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Elastic Flexural Buckling of Columns Formulas

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List of 15 Elastic Flexural Buckling of Columns Formulas

Elastic Flexural Buckling of Columns

1) Axial Buckling Load for Warped Section

Open Calculator

fx $$P_{\text{Buckling Load}} = \left(\frac{A}{I_p}\right) \cdot \left(G \cdot J + \frac{\pi^2 \cdot E \cdot C_w}{L^2}\right)$$

ex $$5.000001\text{N} = \left(\frac{700\text{mm}^2}{322000\text{mm}^4}\right) \cdot \left(230\text{MPa} \cdot 10.0 + \frac{\pi^2 \cdot 50\text{MPa} \cdot 10\text{kg}\cdot\text{m}^2}{(3000\text{mm})^2}\right)$$

2) Cross-Sectional Area given Axial Buckling Load for Warped Section

Open Calculator

fx $$A = \frac{P_{\text{Buckling Load}} \cdot I_p}{G \cdot J + \left(\frac{\pi^2 \cdot E \cdot C_w}{L^2}\right)}$$

ex $$699.9998\text{mm}^2 = \frac{5\text{N} \cdot 322000\text{mm}^4}{230\text{MPa} \cdot 10.0 + \left(\frac{\pi^2 \cdot 50\text{MPa} \cdot 10\text{kg}\cdot\text{m}^2}{(3000\text{mm})^2}\right)}$$

3) Cross-Sectional Area given Torsional Buckling Load for Pin Ended Columns

Open Calculator

$$A = \frac{P_{\text{Buckling Load}} \cdot I_p}{G \cdot J}$$

$$700\text{mm}^2 = \frac{5\text{N} \cdot 322000\text{mm}^4}{230\text{MPa} \cdot 10.0}$$

4) Polar Moment of Inertia for Axial Buckling Load for Warped Section

Open Calculator

$$I_p = \frac{A}{P_{\text{Buckling Load}}} \cdot \left(G \cdot J + \left(\frac{\pi^2 \cdot E \cdot C_w}{L^2} \right) \right)$$

$$322000.1\text{mm}^4 = \frac{700\text{mm}^2}{5\text{N}} \cdot \left(230\text{MPa} \cdot 10.0 + \left(\frac{\pi^2 \cdot 50\text{MPa} \cdot 10\text{kg}\cdot\text{m}^2}{(3000\text{mm})^2} \right) \right)$$

5) Polar Moment of Inertia for Pin Ended Columns

Open Calculator

$$I_p = \frac{G \cdot J \cdot A}{P_{\text{Buckling Load}}}$$

$$322000\text{mm}^4 = \frac{230\text{MPa} \cdot 10.0 \cdot 700\text{mm}^2}{5\text{N}}$$

6) Shear Modulus of Elasticity given Torsional Buckling Load for Pin Ended Columns

Open Calculator

fx $$G = \frac{P_{\text{Buckling Load}} \cdot I_p}{J \cdot A}$$

ex $$230\text{MPa} = \frac{5\text{N} \cdot 322000\text{mm}^4}{10.0 \cdot 700\text{mm}^2}$$

7) Torsional Buckling Load for Pin Ended Columns

Open Calculator

fx $$P_{\text{Buckling Load}} = \frac{G \cdot J \cdot A}{I_p}$$

ex $$5\text{N} = \frac{230\text{MPa} \cdot 10.0 \cdot 700\text{mm}^2}{322000\text{mm}^4}$$

Pin-Ended Columns

8) Critical Buckling Load for Pin Ended Columns by Euler's Formula

Open Calculator

fx $$P_{\text{Buckling Load}} = \frac{\pi^2 \cdot E \cdot A}{\left(\frac{L}{r_{\text{gyration}}}\right)^2}$$

ex $$25.94609\text{N} = \frac{\pi^2 \cdot 50\text{MPa} \cdot 700\text{mm}^2}{\left(\frac{3000\text{mm}}{26\text{mm}}\right)^2}$$

9) Cross-Sectional Area given Critical Buckling Load for Pin Ended Columns by Euler's Formula

Open Calculator

fx $$A = \frac{P_{\text{Buckling Load}} \cdot \left(\frac{L}{r_{\text{gyration}}}\right)^2}{\pi^2 \cdot E}$$

ex $$134.8951\text{mm}^2 = \frac{5\text{N} \cdot \left(\frac{3000\text{mm}}{26\text{mm}}\right)^2}{\pi^2 \cdot 50\text{MPa}}$$

10) Radius of Gyration given Critical Buckling Load for Pin Ended Columns by Euler's Formula

Open Calculator

fx $$r_{\text{gyration}} = \sqrt{\frac{P_{\text{Buckling Load}} \cdot L^2}{\pi^2 \cdot E \cdot A}}$$

ex $$11.41359\text{mm} = \sqrt{\frac{5\text{N} \cdot (3000\text{mm})^2}{\pi^2 \cdot 50\text{MPa} \cdot 700\text{mm}^2}}$$

11) Slenderness Ratio given Critical Buckling Load for Pin Ended Columns by Euler's Formula

Open Calculator

fx $$\lambda = \sqrt{\frac{\pi^2 \cdot E \cdot A}{P_{\text{Buckling Load}}}}$$

ex $$262.8445 = \sqrt{\frac{\pi^2 \cdot 50\text{MPa} \cdot 700\text{mm}^2}{5\text{N}}}$$

Slender Columns

12) Cross-Sectional Area given Elastic Critical Buckling Load

Open Calculator

$$A = \frac{P_{\text{Buckling Load}} \cdot \left(\frac{L}{r_{\text{gyration}}}\right)^2}{\pi^2 \cdot E}$$

$$134.8951\text{mm}^2 = \frac{5\text{N} \cdot \left(\frac{3000\text{mm}}{26\text{mm}}\right)^2}{\pi^2 \cdot 50\text{MPa}}$$

13) Elastic Critical Buckling Load

Open Calculator

$$P_{\text{Buckling Load}} = \frac{\pi^2 \cdot E \cdot A}{\left(\frac{L}{r_{\text{gyration}}}\right)^2}$$

$$25.94609\text{N} = \frac{\pi^2 \cdot 50\text{MPa} \cdot 700\text{mm}^2}{\left(\frac{3000\text{mm}}{26\text{mm}}\right)^2}$$

14) Radius of Gyration of Column given Elastic Critical Buckling Load

Open Calculator

$$r_{\text{gyration}} = \sqrt{\frac{P_{\text{Buckling Load}} \cdot L^2}{\pi^2 \cdot E \cdot A}}$$

$$11.41359\text{mm} = \sqrt{\frac{5\text{N} \cdot (3000\text{mm})^2}{\pi^2 \cdot 50\text{MPa} \cdot 700\text{mm}^2}}$$

15) Slenderness Ratio given Elastic Critical Buckling Load

Open Calculator

fx $$\lambda = \sqrt{\frac{\pi^2 \cdot \mathrm{E} \cdot \mathrm{A}}{\mathrm{P}_{\text{Buckling Load}}}}$$

ex $$262.8445 = \sqrt{\frac{\pi^2 \cdot 50\text{MPa} \cdot 700\text{mm}^2}{5\text{N}}}$$

Variables Used

- **A** Column Cross-Sectional Area *(Square Millimeter)*
- C_w Warping Constant *(Kilogram Square Meter)*
- **E** Modulus of Elasticity *(Megapascal)*
- **G** Shear Modulus of Elasticity *(Megapascal)*
- I_p Polar Moment of Inertia *(Millimeter⁴)*
- **J** Torsional Constant
- **L** Effective Length of Column *(Millimeter)*
- $P_{Buckling\ Load}$ Buckling Load *(Newton)*
- $r_{gyration}$ Radius of Gyration of Column *(Millimeter)*
- **λ** Slenderness Ratio

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: **Moment of Inertia** in Kilogram Square Meter (kg·m²)
  Moment of Inertia Unit Conversion
- Measurement: **Second Moment of Area** in Millimeter⁴ (mm⁴)
  Second Moment of Area Unit Conversion
- Measurement: **Stress** in Megapascal (MPa)
  Stress Unit Conversion

Check other formula lists

- **Allowable Design for Column Formulas**
- **Column Base Plate Design Formulas**
- **Columns of Special Materials Formulas**
- **Eccentric Loads on Columns Formulas**
- **Elastic Flexural Buckling of Columns Formulas**
- **Short Axially Loaded Columns with Helical Ties Formulas**
- **Ultimate Strength Design of Concrete Columns Formulas**

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