

# **NIRO**

## **Cantilever Balcony Connector**



Version: **Peikko Group 11/2011**

# NIRO

## Benefits of Peikko® NIRO

- Simple construction
- Lightweight in installation
- Tested and proven solution
- Wide range of models and sizes
- Fire protection as standard option



**CONCRETE CONNECTIONS**

### Peikko benefits

- reliable: passed demanding test program
- competitive price and delivery time
- economical and easy to use in designing, manufacturing and installation of the elements

<b>1. DESCRIPTION.....</b>	<b>4</b>
<b>2. DIMENSIONS AND MATERIALS .....</b>	<b>4</b>
<b>3. MANUFACTURING .....</b>	<b>6</b>
<b>3.1. Manufacturing method</b>	<b>6</b>
<b>4. RESISTANCES .....</b>	<b>6</b>
<b>5. DESIGN .....</b>	<b>8</b>
<b>6. INSTALLATION .....</b>	<b>9</b>
<b>7. MARKINGS .....</b>	<b>9</b>
<b>8. DESIGN GRAPHS.....</b>	<b>11</b>

# NIRO Cantilever Balcony Connector

## 1. DESCRIPTION

Peikko NIRO Cantilever Balcony Connector supports balcony slab from the intermediate floor of the building through insulated elements. Balcony slab's statical model in this case is cantilever, and NIRO's force transfer is based on force couple. Load bearing parts of NIRO which penetrates through the insulating element are stainless steel C-profiles.

Peikko delivers two basic types of NIRO TKM Cantilever Balcony Connector:

- Type G: Cast-in-situ concrete floors.
- Type E: To be used with Filigran or equivalent, for example prestressed slab solution.
- Model TKA is available for the supported balconies which are stressed only by shear force.

## 2. DIMENSIONS AND MATERIALS

Reinforcement bars:  
(load bearing and supporting rebars)      Ø10 mm, BSt 550, Ö-NORM B 4700 3.4.1.2  
tensile strength  $f_{yk} = 550 \text{ N/mm}^2$

C-profiles:      1.4571 C 850 Ö-NORM - EN 10088-2  
A = 2,05 cm<sup>2</sup>, J = 1,24 cm<sup>4</sup>

Insulation:      EPS – 200, extruded polystyrene,  
ÖNORM B 6050  
Thickness 80 mm, thermal conductivity  $\lambda = 0,032 \text{ W/mK}$

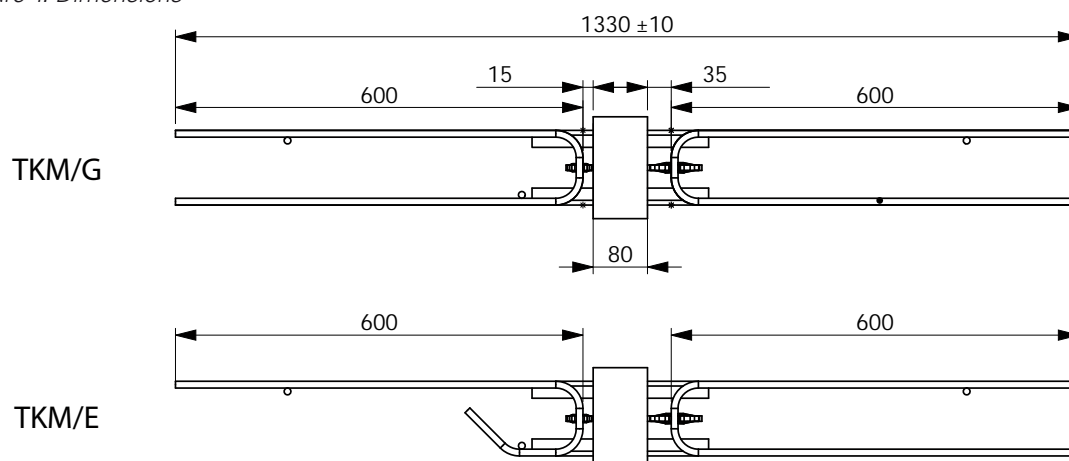
Fire protection:      PROMATECT-H  
Non-combustible A1 –class insulation. EN13501  
Thickness 870 kg/m<sup>3</sup>, thermal conductivity 0,175 W/mK  
Compression strength 9.3 N/mm<sup>2</sup>

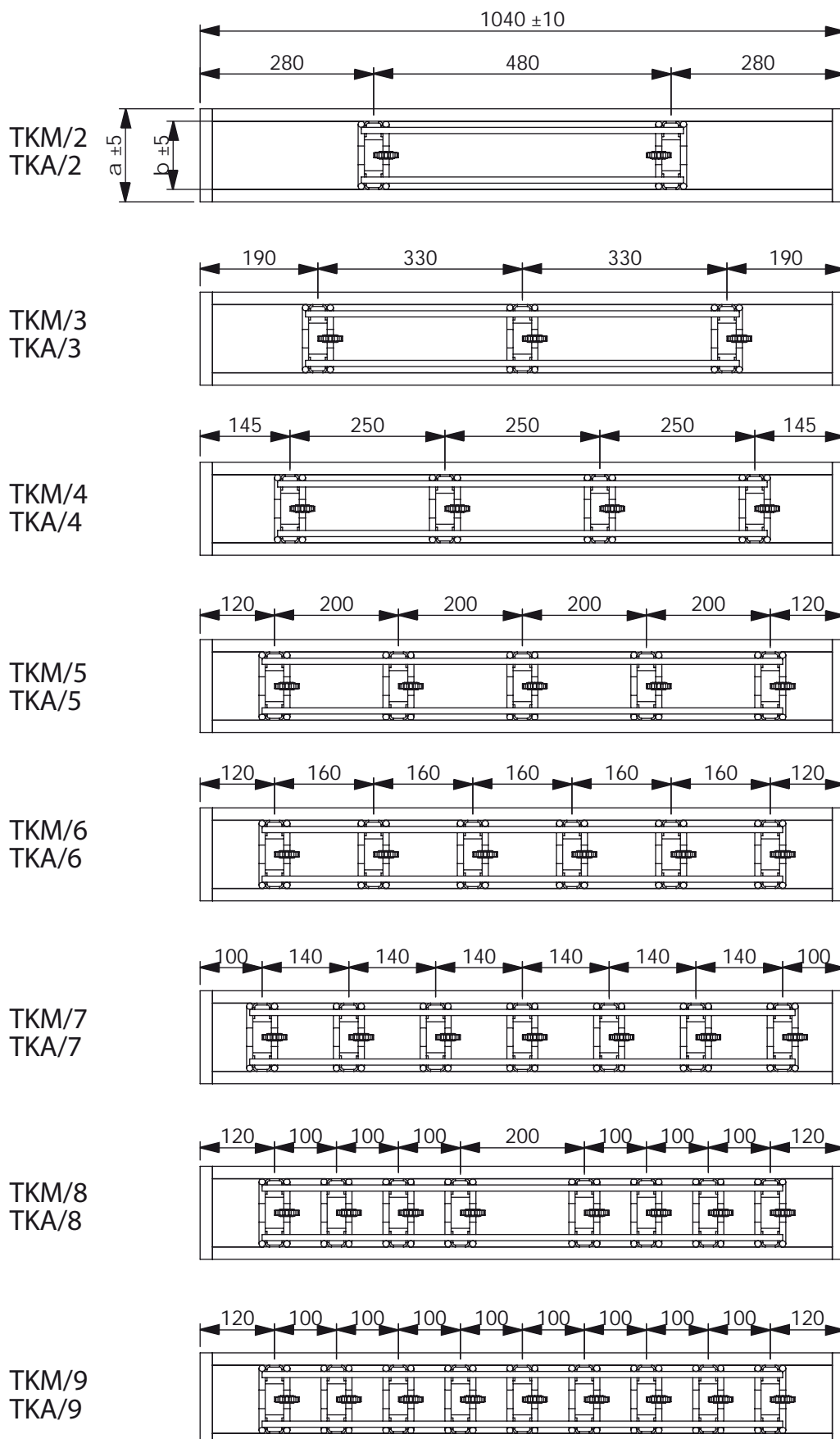
NIRO Cantilever Balcony Connector consists of load bearing rib elements. Number of the rib elements in one balcony connector depends on effecting loads. In standard 1040 mm wide balcony connector, there are 2 to 9 rib elements.

Table 1.

Thickness of balcony slab [mm]:	Height of the rib element [mm]
≥ 160	110
≥ 180	130
≥ 200	150
≥ 220	170

Picture 1. Dimensions





Connectors without fire insulation are 40 mm narrower.

# NIRO Cantilever Balcony Connector

## 3. MANUFACTURING

### 3.1. Manufacturing method

C- Profiles:	Cold rolling and cutting
Rebars:	Mechanical cutting and bending
Welding of ribs:	MAG robot welding
Assembly of rib frame:	MIG hand welding in assembly jig
Insulation, assembly:	Insulation elements are installed manually into rib frame, fixed with hot glue and screws.
Fire protection plates:	Fixed with hot glue, secured by taping the end plates around the insulation.

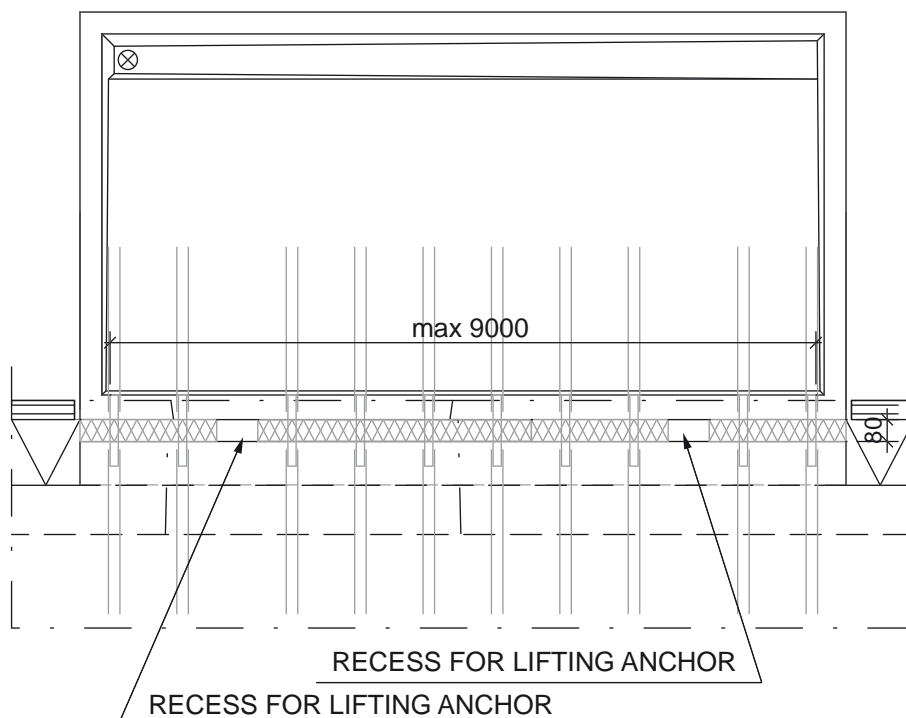
## 4. RESISTANCES

In this user instruction resistances are defined according to following standards:

- EN 1992-1-1: Design of concrete structures general rules and rules for buildings
- EN 1993-1-1: Design of steel structures: General rules and rules for buildings
- EN 1993-1-3: Design of steel structures: Additional rules for cold formed bars and plates
- EN 1993-1-4: Design of steel structures: Additional rules for stainless steel
- EN 1993-1-5: Design of steel structures: Plate structures

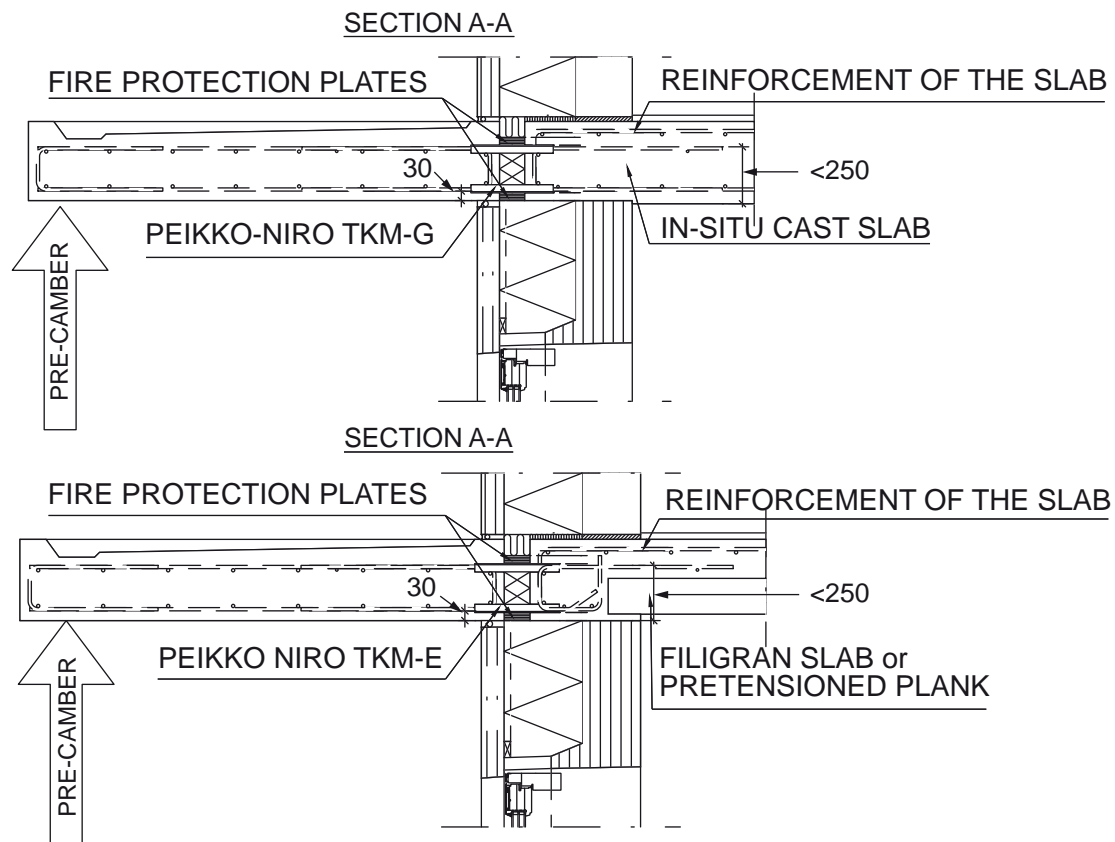
Loads and load combinations are according to EN 1990 design loads.

Picture 2. Drawing of balcony precast element.





Picture 3. Cross sections of balcony structures.



In resistance calculations concrete has been assumed to be class C25/30 and balcony connector's upper rebars to be max. 250 mm from the bottom surface of the balcony slab (see Picture 3). Concrete must reach the design strength before installation supports can be removed.

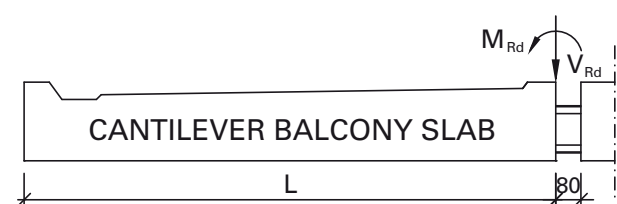
Design for 100 years lifetime requires, that concrete class in balcony slab is minimum C40/45, and concrete cover should comply with local Exposure Class standards.

Balcony slab, as well as the concrete floor slab, must have such a reinforcement in top surface that it can transfer the bending moment as well as shear force effecting the NIRO Cantilever Balcony Connector. All rebar splices have to be according to Eurocode and slabs must have at least the minimum reinforcement required by Eurocode. The shear force effecting to the NIRO Cantilever Balcony Connector is transferred to joining concrete structures via edge stirrups, located to the edges of the slabs (see Picture 3). Stirrups are not needed if shear force is transferred as compression to the structures below.

Note: all resistances given in this user instruction is for static loads only. In case of dynamic loads, the balcony connection must be designed separately.

NIRO Cantilever Balcony Connectors have standard fire protection against 90 minutes fire.

Resistances for single rib element of Peikko NIRO has been presented in Table 2. Intermediate values can be linearly interpolated. Total resistance of the Peikko NIRO is calculated by multiplying the single rib resistance with number of ribs in the element. Resistances are also given as curves in chapter 8: Design Graphs.

Picture 4. Design forces  $M_{Rd}$  and  $V_{Rd}$ .

# NIRO Cantilever Balcony Connector

Table 2. Resistances of a single rib element.

Rib height 110 mm Slab thickness $\geq 160$ mm			Rib height 130 mm Slab thickness $\geq 180$ mm			Rib height 150 mm Slab thickness $\geq 200$ mm			Rib height 170 mm Slab thickness $\geq 220$ mm		
$M_{Rd} / V_{Rd}$	$M_{Rd}$	$V_{Rd}$	$M_{Rd} / V_{Rd}$	$M_{Rd}$	$V_{Rd}$	$M_{Rd} / V_{Rd}$	$M_{Rd}$	$V_{Rd}$	$M_{Rd} / V_{Rd}$	$M_{Rd}$	$V_{Rd}$
0,00	0,0	12,7	0,00	0,0	13,0	0,00	0,0	13,2	0,00	0,0	13,4
0,04	0,5	11,9	0,04	0,5	12,3	0,04	0,5	12,7	0,04	0,5	12,9
0,09	1,0	11,1	0,09	1,0	11,7	0,08	1,0	12,1	0,08	1,0	12,4
0,15	1,5	10,3	0,14	1,5	11,1	0,13	1,5	11,6	0,13	1,5	12,0
0,21	2,0	9,5	0,19	2,0	10,4	0,18	2,0	11,0	0,17	2,0	11,5
0,29	2,5	8,7	0,26	2,5	9,8	0,24	2,5	10,5	0,23	2,5	11,0
0,38	3,0	8,0	0,33	3,0	9,1	0,30	3,0	10,0	0,28	3,0	10,6
0,49	3,5	7,2	0,41	3,5	8,5	0,37	3,5	9,4	0,35	3,5	10,1
0,63	4,0	6,4	0,51	4,0	7,9	0,45	4,0	8,9	0,42	4,0	9,6
0,80	4,5	5,6	0,63	4,5	7,2	0,54	4,5	8,3	0,49	4,5	9,2
1,04	5,0	4,8	0,76	5,0	6,6	0,64	5,0	7,8	0,57	5,0	8,7
1,34	5,5	4,1	0,93	5,5	5,9	0,75	5,5	7,3	0,67	5,5	8,2
2,00	6,0	3,0	1,13	6,0	5,3	0,90	6,0	6,7	0,77	6,0	7,8
-	6,5	-	1,38	6,5	4,7	1,05	6,5	6,2	0,89	6,5	7,3
			1,75	7,0	4,0	1,25	7,0	5,6	1,03	7,0	6,8
			75,00	7,5	0,1	1,47	7,5	5,1	1,17	7,5	6,4
			-	8,0	-	1,74	8,0	4,6	1,36	8,0	5,9
						2,43	8,5	3,5	1,57	8,5	5,4
						-	9,0	-	1,80	9,0	5,0
									2,11	9,5	4,5
									14,29	10,0	0,7

## 5. DESIGN

Peikko NIRO is used to support cantilever balcony slabs from the load bearing slabs of the building. NIRO Cantilever Balcony Connector can be used with both cast-in-situ and precast structures. Structural engineer must assure the load transfer from the connector to load bearing structures of the building.

Standard widths for the Peikko NIRO Cantilever Balcony Connectors are 1040 mm and 540 mm. It is recommended to use these lengths to support arrangement, even though other widths with 100 mm steps are also available.

When NIRO Cantilever Balcony Connector is installed to the level of slab bottom, concrete cover will be 30 mm. If thicker concrete cover is needed, the connector can be installed higher in relation of the slab (see Picture 2). When designing precast balcony slabs, please take into account that transport anchors are needed between the connector elements (see Picture 1).

Temperature variations in balcony slab causes movements in balcony slab, which effect to the connector like fatigue loads. Due to these loads, balcony width is limited to 9 meters with design life time of 100 years.

Deflection of the balcony slab have to be taken into account by precambering the front edge of the balcony slab. Designer must pay attention to note the deflection with connecting structures, like balcony window elements and such. Recommended precambering is shown in Table 4.

Vibration of the structure shall also be considered in dimensioning. Recommended maximum cantilever balcony depths are shown in Table 3.

Table 3. Recommended balcony depth.

Rib height (RH) / slab thickness (H) [mm]	Recommended balcony depth: (L) [mm]
110 / $\geq 160$	$\leq 1750$
130 / $\geq 180$	$\leq 2000$
150 / $\geq 200$	$\leq 2250$
170 / $\geq 220$	$\leq 2500$



## 6. INSTALLATION

NIRO elements are delivered tied into wooden frames. These frames can be lifted with lifting lanes or forklift from the ribs to transfer them to installation site. When storing NIROs outside, user must ensure that the white protection plastic film on the top of the insulation is not damaged.

Picture 5. Transport pallet.



Following precambering is set to the precast balcony slab or to balcony slab formwork:

Table 4. Pre-camber of the balcony slab.

Thickness of the slab [mm]	Rib height [mm]	Pre-camber
≥ 160	110	0,59 %
≥ 180	130	0,50 %
≥ 200	150	0,43 %
≥ 220	170	0,38 %

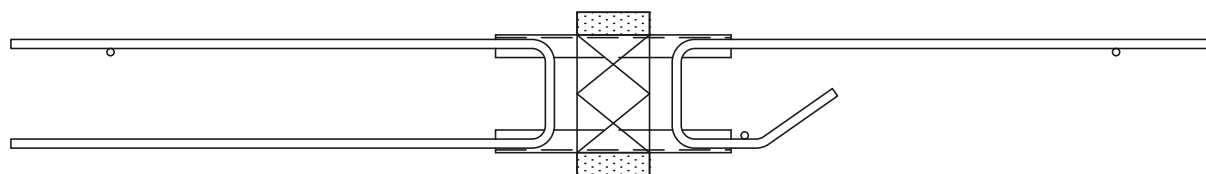
NIRO Cantilever Balcony Connector elements are installed into the formwork according to workshop drawings. Direction and position of installation is marked to the product label glued into the top fireprotection plate. Perpendicular support rebars of the rib-frame can be cut on to make installation easier. Gaps for transport anchors in NIRO elements are filled with insulation. Reinforcement is tied to rib-element and then the slab is cast.

## 7. MARKINGS

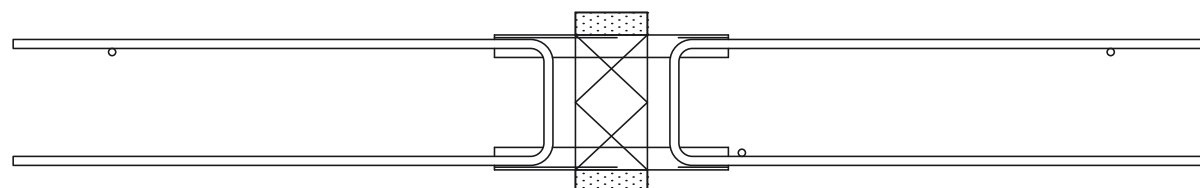
NIRO Cantilever Balcony Connector have fire protection against 90 minutes fire as standard option. Standard length of the NIRO element is 1040 mm, and half length element is 540 mm. If customer needs a half-element for a 3, 5, 7 or 9 rib NIRO element, then half element will have either 2, 3, 8 or 5 ribs.

Picture 6. Standard types.

TKM/E

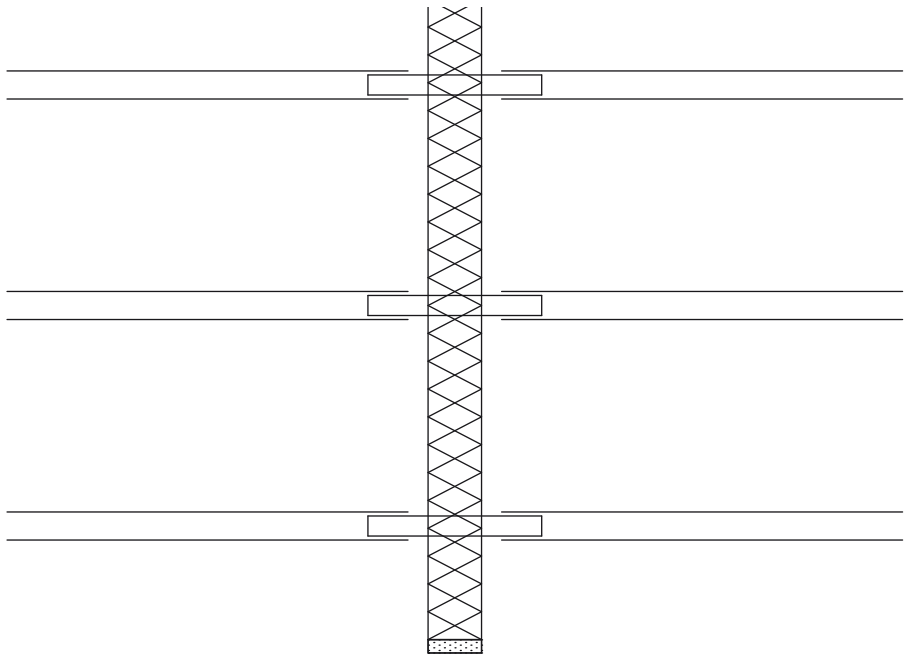


TKM/G

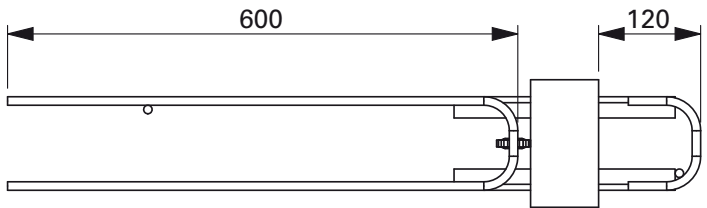


# NIRO Cantilever Balcony Connector

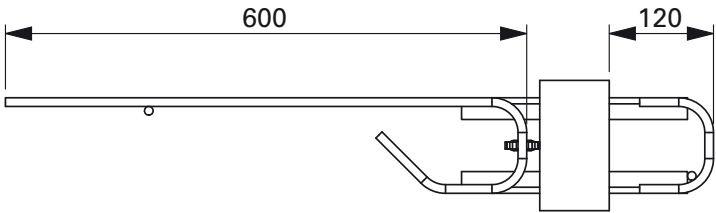
TKM 5-540 or TKM 6-540



TKA/G



TKA/E



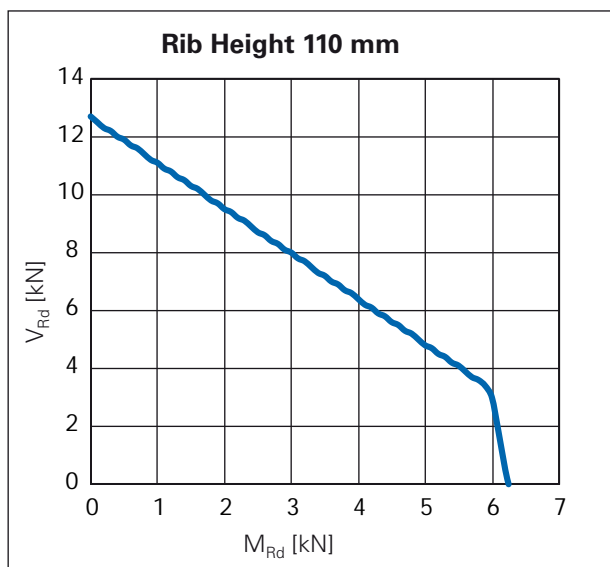
Markings:

Supplier	Product	TKM	Number of rib-elements	Rib type	rib-height [cm]	Height of insulation [cm]	Fire-protection	Length of the element [mm]
Peikko	NIRO	TKM/	2...9	G / E	11/13/15/17	16....22 cm	F90	540/1040

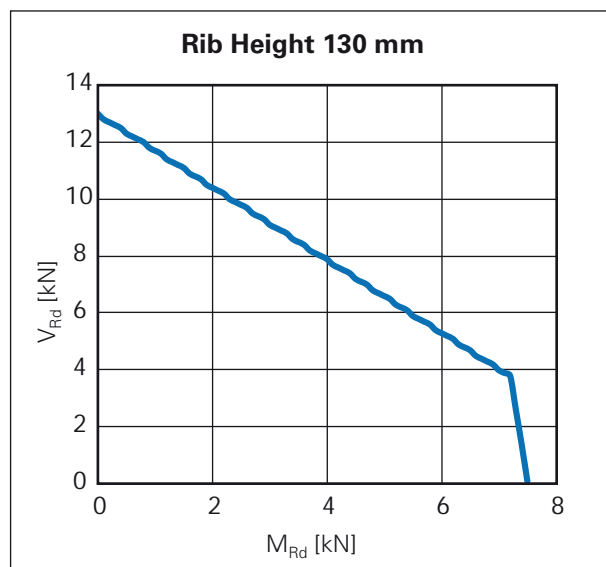
- Peikko NIRO TKM/4G 17/20 F90 – 540  
Half-element, 540 mm of TKM/4G, with 2 ribs
- Peikko NIRO TKM/7E 11/16 F90 – 1040  
1040 mm long, filigran slab type element with 7 ribs
- Peikko NIRO TKM/7G 15/20 F90 - 540  
Half-element, 540 mm of TKM/7G, with 4 ribs

## 8. DESIGN GRAPHS

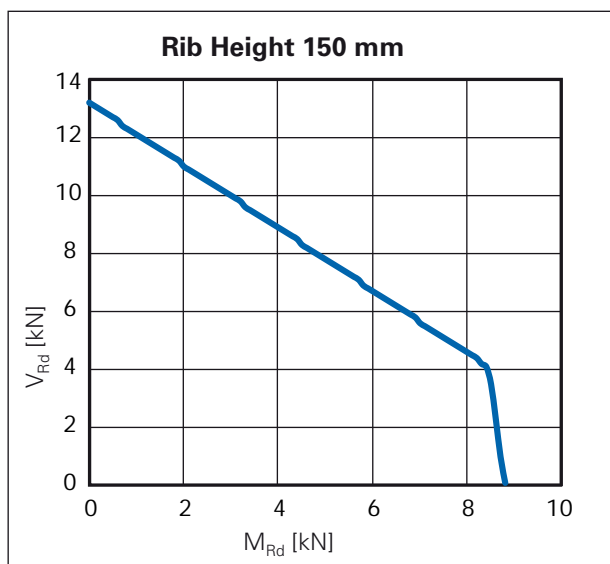
Resistance values shown in these graphs are ultimate limit state.



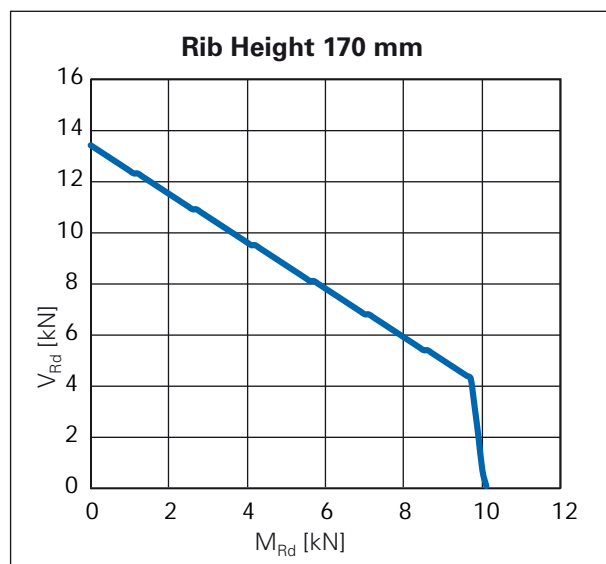
— RH110



— RH130



— RH150



— RH170



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