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Frames and Flat Plate Formulas

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List of 17 Frames and Flat Plate Formulas

Frames and Flat Plate

Braced and Unbraced Frames

Load Bearing Walls

1) 28-Day Concrete Compressive Strength given Axial Capacity of Wall

Open Calculator

fx $$f'_c = \frac{\phi P_n}{0.55 \cdot \phi \cdot A_g \cdot \left(1 - \left(\frac{k \cdot l_c}{32 \cdot h}\right)^2\right)}$$

ex $$52.26706\text{MPa} = \frac{10\text{kN}}{0.55 \cdot 0.7 \cdot 500\text{mm}^2 \cdot \left(1 - \left(\frac{0.5 \cdot 1000\text{mm}}{32 \cdot 200\text{mm}}\right)^2\right)}$$

2) Axial Capacity of Wall

Open Calculator

fx $$\phi P_n = 0.55 \cdot \phi \cdot f'_c \cdot A_g \cdot \left(1 - \left(\frac{k \cdot l_c}{32 \cdot h}\right)^2\right)$$

ex $$9.566254\text{kN} = 0.55 \cdot 0.7 \cdot 50\text{MPa} \cdot 500\text{mm}^2 \cdot \left(1 - \left(\frac{0.5 \cdot 1000\text{mm}}{32 \cdot 200\text{mm}}\right)^2\right)$$

3) Wall Section Gross Area given Axial Capacity of Wall

Open Calculator

fx $$A_g = \frac{\phi P_n}{0.55 \cdot \phi \cdot f'_c \cdot \left(1 - \left(\frac{k \cdot l_c}{32 \cdot h}\right)^2\right)}$$

ex $$522.6706\text{mm}^2 = \frac{10\text{kN}}{0.55 \cdot 0.7 \cdot 50\text{MPa} \cdot \left(1 - \left(\frac{0.5 \cdot 1000\text{mm}}{32 \cdot 200\text{mm}}\right)^2\right)}$$

Shear Walls

4) Concrete Strength given Shear Force

Open Calculator

fx $$f'_c = \left(\left(\frac{1}{3.3 \cdot d \cdot h}\right) \cdot \left(V_c + \left(\frac{N_u \cdot d}{4 \cdot l_w}\right)\right)\right)^2$$

ex $$52.89256\text{MPa} = \left(\left(\frac{1}{3.3 \cdot 2500\text{mm} \cdot 200\text{mm}}\right) \cdot \left(6\text{N} + \left(\frac{30\text{N} \cdot 2500\text{mm}}{4 \cdot 3125\text{mm}}\right)\right)\right)^2$$

5) Maximum Shear Strength

Open Calculator

fx $$V_n = 10 \cdot h \cdot 0.8 \cdot l_w \cdot \sqrt{f'_c}$$

ex $$0.035355\text{MPa} = 10 \cdot 200\text{mm} \cdot 0.8 \cdot 3125\text{mm} \cdot \sqrt{50\text{MPa}}$$

6) Minimum Horizontal Reinforcement

Open Calculator

$$\rho_n = 0.0025 + 0.5 \cdot \left(2.5 - \left(\frac{h_w}{l_w}\right)\right)$$

$$0.7725 = 0.0025 + 0.5 \cdot \left(2.5 - \left(\frac{3000\text{mm}}{3125\text{mm}}\right)\right)$$

7) Nominal Shear Stress

Open Calculator

$$v_u = \left(\frac{V}{\varphi \cdot h \cdot d}\right)$$

$$1176.471\text{N/m}^2 = \left(\frac{500.00\text{N}}{0.85 \cdot 200\text{mm} \cdot 2500\text{mm}}\right)$$

8) Shear carried by Concrete

Open Calculator

$$V_c = 3.3 \cdot \sqrt{f'_c} \cdot h \cdot d - \left(\frac{N_u \cdot d}{4 \cdot l_w}\right)$$

$$5.667262\text{N} = 3.3 \cdot \sqrt{50\text{MPa}} \cdot 200\text{mm} \cdot 2500\text{mm} - \left(\frac{30\text{N} \cdot 2500\text{mm}}{4 \cdot 3125\text{mm}}\right)$$

9) Total Design Shear Force given Nominal Shear Stress

Open Calculator

$$V = v_u \cdot \varphi \cdot h \cdot d$$

$$499.8\text{N} = 1176\text{N/m}^2 \cdot 0.85 \cdot 200\text{mm} \cdot 2500\text{mm}$$

10) Wall Horizontal Length given Nominal Shear Stress

Open Calculator

$$d = \frac{V}{h \cdot \varphi \cdot v_u}$$

$$2501\text{mm} = \frac{500.00\text{N}}{200\text{mm} \cdot 0.85 \cdot 1176\text{N/m}^2}$$

11) Wall Overall Thickness given Nominal Shear Stress

Open Calculator

$$h = \frac{V}{\varphi \cdot v_u \cdot d}$$

$$200.08\text{mm} = \frac{500.00\text{N}}{0.85 \cdot 1176\text{N/m}^2 \cdot 2500\text{mm}}$$

Flat Plate Construction

12) Clear Span in Direction Moments given Total Static Design Moment

Open Calculator

$$l_n = \sqrt{\frac{M_o \cdot 8}{W \cdot l_2}}$$

$$5\text{m} = \sqrt{\frac{125\text{kN*m} \cdot 8}{20\text{kN/m} \cdot 2\text{m}}}$$

13) Concrete Column Elasticity Modulus using Flexural Stiffness

Open Calculator

$$E_c = \frac{K_c}{I}$$

$$0.157303\text{MPa} = \frac{0.56\text{MPa}}{3.56\text{kg}\cdot\text{m}^2}$$

14) Moment of Inertia of Centroidal Axis given Flexural Stiffness

Open Calculator

$$I = \frac{K_c}{E_c}$$

$$3.566879\text{kg·m}^2 = \frac{0.56\text{MPa}}{0.157\text{MPa}}$$

15) Strip Width given Total Static Design Moment

Open Calculator

$$l_2 = \frac{8 \cdot M_o}{W \cdot (l_n)^2}$$

$$2\text{m} = \frac{8 \cdot 125\text{kN*m}}{20\text{kN/m} \cdot (5\text{m})^2}$$

16) Total Static Design Moment in Strip

Open Calculator

$$M_o = \frac{W \cdot l_2 \cdot (l_n)^2}{8}$$

$$125\text{kN*m} = \frac{20\text{kN/m} \cdot 2\text{m} \cdot (5\text{m})^2}{8}$$

17) Uniform Design Load Per Unit of Slab Area given Total Static Design Moment

Open Calculator

$$W = \frac{M_o \cdot 8}{l_2 \cdot l_n^2}$$

$$20\text{kN/m} = \frac{125\text{kN*m} \cdot 8}{2\text{m} \cdot (5\text{m})^2}$$

Variables Used

- A_g Gross Area of Column *(Square Millimeter)*
- d Design Horizontal Length *(Millimeter)*
- E_c Modulus of Elasticity of Concrete *(Megapascal)*
- f'_c Specified 28-Day Compressive Strength of Concrete *(Megapascal)*
- h Overall Thickness of Wall *(Millimeter)*
- h_w Total Height of Wall *(Millimeter)*
- I Moment of Inertia *(Kilogram Square Meter)*
- k Effective Length Factor
- K_c Flexural Stiffness of Column *(Megapascal)*
- l_2 Span Perpendicular to L1 *(Meter)*
- l_c Vertical Distance between Supports *(Millimeter)*
- l_n Clear Span in Direction of Moments *(Meter)*
- l_w Horizontal Length of Wall *(Millimeter)*
- M_o Total Static Design Moment in Strip *(Kilonewton Meter)*
- N_u Design Axial Load *(Newton)*
- V Total Shear *(Newton)*
- V_c Shear carried by Concrete *(Newton)*
- V_n Shear Strength *(Megapascal)*
- v_u Nominal Shear Stress *(Newton per Square Meter)*
- W Uniform Design Load *(Kilonewton per Meter)*
- ρ_n Horizontal Reinforcement
- φ Capacity Reduction Factor
- ϕ Strength Reduction Factor for Bearing Walls
- ϕP_n Axial Capacity of Wall *(Kilonewton)*

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 (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 Inertia** in Kilogram Square Meter (kg·m²)
  Moment of Inertia Unit Conversion
- Measurement: **Moment of Force** in Kilonewton Meter (kN*m)
  Moment of Force Unit Conversion
- Measurement: **Stress** in Megapascal (MPa), Newton per Square Meter (N/m²)
  Stress Unit Conversion

Check other formula lists

- **Beams, Columns and Other Members Design Methods Formulas**
- **Deflection Computations, Column Moments and Torsion Formulas**
- **Frames and Flat Plate Formulas**
- **Mix Design, Modulus of Elasticity and Tensile Strength of Concrete Formulas**
- **Working Stress Design Formulas**

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