



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

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Examples!

Conversions!

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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

$$V_{
m a} = rac{W_{
m L}}{{
m SG} \cdot
ho_{
m water}}$$

Open Calculator

$$oxed{0.375 \mathrm{m}^{_3} = rac{900 \mathrm{kg}}{2.4 \cdot 1000.001 \mathrm{kg/m}^{_3}}}$$

2) Gel-Space Ratio for Complete Hydration

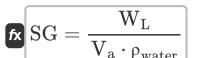
$$ext{GS} = rac{0.657 \cdot ext{C}}{(0.319 \cdot ext{C}) + ext{Wo}}$$

Open Calculator 🖸

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



3) Specific Gravity of Material given its Absolute Volume



Open Calculator

 $m ex = rac{900 kg}{0.375 m^3 \cdot 1000.001 kg/m^3}$

4) Target Mean Strength for Mix Design

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

Open Calculator

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

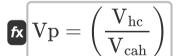
5) Volume of Empty Capillary Pores

 $\left. ext{Vec} = \left(ext{V}_{ ext{cp}} - ext{V}_{ ext{wcp}}
ight)
ight|$

Open Calculator 🖒

 $oxed{ex} 3.5 \mathrm{mL} = (8 \mathrm{mL} - 4.5 \mathrm{mL})$

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

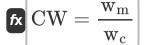


 $oxed{ex} 22.2222 \mathrm{mm}^{_3} = \left(rac{70 \mathrm{mL}}{3.15 \mathrm{g/mL}}
ight)$





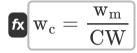
7) Water Cement Ratio



Open Calculator 🚰

 $\boxed{0.45 = \frac{9 \mathrm{kg}}{20 \mathrm{kg}}}$

8) Weight of Cementitious Materials in Concrete Batch



Open Calculator

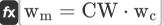
 $20 \text{kg} = \frac{9 \text{kg}}{0.45}$

9) Weight of Material given its Absolute Volume

 $\mathbf{w}_{\mathrm{L}} = V_{\mathrm{a}} \cdot \mathrm{SG} \cdot
ho_{\mathrm{water}}$

Open Calculator

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



10) Weight of Mixing Water in Batch

Open Calculator





Modulus of Elasticity of Concrete

11) Modulus of Elasticity of Concrete

 $\mathbf{f}_{\mathbf{k}} \mathbf{E}_{\mathrm{cmd}} = 5000 \cdot \left(\mathbf{f}_{\mathrm{ck}}
ight)^{0.5}$

Open Calculator [7

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

ACI Code

12) Modulus of Elasticity of Concrete in SI Units

Open Calculator 2

Open Calculator

 $\mathbf{E}_{\mathrm{c}} = 0.043 \cdot \mathrm{w}_{\mathrm{c}}^{1.5} \cdot \sqrt{\mathrm{f'}_{\mathrm{c}}}$ $\mathbf{ex} \left[0.027196 \mathrm{MPa} = 0.043 \cdot \left(20 \mathrm{kg} \right)^{1.5} \cdot \sqrt{50 \mathrm{MPa}} \right]$

13) Modulus of Elasticity of Concrete in USCS Units

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

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

Normal-Weight, Normal-Density Concrete

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



Open Calculator

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







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

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

Open Calculator

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

Modulus of Rupture

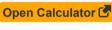
16) Modulus of Rupture of Rectangular Sample in Four-Point Bending

 $\mathbf{f}_{4 ext{ptr}} = rac{\mathrm{F_f \cdot L}}{\mathrm{B \cdot (T^2)}} igg|$

Open Calculator 🗗

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

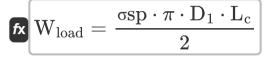
 $\mathbf{f}_{3 ext{ptr}} = rac{3\cdot F_{ ext{f}}\cdot L}{2\cdot B\cdot \left(ext{T}^2
ight)}$





Tensile Strength of Concrete 🗗

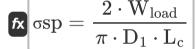
18) Maximum Load Applied during Splitting Tensile Strength of Concrete



Open Calculator 🚰

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

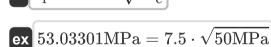
19) Splitting Tensile Strength of Concrete



Open Calculator 🗗

 $extbf{ex} 38.19719 ext{N}/ ext{m}^2 = rac{2\cdot 3.6 ext{kN}}{\pi\cdot 5 ext{m}\cdot 12 ext{m}}$

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

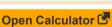


Open Calculator 🗗

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

20) Tensile Strength of Concrete in Combined Stress Design

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



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





Variables Used

- B Width of Section (Millimeter)
- C Mass Of Cement (Kilogram)
- CW Water Cement Ratio
- D₁ 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)
- fck 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)
- Wc Weight of Cementitious Materials (Kilogram)
- W_I Weight of Material (Kilogram)
- W_{load} Maximum Load Applied (Kilonewton)
- W_m Weight of Mixing Water (Kilogram)
- Wo Volume of Mixing Water (Milliliter)
- **P**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 (m³), Milliliter (mL), Cubic Millimeter (mm³)
 - 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/m³), Gram per Milliliter (g/mL)
 Density 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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