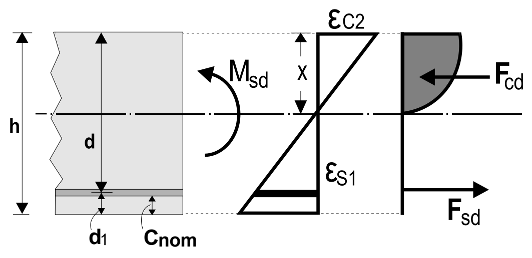
CONTENTS

Example of plates

1. SLAB-001



Cross section of solid slab in bending
(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)

h=0.180 m, Msd=20.00 kNm
Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
γc=1.50, γs=1.15 (EC2 Table 2.1N)

1.1. Dimensions and loads

Slab thickness h=0.180 m, Bending moment Msd=20.00 kNm
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+12/2=21mm, d=180-21=159mm

1.2. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

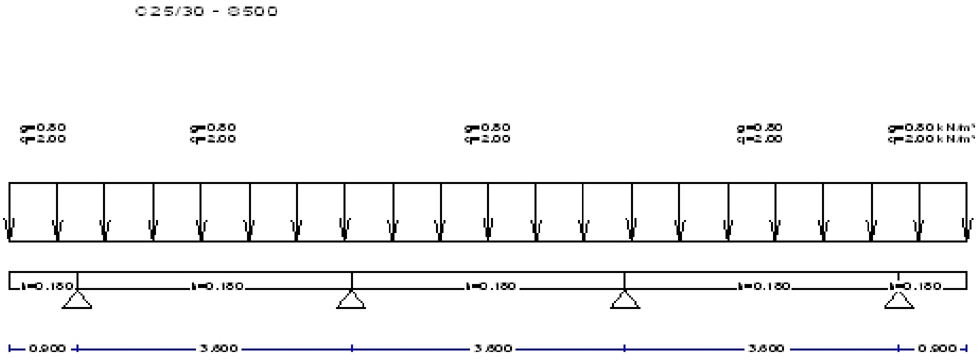
Dimensioning for bending: Allgower,G.-Avak,R. Bemessungstafeln nach Eurocode 2 fur Rechteck und Plattenbalkenquerschnitte, In: Beton - und Stahlbetonbau 87 (1992)
Msd= 20.00kNm/m, d=159mm, Kd=3.56 x/d=0.09 εc/εs=1.9/20.0 ks=2.38, **As= 2.99cm²/m**
Minimum slab reinforcement, As>=0.26bd·Fctm/fyk (As= 2.15cm²/m) (EC2 §9.3.1)
minimum principal reinforcement Ø10/36.5 (2.15cm²/m), secondary Ø8/45.0 (1.12cm²/m)

Slab principal reinforcement Ø12/37.5 (3.01cm²/m), **secondary Ø8/45.0** (1.12cm²/m)

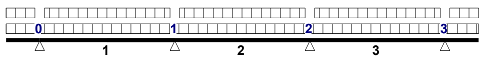
2. SLAB-002

One-way continuous slab

(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)



Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
Concrete weight : 25.0 kN/m³
γ_c=1.50, γ_s=1.15 (EC2 Table 2.1N)

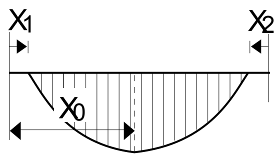


2.1. Dimensions and loads

Continuous slab, number of spans=3, transverse length Ly=9.00 m
Partial safety factors for actions : γ_G=1.35, γ_Q=1.50 (EC0 Annex A1)
Combination of variable actions : ψ_1=0.60, ψ_2=0.30
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+10/2=20mm

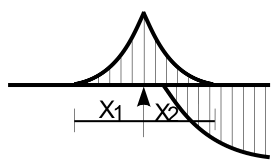
Spans (L), thickness (h), loads on spans (g=self weight +dead, q=live)
Cant-1, L= 0.900 m, h= 0.180 m, g=(4.50+ 0.80)x1.000= 5.30 kN/m², q= 2.00x1.000= 2.00 kN/m²
Span-1, L= 3.600 m, h= 0.180 m, g=(4.50+ 0.80)x1.000= 5.30 kN/m², q= 2.00x1.000= 2.00 kN/m²
Span-2, L= 3.600 m, h= 0.180 m, g=(4.50+ 0.80)x1.000= 5.30 kN/m², q= 2.00x1.000= 2.00 kN/m²
Span-3, L= 3.600 m, h= 0.180 m, g=(4.50+ 0.80)x1.000= 5.30 kN/m², q= 2.00x1.000= 2.00 kN/m²
Cant-2, L= 0.900 m, h= 0.180 m, g=(4.50+ 0.80)x1.000= 5.30 kN/m², q= 2.00x1.000= 2.00 kN/m²

2.2. Shearing forces and bending moments



Maximum bending moments at spans for load combinations 1.35g+1.50q
Cant-1, Msd= -4.11 kNm/m, xo=0.900 m, x1=0.000m, x2=0.000m
Span-1, Msd= 10.06 kNm/m, xo=1.550 m, x1=0.143m, x2=0.642m
Span-2, Msd= 5.58 kNm/m, xo=1.800 m, x1=0.752m, x2=0.752m
Span-3, Msd= 10.06 kNm/m, xo=2.050 m, x1=0.642m, x2=0.143m
Cant-2, Msd= -4.11 kNm/m, xo=0.000 m, x1=0.000m, x2=0.000m

Maximum bending moments at supports for load combinations 1.35g+1.50q
Support-0, Msd= -4.11 kNm/m, x1=0.900 m, x2=0.291 m
Support-1, Msd= -14.97 kNm/m, x1=0.869 m, x2=1.102 m
Support-2, Msd= -14.97 kNm/m, x1=1.102 m, x2=0.869 m
Support-3, Msd= -4.11 kNm/m, x1=0.291 m, x2=0.900 m



Maximum shear forces for load combinations 1.35g+1.50q

Cant-1, Vsd,left= 0.00 kN/m, Vsd,right= -9.14 kN/m
Span-1, Vsd,left= 14.93 kN/m, Vsd,right= -21.63 kN/m
Span-2, Vsd,left= 17.38 kN/m, Vsd,right= -19.18 kN/m
Span-3, Vsd,left= 20.93 kN/m, Vsd,right= -15.62 kN/m
Cant-2, Vsd,left= 9.14 kN/m, Vsd,right= 0.00 kN/m

Maximum reactions due to dead and live loads (Rg and Rq)

Support-0, Rg(x1.35)= 17.23 kN/m, Rq(x1.50)= 7.54 kN/m
Support-1, Rg(x1.35)= 27.85 kN/m, Rq(x1.50)= 12.96 kN/m
Support-2, Rg(x1.35)= 27.85 kN/m, Rq(x1.50)= 12.96 kN/m
Support-3, Rg(x1.35)= 17.23 kN/m, Rq(x1.50)= 7.54 kN/m

2.3. Design actions, shearing forces and bending moments

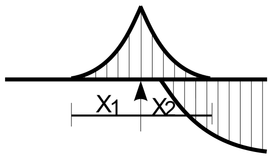
Design action values after moment redistribution by 0% (EC2 §5.5)
Reduction of support moments to moments at support faces (bsup=0.20 m) (EC2 §5.3.2.2.3)
Check for minimum values, (0.65ql^2/8 or 0.65ql^2/12) (EC2 §5.3.2.2.3N)

Maximum span bending moments and shear forces for load combinations 1.35g+1.50q

Cant-1, Msd= -3.20 kNm/m, Vsd,left= 0.00 kN/m, Vsd,right= -9.14 kN/m
Span-1, Msd= 10.06 kNm/m, Vsd,left= 15.74 kN/m, Vsd,right= -20.81 kN/m
Span-2, Msd= 5.58 kNm/m, Vsd,left= 18.28 kN/m, Vsd,right= -18.28 kN/m
Span-3, Msd= 10.06 kNm/m, Vsd,left= 20.81 kN/m, Vsd,right= -15.74 kN/m
Cant-2, Msd= -3.20 kNm/m, Vsd,left= 9.14 kN/m, Vsd,right= 0.00 kN/m

Maximum bending moments at supports for load combinations 1.35g+1.50q

Support-0, Msd= -3.20 kNm/m, x1=0.900 m, x2=0.291 m
Support-1, Msd= -13.14 kNm/m, x1=0.869 m, x2=1.102 m
Support-2, Msd= -13.14 kNm/m, x1=1.102 m, x2=0.869 m
Support-3, Msd= -3.20 kNm/m, x1=0.291 m, x2=0.900 m



2.4. Ultimate limit state, design for bending

(EC2 EN1992-1-1:2004, §6.1, §9.3.1)

Reinforcement of spans

Msd1= 10.06kNm/m, d=160mm, Kd=5.05 x/d=0.06 εc/εs=1.2/20.0 ks=2.35, **As= 1.48cm^2/m**
Msd2= 5.58kNm/m, d=160mm, Kd=6.77 x/d=0.04 εc/εs=0.9/20.0 ks=2.33, **As= 0.81cm^2/m**
Msd3= 10.06kNm/m, d=160mm, Kd=5.05 x/d=0.06 εc/εs=1.2/20.0 ks=2.35, **As= 1.48cm^2/m**

Reinforcement over supports

Msd0= -3.20kNm/m, d=160mm, Kd=8.95 x/d=0.03 εc/εs=0.6/20.0 ks=2.32, **As= 0.46cm^2/m**
Msd1=-13.14kNm/m, d=160mm, Kd=4.41 x/d=0.07 εc/εs=1.4/20.0 ks=2.36, **As= 1.94cm^2/m**
Msd2=-13.14kNm/m, d=160mm, Kd=4.41 x/d=0.07 εc/εs=1.4/20.0 ks=2.36, **As= 1.94cm^2/m**
Msd3= -3.20kNm/m, d=160mm, Kd=8.95 x/d=0.03 εc/εs=0.6/20.0 ks=2.32, **As= 0.46cm^2/m**

2.5. Minimum reinforcement at spans

(EC2 EN1992-1-1:2004, §9.3.1)

Span-1, As>=0.26bd·Fctm/fyk (As= 2.16cm^2/m) Ø10/36.0(2.18cm^2/m), second. Ø8/45.0(1.12cm^2/m)
Span-2, As>=0.26bd·Fctm/fyk (As= 2.16cm^2/m) Ø10/36.0(2.18cm^2/m), second. Ø8/45.0(1.12cm^2/m)
Span-3, As>=0.26bd·Fctm/fyk (As= 2.16cm^2/m) Ø10/36.0(2.18cm^2/m), second. Ø8/45.0(1.12cm^2/m)

2.6. Serviceability limit state, deflection control

(EC2 EN1992-1-1:2004, §7.4.2)

Cant-1, K=0.40, ρ=0.029%, L/d= 900/ 160= 5.62< 8.00 (EC2 T.7.4N)
Span-1, K=1.50, ρ=0.092%, L/d= 3600/ 160=22.50<30.00
Span-2, K=1.50, ρ=0.051%, L/d= 3600/ 160=22.50<30.00
Span-3, K=1.50, ρ=0.092%, L/d= 3600/ 160=22.50<30.00
Cant-2, K=0.40, ρ=0.029%, L/d= 900/ 160= 5.62< 8.00

2.7. Reinforcement

Span reinforcement

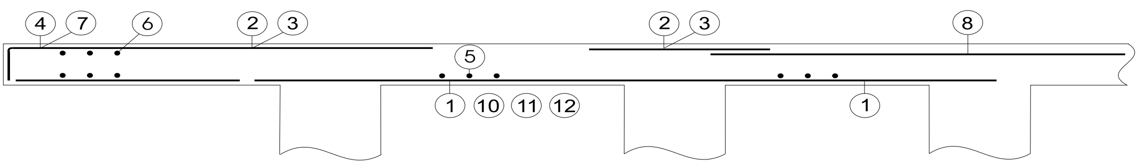
```
Cant-1  Ø10/36.0 ( 2.18cm²/m) principal at top,     Ø8/45.0 ( 1.12cm²/m) secondary
Span-1  Ø10/36.0 ( 2.18cm²/m) principal at bottom,  Ø8/45.0 ( 1.12cm²/m) secondary
Span-2  Ø10/36.0 ( 2.18cm²/m) principal at bottom,  Ø8/45.0 ( 1.12cm²/m) secondary
Span-3  Ø10/36.0 ( 2.18cm²/m) principal at bottom,  Ø8/45.0 ( 1.12cm²/m) secondary
Cant-2  Ø10/36.0 ( 2.18cm²/m) principal at top,     Ø8/45.0 ( 1.12cm²/m) secondary
```

Reinforcement over supports

```
Support-0  Ø10/36.0 ( 2.18cm²/m) reinforcement at top
Support-1  Ø10/36.0 ( 2.18cm²/m) reinforcement at top
Support-2  Ø10/36.0 ( 2.18cm²/m) reinforcement at top
Support-3  Ø10/36.0 ( 2.18cm²/m) reinforcement at top
```

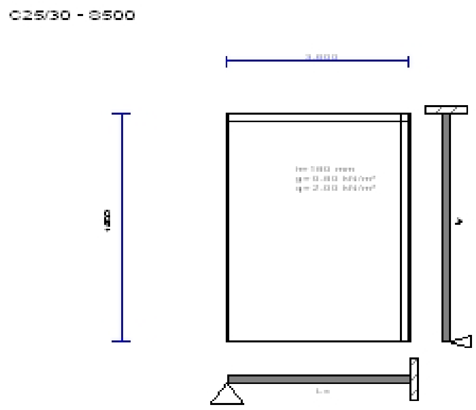
2.8. Reinforcing bar schedule

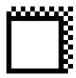
Num		type	reinforcing bar [mm]	items	Ø	g/m [kg/m]	length [m]	weight [kg]
1	(Span-1)	1	4020	25	10	0.617	4.020	62.01
2	(Span-2)	1	4020	25	10	0.617	4.020	62.01
3	(Span-3)	1	4020	25	10	0.617	4.020	62.01
4	(Cant-1)	4	150 2090	25	10	0.617	2.240	34.55
5	(Supp-1)	2	2550	25	10	0.617	2.550	39.33
6	(Supp-2)	2	2550	25	10	0.617	2.550	39.33
7	(Cant-2)	4	2090 160	25	10	0.617	2.250	34.71
8	(Cant-1)	5	9000	2	8	0.395	9.000	7.11
9	(Cant-1)	6	9000	2	8	0.395	9.000	7.11
10	(Span-1)	5	9000	8	8	0.395	9.000	28.44
11	(Span-2)	5	9000	8	8	0.395	9.000	28.44
12	(Span-3)	5	9000	8	8	0.395	9.000	28.44
13	(Cant-2)	5	9000	2	8	0.395	9.000	7.11
14	(Cant-2)	6	9000	2	8	0.395	9.000	7.11
			Total weight [kg]					**447.71**



3. SLAB-003

Two-way slab
(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)





Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
Concrete weight : 25.0 kN/m^3
γ_c=1.50, γ_s=1.15 (EC2 Table 2.1N)

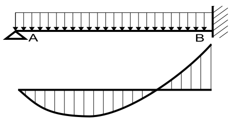
3.1. Dimensions and loads

Slab thickness h=0.180 m, Spans Lx=3.600 m, Ly=4.500 m
Slab loads: dead g=(4.50+0.80)=5.30 kN/m^2, live q=2.00 kN/m^2
Partial safety factors for actions : γ_G=1.35, γ_Q=1.50 (EC0 Annex A1)
Combination of variable actions : ψ_1=0.60, ψ_2=0.30
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+10/2=20mm, d=180-20=160mm

Method of analysis: Czerny F., "Tafeln fur vierseitig und dreiseitig gelagerte Rechteckplatten", Beton Kalender 1983, Berlin, Ernst Sohn, 1983
Ly/Lx=4.500/3.600=1.25, Table 2.2.4

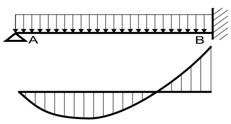
3.2. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

3.2.1. Direction of slab analysis x-x, Lx=3.60 m



Moment at support MsdsupA=0 kNm/m
Moment at support MsdsupB=(1.35x5.30+1.50x2.00)x3.600²/11.10=-11.86 kNm/m
Moment at span Msdspan=(1.35x5.30+1.50x2.00)x3.600²/28.00= 4.70 kNm/m
Reactions dead, VgA= 5.30x3.600/2.53= 7.54 VgB= 5.30x3.600/1.72=11.09 kN/m
Reactions live, VqA= 2.00x3.600/2.53= 2.85 VqB= 2.00x3.600/1.72= 4.19 kN/m

3.2.2. Direction of slab analysis y-y, Ly=4.50 m



Moment at support MsdsupA=0 kNm/m
Moment at support MsdsupB=(1.35x5.30+1.50x2.00)x3.600²/12.90=-10.20 kNm/m
Moment at span Msdspan=(1.35x5.30+1.50x2.00)x3.600²/45.60= 2.89 kNm/m
Reactions dead, VgA= 5.30x3.600/2.56= 7.45 VgB= 5.30x3.600/1.86=10.26 kN/m
Reactions live, VqA= 2.00x3.600/2.56= 2.81 VqB= 2.00x3.600/1.86= 3.87 kN/m

3.3. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

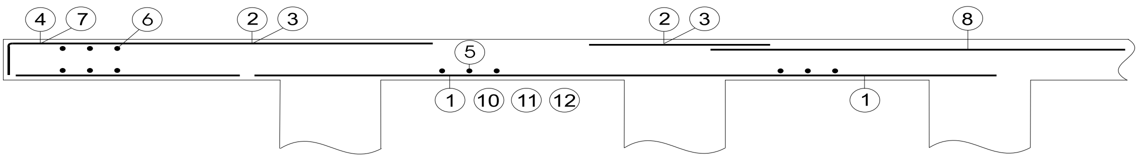
Msd= 4.70kNm/m, d=160mm, Kd=7.38 x/d=0.04 εc/εs=0.8/20.0 ks=2.33, **As= 0.68cm²/m**
Msd= 2.89kNm/m, d=150mm, Kd=8.83 x/d=0.03 εc/εs=0.7/20.0 ks=2.32, **As= 0.45cm²/m**
Msd=-11.86kNm/m, d=160mm, Kd=4.65 x/d=0.06 εc/εs=1.4/20.0 ks=2.35, **As= 1.74cm²/m**
Msd=-10.20kNm/m, d=160mm, Kd=5.01 x/d=0.06 εc/εs=1.2/20.0 ks=2.35, **As= 1.50cm²/m**

Minimum slab reinforcement, As>=0.26bd·Fctm/fyk (As= 2.16cm²/m) (EC2 §9.3.1)
minimum principal reinforcement Ø10/36.0 (2.18cm²/m), secondary Ø8/45.0 (1.12cm²/m)
span/eff. depth, K=1.30, ρ=0.043%, L/d= 3600/ 160=22.50<26.00 (EC2 T.7.4N)

Span reinforcement: **x-x** **Ø10/36.0** (2.18cm²/m), (bottom layer)
y-y **Ø10/36.0** (2.18cm²/m)
Reinforcement over supports: **Left** **Ø8/45.0** (1.12cm²/m)
Right **Ø10/36.0** (2.18cm²/m)
Bottom **Ø8/45.0** (1.12cm²/m)
Top **Ø10/36.0** (2.18cm²/m)

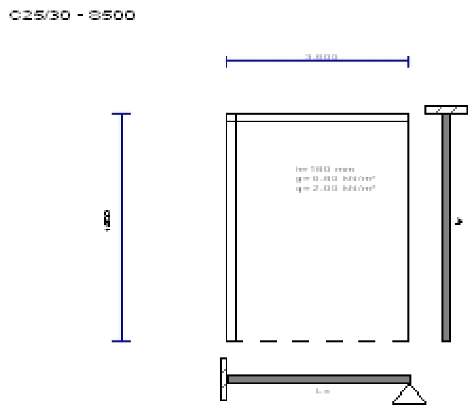
3.4. Reinforcing bar schedule

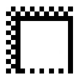
Num	type	reinforcing bar [mm]	items	Ø	g/m [kg/m]	length [m]	weight [kg]
15	1	4020	12	10	0.617	4.020	29.76
16	1	4920	10	10	0.617	4.920	30.36
17	2	2260	10	8	0.395	2.260	8.93
18	2	2380	12	10	0.617	2.380	17.62
19	2	2710	8	8	0.395	2.710	8.56
20	2	2830	10	10	0.617	2.830	17.46
		Total weight [kg]					112.69



4. SLAB-004

Two-way slab with three supported edges
(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)





Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
Concrete weight : 25.0 kN/m^3
$\gamma c=1.50$, $\gamma s=1.15$ (EC2 Table 2.1N)

4.1. Dimensions and loads

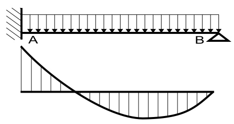
Slab thickness h=0.180 m, Spans Lx=3.600 m, Ly=4.500 m
Slab loads: dead g=(4.50+0.80)=5.30 kN/m^2, live q=2.00 kN/m^2
Partial safety factors for actions : $\gamma G=1.35$, $\gamma Q=1.50$ (EC0 Annex A1)
Combination of variable actions : $\psi 1=0.60$, $\psi 2=0.30$
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+10/2=20mm, d=180-20=160mm

Method of analysis: Czerny F., "Tafeln fur vierseitig und dreiseitig gelagerte Rechteckplatten", Beton Kalender 1983, Berlin, Ernst Sohn, 1983
Ly/Lx=4.500/3.600=1.25, Table 3.2.5

4.2. Ultimate limit state, design for bending

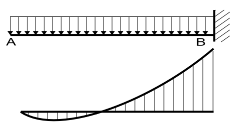
(EC2 EN1992-1-1:2004, §6.1, §9.3.1)

4.2.1. Direction of slab analysis x-x, Lx=3.60 m



Moment at support MsdsupA=(1.35x5.30+1.50x2.00)x4.500²/12.42=-16.56 kNm/m
Moment at support MsdsupB=0 kNm/m
Moment at span Msdspan=(1.35x5.30+1.50x2.00)x4.500²/22.83= 9.01 kNm/m
Reactions dead, VgA= 5.30x4.500/2.16=11.04 VgB= 5.30x4.500/3.34= 7.14 kN/m
Reactions live, VqA= 2.00x4.500/2.16= 4.17 VqB= 2.00x4.500/3.34= 2.69 kN/m

4.2.2. Direction of slab analysis y-y, Ly=4.50 m



Moment at support MsdsupA=0 kNm/m
Moment at support MsdsupB=(1.35x5.30+1.50x2.00)x4.500²/19.30=-10.66 kNm/m
Moment at span Msdspan=(1.35x5.30+1.50x2.00)x4.500²/130.66= 1.57 kNm/m
Reactions dead, VgA= 0.00 VgB= 5.30x4.500/2.27=10.51 kN/m
Reactions live, VqA= 0.00 VqB= 2.00x4.500/2.27= 3.96 kN/m

4.3. Ultimate limit state, design for bending

(EC2 EN1992-1-1:2004, §6.1, §9.3.1)

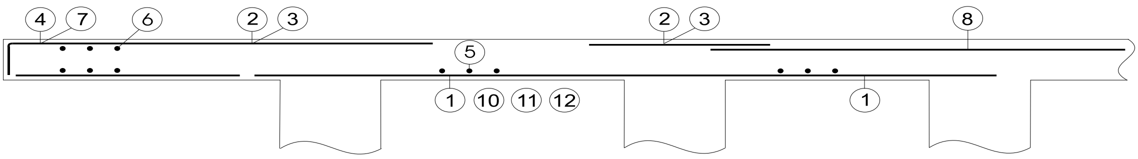
Msd= 9.01kNm/m, d=160mm, Kd=5.33 x/d=0.05 εc/εs=1.2/20.0 ks=2.34, **As= 1.32cm²/m**
Msd= 1.57kNm/m, d=150mm, Kd=11.96 x/d=0.02 εc/εs=0.5/20.0 ks=2.32, **As= 0.24cm²/m**
Msd=-16.56kNm/m, d=160mm, Kd=3.93 x/d=0.08 εc/εs=1.7/20.0 ks=2.37, **As= 2.45cm²/m**
Msd=-10.66kNm/m, d=160mm, Kd=4.90 x/d=0.06 εc/εs=1.3/20.0 ks=2.35, **As= 1.56cm²/m**

Minimum slab reinforcement, As>=0.26bd·Fctm/fyk (As= 2.16cm²/m) (EC2 §9.3.1)
minimum principal reinforcement Ø10/36.0(2.18cm²/m), secondary Ø8/45.0(1.12cm²/m)
span/eff. depth, K=1.30, ρ=0.082%, L/d= 3600/ 160=22.50<26.00 (EC2 T.7.4N)

Span reinforcement: **x-x** **Ø10/36.0**(2.18cm²/m), (bottom layer)
y-y **Ø10/36.0**(2.18cm²/m)
Reinforcement over supports: **Left** **Ø10/32.0**(2.45cm²/m)
Right **Ø8/45.0**(1.12cm²/m)
Bottom **Ø8/45.0**(1.12cm²/m)
Top **Ø10/36.0**(2.18cm²/m)

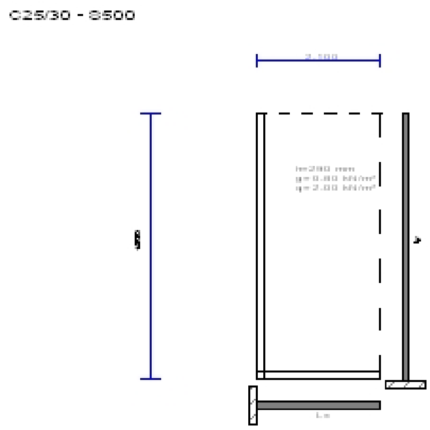
4.4. Reinforcing bar schedule

Num	type	reinforcing bar [mm]	items	Ø	g/m [kg/m]	length [m]	weight [kg]
21	1	4020	12	10	0.617	4.020	29.76
22	1	4920	10	10	0.617	4.920	30.36
23	2	2380	14	10	0.617	2.380	20.56
24	2	2260	10	8	0.395	2.260	8.93
25	2	2710	8	8	0.395	2.710	8.56
26	9	1410 / 1410 / 150	10	10	0.617	2.970	18.32
		Total weight [kg]					**116.49**

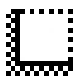


5. SLAB-005

Two-way slab with two supported edges
(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)



Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
Concrete weight : 25.0 kN/m³
γc=1.50, γs=1.15 (EC2 Table 2.1N)



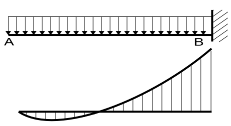
5.1. Dimensions and loads

Slab thickness h=0.290 m, Spans Lx=2.100 m, Ly=4.500 m
Slab loads: dead g=(7.25+0.80)=8.05 kN/m², live q=2.00 kN/m²
Partial safety factors for actions : γG=1.35, γQ=1.50 (EC0 Annex A1)
Combination of variable actions : ψ1=0.60, ψ2=0.30
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+12/2=21mm, d=290-21=269mm

Method of analysis: Bares R., "Tables for the Analysis of Plates, Slabs and Diaphragms Based on the Elastic Theory", Bauverlag GmbH., Wiesbaden und Berlin 1971

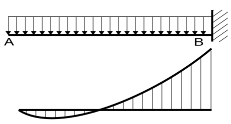
5.2. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

5.2.1. Direction of slab analysis x-x, Lx=2.10 m



Moment at span Msdsp=0.0007x(1.35x8.05+1.50x2.00)x2.100²= 0.04 kNm/m
Moment at support Msdsup=-0.4323x(1.35x8.05+1.50x2.00)x2.100²=-26.44 kNm/m
Reactions Vsg=0.857x 8.05x2.100=14.48, Vsq=0.857x 2.00x2.100= 3.60 kN/m

5.2.2. Direction of slab analysis y-y, Ly=4.50 m



Moment at span Msdsp=0.0101x(1.35x8.05+1.50x2.00)x4.500²= 2.82 kNm/m
Moment at support Msdsup=-0.0724x(1.35x8.05+1.50x2.00)x4.500²=-20.34 kNm/m
Reactions Vsg=0.143x 8.05x4.500=5.20, Vsq=0.143x 2.00x4.500= 1.29 kN/m

5.3. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

Msd= 0.04kNm/m, d=257mm, Kd=124.21 x/d=0.00 εc/εs=0.0/20.0 ks=2.30, **As= 0.00cm²/m**
Msd= 2.82kNm/m, d=269mm, Kd=16.01 x/d=0.02 εc/εs=0.3/20.0 ks=2.31, **As= 0.24cm²/m**
Msd=-26.44kNm/m, d=269mm, Kd=5.23 x/d=0.06 εc/εs=1.2/20.0 ks=2.34, **As= 2.30cm²/m**
Msd=-20.34kNm/m, d=269mm, Kd=5.96 x/d=0.05 εc/εs=1.0/20.0 ks=2.34, **As= 1.77cm²/m**

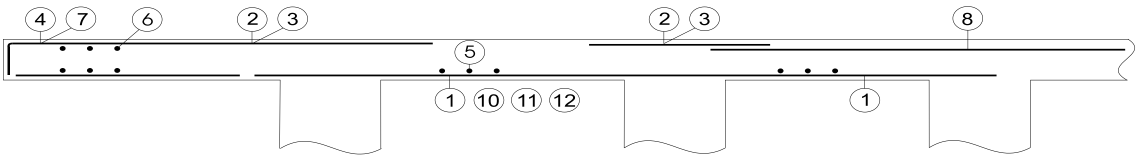
Minimum slab reinforcement, As>=0.26bd·Fctm/fyk (As= 3.64cm²/m) (EC2 §9.3.1)
minimum principal reinforcement Ø12/31.0(3.65cm²/m), secondary Ø8/45.0(1.12cm²/m)
span/eff. depth, K=0.40, ρ=0.000%, L/d= 2100/ 269= 7.81< 8.00 (EC2 T.7.4N)

Span reinforcement: **x-x** **Ø12/31.0** (3.65cm²/m)
y-y **Ø12/31.0** (3.65cm²/m), (bottom layer)
Reinforcement over supports: **Left** **Ø12/31.0** (3.65cm²/m)
Right **Ø8/45.0** (1.12cm²/m)
Bottom **Ø12/31.0** (3.65cm²/m)
Top **Ø8/45.0** (1.12cm²/m)

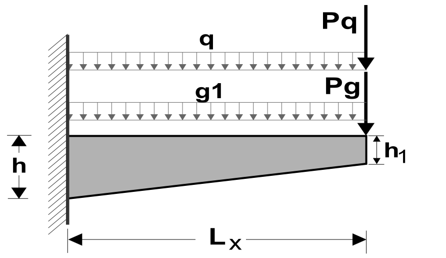
5.4. Reinforcing bar schedule

Num	type	reinforcing bar [mm]	items	Ø	g/m [kg/m]	length [m]	weight [kg]
27	1	2600	15	12	0.888	2.600	34.63
28	1	5000	7	12	0.888	5.000	31.08
29	9	880 / 880 / 260	15	12	0.888	2.020	26.91
30	2	1510	10	8	0.395	2.650	10.47
31	9	1480 / 1480 / 260	7	12	0.888	3.220	20.02
32	2	2710	5	8	0.395	4.450	8.79

Total weight [kg] **131.90**



6. SLAB-006



One way cantilever slab

(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)

Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
Concrete weight : 25.0 kN/m³
γc=1.50, γs=1.15 (EC2 Table 2.1N)

6.1. Dimensions and loads

Cantilever slab, free span Lx=1.200 m, transverse length Ly=4.800 m
Slab thickness, at support h=0.180 m, at free end h1=0.180 m
Slab loads: dead g=(4.50+0.80)=5.30 kN/m², live q=2.00 kN/m²
concentrated loads at free end, Pg=0.00 kN/m, Pq=0.00 kN/m
Partial safety factors for actions : γG=1.35, γQ=1.50 (EC0 Annex A1)
Combination of variable actions : ψ1=0.60, ψ2=0.30
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+10/2=20mm, d=180-20=160mm

6.2. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

Support moment M=-0.5x(1.35x5.30+1.50x2.00)x1.20²=-7.31 kNm/m
Shear force V=(1.35x5.30+1.50x2.00)x1.20=12.19 kN/m
Reaction VgA=1.35x5.30x1.20=8.59 kN/m, VqA=1.50x2.00x1.20=3.60 kN/m

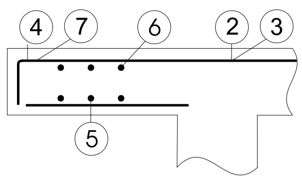
Reinforcement of slab (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

Msd= -7.31kNm/m, d=160mm, Kd=5.92 x/d=0.05 εc/εs=1.0/20.0 ks=2.34, **As= 1.07cm²/m**
Minimum slab reinforcement, As>=0.26bd·Fctm/fyk (As= 2.16cm²/m) (EC2 §9.3.1)
minimum principal reinforcement Ø10/36.0(2.18cm²/m), secondary Ø8/45.0(1.12cm²/m)
span/eff. depth, K=0.40, ρ=0.067%, L/d= 1200/ 160= 7.50< 8.00 (EC2 T.7.4N)

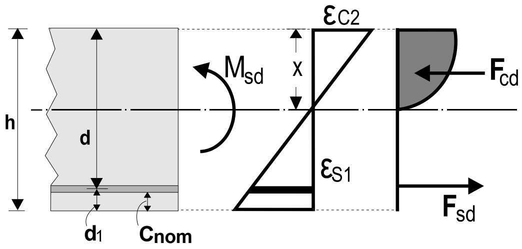
Main reinforcement Ø10/36.0(2.18cm²/m) **(top), secondary Ø8/45.0**(1.12cm²/m) **(top- bottom**

6.3. Reinforcing bar schedule

Num	type	reinforcing bar [mm]	items	Ø	g/m [kg/m]	length [m]	weight [kg]
33	4	150 2660	7	10	0.617	2.810	12.14
34	2	1780	7	10	0.617	1.780	7.69
35	5	4770	3	8	0.395	4.770	5.65
36	6	4770	3	8	0.395	4.770	5.65
		Total weight [kg]					**31.13**

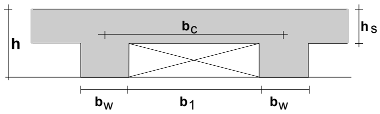


7. SLAB-007



Cross section of ribbed slab in bending
(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)

h= 0.180 m, hs=0.070 m, Msd=20.00 kNm
bw=0.150 m, b1=0.500 m



Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
γc=1.50, γs=1.15 (EC2 Table 2.1N)

7.1. Dimensions and loads

Slab thickness h=0.180 m, hs=0.070 m, Bending moment Msd=20.00 kNm
Rib width bw=0.150m, clear distance between ribs b1=0.500m, rib spacing bc=0.650m
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+10/2=20mm, d=180-20=160mm

7.2. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

Dimensioning for bending: Allgower,G.-Avak,R. Bemessungstafeln nach Eurocode 2 fur Rechteck und Plattenbalkenquerschnitte, In: Beton - und Stahlbetonbau 87 (1992)
Msd= 20.00kNm/m, d=160mm, Kd=3.58 x/d=0.09 εc/εs=1.9/20.0 ks=2.38, **As= 2.97cm²/m**
x=0.09x160= 14mm<= 70mm=hs, neutral axis within the depth of top flange
Minimum slab reinforcement, As>=0.26bd·Fctm/fyk (As= 0.50cm²/m) (EC2 §9.3.1)
minimum principal reinforcement 1Ø10/65.0 (1.21cm²/m)

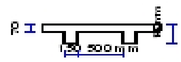
Main slab reinforcement 2Ø12/65.0 (3.48cm²/m)

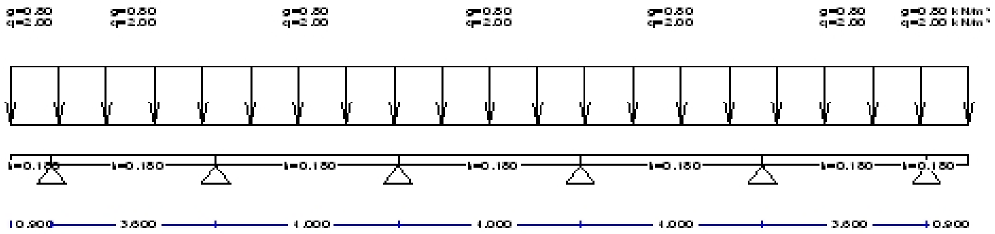
8. SLAB-008

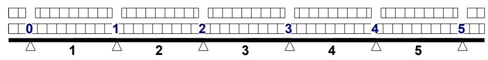
One-way continuous ribbed slab

(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)

C25/30 - S500

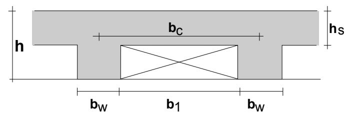






Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
Concrete weight : 25.0 kN/m^3
γ_c=1.50, γ_s=1.15 (EC2 Table 2.1N)

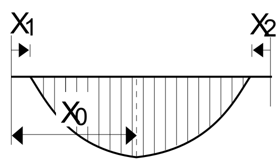
8.1. Dimensions and loads



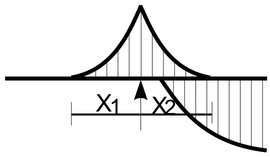
Continuous slab, number of spans=5, transverse length Ly=9.00 m
Partial safety factors for actions : γ_G=1.35, γ_Q=1.50 (EC0 Annex A1)
Combination of variable actions : ψ_1=0.60, ψ_2=0.30
Thickness of top solid slab hs=0.070 m
Rib width bw=0.150m, clear distance between ribs b1=0.500m, rib spacing bc=0.650m
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+10/2=20mm

Spans (L), thickness (h), loads on spans (g=self weight +dead, q=live)
Cant-1, L= 0.900 m, h= 0.180 m, g=(2.38+ 0.80)x1.000= 3.18 kN/m², q= 2.00x1.000= 2.00 kN/m²
Span-1, L= 3.600 m, h= 0.180 m, g=(2.38+ 0.80)x1.000= 3.18 kN/m², q= 2.00x1.000= 2.00 kN/m²
Span-2, L= 4.000 m, h= 0.180 m, g=(2.38+ 0.80)x1.000= 3.18 kN/m², q= 2.00x1.000= 2.00 kN/m²
Span-3, L= 4.000 m, h= 0.180 m, g=(2.38+ 0.80)x1.000= 3.18 kN/m², q= 2.00x1.000= 2.00 kN/m²
Span-4, L= 4.000 m, h= 0.180 m, g=(2.38+ 0.80)x1.000= 3.18 kN/m², q= 2.00x1.000= 2.00 kN/m²
Span-5, L= 3.600 m, h= 0.180 m, g=(2.38+ 0.80)x1.000= 3.18 kN/m², q= 2.00x1.000= 2.00 kN/m²
Cant-2, L= 0.900 m, h= 0.180 m, g=(2.38+ 0.80)x1.000= 3.18 kN/m², q= 2.00x1.000= 2.00 kN/m²

8.2. Shearing forces and bending moments



Maximum bending moments at spans for load combinations 1.35g+1.50q
Cant-1, Msd= -2.95 kNm/m, xo=0.900 m, x1=0.000m, x2=0.000m
Span-1, Msd= 7.40 kNm/m, xo=1.544 m, x1=0.119m, x2=0.632m
Span-2, Msd= 6.72 kNm/m, xo=2.072 m, x1=0.714m, x2=0.570m
Span-3, Msd= 7.58 kNm/m, xo=2.000 m, x1=0.558m, x2=0.558m
Span-4, Msd= 6.72 kNm/m, xo=1.928 m, x1=0.570m, x2=0.714m
Span-5, Msd= 7.40 kNm/m, xo=2.056 m, x1=0.632m, x2=0.119m
Cant-2, Msd= -2.95 kNm/m, xo=0.000 m, x1=0.000m, x2=0.000m



Maximum bending moments at supports for load combinations 1.35g+1.50q
Support-0, Msd= -2.95 kNm/m, x1=0.900 m, x2=0.295 m
Support-1, Msd= -12.17 kNm/m, x1=0.977 m, x2=1.002 m
Support-2, Msd= -10.51 kNm/m, x1=0.900 m, x2=0.856 m
Support-3, Msd= -10.51 kNm/m, x1=0.856 m, x2=0.900 m
Support-4, Msd= -12.17 kNm/m, x1=1.002 m, x2=0.977 m
Support-5, Msd= -2.95 kNm/m, x1=0.295 m, x2=0.900 m

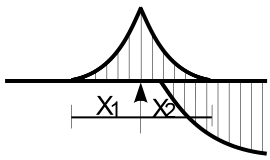
Maximum shear forces for load combinations 1.35g+1.50q
Cant-1, Vsd,left= 0.00 kN/m, Vsd,right= -6.56 kN/m
Span-1, Vsd,left= 10.23 kN/m, Vsd,right= -16.03 kN/m
Span-2, Vsd,left= 14.22 kN/m, Vsd,right= -14.96 kN/m
Span-3, Vsd,left= 13.78 kN/m, Vsd,right= -15.39 kN/m
Span-4, Vsd,left= 13.37 kN/m, Vsd,right= -15.80 kN/m
Span-5, Vsd,left= 15.17 kN/m, Vsd,right= -11.09 kN/m
Cant-2, Vsd,left= 6.56 kN/m, Vsd,right= 0.00 kN/m

Maximum reactions due to dead and live loads (Rg and Rq)
Support-0, Rg(x1.35)= 10.07 kN/m, Rq(x1.50)= 7.58 kN/m
Support-1, Rg(x1.35)= 18.28 kN/m, Rq(x1.50)= 13.55 kN/m
Support-2, Rg(x1.35)= 16.73 kN/m, Rq(x1.50)= 13.62 kN/m
Support-3, Rg(x1.35)= 16.73 kN/m, Rq(x1.50)= 13.62 kN/m
Support-4, Rg(x1.35)= 18.28 kN/m, Rq(x1.50)= 13.55 kN/m
Support-5, Rg(x1.35)= 10.07 kN/m, Rq(x1.50)= 7.58 kN/m

8.3. Design actions, shearing forces and bending moments

Design action values after moment redistribution by 0% (EC2 §5.5)
Reduction of support moments to moments at support faces (bsup=0.20 m) (EC2 §5.3.2.2.3)
Check for minimum values, ($0.65ql^2/8$ or $0.65ql^2/12$) (EC2 §5.3.2.2.3N)

Maximum span bending moments and shear forces for load combinations 1.35g+1.50q
Cant-1, Msd= -2.30 kNm/m, Vsd,left= 0.00 kN/m, Vsd,right= -6.56 kN/m
Span-1, Msd= 7.40 kNm/m, Vsd,left= 11.26 kN/m, Vsd,right= -15.00 kN/m
Span-2, Msd= 6.72 kNm/m, Vsd,left= 15.11 kN/m, Vsd,right= -14.06 kN/m
Span-3, Msd= 7.58 kNm/m, Vsd,left= 14.59 kN/m, Vsd,right= -14.59 kN/m
Span-4, Msd= 6.72 kNm/m, Vsd,left= 14.06 kN/m, Vsd,right= -15.11 kN/m
Span-5, Msd= 7.40 kNm/m, Vsd,left= 15.00 kN/m, Vsd,right= -11.26 kN/m
Cant-2, Msd= -2.30 kNm/m, Vsd,left= 6.56 kN/m, Vsd,right= 0.00 kN/m



Maximum bending moments at supports for load combinations 1.35g+1.50q
Support-0, Msd= -2.30 kNm/m, x1=0.900 m, x2=0.295 m
Support-1, Msd= -10.67 kNm/m, x1=0.977 m, x2=1.002 m
Support-2, Msd= -9.10 kNm/m, x1=0.900 m, x2=0.856 m
Support-3, Msd= -9.10 kNm/m, x1=0.856 m, x2=0.900 m
Support-4, Msd= -10.67 kNm/m, x1=1.002 m, x2=0.977 m
Support-5, Msd= -2.30 kNm/m, x1=0.295 m, x2=0.900 m

8.4. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

Reinforcement of spans
Msd1= 7.40kNm/m, d=160mm, Kd=5.88 x/d=0.05 εc/εs=1.0/20.0 ks=2.34, **As= 1.08cm²/m**
x=0.05x160= 8mm<= 70mm=hs, neutral axis within the depth of top flange
Msd2= 6.72kNm/m, d=160mm, Kd=6.17 x/d=0.05 εc/εs=1.0/20.0 ks=2.34, **As= 0.98cm²/m**
x=0.05x160= 8mm<= 70mm=hs, neutral axis within the depth of top flange
Msd3= 7.58kNm/m, d=160mm, Kd=5.81 x/d=0.05 εc/εs=1.0/20.0 ks=2.34, **As= 1.11cm²/m**
x=0.05x160= 8mm<= 70mm=hs, neutral axis within the depth of top flange
Msd4= 6.72kNm/m, d=160mm, Kd=6.17 x/d=0.05 εc/εs=1.0/20.0 ks=2.34, **As= 0.98cm²/m**
x=0.05x160= 8mm<= 70mm=hs, neutral axis within the depth of top flange
Msd5= 7.40kNm/m, d=160mm, Kd=5.88 x/d=0.05 εc/εs=1.0/20.0 ks=2.34, **As= 1.08cm²/m**
x=0.05x160= 8mm<= 70mm=hs, neutral axis within the depth of top flange

Reinforcement over supports

```
Msd0= -2.30kNm/m, d=160mm, Kd=10.56 x/d=0.03 εc/εs=0.5/20.0 ks=2.32,   As= 0.33cm²/m
Msd1=-10.67kNm/m, d=160mm, Kd=4.90 x/d=0.06 εc/εs=1.3/20.0 ks=2.35,    As= 1.57cm²/m
Msd2= -9.10kNm/m, d=160mm, Kd=5.30 x/d=0.05 εc/εs=1.2/20.0 ks=2.34,    As= 1.33cm²/m
Msd3= -9.10kNm/m, d=160mm, Kd=5.30 x/d=0.05 εc/εs=1.2/20.0 ks=2.34,    As= 1.33cm²/m
Msd4=-10.67kNm/m, d=160mm, Kd=4.90 x/d=0.06 εc/εs=1.3/20.0 ks=2.35,    As= 1.57cm²/m
Msd5= -2.30kNm/m, d=160mm, Kd=10.56 x/d=0.03 εc/εs=0.5/20.0 ks=2.32,   As= 0.33cm²/m
```

8.5. Minimum reinforcement at spans

(EC2 EN1992-1-1:2004, §9.3.1)

```
Span-1, As>=0.26bd·Fctm/fyk (As= 0.50cm²/m) minimum reinforcement 1Ø10/65.0( 1.21cm²/m)
Span-2, As>=0.26bd·Fctm/fyk (As= 0.50cm²/m) minimum reinforcement 1Ø10/65.0( 1.21cm²/m)
Span-3, As>=0.26bd·Fctm/fyk (As= 0.50cm²/m) minimum reinforcement 1Ø10/65.0( 1.21cm²/m)
Span-4, As>=0.26bd·Fctm/fyk (As= 0.50cm²/m) minimum reinforcement 1Ø10/65.0( 1.21cm²/m)
Span-5, As>=0.26bd·Fctm/fyk (As= 0.50cm²/m) minimum reinforcement 1Ø10/65.0( 1.21cm²/m)
```

8.6. Serviceability limit state, deflection control

(EC2 EN1992-1-1:2004, §7.4.2)

```
Cant-1, K=0.40, ρ=0.021%, L/d=  900/ 160= 5.62< 8.00          (EC2 T.7.4N)
Span-1, K=1.50, ρ=0.068%, L/d= 3600/ 160=22.50<30.00
Span-2, K=1.50, ρ=0.061%, L/d= 4000/ 160=25.00<30.00
Span-3, K=1.50, ρ=0.069%, L/d= 4000/ 160=25.00<30.00
Span-4, K=1.50, ρ=0.061%, L/d= 4000/ 160=25.00<30.00
Span-5, K=1.50, ρ=0.068%, L/d= 3600/ 160=22.50<30.00
Cant-2, K=0.40, ρ=0.021%, L/d=  900/ 160= 5.62< 8.00
```

8.7. Reinforcement

Span reinforcement

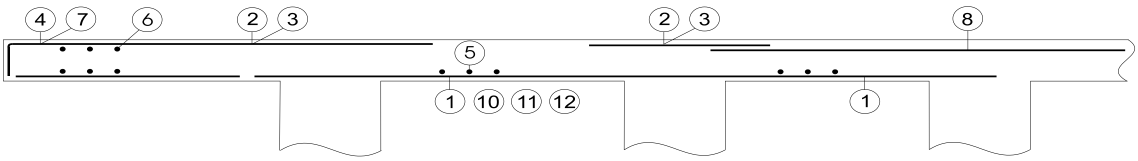
```
Cant-1   Ø10/36.0  ( 2.18cm²/m) principal at top,      Ø8/45.0  ( 1.12cm²/m) secondary
Span-1 1Ø12/ 65.0  ( 1.74cm²/m) principal at bottom, 2Ø12/180.0 ( 1.26cm²/m) secondary
Span-2 1Ø12/ 65.0  ( 1.74cm²/m) principal at bottom, 2Ø12/200.0 ( 1.12cm²/m) secondary
Span-3 1Ø12/ 65.0  ( 1.74cm²/m) principal at bottom, 2Ø12/200.0 ( 1.12cm²/m) secondary
Span-4 1Ø12/ 65.0  ( 1.74cm²/m) principal at bottom, 2Ø12/200.0 ( 1.12cm²/m) secondary
Span-5 1Ø12/ 65.0  ( 1.74cm²/m) principal at bottom, 2Ø12/180.0 ( 1.26cm²/m) secondary
Cant-2   Ø10/36.0  ( 2.18cm²/m) principal at top,      Ø8/45.0  ( 1.12cm²/m) secondary
```

Reinforcement over supports

```
Support-0  Ø10/36.0  ( 2.18cm²/m) reinforcement at top
Support-1  Ø10/36.0  ( 2.18cm²/m) reinforcement at top
Support-2  Ø10/36.0  ( 2.18cm²/m) reinforcement at top
Support-3  Ø10/36.0  ( 2.18cm²/m) reinforcement at top
Support-4  Ø10/36.0  ( 2.18cm²/m) reinforcement at top
Support-5  Ø10/36.0  ( 2.18cm²/m) reinforcement at top
```

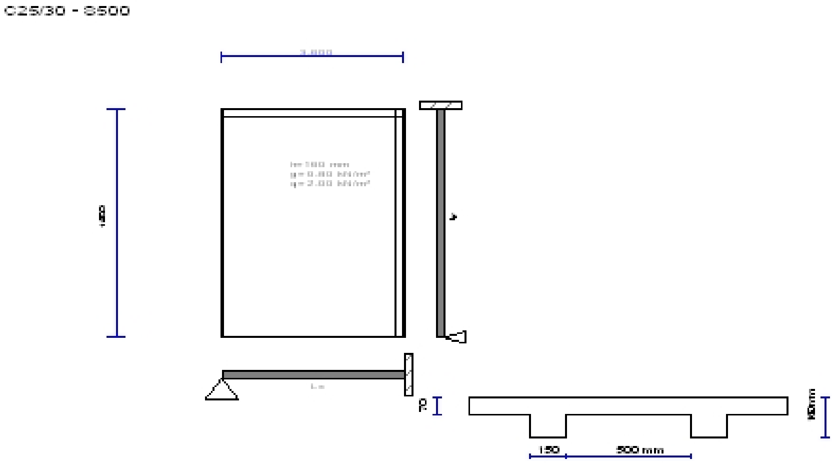
8.8. Reinforcing bar schedule

Num		type	reinforcing bar [mm]	items	∅	g/m [kg/m]	length [m]	weight [kg]
37	(Span-1)	1	4100	14	12	0.888	4.100	50.97
38	(Span-2)	1	4500	14	12	0.888	4.500	55.94
39	(Span-3)	1	4500	14	12	0.888	4.500	55.94
40	(Span-4)	1	4500	14	12	0.888	4.500	55.94
41	(Span-5)	1	4100	14	12	0.888	4.100	50.97
42	(Cant-1)	4	150 2090	25	10	0.617	2.240	34.55
43	(Supp-1)	2	2560	25	10	0.617	2.560	39.49
44	(Supp-2)	2	2580	25	10	0.617	2.580	39.80
45	(Supp-3)	2	2580	25	10	0.617	2.580	39.80
46	(Supp-4)	2	2560	25	10	0.617	2.560	39.49
47	(Cant-2)	4	2090 160	25	10	0.617	2.250	34.71
48	(Cant-1)	5	9000	2	8	0.395	9.000	7.11
49	(Cant-1)	6	9000	2	8	0.395	9.000	7.11
50	(Span-1)	5	9000	4	12	0.888	9.000	31.97
51	(Span-2)	5	9000	4	12	0.888	9.000	31.97
52	(Span-3)	5	9000	4	12	0.888	9.000	31.97
53	(Span-4)	5	9000	4	12	0.888	9.000	31.97
54	(Span-5)	5	9000	4	12	0.888	9.000	31.97
55	(Cant-2)	5	9000	4	8	0.395	9.000	14.22
56	(Cant-2)	6	9000	4	8	0.395	9.000	14.22
			Total weight [kg]					**700.11**

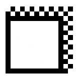


9. SLAB-009

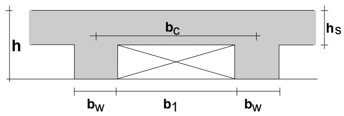
Two-way ribbed slab
(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)



Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
Concrete weight : 25.0 kN/m³
γc=1.50, γs=1.15 (EC2 Table 2.1N)



9.1. Dimensions and loads

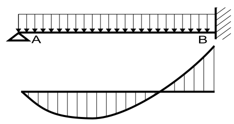


Slab thickness h=0.160 m, Spans Lx=3.600 m, Ly=4.500 m
Thickness of top solid slab hs=0.070 m
Rib width bw=0.150m, clear distance between ribs b1=0.500m, rib spacing bc=0.650m
Slab loads: dead g=(2.67+0.80)=3.47 kN/m², live q=2.00 kN/m²
Partial safety factors for actions : γG=1.35, γQ=1.50 (EC0 Annex A1)
Combination of variable actions : ψ1=0.60, ψ2=0.30
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+10/2=20mm, d=160-20=140mm

Method of analysis: Czerny F., "Tafeln fur vierseitig und dreiseitig gelagerte Rechteckplatten", Beton Kalender 1983, Berlin, Ernst Sohn, 1983
Ly/Lx=4.500/3.600=1.25, Table 2.2.4

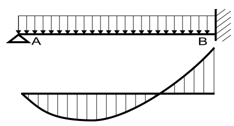
9.2. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

9.2.1. Direction of slab analysis x-x, Lx=3.60 m



Moment at support MsdsupA=0 kNm/m
Moment at support MsdsupB=(1.35x3.47+1.50x2.00)x3.600²/11.10=-8.97 kNm/m
Moment at span Msdspan=(1.35x3.47+1.50x2.00)x3.600²/28.00= 3.56 kNm/m
Reactions dead, VgA= 3.47x3.600/2.53= 4.94 VgB= 3.47x3.600/1.72= 7.26 kN/m
Reactions live, VqA= 2.00x3.600/2.53= 2.85 VqB= 2.00x3.600/1.72= 4.19 kN/m

9.2.2. Direction of slab analysis y-y, Ly=4.50 m



Moment at support MsdsupA=0 kNm/m
Moment at support MsdsupB=(1.35x3.47+1.50x2.00)x3.600²/12.90=-7.72 kNm/m
Moment at span Msdspan=(1.35x3.47+1.50x2.00)x3.600²/45.60= 2.18 kNm/m
Reactions dead, VgA= 3.47x3.600/2.56= 4.88 VgB= 3.47x3.600/1.86= 6.71 kN/m
Reactions live, VqA= 2.00x3.600/2.56= 2.81 VqB= 2.00x3.600/1.86= 3.87 kN/m

9.3. Ultimate limit state, design for bending (EC2 EN1992-1-1:2004, §6.1, §9.3.1)

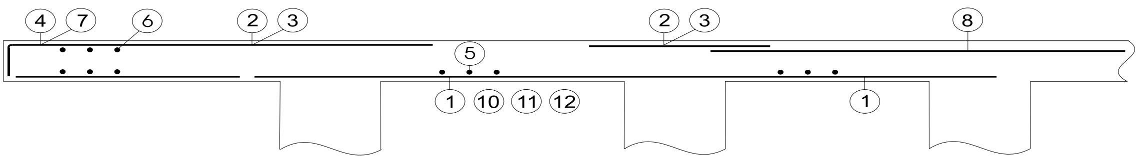
Msd= 3.56kNm/m, d=140mm, Kd=7.42 x/d=0.04 $\varepsilon c/\varepsilon s$=0.8/20.0 ks=2.33, **As= 0.59cm^2/m**
x=0.04x140= 6mm<= 70mm=hs, neutral axis within the depth of top flange
Msd= 2.18kNm/m, d=130mm, Kd=8.80 x/d=0.03 $\varepsilon c/\varepsilon s$=0.7/20.0 ks=2.32, **As= 0.39cm^2/m**
x=0.03x130= 4mm<= 70mm=hs, neutral axis within the depth of top flange
Msd= -8.97kNm/m, d=140mm, Kd=4.67 x/d=0.06 $\varepsilon c/\varepsilon s$=1.3/20.0 ks=2.35, **As= 1.51cm^2/m**
Msd= -7.72kNm/m, d=140mm, Kd=5.04 x/d=0.06 $\varepsilon c/\varepsilon s$=1.2/20.0 ks=2.35, **As= 1.29cm^2/m**

Minimum slab reinforcement, As>=0.26bd·Fctm/fyk (As= 0.44cm^2/m) (EC2 §9.3.1)
minimum principal reinforcement 1Ø10/65.0 (1.21cm^2/m)
span/eff. depth, K=1.30, ρ=0.042%, L/d= 3600/ 140=25.71<26.00 (EC2 T.7.4N)

Span reinforcement:	**x-x**	**1Ø12/65.0**	(1.74cm^2/m), (bottom layer)
	y-y	**1Ø12/65.0**	(1.74cm^2/m)
Reinforcement over supports:	**Left**	**Ø8/45.0**	(1.12cm^2/m)
	Right	**Ø8/33.0**	(1.52cm^2/m)
	Bottom	**Ø8/45.0**	(1.12cm^2/m)
	Top	**Ø8/38.5**	(1.31cm^2/m)

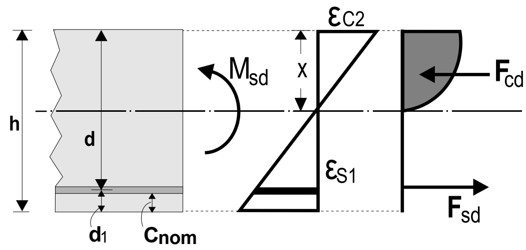
9.4. Reinforcing bar schedule

Num	type	reinforcing bar [mm]	items	Ø	g/m [kg/m]	length [m]	weight [kg]
57	1	4100	7	12	0.888	4.100	25.49
58	1	5000	6	12	0.888	5.000	26.64
59	2	2260	10	8	0.395	2.260	8.93
60	2	2260	14	8	0.395	2.260	12.50
61	2	2710	8	8	0.395	2.710	8.56
62	2	2710	9	8	0.395	2.710	9.63
		Total weight [kg]					**91.75**



10. SLAB-010

Moment capacity of slab section
(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)



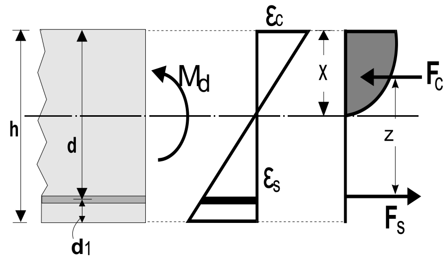
h=0.180 m, Ø10/25.0 (3.14cm²/m)
Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
γc=1.50, γs=1.15 (EC2 Table 2.1N)

10.1. Dimensions and loads

Slab thickness 0.180 m, reinforcement Ø10/25.0(3.14cm²/m)
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+10/2=20mm, d=180-20=160mm

10.2. Cross section moment capacity

(EC2 EN1992-1-1:2004, §6.1)



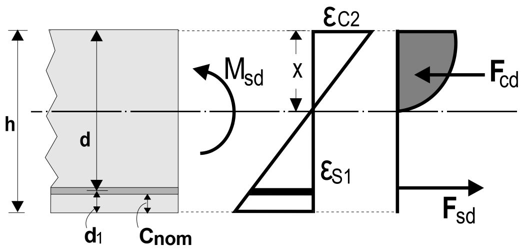
(iterations:3). From internal force equilibrium we have:
εc=2.00(o/oo), Fc=α·0.85fcd·b·x, α=0.667, x=14.5mm, x/d=0.09
Fc= -α·0.85fcd·b·x = 0.001x0.667x0.85x16.67x1000x 14.5= -137kN
εs=20.00(o/oo)>2.17=εy, Fs=As·fyd= 0.001x 314x435.0 = 137kN
z=d-Ka·x, Ka=0.375, z=160-0.375x14.46=155mm
Moment capacity of cross section Md=z·Fs=0.155x137= 21.24kNm

Ultimate moment capacity of slab cross section Md= 21.24 kNm/m

11. SLAB-011

Moment capacity of slab section with FRP strengthening
(EC2 EN1992-1-1:2004, EC0 EN1990-1-1:2002)

h=0.180 m, Ø10/25.0 (3.14cm^2/m)
FRP+epoxy, t(FRP)= 1.00 mm
Concrete-Steel class: C25/30-S500 (EC2 §3)
Concrete cover : Cnom=15 mm (EC2 §4.4.1)
γc=1.50, γs=1.15 (EC2 Table 2.1N)



11.1. Dimensions and loads

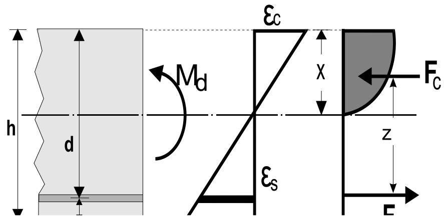
Slab thickness 0.180 m, reinforcement Ø10/25.0(3.14cm^2/m)
Effective depth of cross section d=h-d1, d1=Cnomc+Ø/2=15+10/2=20mm, d=180-20=160mm

Fibre Reinforced Polymer material (FRP)

Characteristic name : FRP+epoxy
Total thickness : 1.00 mm
Modulus of elasticity : 100 GPa
Tensile strength : 1000 MPa
Cross section area : 1000x1.00= 1000 mm^2

11.2. Cross section moment capacity, without FRP strengthening

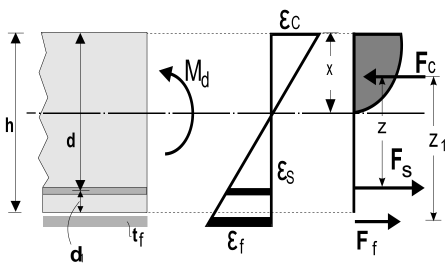
(EC2 EN1992-1-1:2004, §6.1)



(iterations:3). From internal force equilibrium we have:
εc=2.00(o/oo), Fc=α·0.85fcd·b·x, α=0.667, x=14.5mm, x/d=0.09
Fc= -α·0.85fcd·b·x = 0.001x0.667x0.85x16.67x1000x 14.5= -137kN
εs=20.00(o/oo)>2.17=εy, Fs=As·fyd= 0.001x 314x435.0 = 137kN
z=d-Ka·x, Ka=0.375, z=160-0.375x14.46=155mm
Moment capacity of cross section Md=z·Fs=0.155x137= 21.24kNm

11.3. Cross section moment capacity, with FRP strengthening

(EC2 EN1992-1-1:2004, §6.1)



(iterations:5). From internal force equilibrium we have:
initial deformation of bottom face εfo=0.00(o/oo)
εc=3.50(o/oo), Fc=α·0.85fcd·b·x, α=0.810, x=65.5mm, x/d=0.41
Fc= -α·0.85fcd·b·x = 0.001x0.810x0.85x16.67x1000x 65.5= -751kN
εs= 5.05(o/oo)>2.17=εy, Fs=As·fyd= 0.001x 314x435.0 = 137kN
εf+εfo=6.15(o/oo), εf=6.15, σf=Ef·εf=100x6.15=615MPa
σf= 615MPa<1000(tensile strength) Ff=Af·σf= 1000x 615= 615kN
z=d-Ka·x, Ka=0.416, z=160-0.416x65.48=133mm
z1=(z·Fs+(z+d1+tf/2)·Ff)/(Fs+Ff)=(133x137+153x615)/(137+615)=150mm
Moment capacity of cross section Md=z1·(Fs+Ff)=0.150x(137+615)=112.80kNm

Ultimate moment capacity of slab cross section Md= 112.80 kNm/m

Reinforcing bar schedule

Num	Structure object	type	reinforcing bar [mm]	items	Ø	g/m [kg/m]	length [m]	weight [kg]
1	SLAB-002(Span-1)	P1	4020	25	10	0.617	4.020	62.01
2	SLAB-002(Span-2)	P1	4020	25	10	0.617	4.020	62.01
3	SLAB-002(Span-3)	P1	4020	25	10	0.617	4.020	62.01
4	SLAB-002(Cant-1)	P4	150 | 2090	25	10	0.617	2.240	34.55
5	SLAB-002(Supp-1)	P2	2550	25	10	0.617	2.550	39.33
6	SLAB-002(Supp-2)	P2	2550	25	10	0.617	2.550	39.33
7	SLAB-002(Cant-2)	P4	2090 | 160	25	10	0.617	2.250	34.71
8	SLAB-002(Cant-1)	P5	9000	2	8	0.395	9.000	7.11
9	SLAB-002(Cant-1)	P6	9000	2	8	0.395	9.000	7.11
10	SLAB-002(Span-1)	P5	9000	8	8	0.395	9.000	28.44
11	SLAB-002(Span-2)	P5	9000	8	8	0.395	9.000	28.44
12	SLAB-002(Span-3)	P5	9000	8	8	0.395	9.000	28.44
13	SLAB-002(Cant-2)	P5	9000	2	8	0.395	9.000	7.11
14	SLAB-002(Cant-2)	P6	9000	2	8	0.395	9.000	7.11
15	SLAB-003	P1	4020	12	10	0.617	4.020	29.76
16	SLAB-003	P1	4920	10	10	0.617	4.920	30.36
17	SLAB-003	P2	2260	10	8	0.395	2.260	8.93
18	SLAB-003	P2	2380	12	10	0.617	2.380	17.62
19	SLAB-003	P2	2710	8	8	0.395	2.710	8.56
20	SLAB-003	P2	2830	10	10	0.617	2.830	17.46
21	SLAB-004	P1	4020	12	10	0.617	4.020	29.76
22	SLAB-004	P1	4920	10	10	0.617	4.920	30.36
23	SLAB-004	P2	2380	14	10	0.617	2.380	20.56
24	SLAB-004	P2	2260	10	8	0.395	2.260	8.93
25	SLAB-004	P2	2710	8	8	0.395	2.710	8.56
26	SLAB-004	P9	1410 / 1410 | 150	10	10	0.617	2.970	18.32
27	SLAB-005	P1	2600	15	12	0.888	2.600	34.63
28	SLAB-005	P1	5000	7	12	0.888	5.000	31.08
29	SLAB-005	P9	880 / 880 | 260	15	12	0.888	2.020	26.91

30	SLAB-005	P2	1510	10	8	0.395	2.650	10.47
31	SLAB-005	P9	1480 / 1480 / 260	7	12	0.888	3.220	20.02
32	SLAB-005	P2	2710	5	8	0.395	4.450	8.79
33	SLAB-006	P4	150 / 2660	7	10	0.617	2.810	12.14
34	SLAB-006	P2	1780	7	10	0.617	1.780	7.69
35	SLAB-006	P5	4770	3	8	0.395	4.770	5.65
36	SLAB-006	P6	4770	3	8	0.395	4.770	5.65
37	SLAB-008(Span-1)	P1	4100	14	12	0.888	4.100	50.97
38	SLAB-008(Span-2)	P1	4500	14	12	0.888	4.500	55.94
39	SLAB-008(Span-3)	P1	4500	14	12	0.888	4.500	55.94
40	SLAB-008(Span-4)	P1	4500	14	12	0.888	4.500	55.94
41	SLAB-008(Span-5)	P1	4100	14	12	0.888	4.100	50.97
42	SLAB-008(Cant-1)	P4	150 / 2090	25	10	0.617	2.240	34.55
43	SLAB-008(Supp-1)	P2	2560	25	10	0.617	2.560	39.49
44	SLAB-008(Supp-2)	P2	2580	25	10	0.617	2.580	39.80
45	SLAB-008(Supp-3)	P2	2580	25	10	0.617	2.580	39.80
46	SLAB-008(Supp-4)	P2	2560	25	10	0.617	2.560	39.49
47	SLAB-008(Cant-2)	P4	2090 / 160	25	10	0.617	2.250	34.71
48	SLAB-008(Cant-1)	P5	9000	2	8	0.395	9.000	7.11
49	SLAB-008(Cant-1)	P6	9000	2	8	0.395	9.000	7.11
50	SLAB-008(Span-1)	P5	9000	4	12	0.888	9.000	31.97
51	SLAB-008(Span-2)	P5	9000	4	12	0.888	9.000	31.97
52	SLAB-008(Span-3)	P5	9000	4	12	0.888	9.000	31.97
53	SLAB-008(Span-4)	P5	9000	4	12	0.888	9.000	31.97
54	SLAB-008(Span-5)	P5	9000	4	12	0.888	9.000	31.97
55	SLAB-008(Cant-2)	P5	9000	4	8	0.395	9.000	14.22
56	SLAB-008(Cant-2)	P6	9000	4	8	0.395	9.000	14.22
57	SLAB-009	P1	4100	7	12	0.888	4.100	25.49
58	SLAB-009	P1	5000	6	12	0.888	5.000	26.64
59	SLAB-009	P2	2260	10	8	0.395	2.260	8.93
60	SLAB-009	P2	2260	14	8	0.395	2.260	12.50
61	SLAB-009	P2	2710	8	8	0.395	2.710	8.56
62	SLAB-009	P2	2710	9	8	0.395	2.710	9.63

Total weight [kg]	1631.78

slab name		h	Lx	Ly	span reinforcement		support reinforcement			
		[cm]	[m]	[m]	x-x	y-y				
SLAB-002(Cant1)		18.0	0.90	9.00						
SLAB-002(1)		18.0	3.60	9.00	Ø10/36.0_	Ø8/45.0				
SLAB-002(1)		18.0	3.60	9.00	Ø8/45.0					
SLAB-002(2)		18.0	3.60	9.00	Ø10/36.0_	Ø8/45.0		Ø10/36.0		
SLAB-002(2)		18.0	3.60	9.00	Ø10/36.0					
SLAB-002(3)		18.0	3.60	9.00			Ø10/36.0	Ø8/45.0		
SLAB-002(3)		18.0	3.60	9.00	Ø8/45.0					
SLAB-002(Cant2)		18.0	0.90	9.00			Ø8/45.0			
SLAB-003		18.0	3.60	4.50	Ø10/36.0_	Ø10/36.0	Ø8/45.0	Ø10/36.0	Ø8/45.0	Ø10/36.0
SLAB-004		18.0	3.60	4.50	Ø10/38.5	Ø10/38.5_	Ø8/45.0	Ø8/45.0	Ø10/20.0	Ø8/45.0
SLAB-006		18.0	1.20	4.80	Ø10/36.0^	Ø8/45.0:		Ø10/36.0		
SLAB-008(Cant1)		18.0	0.90	9.00				1Ø12/65.		
SLAB-008(1)		18.0	3.60	9.00	1Ø12/65.0_	2Ø12/180.0	1Ø12/65.	2Ø12/180		
SLAB-008(2)		18.0	4.00	9.00	1Ø12/65.0_	2Ø12/180.0	2Ø12/180			
SLAB-008(2)		18.0	4.00	9.00	1Ø12/65.0_					
SLAB-008(3)		18.0	4.00	9.00						
SLAB-008(3)		18.0	4.00	9.00	2Ø12/180.0					
SLAB-008(4)		18.0	4.00	9.00						
SLAB-008(4)		18.0	4.00	9.00	1Ø12/65.0_					
SLAB-008(5)		18.0	3.60	9.00	Ø8/45.0	Ø10/36.0				
SLAB-008(5)		18.0	3.60	9.00	2Ø12/180.0					
SLAB-008(Cant2)		18.0	0.90	9.00						
SLAB-009		16.0	3.60	4.50	1Ø12/65.0_	1Ø12/65.0	Ø8/45.0	Ø8/31.5	Ø8/45.0	Ø8/36.5

(_=bottom layer of reinforcement, ^=span reinforcement at top,:=reinforcement at top and