



Threaded Bolted Joints Formulas

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Examples!

Conversions!

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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

$$\mathrm{d}_\mathrm{c} = \sqrt{rac{\mathrm{P}_\mathrm{tb}}{\left(rac{\pi}{4}
ight) \cdot \mathrm{\sigma} t_\mathrm{max}}}$$

Open Calculator

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

2) Core Diameter of Bolt given Shear Area of Nut

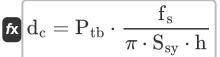
$$\mathrm{d_c} = rac{\mathrm{A}}{\pi \cdot \mathrm{h}}$$

Open Calculator 🗗

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



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



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

$$\mathbf{f}$$
 $\mathbf{d}_{\mathrm{c}} = \sqrt{rac{\mathrm{P}_{\mathrm{tb}}}{rac{\pi}{4} \cdot rac{\mathrm{S}_{\mathrm{yt}}}{\mathrm{f}_{\mathrm{s}}}}}$

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

$$\mathbf{f}\mathbf{x} \left[\mathbf{d} = \sqrt{\mathbf{d}_1^2 + \mathbf{d}_\mathrm{c}^2}
ight]$$

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



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



Open Calculator

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

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

7) Nominal Diameter of Bolt given Stiffness of Bolt 🗗

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

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

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

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



Joint Analysis 🗗

9) Amount of Compression in Parts Joined by Bolt 🗗

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

Open Calculator

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

10) Elongation of Bolt under Action of Pre Load

16500N

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

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 🛂

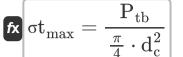
$$\mathbf{f_s} = rac{\pi}{4} \cdot \mathrm{d_c^2} \cdot rac{\mathrm{S_{yt}}}{\mathrm{P_{tb}}}$$

Open Calculator

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



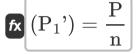
12) Maximum Tensile Stress in Bolt 🗗



Open Calculator

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

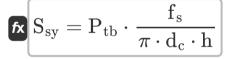
13) Primary Shear Force of Eccentrically Loaded Bolted Connection



Open Calculator

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

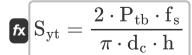
14) Yield Strength of Bolt in Shear given Tensile Force on Bolt in Shear



Open Calculator 🖸

 $ag{232.4965 ext{N/mm}^2 = 9990 ext{N} \cdot rac{3}{\pi \cdot 12 ext{mm} \cdot 6 ext{mm}}}$

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



Open Calculator

 $\mathbf{ex} \left[264.993 \mathrm{N/mm^2} = rac{2 \cdot 9990 \mathrm{N} \cdot 3}{\pi \cdot 12 \mathrm{mm} \cdot 6 \mathrm{mm}}
ight]$







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

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

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 &

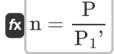
17) Imaginary Force at Center of Gravity of Bolted Joint given Primary Shear Force

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

Open Calculator

 $12000N = 3000N \cdot 4$

18) Number of Bolts given Primary Shear Force 🗗



Open Calculator 2



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

fx $\mathrm{P_i} = \delta_c \cdot \mathrm{k}$

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

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

 $ag{F}_{
m b} = {
m P}_{
m i} + \Delta {
m P}_{
m i}$

Open Calculator

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



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

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

$$oldsymbol{\kappa}(\mathrm{k_b'}) = rac{\pi \cdot \mathrm{d}^2 \cdot \mathrm{E}}{4 \cdot \mathrm{l}}$$

Open Calculator 🚰

 π

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

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

 $\left|\mathbf{r}
ight|\mathrm{P_{tb}}=\sigma\mathrm{t_{max}}\cdotrac{\pi}{4}\cdot\mathrm{d_{c}^{2}}$

 $m \cdot \cdot d_c^2$ Open Calculator $m oldsymbol{C}$

OF) Tamaila Fance on Baltin Oh . . .

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

25) Tensile Force on Bolt in Shear

 $extstyle P_{ ext{tb}} = \pi \cdot ext{d}_{ ext{c}} \cdot ext{h} \cdot rac{ ext{S}_{ ext{sy}}}{ ext{f}_{ ext{s}}}$

Open Calculator 🗗

extstyle= 2 extstyle= 2

26) Tensile Force on Bolt in Tension

extstyle ext

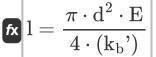
Open Calculator

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





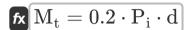
27) Thickness of Parts Held Together by Bolt given Stiffness of Bolt



Open Calculator 🚰

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

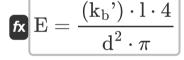
28) Wrench Torque Required to Create Required Pre Load



Open Calculator

 $49500N*mm = 0.2 \cdot 16500N \cdot 15mm$

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



Open Calculator

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

Nut Dimensions

30) Diameter of Hole Inside Bolt

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

Open Calculator

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





Open Calculator

Open Calculator

31) Height of Nut given Shear Area of Nut

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

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

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

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

$$\frac{1}{2}$$

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

33) Height of Standard Nut

fx $h = 0.8 \cdot d$

Open Calculator 2

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

34) Shear Area of Nut

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

Open Calculator 2

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

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_b 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_h' 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)
- P_{th} Tensile Force in Bolt (Newton)
- S_{sv} 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) 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
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