Important Number of Connectors in Bridges Formulas PDF

Formulas
Examples
with Units

List of 29
Important Number of Connectors in Bridges Formulas

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

3) Effective Concrete Area given Force in Slab Formula

Evaluate Formula

Formula

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

Example with Units

$$19215.6863\,\text{mm}^2 = \frac{245\,\text{kN}}{0.85 \cdot 15\,\text{MPa}}$$

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

$$245\,kN = 15.0 \cdot 0.85 \cdot 20.0\,kN - 10\,kN$$

7) Force in Slab given Effective Concrete Area Formula

Evaluate Formula

Formula

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

Example with Units

$$245\,kN = 0.85 \cdot 19215.69\,mm^2 \cdot 15\,MPa$$

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

Evaluate Formula

Formula

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

Example with Units

$$255\,kN = 15.0 \cdot 0.85 \cdot 20.0\,kN$$

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

Evaluate Formula

Formula

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

Example with Units

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

10) Minimum Number of Connectors for Bridges Formula

Evaluate Formula

Formula

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

Example with Units

$$15 = \frac{245\,kN + 10\,kN}{0.85 \cdot 20.0\,kN}$$

11) Number of Connectors in Bridges Formula

Evaluate Formula

Formula

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

Example with Units

$$14.4118 = \frac{245\,kN}{0.85 \cdot 20.0\,kN}$$

12) Reduction Factor given Minimum Number of Connectors in Bridges Formula

Evaluate Formula

Formula

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

Example with Units

$$0.85 = \frac{245\,kN + 10\,kN}{20.0\,kN \cdot 15.0}$$

13) Reduction Factor given Number of Connectors in Bridges Formula

Evaluate Formula

Formula

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

Example with Units

$$0.8167 = \frac{245\,kN}{15.0 \cdot 20.0\,kN}$$

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

Evaluate Formula

Formula

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

Example with Units

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

15) Steel Yield Strength given Total Area of Steel Section Formula

Evaluate Formula

Formula

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

Example with Units

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

16) Total Area of Steel Section given Force in Slab Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

$$20\,\text{kN} = \frac{245\,\text{kN} + 10\,\text{kN}}{0.85 \cdot 15.0}$$

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

Evaluate Formula

Formula

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

Example with Units

$$19.2157\,\text{kN} = \frac{245\,\text{kN}}{15.0 \cdot 0.85}$$

19) Shear Strength Design for Bridges Formulas

19.1) Shear Capacity for Flexural Members Formula

Evaluate Formula

Formula

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

Example with Units

$$7830\,\text{kN} = 0.58 \cdot 250\,\text{MPa} \cdot 200\,\text{mm} \cdot 300\,\text{mm} \cdot 0.90$$

19.2) Shear Capacity for Girders with Transverse Stiffeners Formula

Evaluate Formula

Formula

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

Example with Units

$$8364.9417\,\text{kN} = 0.58 \cdot 250\,\text{MPa} \cdot 200\,\text{mm} \cdot 300\,\text{mm} \cdot \left(0.90 + \left(\frac{1 - 0.90}{\left(1.15 \cdot \left(1 + \left(\frac{5000\,\text{mm}}{5000\,\text{mm}} \right)^2 \right) \right)^{0.5}} \right) \right)$$

20) Ultimate Shear Strength of Connectors in Bridges Formulas

20.1) 28-day Compressive Strength given Ultimate Shear Connector Strength for Welded Studs Formula

Evaluate Formula

Formula

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

Example with Units

$$14.9012\,\text{MPa} = \frac{\left(\frac{20.0\,\text{kN}}{0.4 \cdot 64\,\text{mm} \cdot 64\,\text{mm}} \right)^2}{10.0\,\text{MPa}}$$

20.2) 28-day Compressive Strength of Concrete given Ultimate Shear Connector Strength for Channels Formula

Evaluate Formula

Formula

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

Example with Units

$$14.9778\,\text{MPa} = \left(\frac{20.0\,\text{kN}}{17.4 \cdot 1500\,\text{mm} \cdot \left(188\,\text{mm} + \frac{20\,\text{mm}}{2} \right)} \right)^2$$

20.3) Average Channel Flange Thickness given Ultimate Shear Connector Strength for Channels Formula

Evaluate Formula

Formula

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

Example with Units

$$187.8536\,\text{mm} = \frac{20.0\,\text{kN}}{17.4 \cdot 1500\,\text{mm} \cdot \left(\left(15\,\text{MPa} \right)^{0.5} \right)} - \frac{20\,\text{mm}}{2}$$

20.4) Channel Length given Ultimate Shear Connector Strength for Channels Formula

Evaluate Formula

Formula

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

Example with Units

$$1498.8906\,\text{mm} = \frac{20.0\,\text{kN}}{17.4 \cdot \sqrt{15\,\text{MPa}} \cdot \left(188\,\text{mm} + \frac{20\,\text{mm}}{2} \right)}$$

20.5) Channel Web Thickness given Ultimate Shear Connector Strength for Channels Formula

Evaluate Formula

Formula

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

Example with Units

$$19.7071\,\text{mm} = \left(\left(\frac{20.0\,\text{kN}}{17.4 \cdot 1500\,\text{mm} \cdot \sqrt{15\,\text{MPa}}} \right) - 188\,\text{mm} \right) \cdot 2$$

20.6) Diameter of Connector given Ultimate Shear Connector Strength for Welded Studs Formula

Evaluate Formula

Formula

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

Example with Units

$$63.8943\,\text{mm} = \sqrt{\frac{20.0\,\text{kN}}{0.4 \cdot \sqrt{10.0\,\text{MPa} \cdot 15\,\text{MPa}}}}$$

20.7) Elastic Modulus of Concrete given Ultimate Shear Connector Strength for Welded Studs Formula

Evaluate Formula

Formula

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

Example with Units

$$9.9341\,\text{MPa} = \left(\frac{\left(\frac{20.0\,\text{kN}}{0.4 \cdot 64\,\text{mm} \cdot 64\,\text{mm}} \right)^2}{15\,\text{MPa}} \right)$$

20.8) Ultimate Shear Connector Strength for Channels Formula

Evaluate Formula

Formula

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

Example with Units

$$20.0148\,\text{kN} = 17.4 \cdot 1500\,\text{mm} \cdot \left(\left(15\,\text{MPa} \right)^{0.5} \right) \cdot \left(188\,\text{mm} + \frac{20\,\text{mm}}{2} \right)$$

20.9) Ultimate Shear Strength for Welded Studs Formula

Evaluate Formula

Formula

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

Example with Units

$$20.0662\,\text{kN} = 0.4 \cdot 64\,\text{mm} \cdot 64\,\text{mm} \cdot \sqrt{10.0\,\text{MPa} \cdot 15\,\text{MPa}}$$

Variables used in list of Number of Connectors in Bridges Formulas above

- **a** Clear Distance between Transverse Stiffeners *(Millimeter)*
- $A_{concrete}$ Effective Concrete Area *(Square Millimeter)*
- A_{st} Area of Steel Reinforcement *(Square Millimeter)*
- **bw** Breadth of Web *(Millimeter)*
- **C** Shear Buckling Coefficient C
- **d** Depth of Cross Section *(Millimeter)*
- d_{stud} Stud Diameter *(Millimeter)*
- **E** Modulus Elasticity of Concrete *(Megapascal)*
- f_c 28 Day Compressive Strength of Concrete *(Megapascal)*
- f_y Yield Strength of Steel *(Megapascal)*
- **h** Average Flange Thickness *(Millimeter)*
- **H** Cross Section's Height *(Millimeter)*
- **N** No of Connector in Bridge
- P_3 Force in Slab at Negative Moment Point *(Kilonewton)*
- $P_{on\ slab}$ Slab Force *(Kilonewton)*
- $S_{ultimate}$ Ultimate Shear Connector Stress *(Kilonewton)*
- **t** Web Thickness *(Millimeter)*
- V_u Shear Capacity *(Kilonewton)*
- **w** Channel Length *(Millimeter)*
- **Φ** Reduction Factor

Constants, Functions, Measurements used in list of Number of Connectors in Bridges 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 Millimeter (mm²)
  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

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