Important Elastic Flexural Buckling of Columns Formulas PDF

Formulas
Examples
with Units

List of 15
Important Elastic Flexural Buckling of Columns Formulas

1) Axial Buckling Load for Warped Section Formula

Evaluate Formula

Formula

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

Example with Units

$$5\,\text{N} = \left(\frac{700\,\text{mm}^2}{322000\,\text{mm}^4}\right) \cdot \left(230\,\text{MPa} \cdot 10.0 + \frac{3.1416^2 \cdot 50\,\text{MPa} \cdot 10\,\text{kg·m}^2}{3000\,\text{mm}^2}\right)$$

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

Evaluate Formula

Formula

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

Example with Units

$$699.9998\,\text{mm}^2 = \frac{5\,\text{N} \cdot 322000\,\text{mm}^4}{230\,\text{MPa} \cdot 10.0 + \left(\frac{3.1416^2 \cdot 50\,\text{MPa} \cdot 10\,\text{kg·m}^2}{3000\,\text{mm}^2}\right)}$$

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

$$322000.0768\,\text{mm}^4 = \frac{700\,\text{mm}^2}{5\,\text{N}} \cdot \left(230\,\text{MPa} \cdot 10.0 + \left(\frac{3.1416^2 \cdot 50\,\text{MPa} \cdot 10\,\text{kg·m}^2}{3000\,\text{mm}^2}\right)\right)$$

5) Polar Moment of Inertia for Pin Ended Columns Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

7) Torsional Buckling Load for Pin Ended Columns Formula

Evaluate Formula

Formula

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

Example with Units

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

8) Pin-Ended Columns Formulas

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

Evaluate Formula

Formula

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

Example with Units

$$25.9461\,\text{N} = \frac{3.1416^2 \cdot 50\,\text{MPa} \cdot 700\,\text{mm}^2}{\left(\frac{3000\,\text{mm}}{26\,\text{mm}}\right)^2}$$

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

Evaluate Formula

Formula

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

Example with Units

$$134.8951\,\text{mm}^2 = \frac{5\,\text{N} \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}}\right)^2}{3.1416^2 \cdot 50\,\text{MPa}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$11.4136\,\text{mm} = \sqrt{\frac{5\,\text{N} \cdot 3000\,\text{mm}^2}{3.1416^2 \cdot 50\,\text{MPa} \cdot 700\,\text{mm}^2}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$262.8445 = \sqrt{\frac{3.1416^2 \cdot 50\,\text{MPa} \cdot 700\,\text{mm}^2}{5\,\text{N}}}$$

9) Slender Columns Formulas

9.1) Cross-Sectional Area given Elastic Critical Buckling Load Formula

Evaluate Formula

Formula

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

Example with Units

$$134.8951\,\text{mm}^2 = \frac{5\,\text{N} \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}}\right)^2}{3.1416^2 \cdot 50\,\text{MPa}}$$

9.2) Elastic Critical Buckling Load Formula

Evaluate Formula

Formula

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

Example with Units

$$25.9461\,\text{N} = \frac{3.1416^2 \cdot 50\,\text{MPa} \cdot 700\,\text{mm}^2}{\left(\frac{3000\,\text{mm}}{26\,\text{mm}}\right)^2}$$

9.3) Radius of Gyration of Column given Elastic Critical Buckling Load Formula

Evaluate Formula

Formula

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

Example with Units

$$11.4136\,\text{mm} = \sqrt{\frac{5\,\text{N} \cdot 3000\,\text{mm}^2}{3.1416^2 \cdot 50\,\text{MPa} \cdot 700\,\text{mm}^2}}$$

9.4) Slenderness Ratio given Elastic Critical Buckling Load Formula

Evaluate Formula

Formula

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

Example with Units

$$262.8445 = \sqrt{\frac{3.1416^2 \cdot 50\,\text{MPa} \cdot 700\,\text{mm}^2}{5\,\text{N}}}$$

Variables used in list of Elastic Flexural Buckling of Columns Formulas above

- **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 in list of Elastic Flexural Buckling of Columns Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **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: **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*

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