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A SHORT GUIDE TO TSS AND RVK	Dok. nr.:	K3-11/63E	Control:	ps
SLIDING INSERTS				
PLANNING				

A SHORT GUIDE TO TSS AND RVK SLIDING INSERTS

This short guide is intended to give a brief overview of the use and design methods for the TSS without drilling into the details.

INTENDED USE

The connection units are designed for connecting precast stairs and landing elements to the stairway shaft walls, and transferring vertical shear loads between the concrete components. The connections may also be used for support of slabs mounted between walls for other purposes. Standard units are used indoor in dry conditions. Connections made of hot dip galvanized steel may be used for external exposure according to the requirements for the individual projects.

The TSS unit is specially designed to connect precast stair- and landing elements where the final surface finish of the elements are made in the factory, for example terrazzo. A unit specially designed to reduce impact sound transmission is also available.

The working life of the connection units for the intended use is assumed to be at least 50 years when installed in the works, provided that the units are subject to appropriate design and installation based upon the current state of art and the available knowledge and experience.

TSS/RVK

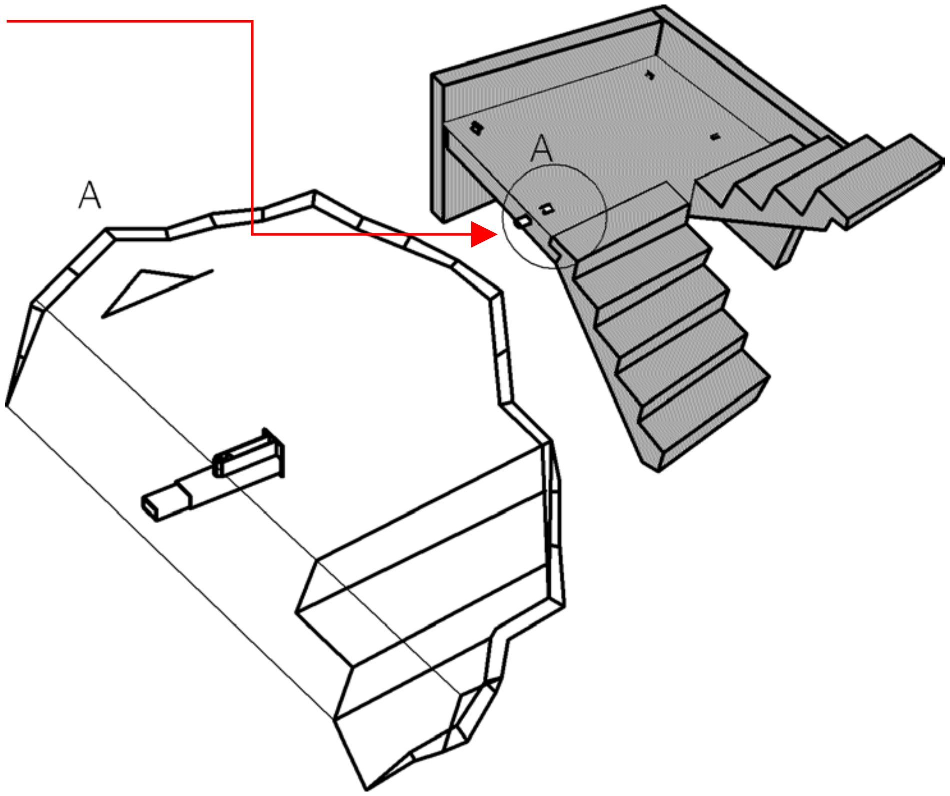


Figure 1: Illustration of unit

HOW IT WORKS

RVK and TSS staircase connections consist of double, extendable, hollow rectangular steel tubes type RHS made of cold worked structural steel to be cast into prefabricated concrete staircase and landing elements. The smaller tube is sliding inside the other one, and form load carrying connections to stairwell walls. Figure 1 illustrates the principle of the staircase connections. The position of the inner tube of the RVK unit is adjusted through a slot in the surface of the staircase element. The units have a safety stop at the rear end of the inner tube to prevent overextension. The TSS unit is identical to the RVK unit except that the TSS unit has no opening to the upper surface. The position of the inner tube is instead adjusted by two strings with different color. The units have a control line marking the correct position of the sliding tube, and a hole for a locking bolt.

TSS 102 is a variant specially designed to reduce impact sound transmission. A rubber layer is glued to the inner tube and the dimension of the outer tube is increased in order to make sufficient space for the rubber. The additional product “Masticord bearing pads” is delivered for providing equal support load distribution and elastic support in order to reduce impact sound transmission. This product can be used in case the TSS 102 unit is not applicable and reduced impact sound transmission is still required. The pads are made of a homogeneous blend of ozone resistant rubber elastomers with a high strength random synthetic fibre cord. The bearing pads are 75 mm wide, 125 mm long and 6,5 mm thick. The hardness is 75shore.

As additional products the manufacturer also provides “Blockout box for RVK/TSS 41 and 101”. used to make recesses in the walls.

MAIN DIMENSIONS

Two sizes of the TSS/RVK unit are produced, with vertical load carrying capacity 40 and 100 kN respectively and are denominated RVK 41/TSS 41 and RVK 101/TSS 101/TSS 102.

Capacity and main dimensions for RVK/TSS staircase connections are shown in Table 1.

Unit	Maximum capacity of steel unit	Minimum slab thickness due to available space *1)	Minimum edge distance *1)	Outer tube w/h/t L	Inner tube w/h/t L	Clearance between tubes	
						Vertically	Horizontally
RVK 41	40kN	150	160	80/50/4 298mm	70/40/4 275mm	2	2
TSS 41	40kN	150	160	80/50/4 320mm	70/40/4 275mm	2	2
RVK 101	100kN	200	180	120/60/4 348mm	100/50/6 295mm	2	12
TSS 101	100kN	200	180	120/60/4 345mm	100/50/6 295mm	2	12
TSS 102	100kN	220 *2)	180	120/80/5 397mm	100/50/6 347mm	4(rubber)	10

Table 1: Capacities and minimum slab dimension to allow for space of the different units.

****1) Note, due to possible concrete failure, it is not recommended to fully utilize the steel capacity of the unit for the smallest edge distances and slab thicknesses. See more information in Memo 52 and Memo 53***

****2) The TSS102 may in special cases fit into slabs with t=200mm if reduced concrete cover is acceptable.***

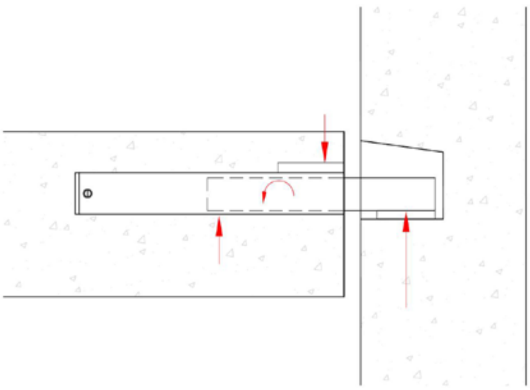
A final evaluation of the slab dimension and required reinforcement in the slab shall be done by qualified engineer in each case. For this purpose, Memo 54a-d, 55a-d, 57 and 60 from the manufacturer may be used as guideline along with the general rules in EC2.

MATERIALS

All parts are made from steel. The main components shown above are grade S355 steel. Designs are based on concrete grade C35/45. Stronger concrete will not increase capacities as they are limited by the steel unit capacity. Weaker concrete **may** lower capacities.

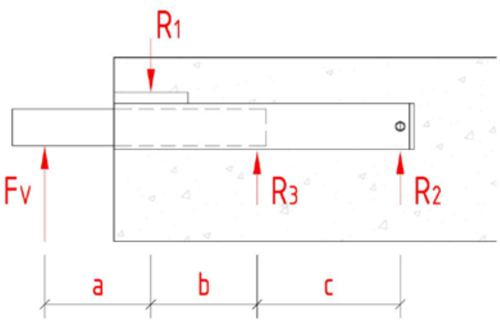
DESIGN PRINCIPLES

When deployed, the sliding inner tube cantilevers from the slab into the wall. It is supported on a shim in the recess at the free end, which induces rotation of the tube. This is resisted by bearing against reinforcement which is not shown in the diagram, but is dealt with later in the guide.



At the front of the unit, the force is transferred into the bends of the anchoring reinforcement by direct steel-steel contact from the webs of the inner tube, through the top flange of the outer tube and further through two welded on half round blocks on top of the outer tube (one above each web of the inner tube). For the TSS/RVK41 units, the half round blocks are replaced with two reinforcement bars. At the rear end of the unit the force is transferred into the reinforcement via the concrete. (For TSS 102 the force will be transferred through the rubber layer).

VERTICAL FORCES



Two different equilibrium situations are considered in order to find the value of the forces R_1 ,R_2 and R_3
Situation 1: Considering only F_v, R_1 and R_3, assuming $R_2=0$: $\Rightarrow R_3 = F_V \times a/b$ & $R_1 = R_3 + F_V$
Situation 2: Considering only F_v, R_1 and R_2, assuming $R_3=0$: $\Rightarrow R_2 = F_V \times a/(b+c)$ & $R_1 = R_2 + F_V$

From these equations, the values for R_1, R_2 and R_3 are found as below.

Type	Fv (kN)	a	b	c	R_1 (kN)	R_2(kN)	R_3 (kN)
TSS 41	40	110	120	155	76,7	16	36,7
RVK 41	40	110	120	130	76,7	17,6	36,7
TSS 101	100	115	135	160	185,2	39	85,2
RVK 101	100	115	135	160	185,2	39	85,2
TSS 102	100	115	187	160	161,5	33,1	61,5

Table 2: Vertical forces (nominal).

The above table is for 'ideal' values for a, b and c. More critical values are obtained by including the unfavourable tolerance on position of the anchoring reinforcement (±5mm). This will lead to the values given in Table 3 below.

Type	Fv (kN)	a	b	c	R_1 (kN)	R_2(kN)	R_3 (kN)
TSS 41	40	115	110	155	81,8	17,4	41,8
RVK 41	40	115	110	130	81,8	19,2	41,8
TSS 101	100	120	125	160	196	42,1	96
RVK 101	100	120	125	160	196	42,1	96
TSS 102	100	120	177	160	167,8	35,6	67,8

Table 3: Vertical forces (maximum).

VERTICAL ANCHORAGE REINFORCEMENT

Reinforcement is grade 500C, with working stress = 435 N/mm². 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.

Special bars, commonly called 'saddle bars' are provided to transmit vertical forces imposed on the half round blocks by the inner tube. The front saddle bars should transmit forces into the lower part of the slab, preferably lapping on to the main tension steel in a beam. Similarly, the rear saddle bars should transmit forces into the top of the member. It is considered good practice to have a transverse bare in the bends in saddle bars to prevent any local concrete crushing inside the bend.

Reinforcement to carry force R_1 is as below.

Type	R_1(kN)	A_s reqd (mm²)	Bars	A_s prov (mm²)
TSS 41/RVK 41	81,8	188	2 x 8 dia	200
TSS 101/RVK101	196	451	2 x 12 dia	452
TSS 102	167,8	386	2 x 12 dia	

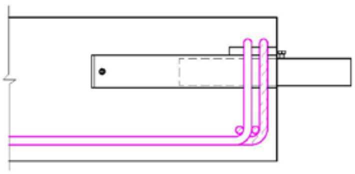


Table 4: Reinforcement for R_1.

Reinforcement to carry force R_2 is as below.

Type	R_2(kN)	A_s reqd (mm²)	Bars	A_s prov (mm²)
TSS 41/RVK 41	19,2	44	1 x 8 dia	100
TSS 101/RVK101	42,1	97	1 x 12 dia	226
TSS 102	35,6	82	1 x 12 dia	

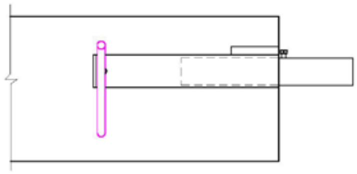


Table 5: Reinforcement for R_2.

Reinforcement to carry force R_3 is as below.

Type	R_3(kN)	A_s reqd (mm²)	Bars	A_s prov (mm²)
TSS 41/RVK 41	41,8	96	1 x 8 dia	100
TSS 101/RVK101	96	221	1 x 12 dia	226
TSS 102	67,8	156	1 x 12 dia	

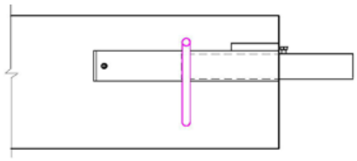


Table 6: Reinforcement for R_3.

REVISION HISTORY	
Date:	Description:
22.01.2015	First Edition
07.01.2016	Included note on reinforcement ductility grade.
21.04.2016	Included TSS 102
25.05.2016	New template