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Threaded Bolted Joints Formulas

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List of 34 Threaded Bolted Joints Formulas

Threaded Bolted Joints

Bolt Dimensions

1) Core Diameter of Bolt given Maximum Tensile Stress in Bolt

Open Calculator

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

ex $$12.02255\text{mm} = \sqrt{\frac{9990\text{N}}{\left(\frac{\pi}{4}\right) \cdot 88\text{N/mm}^2}}$$

2) Core Diameter of Bolt given Shear Area of Nut

Open Calculator

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

ex $$11.98967\text{mm} = \frac{226\text{mm}^2}{\pi \cdot 6\text{mm}}$$

3) Core Diameter of Bolt given Tensile Force on Bolt in Shear

Open Calculator

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

$$11.99063\text{mm} = 9990\text{N} \cdot \frac{3}{\pi \cdot 132.6\text{N/mm}^2 \cdot 6\text{mm}}$$

4) Core Diameter of Bolt given Tensile Force on Bolt in Tension

Open Calculator

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

$$11.98854\text{mm} = \sqrt{\frac{9990\text{N}}{\frac{\pi}{4} \cdot \frac{265.5\text{N/mm}^2}{3}}}$$

5) Nominal Diameter of Bolt given Diameter of Hole inside Bolt

Open Calculator

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

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

6) Nominal Diameter of Bolt given Height of Standard Nut

Open Calculator

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

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

7) Nominal Diameter of Bolt given Stiffness of Bolt

Open Calculator

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

ex $$14.97437\text{mm} = \sqrt{\frac{3.17\text{E\^{}5N/mm} \cdot 115\text{mm} \cdot 4}{207000\text{N/mm}^2 \cdot \pi}}$$

8) Nominal Diameter of Bolt given Wrench Torque

Open Calculator

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

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

Joint Analysis

9) Amount of Compression in Parts Joined by Bolt

Open Calculator

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

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

10) Elongation of Bolt under Action of Pre Load

Open Calculator

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

ex $$0.05205\text{mm} = \frac{16500\text{N}}{3.17\text{E\^{}5N/mm}}$$

11) Factor of Safety given Tensile Force on Bolt in Tension

Open Calculator

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

ex $$3.00574 = \frac{\pi}{4} \cdot (12\text{mm})^2 \cdot \frac{265.5\text{N/mm}^2}{9990\text{N}}$$

12) Maximum Tensile Stress in Bolt

Open Calculator

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

ex $$88.33099\text{N/mm}^2 = \frac{9990\text{N}}{\frac{\pi}{4} \cdot (12\text{mm})^2}$$

13) Primary Shear Force of Eccentrically Loaded Bolted Connection

Open Calculator

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

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

14) Yield Strength of Bolt in Shear given Tensile Force on Bolt in Shear

Open Calculator

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

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

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

Open Calculator

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

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

16) Yield Strength of Bolt in Tension given Tensile Force on Bolt in Tension

Open Calculator

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

$$264.993\text{N/mm}^2 = 4 \cdot 9990\text{N} \cdot \frac{3}{\pi \cdot (12\text{mm})^2}$$

Load and Strength Characteristics

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

Open Calculator

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

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

18) Number of Bolts given Primary Shear Force

Open Calculator

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

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

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

Open Calculator

fx $$P_i = \delta_c \cdot k$$

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

20) Pre Load in Bolt given Elongation of Bolt

Open Calculator

fx $$P_i = \delta_b \cdot (k_b\text{'})$$

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

21) Pre Load in Bolt given Wrench Torque

Open Calculator

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

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

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

Open Calculator

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

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

23) 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 $$318086.3\text{N/mm} = \frac{\pi \cdot (15\text{mm})^2 \cdot 207000\text{N/mm}^2}{4 \cdot 115\text{mm}}$$

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

Open Calculator

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

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

25) Tensile Force on Bolt in Shear

Open Calculator

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

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

26) Tensile Force on Bolt in Tension

Open Calculator

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

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

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

Open Calculator

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

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

28) Wrench Torque Required to Create Required Pre Load

Open Calculator

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

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

29) 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 $$206293.1\text{N/mm}^2 = \frac{3.17\text{E}^\wedge 5\text{N/mm} \cdot 115\text{mm} \cdot 4}{(15\text{mm})^2 \cdot \pi}$$

Nut Dimensions

30) Diameter of Hole Inside Bolt

Open Calculator

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

ex $$9\text{mm} = \sqrt{(15\text{mm})^2 - (12\text{mm})^2}$$

31) Height of Nut given Shear Area of Nut

Open Calculator

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

ex $$5.994836\text{mm} = \frac{226\text{mm}^2}{\pi \cdot 12\text{mm}}$$

32) Height of Nut given Strength of Bolt in Shear

Open Calculator

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

ex $$5.995316\text{mm} = 9990\text{N} \cdot \frac{3}{\pi \cdot 12\text{mm} \cdot 132.6\text{N}/\text{mm}^2}$$

33) Height of Standard Nut

Open Calculator

fx $$h = 0.8 \cdot d$$

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

34) Shear Area of Nut

Open Calculator

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

ex $$226.1947\text{mm}^2 = \pi \cdot 12\text{mm} \cdot 6\text{mm}$$

Variables Used

- 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

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- 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

Check other formula lists

- Design of Clamp and Muff Coupling Formulas
- Design of Cotter Joint Formulas
- Design of Knuckle Joint Formulas
- Packing Formulas
- Retaining Rings and Circlips Formulas
- Riveted Joints Formulas
- Seals Formulas
- Threaded Bolted Joints Formulas
- Welded Joints Formulas

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