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Bearing, Stresses, Plate Girders & Ponding Considerations Formulas

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List of 22 Bearing, Stresses, Plate Girders & Ponding Considerations Formulas

Bearing, Stresses, Plate Girders & Ponding Considerations

Bearing on Milled Surfaces

1) Allowable Bearing Stress for Milled Surface Including Bearing Stiffeners

Open Calculator

fx $F_p = 0.9 \cdot F_y$

ex $225\text{MPa} = 0.9 \cdot 250\text{MPa}$

2) Allowable Bearing Stress for Rollers and Rockers

Open Calculator

fx $F_p = \left(\frac{F_y - 13}{20}\right) \cdot (0.66 \cdot d_r)$

ex $9.899999\text{MPa} = \left(\frac{250\text{MPa} - 13}{20}\right) \cdot (0.66 \cdot 1200\text{mm})$

3) Diameter of Roller or Rocker given Allowable Bearing Stress

Open Calculator

fx $$d_r = \frac{F_p \cdot \left(\frac{20}{F_y - 13}\right)}{0.66}$$

ex $$1187.879\text{mm} = \frac{9.8\text{MPa} \cdot \left(\frac{20}{250\text{MPa} - 13}\right)}{0.66}$$

Plate Girders in Buildings

4) Allowable Bending Stress in Compression Flange

Open Calculator

fx $$F_{b'} = F_b \cdot R_{pg} \cdot R_e$$

ex $$1.884096\text{MPa} = 3\text{MPa} \cdot 0.640 \cdot 0.9813$$

5) Depth to Thickness Ratio of Girder with Transverse Stiffeners

Open Calculator

fx $$ht = \frac{2000}{\sqrt{F_y}}$$

ex $$126.4911 = \frac{2000}{\sqrt{250\text{MPa}}}$$

6) Hybrid Girder Factor

Open Calculator

$$R_e = \frac{12 + \left(\beta \cdot \left(3 \cdot \alpha - \alpha^3\right)\right)}{12 + 2 \cdot \beta}$$

ex $$0.981333 = \frac{12 + \left(3 \cdot \left(3 \cdot 0.8 - (0.8)^3\right)\right)}{12 + 2 \cdot 3}$$

7) Maximum Depth to Thickness Ratio for Unstiffened Web

Open Calculator

$$ht = \frac{14000}{\sqrt{F_y \cdot (F_y + 16.5)}}$$

ex $$54.23872 = \frac{14000}{\sqrt{250\text{MPa} \cdot (250\text{MPa} + 16.5)}}$$

8) Plate Girder Stress Reduction Factor

Open Calculator

$$R_{pg} = \left(1 - 0.0005 \cdot \left(\frac{A_{web}}{A_f}\right) \cdot \left(ht - \left(\frac{760}{\sqrt{F_b}}\right)\right)\right)$$

ex $$0.640295 = \left(1 - 0.0005 \cdot \left(\frac{80\text{mm}^2}{10\text{mm}^2}\right) \cdot \left(90.365 - \left(\frac{760}{\sqrt{3\text{MPa}}}\right)\right)\right)$$

Ponding Considerations in Buildings

9) Capacity Spectrum

Open Calculator

fx $$C_s = \frac{32 \cdot S \cdot L_s^4}{10^7 \cdot I_s}$$

ex $$5.555556 = \frac{32 \cdot 2.5\text{m} \cdot (0.5\text{m})^4}{10^7 \cdot 90\text{mm}^4/\text{mm}}$$

10) Collapse Prevention Level

Open Calculator

fx $$C_p = \frac{32 \cdot L_p^4 \cdot L_s}{10^7 \cdot I_p}$$

ex $$95.29412 = \frac{32 \cdot (1.5\text{m})^4 \cdot 0.5\text{m}}{10^7 \cdot 85\text{mm}^4/\text{mm}}$$

11) Length of Primary Member using Collapse Prevention Level

Open Calculator

fx $$L_p = \left(\frac{C_p \cdot 10^7 \cdot I_p}{32 \cdot L_s}\right)^{\frac{1}{4}}$$

ex $$1.499984\text{m} = \left(\frac{95.29 \cdot 10^7 \cdot 85\text{mm}^4/\text{mm}}{32 \cdot 0.5\text{m}}\right)^{\frac{1}{4}}$$

12) Length of Secondary Member given Capacity Spectrum

Open Calculator

$$L_s = \left(C_s \cdot 10^7 \cdot \frac{I_s}{32 \cdot S} \right)^{\frac{1}{4}}$$

$$0.499875\text{m} = \left(5.55 \cdot 10^7 \cdot \frac{90\text{mm}^4/\text{mm}}{32 \cdot 2.5\text{m}} \right)^{\frac{1}{4}}$$

13) Length of Secondary Member using Collapse Prevention Level

Open Calculator

$$L_s = \frac{C_p \cdot 10^7 \cdot I_p}{32 \cdot L_p^4}$$

$$0.499978\text{m} = \frac{95.29 \cdot 10^7 \cdot 85\text{mm}^4/\text{mm}}{32 \cdot (1.5\text{m})^4}$$

14) Moment of Inertia of Primary Member using Collapse Prevention Level

Open Calculator

$$I_p = \frac{32 \cdot L_p^4 \cdot L_s}{10^7 \cdot C_p}$$

$$85.00367\text{mm}^4/\text{mm} = \frac{32 \cdot (1.5\text{m})^4 \cdot 0.5\text{m}}{10^7 \cdot 95.29}$$

15) Moment of Inertia of Secondary Member given Capacity Spectrum

Open Calculator

fx $$I_s = \frac{32 \cdot S \cdot L_s^4}{10^7 \cdot C_s}$$

ex $$90.09009\text{mm}^4/\text{mm} = \frac{32 \cdot 2.5\text{m} \cdot (0.5\text{m})^4}{10^7 \cdot 5.55}$$

Stresses in Thin Shells

16) Central Shear given Shearing Stress

Open Calculator

fx $$T = \left(v_{xy} - \left(\frac{D \cdot z \cdot 12}{t^3}\right)\right) \cdot t$$

ex $$50\text{kN/m} = \left(3.55\text{MPa} - \left(\frac{110\text{kN*m} \cdot 0.02\text{m} \cdot 12}{(200\text{mm})^3}\right)\right) \cdot 200\text{mm}$$

17) Distance from Middle Surface given Normal Shearing Stress

Open Calculator

fx $$z = \sqrt{\left(\frac{t^2}{4}\right) - \left(\frac{v_{xz} \cdot t^3}{6 \cdot V}\right)}$$

ex $$0.02\text{m} = \sqrt{\left(\frac{(200\text{mm})^2}{4}\right) - \left(\frac{0.72\text{MPa} \cdot (200\text{mm})^3}{6 \cdot 100\text{kN}}\right)}$$

18) Distance from Middle Surface given Normal Stress in Thin Shells

Open Calculator

fx $$z = \left(\frac{t^2}{12 \cdot M_x}\right) \cdot ((f_x \cdot t) - (N_x))$$

ex $$0.019999\text{m} = \left(\frac{(200\text{mm})^2}{12 \cdot 90\text{kN*m}}\right) \cdot ((2.7\text{MPa} \cdot 200\text{mm}) - (15\text{N}))$$

19) Normal Shearing Stresses

Open Calculator

fx $$v_{xz} = \left(\frac{6 \cdot V}{t^3}\right) \cdot \left(\left(\frac{t^2}{4}\right) - \left(z^2\right)\right)$$

ex $$0.72\text{MPa} = \left(\frac{6 \cdot 100\text{kN}}{(200\text{mm})^3}\right) \cdot \left(\left(\frac{(200\text{mm})^2}{4}\right) - \left((0.02\text{m})^2\right)\right)$$

20) Normal Stress in Thin Shells

Open Calculator

fx $$f_x = \left(\frac{N_x}{t}\right) + \left(\frac{M_x \cdot z}{\frac{t^3}{12}}\right)$$

ex $$2.700075\text{MPa} = \left(\frac{15\text{N}}{200\text{mm}}\right) + \left(\frac{90\text{kN*m} \cdot 0.02\text{m}}{\frac{(200\text{mm})^3}{12}}\right)$$

21) Shearing Stresses on Shells

Open Calculator

fx $$v_{xy} = \left(\left(\frac{T}{t}\right) + \left(\frac{D \cdot z \cdot 12}{t^3}\right)\right)$$

ex $$3.55\text{MPa} = \left(\left(\frac{50\text{kN/m}}{200\text{mm}}\right) + \left(\frac{110\text{kN*m} \cdot 0.02\text{m} \cdot 12}{(200\text{mm})^3}\right)\right)$$

22) Twisting Moments given Shearing Stress

Open Calculator

fx $$D = \frac{((v_{xy} \cdot t) - T) \cdot t^2}{12 \cdot z}$$

ex $$110\text{kN*m} = \frac{((3.55\text{MPa} \cdot 200\text{mm}) - 50\text{kN/m}) \cdot (200\text{mm})^2}{12 \cdot 0.02\text{m}}$$

Variables Used

- A_f Area of Flange *(Square Millimeter)*
- A_{web} Web Area *(Square Millimeter)*
- C_p Collapse Prevention Level
- C_s Capacity Spectrum
- D Twisting Moments on Shells *(Kilonewton Meter)*
- d_r Diameter of Rollers and Rockers *(Millimeter)*
- F_b Allowable Bending Stress *(Megapascal)*
- $F_{b'}$ Reduced Allowable Bending Stress *(Megapascal)*
- F_p Allowable Bearing Stress *(Megapascal)*
- f_x Normal Stress on Thin Shells *(Megapascal)*
- F_y Yield Stress of Steel *(Megapascal)*
- ht Depth to Thickness Ratio
- I_p Moment of Inertia of Primary Member *(Millimeter⁴ per Millimeter)*
- I_s Moment of Inertia of Secondary Member *(Millimeter⁴ per Millimeter)*
- L_p Length of Primary Member *(Meter)*
- L_s Length of Secondary Member *(Meter)*
- M_x Unit Bending Moment *(Kilonewton Meter)*
- N_x Unit Normal Force *(Newton)*
- R_e Hybrid Girder Factor
- R_{pg} Plate Girder Strength Reduction Factor
- S Spacing of Secondary Members *(Meter)*

- **t** Shell Thickness *(Millimeter)*
- **T** Central Shear *(Kilonewton per Meter)*
- **V** Unit Shear Force *(Kilonewton)*
- v_{xy} Shearing Stress on Shells *(Megapascal)*
- v_{xz} Normal Shearing Stress *(Megapascal)*
- **z** Distance from Middle Surface *(Meter)*
- **α** Ratio of Yield Stress
- **β** Ratio of Web Area to Flange Area

Constants, Functions, Measurements used

- Function: **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), Meter (m)
  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), Newton (N)
  Force Unit Conversion
- Measurement: **Surface Tension** in Kilonewton per Meter (kN/m)
  Surface Tension Unit Conversion
- Measurement: **Moment of Force** in Kilonewton Meter (kN*m)
  Moment of Force Unit Conversion
- Measurement: **Moment of Inertia per Unit Length** in Millimeter⁴ per Millimeter (mm⁴/mm)
  Moment of Inertia per Unit Length Unit Conversion
- Measurement: **Stress** in Megapascal (MPa)
  Stress Unit Conversion

Check other formula lists

- **Allowable-Stress Design Formulas**
- **Base and Bearing Plates Formulas**
- **Bearing, Stresses, Plate Girders & Ponding Considerations Formulas**
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