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Analysis of Prestressing and Bending Stresses Formulas

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List of 18 Analysis of Prestressing and Bending Stresses Formulas

Analysis of Prestressing and Bending Stresses

Analysis of Behaviour

1) Strain Difference in Prestressed Tendons given Strain in Concrete at level of Steel

Open Calculator

fx $\Delta\varepsilon_p = \left(\varepsilon_p - \varepsilon_c\right)$

ex $0.02 = (1.71 - 1.69)$

2) Strain Difference in Tendons at any Loading Stage

Open Calculator

fx $\Delta\varepsilon_p = \varepsilon_{pe} - \varepsilon_{ce}$

ex $0.02 = 0.05 - 0.03$

3) Strain in Concrete at Level of Steel

Open Calculator

fx $\varepsilon_c = \varepsilon_p - \Delta\varepsilon_p$

ex $1.69 = 1.71 - 0.02$

4) Strain in Prestressed Tendons

Open Calculator

fx $\varepsilon_p = \varepsilon_c + \Delta\varepsilon_p$

ex $1.71 = 1.69 + 0.02$

Analysis of Ultimate Strength

5) Area of Prestressing Tendon for Known Tensile Strength of Section

Open Calculator

fx $$As = \frac{P_{uR}}{0.87 \cdot F_{pkf}}$$

ex $$20.08032mm^2 = \frac{4.35kN}{0.87 \cdot 249MPa}$$

6) Characteristic Tensile Strength of Prestressing Tendons for Known Tensile Strength of Section

Open Calculator

fx $$F_{pkf} = \frac{P_{uR}}{0.87 \cdot As}$$

ex $$247.5248MPa = \frac{4.35kN}{0.87 \cdot 20.2mm^2}$$

7) Ultimate Tensile Force in Absence of Non-Prestressed Reinforcement

Open Calculator

fx $$P_{uR} = 0.87 \cdot F_{pkf} \cdot As$$

ex $$4.375926kN = 0.87 \cdot 249MPa \cdot 20.2mm^2$$

8) Ultimate Tensile Strength of Section in Presence of Non-Prestressing Reinforcement

Open Calculator

fx $$P_{uR} = 0.87 \cdot F_{pkf} \cdot As + (0.87 \cdot f_y \cdot A_s)$$

ex $$113.1259kN = 0.87 \cdot 249MPa \cdot 20.2mm^2 + (0.87 \cdot 250MPa \cdot 500mm^2)$$

At Service Load

9) Strain in Concrete due to Effective Prestress

Open Calculator

fx $$\varepsilon_{ce} = \varepsilon_{pe} - \Delta\varepsilon_p$$

ex $$0.03 = 0.05 - 0.02$$

10) Strain in Tendons due to Effective Prestress

Open Calculator

fx $\varepsilon_{pe} = \Delta\varepsilon_{p} + \varepsilon_{ce}$

ex $0.05 = 0.02 + 0.03$

11) Stress in Concrete Member with Non-Prestressing Steel at Service Load Having Compressive Axial Load

Open Calculator

fx $$f_{concrete} = \left(\frac{P_e}{A_T + \left(\frac{E_s}{E_{concrete}}\right)\cdot A_s}\right) + \left(\frac{P}{A_t}\right)$$

ex $$2.222172\text{MPa} = \left(\frac{20\text{kN}}{1000\text{mm}^2 + \left(\frac{210000\text{MPa}}{100\text{MPa}}\right)\cdot 500\text{mm}^2}\right) + \left(\frac{10\text{N}}{4500.14\text{mm}^2}\right)$$

At Transfer

12) Area of Concrete for Known Stress in Concrete without Non-Prestressed Reinforcement

Open Calculator

fx $$A_T = \left(\frac{P_o}{f_{concrete}}\right)$$

ex $$6024.096\text{mm}^2 = \left(\frac{100\text{kN}}{16.6\text{MPa}}\right)$$

13) Area of Non-Prestressed Reinforcement given Stress in Concrete

Open Calculator

fx $$A_s = \left(\left(\frac{P_o}{f_{concrete}}\right) + A_T\right)\cdot\left(\frac{E_{concrete}}{E_s}\right)$$

ex $$0.476193\text{mm}^2 = \left(\left(\frac{100\text{kN}}{16.6\text{MPa}}\right) + 1000\text{mm}^2\right)\cdot\left(\frac{100\text{MPa}}{210000\text{MPa}}\right)$$

14) Stress in Concrete in Member without Non-Prestressed Reinforcement

Open Calculator

fx $$f_{concrete} = \left(\frac{P_o}{A_T}\right)$$

ex $$100MPa = \left(\frac{100kN}{1000mm^2}\right)$$

Geometrics Properties

15) Area of Concrete about Non-Prestressed Reinforcements and Transformed Section

Open Calculator

fx $$A_T = A_t - \left(\frac{E_s}{E_c}\right) \cdot A_s - \left(\frac{E_P}{E_c}\right) \cdot As$$

ex $$999.9986mm^2 = 4500.14mm^2 - \left(\frac{210000MPa}{30000MPa}\right) \cdot 500mm^2 - \left(\frac{210MPa}{30000MPa}\right) \cdot 20.2mm^2$$

16) Area of Non-Prestressed Reinforcement in Partially Prestressed Members

Open Calculator

fx $$A_s = \left(A_t - A_T - \left(\frac{E_P}{E_c}\right) \cdot As\right) \cdot \left(\frac{E_c}{E_s}\right)$$

ex $$499.9998mm^2 = \left(4500.14mm^2 - 1000mm^2 - \left(\frac{210MPa}{30000MPa}\right) \cdot 20.2mm^2\right) \cdot \left(\frac{30000MPa}{210000MPa}\right)$$

17) Area of Prestressing Tendons about Non-Prestressed Reinforcements and Transformed Section

Open Calculator

fx $$As = \left(A_t - A_T - \left(\frac{E_s}{E_c}\right) \cdot A_s\right) \cdot \left(\frac{E_c}{E_P}\right)$$

ex $$20mm^2 = \left(4500.14mm^2 - 1000mm^2 - \left(\frac{210000MPa}{30000MPa}\right) \cdot 500mm^2\right) \cdot \left(\frac{30000MPa}{210MPa}\right)$$

18) Transformed Area of Partially Prestressed Members

Open Calculator

fx $$A_t = A_T + \left(\frac{E_s}{E_c}\right) \cdot A_s + \left(\frac{E_P}{E_c}\right) \cdot As$$

ex $$4500.141\text{mm}^2 = 1000\text{mm}^2 + \left(\frac{210000\text{MPa}}{30000\text{MPa}}\right) \cdot 500\text{mm}^2 + \left(\frac{210\text{MPa}}{30000\text{MPa}}\right) \cdot 20.2\text{mm}^2$$

Variables Used

- A_s Area of Reinforcement *(Square Millimeter)*
- A_t Transformed Area of Prestressed Member *(Square Millimeter)*
- A_T Transformed Area of Concrete *(Square Millimeter)*
- **As** Area of Prestressing Steel *(Square Millimeter)*
- E_c Modulus of Elasticity of Concrete *(Megapascal)*
- $E_{concrete}$ Modulus of Elasticity Concrete *(Megapascal)*
- E_P Modulus of Elasticity of Prestressing Steel *(Megapascal)*
- E_s Modulus of Elasticity of Steel *(Megapascal)*
- $f_{concrete}$ Stress in Concrete Section *(Megapascal)*
- F_{pkf} Tensile Strength of Prestressed Steel *(Megapascal)*
- f_y Yield Strength of Steel *(Megapascal)*
- **P** Axial Force *(Newton)*
- P_e Effective Prestress *(Kilonewton)*
- P_o Prestress at Transfer *(Kilonewton)*
- P_{uR} Tensile Force *(Kilonewton)*
- $\Delta\varepsilon_p$ Strain Difference
- ε_c Strain in Concrete
- ε_{ce} Concrete Strain
- ε_p Strain in Prestress Steel
- ε_{pe} Strain in Tendon

Constants, Functions, Measurements used

- 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: **Stress** in Megapascal (MPa)
  Stress Unit Conversion

Check other formula lists

- **Analysis of Prestressing and Bending Stresses Formulas**
- **Crack Width and Deflection of Prestress Concrete Members Formulas**
- **General Principles of Prestressed Concrete Formulas**
- **Transmission of Prestress Formulas**

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