



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

$$\mathbf{f}$$
 $\mathrm{d_c} = \sqrt{rac{\mathrm{P_{tb}}}{\left(rac{\pi}{4}
ight) \cdot \mathrm{\sigma t_{max}}}}$

Open Calculator

$$extbf{ex} 12.02255 extrm{mm} = \sqrt{rac{9990 extrm{N}}{\left(rac{\pi}{4}
ight) \cdot 88 extrm{N/mm}^2}}$$

2) Core Diameter of Bolt given Shear Area of Nut

$$\mathrm{d_c} = rac{\mathrm{A}}{\pi \cdot \mathrm{h}}$$

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



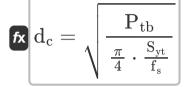
3) Core Diameter of Bolt given Tensile Force on Bolt in Shear

 $\left| \mathrm{d_c} = \mathrm{P_{tb}} \cdot rac{\mathrm{f_s}}{\pi \cdot \mathrm{S_{sv}} \cdot \mathrm{h}}
ight|$

Open Calculator 🗗

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

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



Open Calculator

ex
$$11.98854 \mathrm{mm} = \sqrt{rac{9990 \mathrm{N}}{rac{\pi}{4} \cdot rac{265.5 \mathrm{N/mm^2}}{3}}}$$

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

$$\mathbf{f}$$
 $\mathrm{d}=\sqrt{\mathrm{d}_1^2+\mathrm{d}_\mathrm{c}^2}$

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



6) Nominal Diameter of Bolt given Height of Standard Nut 🛂



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

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

7) Nominal Diameter of Bolt given Stiffness of Bolt 🗗



$$extbf{d} = \sqrt{rac{(k_{
m b}') \cdot l \cdot 4}{E \cdot \pi}}$$

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

8) Nominal Diameter of Bolt given Wrench Torque



$$\mathrm{fz} \! \left[\mathrm{d} = rac{\mathrm{M_t}}{0.2 \cdot \mathrm{P_i}}
ight]$$

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

Joint Analysis 🗗

9) Amount of Compression in Parts Joined by Bolt

$$\delta_{\mathrm{c}} = rac{\mathrm{P_{i}}}{\mathrm{k}}$$

Open Calculator

$$11 {
m mm} = rac{16500 {
m N}}{1500 {
m N/mm}}$$

10) Elongation of Bolt under Action of Pre Load

$$\delta_{\mathrm{b}} = rac{\mathrm{P_{i}}}{\mathrm{k_{b}}},$$

Open Calculator

$$0.05205 \mathrm{mm} = rac{16500 \mathrm{N}}{3.17 \mathrm{E} \hat{\ } 5 \mathrm{N/mm}}$$

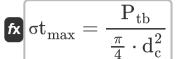
11) Factor of Safety given Tensile Force on Bolt in Tension 🖸

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

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



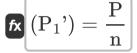
12) Maximum Tensile Stress in Bolt 🛂



Open Calculator

 $ext{ex} 88.33099 ext{N/mm}^2 = rac{9990 ext{N}}{rac{\pi}{4} \cdot \left(12 ext{mm}
ight)^2}$

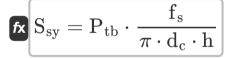
13) Primary Shear Force of Eccentrically Loaded Bolted Connection



Open Calculator

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

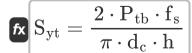
14) Yield Strength of Bolt in Shear given Tensile Force on Bolt in Shear



Open Calculator 🖸

 $extbf{ex} 132.4965 ext{N/mm}^2 = 9990 ext{N} \cdot rac{3}{\pi \cdot 12 ext{mm} \cdot 6 ext{mm}}$

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



Open Calculator

extstyle ext







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

$$\left|\mathbf{f}_{\mathbf{x}}
ight|\mathbf{S}_{\mathrm{yt}}=4\cdot\mathbf{P}_{\mathrm{tb}}\cdotrac{\mathbf{f}_{\mathrm{s}}}{\pi\cdot\mathbf{d}_{\mathrm{c}}^{2}}$$

Open Calculator

 $ext{ex} \ 264.993 ext{N/mm}^2 = 4 \cdot 9990 ext{N} \cdot rac{3}{\pi \cdot (12 ext{mm})^2}$

Load and Strength Characteristics &

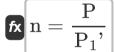
17) Imaginary Force at Center of Gravity of Bolted Joint given Primary Shear Force

 $\mathbf{f} \mathbf{x} = (\mathbf{P}_1') \cdot \mathbf{n}$

Open Calculator

 $12000N = 3000N \cdot 4$

18) Number of Bolts given Primary Shear Force 🗗



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



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

fx $P_i = \delta_c \cdot k$

Open Calculator

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

20) Pre Load in Bolt given Elongation of Bolt

fx $P_{i} = \delta_{b} \cdot (k_{b}$ ')

Open Calculator

$$= 15850 N = 0.05 mm \cdot 3.17 E^5 N/mm$$

21) Pre Load in Bolt given Wrench Torque

 $extbf{P}_{
m i} = rac{ ext{M}_{
m t}}{0.2 \cdot ext{d}}$

Open Calculator

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 🖸

fx ${
m P_b} = {
m P_i} + \Delta {
m P}$

$$= 19000 N = 16500 N + 2500 N$$



23) Stiffness of Bolt given Thickness of Parts Joined by Bolt 🗹

 $(\mathbf{k_b}') = rac{\pi \cdot \mathrm{d}^2 \cdot \mathrm{E}}{4 \cdot 1}$

Open Calculator

 $ag{318086.3 ext{N/mm}} = rac{\pi \cdot (15 ext{mm})^2 \cdot 207000 ext{N/mm}^2}{4 \cdot 115 ext{mm}}$

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

 $\left|\mathbf{r}
ight|\mathrm{P_{tb}}=\sigma t_{\mathrm{max}}\cdotrac{\pi}{arDelta}\cdot\mathrm{d}_{\mathrm{c}}^{2}$

Open Calculator

 $extbf{ex}$ $9952.566 ext{N} = 88 ext{N/mm}^2 \cdot rac{\pi}{ extsf{A}} \cdot (12 ext{mm})^2$

25) Tensile Force on Bolt in Shear 🖸

 $\left| \mathbf{F}_{\mathrm{tb}}
ight| \mathbf{P}_{\mathrm{tb}} = \pi \cdot \mathbf{d}_{\mathrm{c}} \cdot \mathbf{h} \cdot rac{\mathbf{S}_{\mathrm{sy}}}{\mathbf{f}_{\mathrm{c}}}$

Open Calculator 2

26) Tensile Force on Bolt in Tension 🛂

 $\left| \mathbf{F}_{\mathrm{tb}}
ight| = rac{\pi}{4} \cdot \mathrm{d_c^2} \cdot rac{\mathrm{S}_{\mathrm{yt}}}{\mathrm{f}} \, .$

Open Calculator

 $ext{ex} \ 10009.11 ext{N} = rac{\pi}{4} \cdot (12 ext{mm})^2 \cdot rac{265.5 ext{N/mm}^2}{2}$

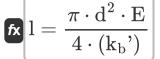
extstyle ext







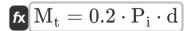
27) Thickness of Parts Held Together by Bolt given Stiffness of Bolt



Open Calculator 🚰

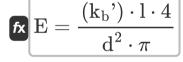
ex $115.3941 \mathrm{mm} = rac{\pi \cdot (15 \mathrm{mm})^2 \cdot 207000 \mathrm{N/mm^2}}{4 \cdot 3.17 \mathrm{E}^5 \mathrm{N/mm}}$

28) Wrench Torque Required to Create Required Pre Load



Open Calculator

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



Open Calculator

 $oxed{ex} 206293.1 ext{N/mm}^2 = rac{3.17 ext{E} ilde{5} ext{N/mm} \cdot 115 ext{mm} \cdot 4}{(15 ext{mm})^2 \cdot \pi}$

Nut Dimensions

30) Diameter of Hole Inside Bolt

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

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





31) Height of Nut given Shear Area of Nut

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

Open Calculator

ex 5.994836mm = $\frac{220...}{\pi \cdot 12$ mm $226 mm^2$

32) Height of Nut given Strength of Bolt in Shear 🗗

 $\mathbf{f}_{\mathbf{k}} = \mathrm{P}_{\mathrm{tb}} \cdot rac{\mathrm{f}_{\mathrm{s}}}{\pi \cdot \mathrm{d}_{\mathrm{c}} \cdot \mathrm{S}_{\mathrm{sv}}}$

 $= 5.995316 \mathrm{mm} = 9990 \mathrm{N} \cdot \frac{5}{\pi \cdot 12 \mathrm{mm} \cdot 132.6 \mathrm{N/mm^2}}$

33) Height of Standard Nut

fx $h = 0.8 \cdot d$ $12 \text{mm} = 0.8 \cdot 15 \text{mm}$ Open Calculator 2

34) Shear Area of Nut

fx $A = \pi \cdot d_{
m c} \cdot h$

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

Open Calculator 2



Variables Used

- ΔP Load due to External Force on Bolt (Newton)
- A Shear Area of Nut (Square Millimeter)
- **d** Nominal Bolt Diameter (Millimeter)
- d₁ Diameter of Hole Inside Bolt (Millimeter)
- d_c Core Diameter of Bolt (Millimeter)
- δ_h Elongation of Bolt (Millimeter)
- E Modulus of Elasticity of Bolt (Newton per Square Millimeter)
- fs 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)
- I 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)
- P₁' Primary Shear Force on Bolt (Newton)
- P_b Resultant Load on Bolt (Newton)
- Pi Pre Load in Bolt (Newton)
- Pth Tensile Force in Bolt (Newton)
- S_{sy} Shear Yield Strength of Bolt (Newton per Square Millimeter)
- S_{vt} 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)

 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





Check other formula lists

- Design of Cotter Joint Formulas
- Design of Knuckle Joint Formulas
- Packing Formulas
- Retaining Rings and Circlips
 Formulas

- Riveted Joints Formulas
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