Important Eccentric Loads on Columns Formulas PDF

Formulas
Examples
with Units

List of 18
Important Eccentric Loads on Columns Formulas

1) Maximum Stress for Circular Cross-Section Columns Formula

Evaluate Formula

Formula

$$S_M = S_c \cdot \left(1 + 8 \cdot \frac{e}{d}\right)$$

Example with Units

$$46.875\,\text{Pa} = 25\,\text{Pa} \cdot \left(1 + 8 \cdot \frac{35\,\text{mm}}{320\,\text{mm}}\right)$$

2) Maximum Stress for Circular Section Column under Compression Formula

Evaluate Formula

Formula

$$S_M = \left(0.372 + 0.056 \cdot \left(\frac{k}{r}\right) \cdot \left(\frac{P}{k}\right) \cdot \sqrt{r \cdot k}\right)$$

Example with Units

$$10.6599\,\text{Pa} = \left(0.372 + 0.056 \cdot \left(\frac{240\,\text{mm}}{160\,\text{mm}}\right) \cdot \left(\frac{150\,\text{N}}{240\,\text{mm}}\right) \cdot \sqrt{160\,\text{mm} \cdot 240\,\text{mm}}\right)$$

3) Maximum Stress for Rectangular Cross-Section Column Formula

Evaluate Formula

Formula

$$S_M = S_c \cdot \left(1 + 6 \cdot \frac{e}{b}\right)$$

Example with Units

$$46\,\text{Pa} = 25\,\text{Pa} \cdot \left(1 + 6 \cdot \frac{35\,\text{mm}}{250\,\text{mm}}\right)$$

4) Maximum Stress for Rectangular Section Column under Compression Formula

Evaluate Formula

Formula

$$S_M = \left(\frac{2}{3}\right) \cdot \frac{P}{h \cdot k}$$

Example with Units

$$46.2963\,\text{Pa} = \left(\frac{2}{3}\right) \cdot \frac{150\,\text{N}}{9000\,\text{mm} \cdot 240\,\text{mm}}$$

5) Radius of Kern for Circular Ring Formula

Evaluate Formula

Formula

$$r_{kern} = \frac{D \cdot \left(1 + \left(\frac{d_i}{D}\right)^2\right)}{8}$$

Example with Units

$$5.4167\,\text{mm} = \frac{30\,\text{mm} \cdot \left(1 + \left(\frac{20.0\,\text{mm}}{30\,\text{mm}}\right)^2\right)}{8}$$

6) Radius of Kern for Hollow Square Formula

Evaluate Formula

Formula

$$r_{kern} = 0.1179 \cdot H \cdot \left(1 + \left(\frac{h_i}{H}\right)^2\right)$$

Example with Units

$$6.8382\,\text{mm} = 0.1179 \cdot 50.0\,\text{mm} \cdot \left(1 + \left(\frac{20\,\text{mm}}{50.0\,\text{mm}}\right)^2\right)$$

7) Thickness of Wall for Hollow Octagon Formula

Evaluate Formula

Formula

$$t = 0.9239 \cdot \left(R_a - R_i\right)$$

Example with Units

$$41.5755\,\text{mm} = 0.9239 \cdot \left(60\,\text{mm} - 15\,\text{mm}\right)$$

8) Long Columns Formulas

8.1) Euler's Formula for Critical Buckling Load Formula

Evaluate Formula

Formula

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

Example with Units

$$10.9662\,\text{N} = 2.0 \cdot \left(3.1416^2\right) \cdot 50\,\text{MPa} \cdot \frac{100000\,\text{mm}^4}{3000\,\text{mm}^2}$$

8.2) Euler's Formula for Critical Buckling Load given Area Formula

Evaluate Formula

Formula

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

Example with Units

$$51.8922\,\text{N} = \frac{2.0 \cdot 3.1416^2 \cdot 50\,\text{MPa} \cdot 700\,\text{mm}^2}{\left(\frac{3000\,\text{mm}}{26\,\text{mm}}\right)^2}$$

9) Typical Short Column Formulas Formulas

9.1) Critical Stress for Carbon Steel by AISC code Formula

Evaluate Formula

Formula

$$S_w = 17000 - 0.485 \cdot \left(\frac{L}{r_{\text{gyration}}}\right)^2$$

Example with Units

$$10542.8994\,\text{Pa} = 17000 - 0.485 \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}}\right)^2$$

9.2) Critical Stress for Carbon Steel by Am. Br. Co. code Formula

Evaluate Formula

Formula

$$S_w = 19000 - 100 \cdot \left(\frac{L}{r_{\text{gyration}}}\right)$$

Example with Units

$$7461.5385\,\text{Pa} = 19000 - 100 \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}}\right)$$

9.3) Critical Stress for Carbon Steel by AREA code Formula

Evaluate Formula

Formula

$$S_w = 15000 - 50 \cdot \left(\frac{L}{r_{gyration}} \right)$$

Example with Units

$$9230.7692\,\text{Pa} = 15000 - 50 \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}} \right)$$

9.4) Critical Stress for Carbon Steel by Chicago code Formula

Evaluate Formula

Formula

$$S_w = 16000 - 70 \cdot \left(\frac{L}{r_{gyration}} \right)$$

Example with Units

$$7923.0769\,\text{Pa} = 16000 - 70 \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}} \right)$$

9.5) Critical Stress for Cast Iron by NYC code Formula

Evaluate Formula

Formula

$$S_w = 9000 - 40 \cdot \left(\frac{L}{r_{gyration}} \right)$$

Example with Units

$$4384.6154\,\text{Pa} = 9000 - 40 \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}} \right)$$

9.6) Theoretical Maximum Stress for ANC Code 2017ST Aluminium Formula

Evaluate Formula

Formula

$$S_{cr} = 34500 - \left(\frac{245}{\sqrt{c}} \right) \cdot \left(\frac{L}{r_{gyration}} \right)$$

Example with Units

$$20365.3846\,\text{Pa} = 34500 - \left(\frac{245}{\sqrt{4}} \right) \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}} \right)$$

9.7) Theoretical Maximum Stress for ANC Code Alloy Steel Tubing Formula

Evaluate Formula

Formula

$$S_{cr} = 135000 - \left(\frac{15.9}{c} \right) \cdot \left(\frac{L}{r_{gyration}} \right)^2$$

Example with Units

$$82078.4024\,\text{Pa} = 135000 - \left(\frac{15.9}{4} \right) \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}} \right)^2$$

9.8) Theoretical Maximum Stress for ANC Code Spruce Formula

Evaluate Formula

Formula

$$S_{cr} = 5000 - \left(\frac{0.5}{c} \right) \cdot \left(\frac{L}{r_{gyration}} \right)^2$$

Example with Units

$$3335.7988\,\text{Pa} = 5000 - \left(\frac{0.5}{4} \right) \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}} \right)^2$$

9.9) Theoretical Maximum Stress for Johnson Code Steels Formula

Evaluate Formula

Formula

$$S_{cr} = S_y \cdot \left(1 - \left(\frac{S_y}{4 \cdot n \cdot \left(\pi^2\right) \cdot E}\right) \cdot \left(\frac{L}{r_{gyration}}\right)^2\right)$$

Example with Units

$$30868.8386\,\text{Pa} = 35000\,\text{Pa} \cdot \left(1 - \left(\frac{35000\,\text{Pa}}{4 \cdot 2.0 \cdot \left(3.1416^2\right) \cdot 50\,\text{MPa}}\right) \cdot \left(\frac{3000\,\text{mm}}{26\,\text{mm}}\right)^2\right)$$

Variables used in list of Eccentric Loads on Columns Formulas above

- **A** Column Cross-Sectional Area *(Square Millimeter)*
- **b** Rectangular Cross-Section Width *(Millimeter)*
- **c** End Fixity Coefficient
- **d** Diameter of Circular Cross-Section *(Millimeter)*
- **D** Outer Diameter of Hollow Circular Section *(Millimeter)*
- d_i Inner Diameter of Hollow Circular Section *(Millimeter)*
- **e** Eccentricity of Column *(Millimeter)*
- **E** Modulus of Elasticity *(Megapascal)*
- **h** Height of Cross-Section *(Millimeter)*
- **H** Length of Outer Side *(Millimeter)*
- h_i Length of Inner Side *(Millimeter)*
- **I** Area Moment of Inertia *(Millimeter⁴)*
- **k** Distance from Nearest Edge *(Millimeter)*
- **L** Effective Length of Column *(Millimeter)*
- **n** Coefficient for Column End Conditions
- **P** Concentrated Load *(Newton)*
- $P_{Buckling\ Load}$ Buckling Load *(Newton)*
- **r** Radius of Circular Cross-Section *(Millimeter)*
- R_a Radii of Circle Circumscribing Outer Side *(Millimeter)*
- $r_{gyration}$ Radius of Gyration of Column *(Millimeter)*
- R_i Radii of Circle Circumscribing Inner Side *(Millimeter)*
- r_{kern} Radius of Kern *(Millimeter)*
- S_c Unit Stress *(Pascal)*
- S_{cr} Theoretical Maximum Stress *(Pascal)*
- S_M Maximum Stress for Section *(Pascal)*
- S_w Critical Stress *(Pascal)*
- S_y Stress at any Point y *(Pascal)*
- **t** Thickness of Wall *(Millimeter)*

Constants, Functions, Measurements used in list of Eccentric Loads on 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: **Second Moment of Area** in Millimeter⁴ (mm⁴) *Second Moment of Area Unit Conversion*
- Measurement: **Stress** in Pascal (Pa), Megapascal (MPa) *Stress Unit Conversion*

Download other Important Columns PDFs

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

Try our Unique Visual Calculators

- Winning percentage
- LCM of two numbers
- Mixed fraction

Please SHARE this PDF with someone who needs it!

This PDF can be downloaded in these languages

English Spanish French German Russian Italian Portuguese Polish Dutch

7/8/2024 | 7:17:33 AM UTC