Important Design of Curved Beams Formulas PDF

Formulas
Examples
with Units

List of 20
Important Design of Curved Beams Formulas

1) Area of cross section of curved beam given bending stress at inner fiber Formula

Evaluate Formula

Formula

$$A = \frac{M_b \cdot h_i}{e \cdot \sigma_b i \cdot R_i}$$

Example with Units

$$240\,\text{mm}^2 = \frac{985000\,\text{N*mm} \cdot 10\,\text{mm}}{2\,\text{mm} \cdot 293.1548\,\text{N/mm}^2 \cdot 70\,\text{mm}}$$

2) Area of cross section of curved beam given bending stress at outer fiber Formula

Evaluate Formula

Formula

$$A = \frac{M_b \cdot h_o}{e \cdot \sigma_b o \cdot R_o}$$

Example with Units

$$240\,\text{mm}^2 = \frac{985000\,\text{N*mm} \cdot 12\,\text{mm}}{2\,\text{mm} \cdot 273.6111\,\text{N/mm}^2 \cdot 90\,\text{mm}}$$

3) Bending moment at fibre of curved beam given bending stress and eccentricity Formula

Evaluate Formula

Formula

$$M_b = \frac{\sigma_b \cdot \left(A \cdot \left(R - R_N \right) \cdot e \right)}{y}$$

Example with Units

$$34561.4034\,\text{N*mm} = \frac{756.0307\,\text{N/mm}^2 \cdot \left(240\,\text{mm}^2 \cdot \left(80\,\text{mm} - 78\,\text{mm} \right) \cdot 2\,\text{mm} \right)}{21\,\text{mm}}$$

4) Bending moment at fibre of curved beam given bending stress and radius of centroidal axis Formula

Evaluate Formula

Formula

$$M_b = \frac{\sigma_b \cdot \left(A \cdot \left(R - R_N \right) \cdot \left(R_N - y \right) \right)}{y}$$

Example with Units

$$984999.9977\,\text{N*mm} = \frac{756.0307\,\text{N/mm}^2 \cdot \left(240\,\text{mm}^2 \cdot \left(80\,\text{mm} - 78\,\text{mm} \right) \cdot \left(78\,\text{mm} - 21\,\text{mm} \right) \right)}{21\,\text{mm}}$$

5) Bending moment in curved beam given bending stress at inner fibre Formula

Evaluate Formula

Formula

$$M_b = \frac{\sigma_b i \cdot A \cdot e \cdot R_i}{h_i}$$

Example with Units

$$985000.128\,\text{N*mm} = \frac{293.1548\,\text{N/mm²} \cdot 240\,\text{mm²} \cdot 2\,\text{mm} \cdot 70\,\text{mm}}{10\,\text{mm}}$$

6) Bending moment in curved beam given bending stress at outer fibre Formula

Evaluate Formula

Formula

$$M_b = \frac{\sigma_b o \cdot A \cdot e \cdot R_o}{h_o}$$

Example with Units

$$984999.96\,\text{N*mm} = \frac{273.6111\,\text{N/mm²} \cdot 240\,\text{mm²} \cdot 2\,\text{mm} \cdot 90\,\text{mm}}{12\,\text{mm}}$$

7) Bending stress at inner fibre of curved beam given bending moment Formula

Evaluate Formula

Formula

$$\sigma_b i = \frac{M_b \cdot h_i}{A \cdot e \cdot R_i}$$

Example with Units

$$293.1548\,\text{N/mm²} = \frac{985000\,\text{N*mm} \cdot 10\,\text{mm}}{240\,\text{mm²} \cdot 2\,\text{mm} \cdot 70\,\text{mm}}$$

8) Bending stress at outer fibre of curved beam given bending moment Formula

Evaluate Formula

Formula

$$\sigma_b o = \frac{M_b \cdot h_o}{(A) \cdot e \cdot (R_o)}$$

Example with Units

$$273.6111\,\text{N/mm²} = \frac{985000\,\text{N*mm} \cdot 12\,\text{mm}}{(240\,\text{mm²}) \cdot 2\,\text{mm} \cdot (90\,\text{mm})}$$

9) Bending stress in fiber of curved beam Formula

Evaluate Formula

Formula

$$\sigma_b = \frac{M_b \cdot y}{A \cdot e \cdot (R_N - y)}$$

Example with Units

$$756.0307\,\text{N/mm²} = \frac{985000\,\text{N*mm} \cdot 21\,\text{mm}}{240\,\text{mm²} \cdot 2\,\text{mm} \cdot (78\,\text{mm} - 21\,\text{mm})}$$

10) Bending stress in fibre of curved beam given eccentricity Formula

Evaluate Formula

Formula

$$\sigma_b = \left(\frac{M_b \cdot y}{A \cdot (e) \cdot (R_N - y)}\right)$$

Example with Units

$$756.0307\,\text{N/mm²} = \left(\frac{985000\,\text{N*mm} \cdot 21\,\text{mm}}{240\,\text{mm²} \cdot (2\,\text{mm}) \cdot (78\,\text{mm} - 21\,\text{mm})}\right)$$

11) Bending stress in fibre of curved beam given radius of centroidal axis Formula

Evaluate Formula

Formula

$$\sigma_b = \left(\frac{M_b \cdot y}{A \cdot \left(R - R_N \right) \cdot \left(R_N - y \right)} \right)$$

Example with Units

$$756.0307\,\text{N/mm}^2 = \left(\frac{985000\,\text{N*mm} \cdot 21\,\text{mm}}{240\,\text{mm}^2 \cdot \left(80\,\text{mm} - 78\,\text{mm} \right) \cdot \left(78\,\text{mm} - 21\,\text{mm} \right)} \right)$$

12) Diameter of circular curved beam given radius of centroidal axis Formula

Evaluate Formula

Formula

$$d = 2 \cdot \left(R - R_i \right)$$

Example with Units

$$20\,\text{mm} = 2 \cdot \left(80\,\text{mm} - 70\,\text{mm} \right)$$

13) Distance of fibre from neutral axis of rectangular curved beam given inner and outer fiber radius Formula

Evaluate Formula

Formula

$$y = R_i \cdot \ln\left(\frac{R_o}{R_i} \right)$$

Example with Units

$$17.592\,\text{mm} = 70\,\text{mm} \cdot \ln\left(\frac{90\,\text{mm}}{70\,\text{mm}} \right)$$

14) Distance of fibre from neutral axis of rectangular curved beam given radius of centroidal axis Formula

Evaluate Formula

Formula

$$y = 2 \cdot \left(R - R_i \right)$$

Example with Units

$$20\,\text{mm} = 2 \cdot \left(80\,\text{mm} - 70\,\text{mm} \right)$$

15) Distance of inner fiber from neutral axis of curved beam given bending stress at fibre Formula

Evaluate Formula

Formula

$$h_i = \frac{\sigma_b i \cdot \left(A \right) \cdot e \cdot \left(R_i \right)}{M_b}$$

Example with Units

$$10\,\text{mm} = \frac{293.1548\,\text{N/mm}^2 \cdot \left(240\,\text{mm}^2 \right) \cdot 2\,\text{mm} \cdot \left(70\,\text{mm} \right)}{985000\,\text{N*mm}}$$

16) Distance of outer fibre from neutral axis of curved beam given bending stress at fibre Formula

Evaluate Formula

Formula

$$h_o = \frac{\sigma_b o \cdot A \cdot e \cdot R_o}{M_b}$$

Example with Units

$$12\,\text{mm} = \frac{273.6111\,\text{N/mm}^2 \cdot 240\,\text{mm}^2 \cdot 2\,\text{mm} \cdot 90\,\text{mm}}{985000\,\text{N*mm}}$$

17) Eccentricity between central and neutral axis of curved beam Formula

Evaluate Formula

Formula

$$e = R - R_N$$

Example with Units

$$2\,\text{mm} = 80\,\text{mm} - 78\,\text{mm}$$

18) Eccentricity between centroidal and neutral axis of curved beam given bending stress at inner fibre Formula

Evaluate Formula

Formula

$$e = \frac{M_b \cdot h_i}{A \cdot \sigma_b i \cdot R_i}$$

Example with Units

$$2\,\text{mm} = \frac{985000\,\text{N*mm} \cdot 10\,\text{mm}}{240\,\text{mm}^2 \cdot 293.1548\,\text{N/mm}^2 \cdot 70\,\text{mm}}$$

19) Eccentricity between centroidal and neutral axis of curved beam given bending stress at outer fibre Formula

Evaluate Formula

Formula

$$e = \frac{M_b \cdot h_o}{A \cdot \sigma_b o \cdot R_o}$$

Example with Units

$$2\,\text{mm} = \frac{985000\,\text{N*mm} \cdot 12\,\text{mm}}{240\,\text{mm}^2 \cdot 273.6111\,\text{N/mm}^2 \cdot 90\,\text{mm}}$$

20) Eccentricity between centroidal and neutral axis of curved beam given radius of both axis Formula

Evaluate Formula

Formula

$$e = R - R_N$$

Example with Units

$$2\,\text{mm} = 80\,\text{mm} - 78\,\text{mm}$$

Variables used in list of Design of Curved Beams Formulas above

- **A** Cross Sectional Area of Curved Beam *(Square Millimeter)*
- **d** Diameter of Circular Curved Beam *(Millimeter)*
- **e** Eccentricity Between Centroidal and Neutral Axis *(Millimeter)*
- h_i Distance of Inner Fibre from Neutral Axis *(Millimeter)*
- h_o Distance of Outer Fibre from Neutral Axis *(Millimeter)*
- M_b Bending Moment in Curved Beam *(Newton Millimeter)*
- **R** Radius of Centroidal Axis *(Millimeter)*
- R_i Radius of Inner Fibre *(Millimeter)*
- R_N Radius of Neutral Axis *(Millimeter)*
- R_o Radius of Outer Fibre *(Millimeter)*
- **y** Distance from Neutral Axis of Curved Beam *(Millimeter)*
- σ_b Bending Stress *(Newton per Square Millimeter)*
- $\sigma_b i$ Bending Stress at Inner Fibre *(Newton per Square Millimeter)*
- $\sigma_b o$ Bending Stress at Outer Fibre *(Newton per Square Millimeter)*

Constants, Functions, Measurements used in list of Design of Curved Beams Formulas above

- Functions: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Area** in Square Millimeter (mm²)
  Area Unit Conversion
- Measurement: **Torque** in Newton Millimeter (N*mm)
  Torque Unit Conversion
- Measurement: **Stress** in Newton per Square Millimeter (N/mm²)
  Stress Unit Conversion

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