MEMO 55 ANCHORING REINFORCEMENT TSS AND RVK UNITS DESIGN	Date: Last rev.: Doc. nr.:	20.04.2020 23.04.2024 K3-10/55E	Sign.: Sign.: Control: IC Control:	sss sss mlr@oo 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

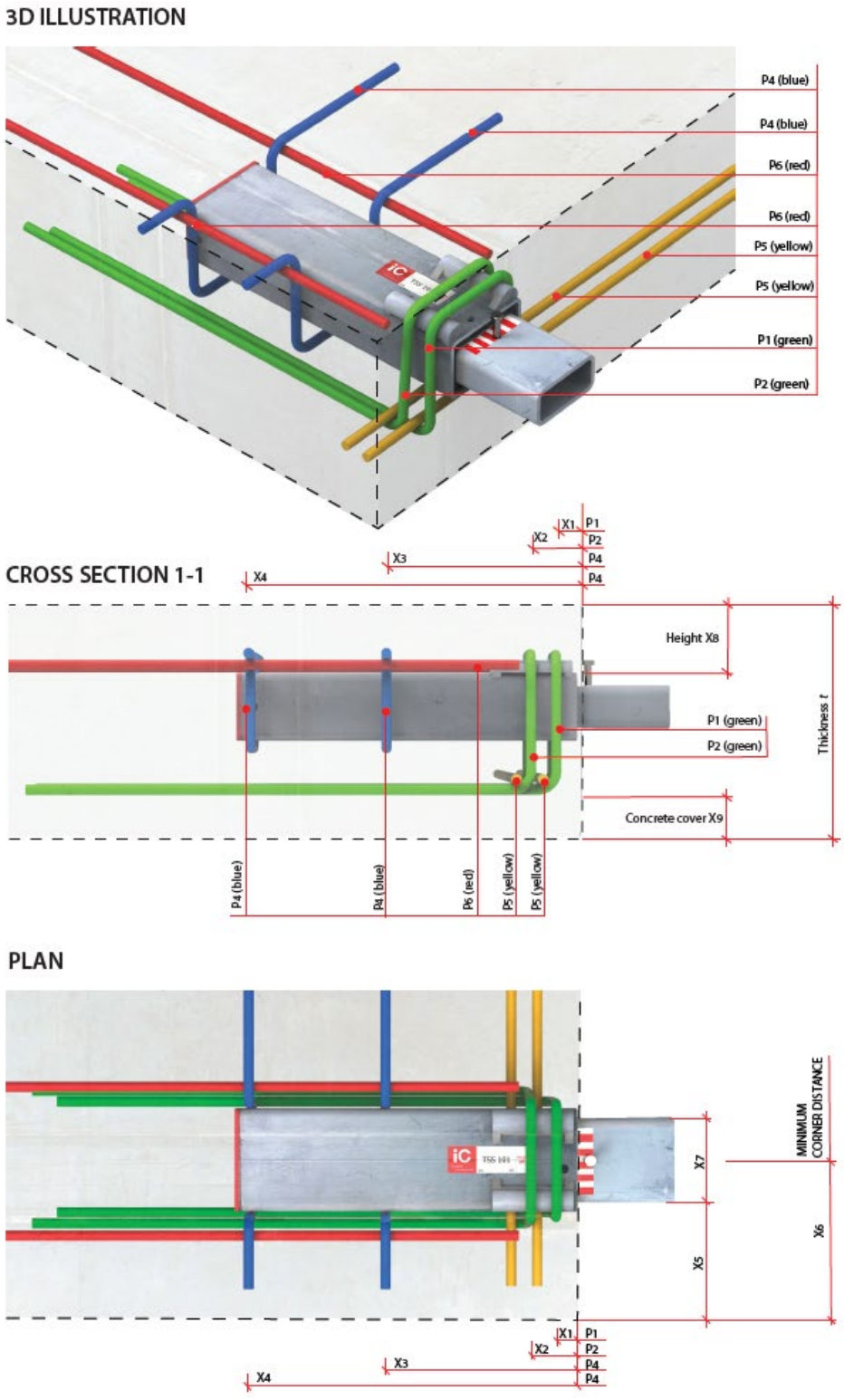
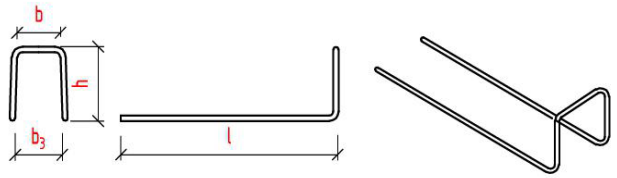
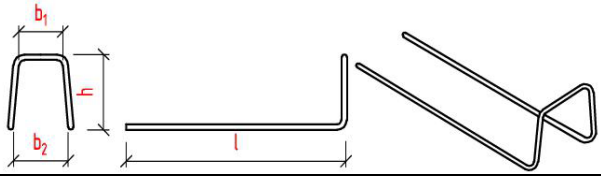
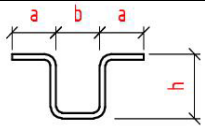


Figure 1: Layout of anchoring reinforcement. Alternative shape of -P4 bars, see Table 2.

ANCHORING REINFORCEMENT

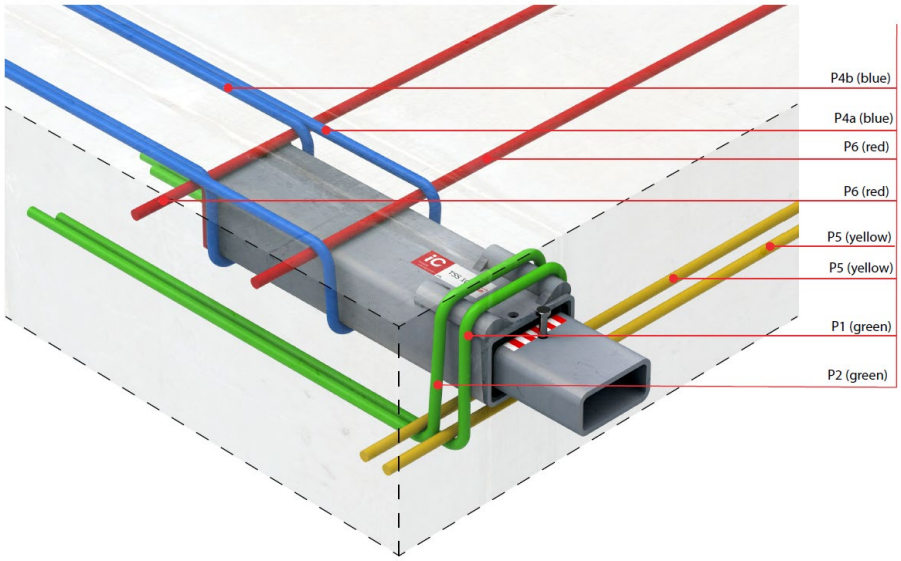
All anchoring reinforcement: Steel grade 500C. Reinforcement steel of different ductility grade may be chosen provided that the bendability is sufficient for fitting the vertical suspension reinforcement to the half round steels in front of the unit. See also Memo 54.

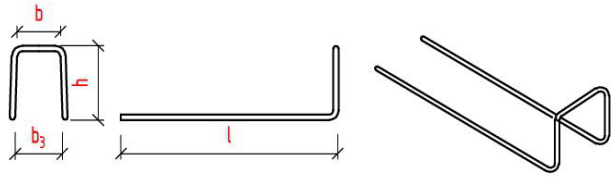
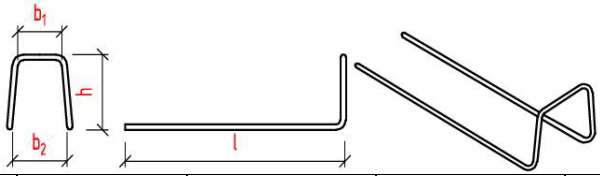
PRODUCT SERIES	RVK 60 P [1)]	TSS 60 P [1)]	TSS 101 TSS 101 G	RVK 101 RVK 101 G	TSS 102 TSS 102 G
Reinforcement P1:					
No. x diameter: x_1 [mm]:	**1 x Ø8** 25	**1 x Ø8** 25	**1 x Ø12** 25 ± 5	**1 x Ø12** 25 ± 5	**1 x Ø12** 25 ± 5
b [mm]: Internal width	98		122		
b_3 [mm]: Internal width	114		b_3 = b = 122		
h [mm]: See Fig. 1, section 1-1.	Depending on slab thickness. The maximum concrete cover x9 shall not be exceeded.				
l [mm]:	600				
Mandrel diameter [mm]:	20		32		
Reinforcement P2:					
No. x diameter: x_2 [mm]:	**1 x Ø8** 45	**1 x Ø8** 45	**1 x Ø12** 55 ± 5	**1 x Ø12** 55 ± 5	**1 x Ø12** 55 ± 5
b_1 [mm]: Internal width	98		122		
b_2 [mm]: Internal width	137		155		
h [mm]: See Fig. 1, section 1-1.	Depending on slab thickness. The maximum concrete cover x9 shall not be exceeded.				
l [mm]:	600				
Mandrel diameter [mm]:	20		32		
Reinforcement P4:					
No. x diameter: x_3 [mm]: x_4 [mm]:	**1+1 x Ø8** 192 301	**1+1 x Ø8** 192 301	**1+1x Ø12** 175 ± 5 335 ± 5	**1+1x Ø12** 175 ± 5 335 ± 5	**1+1x Ø12** 225 ± 5 385 ± 5
a [mm]:	80		120		
b [mm]: Internal width	100		122		
h [mm]: See Fig. 1, section 1-1.	Decided locally.				
Mandrel diameter [mm]:	20		32		
Reinforcement P5: **Reinforcement P6:**					
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]: x_6 [mm]: x_7 [mm]:	 120 160 80	 120 160 80	 130 180 100	 130 180 100	 130 180 100
Minimum concrete cover (top flange of the outer tube) x_8 [mm]:	38	38	70	70	70
Maximum concrete cover P1/P2 at bottom of slab x_9 [mm]:	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	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: x_3 [mm]:	**1 x Ø8** 192	**1 x Ø8** 192	**1 x Ø12** 175 ± 5	**1 x Ø12** 175 ± 5	**1 x Ø12** 225 ± 5
b [mm]: Internal width	100		122		
b_3 [mm]: Internal width	120		155		
h [mm]: See illustration above	Decided locally				
l [mm]:	600				
Mandrel diameter [mm]:	20		32		
Reinforcement P4b:					
No. x diameter: x_4 [mm]:	**1 x Ø8** 301	**1 x Ø8** 301	**1 x Ø12** 335 ± 5	**1 x Ø12** 335 ± 5	**1 x Ø12** 385 ± 5
b_1 [mm]: Internal width	100		122		
b_2 [mm]: Internal width	$b_2 = b_1 = 100$		$b_2 = b_1 = 122$		
h [mm]: See illustration above	Decided locally				
l [mm]:	600				
Mandrel diameter [mm]:	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.

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

PRODUCT SERIES	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)	60	60	100	100	100
Load category b)	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_9) 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		RVK 60 P	TSS 60 P	TSS 101 TSS 101 G	RVK 101 RVK 101 G	TSS 102 TSS 102 G
Load category a) - without *simultaniously acting horizontal design support reaction.* H_{Ed}						
	Recommended maximum ULS load $F_{v,Ed}$ [kN]					
Slab thickness [mm]	120	34	34	-	-	-
	150	46	46	-	-	-
	170	57	57	96	96	-
	200			100	100	96 [1]
	265			100	100	100
Load category b) - with *simultaniously acting horizontal design support reaction.* $H_{Ed}=0,2F_{V,Ed}$						
	Recommended maximum ULS load $F_{v,Ed}$ [kN]					
Slab thickness [mm]	120	33	33	-	-	-
	150	44	44	-	-	-
	170	55	55	90	90	-
	200			94	94	90 [1]
	265			94	94	90

1) *The TSS102 may in special cases fit into slabs with t=200mm if reduced concrete cover is acceptable. The unit should be placed centric in the slab, which will slightly reduce the height x_8 below the minimum value stated in Table 1.*

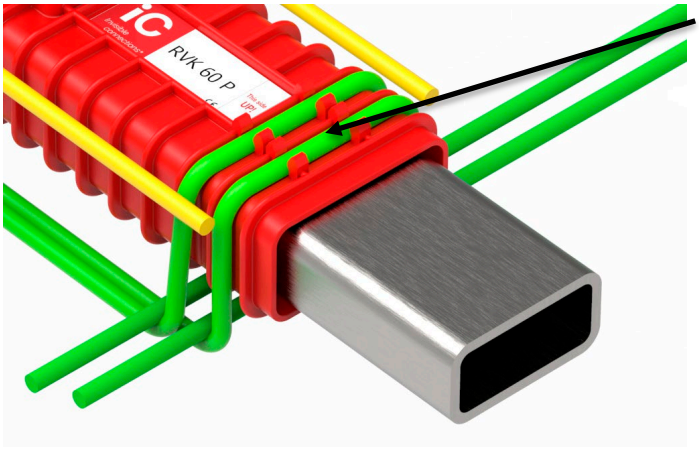
Table 3: Recommended maximum ULS load $F_{V,Ed}$ in load category a) and b). Reinforcement B500NC.

*Load category a) - **without** simultaniously acting horizontal design support reaction. H_{Ed}*				
SLAB THICKNESS [mm]	**UNIT**	**Recommended maximum ULS load $F_{v,Ed}$ [kN]**		
		B500NC	**B500NB**	**B500NA**
265	**TSS 102**	**100**	**100**	**100**
200	**TSS 102**	**96**	**96**	**96**
265	**TSS 101 / RVK 101**	**100**	**100**	**100**
200	**TSS 101 / RVK 101**	**100**	**100**	**100**
170	**TSS 101 / RVK 101**	**96**	**96**	**96**
150	**TSS 60 P / RVK 60 P**	**46**	**36** [1)]	**22**[1)]
120	**TSS 60 P / RVK 60 P**	**34**	**31**[1)]	**22**[1)]

[1)] *When employing TSS 60 P, it is required to utilize a minimum of 8mm diameter bars for the general reinforcement in the slab around the connection. Specifically, there must be at least one transverse Ø8 above the front part of the connection. The analysis indicates that the capacity reduces significantly with lower ductility of the reinforcement. For B500NB the reduction for 150mm and 120mm slab thickness is respectively 23% and 8.8 %. When applying B500NA the corresponding reduction of capacity is 53% and 35%. Based on the results, it is advisable that B500NB and especially B500NA is used with utter cation for TSS 60 P in thin slabs. In general, the responsible engineer should evaluate each separate case, especially the cases where the capacity of the reinforcement is the limiting factor. Reference; Dr. tehcn. Olav Olsen, report: 14299-OO-N-001 «Reanalyse TSS forbindelse med B500NB og B500NA»*

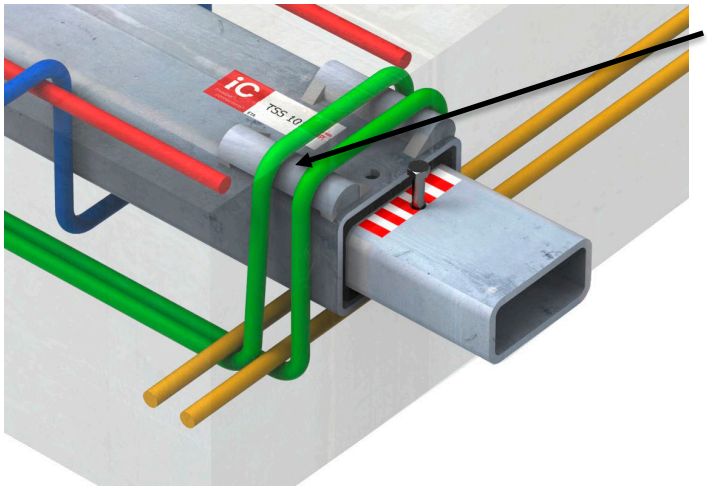
Table 4: Effect of reduced reinforcement ductility.

N.B. IMPORTANT! LAYOUT OF ANCHORING REINFORCEMENT



The reinforcement bars Ø8mm must be located in the «snappers».

This applies to TSS 60 P and RVK 60 P



The reinforcement bars Ø12mm must be located on the halfroundsteel.

This applies to TSS/RVK 101-102

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)
04.02.2022	Removed TSS 41
11.05.2022	Included pictures and important text about reinforcement bars, last page.
23.04.2024	Included Table 4. Effect of reduced reinforcement ductility.