

MEMO 55
ANCHORING REINFORCEMENT
TSS AND RVK UNITS
DESIGN

Date: 20.04.2020
Last rev.: 27.01.2021
Doc. nr.: K3-10/55E

Sign.: sss
Sign.: sss
Control: mlr@oo
IC Control: SB

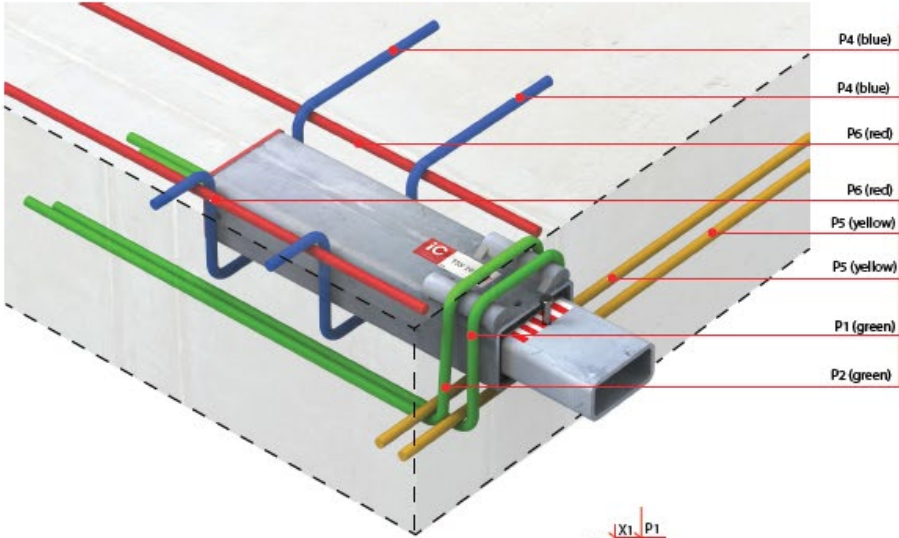
ANCHORING REINFORCEMENT TSS AND RVK UNITS

This memo, together with memo 54, substitutes memo 52, 53, 53a, 54a-d, 55a-d, 56c-e, 57, 60 and 63.

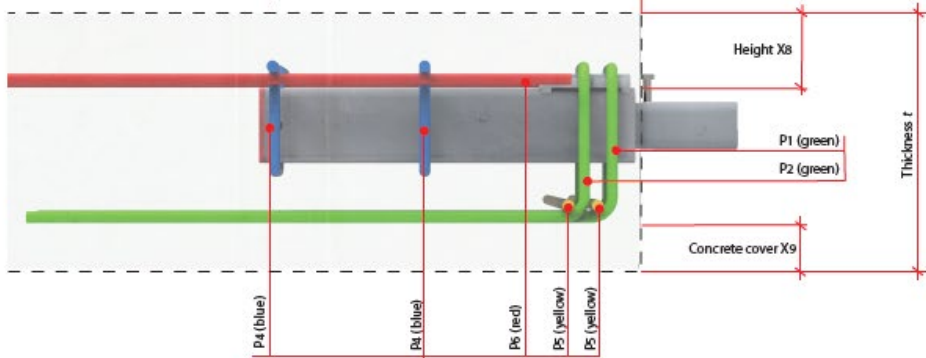
The general, and local reinforcement of the slab in the vicinity of the unit, must be designed by the responsible engineer in order to ensure integrity of the slab itself. The assumed equilibrium situation for the unit, and the corresponding reaction forces from the unit into the slab is found in Memo 54.

LAYOUT OF ANCHORING REINFORCEMENT

3D ILLUSTRATION



CROSS SECTION 1-1



PLAN

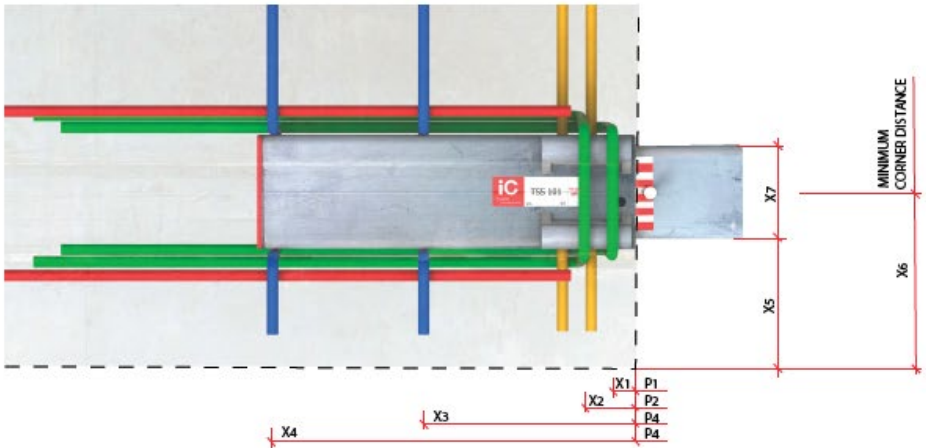
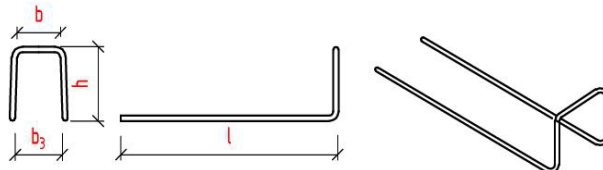
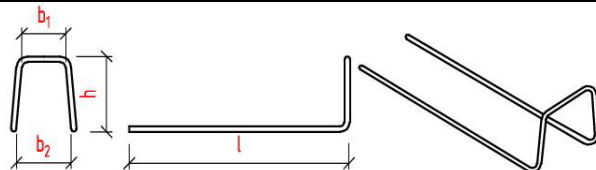
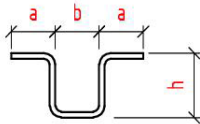



Figure 1: Layout of anchoring reinforcement. Alternative shape of -P4 bars, see Table 2.

ANCHORING REINFORCEMENT

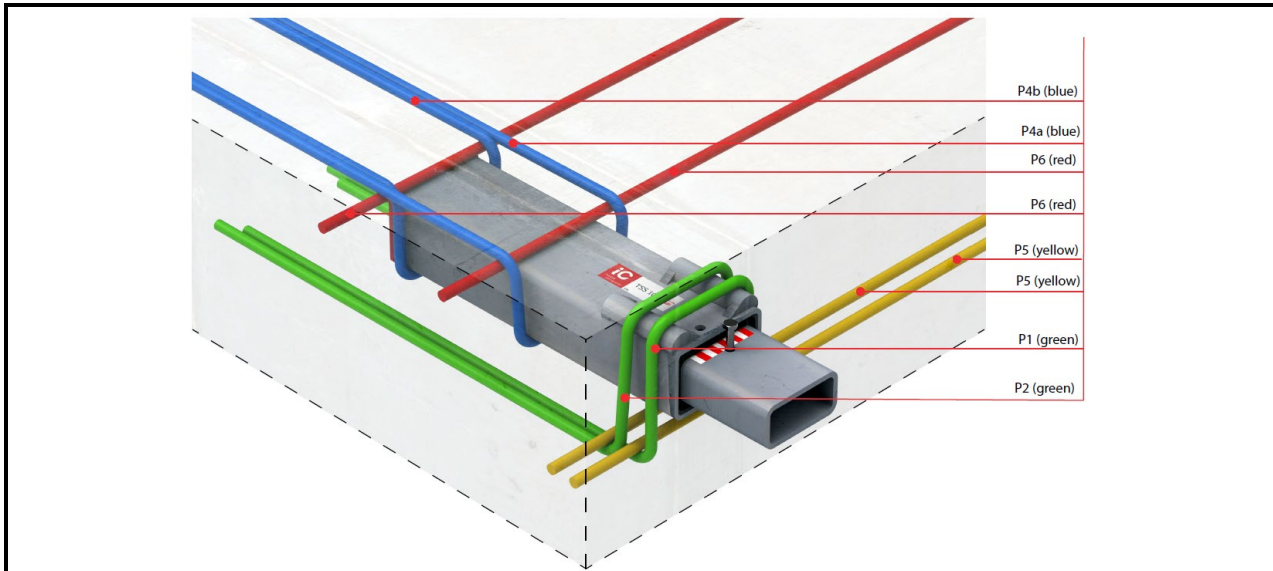
All anchoring reinforcement: Steel grade 500C. Reinforcement steel of different ductility grade may be chosen provided that the bendability is sufficient for fitting the vertical suspension reinforcement to the half round steels in front of the unit. See also Memo 54.

PRODUCT SERIES	TSS 41 TSS 41 G	RVK 60 P ¹⁾	TSS 60 P ¹⁾	TSS 101 TSS 101 G	RVK 101 RVK 101 G	TSS 102 TSS 102 G
Reinforcement P1:						
No. x diameter:	1 x Ø8	1 x Ø8	1 x Ø8	1 x Ø12	1 x Ø12	1 x Ø12
x ₁ [mm]:	25 ± 5	25	25	25 ± 5	25 ± 5	25 ± 5
b [mm]: Internal width	82	98		122		
b ₃ [mm]: Internal width	b ₃ = b = 82		114	b ₃ = b = 122		
h [mm]: See Fig. 1, section 1-1.	Depending on slab thickness. The maximum concrete cover x ₉ shall not be exceeded.					
l [mm]:	600					
Mandrel diameter [mm]:	20	20		32		
Reinforcement P2:						
No. x diameter:	1 x Ø8	1 x Ø8	1 x Ø8	1 x Ø12	1 x Ø12	1 x Ø12
x ₂ [mm]:	45 ± 5	45	45	55 ± 5	55 ± 5	55 ± 5
b ₁ [mm]: Internal width	82	98		122		
b ₂ [mm]: Internal width	105	137		155		
h [mm]: See Fig. 1, section 1-1.	Depending on slab thickness. The maximum concrete cover x ₉ shall not be exceeded.					
l [mm]:	600					
Mandrel diameter [mm]:	20	20		32		
Reinforcement P4:						
No. x diameter:	1+1 x Ø8	1+1 x Ø8	1+1 x Ø8	1+1 x Ø12	1+1 x Ø12	1+1 x Ø12
x ₃ [mm]:	155 ± 5	192	192	175 ± 5	175 ± 5	225 ± 5
x ₄ [mm]:	310 ± 5	301	301	335 ± 5	335 ± 5	385 ± 5
a [mm]:	80	80		120		
b [mm]: Internal width	82	100		122		
h [mm]: See Fig. 1, section 1-1.	Decided locally.					
Mandrel diameter [mm]:	20	20		32		
Reinforcement P5:						
Reinforcement P6:	One transverse bar with the same diameter as the anchorage bar to be placed in the bend of every anchorage bar.					
No. x diameter:	One transverse bar with the same diameter as the anchorage bar to be placed in the bend of every anchorage bar.					
Minimum edge distance:						
x ₅ [mm]:	125	120	120	130	130	130
x ₆ [mm]:	160	160	160	180	180	180
x ₇ [mm]:	70	80	80	100	100	100
Minimum concrete cover (top flange of the outer tube)						
x ₈ [mm]:	50	38	38	70	70	70
Maximum concrete cover P1/P2 at bottom of slab						
x ₉ [mm]:	35	35	35	35	35	35

¹⁾ The plastic outer tube is made with snap-on slots to ensure correct positioning of the reinforcement. Thus, no tolerances are given.

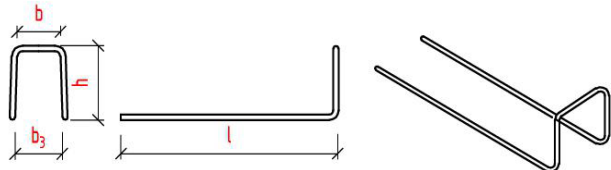
Table 1: Anchoring reinforcement. Alternative shape of reinforcement bars -P4, see Table 2.

ALTERNATIVE SHAPE OF REINFORCEMENT BARS -P4



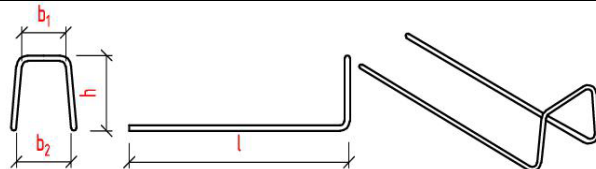
PRODUCT SERIES	TSS 41 TSS 41 G	RVK 60 P ¹⁾	TSS 60 P ¹⁾	TSS 101 TSS 101 G	RVK 101 RVK 101 G	TSS 102 TSS 102 G
----------------	--------------------	------------------------	------------------------	----------------------	----------------------	----------------------

Reinforcement P4a:



No. x diameter:	1 x Ø8	1 x Ø8	1 x Ø8	1 x Ø12	1 x Ø12	1 x Ø12
x ₃ [mm]:	155 ± 5	192	192	175 ± 5	175 ± 5	225 ± 5
b [mm]: Internal width	82	100		122		
b ₃ [mm]: Internal width	105	120		155		
h [mm]: See illustration above	Decided locally					
l [mm]:	600					
Mandrel diameter [mm]:	20	20		32		

Reinforcement P4b:



No. x diameter:	1 x Ø8	1 x Ø8	1 x Ø8	1 x Ø12	1 x Ø12	1 x Ø12
x ₄ [mm]:	310 ± 5	301	301	335 ± 5	335 ± 5	385 ± 5
b ₁ [mm]: Internal width	82	100		122		
b ₂ [mm]: Internal width	b ₂ = b ₁ = 82	b ₂ = b ₁ = 100		b ₂ = b ₁ = 122		
h [mm]: See illustration above	Decided locally					
l [mm]:	600					
Mandrel diameter [mm]:	20	20		32		

¹⁾ The plastic outer tube is made with snap-on slots to ensure correct positioning of the reinforcement. Thus, no tolerances are given.
Table 2: Alternative shape of reinforcement bars -P4, denoted -P4a and -P4b respectively.

RECOMMENDED MAXIMUM ULS LOAD ($F_{V,Ed}$) ON THE UNITS

PRODUCT SERIES	TSS 41 TSS 41 G	RVK 60 P	TSS 60 P	TSS 101 TSS 101 G	RVK 101 RVK 101 G	TSS 102 TSS 102 G
LOAD BEARING CAPACITY $F_{V,Rd}$ [kN] OF STEEL UNIT ITSELF						
Load category a)	40	60	60	100	100	100
Load category b)	39	60	60	94	94	90

RECOMMENDED MAXIMUM ULS LOAD $F_{V,Ed}$ IN LOAD CATEGORY a) AND b) UNDER THE FOLLOWING ASSUMPTIONS:

- Anchoring reinforcement according to Figure 1 and Table 1 (or Table 2).
- Minimum edge distance according to Figure 1 and Table 1.
- The specified maximum concrete cover (x_s) of anchoring bars P1 and P2 according to Figure 1, is not exceeded. With a larger concrete cover on these bars, the capacity is reduced. The reduced capacity will correspond to the capacity of a thinner slab correlating with the change in concrete cover.
- Concrete grade: Minimum C35/45.
- The general reinforcement in the slab is sufficient to carry the load.

The recommended maximum ULS load $F_{V,Ed}$ is based on multiple FEM analyses. The FEM analysis are carried out assuming load category a), with cast-in RVK/TSS 60 P and RVK/TSS 101 units in slabs with various thicknesses. For load category b), the ULS Load is found by requiring the force $R_{1,2}$ to be equal to, or less, than the calculated reaction force $R_{1,1}$, $R_{1,1}$ and $R_{1,2}$ are the front reaction forces in the slab for load category a) and b) respectively, calculated according to the formulas outlined in Memo 54.

PRODUCT SERIES	TSS 41 TSS 41 G	RVK 60 P	TSS 60 P	TSS 101 TSS 101 G	RVK 101 RVK 101 G	TSS 102 TSS 102 G
<i>Load category a) - without simultaneously acting horizontal design support reaction. H_{Ed}</i>						
	Recommended maximum ULS load $F_{V,Ed}$ [kN]					
Slab thickness [mm]	120	-	34	34	-	-
	150	35	46	46	-	-
	170	40	57	57	96	96
	200				100	100
	265				100	100
<i>Load category b) - with simultaneously acting horizontal design support reaction. $H_{Ed}=0,2F_{V,Ed}$</i>						
	Recommended maximum ULS load $F_{V,Ed}$ [kN]					
Slab thickness [mm]	120	-	33	33	-	-
	150	34	44	44	-	-
	170	39	55	55	90	90
	200				94	94
	265				94	94

¹⁾ The TSS102 may in special cases fit into slabs with $t=200\text{mm}$ if reduced concrete cover is acceptable. The unit should be placed centric in the slab, which will slightly reduce the height x_s below the minimum value stated in Table 1.

Table 3: Recommended maximum ULS load $F_{V,Ed}$ in load category a) and b)

REVISION HISTORY	
Date:	Description:
31.03.2020	Preliminary
20.04.2020	Reviewed by company Dr. techn. Olav Olsen. Comments included.
08.05.2020	Updated list of substituted memos. Typing errors corrected.
05.11.2020	Adjusted internal width of P1, P2 and P4.
12.11.2020	Included parameter x_9 , concrete cover.
07.12.2020	Included optional shape of anchoring reinforcement P4. (P4a/P4b). Updated Figure 1
27.01.2021	Increased width of anchoring bars TSS/RVK 60 P: P1, P2 (+2mm) P4, P4a, P4b (+6mm)