ONE-WAY SLABS

This Calcolations uses to the design of nonprestressed solid One-way slabs reinforced for flexture in one direction. Calculations are based on ACI-318 2019.

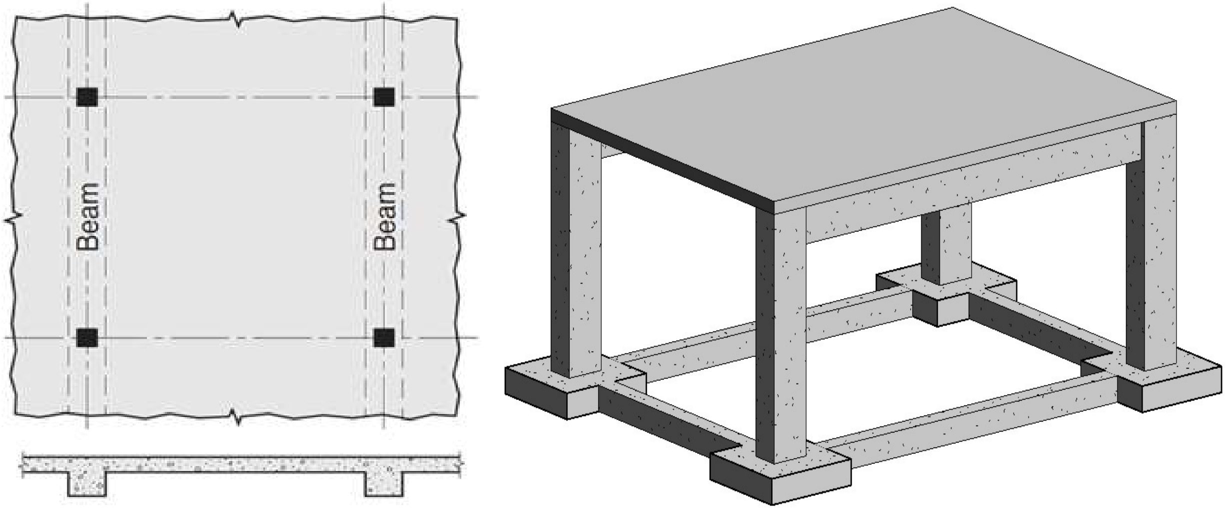

Figure 1-General Geometry

1.Geometry :

Suport Length =	7		
Other Length =	5	→	One-way Slab
2-Edge Suported			

2.Loading :

assume thickness =	150	mm	≡	5.91	in
DL =	360	kg/m^2	≡	73.7	psf
SDL =	200	kg/m^2	≡	41.0	psf
LL =	200	kg/m^2	≡	41.0	psf

Loading Combinations :

ACIB01 : 1.4D

ACIB02 : 1.2D+1.6L

3.Material Properties :

Specification of reinforced concrete materials :

Concrete :

Normal Weight → λ = 1.00

Weight per Unit Volume :	W = 23.54	KN/m^3			
	W = 149.83	lb/ft^3	≡	2400	kg/m^3
Mass per Unit Volume :	M = 15.278	lb/ft^3	≡	245	kg/m^3
Poisson's Ratio :	U = 0.15	-			
Coefficient of Thermal Expansion :	A = 9.90E-06	1/C°			
Compressive strength of concrete:	f'_c = 25	Mpa			
	f'_c = 3625.92	psi	≡	254.93	kgf/cm^2

Modulus of Elasticity :

$$E_c = 0.043\omega_C^{1.5}\sqrt{f'_c}$$ →

E_c = 25278.73	Mpa	≡	257771.4	kgf/cm^2
E_c = 3644254.48	psi			

$$E_c = 4700\sqrt{f'_c}$$ →

E_c = 23500.0	Mpa	≡	239633.3	kgf/cm^2
E_c = 3432290.384	psi			

19-2-1 ~19.2.4.3

Rebars :
Rebar Specifications :

Modulus of Elasticity :		E_s = 200000	Mpa
Category of Longitudinal Rebars:	S420	⟶	Grade 280
Minimum Tensile Stress		f_u = 600	Mpa
Minimum Yield Stress		f_y = 420	Mpa
Category of Transverse Rebars:	S340	⟶	-
Minimum Tensile Stress		f_u = 500	Mpa
Minimum Yield Stress		f_y = 340	Mpa

20.2 - ASTM A370

4.Analysis Results :

The FEM analysis of the slab has been done and the results are as follows.

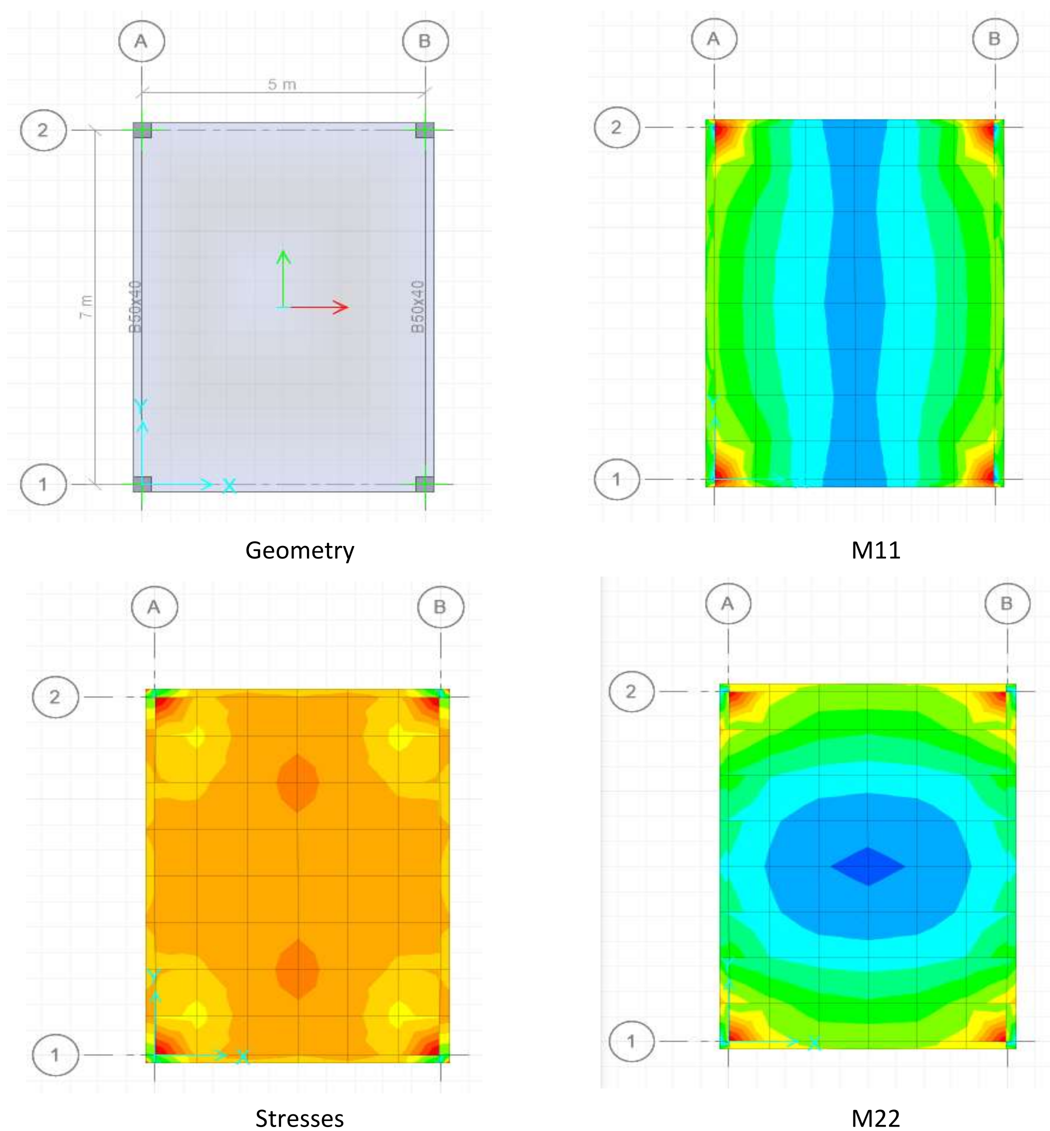

Figure 2-FEM Analysis

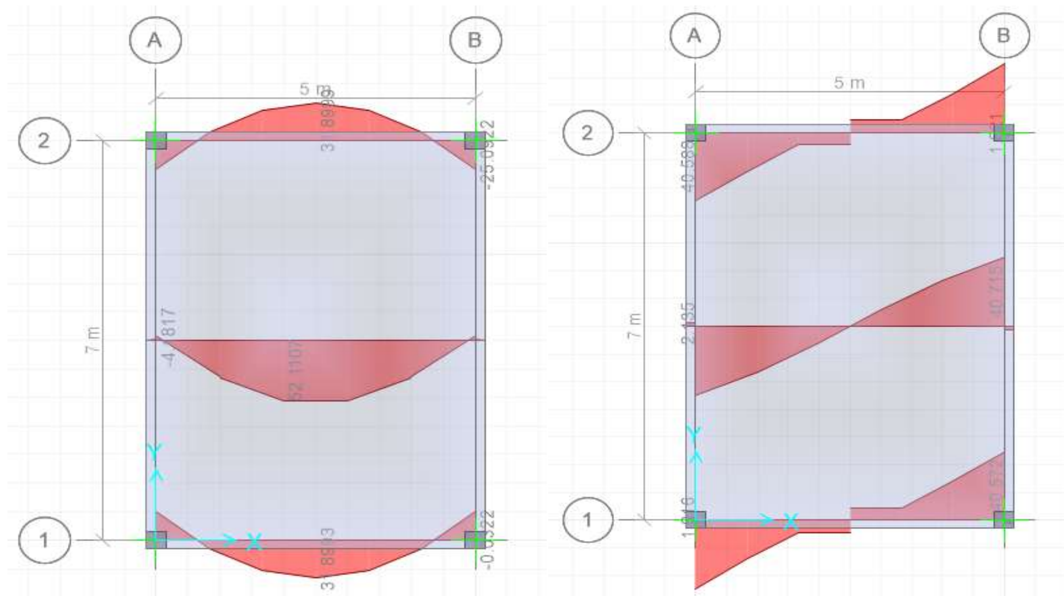

Figure 3-Slab Internal Forces

5.Reinforcement detailing

Provisions for durability of steel reinforcement

Specified concrete cover requirements

7.7.1.1. , 20.5.1.3

Table 20.5.1.3.1—Specified concrete cover for cast-in-place nonprestressed concrete members

Concrete exposure	Member	Reinforcement	Specified cover, in.
Cast against and permanently in contact with ground	All	All	3
Exposed to weather or in contact with ground	All	No. 6 through No. 18 bars	2
		No. 5 bar, W31 or D31 wire, and smaller	1-1/2
Not exposed to weather or in contact with ground	Slabs, joists, and walls	No. 14 and No. 18 bars	1-1/2
		No. 11 bar and smaller	3/4
	Beams, columns, pedestals, and tension ties	Primary reinforcement, stirrups, ties, spirals, and hoops	1-1/2

Concrete exposure : Not exposed to weather or in contact with ground

Slabs, joints and walls

Rebar Size : Ø10

Cover = 0.75 in ≡ 19.05 mm ≈ 20 mm

6.Flexural Design :

d = 130 mm M_u = 52.11 KN.m

$$m = \frac{f_y}{0.85f'_c} \longrightarrow m_\Phi = 19.76$$

$$R_r = \frac{M_r}{\emptyset bd^2} \longrightarrow R_r = 3.43 \text{ N/mm}^2 \quad 496.9 \text{ psi}$$

$$\rho = \frac{1}{m}\left\{1 - \sqrt{1 - \frac{2mR_r}{f_y}}\right\} \longrightarrow \rho = 0.0089$$

$A_s = \rho bd$	→	A_s = 1163.3	mm^2	Ξ	1.80	in^2
$A_{s,min} = 0.0018bd$	→	$A_{s,min}$ = 234.0	mm^2	Ξ	0.36	in^2
	→	S = 350	mm	Ξ	13.8	in
$S_{max} = min\{2h, 18in\}$	→	S_{max} = 300	mm	Ξ	11.8	in

USE Ø10 @ 300

$a = \frac{A_s f_y}{\beta_1 f'_c b}$	→	a = 22.99	mm	Ξ	0.91	in
$c = \frac{a}{\beta_1}$	→	c = 27.05	mm	Ξ	1.06	in

$$\varepsilon_s = \varepsilon_t = \varepsilon_{cu}\left(\frac{d_t - c}{c}\right) \longrightarrow \varepsilon_t = 0.0133$$

$$\begin{cases} if:\ \varepsilon_t \le 0.002 \rightarrow \begin{cases} if: spiral \rightarrow \emptyset = 0.7 \\ if: tie \rightarrow \emptyset = 0.65 \end{cases} \\ if: 0.002 \le \varepsilon_t \le 0.005 \rightarrow \begin{cases} if: spiral \rightarrow \emptyset = 0.567 + 66.7\varepsilon_t \\ if: tie \rightarrow \emptyset = 0.483 + 83.3\varepsilon_t \end{cases} \\ if:\ \varepsilon_t \ge 0.005 \rightarrow \emptyset = 0.9 \end{cases} \longrightarrow \emptyset = 0.900$$

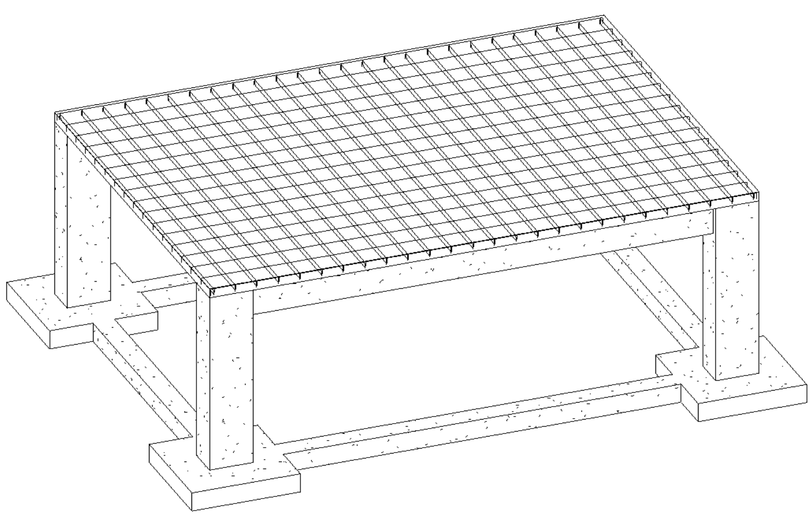

Figure 4-Slab Main and Temperature Reinforcement

22-3

7.Shear Design :

h = 150 mm b = 1000 mm
d = 130 mm V_u = 41 KN

$$V_c = 0.17\lambda\sqrt{f'_c}b_w d \quad \rightarrow \quad V_c = 110.5 \text{ KN}$$

$$\sqrt{f'_c} \le 8.3\ MPa \longrightarrow \sqrt{f'_c} = 5.0 \longrightarrow \text{OK}$$

Ø = 0.6

$$V_u \le \emptyset\left(V_c + 0.066\sqrt{f'_c}b_w d\right) \quad \rightarrow \quad \text{OK}$$

$$\begin{cases} IF:\ V_u < \emptyset V_c \ \rightarrow N.N. \\ IF:\ V_u \ge \emptyset V_c \ \rightarrow \text{transverse reinforcement shall be provided} \end{cases}$$

$\emptyset V_c =$ 66.3 KN

⟶ Vu < ØVc , Shear Reinforcement is not needed

$$V_s \ge \frac{V_u}{\emptyset} - V_c \longrightarrow V_s = -$$

$$V_s = \frac{A_v f_{yt} d}{s} \longrightarrow \frac{A_v}{s} = -$$

Use : 10 @ 100

$$\frac{A_v}{s}\ - \longrightarrow V_s = - \text{ N}$$

$$V_n = V_c + V_s \longrightarrow V_n = 110.5 \text{ N}$$

$$V_r = \emptyset V_n \longrightarrow V_r = 66.3 \text{ N}$$

DCR = 0.615

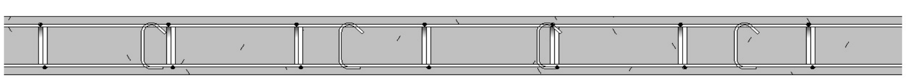

Figure 5-Slab Shear Reinforcement

22.5