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Properties of Basic Material of Concrete Structures Formulas

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List of 26 Properties of Basic Material of Concrete Structures Formulas

Properties of Basic Material of Concrete Structures

Combined Stresses

1) Creep Coefficient given Creep Strain

Open Calculator

fx $$\Phi = \frac{\varepsilon_{cr,ult}}{\varepsilon_{el}}$$

ex $$1.6 = \frac{0.8}{0.50}$$

2) Elastic Strain given Creep Strain

Open Calculator

fx $$\varepsilon_{el} = \frac{\varepsilon_{cr,ult}}{\Phi}$$

ex $$0.5 = \frac{0.8}{1.6}$$

Compression

3) 28-Day Concrete Compressive Strength

Open Calculator

$$f_c = S_7 + \left(30 \cdot \sqrt{S_7}\right)$$

ex $6.8\text{E}\hat{}\text{-}5\text{MPa} = 4.5\text{MPa} + \left(30 \cdot \sqrt{4.5\text{MPa}}\right)$

4) 28-Day Concrete Compressive Strength given Water Cement Ratio

Open Calculator

$$f_c = (2700 \cdot CW) - 760$$

ex $455\text{MPa} = (2700 \cdot 0.45) - 760$

5) Bulk Modulus given Direct Stress

Open Calculator

$$K = \frac{\sigma}{\varepsilon_v}$$

ex $180000\text{MPa} = \frac{18\text{MPa}}{0.0001}$

6) Bulk Modulus using Young's Modulus

Open Calculator

$$K = \frac{E}{3 \cdot (1 - 2 \cdot \nu)}$$

ex $16666.67\text{MPa} = \frac{20000\text{MPa}}{3 \cdot (1 - 2 \cdot 0.3)}$

7) Direct Stress for given Bulk Modulus and Volumetric Strain

Open Calculator

fx $\sigma = K \cdot \varepsilon_v$

ex $1.8\text{MPa} = 18000\text{MPa} \cdot 0.0001$

8) Lateral Strain given Volumetric and Longitudinal Strain

Open Calculator

fx $\varepsilon_L = -\frac{\varepsilon_{longitudinal} - \varepsilon_v}{2}$

ex $-0.09995 = -\frac{0.2 - 0.0001}{2}$

9) Longitudinal Strain given Volumetric and Lateral Strain

Open Calculator

fx $\varepsilon_{longitudinal} = \varepsilon_v - (2 \cdot \varepsilon_L)$

ex $0.1201 = 0.0001 - (2 \cdot -0.06)$

10) Longitudinal Strain given Volumetric Strain and Poisson's Ratio

Open Calculator

fx $\varepsilon_{longitudinal} = \frac{\varepsilon_v}{1 - 2 \cdot \nu}$

ex $0.00025 = \frac{0.0001}{1 - 2 \cdot 0.3}$

11) Modulus of Rupture of Concrete

Open Calculator

$$f_r = 7.5 \cdot \left((fck)^{\frac{1}{2}} \right)$$

$$0.033541\text{MPa} = 7.5 \cdot \left((20\text{MPa})^{\frac{1}{2}} \right)$$

12) Poisson's Ratio given Volumetric Strain and Longitudinal Strain

Open Calculator

$$\nu = \frac{1}{2} \cdot \left(1 - \frac{\varepsilon_v}{\varepsilon_{longitudinal}} \right)$$

$$0.49975 = \frac{1}{2} \cdot \left(1 - \frac{0.0001}{0.2} \right)$$

13) Poisson's Ratio using Bulk Modulus and Young's Modulus

Open Calculator

$$\nu = \frac{3 \cdot K - E}{6 \cdot K}$$

$$0.314815 = \frac{3 \cdot 18000\text{MPa} - 20000\text{MPa}}{6 \cdot 18000\text{MPa}}$$

14) Volumetric Strain given Bulk Modulus

Open Calculator

$$\varepsilon_v = \frac{\sigma}{K}$$

$$0.001 = \frac{18\text{MPa}}{18000\text{MPa}}$$

15) Volumetric Strain given Change in Length

Open Calculator

fx $$\varepsilon_v = \left(\frac{\Delta l}{l}\right) \cdot (1 - 2 \cdot \nu)$$

ex $$0.0004 = \left(\frac{0.0025\text{m}}{2.5\text{m}}\right) \cdot (1 - 2 \cdot 0.3)$$

16) Volumetric Strain given Change in Length, Breadth and Width

Open Calculator

fx $$\varepsilon_v = \frac{\Delta l}{l} + \frac{\Delta b}{b} + \frac{\Delta d}{d}$$

ex $$0.020333 = \frac{0.0025\text{m}}{2.5\text{m}} + \frac{0.014\text{m}}{1.5\text{m}} + \frac{0.012\text{m}}{1.2\text{m}}$$

17) Volumetric Strain given Longitudinal and Lateral Strain

Open Calculator

fx $$\varepsilon_v = \varepsilon_{\text{longitudinal}} + 2 \cdot \varepsilon_L$$

ex $$0.08 = 0.2 + 2 \cdot -0.06$$

18) Volumetric Strain of Cylindrical Rod

Open Calculator

fx $$\varepsilon_v = \varepsilon_{\text{longitudinal}} - 2 \cdot (\varepsilon_L)$$

ex $$0.32 = 0.2 - 2 \cdot (-0.06)$$

19) Volumetric Strain of Cylindrical Rod using Poisson's Ratio

Open Calculator

$$\varepsilon_v = \varepsilon_{longitudinal} \cdot (1 - 2 \cdot \nu)$$

$$0.08 = 0.2 \cdot (1 - 2 \cdot 0.3)$$

20) Volumetric Strain using Young's Modulus and Poisson's Ratio

Open Calculator

$$\varepsilon_v = \frac{3 \cdot \sigma_t \cdot (1 - 2 \cdot \nu)}{E}$$

$$0.000996 = \frac{3 \cdot 16.6\text{MPa} \cdot (1 - 2 \cdot 0.3)}{20000\text{MPa}}$$

21) Water Cement Ratio given 28-Day Concrete Compressive Strength

Open Calculator

$$CW = \frac{f_c + 760}{2700}$$

$$0.287037 = \frac{15\text{MPa} + 760}{2700}$$

Modulus of Elasticity

22) Modulus of Elasticity of Normal Weight and Density Concrete in USCS Units

Open Calculator

$$E_c = 57000 \cdot \sqrt{f_c}$$

$$220.7601\text{MPa} = 57000 \cdot \sqrt{15\text{MPa}}$$

23) Young's Modulus of Concrete

Open Calculator

$$E_c = 5000 \cdot \left(\sqrt{fck}\right)$$

$$22360.68\text{MPa} = 5000 \cdot \left(\sqrt{20\text{MPa}}\right)$$

24) Young's Modulus of Elasticity as per ACI 318 Building Code Requirements for Reinforced Concrete

Open Calculator

$$E = \left(W^{1.5}\right) \cdot 0.043 \cdot \sqrt{f_c}$$

$$5.266403\text{MPa} = \left((1000\text{kg/m}^3)^{1.5}\right) \cdot 0.043 \cdot \sqrt{15\text{MPa}}$$

25) Young's Modulus using Bulk Modulus

Open Calculator

$$E = 3 \cdot K \cdot (1 - 2 \cdot \nu)$$

$$21600\text{MPa} = 3 \cdot 18000\text{MPa} \cdot (1 - 2 \cdot 0.3)$$

26) Young's Modulus using Poisson's Ratio

Open Calculator

$$E = \frac{3 \cdot \sigma_t \cdot (1 - 2 \cdot \nu)}{\varepsilon_v}$$

$$199200\text{MPa} = \frac{3 \cdot 16.6\text{MPa} \cdot (1 - 2 \cdot 0.3)}{0.0001}$$

Variables Used

- **b** Breadth of Bar *(Meter)*
- **CW** Water Cement Ratio
- **d** Depth of Bar *(Meter)*
- **E** Young's Modulus *(Megapascal)*
- E_c Modulus of Elasticity of Concrete *(Megapascal)*
- f_c 28 Day Compressive Strength of Concrete *(Megapascal)*
- f_r Modulus of Rupture of Concrete *(Megapascal)*
- **fck** Characteristic Compressive Strength *(Megapascal)*
- **K** Bulk Modulus *(Megapascal)*
- **l** Length of Section *(Meter)*
- S_7 7 Day Compressive Strength *(Megapascal)*
- **W** Weight of Concrete *(Kilogram per Cubic Meter)*
- **Δb** Change in Breadth *(Meter)*
- **Δd** Change in Depth *(Meter)*
- **Δl** Change in Length *(Meter)*
- $\varepsilon_{cr,ult}$ Ultimate Creep Strain
- ε_{el} Elastic Strain
- ε_L Lateral Strain
- $\varepsilon_{longitudinal}$ Longitudinal Strain
- ε_v Volumetric Strain
- **σ** Direct Stress *(Megapascal)*
- σ_t Tensile Stress *(Megapascal)*

- **Φ** Creep Coefficient of Prestress
- **ν** Poisson's Ratio

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Pressure** in Megapascal (MPa)
  Pressure Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Stress** in Megapascal (MPa)
  Stress Unit Conversion

Check other formula lists

- **Roof Live Loads Formulas**

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