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Torsion of Leaf Spring Formulas

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List of 39 Torsion of Leaf Spring Formulas

Torsion of Leaf Spring

1) Central Deflection of Leaf Spring

$$fx \quad \delta = \frac{l^2}{8 \cdot R}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$ex \quad 0.642857mm = \frac{(6mm)^2}{8 \cdot 7mm}$$

2) Central Deflection of Leaf Spring for given Modulus of Elasticity

$$fx \quad \delta = \frac{\sigma \cdot l^2}{4 \cdot E \cdot t_p}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$ex \quad 11.25mm = \frac{15MPa \cdot (6mm)^2}{4 \cdot 10MPa \cdot 1.2mm}$$

3) Load at One End given Bending Moment at Center of Leaf Spring

$$fx \quad L = \frac{2 \cdot M_b}{l}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$ex \quad 1.733333kN = \frac{2 \cdot 5200N \cdot mm}{6mm}$$



4) Maximum Bending Stress Developed given Central Deflection of Leaf Spring

$$\text{fx } \sigma = \frac{4 \cdot E \cdot t_p \cdot \delta}{l^2}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$\text{ex } 5.333333\text{MPa} = \frac{4 \cdot 10\text{MPa} \cdot 1.2\text{mm} \cdot 4\text{mm}}{(6\text{mm})^2}$$

5) Maximum Bending Stress Developed given Radius of Plate to which they are Bent

$$\text{fx } \sigma = \frac{E \cdot t_p}{2 \cdot R}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$\text{ex } 0.857143\text{MPa} = \frac{10\text{MPa} \cdot 1.2\text{mm}}{2 \cdot 7\text{mm}}$$

6) Maximum Bending Stress Developed in Plates given Point Load at Center

$$\text{fx } \sigma = \frac{3 \cdot w \cdot l}{2 \cdot n \cdot B \cdot t_p^2}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$\text{ex } 1750.837\text{MPa} = \frac{3 \cdot 251\text{kN} \cdot 6\text{mm}}{2 \cdot 8 \cdot 112\text{mm} \cdot (1.2\text{mm})^2}$$



7) Modulus of Elasticity given Central Deflection of Leaf Spring

$$fx \quad E = \frac{\sigma \cdot l^2}{4 \cdot \delta \cdot t_p}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 28.125MPa = \frac{15MPa \cdot (6mm)^2}{4 \cdot 4mm \cdot 1.2mm}$$

8) Modulus of Elasticity given Radius of Plate to which they are Bent

$$fx \quad E = \frac{2 \cdot \sigma \cdot R}{t_p}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 175MPa = \frac{2 \cdot 15MPa \cdot 7mm}{1.2mm}$$

9) Moment of Inertia of each Leaf Spring Plate

$$fx \quad I = \frac{B \cdot t_p^3}{12}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 0.016128g^*mm^2 = \frac{112mm \cdot (1.2mm)^3}{12}$$



10) Number of Plates given Maximum Bending Stress Developed in Plates



$$fx \quad n = \frac{3 \cdot w \cdot l}{2 \cdot \sigma \cdot B \cdot t_p^2}$$

[Open Calculator](#)

$$ex \quad 933.7798 = \frac{3 \cdot 251kN \cdot 6mm}{2 \cdot 15MPa \cdot 112mm \cdot (1.2mm)^2}$$

11) Number of Plates in Leaf Spring given Total Resisting Moment by n Plates



$$fx \quad n = \frac{6 \cdot M_b}{\sigma \cdot B \cdot t_p^2}$$

[Open Calculator](#)

$$ex \quad 12.89683 = \frac{6 \cdot 5200N^*mm}{15MPa \cdot 112mm \cdot (1.2mm)^2}$$

12) Point Load Acting at Center of Spring given Maximum Bending Stress Developed in Plates



$$fx \quad w = \frac{2 \cdot n \cdot B \cdot t_p^2 \cdot \sigma}{3 \cdot l}$$

[Open Calculator](#)

$$ex \quad 2.1504kN = \frac{2 \cdot 8 \cdot 112mm \cdot (1.2mm)^2 \cdot 15MPa}{3 \cdot 6mm}$$



13) Point Load at Center of Spring Load given Bending Moment at Center of Leaf Spring

$$fx \quad w = \frac{4 \cdot M_b}{l}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$ex \quad 3.466667kN = \frac{4 \cdot 5200N \cdot mm}{6mm}$$

14) Radius of Plate to which they are Bent

$$fx \quad R = \frac{E \cdot t_p}{2 \cdot \sigma}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$ex \quad 0.4mm = \frac{10MPa \cdot 1.2mm}{2 \cdot 15MPa}$$

15) Radius of Plate to which they are Bent given Central Deflection of Leaf Spring

$$fx \quad R = \frac{l^2}{8 \cdot \delta}$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$ex \quad 1.125mm = \frac{(6mm)^2}{8 \cdot 4mm}$$



16) Total Resisting Moment by n Plates

$$\text{fx } M_t = \frac{n \cdot \sigma \cdot B \cdot t_p^2}{6}$$

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5_img.jpg\)](#)

$$\text{ex } 3.2256\text{N}\cdot\text{m} = \frac{8 \cdot 15\text{MPa} \cdot 112\text{mm} \cdot (1.2\text{mm})^2}{6}$$

17) Total Resisting Moment by n Plates given Bending Moment on each Plate

$$\text{fx } M_t = n \cdot M_b$$

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5_img.jpg\)](#)

$$\text{ex } 41.6\text{N}\cdot\text{m} = 8 \cdot 5200\text{N}\cdot\text{mm}$$

Bending Moment

18) Bending Moment at Center given Point Load Acting at Center of Spring Load

$$\text{fx } M_b = \frac{w \cdot l}{4}$$

[Open Calculator !\[\]\(0d7ca0919e6c47bbd874bfa0189fe22e_img.jpg\)](#)

$$\text{ex } 376500\text{N}\cdot\text{mm} = \frac{251\text{kN} \cdot 6\text{mm}}{4}$$



19) Bending Moment at Center of Leaf Spring

$$\text{fx } M_b = \frac{L \cdot l}{2}$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107_img.jpg\)](#)

$$\text{ex } 19200\text{N} \cdot \text{mm} = \frac{6.4\text{kN} \cdot 6\text{mm}}{2}$$

20) Bending Moment on each Plate given Total Resisting Moment by n Plates

$$\text{fx } M_b = \frac{M_t}{n}$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)

$$\text{ex } 9750\text{N} \cdot \text{mm} = \frac{78\text{N} \cdot \text{m}}{8}$$

21) Bending Moment on Single Plate

$$\text{fx } M_b = \frac{\sigma \cdot B \cdot t_p^2}{6}$$

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9_img.jpg\)](#)

$$\text{ex } 403.2\text{N} \cdot \text{mm} = \frac{15\text{MPa} \cdot 112\text{mm} \cdot (1.2\text{mm})^2}{6}$$



22) Maximum Bending Moment Developed in Plate given Bending Moment on Single Plate

$$fx \quad \sigma = \frac{6 \cdot M_b}{B \cdot t_p^2}$$

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0_img.jpg\)](#)

$$ex \quad 193.4524MPa = \frac{6 \cdot 5200N \cdot mm}{112mm \cdot (1.2mm)^2}$$

23) Maximum Bending Moment Developed in Plate given Total Resisting Moment by n Plates

$$fx \quad \sigma = \frac{6 \cdot M_b}{B \cdot n \cdot t_p^2}$$

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1_img.jpg\)](#)

$$ex \quad 24.18155MPa = \frac{6 \cdot 5200N \cdot mm}{112mm \cdot 8 \cdot (1.2mm)^2}$$

Span of Spring

24) Span of Leaf Spring given Central Deflection of Leaf Spring

$$fx \quad l = \sqrt{\frac{\delta \cdot 4 \cdot E \cdot t_p}{\sigma}}$$

[Open Calculator !\[\]\(95b425611cbd2b8716a140cf67c81822_img.jpg\)](#)

$$ex \quad 3.577709mm = \sqrt{\frac{4mm \cdot 4 \cdot 10MPa \cdot 1.2mm}{15MPa}}$$



25) Span of Spring given Bending Moment at Center of Leaf Spring

$$fx \quad l = \frac{2 \cdot M_b}{L}$$

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a_img.jpg\)](#)

$$ex \quad 1.625mm = \frac{2 \cdot 5200N \cdot mm}{6.4kN}$$

26) Span of Spring given Bending Moment at Center of Leaf Spring and Point Load at Center

$$fx \quad l = \frac{4 \cdot M_b}{w}$$

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010_img.jpg\)](#)

$$ex \quad 0.082869mm = \frac{4 \cdot 5200N \cdot mm}{251kN}$$

27) Span of Spring given Central Deflection of Leaf Spring

$$fx \quad l = \sqrt{8 \cdot R \cdot \delta}$$

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd_img.jpg\)](#)

$$ex \quad 14.96663mm = \sqrt{8 \cdot 7mm \cdot 4mm}$$

28) Span of Spring given Maximum Bending Stress

$$fx \quad l = \sqrt{\frac{4 \cdot E \cdot t_p \cdot \delta}{\sigma}}$$

[Open Calculator !\[\]\(235bfe13ebf007ce2eea9e689707fac7_img.jpg\)](#)

$$ex \quad 3.577709mm = \sqrt{\frac{4 \cdot 10MPa \cdot 1.2mm \cdot 4mm}{15MPa}}$$



29) Span of Spring given Maximum Bending Stress Developed in Plates

$$fx \quad l = \frac{2 \cdot n \cdot B \cdot t_p^2 \cdot \sigma}{3 \cdot w}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 0.051404\text{mm} = \frac{2 \cdot 8 \cdot 112\text{mm} \cdot (1.2\text{mm})^2 \cdot 15\text{MPa}}{3 \cdot 251\text{kN}}$$

Thickness of Plate

30) Thickness of each Plate given Bending Moment on Single Plate

$$fx \quad t_p = \sqrt{\frac{6 \cdot M_b}{\sigma \cdot B}}$$

[Open Calculator !\[\]\(5361750c22c4e047a52f4eac1ec2d4cc_img.jpg\)](#)

$$ex \quad 4.309458\text{mm} = \sqrt{\frac{6 \cdot 5200\text{N} \cdot \text{mm}}{15\text{MPa} \cdot 112\text{mm}}}$$

31) Thickness of each Plate given Moment of Inertia of each Plate

$$fx \quad t_p = \left(\frac{12 \cdot I}{B} \right)^{\frac{1}{3}}$$

[Open Calculator !\[\]\(b792654f2cef9719eabeb6c5be00811e_img.jpg\)](#)

$$ex \quad 8.121653\text{mm} = \left(\frac{12 \cdot 5\text{g} \cdot \text{mm}^2}{112\text{mm}} \right)^{\frac{1}{3}}$$



32) Thickness of each Plate given Total Resisting Moment by n Plates

$$fx \quad t_p = \sqrt{\frac{6 \cdot M_b}{\sigma \cdot n \cdot B}}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 1.523624mm = \sqrt{\frac{6 \cdot 5200N \cdot mm}{15MPa \cdot 8 \cdot 112mm}}$$

33) Thickness of Plate given Central Deflection of Leaf Spring

$$fx \quad t_p = \frac{\sigma \cdot l^2}{4 \cdot E \cdot \delta}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 3.375mm = \frac{15MPa \cdot (6mm)^2}{4 \cdot 10MPa \cdot 4mm}$$

34) Thickness of Plate given Maximum Bending Stress Developed in Plate

$$fx \quad t_p = \sqrt{\frac{3 \cdot w \cdot l}{2 \cdot n \cdot B \cdot \sigma}}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 12.96458mm = \sqrt{\frac{3 \cdot 251kN \cdot 6mm}{2 \cdot 8 \cdot 112mm \cdot 15MPa}}$$



35) Thickness of Plate given Radius of Plate to which they are Bent

$$fx \quad t_p = \frac{2 \cdot \sigma \cdot R}{E}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$ex \quad 21mm = \frac{2 \cdot 15MPa \cdot 7mm}{10MPa}$$

Width of Plate

36) Width of each Plate given Bending Moment on Single Plate

$$fx \quad B = \frac{6 \cdot M_b}{\sigma \cdot t_p^2}$$

[Open Calculator !\[\]\(8bba887393ca45b761e5cb49e755e762_img.jpg\)](#)

$$ex \quad 1444.444mm = \frac{6 \cdot 5200N^*mm}{15MPa \cdot (1.2mm)^2}$$

37) Width of each Plate given Moment of Inertia of each Plate

$$fx \quad B = \frac{12 \cdot I}{t_p^3}$$

[Open Calculator !\[\]\(0fb13ad0bfa3d86868cdd3883e5665b3_img.jpg\)](#)

$$ex \quad 34722.22mm = \frac{12 \cdot 5g^*mm^2}{(1.2mm)^3}$$



38) Width of each Plate given Total Resisting Moment by n Plates

$$\text{fx } B = \frac{6 \cdot M_b}{\sigma \cdot n \cdot t_p^2}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } 180.5556\text{mm} = \frac{6 \cdot 5200\text{N} \cdot \text{mm}}{15\text{MPa} \cdot 8 \cdot (1.2\text{mm})^2}$$

39) Width of Plates given Maximum Bending Stress Developed in Plates

$$\text{fx } B = \frac{3 \cdot w \cdot l}{2 \cdot n \cdot \sigma \cdot t_p^2}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$\text{ex } 13072.92\text{mm} = \frac{3 \cdot 251\text{kN} \cdot 6\text{mm}}{2 \cdot 8 \cdot 15\text{MPa} \cdot (1.2\text{mm})^2}$$









Variables Used

- **B** Width of Full Size Bearing Plate (*Millimeter*)
- **E** Modulus of Elasticity Leaf Spring (*Megapascal*)
- **I** Moment of Inertia (*Gram Square Millimeter*)
- **l** Span of Spring (*Millimeter*)
- **L** Load at One End (*Kilonewton*)
- **M_b** Bending Moment in Spring (*Newton Millimeter*)
- **M_t** Total Resisting Moments (*Newton Meter*)
- **n** Number of Plates
- **R** Radius of Plate (*Millimeter*)
- **t_p** Thickness of Plate (*Millimeter*)
- **w** Point Load at Center of Spring (*Kilonewton*)
- **δ** Deflection of Centre of Leaf Spring (*Millimeter*)
- **σ** Maximum Bending Stress in Plates (*Megapascal*)



Constants, Functions, Measurements used

- **Function:** **sqrt**, sqrt(Number)
Square root function
- **Measurement:** **Length** in Millimeter (mm)
Length Unit Conversion 
- **Measurement:** **Pressure** in Megapascal (MPa)
Pressure Unit Conversion 
- **Measurement:** **Force** in Kilonewton (kN)
Force Unit Conversion 
- **Measurement:** **Moment of Inertia** in Gram Square Millimeter ($g \cdot mm^2$)
Moment of Inertia Unit Conversion 
- **Measurement:** **Moment of Force** in Newton Millimeter ($N \cdot mm$)
Moment of Force Unit Conversion 
- **Measurement:** **Bending Moment** in Newton Meter ($N \cdot m$)
Bending Moment Unit Conversion 



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