Important Beam Moments Formulas PDF

Formulas
Examples
with Units

List of 24
Important Beam Moments Formulas

1) Bending Moment of Cantilever Beam Subjected to UDL at Any Point from Free End Formula

Evaluate Formula

Formula

$$M = \left(\frac{w \cdot x^2}{2} \right)$$

Example with Units

$$57.0037\,\text{kN*m} = \left(\frac{67.46\,\text{kN/m} \cdot 1300\,\text{mm}^2}{2} \right)$$

2) Bending Moment of Simply Supported Beam Carrying UDL Formula

Evaluate Formula

Formula

$$M = \left(\frac{w \cdot L \cdot x}{2} \right) - \left(w \cdot \frac{x^2}{2} \right)$$

Example with Units

$$57.0037\,\text{kN*m} = \left(\frac{67.46\,\text{kN/m} \cdot 2600\,\text{mm} \cdot 1300\,\text{mm}}{2} \right) - \left(67.46\,\text{kN/m} \cdot \frac{1300\,\text{mm}^2}{2} \right)$$

3) Bending Moment of Simply Supported Beam Subjected to Point Load at Mid-Point Formula

Evaluate Formula

Formula

$$M = \left(\frac{P \cdot x}{2} \right)$$

Example with Units

$$57.2\,\text{kN*m} = \left(\frac{88\,\text{kN} \cdot 1300\,\text{mm}}{2} \right)$$

4) Fixed End Moment at Left Support Carrying Right Angled Triangular Load at Right Angled End A Formula

Evaluate Formula

Formula

$$FEM = \frac{q \cdot \left(L^2 \right)}{20}$$

Example with Units

$$4.394\,\text{kN*m} = \frac{13\,\text{kN/m} \cdot \left(2600\,\text{mm}^2 \right)}{20}$$

5) Fixed End Moment at Left Support with Couple at Distance A Formula

Evaluate Formula

Formula

$$FEM = \frac{M_c \cdot b \cdot (2 \cdot a - b)}{L^2}$$

Example with Units

$$18.2637\,\text{kN*m} = \frac{85\,\text{kN*m} \cdot 350\,\text{mm} \cdot (2 \cdot 2250\,\text{mm} - 350\,\text{mm})}{2600\,\text{mm}^2}$$

6) Fixed End Moment at Left Support with Point Load at Certain Distance from Left Support Formula

Evaluate Formula

Formula

$$FEM = \left(\frac{P \cdot \left(b^2\right) \cdot a}{L^2}\right)$$

Example with Units

$$3.588\,\text{kN*m} = \left(\frac{88\,\text{kN} \cdot \left(350\,\text{mm}^2\right) \cdot 2250\,\text{mm}}{2600\,\text{mm}^2}\right)$$

7) Fixed End Moment of Fixed Beam Carrying Three Equi-spaced Point Loads Formula

Evaluate Formula

Formula

$$FEM = \frac{15 \cdot P \cdot L}{48}$$

Example with Units

$$71.5\,\text{kN*m} = \frac{15 \cdot 88\,\text{kN} \cdot 2600\,\text{mm}}{48}$$

8) Maximum Bending Moment of Cantilever Beam Subjected to Point Load at Free End Formula

Evaluate Formula

Formula

$$M = P \cdot L$$

Example with Units

$$228.8\,\text{kN*m} = 88\,\text{kN} \cdot 2600\,\text{mm}$$

9) Maximum Bending Moment of Cantilever Subject to UDL over Entire Span Formula

Evaluate Formula

Formula

$$M = \frac{w \cdot L^2}{2}$$

Example with Units

$$228.0148\,\text{kN*m} = \frac{67.46\,\text{kN/m} \cdot 2600\,\text{mm}^2}{2}$$

10) Maximum Bending Moment of Overhanging Beam Subjected to Concentrated Load at Free End Formula

Evaluate Formula

Formula

$$M = -P \cdot l_o$$

Example with Units

$$-132000\,\text{kN*m} = -88\,\text{kN} \cdot 1500\,\text{mm}$$

11) Maximum Bending Moment of Simply Supported Beam with Point Load at Distance 'a' from Left Support Formula

Evaluate Formula

Formula

$$M = \frac{P \cdot a \cdot b}{L}$$

Example with Units

$$26.6538\,\text{kN*m} = \frac{88\,\text{kN} \cdot 2250\,\text{mm} \cdot 350\,\text{mm}}{2600\,\text{mm}}$$

12) Maximum Bending Moment of Simply Supported Beam with Uniformly Distributed Load Formula

Evaluate Formula

Formula

$$M = \frac{w \cdot L^2}{8}$$

Example with Units

$$57.0037\,\text{kN*m} = \frac{67.46\,\text{kN/m} \cdot 2600\,\text{mm}^2}{8}$$

13) Maximum Bending Moment of Simply Supported Beams with Point Load at Centre Formula

Evaluate Formula

Formula

$$M = \frac{P \cdot L}{4}$$

Example with Units

$$57.2\,\text{kN*m} = \frac{88\,\text{kN} \cdot 2600\,\text{mm}}{4}$$

14) Maximum Bending Moment of Simply Supported Beams with Uniformly Varying Load Formula

Evaluate Formula

Formula

$$M = \frac{q \cdot L^2}{9 \cdot \sqrt{3}}$$

Example with Units

$$5.6375\,\text{kN*m} = \frac{13\,\text{kN/m} \cdot 2600\,\text{mm}^2}{9 \cdot \sqrt{3}}$$

15) Moment on Fixed End of Fixed Beam carrying Two Equi Spaced Point Loads Formula

Evaluate Formula

Formula

$$FEM = \frac{2 \cdot P \cdot L}{9}$$

Example with Units

$$50.8444\,\text{kN*m} = \frac{2 \cdot 88\,\text{kN} \cdot 2600\,\text{mm}}{9}$$

16) Moment on Fixed End of Fixed Beam Carrying Uniform Varying Load Formula

Evaluate Formula

Formula

$$FEM = \frac{5 \cdot q \cdot \left(L^2\right)}{96}$$

Example with Units

$$4.5771\,\text{kN*m} = \frac{5 \cdot 13\,\text{kN/m} \cdot \left(2600\,\text{mm}^2\right)}{96}$$

17) Moment on Fixed End of Fixed Beam having Point Load at Center Formula

Evaluate Formula

Formula

$$FEM = \frac{P \cdot L}{8}$$

Example with Units

$$28.6\,\text{kN*m} = \frac{88\,\text{kN} \cdot 2600\,\text{mm}}{8}$$

18) Moment on Fixed End of Fixed Beam having UDL over Entire Length Formula

Evaluate Formula

Formula

$$FEM = \frac{w \cdot \left(L^2 \right)}{12}$$

Example with Units

$$38.0025\,\text{kN*m} = \frac{67.46\,\text{kN/m} \cdot \left(2600\,\text{mm}^2 \right)}{12}$$

19) Curved Beams Formulas

19.1) Bending Moment when Stress is Applied at Point in Curved Beam Formula

Evaluate Formula

Formula

$$M = \left(\frac{S \cdot A \cdot R}{1 + \left(\frac{y}{Z \cdot (R + y)} \right)} \right)$$

Example with Units

$$57\,\text{kN*m} = \left(\frac{33.25\,\text{MPa} \cdot 0.04\,\text{m}^2 \cdot 50\,\text{mm}}{1 + \left(\frac{25\,\text{mm}}{2.0 \cdot (50\,\text{mm} + 25\,\text{mm})} \right)} \right)$$

19.2) Cross-Sectional Area when Stress is Applied at Point in Curved Beam Formula

Evaluate Formula

Formula

$$A = \left(\frac{M}{S \cdot R} \right) \cdot \left(1 + \left(\frac{y}{Z \cdot (R + y)} \right) \right)$$

Example with Units

$$0.04\,\text{m}^2 = \left(\frac{57\,\text{kN*m}}{33.25\,\text{MPa} \cdot 50\,\text{mm}} \right) \cdot \left(1 + \left(\frac{25\,\text{mm}}{2.0 \cdot (50\,\text{mm} + 25\,\text{mm})} \right) \right)$$

19.3) Stress at Point for Curved Beam as defined in Winkler-Bach Theory Formula

Evaluate Formula

Formula

$$S = \left(\frac{M}{A \cdot R} \right) \cdot \left(1 + \left(\frac{y}{Z \cdot (R + y)} \right) \right)$$

Example with Units

$$33.25\,\text{MPa} = \left(\frac{57\,\text{kN*m}}{0.04\,\text{m}^2 \cdot 50\,\text{mm}} \right) \cdot \left(1 + \left(\frac{25\,\text{mm}}{2.0 \cdot (50\,\text{mm} + 25\,\text{mm})} \right) \right)$$

20) Flitched Beam Formulas

20.1) Equivalent Width of Flitched Beam Formula

Evaluate Formula

Formula

$$w_f = m \cdot T_{Beam}$$

Example with Units

$$3375\,\text{mm} = 15 \cdot 225\,\text{mm}$$

20.2) Modular Ratio for Equivalent Width of Flitched Beam Formula

Evaluate Formula

Formula

$$m = \frac{w_f}{T_{Beam}}$$

Example with Units

$$15 = \frac{3375\,\text{mm}}{225\,\text{mm}}$$

20.3) Thickness of Steel given Equivalent Width of Flitched Beam Formula

Evaluate Formula

Formula

$$T_{Beam} = \frac{w_f}{m}$$

Example with Units

$$225\,\text{mm} = \frac{3375\,\text{mm}}{15}$$

Variables used in list of Beam Moments Formulas above

- **a** Distance from Support A *(Millimeter)*
- **A** Cross Sectional Area *(Square Meter)*
- **b** Distance from Support B *(Millimeter)*
- **FEM** Fixed End Moment *(Kilonewton Meter)*
- **L** Length of Beam *(Millimeter)*
- l_o Length of Overhang *(Millimeter)*
- **m** Modular Ratio
- **M** Bending Moment *(Kilonewton Meter)*
- M_c Moment of Couple *(Kilonewton Meter)*
- **P** Point Load *(Kilonewton)*
- **q** Uniformly Varying Load *(Kilonewton per Meter)*
- **R** Radius of Centroidal Axis *(Millimeter)*
- **S** Stress *(Megapascal)*
- T_{Beam} Beam Thickness *(Millimeter)*
- **w** Load per Unit Length *(Kilonewton per Meter)*
- w_f Equivalent Width of Flitched Beam *(Millimeter)*
- **x** Distance x from Support *(Millimeter)*
- **y** Distance from Neutral Axis *(Millimeter)*
- **Z** Cross-Section Property

Constants, Functions, Measurements used in list of Beam Moments Formulas above

- 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 Meter (m²)
  Area Unit Conversion
- Measurement: **Force** in Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Surface Tension** in Kilonewton per Meter (kN/m)
  Surface Tension Unit Conversion
- Measurement: **Moment of Force** in Kilonewton Meter (kN*m)
  Moment of Force Unit Conversion
- Measurement: **Stress** in Megapascal (MPa)
  Stress Unit Conversion

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