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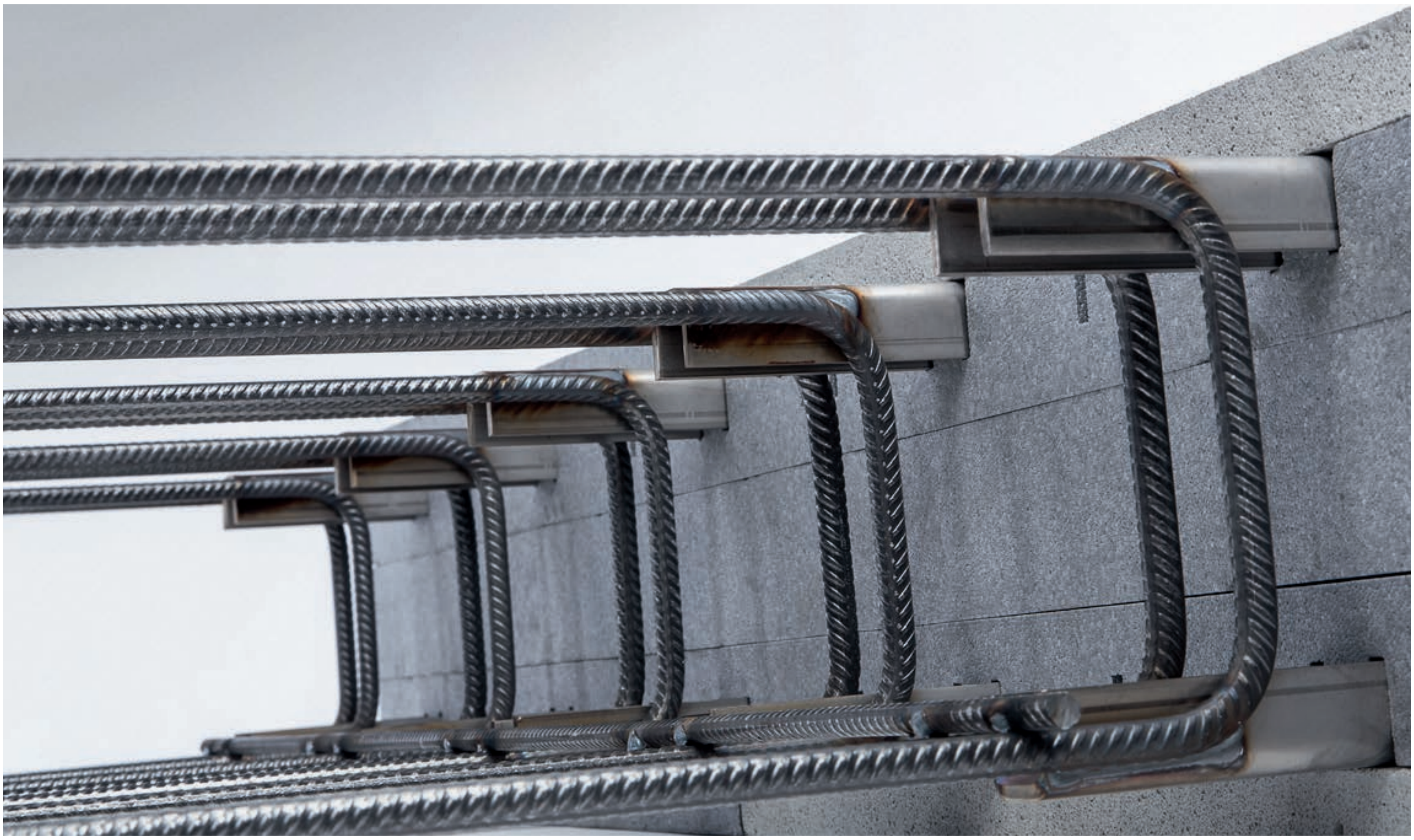
THERMOKORB TK

A LOAD-BEARING CONNECTOR PROVIDING THERMAL INSULATION BETWEEN INSIDE AND OUTSIDE BUILDING ELEMENTS WITH AN INSULATION THICKNESS OF 80 MM



PATENTED

The insulating balcony connector AVI Thermokorb TK is a load-bearing connecting component to be installed between reinforced concrete building elements. It improves thermal insulation at the junction of interior and exterior reinforced concrete building components. Common applications include cantilever balconies, recessed balcony connections, brackets, parapet walls, porches, platforms, etc.

A Thermokorb consists of a structural truss made of independent ribs and of an 80 mm thick expanded polystyrene panel (EPS W30 according to EN 13163). The individual ribs run through the EPS panel. In order to avoid corrosion, they consist in this area of U-shaped stainless steel profiles with stirrups made of ribbed reinforcing steel welded to their ends which transfer the forces from the individual ribs to the subsequent reinforced concrete elements.

As a rule, all individual ribs are designed in a way that they can transfer both positive and negative bending moments and shear forces. The elements consist of a uniform U-shaped stainless steel profile (material no. 1.4571 C 850 according to EN 10088-2) as well as ribbed reinforcing steel stirrups, each 10 mm in diameter (B 550 according to OENORM B4707) which are welded to the flanges of the upper and lower chord.

A Thermokorb is suitable for building element thicknesses from 160 mm. The individual ribs are produced using welding robots and come in heights of 110 mm, 130 mm, 150 mm, 170 mm and 190 mm.

Cross Sectional Height of a Single Rib Element

BCT* (mm)	≥ 160	≥ 180	≥ 200	≥ 220	≥ 240
Rib Height RH (mm)	110	130	150	170	190

DESCRIPTION

On account of its multiaxial strength, Thermokorb TK is appropriate for numerous applications.

For the use in slab-type structures with predominately moment- and/or shear force loading (M_{Ed}, V_{Ed}), standard elements of the TKM and TKA series with a uniform length of 1000 mm and varying number of ribs (2–10 ribs) are provided.

For narrow spaces, however, it is also possible to produce elements with a uniform minimum pitch of ribs of 100 mm. Hence the length of element depends on the number of ribs.

The forces are transferred from the stainless steel profiles to the reinforced concrete through welded ribbed reinforcing steel stirrups of steel grade B550. The 10 mm bar diameter that is always used corresponds optimally to the load bearing capacity of the stainless steel profiles and at the same time, it determines the connection reinforcement to be provided on construction site.

Low deformation and good vibration behaviour are achieved by Thermokorb elements because the individual ribs have a high moment of inertia. The additional cambers for cantilever slabs can therefore be very small.

The load bearing capacity of the ribs depends on rib height RH. The rib height and building component thickness can be matched according to requirements and application. The difference between building component thickness and rib height should not be less than 50 mm in order to ensure sufficient concrete cover.

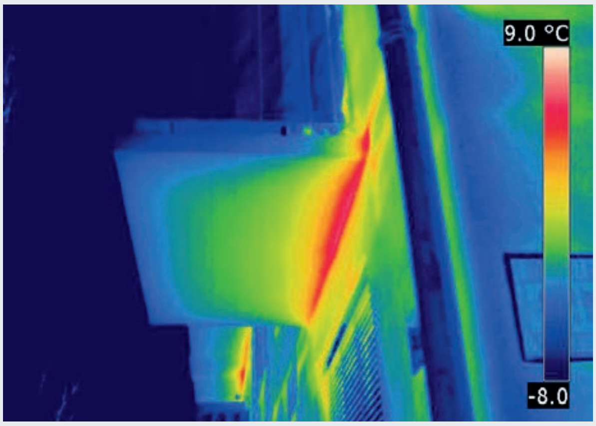
Without additional fire-proofing panels Thermokorb elements are classified as R60. For special fire protection requirements (REI120 execution), fire-proofing panels are glued onto the thermal insulating elements.

For cantilever and terrace slabs, expansion joints should be provided every 12 m. In dependence of loads and application, wider expansion joint spacings may be determined in consultation with AVI's Technical Service.

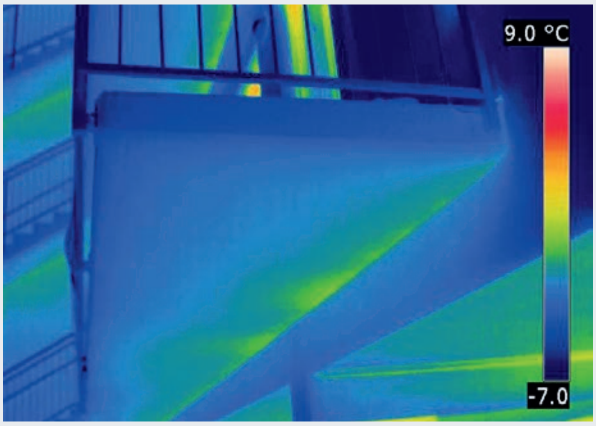
* Building Component Thickness

THERMOGRAPHY OF A BALCONY SLAB

The use of Thermokorb for thermal insulation reduces heat losses which arise from joint-induced and geometric thermal bridges. Uninsulated joint areas also lead to a considerable lowering of the building component surface temperature and an increase in the risk of condensation and mould formation. The use of Thermokorb provides a good heat distribution pattern and heating cost savings.



Uninsulated connection area



Connection area with Thermokorb TK

RECOMMENDED ADDITIONAL CAMBER AS A PERCENTAGE OF CANTILEVER LENGTH

BCT*	Rib Height RH	Rotation ø
mm	mm	%
≥ 160	110	0.51 %
≥ 180	130	0.41 %
≥ 200	150	0.35 %
≥ 220	170	0.30 %
≥ 240	190	0.26 %

The indicated table values of rotation as a percentage of cantilever length result from the deformation of the connector being in a serviceability limit state. They are recommended values. The total camber to be applied to the balcony slab results from the calculation based on EC2 (EN 1992-1-1 and the applicable national annex).

Additional camber c resulting from the deformation of the Thermokorb element:

$$c = l_k \cdot \frac{\phi}{100} \cdot \frac{M_{Ed,c}}{M_{Rd,max}}$$

For the load case combination (ULS) used to determine the additional camber of the slab, it is recommended to consider both the full dead load and 50% of the variable load. The definition of the load case combination for calculation of the deformation can be determined by the structural engineer.

l_k Cantilever length
ϕ Rotation in % – see table

$M_{Ed,c}$ Decisive bending moment in kNm/m in ultimate limit state for "g+q/2"
$M_{Rd,max}$ Maximum design value of applied moment of Thermokorb in kNm/m (see tables on pages 16 and 17)

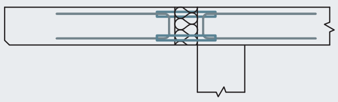
* Building Component Thickness

THERMOKORB OVERVIEW

CANTILEVER BALCONY SLABS

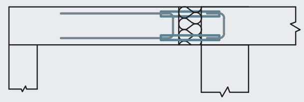
TKM (from page 6)

TKF (page 14)



SUPPORTED BALCONY/RECESSED BALCONY

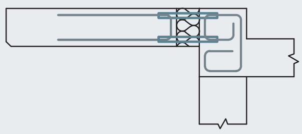
TKA (from page 10)

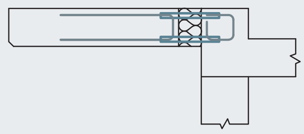


LEVEL CHANGE – UP

TKM special rib shape (page 8)

TKA V1 + V2 (pages 10 and 12)

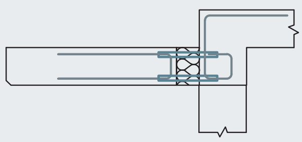


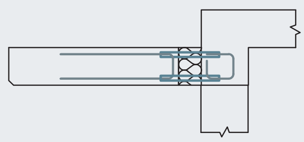


LEVEL CHANGE – DOWN

TKM special rib shape (page 8)

TKA V1 + V2 (pages 10 and 12)

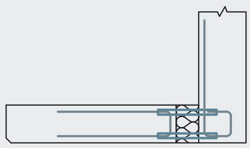


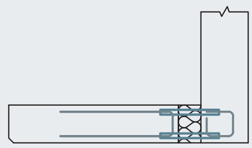


CANTILEVER SLAB CONNECTION – WALL ABOVE

TKM special rib shape (page 9)

TKA V1 + V2 (pages 10 and 13)

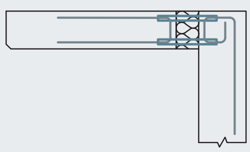


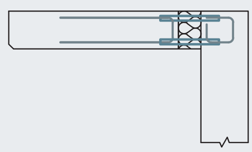


CANTILEVER SLAB CONNECTION – WALL BELOW

TKM special rib shape (page 9)

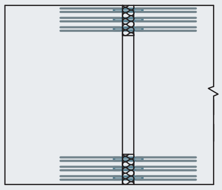
TKA V1 + V2 (pages 10 and 13)





WALL CONNECTION

TKM (pages 6 and 7)

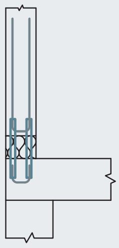


WALL CONNECTION

TKA (pages 10 and 11)

PARAPET WALL ELEMENT

AT/2 (page 15)



THERMOKORB DESIGNATION SYSTEM

Type/Rn(G or E) RH/D (Note)

Type	Rib Execution	Number of Ribs	Execution of Compression Chord	Rib Height	BCT** or Insulation Height	Note
	"empty" = element length 1 m R = element lenght dependent on number of ribs	n	G = straight or E = bent up	RH (mm)	D (mm)	Fire proofing: R60 or REI120
TKM	–/R	maximum 10	G/E	110/130/ 150/170/190	≥ 160/180/ 200/220/240	R60/REI120 special shape SF
TKA	–/R	maximum 10	G/E	110 (standard) or V1 or V2 110/130/150/170/190	≥ 160/180/ 200/220/240	R60/REI120 V1 or V2
TKF split element	–/R	maximum 10	E	130/150/170/190	≥ 180/200/ 220/240	R60/REI120
AT/2* parapet wall element	–	–	G	110	≥ 160	R60/REI120

* Element length 300 mm

Examples:

TKM/R6E 150/200 REI120
TKA/4G 110/180 R60
TKF/9E 130/180 R60
AT/2 110/160 REI120
TKM/7G 150/200 SF REI120
TKA/5G 130/180 V1 R60

** Building Component Thickness

TYPE SERIES: TKM

Thermokorb for Transferring Moments and Shear Forces

DESCRIPTION

The TKM type series primarily serves to transfer bending moments and shear forces (interaction). In case of internal forces with alternating signs, TKM/G ribs must be used. TKM/E ribs are used with precast concrete floor slabs to prevent a collision of the ribbed compression chord with the precast concrete floor slab (see Fig. 4).
The design values of the applied forces and the interaction diagrams for rib heights from 110 to 190 mm are shown on pages 16 to 20.

Main application areas:
- Unsupported cantilever balcony slabs
- Continuous slabs (indirect support)
- Special solutions are possible, e.g. for level changes, cantilever slab connections to walls, wall connections

Reinforcement provided on site:
The connection reinforcement provided on site must be able to transfer the forces acting in the 10 mm diameter stirrups, e.g. 2ø10 mm elements (B550) per rib for the reinforcement subject to tension. The arrangement of the cross bars for the installation cases with TKM special rib shapes can be taken from Fig. 6 through 9.

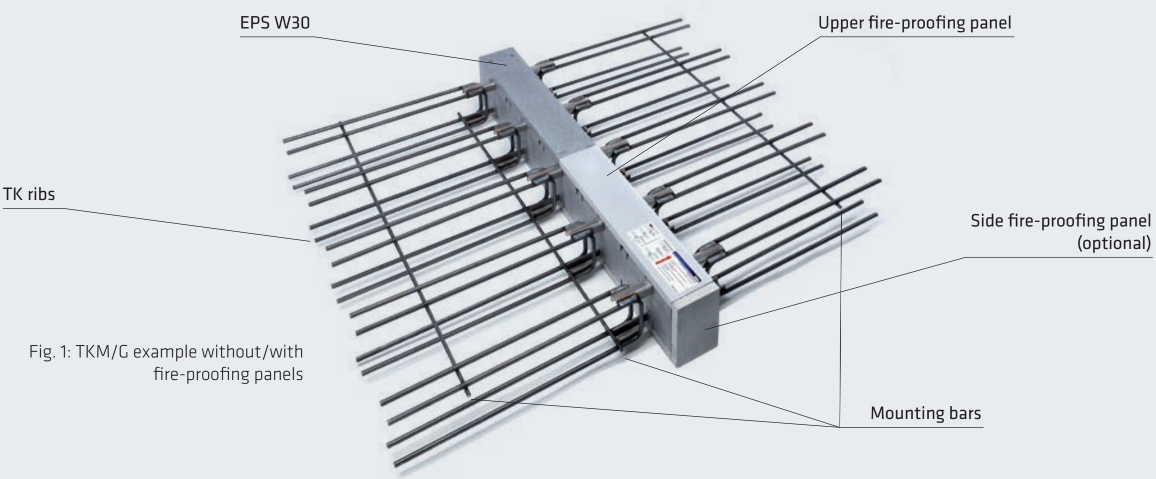


Fig. 1: TKM/G example without/with fire-proofing panels

TYPES OF EXECUTION FOR STANDARD RIBS

The bottom leg of stirrup is available in two variants:
G ... straight (also for applied forces with changing signs)
E ... bent up (e.g. for precast concrete floor slabs)

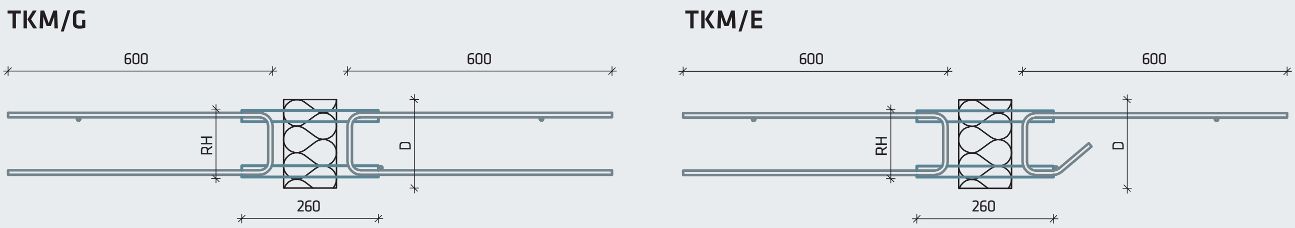


Fig. 2: Rib executions for the TKM type series

Special stirrup shapes different from the TKM series are principally possible (see TKM special rib shapes on pages 8 and 9).

INSTALLATION CASES WITH TKM STANDARD RIBS

Cantilever balcony slab –
External wall with composite heat insulation system
The insulating body of the Thermokorb is located outside of the wall in this installation example and connects with the composite heat insulation system.

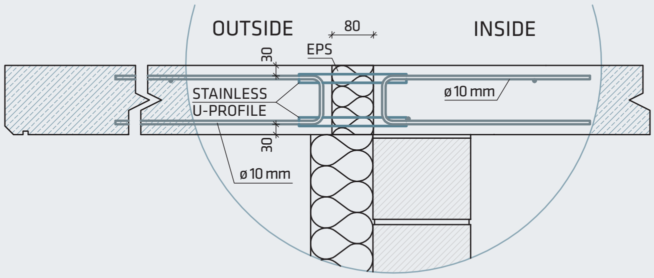


Fig. 3: Cantilever balcony slab with TKM/G rib

Cantilever balcony slab –
External wall without composite heat insulation system
The insulating body of the Thermokorb is located within the wall. In this installation example, a precast concrete floor slab is set on the inside.
The lower stirrup leg of the TKM/E rib is bent up to avoid a collision with the precast slab element.

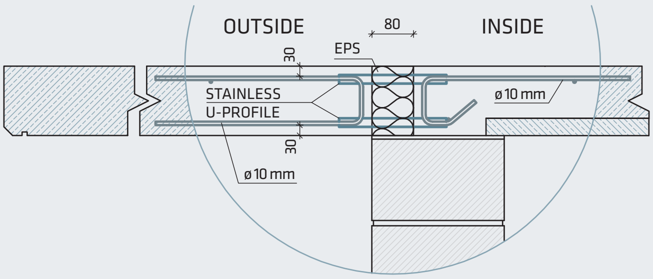


Fig. 4: Cantilever balcony slab with TKM/E ribs

Wall connection
TKM Thermokorb elements can also be used for shear walls when oriented vertically. In this application, they are primarily installed on the top and bottom end of the shear wall. The Thermokorb elements can also be distributed over the entire height, depending on the loading and the effective height of the shear wall.

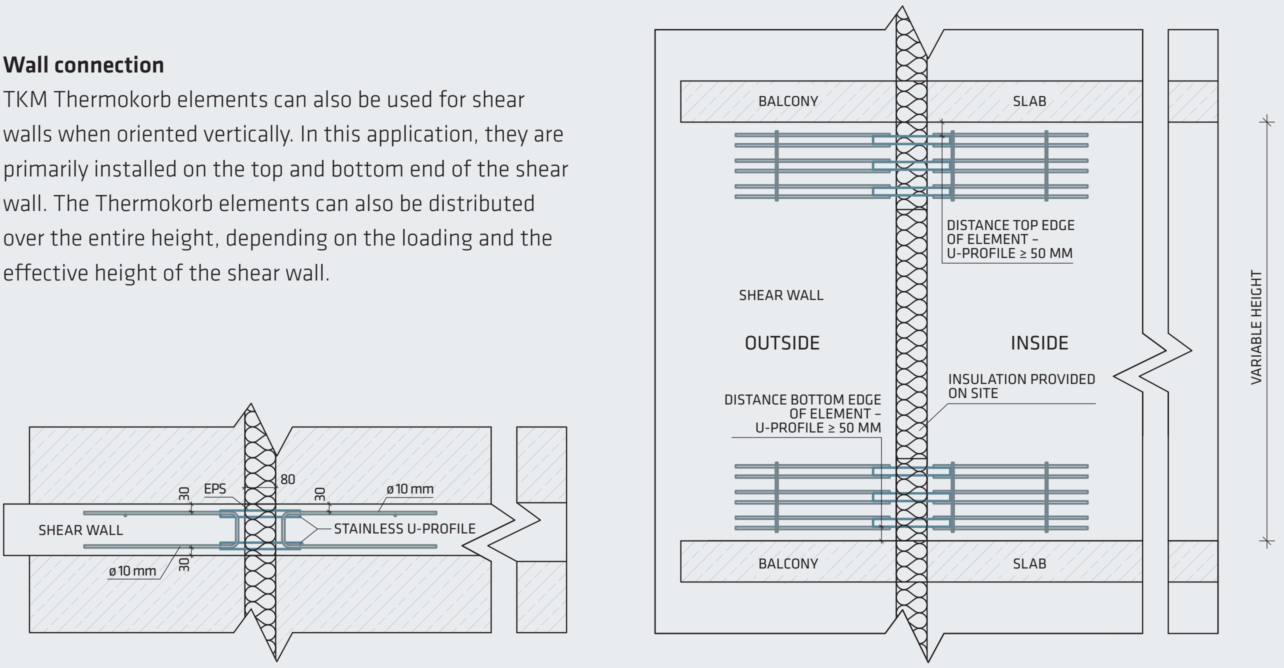


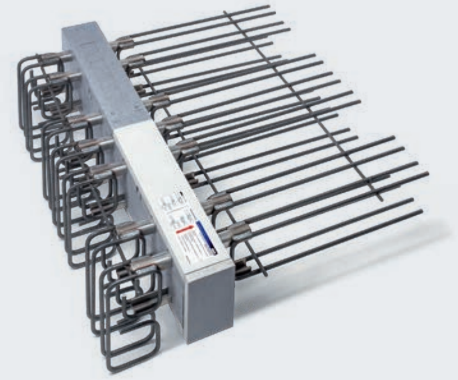
Fig. 5: Wall connection with TKM/G rib (top and front views)

INSTALLATION CASES WITH TKM SPECIAL SHAPES

The same design fundamentals apply not only to the TKM special shapes but also to the TKM standard ribs (see pages 16 to 20).

Balcony with level change – up

TKM special shape for a balcony with level change – up.
(Execution variant with up to 5 ribs per 1 m element,
also possible with TKA V1 or V2 – see page 12)



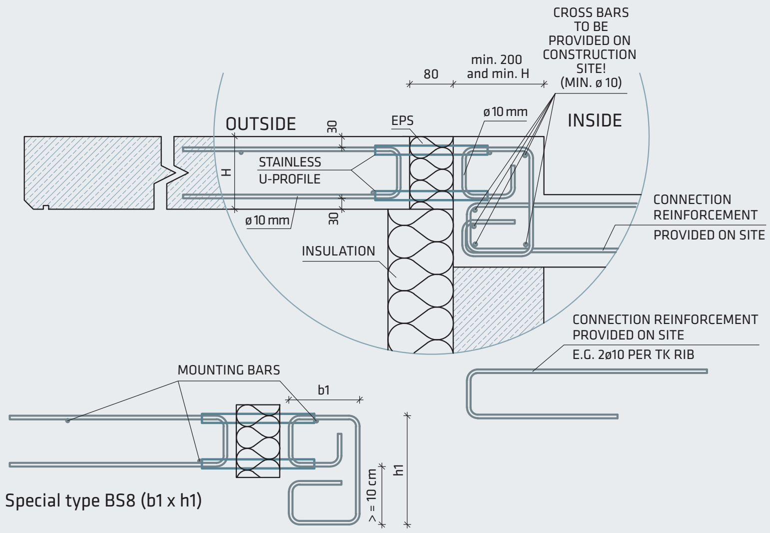
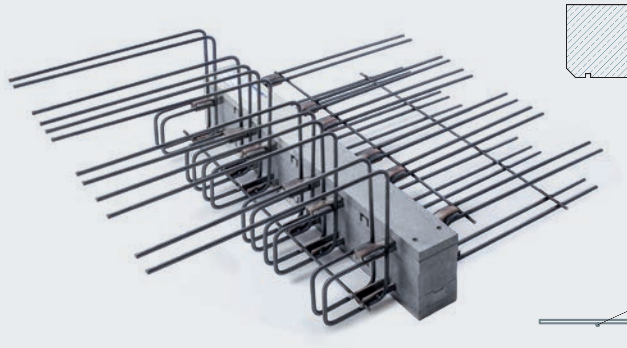


Fig. 6: Balcony with level change (up) with TKM special rib shape

Balcony with level change – down

TKM special shape for a balcony with level change – down.
(Execution variant with up to 5 ribs per 1 m element,
also possible with TKA V1 or V2 – see page 12)



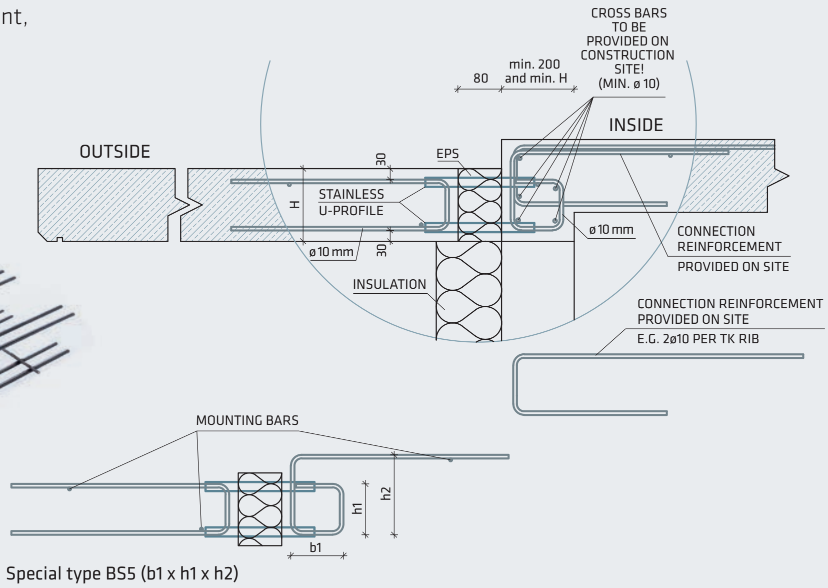
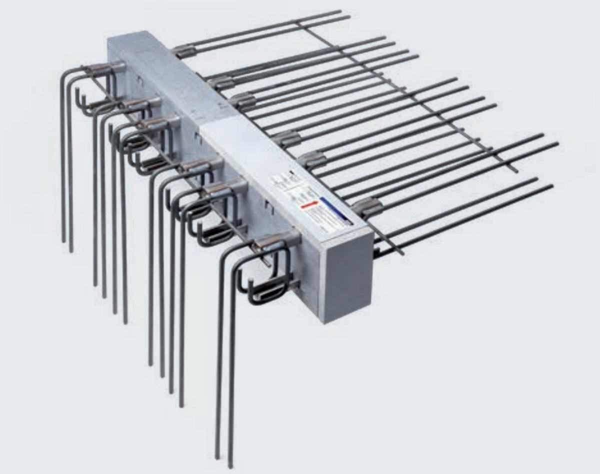


Fig. 7: Balcony with level change (down) with TKM special rib shape

Cantilever slab connection – wall below

TKM special shape for a cantilever slab connection to a wall in which the stirrup is directed downwards.
(Execution variant with up to 5 ribs per 1 m element, also possible with TKA V1 or V2 – see page 13)



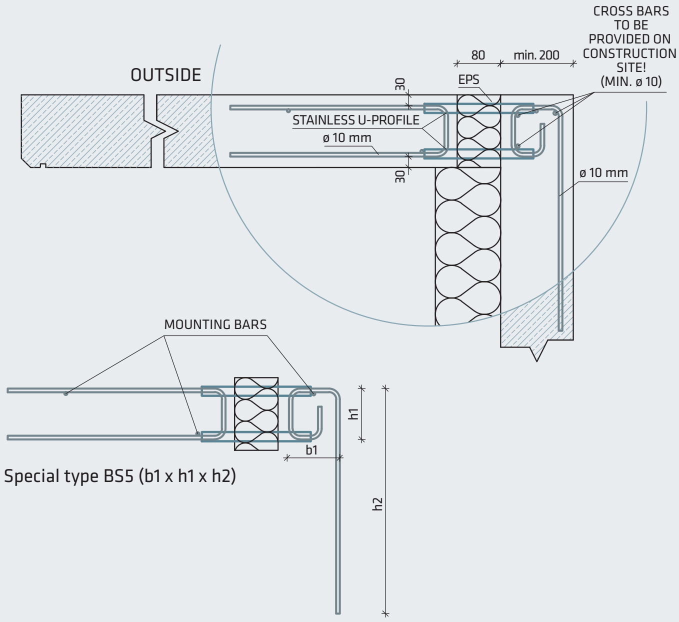
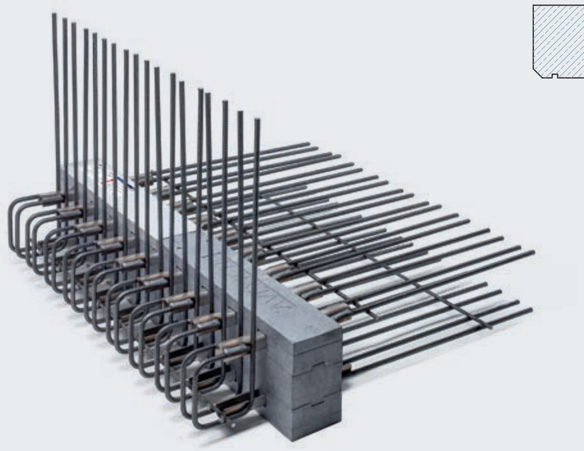


Fig. 8: Cantilever slab connection – wall below with TKM special rib shape

Cantilever slab connection – wall above

TKM special shape for a cantilever slab connection to a wall in which the stirrup is directed upwards.
(Execution variant with up to 5 ribs per 1 m element, also possible with TKA V1 or V2 – see page 13)



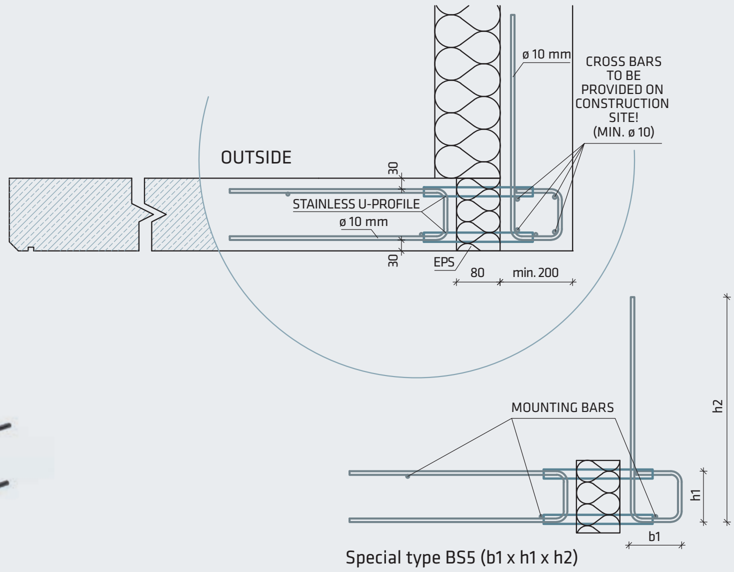


Fig. 9: Cantilever slab connection – wall above with TKM special rib shape

TYPE SERIES: TKA

Thermokorb Primarily Used for Transferring Shear Forces

DESCRIPTION

The TKA type series is primarily suitable for transferring shear forces for applications in supported balconies, recessed balconies, parapet walls and different types of prefabricated connectors. Installation of the TKA V1 or V2 type series also enables the transfer of bending moments and shear forces for level changes and cantilever slab connections to walls (up to a max. of 5 ribs per 1 m element). Corresponding stirrup preparation must be provided on site for this (see Fig. 16 to 19). For higher loads, we recommend using the TKM special shapes. The design values of the applied forces and the interaction diagrams for rib heights from 110 to 190 mm are shown on pages 16 to 20.

Main application areas:
- Supported balconies
- Recessed balconies
- Protruding parapets
- Parapet walls
- Special solutions are possible, e.g. for level changes, cantilever slab connections to walls, wall connections

Reinforcement provided on site:
As additional connection reinforcement, at least two stirrups per rib with a diameter of 10 mm (B550) are recommended for the application of the TKA V1 or V2 as a custom solution. The exact execution of the remaining reinforcement is shown in Figures 16 to 19.

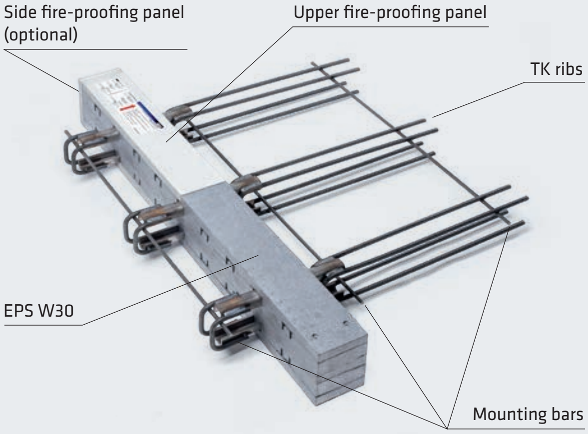


Fig. 10: TKA/G example with/without fire-proofing panels

TYPES OF EXECUTION FOR STANDARD RIBS

The bottom leg of stirrup is available in two variants:
G ... straight (also for applied forces with changing signs)
E ... bent up (e.g. for precast concrete floor slabs)

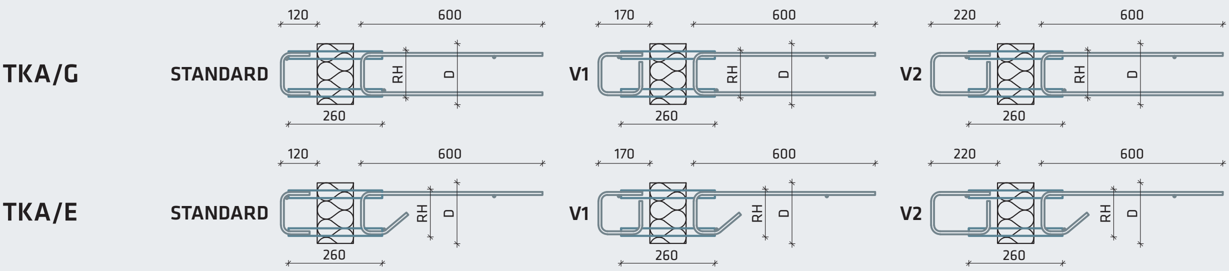


Fig. 11: Rib executions for the TKA type series

Special stirrup shapes different from the TKA series are principally possible.

Please note that for the TKA type series, the rib heights of 130 mm, 150 mm, 170 mm and 190 mm are available only in variants V1 and V2 (170 mm and/or 220 mm projection of stirrup). An adequate design value for bending and shear resistance in the subsequent reinforced concrete elements must be demonstrated by a structural design engineer according to EC2.

INSTALLATION CASES WITH TKA STANDARD RIBS

Protruding parapet

This example using the TKA for a protruding parapet with on-site reinforcing stirrups is executed for a connection to a precast concrete floor slab with a TKA/E rib.

*Options:
Standard: 120 mm
Variant V1: 170 mm
Variant V2: 220 mm

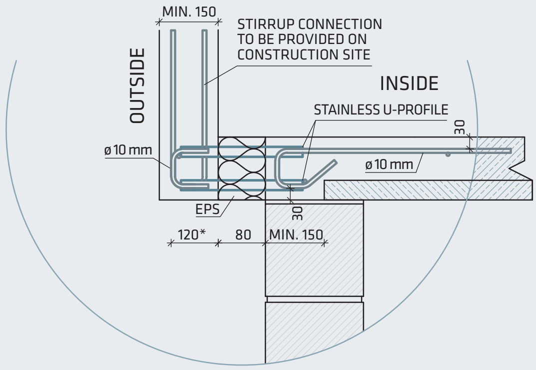


Fig. 12: Protruding parapet with TKA/E rib

Recessed balcony

The TKA is used as a shear force element e.g. for a recessed balcony.

*Options:
Standard: 120 mm
Variant V1: 170 mm
Variant V2: 220 mm

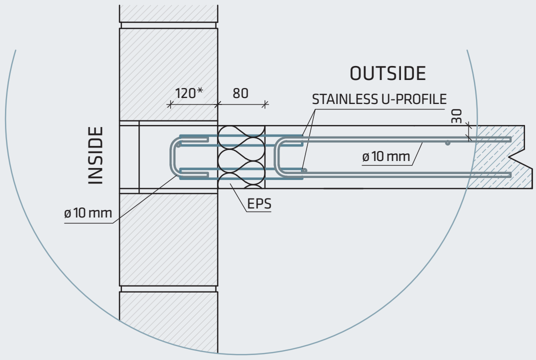


Fig. 13: Recessed balcony with TKA/G rib

Wall connection

TKA Thermokorb elements can also be used for shear walls when oriented vertically. In this application, they are primarily installed on the top and bottom end of the shear wall. The Thermokorb elements can also be distributed over the entire height, depending on the loading and the effective height of the shear wall.

*Options:
Variant V1: 170 mm
Variant V2: 220 mm

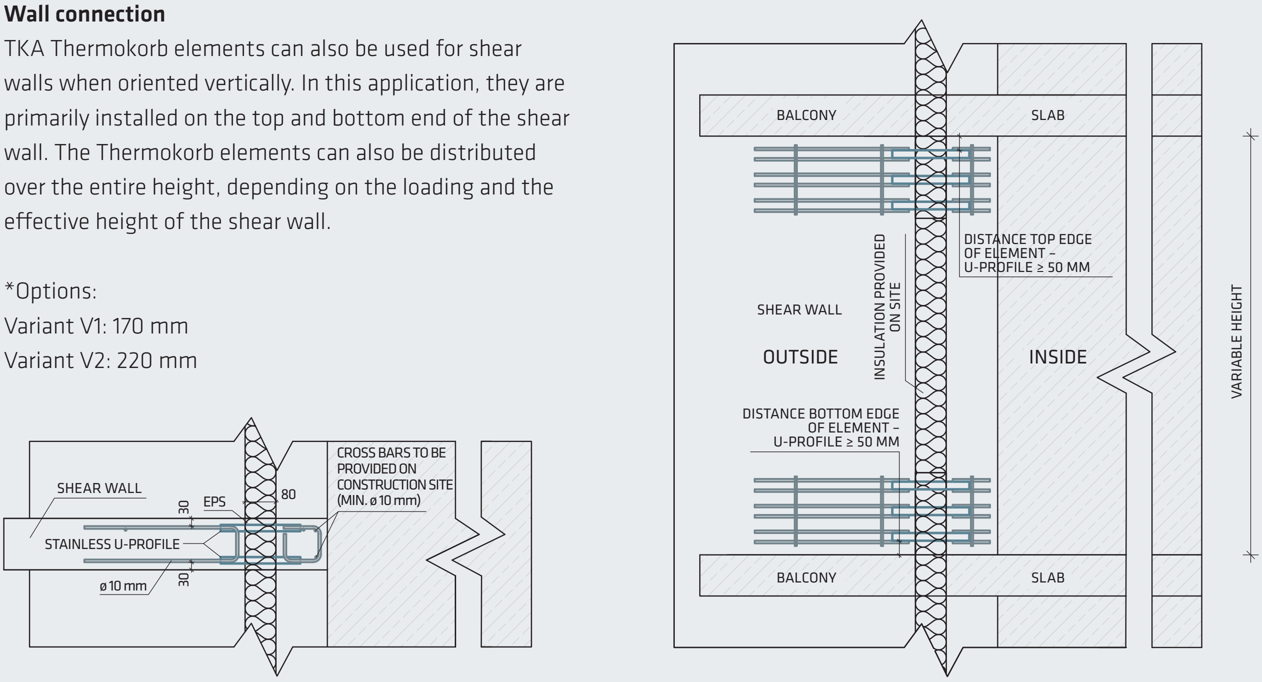


Fig. 14: Wall connection with TKA/G rib (top and front views)

INSTALLATION CASES WITH TKA RIBS IN V1 OR V2 EXECUTION FOR SPECIAL SOLUTIONS

For installation of the TKA ribs in the executions V1 or V2 for special solutions, the design fundamentals found on pages 16 to 20 must be applied.

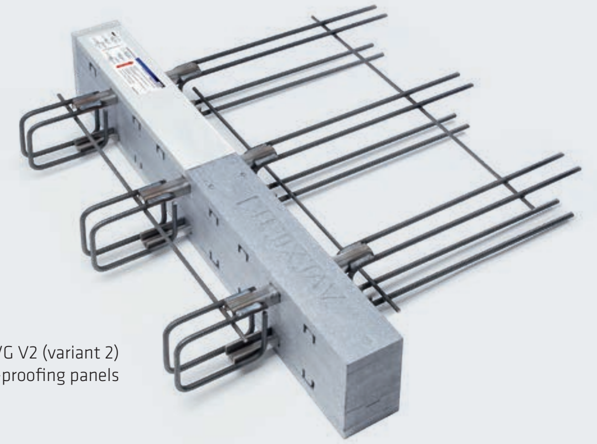


Fig. 15: TKA/G V2 (variant 2)
example with/without fire-proofing panels

Balcony with level change – up

The types TKA V1 or V2 are used for a balcony with a level change with up to max. 5 ribs per 1 m element.

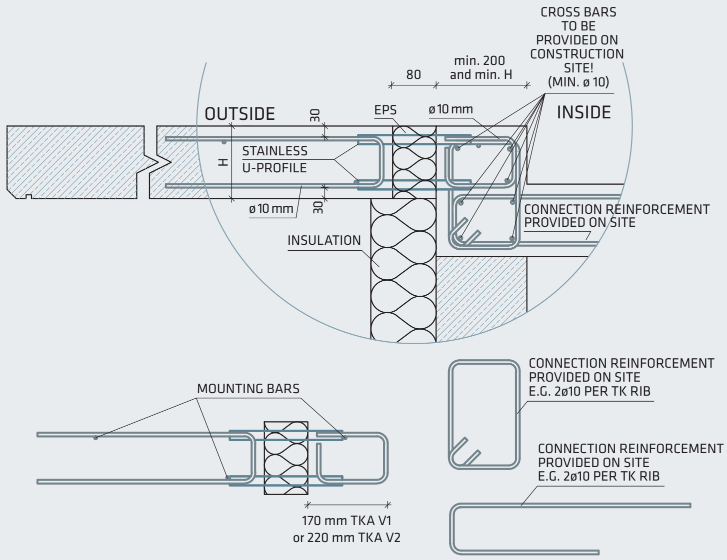


Fig. 16: Balcony with level change (up) with TKA V1 or V2

Balcony with level change – down

The types TKA V1 or V2 are used for a balcony with a level change with up to max. 5 ribs per 1 m element.

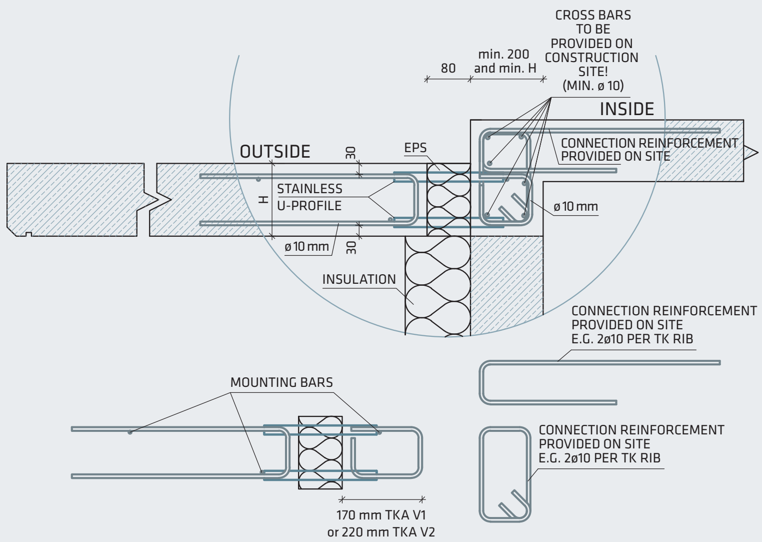


Fig. 17: Balcony with level change (down) with TKA V1 or V2

Cantilever slab connection – wall below

The types TKA V1 or V2 are used for a cantilever slab connection to a wall with up to max. 5 ribs per 1 m element.

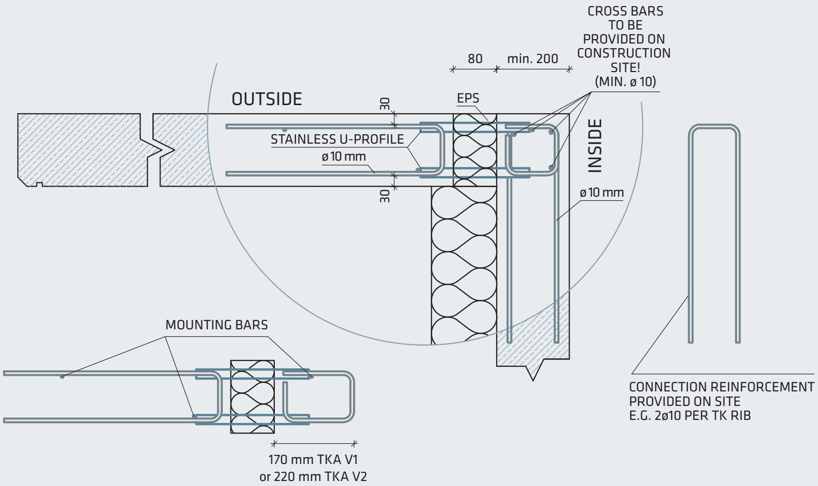


Fig. 18: Cantilever slab connection – wall below with TKA V1 or V2

Cantilever slab connection – wall above

The types TKA V1 or V2 are used for a cantilever slab connection to a wall with up to max. 5 ribs per 1 m element.

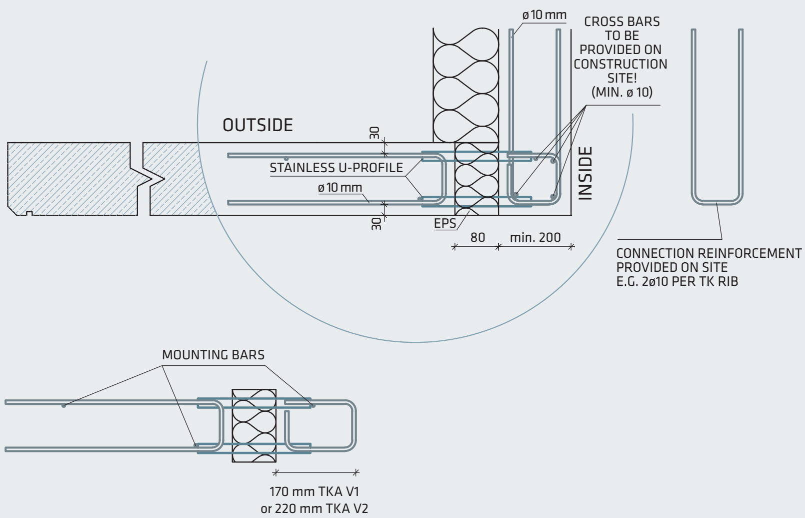


Fig. 19: Cantilever slab connection – wall above with TKA V1 or V2

TYPE SERIES: TKF

Thermokorb for Transferring Moments and Shear Forces for Precast Slab Elements as a Split Element

DESCRIPTION

The TKF type series is used as split element primarily for unsupported cantilever balcony slabs, especially for the requirements of the prefabricated concrete elements industry (precast slab elements). One part (the compression chord) is installed in the precast slab element in the precast concrete factory; the second part (the tension chord) is then put in place on site. Minimum slab thickness is 180 mm. The design values of the applied forces and the interaction diagrams for rib heights from 130 to 190 mm are shown on pages 17, 19 and 20.

Main application areas:

- Unsupported cantilever balcony slabs for precast concrete floor slabs

Reinforcement provided on site:

The connection reinforcement provided on site must be able to transfer the forces acting in the 10 mm diameter stirrups, e.g. 2ø10 mm elements (B550) per rib for the reinforcement subject to tension.

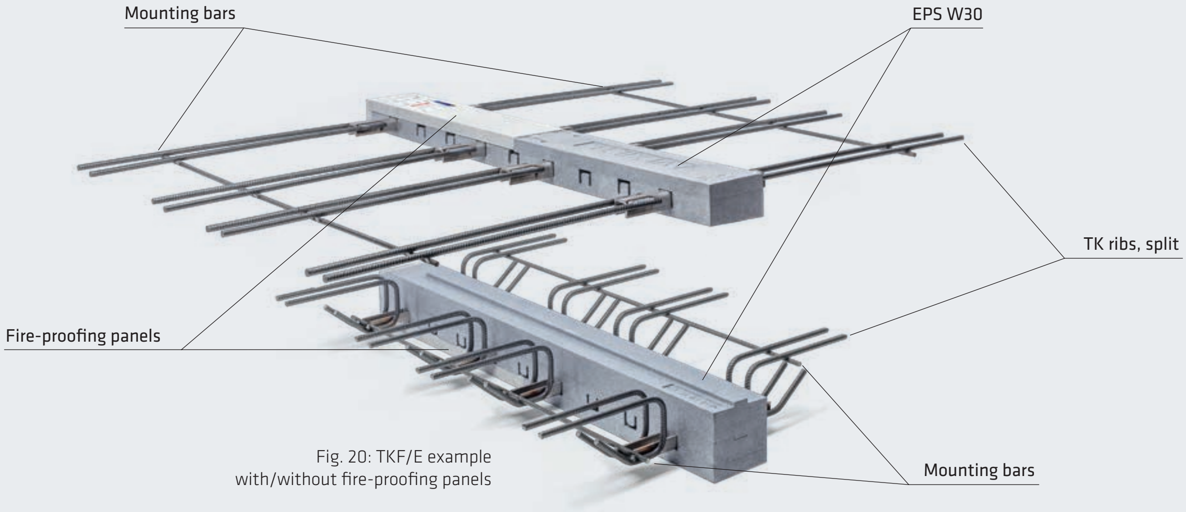
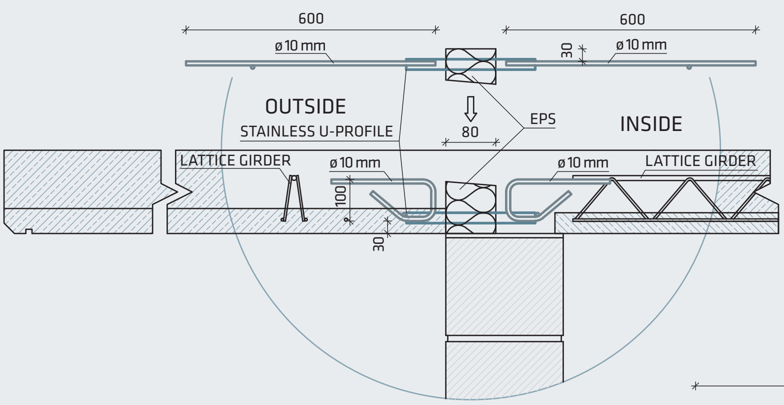


Fig. 20: TKF/E example with/without fire-proofing panels



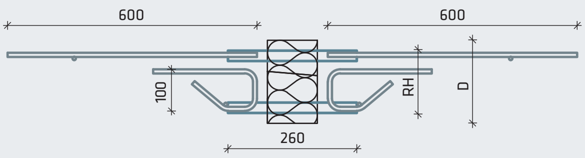


Fig. 21: Cantilever balcony slab with split TKF/E ribs

TYPE SERIES: AT/2

Thermokorb Used in Particular in Parapet Walls

DESCRIPTION

The AT/2 Thermokorb is a load bearing connector providing thermal insulation and is used for the transfer of axial forces, shear forces and bending moments between parapet wall and floor slabs. The distance between elements is chosen according to the prevailing structural and/or design conditions and can be determined using the design program “Thermotool”. The thermal insulation between adjacent Thermokorb elements must be provided on site. The AT/2 Thermokorb comes with a rib height of 110 mm. The minimum thickness of the parapet wall amounts to 160 mm.

Main application areas:

• Parapet walls

Reinforcement provided on site:

The connection reinforcement provided on site must be able to transfer the forces acting in the 10 mm diameter stirrups, e.g. 2ø10 mm elements (B550) per rib for the reinforcement subject to tension.

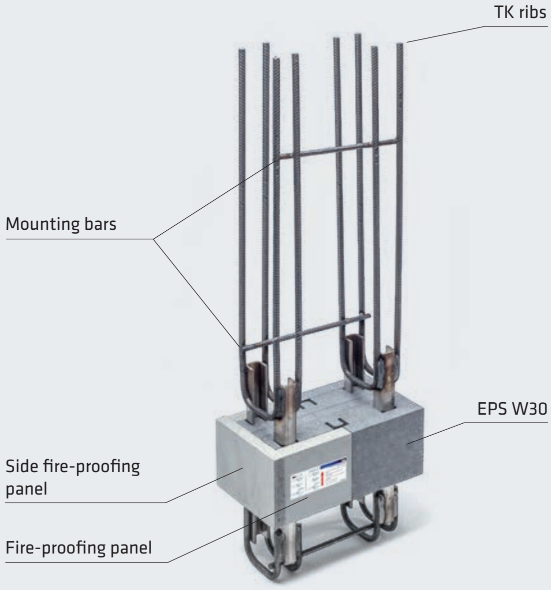


Fig. 22: AT/2 example with/without fire-proofing panels

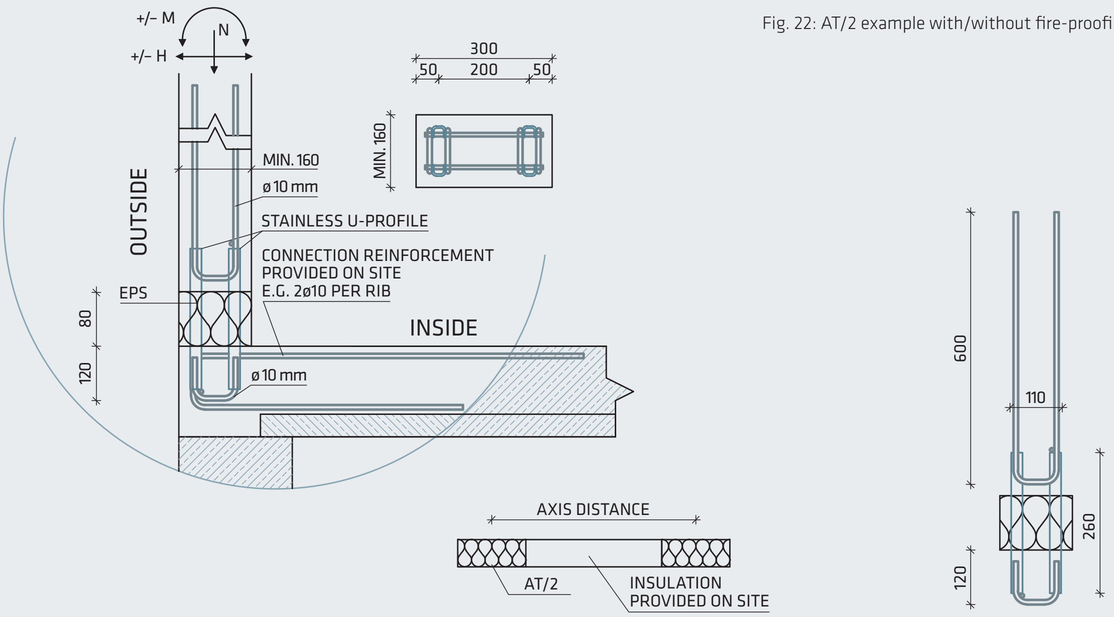


Fig. 23: Use of TK-AT/2 for parapet wall connection

THERMOKORB LOAD-BEARING BEHAVIOUR

Transfer of the bending moment is accomplished by transferring tensile and compression force via reinforcement stirrups to the upper or lower U-profile and from here via the reinforcement stirrups into the adjacent concrete member. The shear force is transferred via local bending of the individual profiles. This is divided equally between both profiles. The structural boundary conditions result in a mutual dependency of the acting bending moments and shear forces and therefore a max. transferable bending moment $M_{Rd,max}$ with the associated shear force V_{Rd} and a max. transferable shear force $V_{Rd,max}$ with the associated bending moment M_{Rd}. This applies to pos. and neg. moments (+/– M_{Ed}, prerequisite of a TK/G rib) and shear forces (+/– V_{Ed}).

BENDING MOMENTS AND SHEAR FORCES

MAXIMUM SHEAR RESISTANCE AND ASSOCIATED BENDING MOMENTS ACCORDING TO EUROCODE

	BCT*	Rib Height	Internal Forces	Number of Ribs									
	mm	mm		1	2	3	4	5	6	7	8	9	10
TKM TKA	≥ 160	110	M_{Rd} (kNm)	1.7	3.4	5.1	6.8	8.6	10.3	12.0	13.7	15.4	17.1
			$V_{Rd,max}$ (kN)	21.4	42.8	64.3	85.7	107.1	128.5	149.9	171.4	192.8	214.2
	≥ 180	130	M_{Rd} (kNm)	1.7	3.5	5.2	6.9	8.7	10.4	12.1	13.8	15.6	17.3
			$V_{Rd,max}$ (kN)	21.6	43.3	64.9	86.5	108.2	129.8	151.4	173.0	194.7	216.3
	≥ 200	150	M_{Rd} (kNm)	1.8	3.5	5.3	7.0	8.8	10.5	12.3	14.0	15.8	17.5
			$V_{Rd,max}$ (kN)	21.8	43.7	65.5	87.3	109.2	131.0	152.8	174.6	196.5	218.3
	≥ 220	170	M_{Rd} (kNm)	1.8	3.5	5.3	7.0	8.8	10.6	12.3	14.1	15.8	17.6
			$V_{Rd,max}$ (kN)	22.0	44.0	66.0	88.0	110.0	132.0	154.0	176.0	198.0	220.0
	≥ 240	190	M_{Rd} (kNm)	1.8	3.5	5.3	7.1	8.9	10.6	12.4	14.2	15.9	17.7
			$V_{Rd,max}$ (kN)	22.2	44.3	66.5	88.6	110.8	132.9	155.1	177.2	199.4	221.5

* Building Component Thickness

Please note that for the TKA type series, the rib heights of 130 mm, 150 mm, 170 mm and 190 mm are available only in variants V1 and V2 (170 mm and/or 220 mm projection of stirrup). An adequate design value for bending and shear resistance in the subsequent reinforced concrete elements must be demonstrated by a structural design engineer according to EC2.

MAXIMUM MOMENT CAPACITY AND ASSOCIATED SHEAR FORCES ACCORDING TO EUROCODE

	BCT**	Rib Height	Internal Forces	Number of Ribs									
	mm	mm		1	2	3	4	5	6	7	8	9	10
TKM TKA V1 TKA V2	≥ 160	110	$M_{Rd,max}$ (kNm)*	7.4	14.9	22.3	29.7	37.2	44.6	52.0	59.4	66.9	74.3
			V_{Rd} (kN)	7.6	15.2	22.8	30.4	38.1	45.7	53.3	60.9	68.5	76.1
	≥ 180	130	$M_{Rd,max}$ (kNm)*	8.9	17.9	26.8	35.8	44.7	53.6	62.6	71.5	80.5	89.4
			V_{Rd} (kN)	8.7	17.5	26.2	35.0	43.7	52.4	61.2	69.9	78.7	87.4
	≥ 200	150	$M_{Rd,max}$ (kNm)*	10.4	20.9	31.3	41.8	52.2	62.6	73.1	83.5	94.0	104.4
			V_{Rd} (kN)	9.6	19.1	28.7	38.2	47.8	57.3	66.9	76.4	86.0	95.5
	≥ 220	170	$M_{Rd,max}$ (kNm)*	11.9	23.9	35.8	47.8	59.7	71.6	83.6	95.5	107.5	119.4
			V_{Rd} (kN)	10.2	20.3	30.5	40.6	50.8	61.0	71.1	81.3	91.4	101.6
	≥ 240	190	$M_{Rd,max}$ (kNm)*	13.4	26.9	40.3	53.8	67.2	80.6	94.1	107.5	121.0	134.4
			V_{Rd} (kN)	10.6	21.3	31.9	42.5	53.2	63.8	74.4	85.0	95.7	106.3
TKF	≥ 180	130	$M_{Rd,max}$ (kNm)	8.9	17.9	26.8	35.8	44.7	53.6	62.6	71.5	80.5	89.4
			V_{Rd} (kN)	4.4	8.7	13.1	17.5	21.9	26.2	30.6	35.0	39.3	43.7
	≥ 200	150	$M_{Rd,max}$ (kNm)	10.4	20.9	31.3	41.8	52.2	62.6	73.1	83.5	94.0	104.4
			V_{Rd} (kN)	4.8	9.6	14.3	19.1	23.9	28.7	33.4	38.2	43.0	47.8
	≥ 220	170	$M_{Rd,max}$ (kNm)	11.9	23.9	35.8	47.8	59.7	71.6	83.6	95.5	107.5	119.4
			V_{Rd} (kN)	5.1	10.2	15.2	20.3	25.4	30.5	35.6	40.6	45.7	50.8
	≥ 240	190	$M_{Rd,max}$ (kNm)	13.4	26.9	40.3	53.8	67.2	80.6	94.1	107.5	121.0	134.4
			V_{Rd} (kN)	5.3	10.6	15.9	21.3	26.6	31.9	37.2	42.5	47.8	53.2

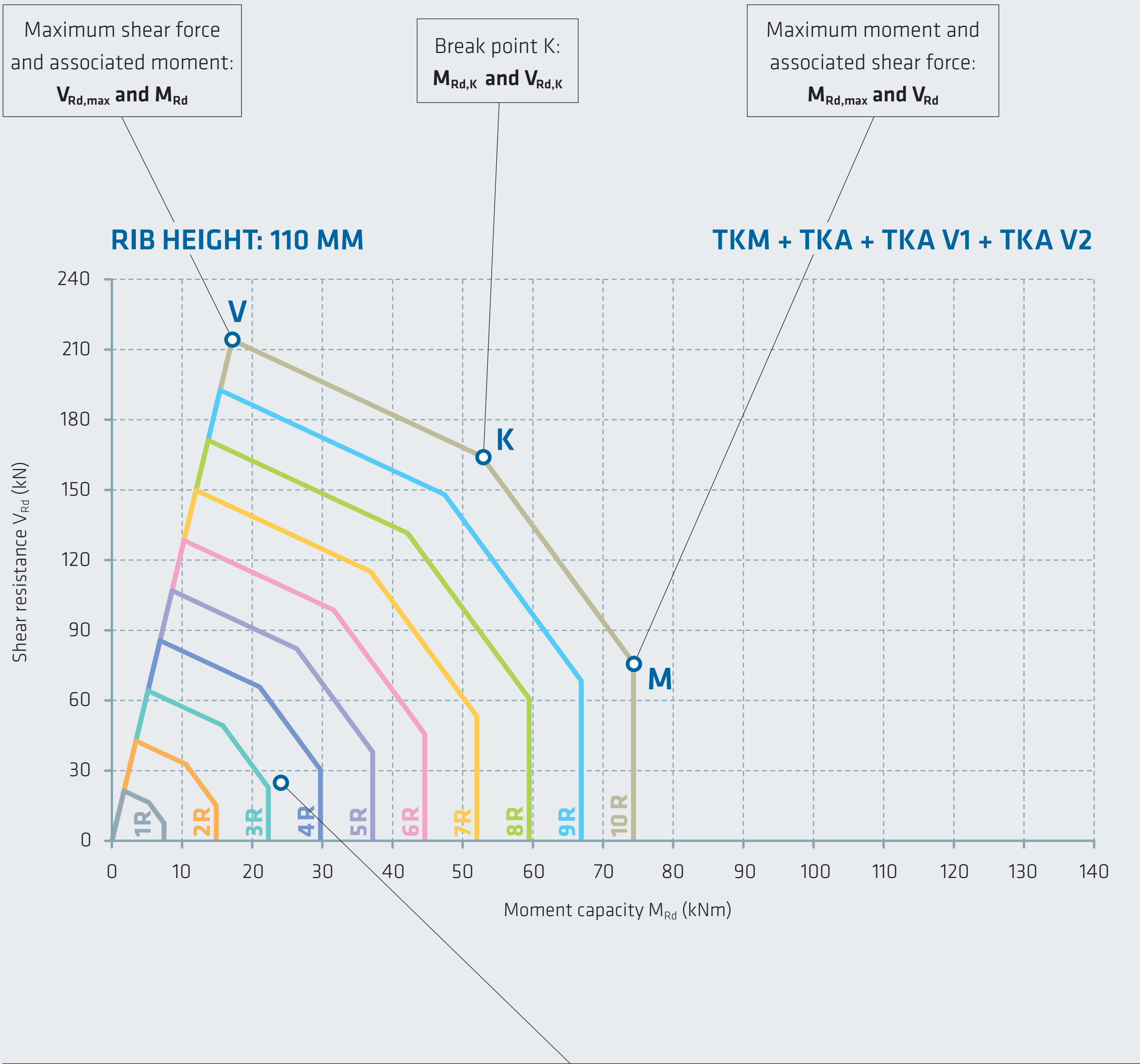
** Building Component Thickness

* When using a TKA Thermokorb, $M_{Rd,max}$ shall apply just to variants V1 or V2 with up to 5 ribs per 1 m element and when the corresponding stirrups are provided on site (see Fig. 16 to 19).

EXPLANATION OF INTERACTION DIAGRAMS

The diagrams can be used to determine the number of ribs required to transfer the applied forces. The curves basically apply to the type series TKM, TKA V1 or V2 and TKF.

For the type series TKA with a standard projection of stirrup (120 mm) the M-V curve shall apply just up to $V_{Rd,max}$. The transfer of larger bending moments (up to $M_{Rd,max}$) is possible by installing stirrups of variants V1 and V2 (with a projection of stirrup of 170 and 220 mm). In this case, it is necessary to make sure that the corresponding stirrups are provided on site (see TKA type series, Fig. 16 to 19).



APPLICATION EXAMPLE:

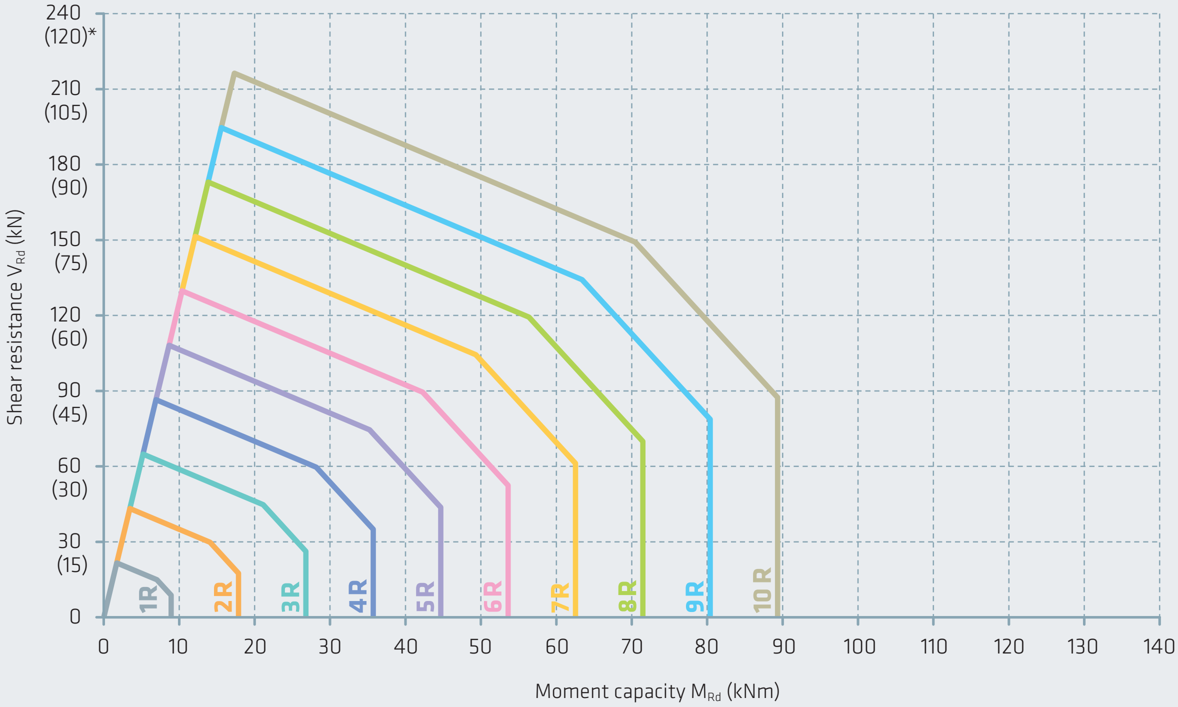
d= 160 mm, l_k = 1.7 m, g_k = 4.0 kN/m², g_{k2} = 2.5 kN/m², q_k = 4.0 kN/m², $l_{1,k}$ = 1.0 kN/m

M_{Ed} = **–23.90 kNm/m** V_{Ed} = **26.62 kN/m** Required number of ribs for a rib height of 110 mm = **4**

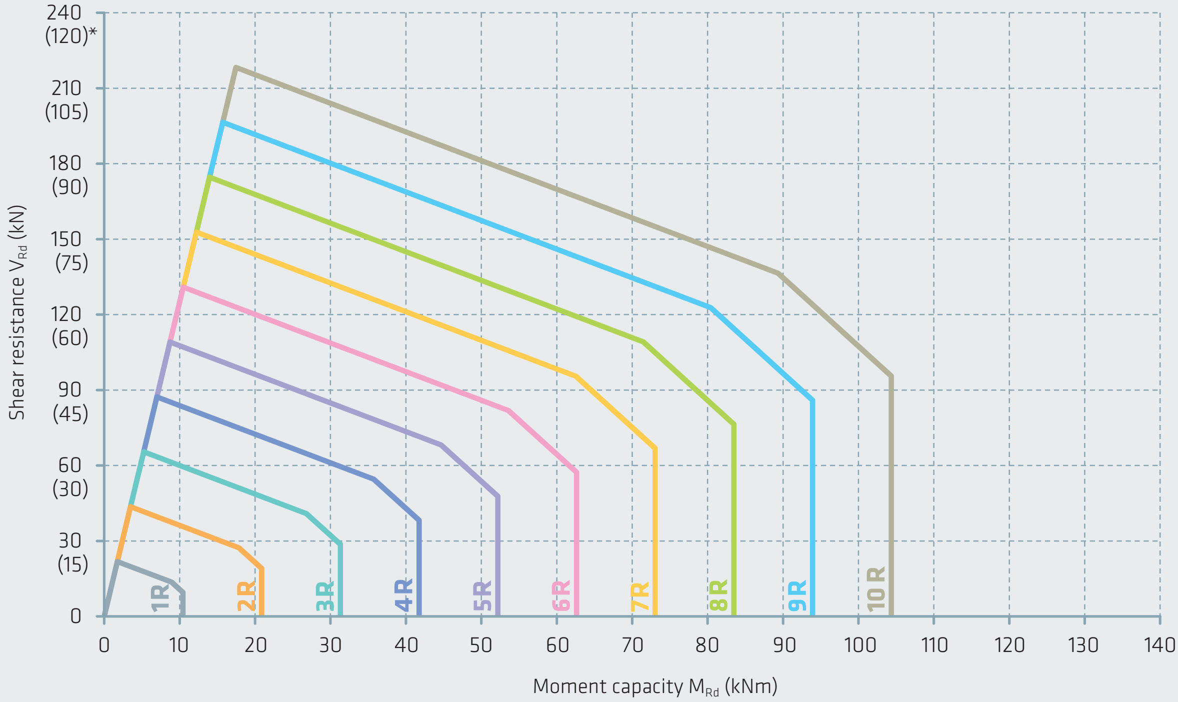
INTERACTION DIAGRAMS FOR SLABS

For TKF type series designing shear resistance V_{Rd} shown in brackets shall apply. For the validity of the diagrams for the TKA type series with standard projection of stirrup (120 mm), see the explanation on page 18.

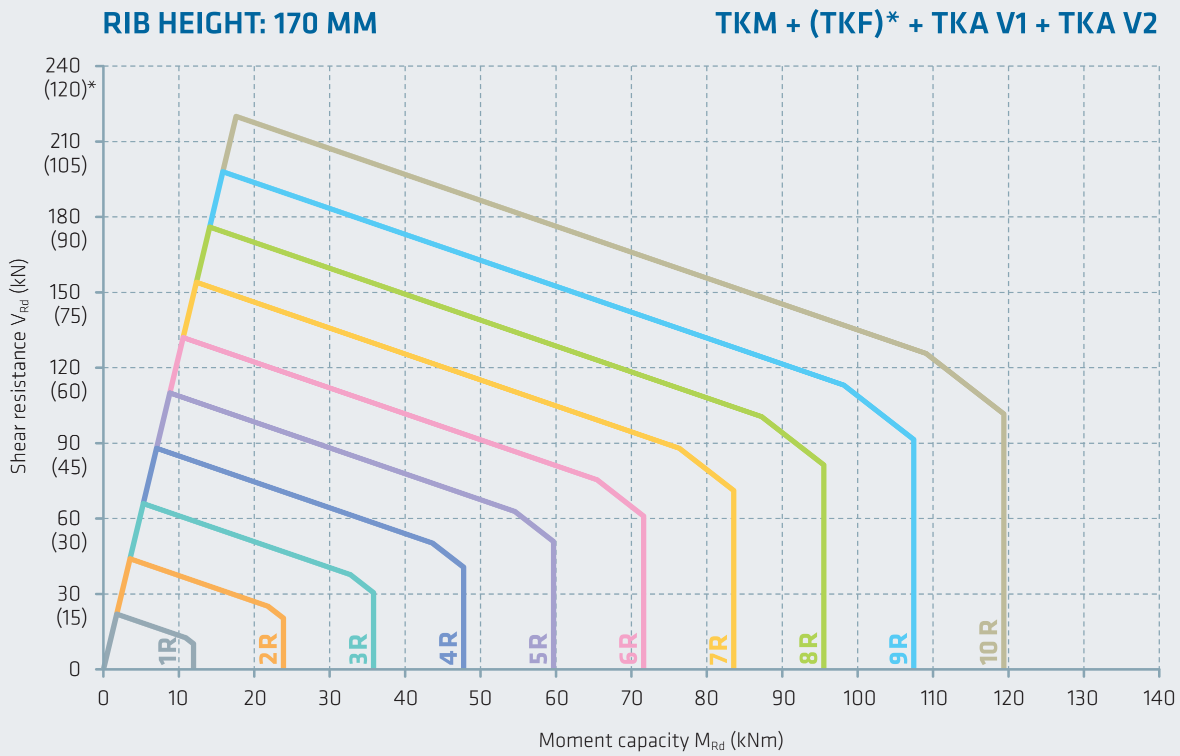
RIB HEIGHT: 130 MM
TKM + (TKF)* + TKA V1 + TKA V2

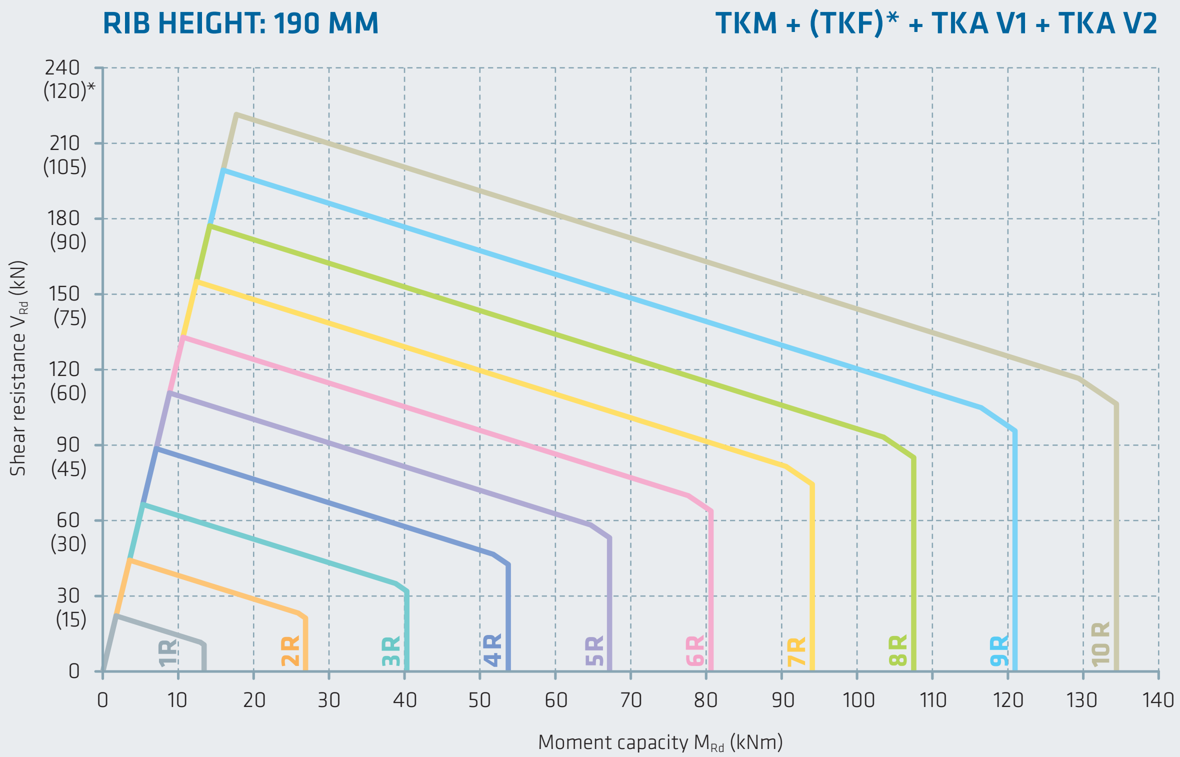


RIB HEIGHT: 150 MM
TKM + (TKF)* + TKA V1 + TKA V2



* Values in brackets apply to the TKF type series





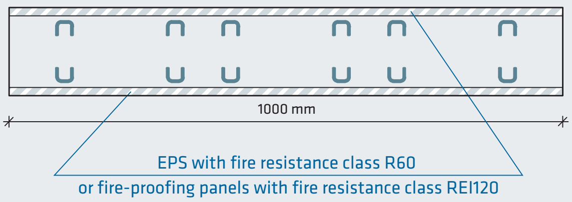
* Values in brackets apply to the TKF type series

STANDARD EXECUTION

DESCRIPTION

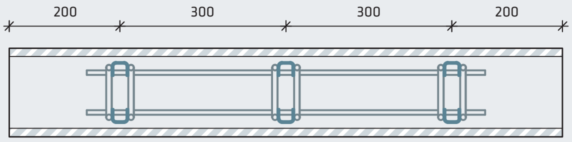
The length of standard Thermokorb elements (fire resistance class R60) is 1000 mm. As an option, Thermokorb elements with fire-proofing panels on all sides are available. They are longer by 30 mm.

Explanation of Thermokorb lengths without/with fire-proofing panels R60/REI120

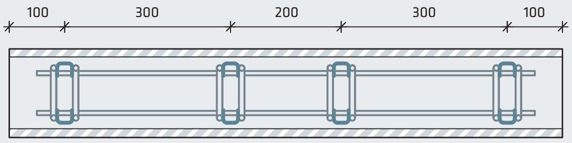


TKM/2
TKA/2

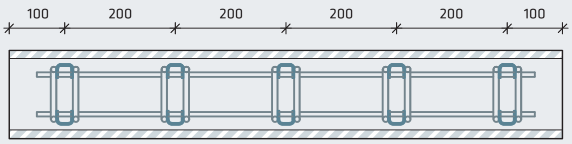
TKM/3
TKA/3



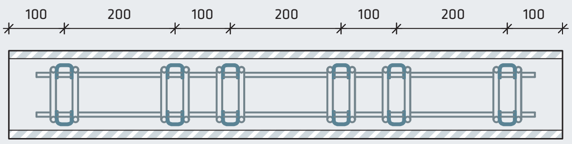
TKM/4
TKA/4



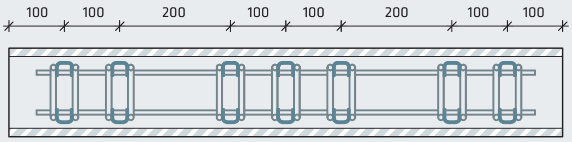
TKM/5
TKA/5



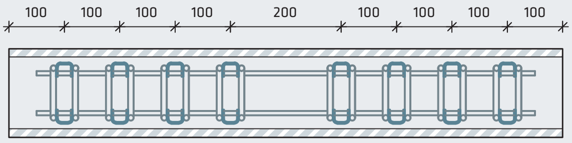
TKM/6
TKA/6



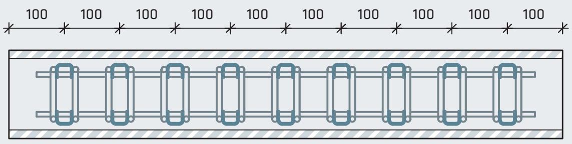
TKM/7
TKA/7



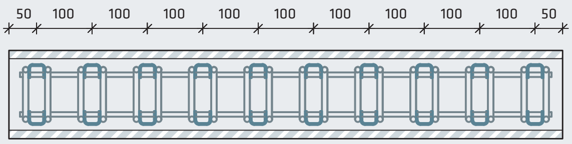
TKM/8
TKA/8



TKM/9
TKA/9



TKM/10
TKA/10

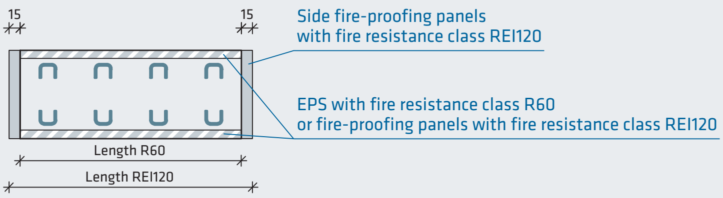


RIB EXECUTION

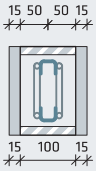
DESCRIPTION

The length of Thermokorb elements depends on the required number of ribs. Elements with fire-proofing panels on all sides (REI120) are longer by 30 mm.

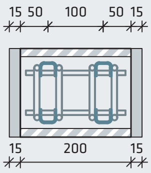
Explanation of Thermokorb lengths without/with fire-proofing panels



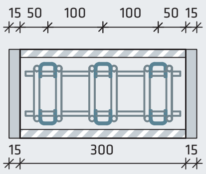
TKM/R1
TKA/R1



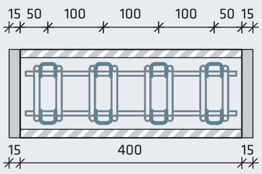
TKM/R2
TKA/R2



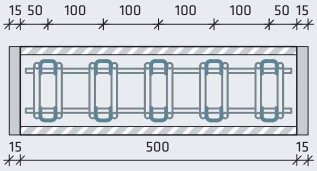
TKM/R3
TKA/R3



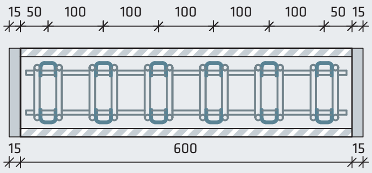
TKM/R4
TKA/R4



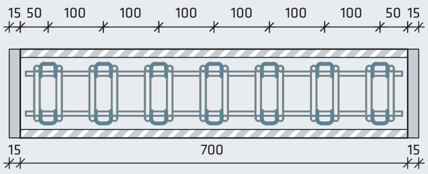
TKM/R5
TKA/R5



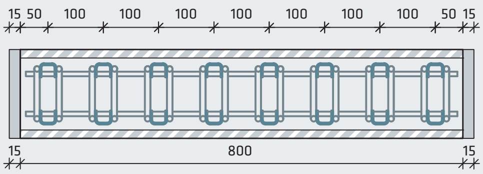
TKM/R6
TKA/R6



TKM/R7
TKA/R7



TKM/R8
TKA/R8



STRUCTURAL-PHYSICAL CHARACTERISTICS FOR THERMAL INSULATION

THERMOKORB IN STANDARD EXECUTION

FIRE RESISTANCE CLASS R60

BCT*	Rib Height		Number of Ribs								
mm	mm		2	3	4	5	6	7	8	9	10
160	110	λ_{eq} (W/mK)	0.108	0.146	0.184	0.223	0.261	0.300	0.338	0.376	0.415
		R_{eq} (m²K/W)	0.743	0.548	0.434	0.359	0.306	0.267	0.237	0.213	0.193
180	130	λ_{eq} (W/mK)	0.099	0.133	0.167	0.201	0.236	0.270	0.304	0.338	0.372
		R_{eq} (m²K/W)	0.807	0.600	0.478	0.397	0.340	0.297	0.263	0.237	0.215
200	150	λ_{eq} (W/mK)	0.092	0.123	0.154	0.184	0.215	0.246	0.276	0.307	0.338
		R_{eq} (m²K/W)	0.866	0.650	0.520	0.434	0.372	0.325	0.289	0.260	0.237
220	170	λ_{eq} (W/mK)	0.087	0.115	0.143	0.170	0.198	0.226	0.254	0.282	0.310
		R_{eq} (m²K/W)	0.922	0.698	0.561	0.469	0.403	0.354	0.315	0.284	0.258
240	190	λ_{eq} (W/mK)	0.082	0.108	0.133	0.159	0.184	0.210	0.236	0.261	0.287
		R_{eq} (m²K/W)	0.974	0.743	0.600	0.504	0.434	0.381	0.340	0.306	0.279

FIRE RESISTANCE CLASS REI120

BCT*	Rib Height		Number of Ribs								
mm	mm		2	3	4	5	6	7	8	9	10
160	110	λ_{eq} (W/mK)	0.129	0.168	0.206	0.245	0.283	0.321	0.360	0.398	0.436
		R_{eq} (m²K/W)	0.618	0.477	0.388	0.327	0.283	0.249	0.222	0.201	0.183
180	130	λ_{eq} (W/mK)	0.119	0.153	0.187	0.221	0.255	0.289	0.323	0.357	0.391
		R_{eq} (m²K/W)	0.675	0.524	0.428	0.362	0.314	0.277	0.248	0.224	0.204
200	150	λ_{eq} (W/mK)	0.110	0.140	0.171	0.202	0.233	0.263	0.294	0.325	0.355
		R_{eq} (m²K/W)	0.729	0.570	0.467	0.396	0.344	0.304	0.272	0.246	0.225
220	170	λ_{eq} (W/mK)	0.103	0.131	0.158	0.186	0.214	0.242	0.270	0.298	0.326
		R_{eq} (m²K/W)	0.780	0.613	0.505	0.429	0.373	0.330	0.296	0.269	0.246
240	190	λ_{eq} (W/mK)	0.097	0.122	0.148	0.173	0.199	0.225	0.250	0.276	0.301
		R_{eq} (m²K/W)	0.828	0.655	0.541	0.461	0.402	0.356	0.320	0.290	0.266

* Building Component Thickness

THERMOKORB IN RIB EXECUTION

FIRE RESISTANCE CLASS R60

BCT*	Rib Height		Number of Ribs								
mm	mm		1	2	3	4	5	6	7	8	AT/2
160	110	λ_{eq} (W/mK)	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.287
		R_{eq} (m^2K/W)	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.279
180	130	λ_{eq} (W/mK)	0.372	0.372	0.372	0.372	0.372	0.372	0.372	0.372	–
		R_{eq} (m^2K/W)	0.215	0.215	0.215	0.215	0.215	0.215	0.215	0.215	–
200	150	λ_{eq} (W/mK)	0.338	0.338	0.338	0.338	0.338	0.338	0.338	0.338	–
		R_{eq} (m^2K/W)	0.237	0.237	0.237	0.237	0.237	0.237	0.237	0.237	–
220	170	λ_{eq} (W/mK)	0.310	0.310	0.310	0.310	0.310	0.310	0.310	0.310	–
		R_{eq} (m^2K/W)	0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258	–
240	190	λ_{eq} (W/mK)	0.287	0.287	0.287	0.287	0.287	0.287	0.287	0.287	–
		R_{eq} (m^2K/W)	0.279	0.279	0.279	0.279	0.279	0.279	0.279	0.279	–

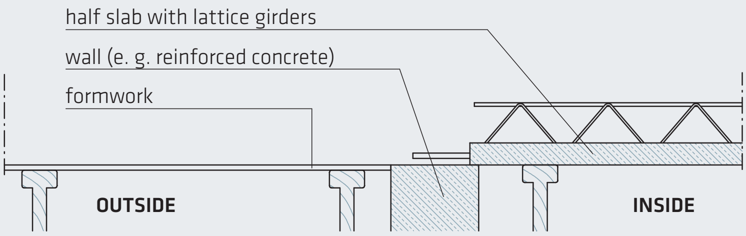
FIRE RESISTANCE CLASS REI120

BCT*	Rib Height		Number of Ribs								
mm	mm		1	2	3	4	5	6	7	8	AT/2
160	110	λ_{eq} (W/mK)	0.370	0.399	0.410	0.416	0.420	0.423	0.424	0.426	0.294
		R_{eq} (m^2K/W)	0.216	0.201	0.195	0.192	0.190	0.189	0.188	0.188	0.272
180	130	λ_{eq} (W/mK)	0.335	0.359	0.369	0.374	0.377	0.380	0.381	0.382	–
		R_{eq} (m^2K/W)	0.239	0.223	0.217	0.214	0.212	0.211	0.210	0.209	–
200	150	λ_{eq} (W/mK)	0.307	0.328	0.336	0.341	0.343	0.345	0.347	0.348	–
		R_{eq} (m^2K/W)	0.260	0.244	0.238	0.235	0.233	0.232	0.231	0.230	–
220	170	λ_{eq} (W/mK)	0.285	0.302	0.310	0.313	0.316	0.317	0.318	0.319	–
		R_{eq} (m^2K/W)	0.281	0.264	0.258	0.255	0.253	0.252	0.251	0.251	–
240	190	λ_{eq} (W/mK)	0.266	0.281	0.287	0.290	0.292	0.294	0.295	0.296	–
		R_{eq} (m^2K/W)	0.301	0.285	0.279	0.275	0.274	0.272	0.271	0.271	–

* Building Component Thickness

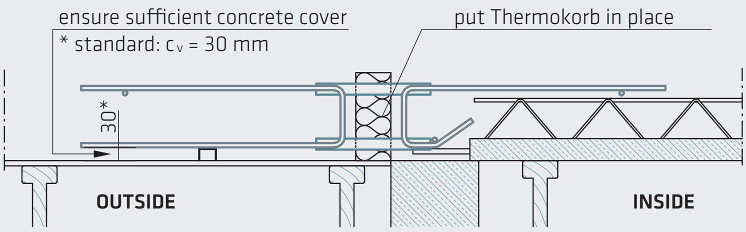
INSTALLATION INSTRUCTIONS

Example: TKM/E



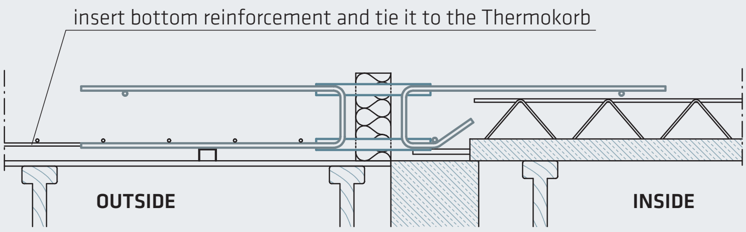
1. Formwork

The formwork of the entire slab has to be erected before placing Thermokorb elements. Required camber should be made in the formwork, as well. If half slabs are used they also have to be placed.



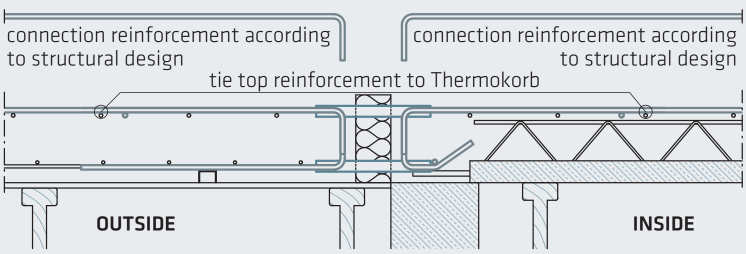
2. Thermokorb

When placing Thermokorb elements the required concrete cover has to be achieved. Standard concrete cover of U-stirrups of Thermokorb elements is at least 30mm. Thermokorb elements have to be laid in their correct positions according to construction drawing and/or affixed labels.



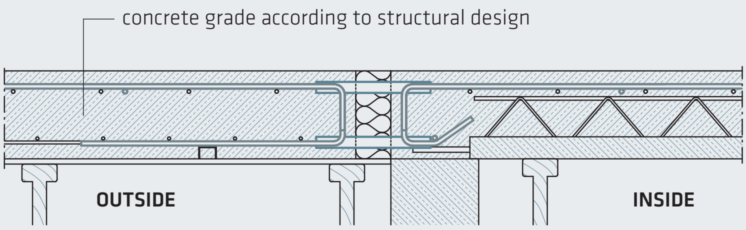
3. Bottom Reinforcement

In order to ensure the required concrete cover the bottom reinforcement has to be placed on top of the bottom legs of the U-stirrups.



4. Top Reinforcement

Outside and inside connection reinforcement acc. to structural design. This reinforcement can be placed in the form of straight rebars, stirrups or reinforcing wire mesh.



5. Concrete

In order to ensure that the Thermokorb elements stay in position during concreting it is essential to pour and vibrate concrete evenly. It is also recommended to secure the Thermokorb elements in place.

THERMOKORB DESIGNING

The calculation software “AVI Thermotool” serves to design Thermokorb elements. This software consists of different modules which allow designing thermal insulations for a number of standard applications.

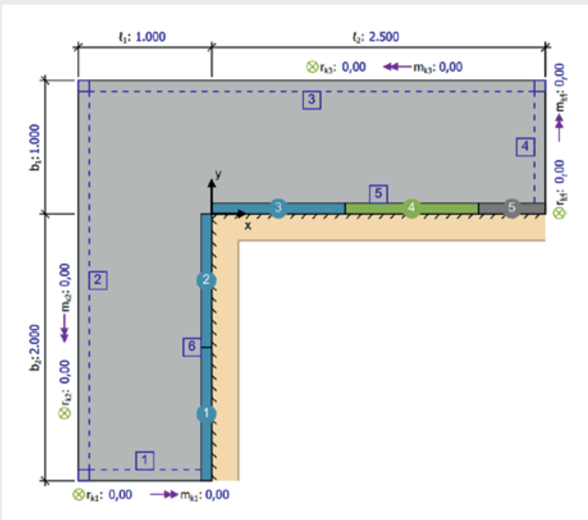
Thermotool provides for altogether seven modules for designing, each of them allowing calculating different installation cases.

- Rectangular Balcony
- Loggia
- Outer Corner Balcony
- Inner Corner Balcony
- Bracket Parapet
- Wall Cantilevered
- Balcony

The modules Rectangular Balcony, Outer Corner Balcony, Inner Corner Balcony and Loggia determine moments and shear forces on the basis of the dimensions and loads of every component. The Bracket module enables entering moments and forces along all spatial axes. Furthermore the Cantilevered Balcony module allows Thermokorb designing for a balcony by entering moment and shear force.

At designing, every Thermokorb element will be defined individually. In this process, the user can either choose between automatic or manual allocation. The example on the right shows a hinged support in area no. 4, edge no. 5, for which type TKA is used. Area no. 5 is an opening, so no Thermokorb will be installed there. The areas 1 to 3 are fixed supports.

When calculating the components, the user is free to add extra columns in any position of the unsupported edges. The example on the right shows an outer corner balcony with three columns in freely chosen positions.



Thermotool uses the finite element method to determine the occurring moments and shear forces. At designing, the relevant internal forces are determined individually for every Thermokorb.

The example below shows an outer corner balcony (slab thickness 200 mm) with four Thermokorb elements and an unsupported section in one of the supports (edge 5). Every single Thermokorb is calculated individually.

In order to avoid a collision with the ribs in the corner, the determined rib height in position 3 is 130 mm while all other TKM Thermokorb elements have a rib height of 150 mm.

The internal force diagrams show clearly the distribution of moments and shear forces along the supports. The Thermokorb types are determined on the basis of these internal forces and the latter can also be used by the structural design engineer to design the reinforced concrete elements. A report can be created to prove that calculations have been made.

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For any information about availability and price of our products, please contact our sales department.

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