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Composite Construction in Highway Bridges Formulas

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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



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

[Open Calculator](#)

$$ex \quad 14885N*mm = (250mm^3 \cdot 60N/mm^2) - 115N*mm$$

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



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

[Open Calculator](#)

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

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



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

[Open Calculator](#)

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



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

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

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



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

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

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

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

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

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

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

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

9) Stress in Steel for Shored Members

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

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



10) Stress in Steel for Unshored Members

[Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff_img.jpg\)](#)

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

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

Shear Range

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{fx } Z_r = 4 \cdot w$$

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

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$\text{fx } Z_r = 2.4 \cdot w$$

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

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

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

$$\text{fx } Z_r = 3 \cdot w$$

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



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

$$\text{fx } Z_r = 2.1 \cdot w$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

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

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

$$\text{fx } Z_r = 13.0 \cdot (d^2)$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

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

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

$$\text{fx } Z_r = 7.85 \cdot (d^2)$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

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

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

$$\text{fx } Z_r = 10.6 \cdot (d^2)$$

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487_img.jpg\)](#)

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



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



$$fx \quad Z_r = 5.5 \cdot (d^2)$$

Open Calculator

$$ex \quad 352kN = 5.5 \cdot ((8mm)^2)$$

19) Horizontal Shear Range at Juncture of Slab and Beam

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

Open Calculator

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

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

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

Open Calculator

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



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

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

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107_img.jpg\)](#)

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

22) Static Moment of Transformed Section given Horizontal Shear Range

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

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)

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



Variables Used

- **d** Stud Diameter (Millimeter)
- **$f_{\text{steel stress}}$** Tensile Steel Stress (Newton per Square Millimeter)
- **I_h** Moment of Inertia of Transformed Section (Millimeter⁴)
- **$M_{D(\text{shored})}$** Dead Load Moment for Shored Member (Newton Millimeter)
- **$M_{D(\text{unshored})}$** 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 Millimeter⁴ (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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