ACCREDITED
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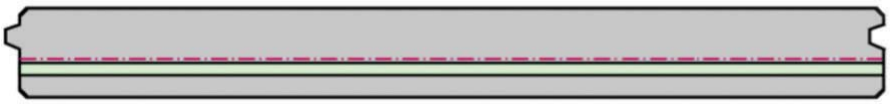
Konnektor®

System for **insulated panels**

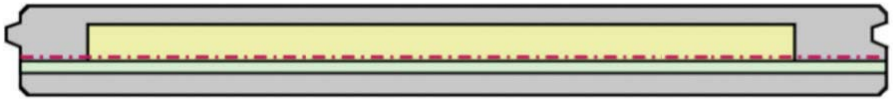
Konnektor
System for insulated panels

What is Konnektor?

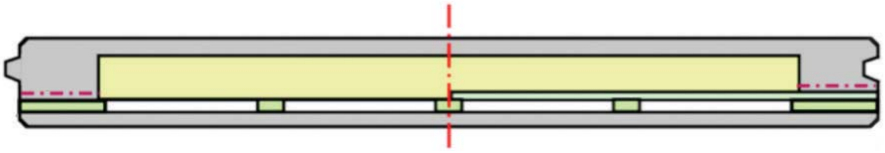
Konnektor® is a patented system that uses support and connection devices between two freely expansible reinforced concrete layers, for the construction of concrete panels with insulation and structural section.



Panel with insulation.



Panel with insulation and lightened carrier layer.



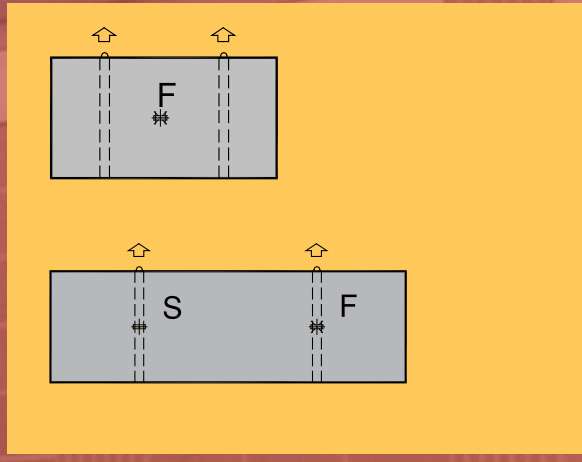
Ventilated panel with insulation.

The connecting devices between the two layers are designed to allow the **construction of panels without size limit**.
Konnektor® allows the production of panels with insulation of various kinds: lightened, aerated, and ventilated.

Support devices

The supports are bound to the carrier layer and bear the weight of the supported layer in an isostatic manner, without preventing thermal expansions/contractions of the hanging layer. They are made with a Ø 40 mm galvanized steel pin, which is anchored in the carrier layer and supports the load of the hanging layer.
At the base of the supports, suitably shaped, a metal bar (hereinafter called guide) is installed to distribute the load and to be fixed to the reinforcing mesh of the hanging layer, keeping the support in the appropriate position during casting operations (*Fig. 1*).

Fig. 1
The support is anchored to the reinforcing mesh of the hanging layer.



When the guide is filled with concrete, a hinge is created (**fixed support**); the free guide, provided with its appropriate sponge, is a sliding system which can be moved up to 8 mm (**sliding support**).
The bar that acts as a guide to the sliding support is coated internally with Teflon, a material that allows canceling internal friction, guaranteeing sliding between layers in any situation.
Around the pin, the insulation thickness should be reduced, creating a cylinder of at least 12 cm in diameter within which the **fretting spring** is located.
As summarized in ***table 1***, the insulation thickness in the area around the support may be maximum 4 cm, compatibly with the required carrying capacity and strength of the concrete.

Especially for vertical panels, which, after being balanced, unload all the weight of the outer layer only on the fixed support, the carrying capacity of the support should be used as much as possible, reducing up to 1 cm.

Using insulating panels with thickness greater than 4 cm, it is always necessary to operate a reduction as shown in ***figures 2*** and ***3***, depending on whether there are reinforcements or not.

During formwork removal, storage, and transport, all panels are always considered horizontal. During formwork removal, which is characterized by a reduced strength of concrete, it is necessary to set the number of supports and the insulation thickness on each support. The number of supports is determined in relation to the weight to be supported, panel dimensions, and thickness of the hanging layer. The cases that can be found are summarized in ***figure 4***.

PN = RATED CARRYING CAPACITY OF SUPPORT (KN)					
insulation layer thick s (cm)	Rckj (N/mmq)				
	10	15	20	25	30
1	19	29	38	48	48
2	14	22	29	36	36
3	12	18	24	30	30
4	10	15	20	25	25

Tab. 1

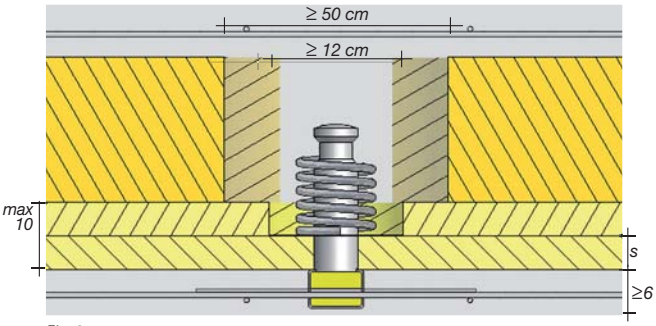


Fig. 2

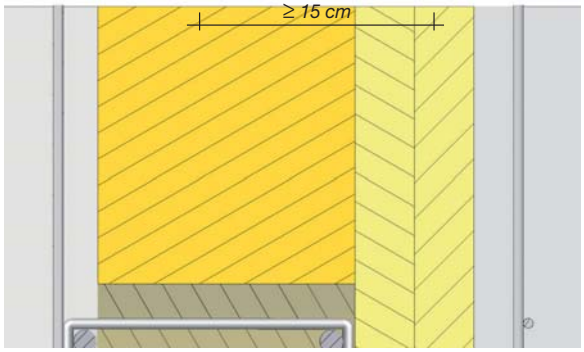


Fig. 3

Fig. 2 and 3
Reduction of insulation around the supports. The reduction of the insulation, and possibly lightening, must be such as to enable full development of the distribution load at 45° in the carrier layer from the fretting spring plate, with the exception of cases in which the support is within a reinforced curb.

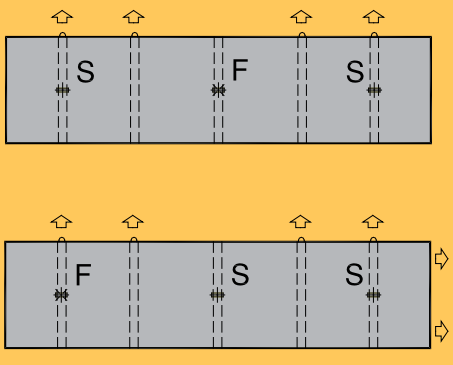


Fig. 4
In a small size panel, the fixed support only should be exactly in the center. To avoid torsion effects during handling, a double crossed fork should be added or continuous connections should be used.
In panels with two supports, they are placed on cross curbs at a distance from the edge between 0.2 and 0.25 L.
In long horizontal panels, the fixed support is designed to be in the center and the two sliding supports are placed at a distance from the edge between 0.1 and 0.25 L.
It is advisable, in the case of vertical panels, to put **F** at the base or on the head.

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Connection devices

It is planned to give a type of perimeter connections installed after laying of the insulation (**C10 and Forks**) and a second type, an alternative to the previous one, which is put in place before casting the hanging layer, simultaneously with the support devices (**continuous connections**).
The choice is made in relation to the production method and time of concrete setting.
All types of perimeter connections are made of stainless steel and prevent that the carrier layer is detached from the carried layer, leaving them to be free and independent to dilate or contract.

When the panel is made on folding tables, the connections keep the 2 layers connected in handling during storage, transport, and assembly, resisting to wind suction in place. If the panel is manufactured on fixed platforms, the connections also support the direct weight of the carried layer during tilting.

If the traditional method is used, by inserting the connections after laying of the insulation *(Fig. 5)*, the nominal carrying capacity of connectors C10 and Forks is in relation to the strength of concrete and is reported in *Table 2*. Unlike the forks, C10 connectors were made with stainless steel wire cables consisting of very small diameter wires, which bend without yielding and effectively anchor in wet concrete. The follo-wing figures show the insertion procedure of C10 connectors.

First, the C10 connector is coupled to the polystyrene spacer, the height of which is determined according to the insulator thickness to ensure a fixed distance of 10 cm between the two anchoring points.
Subsequently, the two ends of the cable are folded manually. The C10 connectors allow a relative displacement between the two layers of about 1 cm.
The forks are simply pushed into the insulation layer from above, until they reach the bottom of the caisson or the outer finishing layer.

RATED CARRYING CAPACITY OF CONNECTORS			
Cls Rcj (N/mm²)	supportable kN	m² supportable	
		for thickness 6 cm	for thickness 7 cm
≥ 10	1,50	1,00	0,86
≥ 15	2,25	1,50	1,30
≥ 20	3,00	2,00	1,72
≥ 25	3,75	2,50	2,15
≥ 30	4,50	3,00	2,60

Tab. 2

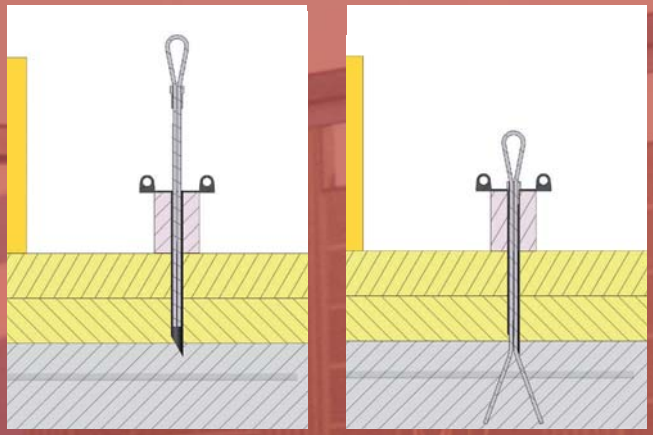


Fig. 5
The polystyrene tubular bar is used as the template to give the right penetration of the 2 cable ends in the concrete.

Connector C10

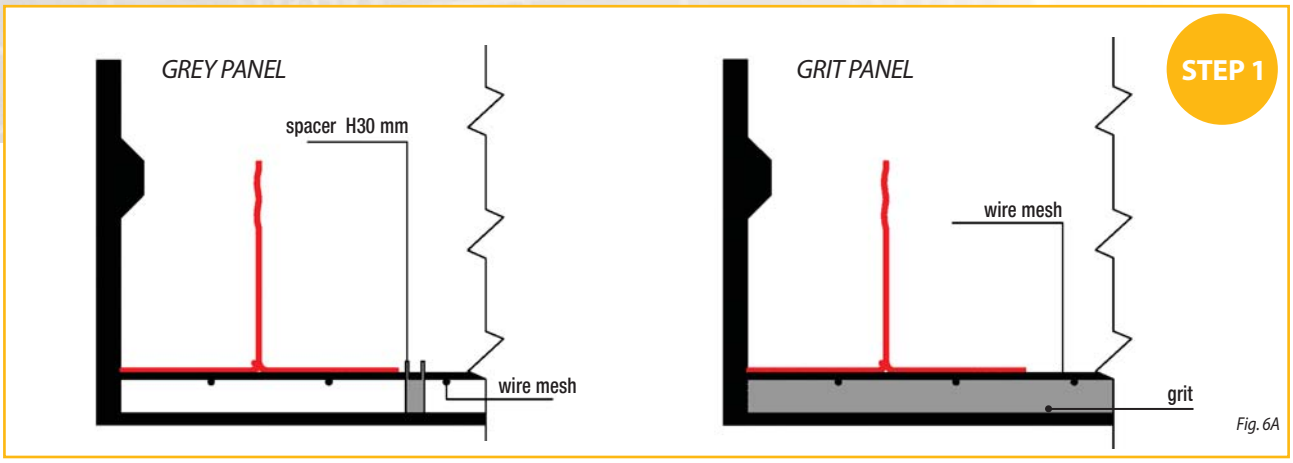


Fig. 6A

To disconnect manufacturing from concrete setting time, ensuring formwork removal on the next day, it is possible to use "C-shaped" and "knurled" continuous connections. These items are 2 meters long and are made of stainless steel to keep high ductility, as it is certified by laboratory tests carried out at the ITC-CNR in Milan.

It is planned to have a connection every 50 cm on the entire perimeter and possibly in the central curb for panels of a width exceeding 2.50 meters.

The connections are placed by fixing them to the wire mesh of the hanging layer (see casting sequence in *Fig. 6*). The choice of the type of continuous connection to be used is guided by the type of reinforcement or shape of the formwork bank; their behavior for the purpose of formwork removal is still the same.

Fig. 6A
GREY PANEL
1. Position of the wire mesh with 3 cm spacer.
2. Laying on the wire mesh and anchoring with at least two brackets of pebbled connections.

WASHED PANEL
1. Casting with 3 cm grit.
2. Straight edge of grit.
3. Laying on the wire mesh and anchoring with at least two brackets of pebbled connections.

Fig. 6B
Completion of supported layer casting.

Fig. 6C
Positioning of the insulating material layer in double layer, or interposing a polyethylene sheet between the carrier layer and the insulating layer.

Fig. 6D
Positioning of reinforcements and lightening material.

Fig. 6E
Casting of the carrier layer.

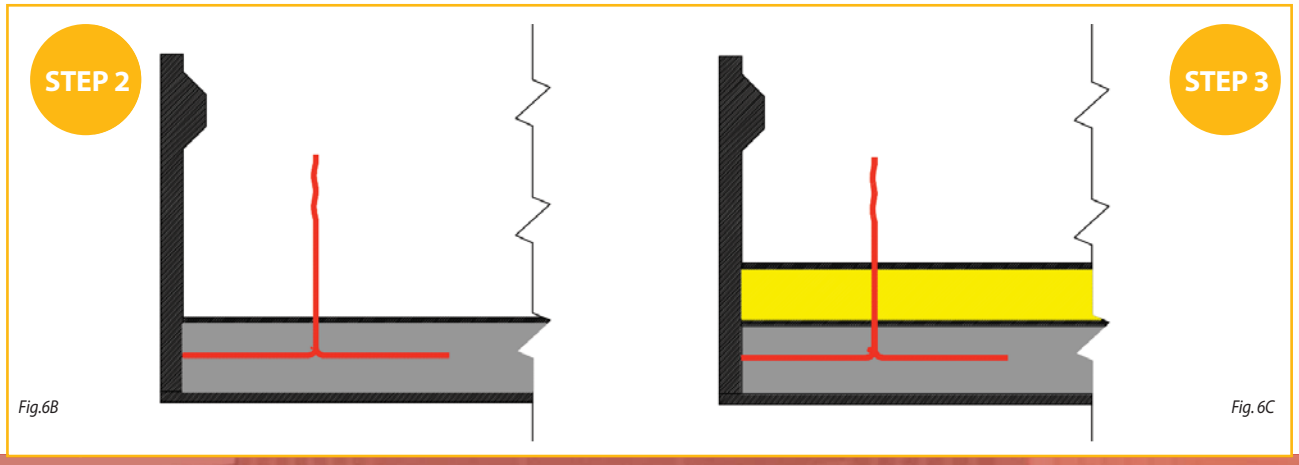


Fig.6B

Fig. 6C

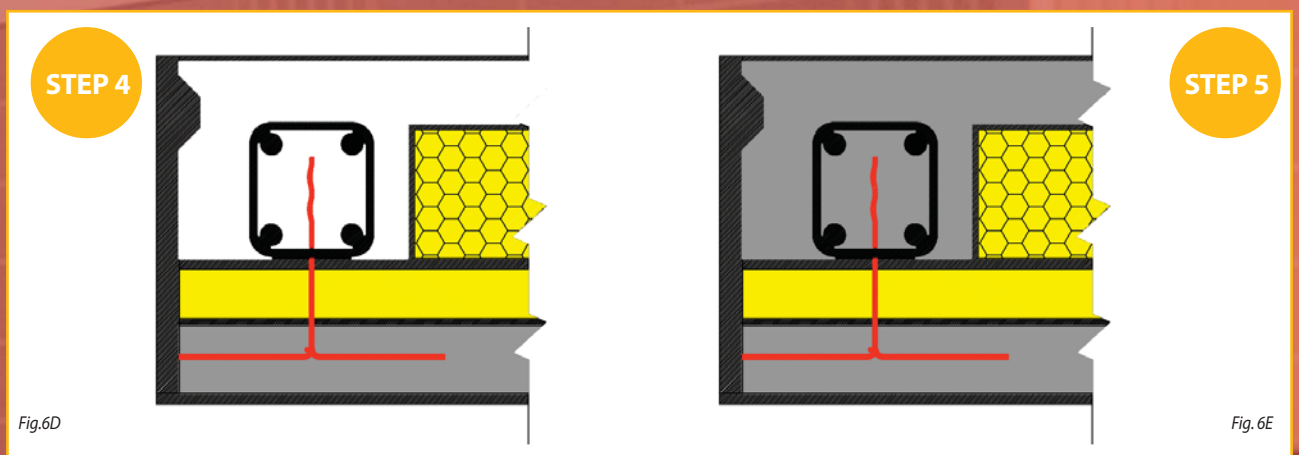


Fig.6D

Fig. 6E

Konnektor
Design criteria

To determine the number and type of connections, in the design stage, reference is made to a calculation program ***(Fig. 7)***, ICMQ certificate, which is provided free of charge and also allows the check of transmittance in relation to the regulations in force.

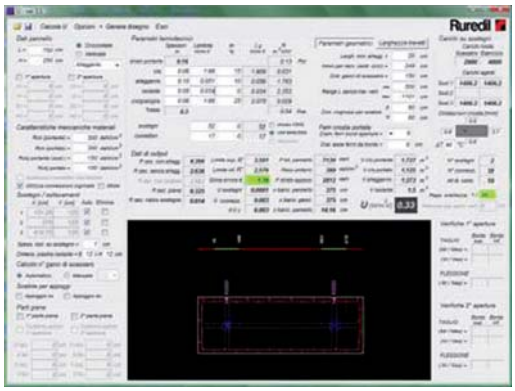


Fig. 7
Page taken from a calculation software with "Ruredil Konnektorr"

Design of supports

In horizontal panels, the number of supports is decided by the weight of the carrier layer and the strength of concrete at the time of formwork removal ***(see Table 1)***. The vertical panels are removed from the formwork, stored, and transported as if they were horizontal panels, i.e. distributing the weight of the carried layer on all the supports. When, upon assembly, it is rotated by 90° to bring it into the vertical position, the whole weight of the carried layer is loaded on the fixed support only, which is anchored to a carrier layer and has its final strength. The support is inserted into a concrete volume side ≥ 15 cm, in a position coinciding with a rib. If, during assembly, the support cannot be entered in a rib on its vertical side (as is often the case in vertical panels), a reinforcement of the concrete volume should be prepared consisting of two vertical brackets Ø 14 ***(Fig. 8)***. For very high vertical panels, it may be necessary to put two fixed supports in one transverse bead, taking care to keep them spaced apart by at least 50 cm.
Sometimes, for example when there are doors inserted in the panel, the end connection between the two layers can be considered a fixed point and it will be possible to put only one sliding support.

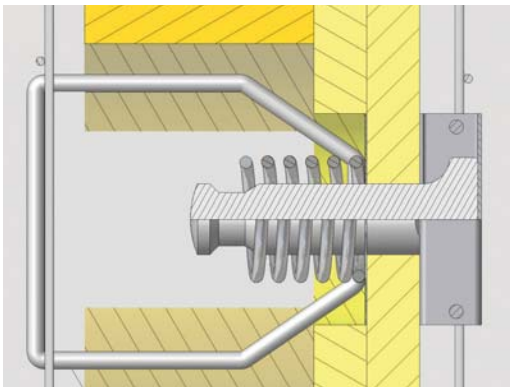


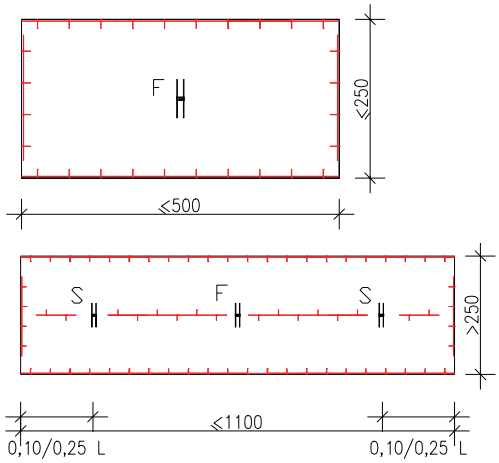
Fig. 8
Reinforcement of the supports when there is no longitudinal reinforcement curb.

Design of connection devices

The frequency of connectors can be found in table 2. Of these, the frequency of connectors C10 may be determined assuming the characteristic strength of concrete after curing, and interposing a fork between two C10 connectors. In installed panels, it is intended to yield due to expansion. In any case, it will be very useful in the early handling stages with lower strength concrete. Other forks are positioned in correspondence of anchors by tilting, or edges due to the presence of openings or protrusions in the panel, which are the most stressed points during formwork removal.
The forks H160 are used for insulations with up to 6 cm thickness; for thicker panels, sup to 10 cm, H200 forks are necessary.
Regarding the design of continuous connections, it will be sufficient

Konnektor
Thermal performance

to calculate the perimeter of the panel and possibly the presence of openings, to obtain the linear meters of connection required.
In this case, reinforcements are not needed at the anchors.
For insulation thicknesses from 8 to 10 cm, H200 knurled connections are to be used.
As an example, two situations are reported as follows:



Positioning of supports and knurled connections in the panel.

Calculation of thermal transmittance of panels

The reference standard for calculating the transmittance of components for building is UNI EN ISO 6946:2008.
This simplified calculation method is implemented in the system software which also provides an alternative method, if the limits of applicability of the simplified method are exceeded.

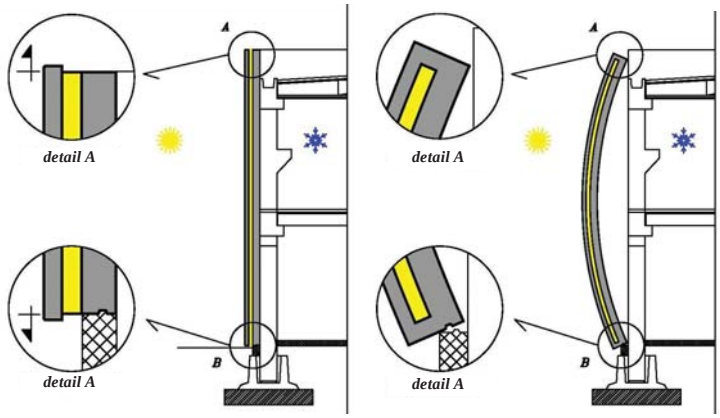
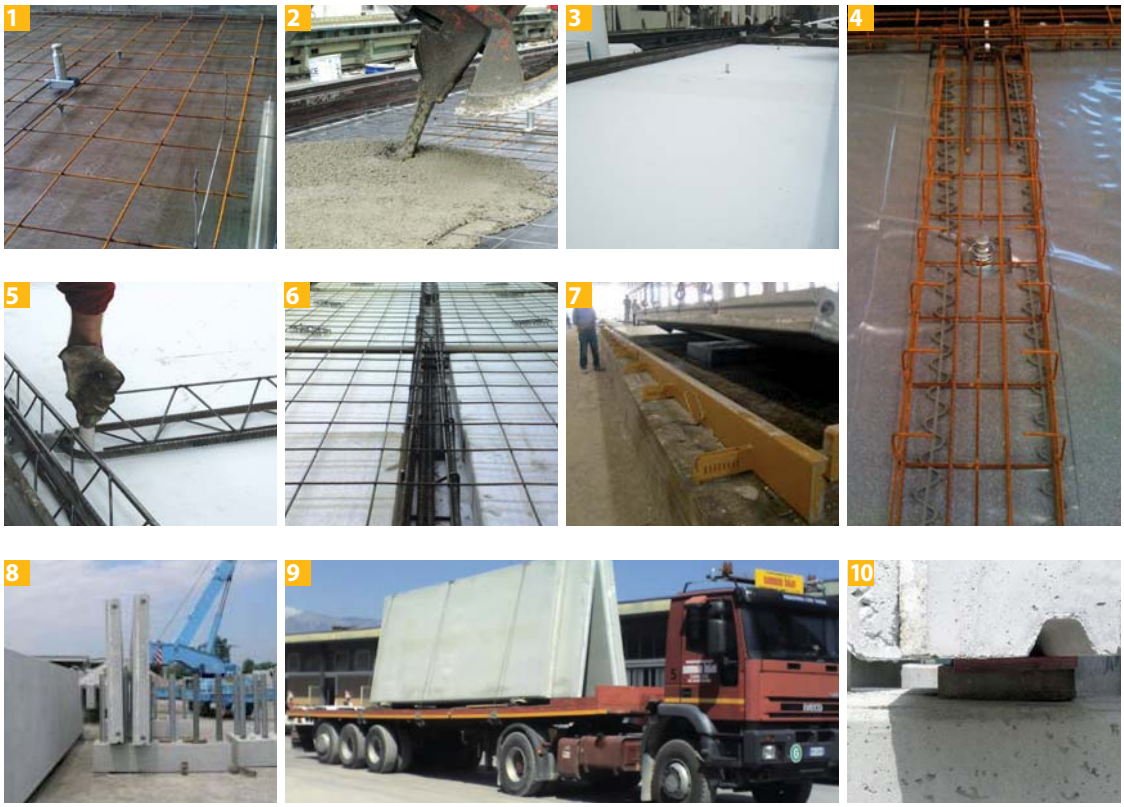


Fig. 9
Panels without structural section often take non-acceptable curves on a daily cycle, while structural section panels are not exposed to these problems.

Considerations

- *The Konnektor system requires no special compressive strength of insulation other than that required to withstand the wind pressure.*
  It is therefore also possible to use the cheapest insulation (if the insulator is polystyrene, with EPS ≥ 70).
  It is always recommended to use the insulation in a double overlay sheet to reduce the frictions between the two layers due to the expansions and, at the same time, to close the thermal bridges between juxtaposed slabs.
- *The advantage of structural cutting is to avoid that the panel is deformed by curving with different temperatures of the layers. (Fig. 9)*
- *When requested, humidity control must ensure that no condensation is formed inside the panel, for which a vapor barrier may be needed.*
- *Ventilated panels eliminate the internal condensation in the winter, leaving a breathable wall, and in the summer they do not allow sunlight to increase the internal temperature.*

Konnektor
Operation steps



1 *Once the formwork has been prepared, Ø 5/15 wire mesh of the supported layer (e.g. 6 cm) is placed on 3 cm spacers (or, possibly, on the layer of grit already casted). The supports should be placed vertically and anchored to the wire mesh using two extra Ø 8 rods with a length of at least 25 cm to be inserted into the holes of the guide. The guide must always be parallel to the longer side of the panel, without distinction for horizontal and vertical panels and for each type of support. At this stage, also C-shaped and knurled connections are anchored to the wire mesh along the entire perimeter of the panel..*

2 *The carried layer is casted to the upper edge of the guide, which will be consequently at 6 cm. If the thickness of the hanging layer is more than 6 cm, the spacers for wire mesh shall be selected accordingly (example 7 cm = 4 cm spacer).*

3 *The insulation is positioned in double layer or interposing a polyethylene sheet over the entire surface, between the carrier layer and the insulating material, the appropriate holes are drilled and reductions are made on the supports. If required, the vapor barrier is laid on the insulating layer.*

4 *The reinforcing cage with its lifting anchors is prepared. To speed up the operations, it is necessary to prepare the reinforcing cage (preferably with the anchoring material already in place).*

5 *If continuous connections are not used, C10 connectors and the forks shall be inserted at this stage.*
Between operations 3 and 5, using the C10 connectors and forks, concrete should not start setting.

6 *The lightening insulation is placed. The wire mesh of the carrier layer is placed.*
The upper concrete cast is completed, making sure to vibrate with needle or through paver, then making the final straight edge.

7 *De-molding. For panels longer than 8 meters, it is recommended overturning by 4 anchors.*

8 *Storage.*

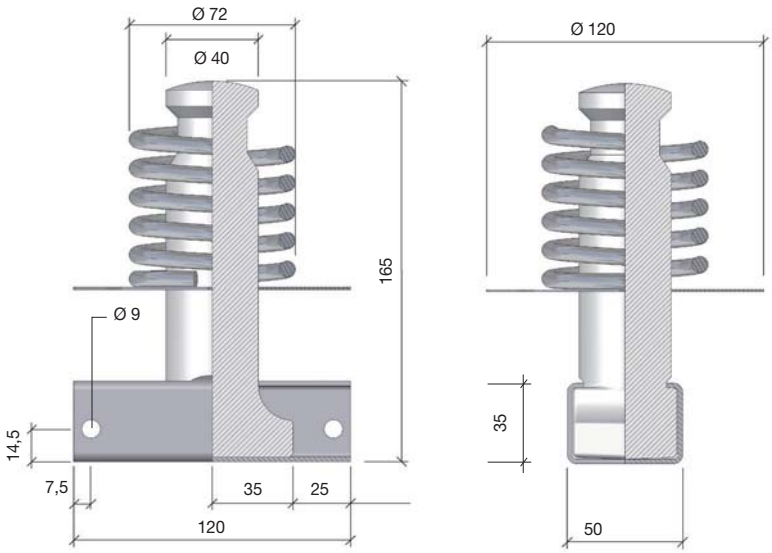
9 *Transport.*

10 *Assembly.*

In steps 8, 9, 10, the panels must be placed on the carrier layer only.

Konnektor
Description of items

1 SUPPORTS (FIXED AND SLIDING)

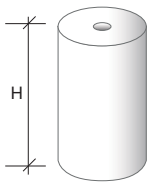


Code	Item	Pack.
0318002001	Fixed Support	6 pcs.
0318003001	Sliding Support	6 pcs.

Materials:
A: FIXED SUPPORT
- pin Ø 40 mm ST 52.3 galvanized
- section bar: Fe 37 galvanized
- spring: C70 galvanized
- electrolytic galvanization UNI-ISO 2081 standard

B: SLIDING SUPPORT
- filling with synthetic foam
- SECTION BAR: Fe 37 with Teflon internal coating

2 SPACER

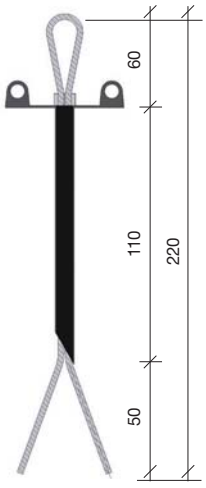


Polystyrene spacer

Code	Item	Pack.
0318051001	Spacer H 40	500 pcs.
0318051002	Spacer H 60	500 pcs.
0318051003	Spacer H 20	500 pcs.

Materials:
- polystyrene d ≥ 25 kg/m^3 sizes on request H = 20 / 40 / 60

3 CONNECTOR C10



Connector C10

Code	Item	Pack.
0318052001	Connector C10	500 pcs.

Materials:
- cable AISI 316 Ø 3 mm
- nylon + glass fiber tubular bar

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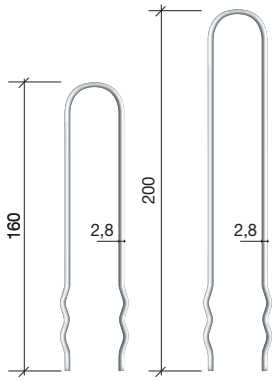
Description of items

Third Edition 06/2016

4 FORK



Fork H 160 — Fork H 200

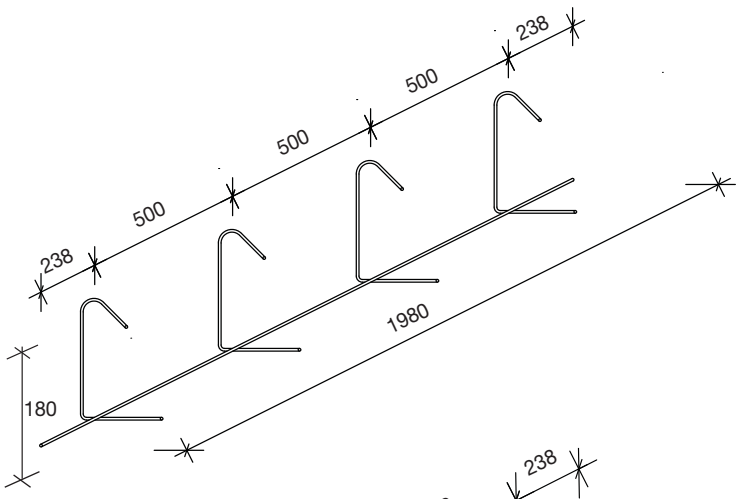
Code	Item	Pack.
0318004001	Fork H 160	500 pcs.
0318031001	Fork H 200	500 pcs.

Materials:
- stainless steel

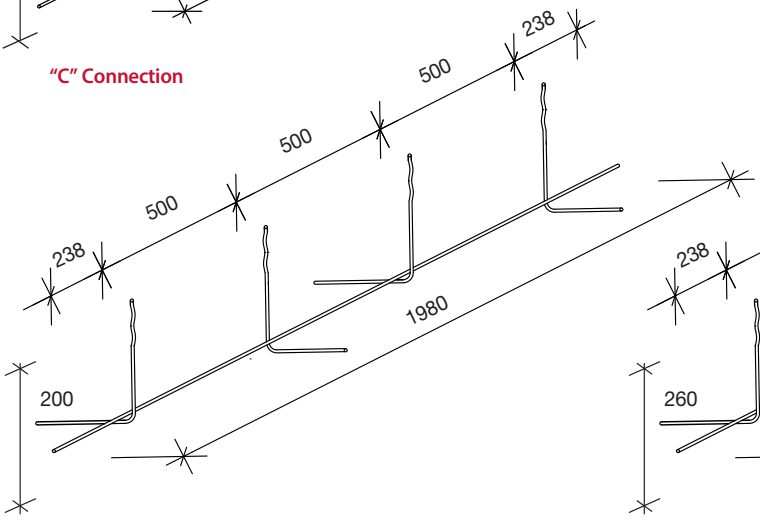
5 CONTINUOUS CONNECTIONS

Code	Item	Pack.
0318055001	C Connection	40 meters
0318054002	Knurled connection H 200	40 meters
0318054003	Knurled connection H 260	40 meters

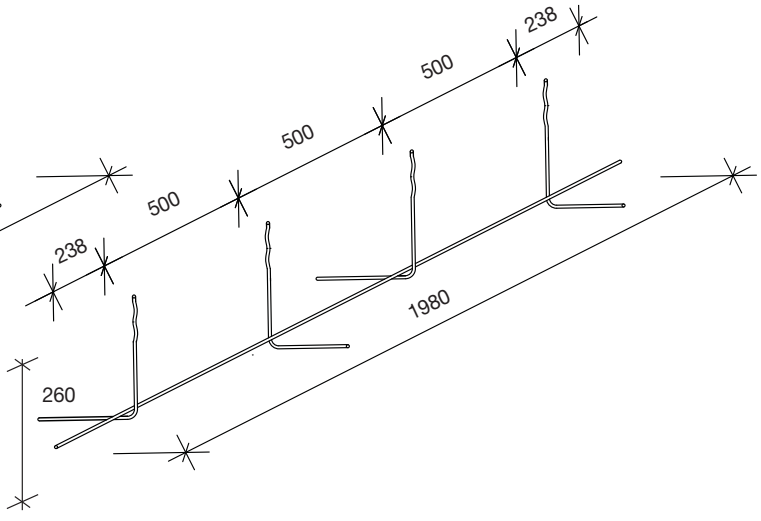
Materials:
- Stainless steel



"C" Connection



Knurled connection H 200



Knurled connection H 260