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Mix Design, Modulus of Elasticity and Tensile Strength of Concrete Formulas

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List of 21 Mix Design, Modulus of Elasticity and Tensile Strength of Concrete Formulas

Mix Design, Modulus of Elasticity and Tensile Strength of Concrete

Job Mix Concrete Volume

1) Absolute Volume of Component

Open Calculator

fx $$V_a = \frac{W_L}{SG \cdot \rho_{water}}$$

ex $$0.375\text{m}^3 = \frac{900\text{kg}}{2.4 \cdot 1000.001\text{kg/m}^3}$$

2) Gel-Space Ratio for Complete Hydration

Open Calculator

fx $$GS = \frac{0.657 \cdot C}{(0.319 \cdot C) + Wo}$$

ex $$1.568019 = \frac{0.657 \cdot 10\text{kg}}{(0.319 \cdot 10\text{kg}) + 1000\text{mL}}$$

3) Specific Gravity of Material given its Absolute Volume

Open Calculator

$$SG = \frac{W_L}{V_a \cdot \rho_{water}}$$

$$2.399998 = \frac{900\text{kg}}{0.375\text{m}^3 \cdot 1000.001\text{kg/m}^3}$$

4) Target Mean Strength for Mix Design

Open Calculator

$$f'_{ck} = f_{ck} + (1.65 \cdot \sigma)$$

$$20.01001\text{MPa} = 20.01\text{MPa} + (1.65 \cdot 4)$$

5) Volume of Empty Capillary Pores

Open Calculator

$$Vec = (V_{cp} - V_{wcp})$$

$$3.5\text{mL} = (8\text{mL} - 4.5\text{mL})$$

6) Volume of Products of Hydration Per Unit of Dry Cement

Open Calculator

$$Vp = \left(\frac{V_{hc}}{V_{cah}}\right)$$

$$22.22222\text{mm}^3 = \left(\frac{70\text{mL}}{3.15\text{g/mL}}\right)$$

7) Water Cement Ratio

Open Calculator

fx $$CW = \frac{w_m}{w_c}$$

ex $$0.45 = \frac{9kg}{20kg}$$

8) Weight of Cementitious Materials in Concrete Batch

Open Calculator

fx $$w_c = \frac{w_m}{CW}$$

ex $$20kg = \frac{9kg}{0.45}$$

9) Weight of Material given its Absolute Volume

Open Calculator

fx $$W_L = V_a \cdot SG \cdot \rho_{water}$$

ex $$900.0009kg = 0.375m^3 \cdot 2.4 \cdot 1000.001kg/m^3$$

10) Weight of Mixing Water in Batch

Open Calculator

fx $$w_m = CW \cdot w_c$$

ex $$9kg = 0.45 \cdot 20kg$$

Modulus of Elasticity of Concrete

11) Modulus of Elasticity of Concrete

Open Calculator

fx $E_{cmd} = 5000 \cdot (f_{ck})^{0.5}$

ex $22.36627\text{MPa} = 5000 \cdot (20.01\text{MPa})^{0.5}$

ACI Code

12) Modulus of Elasticity of Concrete in SI Units

Open Calculator

fx $E_c = 0.043 \cdot w_c^{1.5} \cdot \sqrt{f'_c}$

ex $0.027196\text{MPa} = 0.043 \cdot (20\text{kg})^{1.5} \cdot \sqrt{50\text{MPa}}$

13) Modulus of Elasticity of Concrete in USCS Units

Open Calculator

fx $E_c = 33 \cdot w_c^{1.5} \cdot \sqrt{f'_c}$

ex $20.87103\text{MPa} = 33 \cdot (20\text{kg})^{1.5} \cdot \sqrt{50\text{MPa}}$

Normal-Weight, Normal-Density Concrete

14) Modulus of Elasticity for Normal Weight Concrete in UCSC Units

Open Calculator

fx $E_c = 57000 \cdot \sqrt{f'_c}$

ex $403.0509\text{MPa} = 57000 \cdot \sqrt{50\text{MPa}}$

15) Modulus of Elasticity of Normal Weight and Density Concrete in SI Units

Open Calculator

fx $$E_c = 4700 \cdot \sqrt{f'_c}$$

ex $$33.23402\text{MPa} = 4700 \cdot \sqrt{50\text{MPa}}$$

Modulus of Rupture

16) Modulus of Rupture of Rectangular Sample in Four-Point Bending

Open Calculator

fx $$f_{4ptr} = \frac{F_f \cdot L}{B \cdot \left(T^2\right)}$$

ex $$56.25\text{MPa} = \frac{80\text{N} \cdot 180\text{mm}}{100\text{mm} \cdot \left((1.6\text{mm})^2\right)}$$

17) Modulus of Rupture of Rectangular Sample in Three-Point Bending

Open Calculator

fx $$f_{3ptr} = \frac{3 \cdot F_f \cdot L}{2 \cdot B \cdot \left(T^2\right)}$$

ex $$84.375\text{MPa} = \frac{3 \cdot 80\text{N} \cdot 180\text{mm}}{2 \cdot 100\text{mm} \cdot \left((1.6\text{mm})^2\right)}$$

Tensile Strength of Concrete

18) Maximum Load Applied during Splitting Tensile Strength of Concrete

Open Calculator

$$W_{load} = \frac{\sigma sp \cdot \pi \cdot D_1 \cdot L_c}{2}$$

$$3.769911\text{kN} = \frac{40\text{N/m}^2 \cdot \pi \cdot 5\text{m} \cdot 12\text{m}}{2}$$

19) Splitting Tensile Strength of Concrete

Open Calculator

$$\sigma sp = \frac{2 \cdot W_{load}}{\pi \cdot D_1 \cdot L_c}$$

$$38.19719\text{N/m}^2 = \frac{2 \cdot 3.6\text{kN}}{\pi \cdot 5\text{m} \cdot 12\text{m}}$$

20) Tensile Strength of Concrete in Combined Stress Design

Open Calculator

$$f_r = 7.5 \cdot \sqrt{f'_c}$$

$$53.03301\text{MPa} = 7.5 \cdot \sqrt{50\text{MPa}}$$

21) Tensile Strength of Normal Weight and Density Concrete in SI Units

Open Calculator

$$f_r = 0.7 \cdot \sqrt{f'_c}$$

$$0.00495\text{MPa} = 0.7 \cdot \sqrt{50\text{MPa}}$$

Variables Used

- **B** Width of Section *(Millimeter)*
- **C** Mass Of Cement *(Kilogram)*
- **CW** Water Cement Ratio
- D_1 Diameter of Cylinder 1 *(Meter)*
- E_c Modulus of Elasticity of Concrete *(Megapascal)*
- E_{cmd} Elastic Modulus of Concrete for Mix Design *(Megapascal)*
- f_{3ptr} Modulus of Rupture of Concrete Threepoint bending *(Megapascal)*
- f_{4ptr} Modulus of Rupture of Concrete Fourpoint bending *(Megapascal)*
- f'_c Specified 28-Day Compressive Strength of Concrete *(Megapascal)*
- f_{ck} Characteristic Compressive Strength *(Megapascal)*
- f'_{ck} Target Average Compressive Strength *(Megapascal)*
- F_f Load at Fracture Point *(Newton)*
- f_r Tensile Strength of Concrete *(Megapascal)*
- **GS** Gel Space Ratio
- **L** Length of Section *(Millimeter)*
- L_c Length of Cylinder *(Meter)*
- **SG** Specific Gravity of Material
- **T** Average Section Thickness *(Millimeter)*
- V_a Absolute Volume *(Cubic Meter)*
- V_{cah} Absolute Volume of Dry Cement actually Hydrated *(Gram per Milliliter)*
- V_{cp} Volume of Capillary Pores *(Milliliter)*

- V_{hc} Volume of Hydrated Cement *(Milliliter)*
- V_{wcp} Volume of Water Filled Capillary Pores *(Milliliter)*
- Vec Volume of Empty Capillary Pores *(Milliliter)*
- Vp Volume of Solid Products of Hydration *(Cubic Millimeter)*
- w_c Weight of Cementitious Materials *(Kilogram)*
- W_L Weight of Material *(Kilogram)*
- W_{load} Maximum Load Applied *(Kilonewton)*
- w_m Weight of Mixing Water *(Kilogram)*
- Wo Volume of Mixing Water *(Milliliter)*
- ρ_{water} Water Density *(Kilogram per Cubic Meter)*
- σ Standard Deviation of Distribution
- σsp Splitting Tensile Strength of Concrete *(Newton per Square Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Millimeter (mm), Meter (m)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Volume** in Cubic Meter (m^3), Milliliter (mL), Cubic Millimeter (mm^3)
  Volume Unit Conversion
- Measurement: **Pressure** in Megapascal (MPa)
  Pressure Unit Conversion
- Measurement: **Force** in Newton (N), Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3), Gram per Milliliter (g/mL)
  Density Unit Conversion
- Measurement: **Stress** in Megapascal (MPa), Newton per Square Meter (N/m^2)
  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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