Composite Construction in Highway Bridges Formulas

List of 22 Composite Construction in Highway Bridges Formulas

Composite Construction in Highway Bridges

Bending Stresses

1) Dead Load Moment given Stress in Steel for Shored Members

Open Calculator

fx $$M_{D(shored)} = \left(S_{tr} \cdot f_{steel\ stress}\right) - M_L$$

ex $$14885\text{N*mm} = \left(250\text{mm}^3 \cdot 60\text{N/mm}^2\right) - 115\text{N*mm}$$

2) Dead Load Moment given Stress in Steel for Unshored Members

Open Calculator

fx $$M_{D(unshored)} = S_s \cdot \left(f_{steel\ stress} - \left(\frac{M_L}{S_{tr}}\right)\right)$$

ex $$8931\text{N*mm} = 150\text{mm}^3 \cdot \left(60\text{N/mm}^2 - \left(\frac{115\text{N*mm}}{250\text{mm}^3}\right)\right)$$

3) Live Load Moment given Stress in Steel for Shored Members

Open Calculator

fx $$M_L = S_{tr} \cdot f_{steel\ stress} - M_{D(shored)}$$

ex $$115\text{N*mm} = 250\text{mm}^3 \cdot 60\text{N/mm}^2 - 14885\text{N*mm}$$

4) Live Load Moment given Stress in Steel for Unshored Members

Open Calculator

$$M_L = S_{tr} \cdot \left(f_{\text{steel stress}} - \frac{M_{D(\text{unshored})}}{S_s} \right)$$

$$115\text{N*mm} = 250\text{mm}^3 \cdot \left(60\text{N/mm}^2 - \frac{8931\text{N*mm}}{150\text{mm}^3} \right)$$

5) Multiplier for Allowable Stress when Flange Bending Stress is lesser than Allowable Stress

Open Calculator

$$R = 1 - \frac{(1-\alpha)^2 \cdot (\beta \cdot \psi) \cdot (3 - \psi + \psi \cdot \alpha)}{6 + \beta \cdot \psi \cdot (3 - \psi)}$$

$$0.5 = 1 - \frac{(1-1.5)^2 \cdot (3 \cdot 2.0) \cdot (3 - 2.0 + 2.0 \cdot 1.5)}{6 + 3 \cdot 2.0 \cdot (3 - 2.0)}$$

6) Section Modulus of Steel Beam given Stress in Steel for Unshored Members

Open Calculator

$$S_s = \frac{M_{D(\text{unshored})}}{f_{\text{steel stress}} - \left(\frac{M_L}{S_{tr}} \right)}$$

$$150\text{mm}^3 = \frac{8931\text{N*mm}}{60\text{N/mm}^2 - \left(\frac{115\text{N*mm}}{250\text{mm}^3} \right)}$$

7) Section Modulus of Transformed Composite Section given Stress in Steel for Shored Members

Open Calculator

$$S_{tr} = \frac{M_{D(shored)} + M_L}{f_{steel\ stress}}$$

$$250mm^3 = \frac{14885N*mm + 115N*mm}{60N/mm^2}$$

8) Section Modulus of Transformed Composite Section given Stress in Steel for Unshored Members

Open Calculator

$$S_{tr} = \frac{M_L}{f_{steel\ stress} - \left(\frac{M_{D(unshored)}}{S_s}\right)}$$

$$250mm^3 = \frac{115N*mm}{60N/mm^2 - \left(\frac{8931N*mm}{150mm^3}\right)}$$

9) Stress in Steel for Shored Members

Open Calculator

$$f_{steel\ stress} = \frac{M_{D(shored)} + M_L}{S_{tr}}$$

$$60N/mm^2 = \frac{14885N*mm + 115N*mm}{250mm^3}$$

10) Stress in Steel for Unshored Members

Open Calculator

$$f_{\text{steel stress}} = \left(\frac{M_{D(\text{unshored})}}{S_s}\right) + \left(\frac{M_L}{S_{tr}}\right)$$

$$60\text{N/mm}^2 = \left(\frac{8931\text{N*mm}}{150\text{mm}^3}\right) + \left(\frac{115\text{N*mm}}{250\text{mm}^3}\right)$$

Shear Range

11) Allowable Horizontal Shear for Individual Connector for 100,000 Cycles

Open Calculator

$$Z_r = 4 \cdot w$$

$$832\text{kN} = 4 \cdot 208\text{mm}$$

12) Allowable Horizontal Shear for Individual Connector for 2 Million Cycles

Open Calculator

$$Z_r = 2.4 \cdot w$$

$$499.2\text{kN} = 2.4 \cdot 208\text{mm}$$

13) Allowable Horizontal Shear for Individual Connector for 500,000 Cycles

Open Calculator

$$Z_r = 3 \cdot w$$

$$624\text{kN} = 3 \cdot 208\text{mm}$$

14) Allowable Horizontal Shear for Individual Connector for over 2 Million Cycles

Open Calculator

$$Z_r = 2.1 \cdot w$$

$$436.8\text{kN} = 2.1 \cdot 208\text{mm}$$

15) Allowable Horizontal Shear for Welded Studs for 100,000 Cycles

Open Calculator

$$Z_r = 13.0 \cdot \left(d^2\right)$$

$$832\text{kN} = 13.0 \cdot \left((8\text{mm})^2\right)$$

16) Allowable Horizontal Shear for Welded Studs for 2 Million Cycles

Open Calculator

$$Z_r = 7.85 \cdot \left(d^2\right)$$

$$502.4\text{kN} = 7.85 \cdot \left((8\text{mm})^2\right)$$

17) Allowable Horizontal Shear for Welded Studs for 500,000 Cycles

Open Calculator

$$Z_r = 10.6 \cdot \left(d^2\right)$$

$$678.4\text{kN} = 10.6 \cdot \left((8\text{mm})^2\right)$$

18) Allowable Horizontal Shear for Welded Studs for over 2 Million Cycles

$$Z_r = 5.5 \cdot \left(d^2\right)$$

Open Calculator

$$352\text{kN} = 5.5 \cdot \left((8\text{mm})^2\right)$$

19) Horizontal Shear Range at Juncture of Slab and Beam

$$S_r = \frac{V_r \cdot Q}{I_h}$$

Open Calculator

$$6.4\text{kN/mm} = \frac{80\text{kN} \cdot 10\text{mm}^3}{125\text{mm}^4}$$

20) Moment of Inertia of Transformed Section given Horizontal Shear Range

$$I_h = \frac{Q \cdot V_r}{S_r}$$

Open Calculator

$$125\text{mm}^4 = \frac{10\text{mm}^3 \cdot 80\text{kN}}{6.4\text{kN/mm}}$$

21) Shear Range due to Live and Impact Load given Horizontal Shear Range

Open Calculator

$$V_r = \frac{S_r \cdot I_h}{Q}$$

$$80\text{kN} = \frac{6.4\text{kN/mm} \cdot 125\text{mm}^4}{10\text{mm}^3}$$

22) Static Moment of Transformed Section given Horizontal Shear Range

Open Calculator

$$Q = \frac{S_r \cdot I_h}{V_r}$$

$$10\text{mm}^3 = \frac{6.4\text{kN/mm} \cdot 125\text{mm}^4}{80\text{kN}}$$

Variables Used

- **d** Stud Diameter *(Millimeter)*
- **$f_{steel\ stress}$** Tensile Steel Stress *(Newton per Square Millimeter)*
- **I_h** Moment of Inertia of Transformed Section *(Millimeter⁴)*
- **$M_{D(shored)}$** Dead Load Moment for Shored Member *(Newton Millimeter)*
- **$M_{D(unshored)}$** Dead Load Moment for Unshored Member *(Newton Millimeter)*
- **M_L** Live Load Moment *(Newton Millimeter)*
- **Q** Static Moment *(Cubic Millimeter)*
- **R** Allowable Stress Multiplier
- **S_r** Horizontal Shear Range *(Kilonewton per Millimeter)*
- **S_s** Section Modulus of Steel Beam *(Cubic Millimeter)*
- **S_{tr}** Section Modulus of Transformed Composite Section *(Cubic Millimeter)*
- **V_r** Shear Range *(Kilonewton)*
- **w** Length of Channel *(Millimeter)*
- **Z_r** Allowable Range of Horizontal Shear *(Kilonewton)*
- **α** Ratio of Web to Flange Yield Strength
- **β** Ratio of Web to Flange Area
- **ψ** Distance Ratio of Flange to Depth

Constants, Functions, Measurements used

- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Volume** in Cubic Millimeter (mm^3)
  Volume Unit Conversion
- Measurement: **Pressure** in Newton per Square Millimeter (N/mm^2)
  Pressure Unit Conversion
- Measurement: **Force** in Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Torque** in Newton Millimeter (N*mm)
  Torque Unit Conversion
- Measurement: **Second Moment of Area** in Millimeter^4 (mm^4)
  Second Moment of Area Unit Conversion
- Measurement: **Shear Range** in Kilonewton per Millimeter (kN/mm)
  Shear Range 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
- Number of Connectors in Bridges Formulas
- Stiffeners on Bridge Girders Formulas
- Suspension Cables Formulas

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