DESIGN OF GRADE SLABS FOR DISTRIBUTED LOADS

Input Data

Concrete cube compressive stress $f_{cu} := 30\ MPa$

Concrete cylinder compressive stress $f_{ck} := f_{cu} \cdot 0.8 = 24\ MPa$

Mean Axial Tensile Strength $f_{ctm} := 0.3 \cdot \left(0.8 \cdot \dfrac{f_{cu}}{MPa}\right)^{\frac{2}{3}} MPa = 2.496\ MPa$

Charecteristic Axial tensile strength $f_{ctk0.05} := 0.7 \cdot f_{ctm} = 1.747\ MPa$

Mean value of concrete cylinder strength $f_{cm} := f_{ck} + 8 \cdot MPa = 32\ MPa$

Secant Modulus of concrete $E_{cm} := 22 \cdot \left(\dfrac{(f_{cm})}{10\ MPa}\right)^{0.3} \cdot 1000\ MPa = 31186.574\ MPa$

Partial factor for concrete $\gamma_C := 1.5$

Poissons Coeffecient $\mu := 0.20$

Coeffecient of thermal expansion $\alpha := \dfrac{1}{10^{-5}\ °C}$

Steel fibre charecteristics

Bekaert's Dramix 3D fibre has been used in the calculations

Fibre dosage $D_f := 12\ \dfrac{kg}{m^3}$

$R_{e3} := 0.3$

Sub base charecterisitics

The sub base constant should be obtained from plate load test. In this case the

Modulus of subgrade $k := 0.06\ \dfrac{N}{mm^3}$

Loading

Distributed load on the floor $w := 100\ \dfrac{kN}{m^2}$

Load and material factors

Partial factor for variable action $\gamma_Q := 1.2$

Partial factor for concrete $\gamma_M := 1.5$

Partial factor for steel $\gamma_S := 1.15$

Geometry

Slab length $L := 5000\ mm$

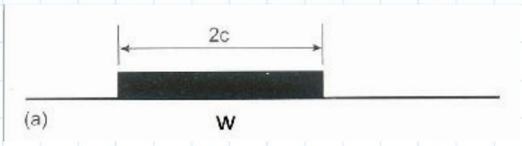
Slab width $B := 5000\ mm$

Trial thickness $h := 350\ mm$

Design

Acting bending moments

Thickness checks are carried out as per Hetenyi's equation



$$\lambda := \sqrt[4]{\frac{3 \cdot k}{E_{cm} \cdot h^3}} \cdot mm = 6.057 \cdot 10^{-4}$$

$$\lambda \cdot \frac{m}{m} \cdot c = \left(1.816 \cdot 10^5\right) \frac{1}{s} \cdot m$$

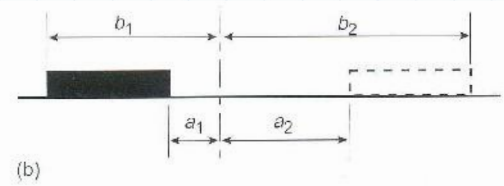
$$c := 0.5 \cdot L = 2.5\ m$$

Positive moment $M_p := \frac{w}{2 \cdot \lambda^2} \left(e^{-\lambda \cdot c} \cdot \sin(\lambda \cdot c \cdot deg)\right) \cdot m = ?\ kN \cdot m$ per unit width

Check for maximum possible moment

$M_{pmax} := \frac{0.161 \cdot w}{\lambda^2} \cdot m = \left(4.388 \cdot 10^7\right) \frac{1}{m^2} \cdot kN \cdot m$ per unit width

$2\ c = 5\ m$



Calculation of Mean flexural tensile strength of concrete

$$f_{ctmfl1} := \left(1.6 - \frac{h}{1000 \cdot mm}\right) \cdot f_{ctm} = 3.12\ MPa$$

$$f_{ctmfl2} := f_{ctm} = 2.496\ MPa$$

$$status := \begin{cases} \text{if } f_{ctmfl1} \geq f_{ctmfl2} \\ \quad f_{ctmfl} \\ \text{else} \\ \quad \text{"FAIL"} \end{cases} = ?$$

Charecteristic flexural strength of plain concrete

$$f_{ctkfl} := \left[1 + \sqrt{\frac{200}{h} \cdot mm}\right] \cdot f_{ctk0.05} = [3.068]\ MPa$$

Negative moment capacity $M_n := \frac{f_{ctmfl1}}{\gamma_C} \left(\frac{h^2}{6}\right) \cdot m = 42.468\ kN \cdot m$

The maximum moment is negative and is induced by the arrangement of loading shown above. The equivalent distributed load for the moment capacity is

$$w_{cap} := \frac{1}{0.168 \cdot m} \cdot \lambda^2 \cdot M_n = \left(9.275 \cdot 10^{-5}\right)\ m^2 \cdot \frac{kN}{m^2}$$

The capacity of the slab is greater than the applied load on the slab of 100 kN/sq.m. Hence the design is safe.