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ProtaStructure Design Guide

RC Slab Deflection Checks to TS500

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Notations

f_{ck}	Characteristic Compressive Strength
f_{ctk}	Characteristic Tensile Strength
f_{ctd}	Design Tensile Strength
f_{yd}	Design yield strength of longitudinal reinforcement
f_{yk}	Characteristic yield strength of longitudinal reinforcement
d	Effective depth in case of flexural members
$d^{'}$	Concrete cover measured from the centroid of compression reinforcement
h	Section Height
b	Flange Dimensions
b_w	Section Width
h_t	Flange Thickness
l_n	Clear Span
γ_{mc}	The material factor for concrete
γ_t	The factor for permanent load
E_s	Modüls of elasticity of reinforcement
E_c	Modüls of elasticity of concrete
A_{stop}	The cross-sectional area of the top reinforcement
$A_{sbottom}$	The cross-sectional area of the bottom reinforcement
y_{top}	Distance of section center of gravity to the top of the section
y_{bottom}	Distance of section center of gravity to the bottom of the section
I_c	Gross moment of inertia
I_{cr}	Cracked moment of inertia about the neutral axis
I_{ef}	Effective moment of inertia
M_{cr}	Cracking moment of the member under bending
M_{max}	Maximum bending moment of member
n	Number of tension bars
y	Distance between extreme tension fiber and neutral axis
δ_{ig}	Instantaneous deflection due to permanent loads
δ_i	Instantaneous deflection
δ_t	Total Deflection

λ	Permanent deflection multiplier
ρ'	The ratio of compression reinforcement in beams

Reinforced Concrete Slab Deflection Design

In slab deflection design, deflection calculation requirement control is controlled according to the clear span of the slab. A 1-meter-long rectangular section is considered in the calculations.

A simplified slab block is used in the example, explained in the relevant sections. The calculations are done based on the **TS500** regulations.

Deflection is checked along the RC beam. Details of the calculations are described below.

Amount of Reinforcement Used in Calculations

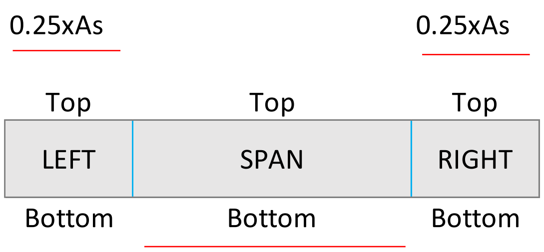
Deflection Design

$f_{ctk} = 0.35\sqrt{f_{ck}}$	TS500, Subs. 3.3 – Equ. 3.1
$f_{ctd} = \dfrac{f_{ctk}}{\gamma_{mc}}$	TS500, Subs. 6.2.5 – Equ. 6.2
$f_{cd} = \dfrac{f_{ck}}{\gamma_{mc}}$	
$E_s = 2E^7 \dfrac{t}{m^2}$	
$E_c = 3250\sqrt{fck} + 14000\ Mpa$	TS500, Subs. 3.3 – Equ. 3.2
$A_{s_{top}}, A_{s_{bottom}} = Total\ Reinforcement \times Reinforcement\ Area$	

The reinforcement ratio of cantilevers and two-way slabs is used in the calculations.

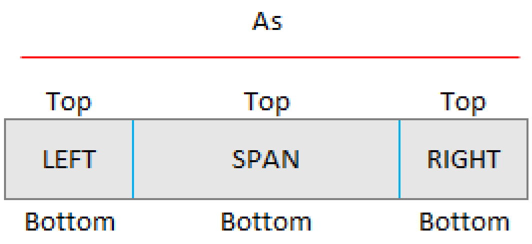
Two-way slabs;

- 25% of the upper right and left support reinforcement and 50% of the span bottom reinforcement shall be used as the total reinforcement area in the calculations.



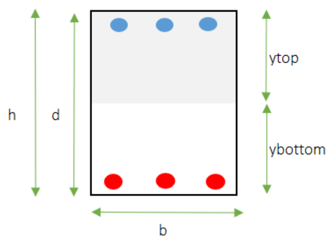
Cantilever Slabs;

- Since only the top reinforcement will work as the reinforcement area in the cantilever slabs, only the top reinforcement is used as the reinforcement area in the calculations.



For each region mentioned above, the maximum bending moment along the entire length of the region, $'M_{max}'$, is determined for the load cases, G and G+Q.
The moment of inertia, I_c , is calculated for a rectangular or flanged section. This moment of inertia is calculated according to the section center of gravity. The center of gravity of the section is denoted by y_{bottom} and y_{top} . The value is calculated as follows.

Rectangular Section Deflection Check



ProtaStructure applies the following steps for the bending design of rectangular sections:

Immediate Deflection

1.	$y_{top} = \frac{h}{2}$
2.	$y_{bottom} = h - y_{top}$
3.	$I_c = \frac{b_w h^3}{12} \quad (for\ one\ meter)$
4.	$I_{ef} = (\frac{M_{cr}}{M_{max}})^3 I_c + (1 - (\frac{M_{cr}}{M_{max}})^3) I_{cr}$
5.	$I_{cr} = \frac{b_w c^3}{3} + (n-1) As_{bottom} (c - d')^2 + n As_{top} (d - c)^2$

6.	$M_{cr} = 2{,}5\, f_{ctd}\dfrac{I_c}{y}$
7.	$I_{cr-span} = \dfrac{b_w c^3}{3} + (n-1)As_{top}(c-d')^2 + nAs_{bottom}(d-c)^2$
8.	$I_{cr-support} = \dfrac{b_w c^3}{3} + (n-1)As_{bottom}(c-d')^2 + nAs_{top}(d-c)^2$
9.	$n = \dfrac{E_s}{E_c}$
10.	$a = 0.5\, b_w(span) \quad a = 0.5\, b_w\, (support)$
11.	$b_1 = nAs_{top} + n\, As_{bottom} - As_{top}\, (span)$
12.	$b_1 = nAs_{bottom} + n\, As_{top} - As_{bottom}\, (support)$
13.	$c_1 = -nAs_{bottom}d - n\, As_{top}d' + As_{top}d'(span)$
14.	$c_1 = -nAs_{top}d - n\, As_{bottom}d' + As_{bottom}d'(support)$
15.	$\Delta = {b_1}^2 - 4ac_1 \quad when\ \Delta > 0\ \ x_1\ and\ x_2\ \ calculated. Positive\ value\ is\ considered\ as\ 'c'.$
16.	$x_{1,2} = c = \dfrac{-b_1 \pm \sqrt{\Delta}}{2a}$

Case 1: $\boldsymbol{M_{max} \leq M_{cr}}$

Moment of inertia, I_c, is used in the deflection calculation. It is assumed that no cracking occurs in the beam. The value M_{max} describes the bending moment automatically obtained from the analysis.

Case 2: $\boldsymbol{M_{max} > M_{cr}}$

Effective inertia moment, I_{ef}, is used in the beam deflection check. It is assumed that cracking has occurred in the beam. The value M_{max} describes the bending moment automatically obtained from the analysis.

Case 3: **Cantilever Slabs**

$I_{efsupport} = I_{ef}$ is considered.

Long-Term Deflection

Long-term deflection is calculated by considering the formula below.

$$\delta_t = \delta_i + \delta_{ig}\lambda$$

$$\lambda = \frac{\gamma_t}{1 + 50\rho'}$$

Immediate Deflection Calculation

The immediate deflection calculation is made by considering the formula below in two-way slabs.

$$\delta_{iQ} = \frac{5ln^2}{48E_c I_c} \left(M_{span} - 0.1\left(M_{left} + M_{right}\right)\right)$$

The immediate deflection calculation is made by considering the formula below in cantilever slabs.

$$\delta_{iQ} = \frac{M_{max}\, ln^2}{4\, E_c\, I_c}$$

Permanent Load Duration Coefficient

The time coefficient, γ_t, is obtained from TS500 Table 13.

Loading Duration	Duration Coefficient γ_t
5 years or more	2.0
12 months	1.4
6 months	1.2
3 months	1.0

Table 1: Permanent Load Duration Coefficient Table (TS500 Table 13.2)

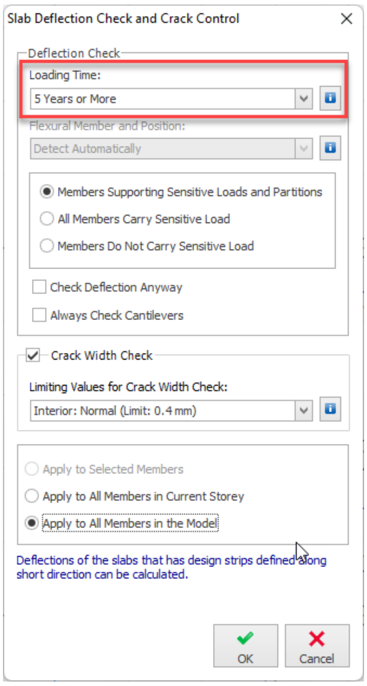


Figure 1: ProtaStructure Slab Deflection Check UI – Loading Time Selection

Deflection Limits

Allowable deflection limits in bending elements are given in Table 13.3, depending on the free span. ProtaStructure will issue a warning when the calculated deflections do not satisfy these limits.

Flexural Member and Location	Cause of Deflection	Span/Deflection
Roof member with no partition walls	Instantaneous deflection due to live load	ln / 180
Floor member with no partition walls	Instantaneous deflection due to live load	ln / 360
Roof or floor member with partition walls(Carrying Members that may be affected by large deflections)	The sum of deflection due to permanent load and deflection due to the remainder of the live load	ln / 480
Roof or floor member with partition walls		ln / 240

Table 2: Deflection Limits Table

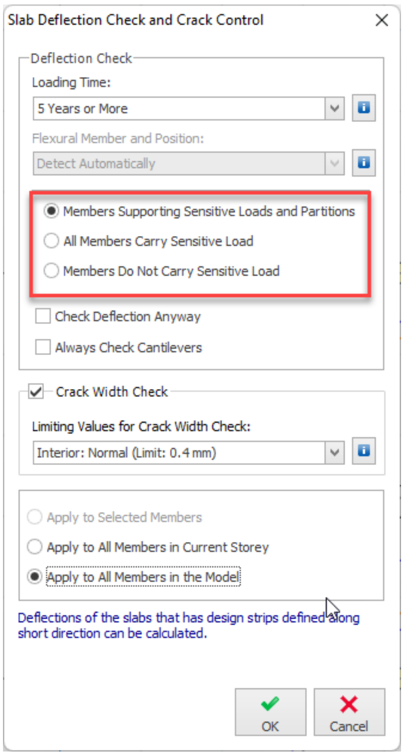


Figure 2: Program Slab Deflection Control Selection Table -Flexural Member and Position

The location of the slab element is determined according to the floor number that appears in the "**Building / Storey Operations/ Edit Storey / Effective Top Storey No**" field in ProtaStructure. The floor number in the "**Effective Top Storey No**" field is automatically accepted as the attic. Other stories will be considered regular stories. The algorithm for using this table by the program is as follows.

Members Supporting Sensitive Loads and Partitions:

If this option is checked, the member is considered in the 3rd category in Table 2, and the limit value is calculated by Ln/480. G+Q is taken into account in the total deflection calculation.

All Members Carry Sensitive Load:

If this option is checked, the member is considered in the 3rd category in Table 2, and the limit value is calculated by Ln/480. G+Q is taken into account in the total deflection calculation.

Members Do Not Carry Sensitive Load:

- Suppose there is a partition wall on the slab. In that case, the beam is considered in the 4th category in Table 2. The limit value is calculated by Ln/240, and G+Q is considered in the total deflection calculation.
- If no partition wall is on the slab and the slab is located on the effective top floor, it is considered in the 1st category in Table 2. The limiting deflection is calculated by Ln/180. Q is taken into account in the total deflection calculation.
- If no partition wall is on the slab and the slab is located on a regular storey, it is considered in the 2nd category in Table 2. The limiting deflection is calculated by Ln/360. Q is taken into account in the total deflection calculation.

Members that Don't Require Deflection Calculations

According to TS500 Article 13.2.1, it is not necessary to perform a detailed deflection check if the Height to Span ratio satisfies the limiting values in Table 13.1. The members in question should not also be carrying deflection-sensitive elements. If you still want to perform the deflection checks for these members, check the UI option **'Check Even if Deflection Calculation Does Not Require'**. Additionally, when you check the option "**Always Check Cantilever Members**" for checking the deflection of cantilever members even if they don't require a check. The program automatically determines span types.

Member	Simple Support	Exterior Span	Interior Span	Cantilever
One-way Slab	1/20	1/25	1/30	1/10
Two-way Slab(Short Span)	1/25	1/30	1/35	-
Joist Slab	1/15	1/18	1/20	1/8
Beam	1/10	1/12	1/15	1/5

Table 3: Depth/Span ratios for flexural members for which deflection calculations are not necessary

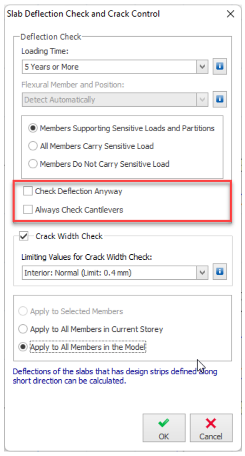


Figure 3: Slab Deflection Control Selection Table - Depth/Span ratios for flexural members for which deflection calculations are not necessary

Example

Example 1: Two-way Slabs

This example will examine the deflection calculation of slab D101 with the following rectangular section properties spanning 475 cm. The following tables show the load on the slab.

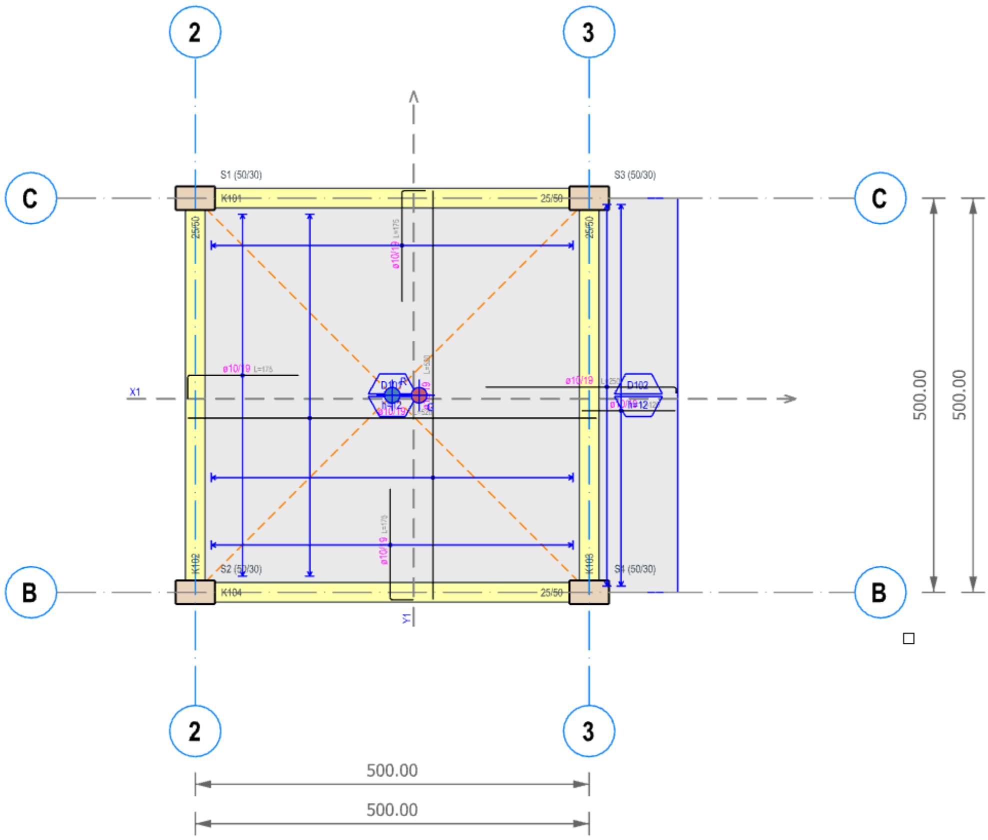


Figure 4: Building plan view

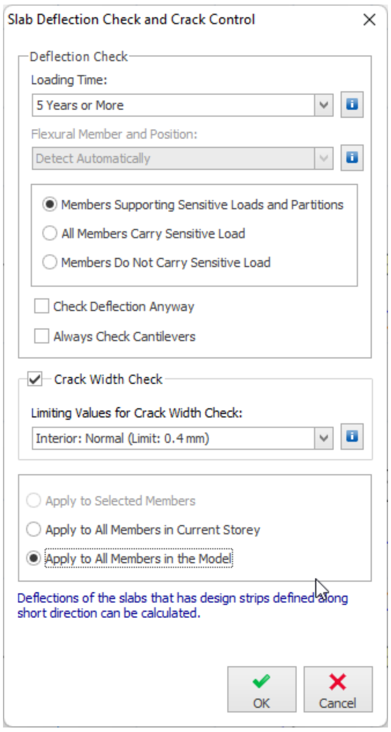
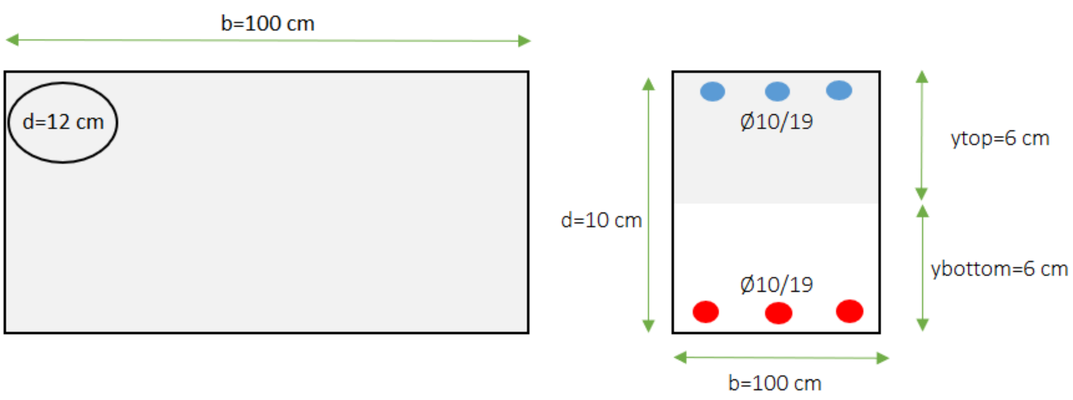


Figure 5:Slab Deflection Check and Crack Control Parameters

Member	G(t/m^2)	Q(t/m^2)
D101	0.238	0.2
D102	0.238	0.5

Parameters	Value (mm)	Parameters	Value (MPa)
$\boldsymbol{b}$	1000	$f_c{}'$	25
$\boldsymbol{h}$	120	f_y	420
$\boldsymbol{d}$	10	f_{yt}	240
$\boldsymbol{d}'$	2	E_s	200000



Deflection Calculation Requirement Check

1.	Flexural Member Type: Two-way Slab
2.	Span Type: Simple Support
3.	$\frac{Clear\ Span}{Height} = \frac{475}{12} = 39.6$
4.	$39.6 > 35\ \ deflection\ calculation\ is\ required..$

Immediate Deflection Calculation

1.	$y_{top} = \frac{12}{2} = 6\ cm$
2.	$y_{bottom} = 12 - 6 = 6\ cm$
3.	$I_c = \frac{100 \times 12^3}{12} = 14400\ cm^4 = 0.000144\ m^4$
5.	$\mathrm{M}_{cr-span} = 2{,}5\ \times 116.67 \times \frac{0.000144}{0.06} = 0.7\ \ tm$
6.	$\mathrm{M}_{cr-support} = 2{,}5\ \times 116.67 \times \frac{0.000144}{0.06} = 0.7\ \ tm$
7.	$M_{max} \leq M_{cr}$ or $M_{max} > M_{cr}$ $control\ is\ shown\ in\ Figure\ 7.$
8.	$M_{max} \leq M_{cr}\ \ should\ be\ used\ in\ calculations\ since\ it\ is\ on\ right\ and\ left\ support.$
9.	$M_{max} > M_{cr}\ \ Since\ it\ is\ span, I_{ef}\ \ should\ be\ used\ in\ calculations.$
10.	$n = \frac{20000000}{3025000} = 6.6$
11.	$As_{top-support} = \frac{1000}{190} \times \frac{\pi \times 10^2}{4} = 413\ mm^2 = 4.13\ cm^2$
12.	$As_{bottom-support} = \frac{1000}{190} \times \frac{\pi \times 10^2}{4} = 413\ mm^2 = 4.13\ cm^2$
13.	$As_{top-span} = 0.0$
14.	$As_{bottom-span} = \frac{1000}{190} \times \frac{\pi \times 10^2}{4} = 413\ mm^2 = 4.13\ cm^2$

The M_{max} is automatically calculated by the program. Calculated values are automatically written to the report.

Case	Left Support (t.m)	Right Support (t.m)	Span (t.m)
G (Mmax)	0	0.703	0.53
G+Q (Mmax)	0	0.97	0.73
Mcr	0.7	0.7	0.7

Figure 6: G and G+Q Load Case M_{max} and M_{cr} Values

Case	Left Support (t.m)	Craking Control	Right Support(t.m)	Craking Control	Span(t.m)	Craking Control
G (Mmax)	0<0.7	No	0.703>0.7	Yes	0.53<0.7	No
G+Q (Mmax)	0<0.7	No	0.97>0.7	Yes	0.73<0.7	Yes

Figure 7: G and G+Q Load Case Cracking Control

Since the cracking is in the right and left support and lower opening regions, the Δ value required in cracked inertia for these sections is calculated as follows.

1. $n = \frac{20000000}{3025000} = 6.6$
2. $a = 0.5 \times 100 = 50$
3. $b = 6.6 \times 4.13 + 6.6 \times 4.13 - 4.13 = 50.52$
4. $c = -6.61 \times 4.13 \times 10 - 6.61 \times 4.13 \times 2 + 4.13 \times 2 = -319.69$
5. $\Delta = 50.52^2 - 4 \times 50 \times -319.69 = 66491.64 \quad \Delta > 0 \ when\ x_1\ and\ x_2\ are\ calculated. Positive\ value\ is\ considered\ as\ 'c'.$
6. $x_{1,2} = c = \frac{-50.52 \pm \sqrt{66491.64}}{2 \times 50} = 0.00002733$

Moment of inertia values for the section are calculated in the section below.

	Left Support	*Right Support*	*Span*
Uncracked Section Inertia (G) m^4	$\frac{\frac{100 \times 12^3}{12}}{100000000} = 0.000144$	$\frac{\frac{100 \times 12^3}{12}}{100000000} = 0.000144$	$\frac{\frac{100 \times 12^3}{12}}{100000000} = 0.000144$
Uncracked Section Inertia (G+Q)	$\frac{\frac{100 \times 12^3}{12}}{100000000} = 0.000144$	$\frac{\frac{100 \times 12^3}{12}}{100000000} = 0.000144$	$\frac{\frac{100 \times 12^3}{12}}{100000000} = 0.000144$
$\frac{M_{cr}}{M}$ $ratio\ (G)$	$\frac{0.7}{0} = Undefined$	$\frac{0.7}{0.703} = 0.99$	$\frac{0.7}{0.53} = 1.3207$
$\frac{M_{cr}}{M}$ $ratio\ (G+Q)$	$\frac{0.7}{0} = Undefined$	$\frac{0.7}{0.97} = 0.7216$	$\frac{0.7}{0.73} = 0.9589$
Cracking Section Inertia (G)	-	$\frac{\frac{100 \times 2.0733^3}{3} + (6.611 - 1) \times 4.1336 \times (2.073 - 2)^2 + 6.611 \times (10 - 2.07)^2}{100000000}$ $= 0.000020$	-
Cracking Section Inertia (G+Q)	-	$\frac{\frac{100 \times 2.0733^3}{3} + (6.611 - 1) \times 4.1336 \times (2.073 - 2)^2 + 6.611 \times (10 - 2.07)^2}{100000000}$ $= 0.000020$	$\frac{\frac{100 \times 2.0733^3}{3} + (6.611 - 1) \times 0 \times (2.073 - 2)^2 + 6.611 \times (10 - 2.07)^2}{100000000}$ $= 0.000020$
Effective Inertia (G)	*0.000144*	$000144 \times (0.99)^3 + (1 - 0.99)^3 \times 0.000020 = 0.000142$	*0.000144*
Effective Inertia (G+Q)	*0.000144*	$0.000144 \times (0.7216)^3 + (1 - 0.7216)^3 \times 0.000020 = 0.000067$	$0.000144 \times (0.9589)^3 + (1 - 0.9589)^3 \times 0.000020 = 0.000128$

Using the values from the table, the average moment of inertia is calculated using 25% of the support moment of inertia and 50% of the span.

1.	Effective Inertia $G_{ort} = 0.25 \times (0.000144 + 0.000142) + 0.5 \times 0.000144 = 0.000144 m^4$
2.	Effective Inertia $G + Q_{ort} = 0.25 \times (0.000144 + 0.000066) + 0.5 \times 0.000127 = 0.000117\ m^4$
3.	Immediate Deflection $G = \frac{5 \times 4.75^2}{48 \times 3025000 \times 0.000143} \times (0.53 - 0.1 \times 0.703) = 0.0025\ m$
4.	Immediate Deflection $G + Q = \frac{5 \times 4.75^2}{48 \times 3025000 \times 0.000116} \times (0.73 - 0.1 \times 0.97) = 0.0042\ m$
5.	Immediate Deflection $Q = 0.0042 - 0.0025 = 0.0017\ \mathrm{m}$
6.	$Loading\ time\ accepted\ 5\ years\ or\ more.$
7.	$\gamma_t = 2$
8.	$\rho'_{top} = \frac{4.13}{100 \times 10} = 0.00413$
9.	$\rho_{bottom} = \frac{4.13}{100 \times 10} = 0.00413$
10.	$\rho'_{ort} = 0.25 * (0.00413 + 0.00413) + 0.5 * 0 = 0.00206$
11.	$\lambda = \frac{2}{1 + 50 \times 0.00206} = 1.812$
12.	$\delta_t = 4.2 + 1.812 \times 2.5 = 8.73\ \mathrm{mm}$
13.	$Total\ Deflection = 8.73 \leq \frac{4750}{480} = 9.896\ mm$ ✓

D101 - Storey: 1

Flexural Member Type	: Two-way Slab
Span Type	: Interior Span
Clear Span / Height	: 475.0 / 12.0 cm = 39.6 > 35 (TS-500 Table 13.1)

Section Dimensions:	100.0 / 12.0 cm	d = 10.0 cm	d' = 2.0 cm
Flange Dimensions:	b = 100.0 cm	h_f = 0.0 cm	
Uncracked Section:	I_c = 0.000144 m⁴	y(b) = 6.0 cm	y(t) = 6.0 cm
Concrete:	F_{cd} = 1666.67 t/m²	F_{ctd} = 116.67 t/m²	E_c = 3025000.0 t/m²
Steel:	F_{yd} = 36521.74 t/m²	E_s = 2.000E+07 t/m²	E_s/E_c = 6.6

	Left Support	Right Support	Span
$A_s(t)/A_s(b)$	4.13 / 4.13 cm²	4.13 / 4.13 cm²	0.00 / 4.13 cm²
M(g) / M(g+q)	0.00 / 0.00 t.m	0.70 / 0.97 t.m	0.53 / 0.73 t.m
M_{cr}	0.70 t.m	0.70 t.m	0.70 t.m
Cracking Status (G)	NO	YES	NO
Cracking Status (G+Q)	NO	YES	YES
Cracked Inertia (G)	-	0.000020 m⁴	-
Cracked Inertia (G+Q)	-	0.000020 m⁴	0.000020 m⁴
Effective Inertia (G)	0.000144 m⁴	0.000142 m⁴	0.000144 m⁴
Effective Inertia (G+Q)	0.000144 m⁴	0.000067 m⁴	0.000128 m⁴

Effective Inertia (G)	0.000144 m⁴
Effective Inertia (G+Q)	0.000117 m⁴
Immediate Def. (G)	2.507 mm
Immediate Def. (G+Q)	4.219 mm
Immediate Def. (Q)	1.712 mm
Loading Time	FIVE YEARS or MORE
Total Time Dep. Deflection	8.764 mm

Flexural Member and Position: Storey/Roof Member Supporting Partition (Sensitive Load)
Total Deflection = 8.764 mm ≤ 9.896 mm (4750/480) ... **Adequate** √

Figure 8:Concrete Slab Deflection Check

Example 2: Cantilever Slab

This example will examine the deflection calculation of slab D102 with the following flanged section properties spanning 100 cm.

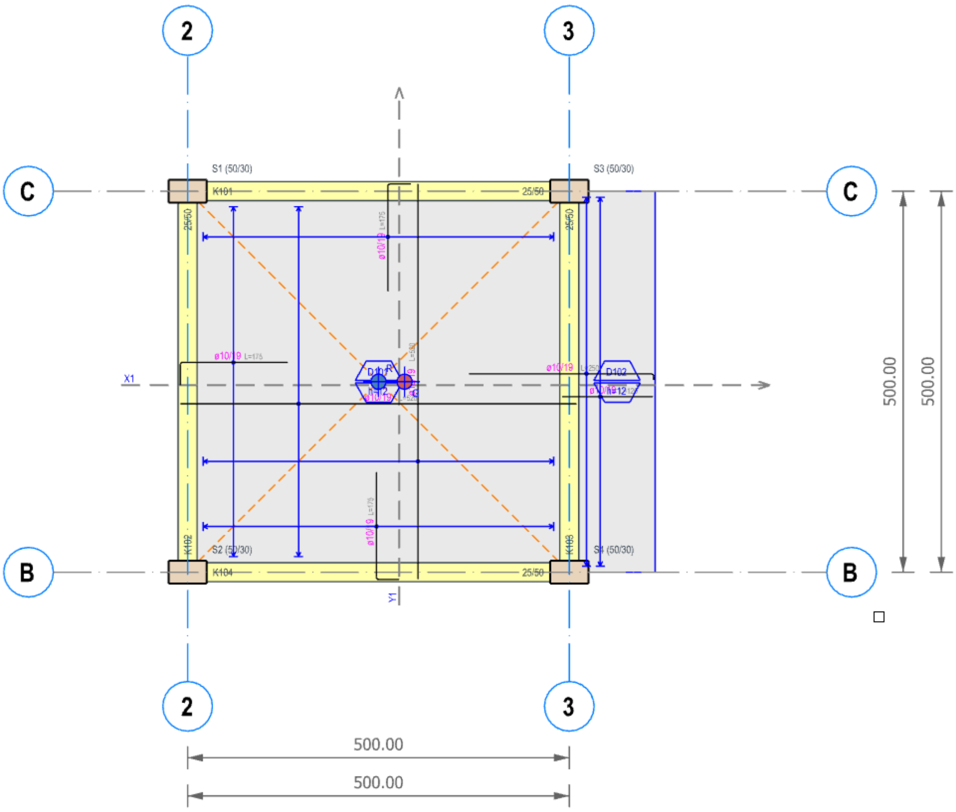


Figure 9: Building plan view

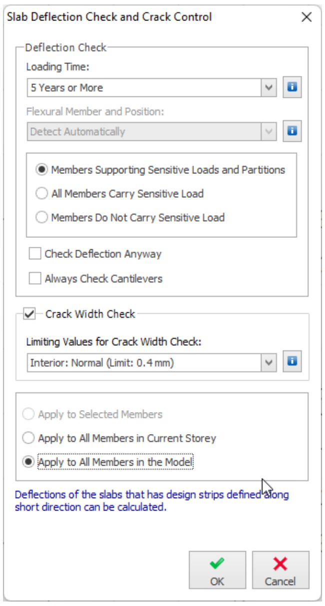


Figure 10: Slab Deflection Check and Crack Control Parameters

Deflection Calculation Requirement Check

1.	Span Type: Cantiliver
2.	$\frac{Clear\ Span}{Height} = \frac{100}{12} = 8.3$
3.	$8.3 \leq 10\ \ Deflection\ check\ is\ not\ required.$

D102 - Storey: 1

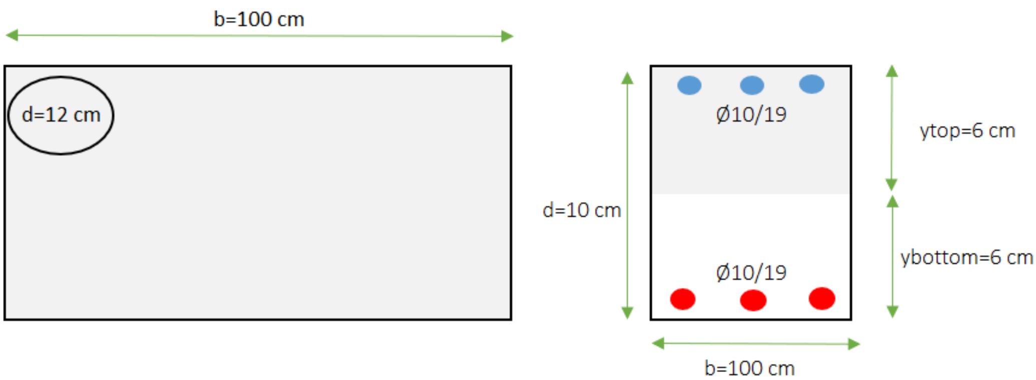
Flexural Member Type	: One-way Slab
Span Type	: Cantilever
Clear Span / Height	: 100.0 / 12.0 cm = 8.3 ≤ 10 (TS-500 Table 13.1)

DEFLECTION CHECK IS NOT REQUIRED.

Figure 11: Concrete Slab Deflection Check

Although deflection calculation is not required for cantilever floors, you may want to calculate deflection. For this, it is sufficient to check the 'Check Cantilevers Even If Deflection Calculation Is Not Required' button in the selection section.

Parameters	Value (mm)	Parameters	Value (MPa)
$\boldsymbol{b}$	1000	$f_c{}'$	25
$\boldsymbol{h}$	120	f_y	420
$\boldsymbol{d}$	10	f_{yt}	240
$\boldsymbol{d'}$	12	E_s	200000



Immediate Deflection Calculation

Since the left support area, where the moment is excessive in cantilever floors, is critical, calculations will be made considering the values in the left support area.

1.	$y_{top} = \frac{12}{2} = 6\ cm$
2.	$y_{bottom} = 12 - 6 = 6\ cm$
3.	$I_c = \frac{100 \times 12^3}{12} = 14400\ cm^4 = 0.000144\ m^4$
4.	$\mathrm{M}_{cr-support} = 2{,}5\ \times 116.67 \times \frac{0.000144}{0.06} = 0.7\ \ tm$
5.	$M_{max} \leq M_{cr}$ or $M_{max} > M_{cr}\ control\ is\ shown\ in\ Figure\ 13.$
6.	$M_{max} \leq M_{cr}\ I_c\ should\ be\ used\ in\ calculations.$
7.	$n = \frac{20000000}{3025000} = 6.6$
8.	$As_{top-support} = \frac{1000}{190} \times \frac{\pi \times 10^2}{4} = 413\ mm^2 = 4.13\ cm^2$
9.	$As_{bottom-support} = \frac{1000}{190} \times \frac{\pi \times 10^2}{4} = 413\ mm^2 = 4.13\ cm^2$
10.	$As_{top-span} = 0.0$
11.	$As_{bottom-span} = \frac{1000}{190} \times \frac{\pi \times 10^2}{4} = 413\ mm^2 = 4.13\ cm^2$

The M_{max} values are automatically calculated by the program. Calculated values are automatically written to the report.

Case	Left Support (t.m)	Right Support (t.m)	Span (t.m)
G (Mmax)	0.27	-	-
G+Q (Mmax)	0.52	-	-
Mcr	0.7	-	-

Figure 12: G and G+Q Load Case M_{max} and M_{cr} Values

Case	Left Support (t.m)	Craking Control	Right Support(t.m)	Craking Control	Span(t.m)	Craking Control
G (Mmax)	0.27<0.7	No	-	-	-	-
G+Q (Mmax)	0.52<0.7	No	-	-	-	-

Figure 13: G and G+Q Load Case Cracking Control

1.	$\text{Immediate Deflection G} = \dfrac{0.27 \times 1^2}{4 \times 3025000 \times 0.000144} = 0.000154\, m$
2.	$\text{Immediate Deflection G + Q} = \dfrac{0.52 \times 1^2}{4 \times 3025000 \times 0.000144} = 0.000298\, m$
3.	$\text{Immediate Deflection Q} = 0.000298 - 0.000154 = 0.000144 \text{ m}$
4.	$\textit{Loading time accepted } 5 \textit{ years or more.}$
5.	$\gamma_t = 2$
6.	$\rho'_{top} = \dfrac{4.13}{100 \times 10} = 0.00413$
7.	$\lambda = \dfrac{2}{1 + 50 \times 0.00413} = 1.65$
8.	$\delta_t = 0.298 + 1.65 \times 0.154 = 0.553 \text{ mm}$
9.	$Total\ Deflection = 0.553 \leq \dfrac{1000}{480} = 2.083\ mm$ ✓

D102 - Storey: 1

Flexural Member Type	: One-way Slab
Span Type	: Cantilever
Clear Span / Height	: 100.0 / 12.0 cm = 8.3 ≤ 10 (TS-500 Table 13.1)

Section Dimensions:	100.0 / 12.0 cm	d = 10.0 cm	d' = 2.0 cm
Flange Dimensions:	b = 100.0 cm	h_f = 0.0 cm	
Uncracked Section:	I_c = 0.000144 m^4	y(b) = 6.0 cm	y(t) = 6.0 cm
Concrete:	F_{cd} = 1666.67 t/m^2	F_{ctd} = 116.67 t/m^2	E_c = 3025000.0 t/m^2
Steel:	F_{yd} = 36521.74 t/m^2	E_s = 2.000E+07 t/m^2	E_s/E_c = 6.6

	Left Support	Right Support	Span
$A_s(t)/A_s(b)$	4.13 / 4.13 cm^2	0.00 / 0.00 cm^2	0.00 / 4.13 cm^2
M(g) / M(g+q)	0.27 / 0.52 t.m	0.00 / 0.00 t.m	0.00 / 0.00 t.m
M_{cr}	0.70 t.m	-	-
Cracking Status (G)	NO	-	-
Cracking Status (G+Q)	NO	-	-
Cracked Inertia (G)	-	-	-
Cracked Inertia (G+Q)	-	-	-
Effective Inertia (G)	0.000144 m^4	-	-
Effective Inertia (G+Q)	0.000144 m^4	-	-

Effective Inertia (G)	0.000144 m^4
Effective Inertia (G+Q)	0.000144 m^4
Immediate Def. (G)	0.154 mm
Immediate Def. (G+Q)	0.298 mm
Immediate Def. (Q)	0.143 mm
Loading Time	FIVE YEARS or MORE
Total Time Dep. Deflection	0.553 mm

Flexural Member and Position: Storey/Roof Member Supporting Partition (Sensitive Load)
Total Deflection = 0.553 mm ≤ 2.083 mm (1000/480) ... **Adequate** √

Figure 14: Concrete Slab Deflection Check

Thank You…

Thank you for choosing the ProtaStructure Suite product family.

Our top priority is to make your experience excellent with our software technology solutions.

Should you have any technical support requests or questions, please do not hesitate to contact us at all times through globalsupport@protasoftware.com and asiasupport@protasoftware.com

Our dedicated online support center and responsive technical support team are available to help you get the most out of Prota's technology solutions.

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