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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

Open Calculator

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

ex $$1.6625\text{kN} = \frac{20000\text{N*mm} - 50\text{N*mm}}{12\text{mm}}$$

2) Crippling Load if Both Ends of Column are Fixed

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

Both Ends of Columns are Hinged

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

Open Calculator

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

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

10) Crippling Load when Both Ends of Column are Hinged

Open Calculator

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

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

Open Calculator

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

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

fx $$M_t = -P \cdot \delta$$

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

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

Open Calculator

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

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

Open Calculator

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

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

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

Open Calculator

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

$$M_t = -P \cdot \delta + H \cdot (l - x)$$

$$4E\hat{}6N*mm = -3kN \cdot 12mm + 2kN \cdot (5000mm - 3000mm)$$

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

Open Calculator

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

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

Variables Used

- **a** Deflection of Free End *(Millimeter)*
- **E** Modulus of Elasticity of Column *(Megapascal)*
- **H** Horizontal Reaction *(Kilonewton)*
- **I** Moment of Inertia Column *(Centimeter^4)*
- **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)
  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: **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 Initial Curvature Formulas
- Effective Length of Column Formulas
- Euler and Rankine's Theory Formulas
- Expressions For Crippling Load Formulas
- Failure of a Column Formulas
- Formula By I.S. Code For Mild Steel Formulas
- Johnson's Parabolic Formula Formulas
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