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Stress and Strain Formulas

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List of 61 Stress and Strain Formulas

Stress and Strain

Bar of Uniform Strength

1) Area at Section 1 of Bars of Uniform Strength

$$\text{fx } A_1 = A_2 \cdot e^{\gamma \cdot \frac{L_{\text{Rod}}}{\sigma_{\text{Uniform}}}}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2_img.jpg\)](#)

$$\text{ex } 0.001256\text{m}^2 = 0.001250\text{m}^2 \cdot e^{70\text{kN/m}^3 \cdot \frac{1.83\text{m}}{27\text{MPa}}}$$

2) Area at Section 2 of Bars of Uniform Strength

$$\text{fx } A_2 = \frac{A_1}{e^{\gamma \cdot \frac{L_{\text{Rod}}}{\sigma_{\text{Uniform}}}}}$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa_img.jpg\)](#)

$$\text{ex } 0.00125\text{m}^2 = \frac{0.001256\text{m}^2}{e^{70\text{kN/m}^3 \cdot \frac{1.83\text{m}}{27\text{MPa}}}}$$

3) Weight Density of Bar using Area at Section 1 of Bars of uniform Strength

$$\text{fx } \gamma = \left(2.303 \cdot \log_{10} \left(\frac{A_1}{A_2} \right) \right) \cdot \frac{\sigma_{\text{Uniform}}}{L_{\text{Rod}}}$$

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d_img.jpg\)](#)

$$\text{ex } 70.66298\text{kN/m}^3 = \left(2.303 \cdot \log_{10} \left(\frac{0.001256\text{m}^2}{0.001250\text{m}^2} \right) \right) \cdot \frac{27\text{MPa}}{1.83\text{m}}$$



Circular Tapering Rod

4) Diameter at One End of Circular Tapering Rod

$$\text{fx } d_2 = 4 \cdot W_{\text{Applied load}} \cdot \frac{L}{\pi \cdot E \cdot \delta l \cdot d_1}$$

[Open Calculator !\[\]\(a03a7eb2f4046e1d3c76772003e549ea_img.jpg\)](#)

$$\text{ex } 0.031831\text{m} = 4 \cdot 150\text{kN} \cdot \frac{3\text{m}}{\pi \cdot 20000\text{MPa} \cdot 0.020\text{m} \cdot 0.045\text{m}}$$

5) Diameter at Other End of Circular Tapering Rod

$$\text{fx } d_1 = 4 \cdot W_{\text{Applied load}} \cdot \frac{L}{\pi \cdot E \cdot \delta l \cdot d_2}$$

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

$$\text{ex } 0.040926\text{m} = 4 \cdot 150\text{kN} \cdot \frac{3\text{m}}{\pi \cdot 20000\text{MPa} \cdot 0.020\text{m} \cdot 0.035\text{m}}$$

6) Diameter of Circular Tapered Rod with Uniform Cross Section

$$\text{fx } d = \sqrt{4 \cdot W_{\text{Applied load}} \cdot \frac{L}{\pi \cdot E \cdot \delta l}}$$

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

$$\text{ex } 0.037847\text{m} = \sqrt{4 \cdot 150\text{kN} \cdot \frac{3\text{m}}{\pi \cdot 20000\text{MPa} \cdot 0.020\text{m}}}$$



7) Elongation of Circular Tapering Rod

$$\text{fx } \delta l = 4 \cdot W_{\text{Applied load}} \cdot \frac{L}{\pi \cdot E \cdot d_1 \cdot d_2}$$

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

$$\text{ex } 0.018189\text{m} = 4 \cdot 150\text{kN} \cdot \frac{3\text{m}}{\pi \cdot 20000\text{MPa} \cdot 0.045\text{m} \cdot 0.035\text{m}}$$

8) Elongation of Prismatic Rod

$$\text{fx } \delta l = 4 \cdot W_{\text{Applied load}} \cdot \frac{L}{\pi \cdot E \cdot (d^2)}$$

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

$$\text{ex } 0.001989\text{m} = 4 \cdot 150\text{kN} \cdot \frac{3\text{m}}{\pi \cdot 20000\text{MPa} \cdot ((0.12\text{m})^2)}$$

9) Length of Circular Tapered Rod with Uniform Cross Section

$$\text{fx } L = \frac{\delta l}{4 \cdot \frac{W_{\text{Applied load}}}{\pi \cdot E \cdot (d^2)}}$$

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

$$\text{ex } 30.15929\text{m} = \frac{0.020\text{m}}{4 \cdot \frac{150\text{kN}}{\pi \cdot 20000\text{MPa} \cdot ((0.12\text{m})^2)}}$$



10) Length of Circular Tapering rod

$$\text{fx } L = \frac{\delta l}{4 \cdot \frac{W_{\text{Applied load}}}{\pi \cdot E \cdot d_1 \cdot d_2}}$$

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

$$\text{ex } 3.298672\text{m} = \frac{0.020\text{m}}{4 \cdot \frac{150\text{kN}}{\pi \cdot 20000\text{MPa} \cdot 0.045\text{m} \cdot 0.035\text{m}}}$$

11) Load at End with known Extension of Circular Tapering Rod

$$\text{fx } W_{\text{Applied load}} = \frac{\delta l}{4 \cdot \frac{L}{\pi \cdot E \cdot d_1 \cdot d_2}}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{ex } 164.9336\text{kN} = \frac{0.020\text{m}}{4 \cdot \frac{3\text{m}}{\pi \cdot 20000\text{MPa} \cdot 0.045\text{m} \cdot 0.035\text{m}}}$$

12) Modulus of Elasticity of Circular Tapering Rod with Uniform Cross Section

$$\text{fx } E = 4 \cdot W_{\text{Applied load}} \cdot \frac{L}{\pi \cdot \delta l \cdot (d^2)}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$\text{ex } 1989.437\text{MPa} = 4 \cdot 150\text{kN} \cdot \frac{3\text{m}}{\pi \cdot 0.020\text{m} \cdot ((0.12\text{m})^2)}$$



13) Modulus of Elasticity using Elongation of Circular Tapering Rod

$$\text{fx } E = 4 \cdot W_{\text{Applied load}} \cdot \frac{L}{\pi \cdot \delta l \cdot d_1 \cdot d_2}$$

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

$$\text{ex } 18189.14 \text{MPa} = 4 \cdot 150 \text{kN} \cdot \frac{3 \text{m}}{\pi \cdot 0.020 \text{m} \cdot 0.045 \text{m} \cdot 0.035 \text{m}}$$

Elongation due to Self weight

14) Cross Sectional Area with known Elongation of Tapering Bar due to Self Weight

$$\text{fx } A = W_{\text{Load}} \cdot \frac{L}{6 \cdot \delta l \cdot E}$$

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719_img.jpg\)](#)

$$\text{ex } 2187.5 \text{mm}^2 = 1750 \text{kN} \cdot \frac{3 \text{m}}{6 \cdot 0.020 \text{m} \cdot 20000 \text{MPa}}$$

15) Elongation due to Self Weight in Prismatic Bar

$$\text{fx } \delta l = \gamma_{\text{Rod}} \cdot L \cdot \frac{L}{E \cdot 2}$$

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7_img.jpg\)](#)

$$\text{ex } 0.001109 \text{m} = 4930.96 \text{kN/m}^3 \cdot 3 \text{m} \cdot \frac{3 \text{m}}{20000 \text{MPa} \cdot 2}$$



16) Elongation due to Self Weight in Prismatic Bar using Applied Load

$$\text{fx } \delta l = W_{\text{Load}} \cdot \frac{L}{2 \cdot A \cdot E}$$

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

$$\text{ex } 0.023438\text{m} = 1750\text{kN} \cdot \frac{3\text{m}}{2 \cdot 5600\text{mm}^2 \cdot 20000\text{MPa}}$$

17) Elongation of Truncated Conical Rod due to Self Weight

$$\text{fx } \delta l = \frac{(\gamma_{\text{Rod}} \cdot l^2) \cdot (d_1 + d_2)}{6 \cdot E \cdot (d_1 - d_2)}$$

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

$$\text{ex } 0.02\text{m} = \frac{(4930.96\text{kN/m}^3 \cdot (7.8\text{m})^2) \cdot (0.045\text{m} + 0.035\text{m})}{6 \cdot 20000\text{MPa} \cdot (0.045\text{m} - 0.035\text{m})}$$

18) Length of Bar using Elongation due to Self Weight in Prismatic bar

$$\text{fx } L = \sqrt{\frac{\delta l}{\frac{\gamma_{\text{Rod}}}{E \cdot 2}}}$$

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2_img.jpg\)](#)

$$\text{ex } 12.73736\text{m} = \sqrt{\frac{0.020\text{m}}{\frac{4930.96\text{kN/m}^3}{20000\text{MPa} \cdot 2}}}$$



19) Length of Bar using its Uniform Strength

[Open Calculator !\[\]\(3d8c13c92b853674f749aac6fa869926_img.jpg\)](#)

$$\text{fx } L = \left(2.303 \cdot \log 10 \left(\frac{A_1}{A_2} \right) \right) \cdot \left(\frac{\sigma_{\text{Uniform}}}{\gamma_{\text{Rod}}} \right)$$

$$\text{ex } 0.026225\text{m} = \left(2.303 \cdot \log 10 \left(\frac{0.001256\text{m}^2}{0.001250\text{m}^2} \right) \right) \cdot \left(\frac{27\text{MPa}}{4930.96\text{kN/m}^3} \right)$$

20) Length of Rod of Truncated Conical Section

[Open Calculator !\[\]\(17acf1afa8cdf0b67c53d4865a5ed469_img.jpg\)](#)

$$\text{fx } l = \sqrt{\frac{\delta l}{\frac{(\gamma_{\text{Rod}}) \cdot (d_1 + d_2)}{6 \cdot E \cdot (d_1 - d_2)}}$$

$$\text{ex } 7.800005\text{m} = \sqrt{\frac{0.020\text{m}}{\frac{(4930.96\text{kN/m}^3) \cdot (0.045\text{m} + 0.035\text{m})}{6 \cdot 20000\text{MPa} \cdot (0.045\text{m} - 0.035\text{m})}}$$

21) Modulus of Elasticity of Bar with known elongation of Truncated Conical Rod due to Self Weight

[Open Calculator !\[\]\(d8ab143e904bfa3467271eec5af75a9b_img.jpg\)](#)

$$\text{fx } E = \frac{(\gamma_{\text{Rod}} \cdot l^2) \cdot (d_1 + d_2)}{6 \cdot \delta l \cdot (d_1 - d_2)}$$

$$\text{ex } 19999.97\text{MPa} = \frac{(4930.96\text{kN/m}^3 \cdot (7.8\text{m})^2) \cdot (0.045\text{m} + 0.035\text{m})}{6 \cdot 0.020\text{m} \cdot (0.045\text{m} - 0.035\text{m})}$$



22) Modulus of Elasticity of Rod using Extension of Truncated Conical Rod due to Self Weight

$$\text{fx } E = \frac{(\gamma_{\text{Rod}} \cdot l^2) \cdot (d_1 + d_2)}{6 \cdot \delta l \cdot (d_1 - d_2)}$$

[Open Calculator !\[\]\(71ceb62b681518c82e95d615e7265d66_img.jpg\)](#)

$$\text{ex } 19999.97 \text{ MPa} = \frac{(4930.96 \text{ kN/m}^3 \cdot (7.8 \text{ m})^2) \cdot (0.045 \text{ m} + 0.035 \text{ m})}{6 \cdot 0.020 \text{ m} \cdot (0.045 \text{ m} - 0.035 \text{ m})}$$

23) Specific weight of Truncated Conical Rod using its elongation due to Self Weight

$$\text{fx } \gamma_{\text{Rod}} = \frac{\delta l}{\frac{(l^2) \cdot (d_1 + d_2)}{6 \cdot E \cdot (d_1 - d_2)}}$$

[Open Calculator !\[\]\(fc3a57079704ef1b99671c8cafae23be_img.jpg\)](#)

$$\text{ex } 4930.966 \text{ kN/m}^3 = \frac{0.020 \text{ m}}{\frac{((7.8 \text{ m})^2) \cdot (0.045 \text{ m} + 0.035 \text{ m})}{6 \cdot 20000 \text{ MPa} \cdot (0.045 \text{ m} - 0.035 \text{ m})}}$$

24) Uniform Stress on Bar due to Self-Weight

$$\text{fx } \sigma_{\text{Uniform}} = \frac{L}{\frac{2.303 \cdot \log 10 \left(\frac{A_1}{A_2} \right)}{\gamma_{\text{Rod}}}}$$

[Open Calculator !\[\]\(d5831b2ac75eb48b4c49d27e61d24c03_img.jpg\)](#)

$$\text{ex } 3088.684 \text{ MPa} = \frac{3 \text{ m}}{\frac{2.303 \cdot \log 10 \left(\frac{0.001256 \text{ m}^2}{0.001250 \text{ m}^2} \right)}{4930.96 \text{ kN/m}^3}}$$



Elongation of Tapering Bar due to Self Weight

25) Elongation of Conical bar due to Self Weight

$$\text{fx } \delta l = \frac{\gamma \cdot L_{\text{Taperedbar}}^2}{6 \cdot E}$$

[Open Calculator !\[\]\(4cafc60cd39da821525d7c6589540296_img.jpg\)](#)

$$\text{ex } 0.019965\text{m} = \frac{70\text{kN/m}^3 \cdot (185\text{m})^2}{6 \cdot 20000\text{MPa}}$$

26) Elongation of Conical Bar due to Self Weight with known Cross-sectional area

$$\text{fx } \delta l = W_{\text{Load}} \cdot \frac{l}{6 \cdot A \cdot E}$$

[Open Calculator !\[\]\(8a8ea273bba45b658cf4779d37ab61e8_img.jpg\)](#)

$$\text{ex } 0.020312\text{m} = 1750\text{kN} \cdot \frac{7.8\text{m}}{6 \cdot 5600\text{mm}^2 \cdot 20000\text{MPa}}$$

27) Length of Bar given Elongation of Conical Bar due to Self Weight

$$\text{fx } L_{\text{Taperedbar}} = \sqrt{\frac{\delta l}{\frac{\gamma}{6 \cdot E}}}$$

[Open Calculator !\[\]\(07e95c4c760ed8b72579d140ce510c89_img.jpg\)](#)

$$\text{ex } 185.164\text{m} = \sqrt{\frac{0.020\text{m}}{\frac{70\text{kN/m}^3}{6 \cdot 20000\text{MPa}}}}$$



28) Length of Bar using Elongation of Conical Bar with Cross-sectional area

$$\text{fx } l = \frac{\delta l}{\frac{W_{\text{Load}}}{6 \cdot A \cdot E}}$$

[Open Calculator !\[\]\(f4349ea867b307dd2675269f68d0971f_img.jpg\)](#)

$$\text{ex } 7.68\text{m} = \frac{0.020\text{m}}{\frac{1750\text{kN}}{6 \cdot 5600\text{mm}^2 \cdot 20000\text{MPa}}}$$

29) Length of Circular Tapering Rod when deflection due to load

$$\text{fx } L = \frac{\delta l}{4 \cdot \frac{W_{\text{Load}}}{\pi \cdot E \cdot (d_1 \cdot d_2)}}$$

[Open Calculator !\[\]\(4d25d87d94191bbe34f0046ad604e903_img.jpg\)](#)

$$\text{ex } 0.282743\text{m} = \frac{0.020\text{m}}{4 \cdot \frac{1750\text{kN}}{\pi \cdot 20000\text{MPa} \cdot (0.045\text{m} \cdot 0.035\text{m})}}$$

30) Length of Prismatic Rod given Elongation due to Self Weight in Uniform Bar

$$\text{fx } L = \frac{\delta l}{\frac{W_{\text{Load}}}{2 \cdot A \cdot E}}$$

[Open Calculator !\[\]\(7453c0f29ed3a7dcecf77fe714fbbf84_img.jpg\)](#)

$$\text{ex } 2.56\text{m} = \frac{0.020\text{m}}{\frac{1750\text{kN}}{2 \cdot 5600\text{mm}^2 \cdot 20000\text{MPa}}}$$



31) Load on Conical Bar with known Elongation due to Self Weight

$$\text{fx } W_{\text{Load}} = \frac{\delta l}{\frac{1}{6 \cdot A \cdot E}}$$

[Open Calculator !\[\]\(65669ef2a9341eca7c5ba6092e766555_img.jpg\)](#)

$$\text{ex } 1723.077\text{kN} = \frac{0.020\text{m}}{\frac{7.8\text{m}}{6 \cdot 5600\text{mm}^2 \cdot 20000\text{MPa}}}$$

32) Load on Prismatic Bar with known Elongation due to Self Weight

$$\text{fx } W_{\text{Load}} = \frac{\delta l}{\frac{L}{2 \cdot A \cdot E}}$$

[Open Calculator !\[\]\(eaac180de418db4eae4b4cefebda75e8_img.jpg\)](#)

$$\text{ex } 1493.333\text{kN} = \frac{0.020\text{m}}{\frac{3\text{m}}{2 \cdot 5600\text{mm}^2 \cdot 20000\text{MPa}}}$$

33) Modulus of Elasticity of Bar given Elongation of Conical Bar due to Self Weight

$$\text{fx } E = \gamma \cdot \frac{L_{\text{Taperedbar}}^2}{6 \cdot \delta l}$$

[Open Calculator !\[\]\(43fda5baa5446493352974e4b4060607_img.jpg\)](#)

$$\text{ex } 19964.58\text{MPa} = 70\text{kN/m}^3 \cdot \frac{(185\text{m})^2}{6 \cdot 0.020\text{m}}$$



34) Modulus of Elasticity of Conical Bar with known Elongation and Cross-sectional area

$$\text{fx } E = W_{\text{Load}} \cdot \frac{l}{6 \cdot A \cdot \delta l}$$

[Open Calculator !\[\]\(b3131996c2d47980618867ba93d92313_img.jpg\)](#)

$$\text{ex } 20312.5\text{MPa} = 1750\text{kN} \cdot \frac{7.8\text{m}}{6 \cdot 5600\text{mm}^2 \cdot 0.020\text{m}}$$

35) Modulus of Elasticity of Prismatic Bar with known Elongation due to Self Weight

$$\text{fx } E = \gamma \cdot L \cdot \frac{L}{\delta l \cdot 2}$$

[Open Calculator !\[\]\(99af31d6d7b9b738106c66bf7ffde536_img.jpg\)](#)

$$\text{ex } 15.75\text{MPa} = 70\text{kN/m}^3 \cdot 3\text{m} \cdot \frac{3\text{m}}{0.020\text{m} \cdot 2}$$

36) Self Weight of Conical section with known Elongation

$$\text{fx } \gamma = \frac{\delta l}{\frac{L_{\text{Taperedbar}}^2}{6 \cdot E}}$$

[Open Calculator !\[\]\(51c8b64a0f70f0b96d4cbd0a65299579_img.jpg\)](#)

$$\text{ex } 70.12418\text{kN/m}^3 = \frac{0.020\text{m}}{\frac{(185\text{m})^2}{6 \cdot 20000\text{MPa}}}$$



37) Self Weight of Prismatic Bar with known Elongation

[Open Calculator !\[\]\(90164f74041f71b612f1c8605a7ede54_img.jpg\)](#)

$$\text{fx } \gamma = \frac{\delta l}{L \cdot \frac{L}{E \cdot 2}}$$

$$\text{ex } 88888.89 \text{ kN/m}^3 = \frac{0.020 \text{ m}}{3 \text{ m} \cdot \frac{3 \text{ m}}{20000 \text{ MPa} \cdot 2}}$$

Hoop Stress due to Temperature Fall

38) Diameter of Tyre given Hoop Stress due to Temperature Fall

[Open Calculator !\[\]\(2becda4813f27b5edb43f5299d7596ac_img.jpg\)](#)

$$\text{fx } d_{\text{tyre}} = \frac{D_{\text{wheel}}}{\left(\frac{\sigma_h}{E} \right) + 1}$$

$$\text{ex } 0.230286 \text{ m} = \frac{0.403 \text{ m}}{\left(\frac{15000 \text{ MPa}}{20000 \text{ MPa}} \right) + 1}$$

39) Diameter of Wheel given Hoop Stress due to Temperature Fall

[Open Calculator !\[\]\(d3b4f22af99c507f55d7924c8d6d7349_img.jpg\)](#)

$$\text{fx } D_{\text{wheel}} = \left(1 + \left(\frac{\sigma_h}{E} \right) \right) \cdot d_{\text{tyre}}$$

$$\text{ex } 0.4025 \text{ m} = \left(1 + \left(\frac{15000 \text{ MPa}}{20000 \text{ MPa}} \right) \right) \cdot 0.230 \text{ m}$$



40) Hoop Stress due to Temperature Fall

[Open Calculator !\[\]\(aef305f57b9557b4e73b8de50f6d555d_img.jpg\)](#)

$$fx \quad \sigma_h = \left(\frac{D_{\text{wheel}} - d_{\text{tyre}}}{d_{\text{tyre}}} \right) \cdot E$$

$$ex \quad 15043.48 \text{MPa} = \left(\frac{0.403\text{m} - 0.230\text{m}}{0.230\text{m}} \right) \cdot 20000 \text{MPa}$$

41) Hoop Stress due to Temperature Fall given Strain

[Open Calculator !\[\]\(09a4f46fd00963d10017c74e09f87500_img.jpg\)](#)

$$fx \quad \sigma_h = \varepsilon \cdot E$$

$$ex \quad 15000 \text{MPa} = 0.75 \cdot 20000 \text{MPa}$$

42) Modulus of Elasticity given Hoop Stress due to Temperature Fall with Strain

[Open Calculator !\[\]\(e9e105440a4f0af15d76f8d500ffbd8a_img.jpg\)](#)

$$fx \quad E = \frac{\sigma_h}{\varepsilon}$$

$$ex \quad 20000 \text{MPa} = \frac{15000 \text{MPa}}{0.75}$$

43) Strain for Hoop Stress due to Temperature Fall

[Open Calculator !\[\]\(9321542a4f5100bf6d54b71e7f20e8cc_img.jpg\)](#)

$$fx \quad \varepsilon = \frac{\sigma_h}{E}$$

$$ex \quad 0.75 = \frac{15000 \text{MPa}}{20000 \text{MPa}}$$



Temperature Stresses and Strains

44) Change in Temperature using Temperature Stress for Tapering Rod

$$\text{fx } \Delta t = \frac{\sigma}{t \cdot E \cdot \alpha \cdot \frac{D_2 - h_1}{\ln\left(\frac{D_2}{h_1}\right)}}$$

[Open Calculator !\[\]\(115eff7009a76771e6b7adb966005e4c_img.jpg\)](#)

$$\text{ex } 13.5155^\circ\text{C} = \frac{20\text{MPa}}{0.006\text{m} \cdot 20000\text{MPa} \cdot 0.001^\circ\text{C}^{-1} \cdot \frac{15\text{m} - 10\text{m}}{\ln\left(\frac{15\text{m}}{10\text{m}}\right)}}$$

45) Coefficient of Thermal Expansion given Temperature Stress for Tapering Rod Section

$$\text{fx } \alpha = \frac{W}{t \cdot E \cdot \Delta t \cdot \frac{D_2 - h_1}{\ln\left(\frac{D_2}{h_1}\right)}}$$

[Open Calculator !\[\]\(9f63f5ec98cc2eddf66038fdc55c1091_img.jpg\)](#)

$$\text{ex } 0.001^\circ\text{C}^{-1} = \frac{18497\text{kN}}{0.006\text{m} \cdot 20000\text{MPa} \cdot 12.5^\circ\text{C} \cdot \frac{15\text{m} - 10\text{m}}{\ln\left(\frac{15\text{m}}{10\text{m}}\right)}}$$

46) Diameter of Tyre given Temperature Strain

$$\text{fx } d_{\text{tyre}} = \left(\frac{D_{\text{wheel}}}{\varepsilon + 1} \right)$$

[Open Calculator !\[\]\(e088a60aba18ad7619b846dde34cd067_img.jpg\)](#)

$$\text{ex } 0.230286\text{m} = \left(\frac{0.403\text{m}}{0.75 + 1} \right)$$



47) Diameter of Wheel given Temperature Strain

$$\text{fx } D_{\text{wheel}} = d_{\text{tyre}} \cdot (\varepsilon + 1)$$

[Open Calculator !\[\]\(dfc59eaff22f8544bedb238cca58d143_img.jpg\)](#)

$$\text{ex } 0.4025\text{m} = 0.230\text{m} \cdot (0.75 + 1)$$

48) Modulus of Elasticity given Temperature Stress for Tapering Rod Section

$$\text{fx } E = \frac{\sigma}{t \cdot \alpha \cdot \Delta t \cdot \frac{D_2 - h_1}{\ln\left(\frac{D_2}{h_1}\right)}}$$

[Open Calculator !\[\]\(2b0f02b4a70afa75816b328a8d32ffe7_img.jpg\)](#)

$$\text{ex } 21624.81\text{MPa} = \frac{20\text{MPa}}{0.006\text{m} \cdot 0.001^\circ\text{C}^{-1} \cdot 12.5^\circ\text{C} \cdot \frac{15\text{m} - 10\text{m}}{\ln\left(\frac{15\text{m}}{10\text{m}}\right)}}$$

49) Modulus of Elasticity using Hoop Stress due to Temperature Fall

$$\text{fx } E = \frac{\sigma_h \cdot d_{\text{tyre}}}{D_{\text{wheel}} - d_{\text{tyre}}}$$

[Open Calculator !\[\]\(9563e6845e9460f02a8b96af0592b0be_img.jpg\)](#)

$$\text{ex } 19942.2\text{MPa} = \frac{15000\text{MPa} \cdot 0.230\text{m}}{0.403\text{m} - 0.230\text{m}}$$

50) Temperature Strain

$$\text{fx } \varepsilon = \left(\frac{D_{\text{wheel}} - d_{\text{tyre}}}{d_{\text{tyre}}} \right)$$

[Open Calculator !\[\]\(a80830b95104dac0ade8ec99d6ea62cf_img.jpg\)](#)

$$\text{ex } 0.752174 = \left(\frac{0.403\text{m} - 0.230\text{m}}{0.230\text{m}} \right)$$



51) Temperature Stress for Tapering Rod Section

$$fx \quad W = t \cdot E \cdot \alpha \cdot \Delta t \cdot \frac{D_2 - h_1}{\ln\left(\frac{D_2}{h_1}\right)}$$

Open Calculator 

ex

$$18497.28\text{kN} = 0.006\text{m} \cdot 20000\text{MPa} \cdot 0.001^\circ\text{C}^{-1} \cdot 12.5^\circ\text{C} \cdot \frac{15\text{m} - 10\text{m}}{\ln\left(\frac{15\text{m}}{10\text{m}}\right)}$$

52) Thickness of Tapered Bar using Temperature Stress

$$fx \quad t = \frac{\sigma}{E \cdot \alpha \cdot \Delta t \cdot \frac{D_2 - h_1}{\ln\left(\frac{D_2}{h_1}\right)}}$$

Open Calculator 

$$ex \quad 0.006487\text{m} = \frac{20\text{MPa}}{20000\text{MPa} \cdot 0.001^\circ\text{C}^{-1} \cdot 12.5^\circ\text{C} \cdot \frac{15\text{m} - 10\text{m}}{\ln\left(\frac{15\text{m}}{10\text{m}}\right)}}$$

Volumetric Strain of a Rectangular Bar 53) Strain along Breadth given Volumetric Strain of Rectangular Bar

$$fx \quad \varepsilon_b = \varepsilon_v - (\varepsilon_l + \varepsilon_d)$$

Open Calculator 

$$ex \quad -0.0052 = 0.0001 - (0.002 + 0.0033)$$



54) Strain along Depth given Volumetric Strain of Rectangular Bar

$$\text{fx } \varepsilon_d = \varepsilon_v - (\varepsilon_l + \varepsilon_b)$$

[Open Calculator !\[\]\(3b451835b5cf44dc087a11f8c88642da_img.jpg\)](#)

$$\text{ex } -0.0266 = 0.0001 - (0.002 + 0.0247)$$

55) Strain along Length given Volumetric Strain of Rectangular Bar

$$\text{fx } \varepsilon_l = \varepsilon_v - (\varepsilon_b + \varepsilon_d)$$

[Open Calculator !\[\]\(f42f75e81f61fd5f9f313cac09f9aa39_img.jpg\)](#)

$$\text{ex } -0.0279 = 0.0001 - (0.0247 + 0.0033)$$

56) Volumetric Strain of Rectangular Bar

$$\text{fx } \varepsilon_v = \varepsilon_l + \varepsilon_b + \varepsilon_d$$

[Open Calculator !\[\]\(9208b08aaac7a2e8dbe35c838e5046e3_img.jpg\)](#)

$$\text{ex } 0.03 = 0.002 + 0.0247 + 0.0033$$

Volumetric Strain of Sphere

57) Change in Diameter given Volumetric Strain of Sphere

$$\text{fx } \delta_{\text{dia}} = \varepsilon_v \cdot \frac{\Phi}{3}$$

[Open Calculator !\[\]\(40ea97637c564e3be05a46f598703620_img.jpg\)](#)

$$\text{ex } 0.000168\text{m} = 0.0001 \cdot \frac{5.05\text{m}}{3}$$



58) Diameter of Sphere using Volumetric Strain of sphere [Open Calculator](#) 

$$\text{fx } \Phi = 3 \cdot \frac{\delta_{\text{dia}}}{\varepsilon_v}$$

$$\text{ex } 1515\text{m} = 3 \cdot \frac{0.0505\text{m}}{0.0001}$$

59) Strain given Volumetric Strain of Sphere [Open Calculator](#) 

$$\text{fx } \varepsilon_L = \frac{\varepsilon_v}{3}$$

$$\text{ex } 3.3\text{E}^{-5} = \frac{0.0001}{3}$$

60) Volumetric Strain of sphere [Open Calculator](#) 

$$\text{fx } \varepsilon_v = 3 \cdot \frac{\delta_{\text{dia}}}{\Phi}$$

$$\text{ex } 0.03 = 3 \cdot \frac{0.0505\text{m}}{5.05\text{m}}$$

61) Volumetric Strain of Sphere given Lateral Strain [Open Calculator](#) 

$$\text{fx } \varepsilon_v = 3 \cdot \varepsilon_L$$

$$\text{ex } 0.06 = 3 \cdot 0.02$$



Variables Used

- **A** Area of Cross-Section (Square Millimeter)
- **A₁** Area 1 (Square Meter)
- **A₂** Area 2 (Square Meter)
- **d** Diameter of Shaft (Meter)
- **d₁** Diameter1 (Meter)
- **d₂** Diameter2 (Meter)
- **D₂** Depth of Point 2 (Meter)
- **d_{tyre}** Diameter of Tyre (Meter)
- **D_{wheel}** Wheel Diameter (Meter)
- **E** Young's Modulus (Megapascal)
- **h₁** Depth of Point 1 (Meter)
- **l** Length of Tapered Bar (Meter)
- **L** Length (Meter)
- **L_{Rod}** Length of Rod (Meter)
- **L_{Taperedbar}** Tapered Bar Length (Meter)
- **t** Section Thickness (Meter)
- **W** Load Applied KN (Kilonewton)
- **W_{Applied load}** Applied Load (Kilonewton)
- **W_{Load}** Applied Load SOM (Kilonewton)
- **α** Coefficient of Linear Thermal Expansion (Per Degree Celsius)
- **γ** Specific Weight (Kilonewton per Cubic Meter)
- **Y_{Rod}** Specific Weight of Rod (Kilonewton per Cubic Meter)



- δ_{dia} Change in Diameter (Meter)
- δl Elongation (Meter)
- Δt Change in Temperature (Degree Celsius)
- ϵ Strain
- ϵ_b Strain along Breadth
- ϵ_d Strain along Depth
- ϵ_l Strain along Length
- ϵ_L Lateral Strain
- ϵ_v Volumetric Strain
- σ Thermal Stress (Megapascal)
- σ_h Hoop Stress SOM (Megapascal)
- $\sigma_{Uniform}$ Uniform Stress (Megapascal)
- Φ Diameter of Sphere (Meter)



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Constant:** **e**, 2.71828182845904523536028747135266249
Napier's constant
- **Function:** **ln**, $\ln(\text{Number})$
Natural logarithm function (base e)
- **Function:** **log10**, $\log_{10}(\text{Number})$
Common logarithm function (base 10)
- **Function:** **sqrt**, $\sqrt{\text{Number}}$
Square root function
- **Measurement:** **Length** in Meter (m)
Length Unit Conversion 
- **Measurement:** **Area** in Square Meter (m^2), Square Millimeter (mm^2)
Area Unit Conversion 
- **Measurement:** **Force** in Kilonewton (kN)
Force Unit Conversion 
- **Measurement:** **Temperature Difference** in Degree Celsius ($^{\circ}\text{C}$)
Temperature Difference Unit Conversion 
- **Measurement:** **Temperature Coefficient of Resistance** in Per Degree Celsius ($^{\circ}\text{C}^{-1}$)
Temperature Coefficient of Resistance Unit Conversion 
- **Measurement:** **Specific Weight** in Kilonewton per Cubic Meter (kN/m^3)
Specific Weight Unit Conversion 
- **Measurement:** **Stress** in Megapascal (MPa)
Stress Unit Conversion 



Check other formula lists

- **Mohr's Circle of Stresses Formulas** 
- **Beam Moments Formulas** 
- **Bending Stress Formulas** 
- **Combined Axial and Bending Loads Formulas** 
- **Elastic Stability of Columns Formulas** 
- **Principal Stress Formulas** 
- **Shear Stress Formulas** 
- **Slope and Deflection Formulas** 
- **Strain Energy Formulas** 
- **Stress and Strain Formulas** 
- **Torsion Formulas** 

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