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Expressions For Crippling Load Formulas

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List of 32 Expressions For Crippling Load Formulas

Expressions For Crippling Load

Both Ends of Column are Fixed

1) Crippling Load given Moment of Section if Both Ends of Column are Fixed

$$fx \quad P = \frac{M_{\text{Fixed}} - M_t}{\delta}$$

Open Calculator 

$$ex \quad 1.6625kN = \frac{20000N \cdot mm - 50N \cdot mm}{12mm}$$

2) Crippling Load if Both Ends of Column are Fixed

$$fx \quad P = \frac{\pi^2 \cdot E \cdot I}{l^2}$$

Open Calculator 

$$ex \quad 0.23346kN = \frac{\pi^2 \cdot 10.56MPa \cdot 5600cm^4}{(5000mm)^2}$$



3) Deflection at Section given Moment of Section if Both Ends of Column are Fixed

$$fx \quad \delta = \frac{M_{\text{Fixed}} - M_t}{P}$$

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

$$ex \quad 6.65\text{mm} = \frac{20000\text{N} \cdot \text{mm} - 50\text{N} \cdot \text{mm}}{3\text{kN}}$$

4) Length of Column given Crippling Load if Both Ends of Column are Fixed

$$fx \quad l = \sqrt{\frac{\pi^2 \cdot E \cdot I}{P}}$$

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

$$ex \quad 1394.811\text{mm} = \sqrt{\frac{\pi^2 \cdot 10.56\text{MPa} \cdot 5600\text{cm}^4}{3\text{kN}}}$$

5) Modulus of Elasticity given Crippling Load if Both Ends of Column are Fixed

$$fx \quad E = \frac{P \cdot l^2}{\pi^2 \cdot I}$$

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

$$ex \quad 135.698\text{MPa} = \frac{3\text{kN} \cdot (5000\text{mm})^2}{\pi^2 \cdot 5600\text{cm}^4}$$



6) Moment of Fixed Ends given Moment of Section if Both Ends of Column are Fixed

$$fx \quad M_{\text{Fixed}} = M_t + P \cdot \delta$$

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

$$ex \quad 36050\text{N} \cdot \text{mm} = 50\text{N} \cdot \text{mm} + 3\text{kN} \cdot 12\text{mm}$$

7) Moment of Inertia given Crippling Load if Both Ends of Column are Fixed

$$fx \quad I = \frac{P \cdot l^2}{\pi^2 \cdot E}$$

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

$$ex \quad 71961.07\text{cm}^4 = \frac{3\text{kN} \cdot (5000\text{mm})^2}{\pi^2 \cdot 10.56\text{MPa}}$$

8) Moment of Section if Both Ends of Column are Fixed

$$fx \quad M_t = M_{\text{Fixed}} - P \cdot \delta$$

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

$$ex \quad -16000\text{N} \cdot \text{mm} = 20000\text{N} \cdot \text{mm} - 3\text{kN} \cdot 12\text{mm}$$

Both Ends of Columns are Hinged

9) Crippling Load given Moment at Section if Both Ends of Column are Hinged

$$fx \quad P = -\frac{M_t}{\delta}$$

[Open Calculator !\[\]\(c1168d6a8b365d11e842ece304635fa7_img.jpg\)](#)

$$ex \quad -0.004167\text{kN} = -\frac{50\text{N} \cdot \text{mm}}{12\text{mm}}$$



10) Crippling Load when Both Ends of Column are Hinged

$$\text{fx } P = \frac{\pi^2 \cdot E \cdot I}{l^2}$$

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

$$\text{ex } 0.23346\text{kN} = \frac{\pi^2 \cdot 10.56\text{MPa} \cdot 5600\text{cm}^4}{(5000\text{mm})^2}$$

11) Deflection at Section given Moment at Section if Both Ends of Column are Hinged

$$\text{fx } \delta = -\frac{M_t}{P}$$

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

$$\text{ex } -0.016667\text{mm} = -\frac{50\text{N} \cdot \text{mm}}{3\text{kN}}$$

12) Length of Column given Crippling Load with Both Ends of Column Hinged

$$\text{fx } l = \sqrt{\frac{\pi^2 \cdot E \cdot I}{P}}$$

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

$$\text{ex } 1394.811\text{mm} = \sqrt{\frac{\pi^2 \cdot 10.56\text{MPa} \cdot 5600\text{cm}^4}{3\text{kN}}}$$



13) Modulus of Elasticity given Crippling Load with Both Ends of Column Hinged

$$\text{fx } E = \frac{P \cdot l^2}{\pi^2 \cdot I}$$

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

$$\text{ex } 135.698\text{MPa} = \frac{3\text{kN} \cdot (5000\text{mm})^2}{\pi^2 \cdot 5600\text{cm}^4}$$

14) Moment due to Crippling Load at Section if Both Ends of Column are Hinged

$$\text{fx } M_t = -P \cdot \delta$$

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

$$\text{ex } -36000\text{N} \cdot \text{mm} = -3\text{kN} \cdot 12\text{mm}$$

15) Moment of Inertia given Crippling Load with Both Ends of Column Hinged


$$\text{fx } I = \frac{P \cdot l^2}{\pi^2 \cdot E}$$

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

$$\text{ex } 71961.07\text{cm}^4 = \frac{3\text{kN} \cdot (5000\text{mm})^2}{\pi^2 \cdot 10.56\text{MPa}}$$




One End of Column is Fixed and Other is Free

16) Crippling Load given Moment of Section if One End of Column is Fixed and Other is Free 

$$\text{fx } P = \frac{M_t}{a - \delta}$$

Open Calculator 


$$\text{ex } 0.025\text{kN} = \frac{50\text{N} \cdot \text{mm}}{14\text{mm} - 12\text{mm}}$$

17) Crippling Load if One End of Column is Fixed and Other is Free 

$$\text{fx } P = \frac{\pi^2 \cdot E \cdot I}{4 \cdot l^2}$$

Open Calculator 

$$\text{ex } 0.058365\text{kN} = \frac{\pi^2 \cdot 10.56\text{MPa} \cdot 5600\text{cm}^4}{4 \cdot (5000\text{mm})^2}$$

18) Deflection at Free End given Moment of Section if One End of Column is Fixed and Other is Free 

$$\text{fx } a = \frac{M_t}{P} + \delta$$

Open Calculator 

$$\text{ex } 12.01667\text{mm} = \frac{50\text{N} \cdot \text{mm}}{3\text{kN}} + 12\text{mm}$$



19) Deflection of Section given Moment of Section if One End of Column is Fixed and Other is Free

$$\text{fx } \delta = a - \frac{M_t}{P}$$

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

$$\text{ex } 13.98333\text{mm} = 14\text{mm} - \frac{50\text{N} \cdot \text{mm}}{3\text{kN}}$$

20) Length of Column given Crippling Load if One End of Column is Fixed and Other is Free

$$\text{fx } l = \sqrt{\frac{\pi^2 \cdot E \cdot I}{4 \cdot P}}$$

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

$$\text{ex } 697.4053\text{mm} = \sqrt{\frac{\pi^2 \cdot 10.56\text{MPa} \cdot 5600\text{cm}^4}{4 \cdot 3\text{kN}}}$$

21) Modulus of Elasticity given Crippling Load if One End of Column is Fixed and Other is Free

$$\text{fx } E = \frac{4 \cdot l^2 \cdot P}{\pi^2 \cdot I}$$

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

$$\text{ex } 542.7921\text{MPa} = \frac{4 \cdot (5000\text{mm})^2 \cdot 3\text{kN}}{\pi^2 \cdot 5600\text{cm}^4}$$



22) Moment of Inertia given Crippling Load if One End of Column is Fixed and Other is Free

$$\text{fx } I = \frac{4 \cdot l^2 \cdot P}{\pi^2 \cdot E}$$

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

$$\text{ex } 287844.3\text{cm}^4 = \frac{4 \cdot (5000\text{mm})^2 \cdot 3\text{kN}}{\pi^2 \cdot 10.56\text{MPa}}$$

23) Moment of Section due to Crippling Load if One End of Column is Fixed and Other is Free

$$\text{fx } M_t = P \cdot (a - \delta)$$

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

$$\text{ex } 6000\text{N*mm} = 3\text{kN} \cdot (14\text{mm} - 12\text{mm})$$

One End of Column is Fixed and Other is Hinged

24) Crippling Load given Moment at Section if One End of Column is Fixed and Other is Hinged

$$\text{fx } P = \frac{-M_t + H \cdot (l - x)}{\delta}$$

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

$$\text{ex } 333.3292\text{kN} = \frac{-50\text{N*mm} + 2\text{kN} \cdot (5000\text{mm} - 3000\text{mm})}{12\text{mm}}$$



25) Crippling Load if One End of Column is Fixed and Other is Hinged

$$\text{fx } P = \frac{2 \cdot \pi^2 \cdot E \cdot I}{l^2}$$

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

$$\text{ex } 0.466919\text{kN} = \frac{2 \cdot \pi^2 \cdot 10.56\text{MPa} \cdot 5600\text{cm}^4}{(5000\text{mm})^2}$$

26) Deflection at Section given Moment at Section if One End of Column is Fixed and Other is Hinged

$$\text{fx } \delta = \frac{-M_t + H \cdot (l - x)}{P}$$

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

$$\text{ex } 1333.317\text{mm} = \frac{-50\text{N} \cdot \text{mm} + 2\text{kN} \cdot (5000\text{mm} - 3000\text{mm})}{3\text{kN}}$$

27) Horizontal Reaction given Moment at Section if One End of Column is Fixed and Other is Hinged

$$\text{fx } H = \frac{M_t + P \cdot \delta}{l - x}$$

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

$$\text{ex } 0.018025\text{kN} = \frac{50\text{N} \cdot \text{mm} + 3\text{kN} \cdot 12\text{mm}}{5000\text{mm} - 3000\text{mm}}$$



28) Length of Column given Crippling Load if One End of Column is Fixed and Other is Hinged

$$fx \quad l = \sqrt{\frac{2 \cdot \pi^2 \cdot E \cdot I}{P}}$$

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

$$ex \quad 1972.56\text{mm} = \sqrt{\frac{2 \cdot \pi^2 \cdot 10.56\text{MPa} \cdot 5600\text{cm}^4}{3\text{kN}}}$$

29) Length of Column given Moment at Section if One End of Column is Fixed and Other is Hinged

$$fx \quad l = \frac{M_t + P \cdot \delta}{H} + x$$

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

$$ex \quad 3018.025\text{mm} = \frac{50\text{N} \cdot \text{mm} + 3\text{kN} \cdot 12\text{mm}}{2\text{kN}} + 3000\text{mm}$$

30) Modulus of Elasticity given Crippling Load if One End of Column is Fixed and Other is Hinged

$$fx \quad E = \frac{P \cdot l^2}{2 \cdot \pi^2 \cdot I}$$

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

$$ex \quad 67.84901\text{MPa} = \frac{3\text{kN} \cdot (5000\text{mm})^2}{2 \cdot \pi^2 \cdot 5600\text{cm}^4}$$



31) Moment at Section if One End of Column is Fixed and Other is Hinged

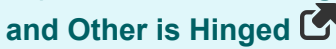


$$fx \quad M_t = -P \cdot \delta + H \cdot (1 - x)$$

[Open Calculator](#)

$$ex \quad 4E^6N^*mm = -3kN \cdot 12mm + 2kN \cdot (5000mm - 3000mm)$$

32) Moment of Inertia given Crippling Load if One End of Column is Fixed and Other is Hinged



$$fx \quad I = \frac{P \cdot l^2}{2 \cdot \pi^2 \cdot E}$$

[Open Calculator](#)

$$ex \quad 35980.53cm^4 = \frac{3kN \cdot (5000mm)^2}{2 \cdot \pi^2 \cdot 10.56MPa}$$








Variables Used

- **a** Deflection of Free End (*Millimeter*)
- **E** Modulus of Elasticity of Column (*Megapascal*)
- **H** Horizontal Reaction (*Kilonewton*)
- **I** Moment of Inertia Column (*Centimeter⁴*)
- **l** Column Length (*Millimeter*)
- **M_{Fixed}** Fixed End Moment (*Newton Millimeter*)
- **M_t** Moment of Section (*Newton Millimeter*)
- **P** Column Crippling Load (*Kilonewton*)
- **x** Distance b/w Fixed End and Deflection Point (*Millimeter*)
- **δ** Deflection at Section (*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:** **Pressure** in Megapascal (MPa)
Pressure Unit Conversion 
- **Measurement:** **Force** in Kilonewton (kN)
Force Unit Conversion 
- **Measurement:** **Moment of Force** in Newton Millimeter (N*mm)
Moment of Force Unit Conversion 
- **Measurement:** **Second Moment of Area** in Centimeter⁴ (cm⁴)
Second Moment of Area Unit Conversion 



Check other formula lists

- [Columns With Eccentric Load Formulas](#) 
- [Columns With Initial Curvature Formulas](#) 
- [Effective Length of Column Formulas](#) 
- [Euler and Rankine's Theory Formulas](#) 
- [Expressions For Crippling Load Formulas](#) 
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