



# Load Factor Design (LFD) Formulas

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## List of 28 Load Factor Design (LFD) Formulas

## Load Factor Design (LFD) 🕑

### Load and Resistance Factor for Bridge Columns 🕑

1) Buckling Stress for Q Factor Less than or Equal to 1 💪

fx 
$$\mathbf{F}_{\mathrm{cr}} = \left(1 - \left(rac{\mathrm{Q}_{\mathrm{factor}}}{2}
ight)
ight) \cdot \mathrm{f}_{\mathrm{y}}$$

### 2) Buckling Stress given Maximum Strength 🕑

fx 
$$F_{cr} = \frac{P_u}{0.85 \cdot A_g}$$
 Open  
ex  $248MPa = \frac{1054kN}{0.85 \cdot 5000mm^2}$ 

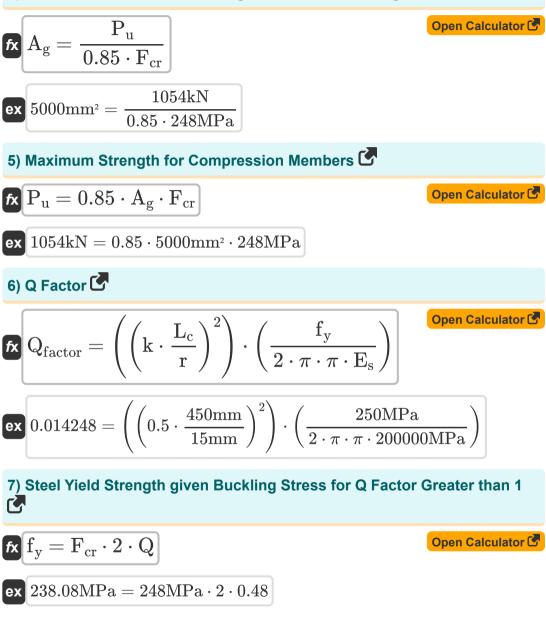
#### 3) Buckling Stress when Q Factor is Greater than 1 🕑



Open Calculator

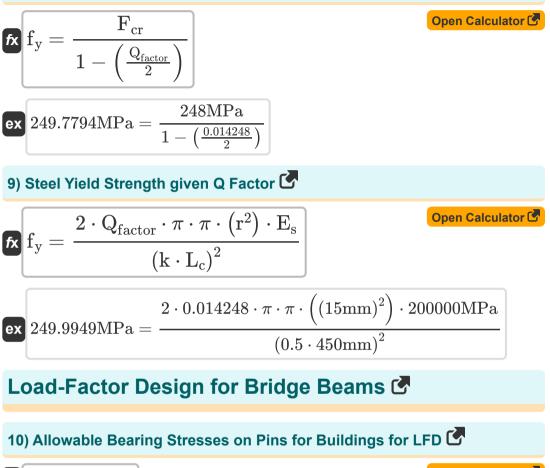
Calculator 🕑

4) Column Gross Effective Area given Maximum Strength 🕑





# 8) Steel Yield Strength given Buckling Stress for Q Factor Less than or Equal to 1



fx 
$${f F}_{
m p}=0.9\cdot{f f}_{
m y}$$
 Open Calculator C  
ex  $225{
m MPa}=0.9\cdot250{
m MPa}$ 



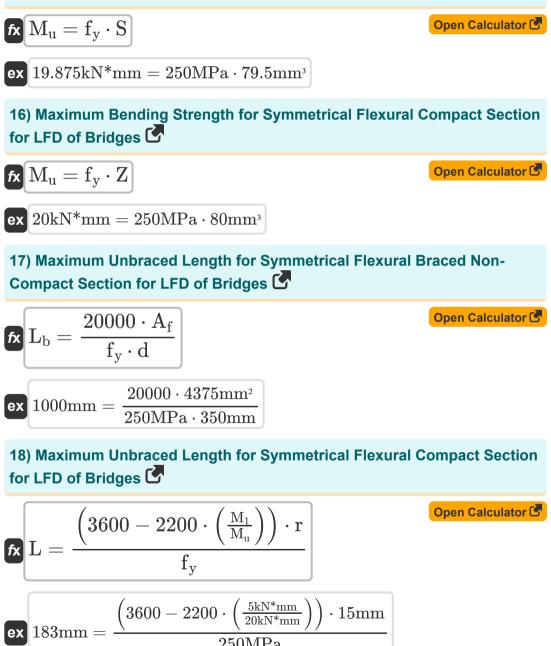
# 11) Allowable Bearing Stresses on Pins not Subject to Rotation for Bridges for LFD

$$\begin{split} & \fbox{F}_{p} = 0.80 \cdot f_{y} & \texttt{Open Calculator } \\ & \textcircled{S} 200MPa = 0.80 \cdot 250MPa \\ & \texttt{12) Allowable Bearing Stresses on Pins Subject to Rotation for Bridges for \\ & \texttt{LFD} \\ & \textcircled{S} \\ & \texttt{F}_{p} = 0.40 \cdot f_{y} & \texttt{Open Calculator } \\ & \textcircled{S} \\ & \texttt{100MPa} = 0.40 \cdot 250MPa \\ & \texttt{13) Area of Flange for Braced Non-Compact Section for LFD} \\ & \fbox{M}_{f} = \frac{L_{b} \cdot f_{y} \cdot d}{20000} & \texttt{Open Calculator } \\ & \textcircled{S} \\ & \texttt{4375mm}^{2} = \frac{1000mm \cdot 250MPa \cdot 350mm}{20000} \\ & \texttt{14) Depth of Section for Braced Non-Compact Section for LFD given Maximum Unbraced Length \\ & \textcircled{M} \\ & \textcircled{M} = \frac{20000 \cdot A_{f}}{f_{y} \cdot L_{b}} & \texttt{Open Calculator } \\ & \textcircled{M} \\ & \textcircled{M} = \frac{20000 \cdot A_{f}}{f_{y} \cdot L_{b}} & \texttt{Open Calculator } \\ & \textcircled{M} \\ &$$

ex 
$$350 \text{mm} = \frac{20000 \cdot 4375 \text{mm}^2}{250 \text{MPa} \cdot 1000 \text{mm}}$$

U

15) Maximum Bending Strength for Symmetrical Flexural Braced Non-Compacted Section for LFD of Bridges



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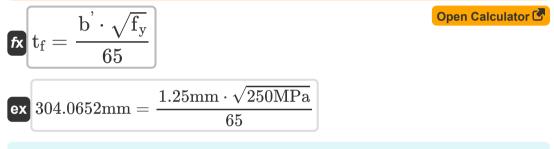
250 MPa

19) Minimum Flange Thickness for Symmetrical Flexural Braced Non-Compact Section for LFD of Bridges

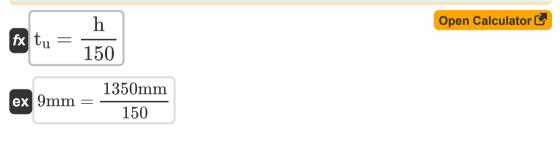
fx 
$$t_{f} = rac{b^{'} \cdot \sqrt{f_{y}}}{69.6}$$
 Open Calculator IP

ex 
$$283.9689 \text{mm} = \frac{1.25 \text{mm} \cdot \sqrt{250 \text{MPa}}}{69.6}$$

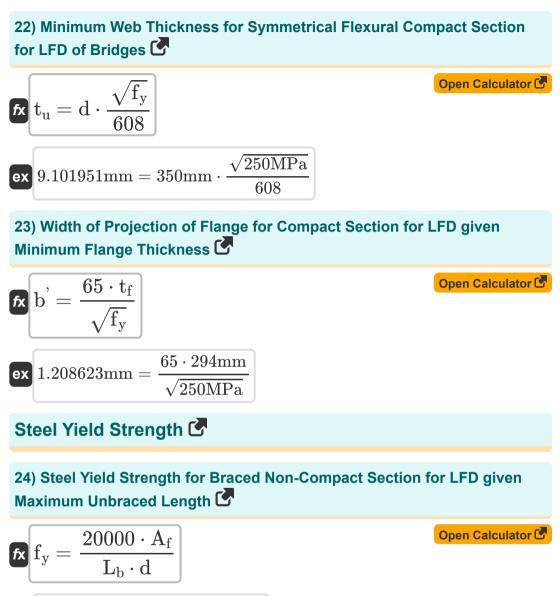
20) Minimum Flange Thickness for Symmetrical Flexural Compact Section for LFD of Bridges



### 21) Minimum Web Thickness for Symmetrical Flexural Braced Non-Compact Section for LFD of Bridges







ex 
$$250 \text{MPa} = \frac{20000 \cdot 4375 \text{mm}^2}{1000 \text{mm} \cdot 350 \text{mm}}$$





fx  $\left| {{{\mathbf{f}}_{y}} = \left( {65 \cdot \frac{{{{\mathbf{t}}_{f}}}}{{{\mathbf{b}}^{'}}}} 
ight)^2 } 
ight|$ 

#### 25) Steel Yield Strength for Compact Section for LFD given Minimum Flange Thickness

Open Calculator

$$\begin{array}{c} \begin{array}{c} \\ \end{array} \mathbf{ex} \end{array} 233.7229 \mathrm{MPa} = \left( 65 \cdot \frac{294 \mathrm{mm}}{1.25 \mathrm{mm}} \right)^2 \end{array}$$

26) Steel Yield Strength on Pins for Buildings for LFD given Allowable Bearing Stress



0.90

fx 
$$f_y = \frac{F_p}{0.80}$$
 Open Calculator   
ex  $218.75 MPa = \frac{175 MPa}{0.80}$ 



# 28) Steel Yield Strength on Pins subject to Rotation for Bridges for LFD given Pin Stress







## Variables Used

- **A<sub>f</sub>** Flange Area (Square Millimeter)
- Ag Gross Effective Area of Column (Square Millimeter)
- **b** Width of Projection of Flange (*Millimeter*)
- **d** Depth of Section (Millimeter)
- Es Modulus of Elasticity (Megapascal)
- Fcr Buckling Stress (Megapascal)
- Fp Allowable Bearing Stresses on Pins (Megapascal)
- fv Yield Strength of Steel (Megapascal)
- h Unsupported Distance between Flanges (Millimeter)
- k Effective Length Factor
- L Max Unbraced Length for Flexural Compact Section (Millimeter)
- Lb Maximum Unbraced Length (Millimeter)
- L<sub>c</sub> Length of Member between Supports (*Millimeter*)
- M<sub>1</sub> Smaller Moment (Kilonewton Millimeter)
- Mu Maximum Bending Strength (Kilonewton Millimeter)
- **P**<sub>u</sub> Strength of Column (*Kilonewton*)
- **Q** Q Factors
- Q<sub>factor</sub> Factor Q
- **r** Radius of Gyration (Millimeter)
- S Section Modulus (Cubic Millimeter)
- **t**<sub>f</sub> Flange Minimum Thickness (Millimeter)



- **t**<sub>u</sub> Web Minimum Thickness (*Millimeter*)
- Z Plastic Section Modulus (Cubic Millimeter)



### **Constants, Functions, Measurements used**

- Constant: pi, 3.14159265358979323846264338327950288 Archimedes' constant
- Function: **sqrt**, sqrt(Number) Square root function
- Measurement: Length in Millimeter (mm) Length Unit Conversion
- Measurement: Volume in Cubic Millimeter (mm<sup>3</sup>) Volume Unit Conversion
- Measurement: Area in Square Millimeter (mm<sup>2</sup>) Area Unit Conversion
- Measurement: Pressure in Megapascal (MPa)
   Pressure Unit Conversion
- Measurement: Force in Kilonewton (kN)
   Force Unit Conversion
- Measurement: Moment of Force in Kilonewton Millimeter (kN\*mm)
   Moment of Force Unit Conversion G
- Measurement: Stress in Megapascal (MPa)
   Stress Unit Conversion





- Additional Bridge Column
  Formulas
- Allowable Stress Design for Bridges Formulas
- Bearing on Milled Surfaces and Bridge Fasteners Formulas
- Composite Construction in Highway Bridges Formulas

- Load Factor Design (LFD) Formulas
- Number of Connectors in Bridges Formulas
- Stiffeners on Bridge Girders
   Formulas
- Suspension Cables Formulas G

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