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# Number of Connectors in Bridges Formulas

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## List of 29 Number of Connectors in Bridges Formulas

### Number of Connectors in Bridges

#### 1) 28-day Compressive Strength of Concrete given Force in Slab

$$f_x \quad f_c = \frac{P_{\text{on slab}}}{0.85 \cdot A_{\text{concrete}}}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b\_img.jpg\)](#)

$$ex \quad 15MPa = \frac{245kN}{0.85 \cdot 19215.69mm^2}$$

#### 2) Area of Longitudinal Reinforcing given Force in Slab at Maximum Negative Moments

$$f_x \quad A_{st} = \frac{P_{\text{on slab}}}{f_y}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\)](#)

$$ex \quad 980mm^2 = \frac{245kN}{250MPa}$$

#### 3) Effective Concrete Area given Force in Slab

$$f_x \quad A_{\text{concrete}} = \frac{P_{\text{on slab}}}{0.85 \cdot f_c}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d\_img.jpg\)](#)

$$ex \quad 19215.69mm^2 = \frac{245kN}{0.85 \cdot 15MPa}$$

#### 4) Force in Slab at Maximum Negative Moments given Minimum Number of Connectors for Bridges

$$f_x \quad P_3 = N \cdot \Phi \cdot S_{\text{ultimate}} - P_{\text{on slab}}$$

[Open Calculator !\[\]\(83bbbd261710c59db0214aa27b2edc0d\_img.jpg\)](#)

$$ex \quad 10kN = 15.0 \cdot 0.85 \cdot 20.0kN - 245kN$$

#### 5) Force in Slab at Maximum Negative Moments given Reinforcing Steel Yield Strength

$$f_x \quad P_{\text{on slab}} = A_{st} \cdot f_y$$

[Open Calculator !\[\]\(f507db636256ac11a5525ef93ec6b8d7\_img.jpg\)](#)

$$ex \quad 245kN = 980mm^2 \cdot 250MPa$$



### 6) Force in Slab at Maximum Positive Moments given Minimum Number of Connectors for Bridges

$$fx \quad P_{\text{on slab}} = N \cdot \Phi \cdot S_{\text{ultimate}} - P_3$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$ex \quad 245\text{kN} = 15.0 \cdot 0.85 \cdot 20.0\text{kN} - 10\text{kN}$$

### 7) Force in Slab given Effective Concrete Area

$$fx \quad P_{\text{on slab}} = 0.85 \cdot A_{\text{concrete}} \cdot f_c$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$ex \quad 245\text{kN} = 0.85 \cdot 19215.69\text{mm}^2 \cdot 15\text{MPa}$$

### 8) Force in Slab given Number of Connectors in Bridges

$$fx \quad P_{\text{on slab}} = N \cdot \Phi \cdot S_{\text{ultimate}}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$ex \quad 255\text{kN} = 15.0 \cdot 0.85 \cdot 20.0\text{kN}$$

### 9) Force in Slab given Total Area of Steel Section

$$fx \quad P_{\text{on slab}} = A_{\text{st}} \cdot f_y$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$ex \quad 245\text{kN} = 980\text{mm}^2 \cdot 250\text{MPa}$$

### 10) Minimum Number of Connectors for Bridges

$$fx \quad N = \frac{P_{\text{on slab}} + P_3}{\Phi \cdot S_{\text{ultimate}}}$$

[Open Calculator !\[\]\(aff7c69c44a5e015f18c35867ef3f5c3\_img.jpg\)](#)

$$ex \quad 15 = \frac{245\text{kN} + 10\text{kN}}{0.85 \cdot 20.0\text{kN}}$$


### 11) Number of Connectors in Bridges

$$fx \quad N = \frac{P_{\text{on slab}}}{\Phi \cdot S_{\text{ultimate}}}$$

[Open Calculator !\[\]\(a25a22d88c5882f4a20f36103df86562\_img.jpg\)](#)

$$ex \quad 14.41176 = \frac{245\text{kN}}{0.85 \cdot 20.0\text{kN}}$$




12) Reduction Factor given Minimum Number of Connectors in Bridges 

$$fx \quad \Phi = \frac{P_{\text{on slab}} + P_3}{S_{\text{ultimate}} \cdot N}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$ex \quad 0.85 = \frac{245\text{kN} + 10\text{kN}}{20.0\text{kN} \cdot 15.0}$$

13) Reduction Factor given Number of Connectors in Bridges 

$$fx \quad \Phi = \frac{P_{\text{on slab}}}{N \cdot S_{\text{ultimate}}}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$ex \quad 0.816667 = \frac{245\text{kN}}{15.0 \cdot 20.0\text{kN}}$$

14) Reinforcing Steel Yield Strength given Force in Slab at Maximum Negative Moments 

$$fx \quad f_y = \frac{P_{\text{on slab}}}{A_{\text{st}}}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 250\text{MPa} = \frac{245\text{kN}}{980\text{mm}^2}$$

15) Steel Yield Strength given Total Area of Steel Section 

$$fx \quad f_y = \frac{P_{\text{on slab}}}{A_{\text{st}}}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b\_img.jpg\)](#)

$$ex \quad 250\text{MPa} = \frac{245\text{kN}}{980\text{mm}^2}$$

16) Total Area of Steel Section given Force in Slab 

$$fx \quad A_{\text{st}} = \frac{P_{\text{on slab}}}{f_y}$$

[Open Calculator !\[\]\(40770d9ed6ed4f1222ebf89a1396e8b2\_img.jpg\)](#)

$$ex \quad 980\text{mm}^2 = \frac{245\text{kN}}{250\text{MPa}}$$




17) Ultimate Shear Connector Strength given Minimum Number of Connectors in Bridges 

[Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff\_img.jpg\)](#)

$$fx \quad S_{ultimate} = \frac{P_{on\ slab} + P_3}{\Phi \cdot N}$$

$$ex \quad 20kN = \frac{245kN + 10kN}{0.85 \cdot 15.0}$$

18) Ultimate Shear Connector Strength given Number of Connectors in Bridges 

[Open Calculator !\[\]\(830769b31eeeaca920791081939ff8ba\_img.jpg\)](#)

$$fx \quad S_{ultimate} = \frac{P_{on\ slab}}{N \cdot \Phi}$$

$$ex \quad 19.21569kN = \frac{245kN}{15.0 \cdot 0.85}$$

Shear Strength Design for Bridges 

19) Shear Capacity for Flexural Members 

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$fx \quad V_u = 0.58 \cdot f_y \cdot d \cdot bw \cdot C$$

$$ex \quad 7830kN = 0.58 \cdot 250MPa \cdot 200mm \cdot 300mm \cdot 0.90$$

20) Shear Capacity for Girders with Transverse Stiffeners 

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$fx \quad V_u = 0.58 \cdot f_y \cdot d \cdot bw \cdot \left( C + \left( \frac{1 - C}{\left( 1.15 \cdot \left( 1 + \left( \frac{a}{H} \right)^2 \right)^{0.5} \right)} \right) \right)$$

$$ex \quad 8364.942kN = 0.58 \cdot 250MPa \cdot 200mm \cdot 300mm \cdot \left( 0.90 + \left( \frac{1 - 0.90}{\left( 1.15 \cdot \left( 1 + \left( \frac{5m}{5.0m} \right)^2 \right)^{0.5} \right)} \right) \right)$$



## Ultimate Shear Strength of Connectors in Bridges

### 21) 28-day Compressive Strength given Ultimate Shear Connector Strength for Welded Studs

$$f_x \quad f_c = \frac{\left( \frac{S_{\text{ultimate}}}{0.4 \cdot d_{\text{stud}} \cdot d_{\text{stud}}} \right)^2}{E}$$

[Open Calculator !\[\]\(950a62bbddad88d64435fd35607dfc42\_img.jpg\)](#)

$$\text{ex} \quad 14.90116 \text{MPa} = \frac{\left( \frac{20.0 \text{kN}}{0.4 \cdot 64 \text{mm} \cdot 64 \text{mm}} \right)^2}{10.0 \text{MPa}}$$

### 22) 28-day Compressive Strength of Concrete given Ultimate Shear Connector Strength for Channels

$$f_x \quad f_c = \left( \frac{S_{\text{ultimate}}}{17.4 \cdot w \cdot \left( h + \frac{t_w}{2} \right)} \right)^2$$

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719\_img.jpg\)](#)

$$\text{ex} \quad 15.44222 \text{MPa} = \left( \frac{20.0 \text{kN}}{17.4 \cdot 1500 \text{mm} \cdot \left( 150 \text{mm} + \frac{90 \text{mm}}{2} \right)} \right)^2$$

### 23) Average Channel Flange Thickness given Ultimate Shear Connector Strength for Channels

$$f_x \quad h = \frac{S_{\text{ultimate}}}{17.4 \cdot w \cdot \left( (f_c)^{0.5} \right)} - \frac{t_w}{2}$$

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7\_img.jpg\)](#)

$$\text{ex} \quad 152.8536 \text{mm} = \frac{20.0 \text{kN}}{17.4 \cdot 1500 \text{mm} \cdot \left( (15 \text{MPa})^{0.5} \right)} - \frac{90 \text{mm}}{2}$$


### 24) Channel Length given Ultimate Shear Connector Strength for Channels

$$f_x \quad w = \frac{S_{\text{ultimate}}}{17.4 \cdot \sqrt{f_c} \cdot \left( h + \frac{t_w}{2} \right)}$$

[Open Calculator !\[\]\(21226b58c700e5231ab98d27101bac58\_img.jpg\)](#)


$$\text{ex} \quad 1521.95 \text{mm} = \frac{20.0 \text{kN}}{17.4 \cdot \sqrt{15 \text{MPa}} \cdot \left( 150 \text{mm} + \frac{90 \text{mm}}{2} \right)}$$



25) Channel Web Thickness given Ultimate Shear Connector Strength for Channels [Open Calculator](#) 


$$f_x \quad t_w = \left( \left( \frac{S_{ultimate}}{17.4 \cdot w \cdot \sqrt{f_c}} \right) - h \right) \cdot 2$$

$$ex \quad 95.70711mm = \left( \left( \frac{20.0kN}{17.4 \cdot 1500mm \cdot \sqrt{15MPa}} \right) - 150mm \right) \cdot 2$$

26) Diameter of connector given Ultimate Shear Connector Strength for Welded Studs [Open Calculator](#) 

$$f_x \quad d_{stud} = \sqrt{\frac{S_{ultimate}}{0.4 \cdot \sqrt{E \cdot f_c}}}$$

$$ex \quad 63.89431mm = \sqrt{\frac{20.0kN}{0.4 \cdot \sqrt{10.0MPa \cdot 15MPa}}}$$

27) Elastic Modulus of Concrete given Ultimate Shear Connector Strength for Welded Studs [Open Calculator](#) 

$$f_x \quad E = \left( \frac{\left( \frac{S_{ultimate}}{0.4 \cdot d_{stud} \cdot d_{stud}} \right)^2}{f_c} \right)$$


$$ex \quad 9.934107MPa = \left( \frac{\left( \frac{20.0kN}{0.4 \cdot 64mm \cdot 64mm} \right)^2}{15MPa} \right)$$

28) Ultimate Shear Connector Strength for Channels [Open Calculator](#) 

$$f_x \quad S_{ultimate} = 17.4 \cdot w \cdot \left( (f_c)^{0.5} \right) \cdot \left( h + \frac{t_w}{2} \right)$$

$$ex \quad 19.71155kN = 17.4 \cdot 1500mm \cdot \left( (15MPa)^{0.5} \right) \cdot \left( 150mm + \frac{90mm}{2} \right)$$



29) Ultimate Shear Strength for Welded Studs [Open Calculator](#) 

$$f_x \quad S_{\text{ultimate}} = 0.4 \cdot d_{\text{stud}} \cdot d_{\text{stud}} \cdot \sqrt{E \cdot f_c}$$

$$ex \quad 20.06622kN = 0.4 \cdot 64mm \cdot 64mm \cdot \sqrt{10.0MPa \cdot 15MPa}$$










## Variables Used

- **a** Clear Distance between Transverse Stiffeners (Meter)
- **A<sub>concrete</sub>** Effective Concrete Area (Square Millimeter)
- **A<sub>st</sub>** Area of Steel Reinforcement (Square Millimeter)
- **bw** Breadth of Web (Millimeter)
- **C** Shear Buckling Coefficient C
- **d** Depth of Cross Section (Millimeter)
- **d<sub>stud</sub>** Stud Diameter (Millimeter)
- **E** Modulus Elasticity of Concrete (Megapascal)
- **f<sub>c</sub>** 28 Day Compressive Strength of Concrete (Megapascal)
- **f<sub>y</sub>** Yield Strength of Steel (Megapascal)
- **h** Average Flange Thickness (Millimeter)
- **H** Cross Section's Height (Meter)
- **N** No of Connector in Bridge
- **P<sub>3</sub>** Force in Slab at Negative Moment Point (Kilonewton)
- **P<sub>on slab</sub>** Slab Force (Kilonewton)
- **S<sub>ultimate</sub>** Ultimate Shear Connector Stress (Kilonewton)
- **t<sub>w</sub>** Web Thickness (Millimeter)
- **V<sub>u</sub>** Shear Capacity (Kilonewton)
- **w** Channel Length (Millimeter)
- **Φ** Reduction Factor











## Constants, Functions, Measurements used

- **Function:** **sqrt**, sqrt(Number)  
*Square root function*
- **Measurement:** **Length** in Millimeter (mm), Meter (m)  
*Length 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:** **Stress** in Megapascal (MPa)  
*Stress Unit Conversion* 



## Check other formula lists

- [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](#) 
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