = \frac{226\,\text{mm}^2}{3.1416 \cdot 6\,\text{mm}}$$

1.3) Core Diameter of Bolt given Tensile Force on Bolt in Shear Formula

Evaluate Formula

Formula

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

Example with Units

$$11.9906\,\text{mm} = 9990\,\text{N} \cdot \frac{3}{3.1416 \cdot 132.6\,\text{N/mm}^2 \cdot 6\,\text{mm}}$$

1.4) Core Diameter of Bolt given Tensile Force on Bolt in Tension Formula

Evaluate Formula

Formula

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

Example with Units

$$11.9885\,\text{mm} = \sqrt{\frac{9990\,\text{N}}{\frac{3.1416}{4} \cdot \frac{265.5\,\text{N/mm}^2}{3}}}$$

1.5) Nominal Diameter of Bolt given Diameter of Hole inside Bolt Formula

Evaluate Formula

Formula

$$d = \sqrt{d_1^2 + d_c^2}$$

Example with Units

$$15\,\text{mm} = \sqrt{9\,\text{mm}^2 + 12\,\text{mm}^2}$$

1.6) Nominal Diameter of Bolt given Height of Standard Nut Formula

Evaluate Formula

Formula

$$d = \frac{h}{0.8}$$

Example with Units

$$7.5\,\text{mm} = \frac{6\,\text{mm}}{0.8}$$

1.7) Nominal Diameter of Bolt given Stiffness of Bolt Formula

Evaluate Formula

Formula

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

Example with Units

$$14.9744\,\text{mm} = \sqrt{\frac{3.17E{+}5\,\text{N/mm} \cdot 115\,\text{mm} \cdot 4}{207000\,\text{N/mm}^2 \cdot 3.1416}}$$

1.8) Nominal Diameter of Bolt given Wrench Torque Formula

Evaluate Formula

Formula

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

Example with Units

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

2) Joint Analysis Formulas

2.1) Amount of Compression in Parts Joined by Bolt Formula

Evaluate Formula

Formula

$$\delta_c = \frac{P_i}{k}$$

Example with Units

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

2.2) Elongation of Bolt under Action of Pre Load Formula

Evaluate Formula

Formula

$$\delta_b = \frac{P_i}{k_b'}$$

Example with Units

$$0.0521\,\text{mm} = \frac{16500\,\text{N}}{3.17E{+}5\,\text{N/mm}}$$

2.3) Factor of Safety given Tensile Force on Bolt in Tension Formula

Evaluate Formula

Formula

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

Example with Units

$$3.0057 = \frac{3.1416}{4} \cdot 12\,\text{mm}^2 \cdot \frac{265.5\,\text{N/mm}^2}{9990\,\text{N}}$$

2.4) Maximum Tensile Stress in Bolt Formula

Evaluate Formula

Formula

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

Example with Units

$$88.331\,\text{N/mm}^2 = \frac{9990\,\text{N}}{\frac{3.1416}{4} \cdot 12\,\text{mm}^2}$$

2.5) Primary Shear Force of Eccentrically Loaded Bolted Connection Formula

Evaluate Formula

Formula

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

Example with Units

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

2.6) Yield Strength of Bolt in Shear given Tensile Force on Bolt in Shear Formula

Evaluate Formula

Formula

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

Example with Units

$$132.4965\,\text{N/mm}^2 = 9990\,\text{N} \cdot \frac{3}{3.1416 \cdot 12\,\text{mm} \cdot 6\,\text{mm}}$$

2.7) Yield Strength of Bolt in Tension given Tensile Force on Bolt in Shear Formula

Evaluate Formula

Formula

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

Example with Units

$$264.993\,\text{N/mm}^2 = \frac{2 \cdot 9990\,\text{N} \cdot 3}{3.1416 \cdot 12\,\text{mm} \cdot 6\,\text{mm}}$$

2.8) Yield Strength of Bolt in Tension given Tensile Force on Bolt in Tension Formula

Evaluate Formula

Formula

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

Example with Units

$$264.993\,\text{N/mm}^2 = 4 \cdot 9990\,\text{N} \cdot \frac{3}{3.1416 \cdot 12\,\text{mm}^2}$$

3) Load and Strength Characteristics Formulas

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

Evaluate Formula

Formula

$$P = P_1' \cdot n$$

Example with Units

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

3.2) Number of Bolts given Primary Shear Force Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

$$P_i = \delta_c \cdot k$$

Example with Units

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

3.4) Pre Load in Bolt given Elongation of Bolt Formula

Evaluate Formula

Formula

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

Example with Units

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

3.5) Pre Load in Bolt given Wrench Torque Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

$$P_b = P_i + \Delta P$$

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

3.9) Tensile Force on Bolt in Shear Formula

Evaluate Formula

Formula

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

Example with Units

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

3.10) Tensile Force on Bolt in Tension Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

3.12) Wrench Torque Required to Create Required Pre Load Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

$$206293.1005\,\text{N/mm²} = \frac{3.17\text{E+}5\,\text{N/mm} \cdot 115\,\text{mm} \cdot 4}{15\,\text{mm}^2 \cdot 3.1416}$$

4) Nut Dimensions Formulas

4.1) Diameter of Hole Inside Bolt Formula

Evaluate Formula

Formula

$$d_1 = \sqrt{d^2 - d_c^2}$$

Example with Units

$$9\,\text{mm} = \sqrt{15\,\text{mm}^2 - 12\,\text{mm}^2}$$

4.2) Height of Nut given Shear Area of Nut Formula

Evaluate Formula

Formula

$$h = \frac{A}{\pi \cdot d_c}$$

Example with Units

$$5.9948\,\text{mm} = \frac{226\,\text{mm²}}{3.1416 \cdot 12\,\text{mm}}$$

4.3) Height of Nut given Strength of Bolt in Shear Formula

Evaluate Formula

Formula

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

Example with Units

$$5.9953\,\text{mm} = 9990\,\text{N} \cdot \frac{3}{3.1416 \cdot 12\,\text{mm} \cdot 132.6\,\text{N/mm²}}$$

4.4) Height of Standard Nut Formula

Evaluate Formula

Formula

$$h = 0.8 \cdot d$$

Example with Units

$$12\,\text{mm} = 0.8 \cdot 15\,\text{mm}$$

4.5) Shear Area of Nut Formula

Evaluate Formula

Formula

$$A = \pi \cdot d_c \cdot h$$

Example with Units

$$226.1947\,\text{mm²} = 3.1416 \cdot 12\,\text{mm} \cdot 6\,\text{mm}$$

Variables used in list of Threaded Bolted Joints Formulas above

- ΔP Load due to External Force on Bolt *(Newton)*
- **A** Shear Area of Nut *(Square Millimeter)*
- **d** Nominal Bolt Diameter *(Millimeter)*
- d_1 Diameter of Hole Inside Bolt *(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 Threaded Bolted Joints Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **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: **Area** in Square Millimeter (mm²) *Area 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*

Download other Important Design of Coupling PDFs

- Important Design of Cotter Joint Formulas
- Important Design of Knuckle Joint Formulas
- Important Design of Rigid Flange Coupling Formulas
- Important Packing Formulas
- Important Retaining Rings and Circlips Formulas
- Important Riveted Joints Formulas
- Important Seals Formulas
- Important Threaded Bolted Joints Formulas

Try our Unique Visual Calculators

- Percentage error
- LCM of three numbers
- Subtract fraction

Please SHARE this PDF with someone who needs it!

This PDF can be downloaded in these languages

English Spanish French German Russian Italian Portuguese Polish Dutch

9/18/2024 | 11:08:35 AM UTC