Important Webs under Concentrated Loads Formulas PDF

Formulas
Examples
with Units

List of 16
Important Webs under Concentrated Loads Formulas

1) Beam Depth for given Column Load Formula

Evaluate Formula

Formula

$$D = \frac{N \cdot \left(3 \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right)}{\left(\frac{R}{\left(67.5 \cdot t_w^{\frac{3}{2}}\right) \cdot \sqrt{F_y \cdot t_f}} - 1\right)}$$

Example with Units

$$147.9322\,\text{mm} = \frac{160\,\text{mm} \cdot \left(3 \cdot \left(\frac{100\,\text{mm}}{15\,\text{mm}}\right)^{1.5}\right)}{\left(\frac{235\,\text{kN}}{\left(67.5 \cdot 100\,\text{mm}^{\frac{3}{2}}\right) \cdot \sqrt{250\,\text{MPa} \cdot 15\,\text{mm}}} - 1\right)}$$

2) Clear Distance from Flanges for Concentrated Load with Stiffeners Formula

Evaluate Formula

Formula

$$h = \left(\frac{6800 \cdot t_w^{\,3}}{R}\right) \cdot \left(1 + \left(0.4 \cdot r_{wf}^{\,3}\right)\right)$$

Example with Units

$$121.5319\,\text{mm} = \left(\frac{6800 \cdot 100\,\text{mm}^{\,3}}{235\,\text{kN}}\right) \cdot \left(1 + \left(0.4 \cdot 2^{\,3}\right)\right)$$

3) Length of Bearing for Applied Load at least Half of Depth of Beam Formula

Evaluate Formula

Formula

$$N = \left(\frac{R}{\left(67.5 \cdot t_w^{\frac{3}{2}}\right) \cdot \sqrt{F_y \cdot t_f}} - 1 \right) \cdot \frac{D}{3 \cdot \left(\frac{t_w}{t_f}\right)^{1.5}}$$

Example with Units

$$130.8707\,\text{mm} = \left(\frac{235\,\text{kN}}{\left(67.5 \cdot 100\,\text{mm}^{\frac{3}{2}}\right) \cdot \sqrt{250\,\text{MPa} \cdot 15\,\text{mm}}} - 1 \right) \cdot \frac{121\,\text{mm}}{3 \cdot \left(\frac{100\,\text{mm}}{15\,\text{mm}}\right)^{1.5}}$$

4) Length of Bearing if Column Load is at Distance of Half Beam Depth Formula

Evaluate Formula

Formula

$$N = \left(\frac{R}{\left(34 \cdot t_w^{\frac{3}{2}}\right) \cdot \sqrt{F_y \cdot t_f}} - 1 \right) \cdot \frac{D}{3 \cdot \left(\frac{t_w}{t_f}\right)^{1.5}}$$

Example with Units

$$262.1256\,\text{mm} = \left(\frac{235\,\text{kN}}{\left(34 \cdot 100\,\text{mm}^{\frac{3}{2}}\right) \cdot \sqrt{250\,\text{MPa} \cdot 15\,\text{mm}}} - 1 \right) \cdot \frac{121\,\text{mm}}{3 \cdot \left(\frac{100\,\text{mm}}{15\,\text{mm}}\right)^{1.5}}$$

5) Length of Bearing when Load applied at Distance Larger than Depth of Beam Formula

Evaluate Formula

Formula

$$N = \left(\frac{R}{f_a \cdot t_w} \right) - 5 \cdot k$$

Example with Units

$$135.29\,\text{mm} = \left(\frac{235\,\text{kN}}{10.431\,\text{MPa} \cdot 100\,\text{mm}} \right) - 5 \cdot 18\,\text{mm}$$

6) Reaction of Concentrated Load applied at least Half of Depth of Beam Formula

Evaluate Formula

Formula

$$R = 67.5 \cdot t_w^{\,2} \cdot \left(1 + 3 \cdot \left(\frac{N}{D}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right) \cdot \sqrt{\frac{F_y}{\frac{t_w}{t_f}}}$$

Example with Units

$$286.3864\,\text{kN} = 67.5 \cdot 100\,\text{mm}^{\,2} \cdot \left(1 + 3 \cdot \left(\frac{160\,\text{mm}}{121\,\text{mm}}\right) \cdot \left(\frac{100\,\text{mm}}{15\,\text{mm}}\right)^{1.5}\right) \cdot \sqrt{\frac{250\,\text{MPa}}{\frac{100\,\text{mm}}{15\,\text{mm}}}}$$

7) Reaction of Concentrated Load given Allowable Compressive Stress Formula

Evaluate Formula

Formula

$$R = f_a \cdot t_w \cdot (N + 5 \cdot k)$$

Example with Units

$$260.775\,\text{kN} = 10.431\,\text{MPa} \cdot 100\,\text{mm} \cdot (160\,\text{mm} + 5 \cdot 18\,\text{mm})$$

8) Reaction of Concentrated Load when Applied at distance at least Half of Beam Depth Formula

Evaluate Formula

Formula

$$R = 34 \cdot t_w^{\,2} \cdot \left(1 + 3 \cdot \left(\frac{N}{D}\right) \cdot \left(\frac{t_w}{t_f}\right)^{1.5}\right) \cdot \sqrt{\frac{F_y}{\frac{t_w}{t_f}}}$$

Example with Units

$$144.2539\,\text{kN} = 34 \cdot 100\,\text{mm}^{\,2} \cdot \left(1 + 3 \cdot \left(\frac{160\,\text{mm}}{121\,\text{mm}}\right) \cdot \left(\frac{100\,\text{mm}}{15\,\text{mm}}\right)^{1.5}\right) \cdot \sqrt{\frac{250\,\text{MPa}}{\frac{100\,\text{mm}}{15\,\text{mm}}}}$$

9) Relative Slenderness of Web and Flange Formula

Evaluate Formula

Formula

$$r_{wf} = \frac{\frac{d_c}{t_w}}{\frac{l_{max}}{b_f}}$$

Example with Units

$$1.0776 = \frac{\frac{46\,\text{mm}}{100\,\text{mm}}}{\frac{1921\,\text{mm}}{4500\,\text{mm}}}$$

10) Required Stiffeners if Concentrated Load exceeds Load of Reaction R Formula

Evaluate Formula

Formula

$$R = \left(\frac{6800 \cdot t_w^3}{h}\right) \cdot \left(1 + \left(0.4 \cdot r_{wf}^3\right)\right)$$

Example with Units

$$234.0984\,\text{kN} = \left(\frac{6800 \cdot 100\,\text{mm}^3}{122\,\text{mm}}\right) \cdot \left(1 + \left(0.4 \cdot 2^3\right)\right)$$

11) Slenderness of Web and Flange given Stiffeners and Concentrated Load Formula

Evaluate Formula

Formula

$$r_{wf} = \left(\frac{\left(\frac{R \cdot h}{6800 \cdot t_w^3}\right) - 1}{0.4}\right)^{\frac{1}{3}}$$

Example with Units

$$2.0034 = \left(\frac{\left(\frac{235\,\text{kN} \cdot 122\,\text{mm}}{6800 \cdot 100\,\text{mm}^3}\right) - 1}{0.4}\right)^{\frac{1}{3}}$$

12) Stress for Concentrated Load Applied at Distance Larger than Depth of Beam Formula

Evaluate Formula

Formula

$$f_a = \frac{R}{t_w \cdot (N + 5 \cdot k)}$$

Example with Units

$$9.4\,\text{MPa} = \frac{235\,\text{kN}}{100\,\text{mm} \cdot (160\,\text{mm} + 5 \cdot 18\,\text{mm})}$$

13) Stress when Concentrated Load is Applied Close to Beam End Formula

Evaluate Formula

Formula

$$f_a = \frac{R}{t_w \cdot (N + 2.5 \cdot k)}$$

Example with Units

$$11.4634\,\text{MPa} = \frac{235\,\text{kN}}{100\,\text{mm} \cdot (160\,\text{mm} + 2.5 \cdot 18\,\text{mm})}$$

14) Web Depth Clear of fillets Formula

Evaluate Formula

Formula

$$d_c = D - 2 \cdot k$$

Example with Units

$$85\,\text{mm} = 121\,\text{mm} - 2 \cdot 18\,\text{mm}$$

15) Web Thickness for Given Stress Formula

Evaluate Formula

Formula

$$t_w = \frac{R}{f_a \cdot (N + 5 \cdot k)}$$

Example with Units

$$90.116\,\text{mm} = \frac{235\,\text{kN}}{10.431\,\text{MPa} \cdot (160\,\text{mm} + 5 \cdot 18\,\text{mm})}$$

16) Web Thickness for given Stress Due to Load near Beam End Formula

Evaluate Formula

Formula

$$t_w = \frac{R}{f_a \cdot \left(N + 2.5 \cdot k \right)}$$

Example with Units

$$109.8976\,\text{mm} = \frac{235\,\text{kN}}{10.431\,\text{MPa} \cdot \left(160\,\text{mm} + 2.5 \cdot 18\,\text{mm} \right)}$$

Variables used in list of Webs under Concentrated Loads Formulas above

- b_f Width of Compression Flange *(Millimeter)*
- **D** Depth of Section *(Millimeter)*
- d_c Web Depth *(Millimeter)*
- f_a Compressive Stress *(Megapascal)*
- F_y Yield Stress of Steel *(Megapascal)*
- **h** Clear Distance between Flanges *(Millimeter)*
- **k** Distance from Flange to Web Fillet *(Millimeter)*
- l_{max} Maximum Unbraced Length *(Millimeter)*
- **N** Bearing or Plate Length *(Millimeter)*
- **R** Concentrated Load of Reaction *(Kilonewton)*
- r_{wf} Slenderness of Web and Flange
- t_f Flange Thickness *(Millimeter)*
- t_w Web Thickness *(Millimeter)*

Constants, Functions, Measurements used in list of Webs under Concentrated Loads 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: **Force** in Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Stress** in Megapascal (MPa)
  Stress Unit Conversion

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