

Less is more

PFEIFER Hybridbeam®

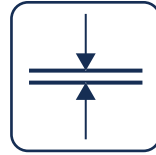


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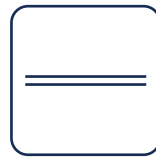
Less is more



Lower storey height while maintaining functional parameters



Elimination of joists protruding from the ceiling - smooth ceiling



Lighter ceiling



Reduced demand for "grey" energy in production, transport, and assembly



Removable elements - beams can be reused in subsequent structures



PFEIFER Hybridbeam®
steel and concrete composite beam
integrated in the ceiling height

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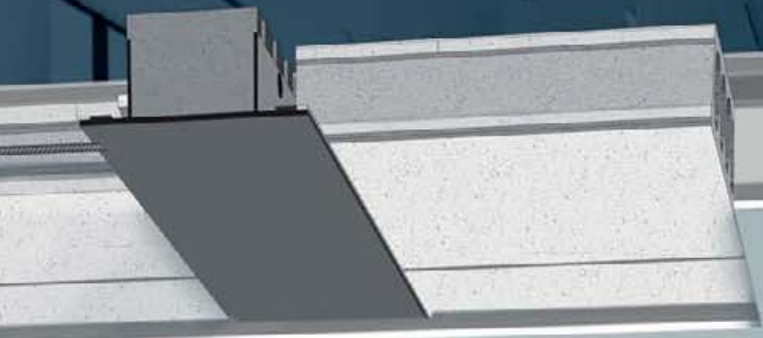


Table of contents

PFEIFER Hybridbeam®	5
Double composite	6
Types of hybrid beams	8
Hybrid beam capacities	10
Sustainable development	12
“Beamless” ceilings with hybrid beams	14
Composite prefabricated slabs on hybrid beams	16
Timber or composite timber-concrete ceilings on hybrid beams	20
Hollow-core slabs on hybrid beams	26
Monolithic ceilings with hybrid beams	30
Composite reinforced concrete floors on a trapezoidal sheet on hybrid beams	32
Interconnection of hybrid beams	34
Hybrid beam connections to the structure of the facility – direct support	36
Hybrid beam connections to the structure of the facility – indirect support	40
Expansion joints on hybrid beams	42
Assembly of hybrid beams	44
Corrosion protection of hybrid beams	48
Fire resistance of hybrid beams	50



PFEIFER Hybridbeam®



Sustainable development

- Perfect combination of materials with high mechanical properties
- Flat ceiling surfaces
- Minimum amount of steel thanks to the use of combination of highstrength materials
- Possibility of reuse in a building
- The materials used for the production of beams are 100% recyclable and used in the production of building materials; steel and concrete



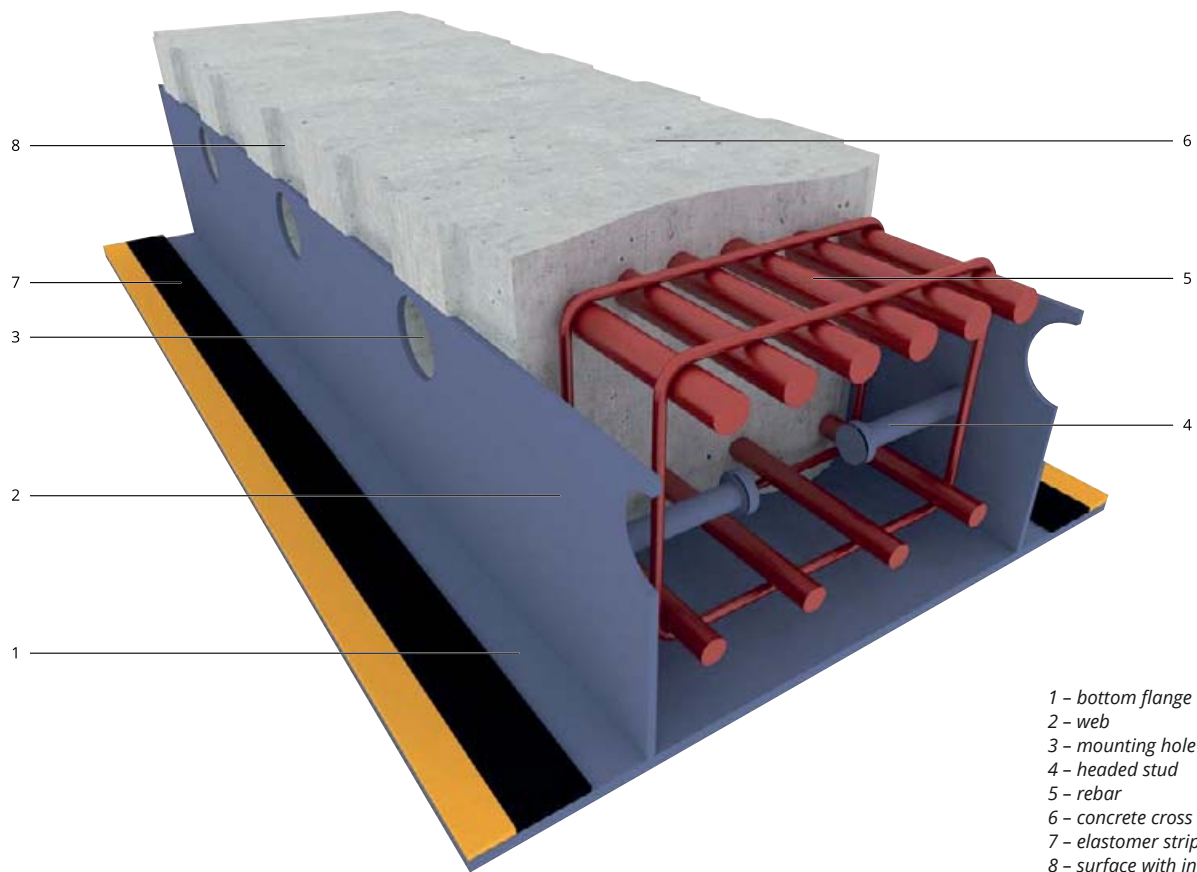
Economy

- Optimal use of the facility
- Can be used in all known ceiling constructions
- Fast and support-free assembly
- Reduction of concrete work on the construction site
- Free spaces for installations
- Flexible assembly order
- High degree of prefabrication – the composite is ready for assembly
- Reduction of construction time



Reliability

- High torsional and bending stiffness already in the assembly phase
- Corrosion and fire protection in accordance with building standards
- Certified production according to EN 1090
- Load capacity confirmed by technical tests
- Flexibility in terms of connections with other elements of the object's load-bearing structure
- Full technical support at the design and construction stage of the facility

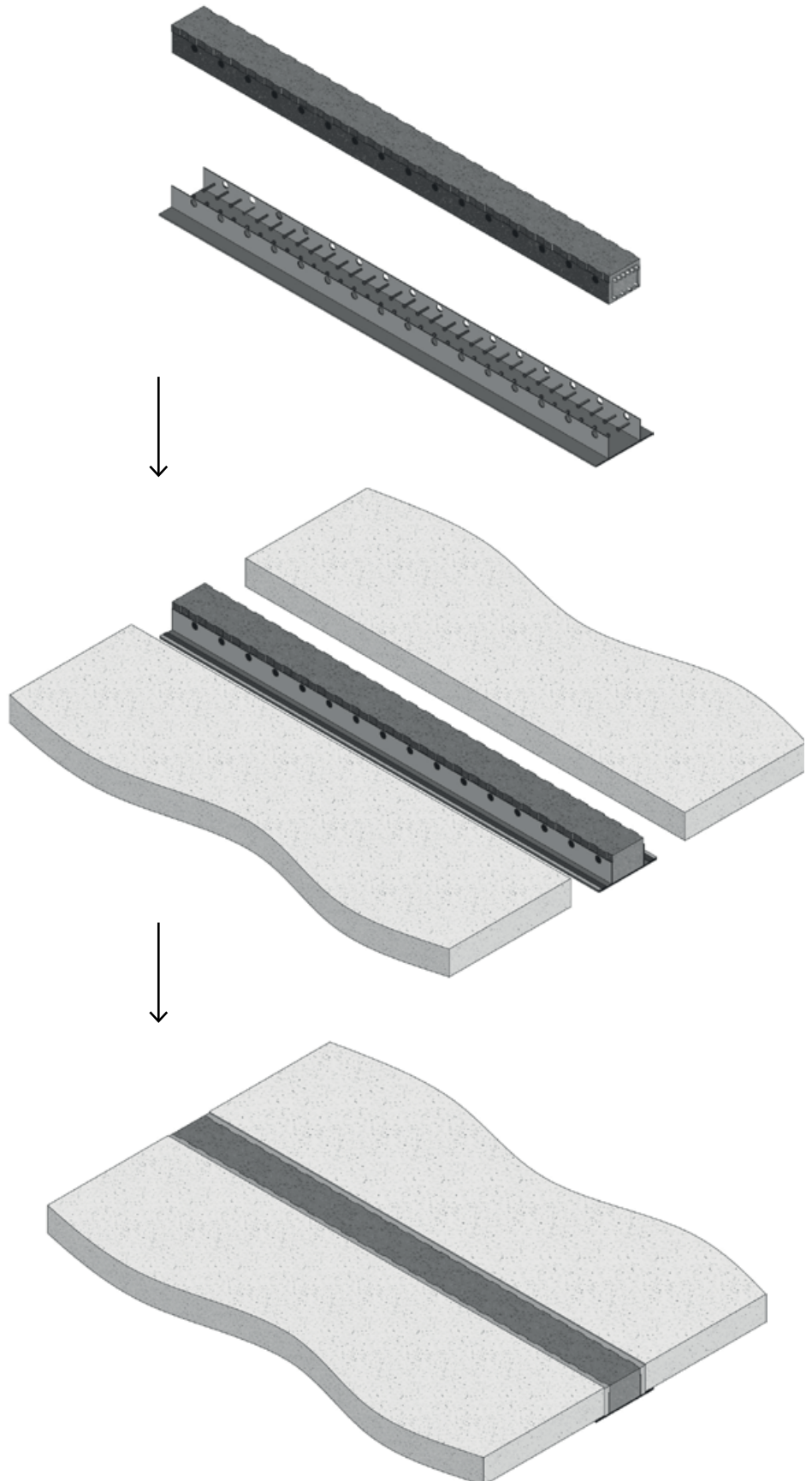


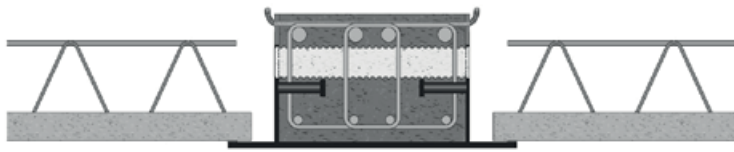
Double composite

The effective combination of building materials with different physical properties allows to achieve an optimal design solution. The **PFEIFER Hybridbeam®** achieves a high degree of efficiency thanks to the optimal use of the properties of its individual components – reinforced concrete and construction steel – in the structural cross-section. The idea that the **PFEIFER Hybridbeam®** creators had was to minimize the cross-section of structural steel at low height and high bending, shear and torsion strength. Therefore, a combination of these two construction materials was used – steel and concrete. The parameters of the beam can be compared with a traditional reinforced concrete joist, which requires twice the height and a high degree of reinforcement of the element to achieve its load-bearing capacity. The combination thus becomes an economic solution that allows to reduce the demand for the amount of material to meet the planned construction tasks.

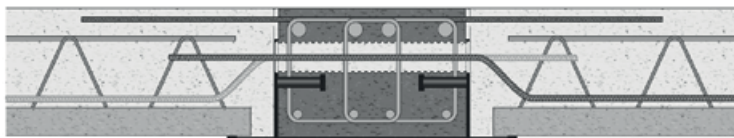
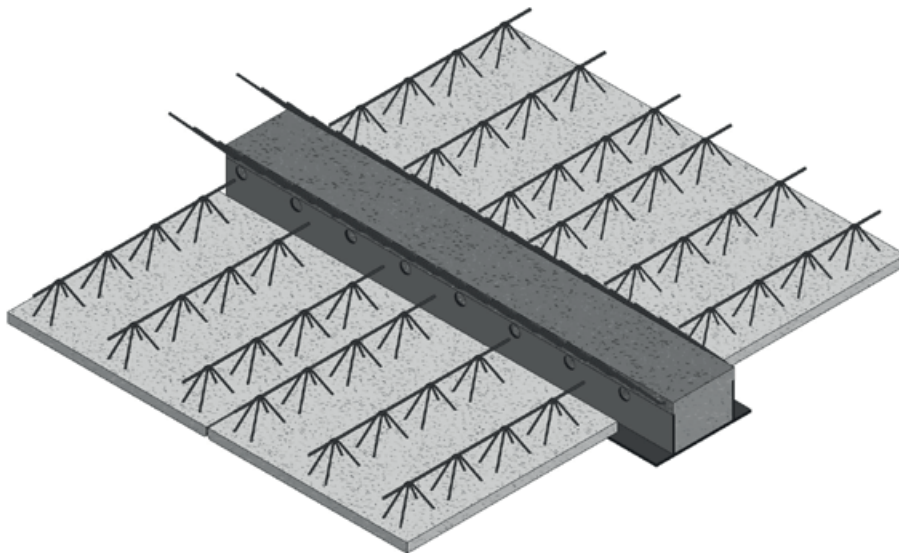
The composition of these materials with properly selected parameters and cross-section geometry creates a building element – a loadbearing beam for the structural system in the building. This beam is a composite girder and can independently cooperate with the other parts of the structure. During assembly, it reliably transfers assembly loads of the construction process. After joining with the ceiling, it increases its load-bearing capacity and in the operational phase, cooperates with the structure of the building, transferring the designed loads.

The composite element, a beam, is an ideal example of the implementation of the sustainable development postulate. The hybrid beam does not require additional maintenance during the lifetime of the facility. After the building's lifetime, it can be easily detached from other elements of the structure of the building and can be used again in a different building structure. At the same time, it consistently maintains its strength parameters.

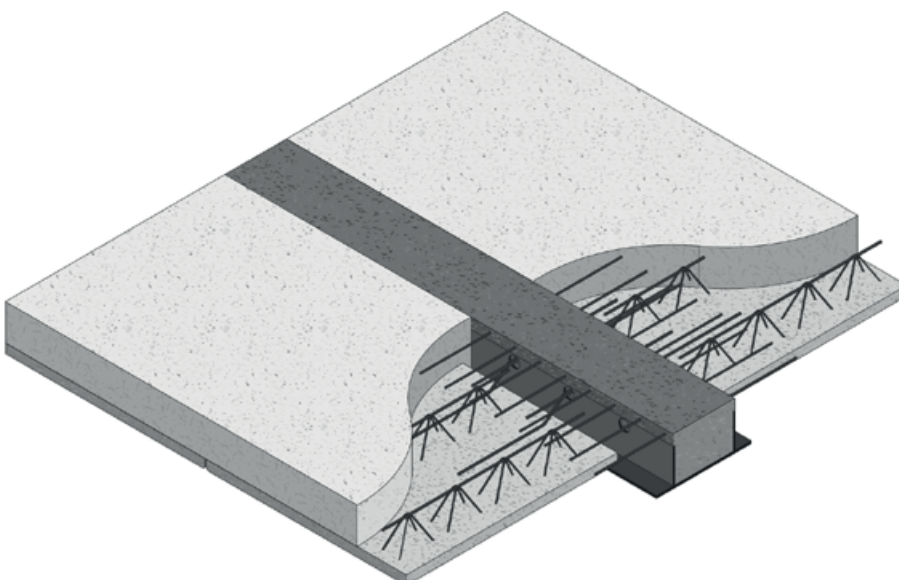




The steel body of the beam, thanks to the use of headed studs, is combined with its reinforced concrete cross-section at the production stage. After the concrete has hardened, the beam achieves its loadbearing capacity and installation rigidity. The assembly load capacity is sufficient to transfer the bending loads of the beam with the ceiling elements together with the possible load of concrete overlay and technological load, resting on the supports formed by the flange. The beam also achieves sufficient torsional stiffness as a result of a one-sided load during the assembly phase. The need to fix it on the support due to torsional forces is subject to separate calculation checks.



After laying the floor, connecting it with the reinforcement to the beam body and pouring concrete into the joints between the vertical walls of the beams and the front floor slabs (optionally finishing with concrete topping) and achieving their design strength, we obtain the composite of the beam with the ceiling, both through the produced channels reinforced in the beam and by mechanical indentations of the beam with a ceiling in its upper part.



Types of hybrid beams

The **PFEIFER Hybridbeam®** composite beam is a prefabricated load-bearing element that is used as a flat beam for the construction of slim floor ceilings – integrated ceilings with a small construction height. The standard design of the **PFEIFER Hybridbeam®** is flush with the ceiling.

The beams are made of high-quality materials:

- steel cross-section: steel S 460 N, in accordance with the PN-EN 10025: 2007 standard;
- reinforced concrete cross-section: reinforcing steel B 500 B (C) + high-performance concrete HPC - C 60/75;
- headed studs: steel S 235 J2 + C 450 in accordance with PN-EN 10025: 2007.

Designation:

H_c : height of the beam from the upper surface of the lower flange [cm]; standard beam heights can be easily adapted to different production programs of prefabricated ceilings (e.g. prestressed hollow core slabs 20, 27, 32, 40, 45 and 50); beams are designed at heights appropriate to the cross-section of the designed ceiling,

B_h : beam core width including web thickness (outer width of the beam section) [mm] – 200–700 mm; beam width adapted to the given ceiling structure,

W : beam type in a given project – 1–99,

L : beam length [cm] standard beam lengths are 1600 cm.

Cross-section geometry parameters:

B : total width of the bottom beam [mm],

B_f : working width of the floor element support [mm] – 15–300 mm,

t_f : thickness of the lower flange [mm] – 10–20 mm,

t_s : beam web thickness [mm] – 6–20 mm,

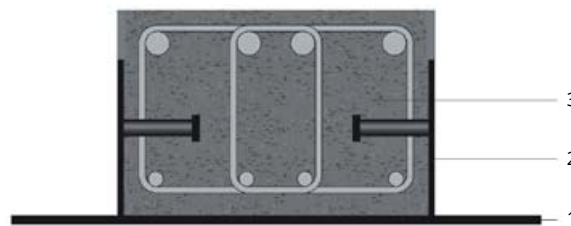
h_s : web height [mm] – 120–400 mm,

D_o : diameter of the hole in the beam [mm] – 40–80 mm.

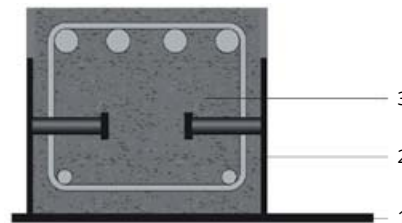
The **BHM** intermediate beam has a bottom flange on both sides to support the ceiling. The edges of the floor are supported by the **BHR** edge beams, which on one side have a flange to support the floor, and on the other side end with a web up to the beam's structural height. When using intermediate beams to

transfer concentrated loads, e.g. from columns or secondary beams supported by the main beam, or when the load transfer from the floor takes place on the upper surface of the beam, we use special **BHS** beams.

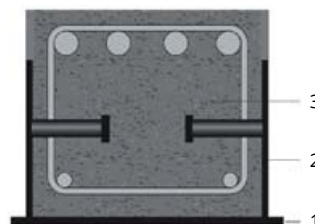
BHM – central beam – designation: $BHM H_c - B_h - W - L$



BHR – edge beam – designation: $BHR H_c - B_h - W - L$



BHS – special beam – designation: $BHS H_c - B_h - W - L$



1 – lower flange thickness t_f and overhang B_f ; overall width B
 2 – webs with a thickness t_s and height h_s
 3 – concrete core, width B_h and height H_c



BHM – central beam



BHR – edge beam



BHS – special beam

Hybrid beam capacities

Dimensioning of the PFEIFER Hybridbeam®

The **PFEIFER Hybridbeam®** is dimensioned on the basis of calculation algorithms found in the European technical standards – EC Eurocode with the use of safety factors determined on the basis of empirical tests. Until the publication of the auxiliary calculation program, the exact dimensioning of the ceilings with the **PFEIFER Hybridbeam®** is carried out at the Consulting and Technical Center at PFEIFER Steel Production Poland Sp. z o.o. Data sent to our engineers is verified in terms of its completeness and computational analysis. These calculations allow to verify the customer's initial assumptions regarding their beam selection, and when ordering, constitute the documentation used to verify the project and its implementation.

Initial selection of beams

For the initial selection of beams, you can use the nomogram on the next page or the simplified beam cross-section selection calculator found on www.hybridbeam.eu. For this, the following indicative data is needed:

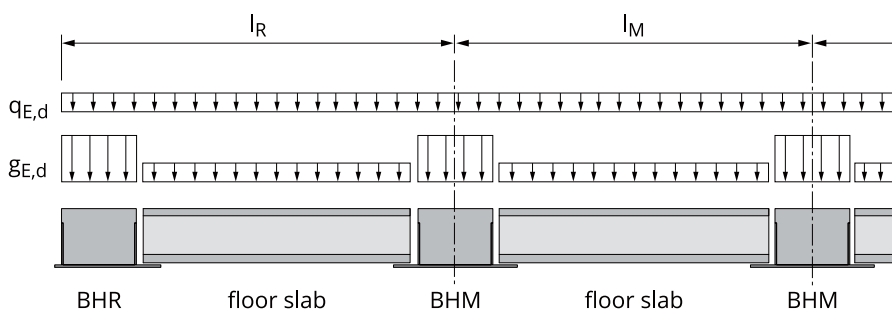
- a diagram of the floor span (selected beam and floor fields l_M and l_R based on the beam),
- height (thickness) of the planned floor slab; as a rule, we choose the height of the beam in the amount of the planned thickness of the prefabricated floor slab or as a lower value in the case of using floor schemes with the use of concrete overlay,
- weight of the floor with finishing layers expressed as the design value $g_{E,d}$ [kN/m²] (the dead weight of the beam does not to be taken into account, as it already has been independently in the calculation of the load-bearing curves),
- variable loads (operational and additional) expressed as a design value $q_{E,d}$ [kN/m²].

With the data prepared in such a way, in the first step we define the width of the influence zone as a half of the sum of the spans of the floor fields supported by

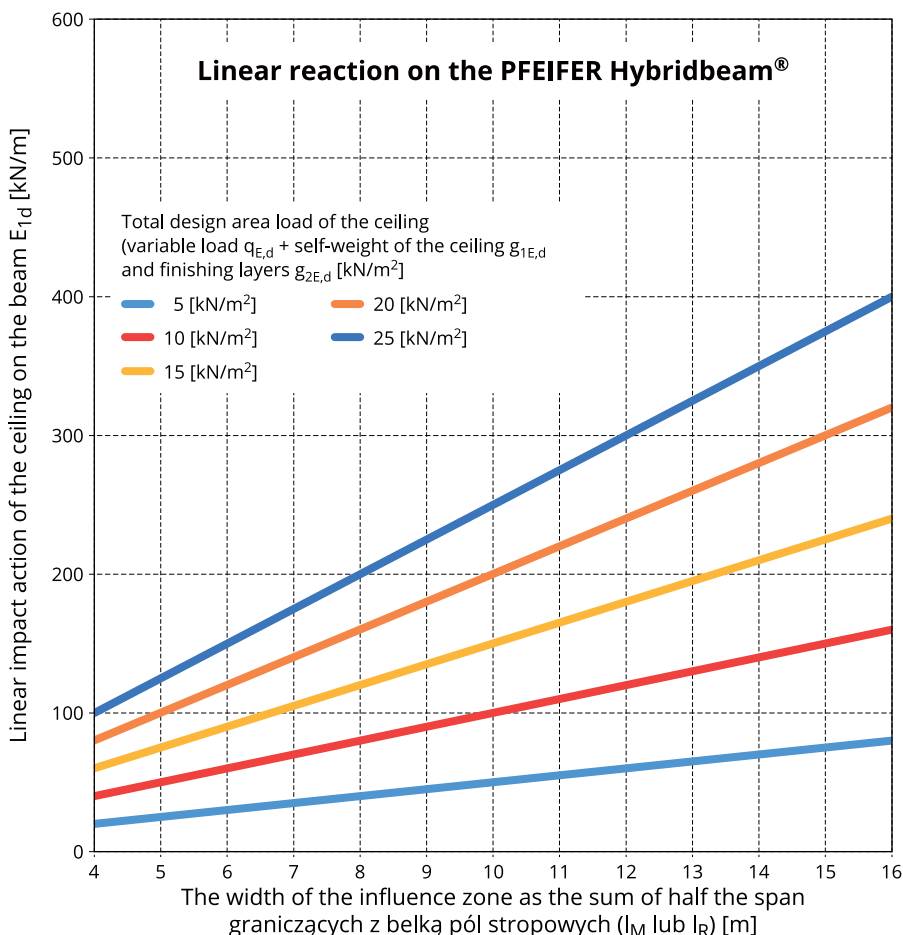
the beam. In the next step, we calculate or read from the diagram below the value of the linear influence of the floor on the beam E_{1d} [kN/m] depending on the determined width of the influence zone and constant and variable loads.

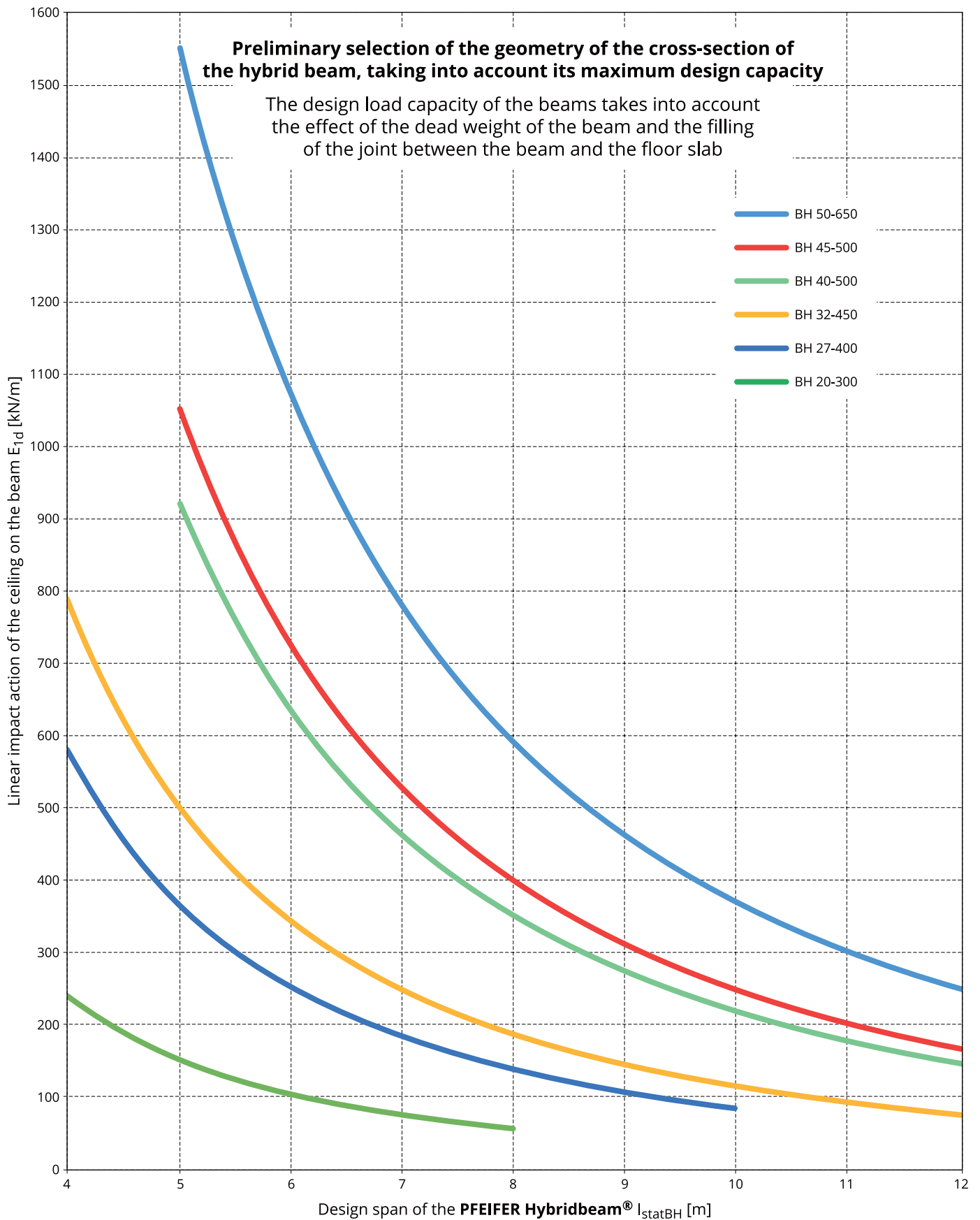
After reading (determining) the linear effect of the floor on the beam E_{1d} [kN/m] depending on the span of

a given beam a range of beams enabling the implementation of the design task can be found. The diagram shows the range of beams without their division into edge or middle beams with approximate heights [cm] and the widest beam cores in a given standard [mm].



The static system of a floor supported on a **PFEIFER Hybridbeam®** with the necessary parameters for its Preliminary selection





Sustainable development

Protection of the natural environment is one of the greatest challenges of the modern world. Regardless of our activity and the related environmental impact, maintaining balance and respect for nature around us should be one of the main concerns of our development. That is why sustainable development is one of the most important pillars of modern construction – maintaining balance between economic needs, the environment and society.



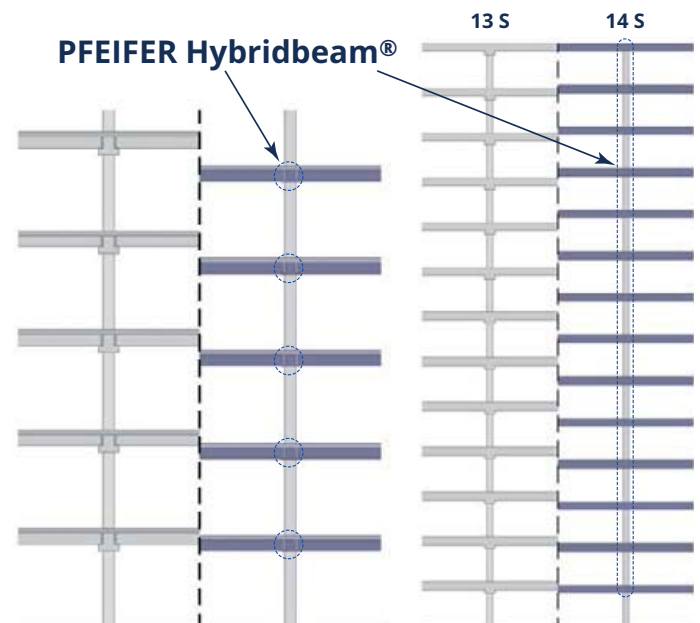
Construction is one of the most energy consuming branches of the economy.

This begs the question – what direction should we be going in when planning future building investments? Although there are countless answers to this question, there are a few common basic guidelines of modern construction:

- Limit material needs, relying as much as possible on materials and raw materials already used for the construction of buildings.
- Implement facilities with the lowest possible demand for "grey" energy (derived from the combustion of fossil fuels) during their use.
- The reuse of building elements from dismantled buildings when erecting new buildings.
- Use materials in production, ensuring their return after recycling to the production process.
- Reduce energy consumption when erecting new buildings.
- Reduce noise during production and construction.
- Build buildings that do not spread noise and vibrations.

Flat ceilings with the use of hybrid beams allow for the most effective use of the building's volume. It is thanks to this that

it is possible to obtain its expected functionality with optimal energy demand during use. It is thanks to this that it is possible to obtain its expected functionality with optimal Energy demand during use.



“Less is more”

The **PFEIFER Hybridbeam®** was developed as a solution that has the best cooperation of a composite steel section and a reinforced concrete section. The task of the founders was to find a solution to the structural problem of hiding the beam within the height of the floor slab while minimizing the amount of steel in the cross-section. The phrase “to make more out of less” gave way to the innovative thinking that allowed to reduce the use of steel in the cross-section by even 3.5%.





Eliminating or reducing the height of protruding joists under the ceiling facilitates installation with optimal use of materials and human resources.






Flat ceilings reduce expenditure on finishing works in the building and contribute to energy savings during its erection.

The industrial production of building elements reduces the cost of processes on the construction site. Thanks to the use of energy-saving technologies and investments in the production of our own green energy from a photovoltaic power plant, we are able to contribute to the reduction of CO₂ emissions.

PFEIFER works with suppliers that use mainly recycled raw materials for steel production and use energy-saving processing.

Our **PFEIFER Hybridbeam®** is fully recyclable and reusable in subsequent buildings. Other elements that are not used in this process are 100% recyclable and used in the production of steel or concrete.

Hybrid beams can therefore be designed as a demountable structure in a building. Flexibility in the use of bolted connectors for floor slabs and the supporting structure of the building in a simple mechanical way allows them to be reused in a new facility.

Indication	Group No.	Concrete C60/75 mass content in a Hybridbeam® group
 Hybridbeam®	1+	>70%
 Hybridbeam®	1	65-70%
 Hybridbeam®	2	60-65%
 Hybridbeam®	3	55-60%
 Hybridbeam®	4	<55%

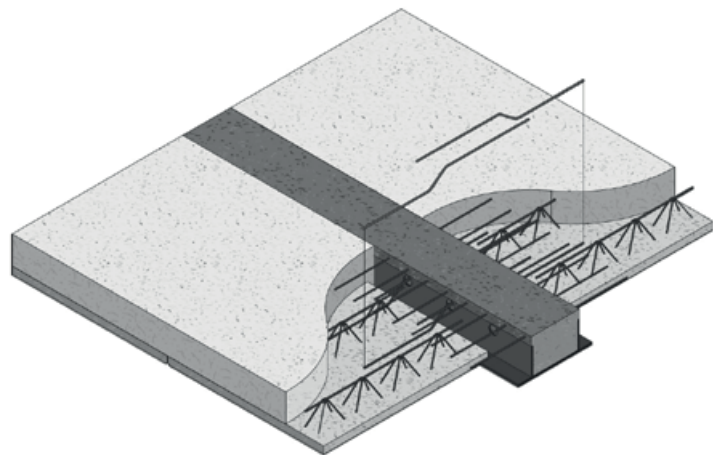
Environmental characteristics for five groups of beams with different concrete content in the total product.

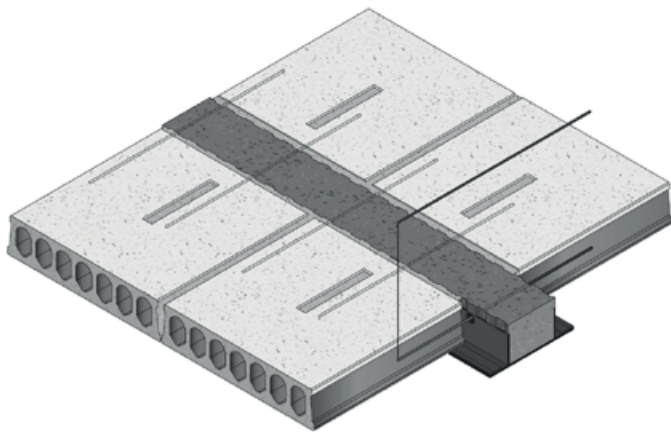
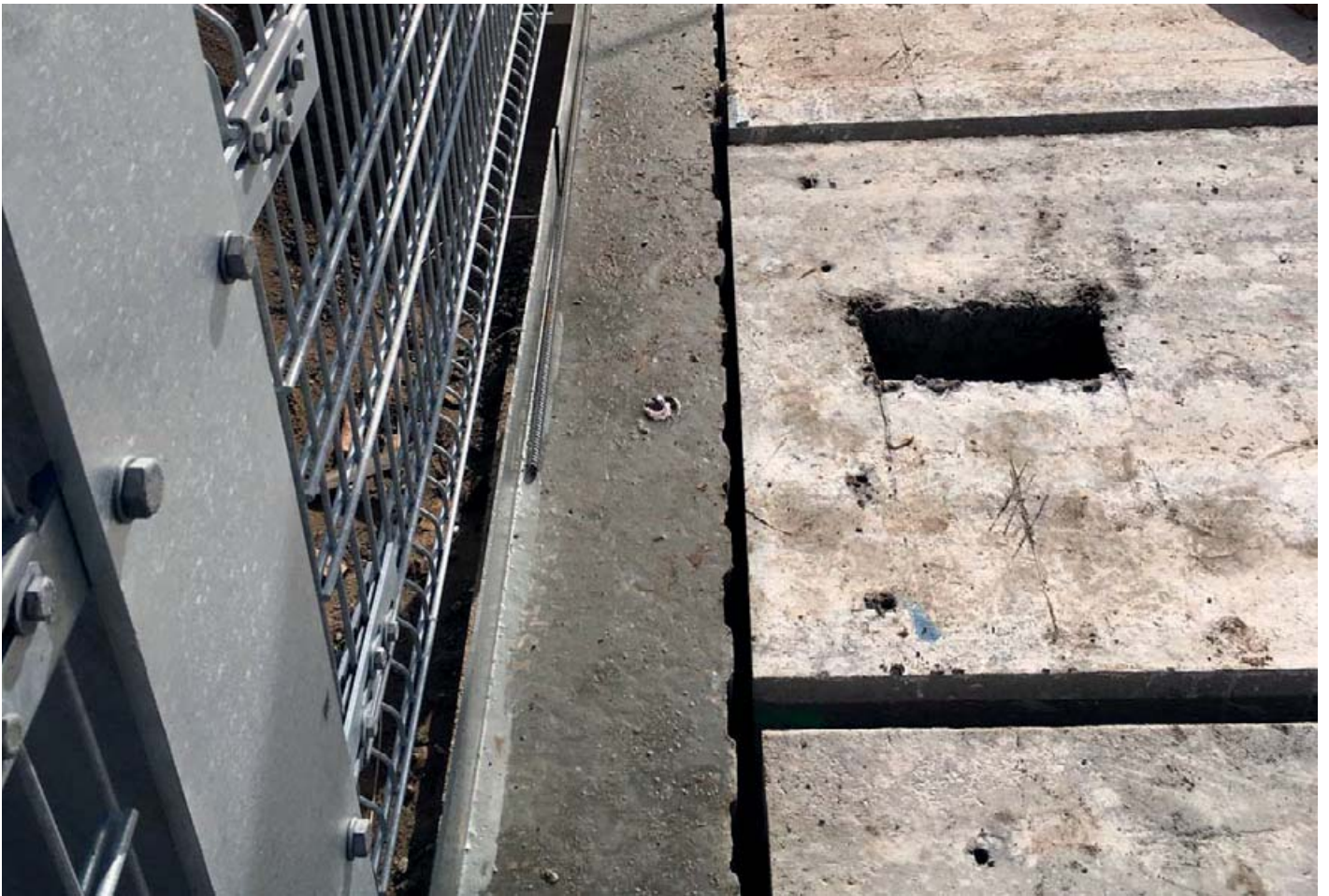
“Beamless” ceilings with hybrid beams

The **PFEIFER Hybridbeam®** is a universal load-bearing structural element of the ceiling. They cooperate with all types of ceiling structures – from monolithic concrete structures, through composite slabs made of flat reinforced concrete prefabricated elements (e.g. of the filigree type), ceilings made of pre-stressed hollow-core slabs, to composite timber-concrete ceilings. They are perfect for the construction of timber ceilings (for so-called dry assembly), and complement the ecological wooden structure.

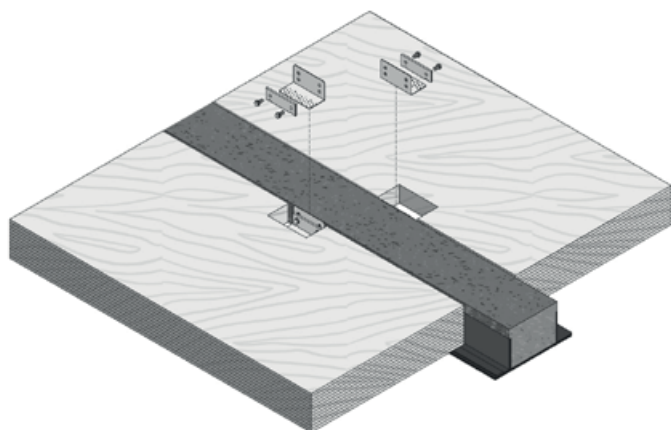
Due to the characteristics of the cooperation of the beam with the floor slab, we can distinguish the following types of beam-ceiling combinations:

A ceiling that is fully combined with a hybrid beam (using the maximum capacity in terms of ceiling load capacity), where there is a combination of the beam through the use of joint reinforcement built in at the beam production stage (or added during the assembly of floor slabs on site).





Semi-composite floors with regular point connections to the floor slab in the form of reinforcement, reinforced concrete indentations or other mechanical connectors.



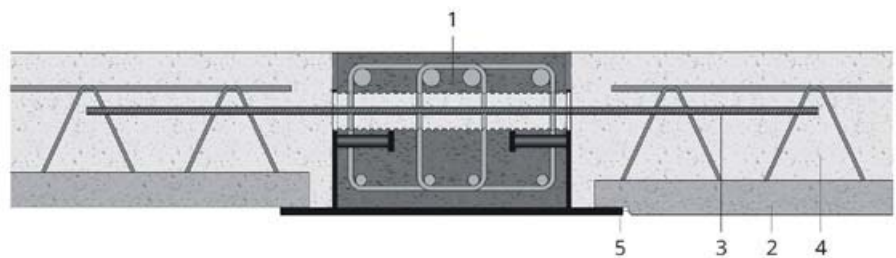
Ceilings for which the combination with the hybrid beam is not taken into account in the calculation of the floor load capacity. The connection of the floor slab is only for the assembly connection or suspension of the floor slab to the core of the beam during a fire.

Composite prefabricated slabs on hybrid beams

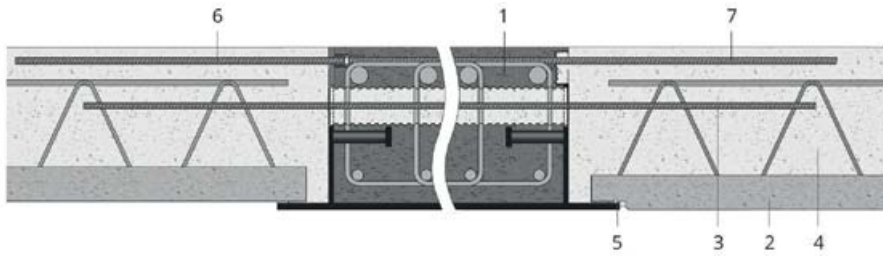
In many floor solutions, prefabricated composite slabs are used as the load-bearing formwork element for the composite – monolithic – ceiling structure. Standard composite (non-stressed) panels are manufactured with a thickness of 7 to 8 cm of the prefabricated panel and a span of up to approx. 9 meters. From a certain span, such ceilings require (determined by the statics of the object) additional support during assembly and during the maturation of the filling concrete. In the case of using pre-stressed composite slabs, the thickness of the prefabricated element exceeds 10 cm, and the spans of these slabs can be up to 12 meters. Assembly support is not provided for most pre-stressed prefabricated slabs as it is for unstressed elements.

The classic hybrid beam is equal to the height of the designed floor slab. In the case of a floor that rests freely on a hybrid beam, we can optionally use straight connecting reinforcement (3) led through the corrugated pipe in the beam or screwed into the reinforcement connector. In combination with the hybrid beam, it is also possible to achieve a “perfectly” smooth floor by forming composite slabs with a recess in the beam support area, as shown on the right-hand side of the drawings.

A Hybrid beam in combination with a single-span monolithic floor on prefabricated slabs



A hybrid beam with continued reinforcement of the concrete topping embedded in the side of the beam



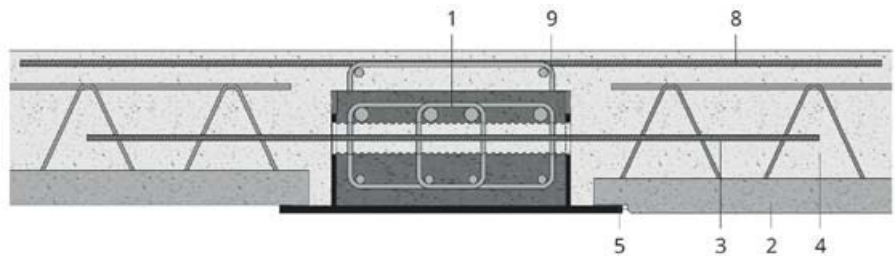
Hybrid beams enable the adoption of multi-span patterns for the floor slabs. In the case of hybrid beams with a height equal to the thickness of the floor slab, we use threaded reinforcement bars (6) screwed into the beam or bendable reinforcement (7).

- 1 - hybrid beam
- 2 - composite reinforced concrete or pre-stressed slab
- 3 - reinforcement connecting the beam and the floor
- 4 - concrete topping
- 5 - possible execution of the front of floor slabs with a choice of $h = -15 \text{ mm}$ for the so-called hidden slab support
- 6 - reinforcement screwed in at the construction site to be connected with the top reinforcement of the concrete topping
- 7 - reinforcement bent at the construction site to continue the top reinforcement of the concrete topping
- 8 - top bars of the concrete topping built at the construction site
- 9 - connecting reinforcement with concrete topping embedded in the beam
- 10 - raising the hybrid beam above the top edge of the floor slab
- 11 - concrete of longitudinal raised support for hollow-core slabs



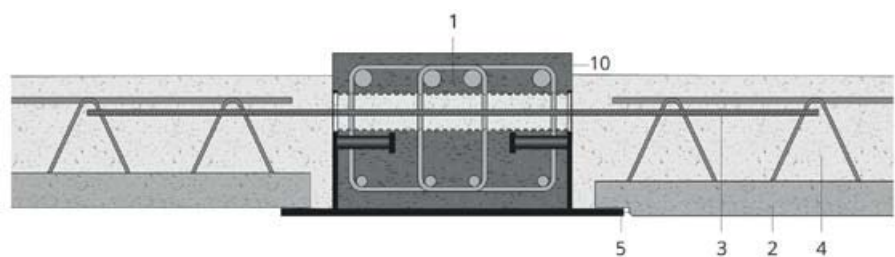
Hybrid beam in a multi-span slab floor

In the simplest situation for multi-span floors, when the beam is lower than the thickness of the total floor slab by approx. 8 cm, we can place the upper reinforcement of the slab (8) above the beam's horizontally protruding connecting stirrups (9), fastened with longitudinal reinforcement.

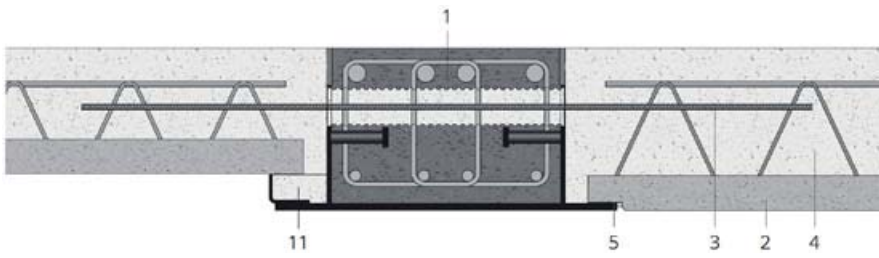


In some cases, for static reasons, the height of the hybrid beam may exceed the assumed thickness of the floor slab. Depending on the possibilities and requirements of the designer of the facility, it is possible to raise the upper edge of the beam above the upper edge of the floor slab (10). Possible joining with the upper reinforcement of the floor slab (if necessary) takes place through the use of bent or screwed in reinforcement connectors.

Hybrid beam protruding above the upper edge of the floor



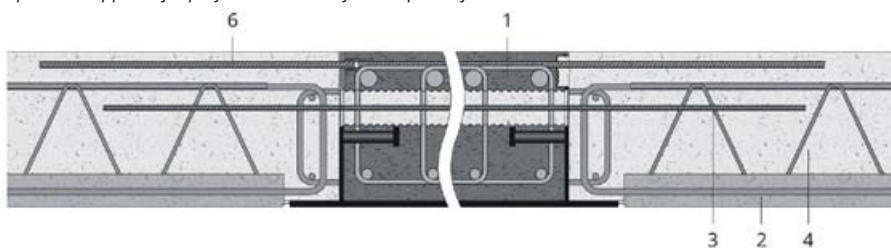
Raised bearing of a prefabricated panel



If the structural height of the beam exceeds the thickness of the floor slab, we use the so-called raised plate support. In such a situation, the prefabricated element rests on an elongated linear bracket (11) – concreted in the manufacturing plant or on the construction site.



Suspended support of a prefabricated slab for composite floors



The standard support depth of floor slabs ranges from 70 to 90 mm. In this case, we do not use elastomeric strips for prefabricated elements. In the case of the so-called suspended support should also include front composite bars and additional suspension reinforcement for the ceiling in the cross-section of the beam or mounted over its cross-section in the case of low beams.

Timber or composite timber-concrete ceilings on hybrid beams

The excellent technical parameters of wood are attracting the attention of modern designers more and more often. Additionally, when looking for construction solutions that minimize energy demands and have a low emission of CO₂, it is impossible to ignore the properties of this natural material. The process of its preparation for building construction is characterized by one of the lowest CO₂ emissions when compared to other building materials. Also, the specific weight of wood is many times lower than that of other materials used in the construction of ceilings. All of this makes it an increasingly popular material in modern constructions.

From the point of view of the classification of timber ceiling structures, two basic groups can be distinguished:

- timber ceilings,
 - composite timber-concrete ceilings.
- Depending on the type of floor slab, they can be divided into:
- flat ceilings made of glued wooden boards (prefabricated strips of glued

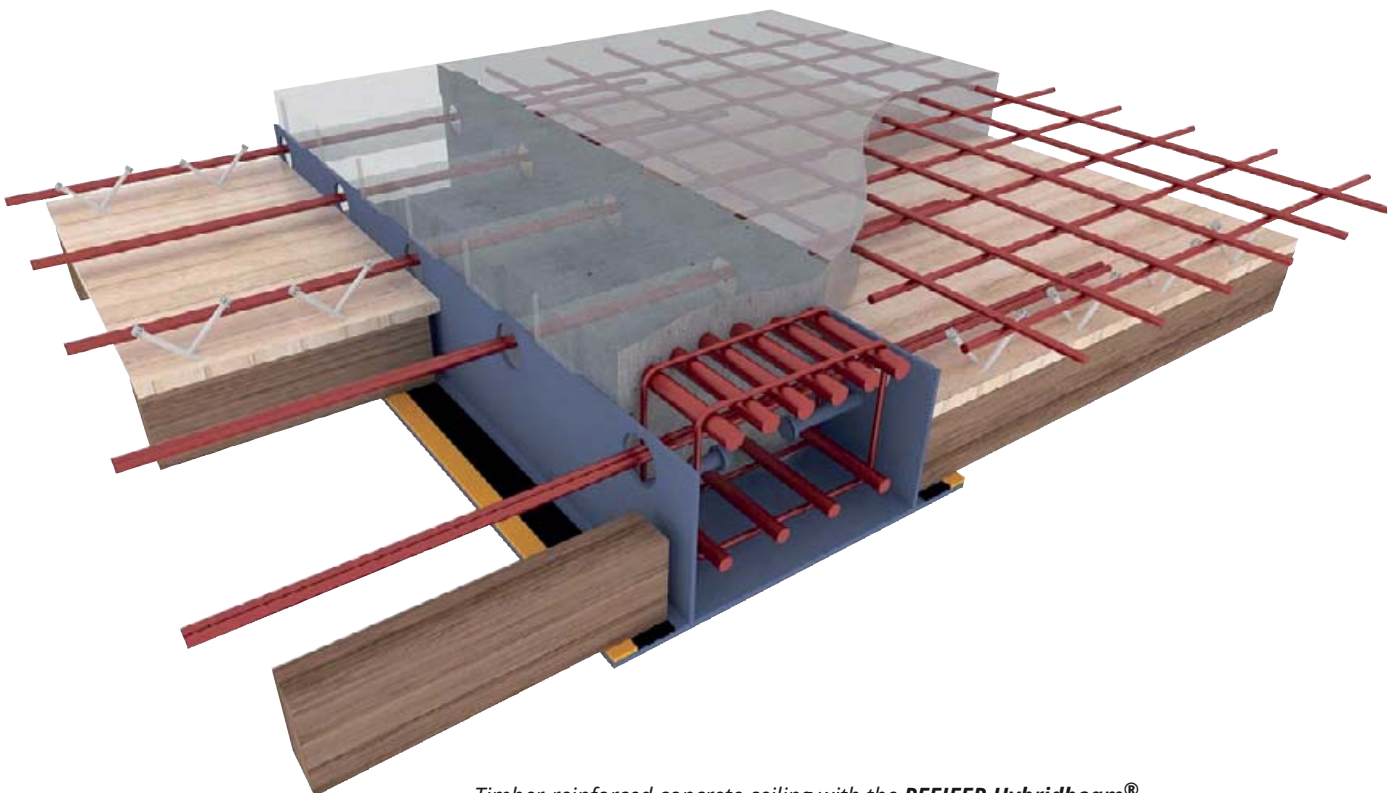
layers of timber); this type of floor can also be combined with concrete in a prefabrication plant or on site,

- beamed ceilings (beams connected to wooden slabs or combined with a concrete slab); they are prefabricated or are made entirely on site,
 - wooden channel ceilings (made of closed hollow-core sections).
- Depending on the method of installation of these ceilings, they can be divided into:
- dry-mounted ceilings (prefabricated wooden elements or wooden elements assembled on site),
 - dry-mounted ceilings with small supplementary concrete fillings (wooden prefabricated elements or combined wood-concrete prefabricated elements),
 - ceilings assembled and wet joined on the construction site (the concrete topping is made on site on a wooden slab).

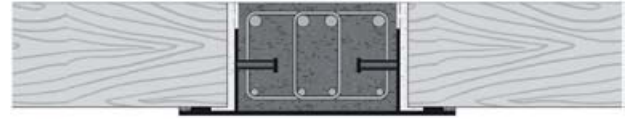
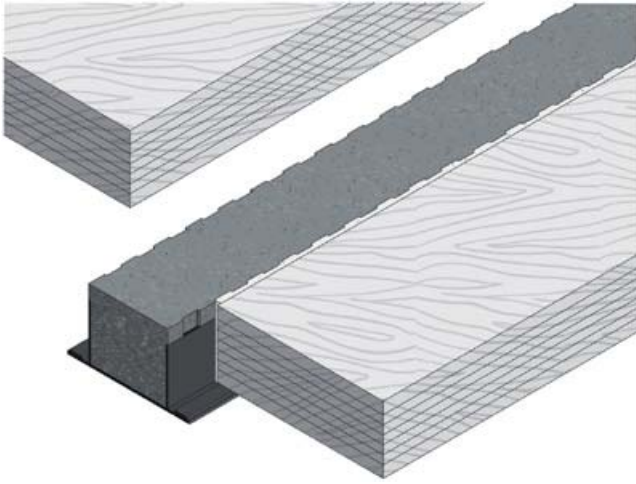
The use of concrete in the construction of a timber ceiling is related to the optimal use of a lightweight,

self-supporting wooden structure already at the assembly stage, and concrete increasing the load capacity of the floor slab and guaranteeing appropriate vibration and noise damping parameters.

The **PFEIFER Hybridbeam®** can be reliably used in this type of construction. Due to the high load-bearing capacity and rigidity, they guarantee efficient support of the floor slabs and connecting them to the beam. The **PFEIFER Hybridbeam®** perfectly cooperates with a floor slab, transmitting the planned horizontal forces in the floor slab. Through the use of appropriate connectors or reinforcement in composite floors, they also guarantee obtaining the appropriate fire resistance class. In the case of beam ceilings, the webs of hybrid beams, additionally protected against heating up during fire, are a suitable concrete cover.

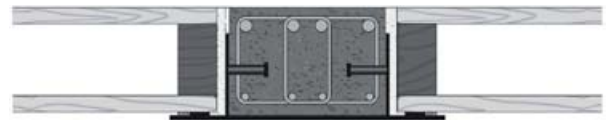
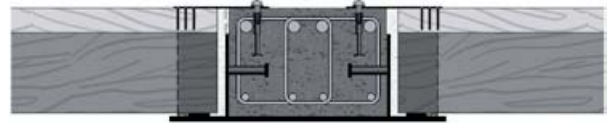
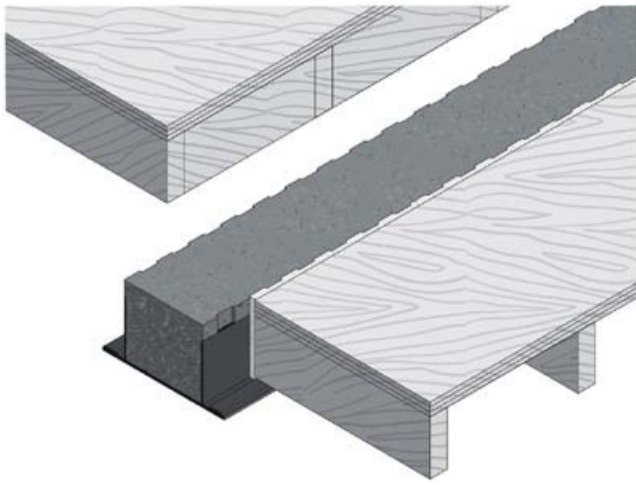


Timber-reinforced concrete ceiling with the PFEIFER Hybridbeam®



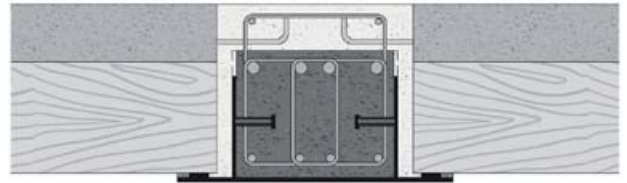
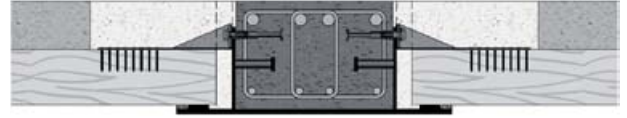
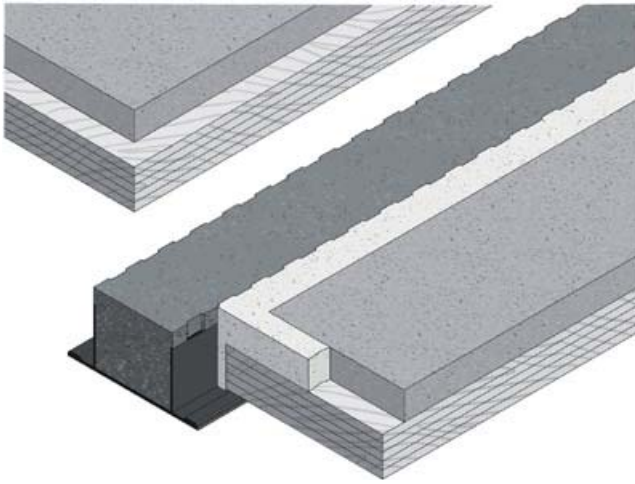
Timber ceilings. Timber slabs.



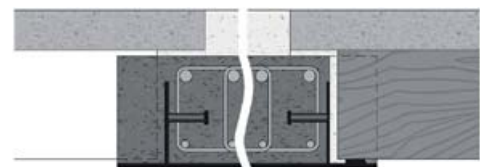
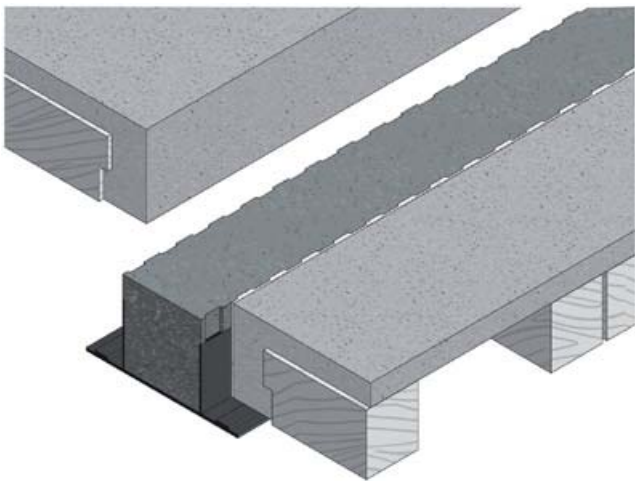


Timber ceilings. Timber ribs.

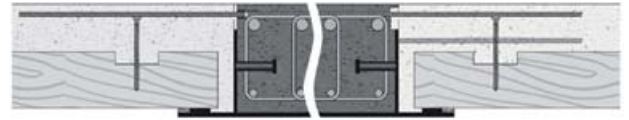
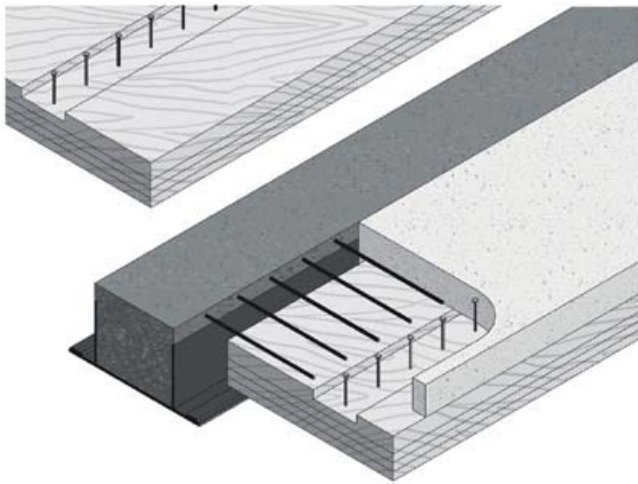




Composite timber-concrete ceilings (prefabricated concrete section). Wooden slab.

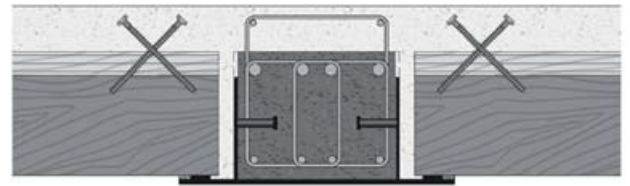
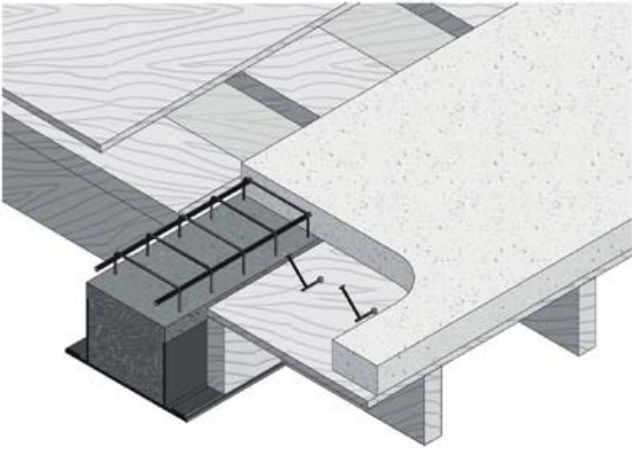


Composite timber-concrete floors (prefabricated concrete section). Wooden ribs.



Composite wood-concrete ceilings (wet concrete section). Wooden slabs.





Composite timber-concrete floors (wet concrete section). Wooden ribs.



Hollow-core slabs on hybrid beams

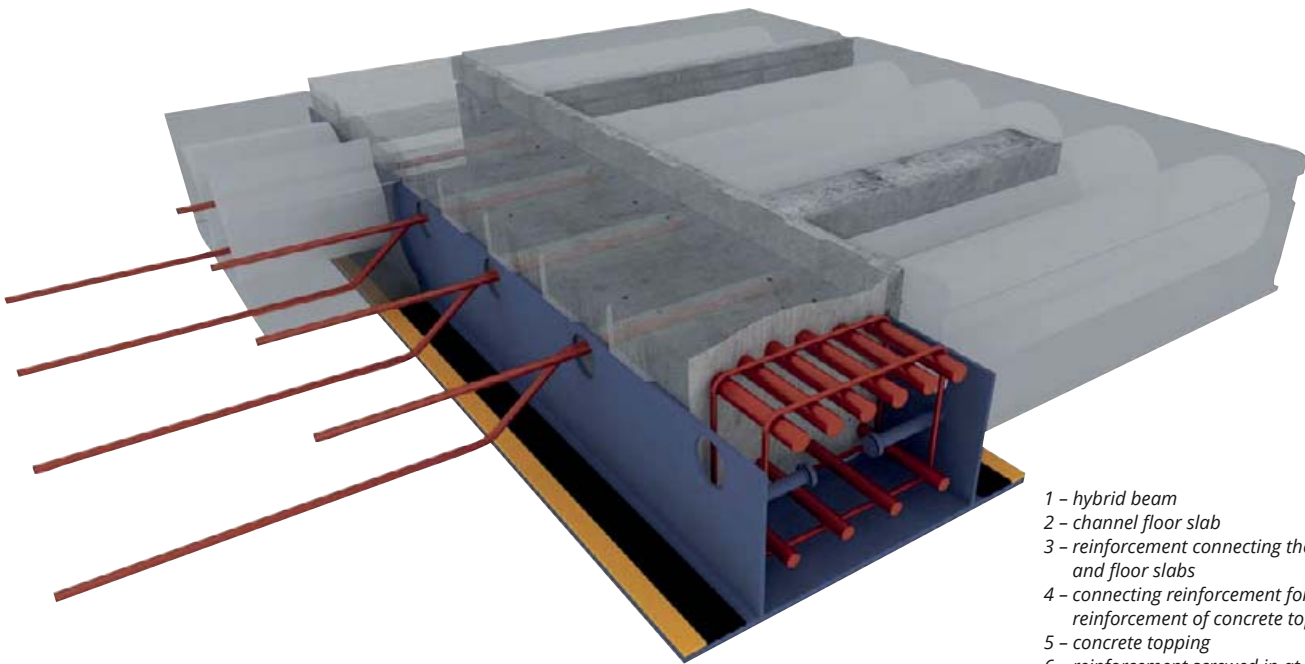
The **PFEIFER Hybridbeam®** can be used used in combination with prefabricated HC floor slabs in many different combinations depending on the requirements of the static calculations. Below are characteristic cross-sections of beams for several basic variants:

- hybrid beam equal to the height of the channel slab used,

- channel floor with structural concrete topping and connecting stirrups built into the hybrid beam,
- continuation of the reinforcement with the concrete topping above the hollow-core slabs in the case of a beam higher than the hollowcore floor slabs supported on it,
- the beam is structurally lower than the

floor slabs used and the remaining space is filled with concrete overlay to the level of the upper edge of the ceiling,

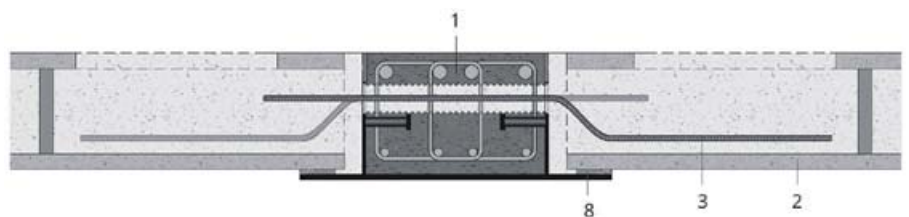
- the hybrid beam, for structural reasons, higher than the thickness of the hollow-core slabs used; support of the so-called raised HC slabs – on the longitudinal support of the beam.

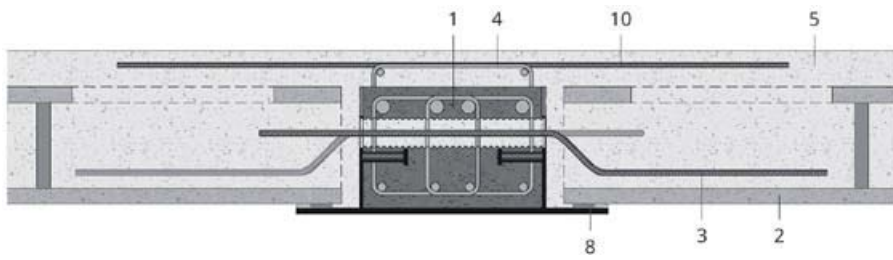


Floor made of pre-stressed hollow-core slabs supported on the **PFEIFER Hybridbeam®**

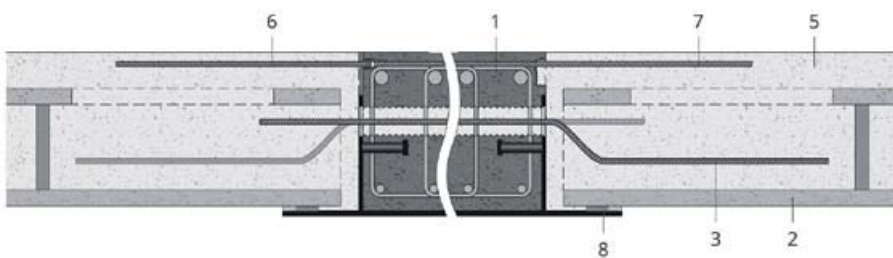
- 1 - hybrid beam
- 2 - channel floor slab
- 3 - reinforcement connecting the beam and floor slabs
- 4 - connecting reinforcement for reinforcement of concrete topping
- 5 - concrete topping
- 6 - reinforcement screwed in at the construction site to continue with top reinforcement of concrete topping
- 7 - reinforcement bent at the construction site, concreted in a beam to continue with top reinforcement concrete topping
- 8 - elastomer strip
- 9 - concrete of the longitudinal raised support for hollow-core slabs
- 10 - top bars of the concrete topping installed at the construction site

Hybrid beam with hollow-core slabs of the same construction height

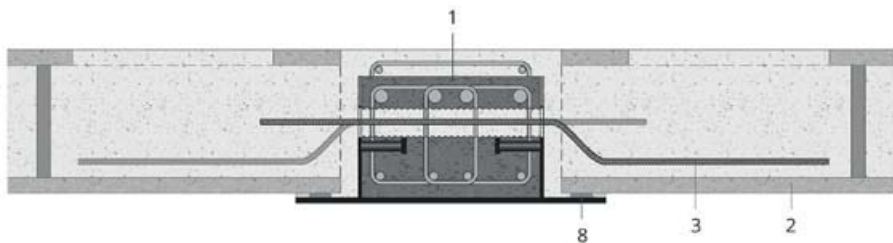




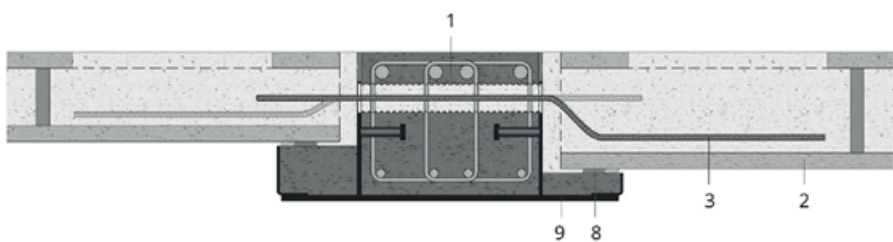
Hybrid beam in a hollow-core slab ceiling of the same height as the beam. Structural concrete over the ceiling. With a concrete overlay thickness of more than 8 cm, it is possible to expose the stitching stirrups from the cross-section of the beam



Hybrid beam with a height equal to the height of the floor slabs with concrete topping and the options of reinforcement of the reinforcement with top reinforcement of the floor slab (6 – screw-in reinforcement, 7 – bendable reinforcement)



Hybrid beam with built-in connecting reinforcement for concrete topping in the case of floor slabs higher than 8 cm from the beam construction height



Hybrid beam with an raised bearing for ceiling slabs (support adapted to the given height of the hollow-core slab)

Pre-stressed hollow-core slabs on composite beams

A popular solution proven in many structures around the world. Pre-stressed hollow-core slabs allow for the lightest ceilings in terms of the dead weight of the structure to be realized. They are also a very resistant element in terms of the bending load capacity of the ceiling. There are some limitations with regard to the transfer of transverse forces when considering the support of the slab on a flexible beam. For this purpose, various dimensioning methods are used to ensure a safe load-bearing

capacity. In combination with a composite hybrid beam, they allow for obtaining flush slim floors with a large span, which results in a very effective use of the usable floor space. The following are used:

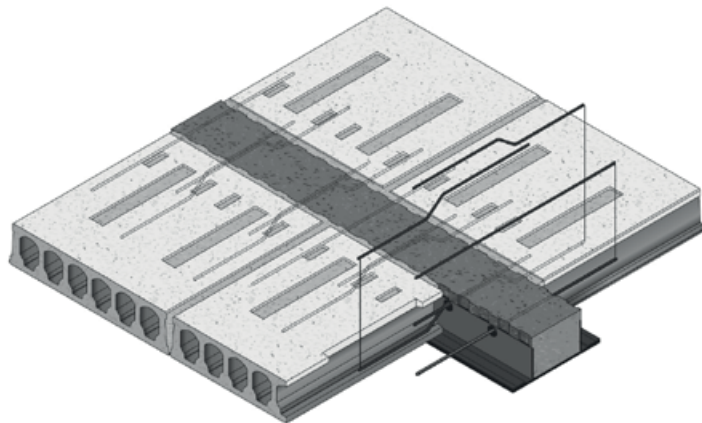
- full composite of the floor (A),
- partial joint of the floor (B),
- joining with the ceiling to obtain appropriate bending stiffness (C).

Thanks to the elastomer washer integrated with the beam, it is possible to efficiently install floor slabs without additional expenditure. These ceilings

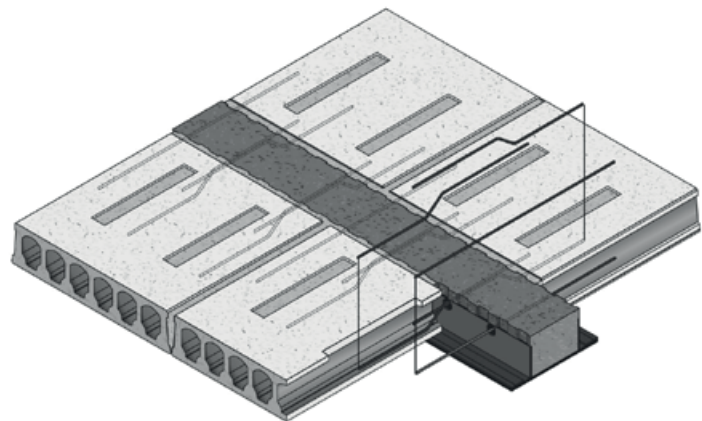
are made without the need for additional assembly support.

In each of the cases described on the next page, regardless of the composite implemented by the reinforcement built into the beam and slabs, a mechanical composite is also obtained. Thanks to the indented surface in the upper part of the beam, the redistribution of horizontal stresses from the beam body to the ceiling is possible despite cracking or opening of the upper sections of the joints between the ceiling and the beam.

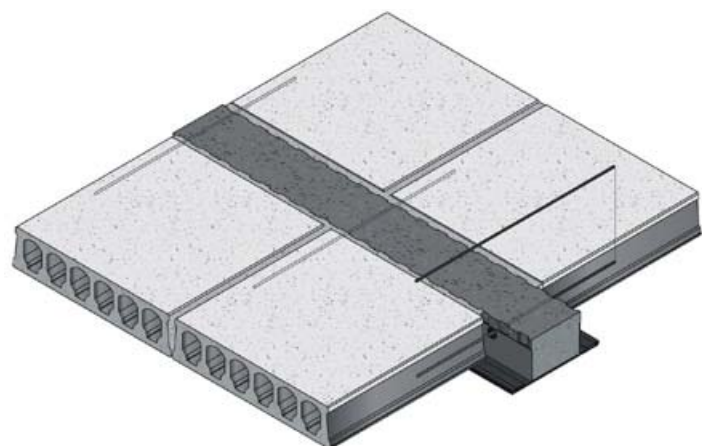
A – Full composite of the floor with the beam; we use bonding reinforcement both in the joints between the slabs and in the two central (open) channels of the slab. Fill the remaining slab channels with grouting concrete while concreting the joint in the ceiling to a depth of 35 cm. We place the connecting bars through the channels left in the hybrid beam or screw them into the previously concreted threaded sockets in the hybrid beams.



B – Partial composite with a beam; solution similar to variant A - only open channels are filled with concrete, but without flooding the channels in the ceiling to a depth of 35 cm.



C – The joining of the beam with the hollow-core slab is not taken into account for the purposes of the beam load capacity (only in terms of increasing the stiffness of the load-bearing system). In this case, we use reinforcement connecting the beam with the ceiling only according to the guidelines of the panel manufacturer (most often in the joints between the panels). We do not open and flood the channels in the channel slab at the stage of filling the assembly gap between the slab and the beam. The channels are filled with pouring concrete to the depth of the so-called lids closing the plate and in the outer plates - one open and reinforced channel at a length of at least 80 cm.

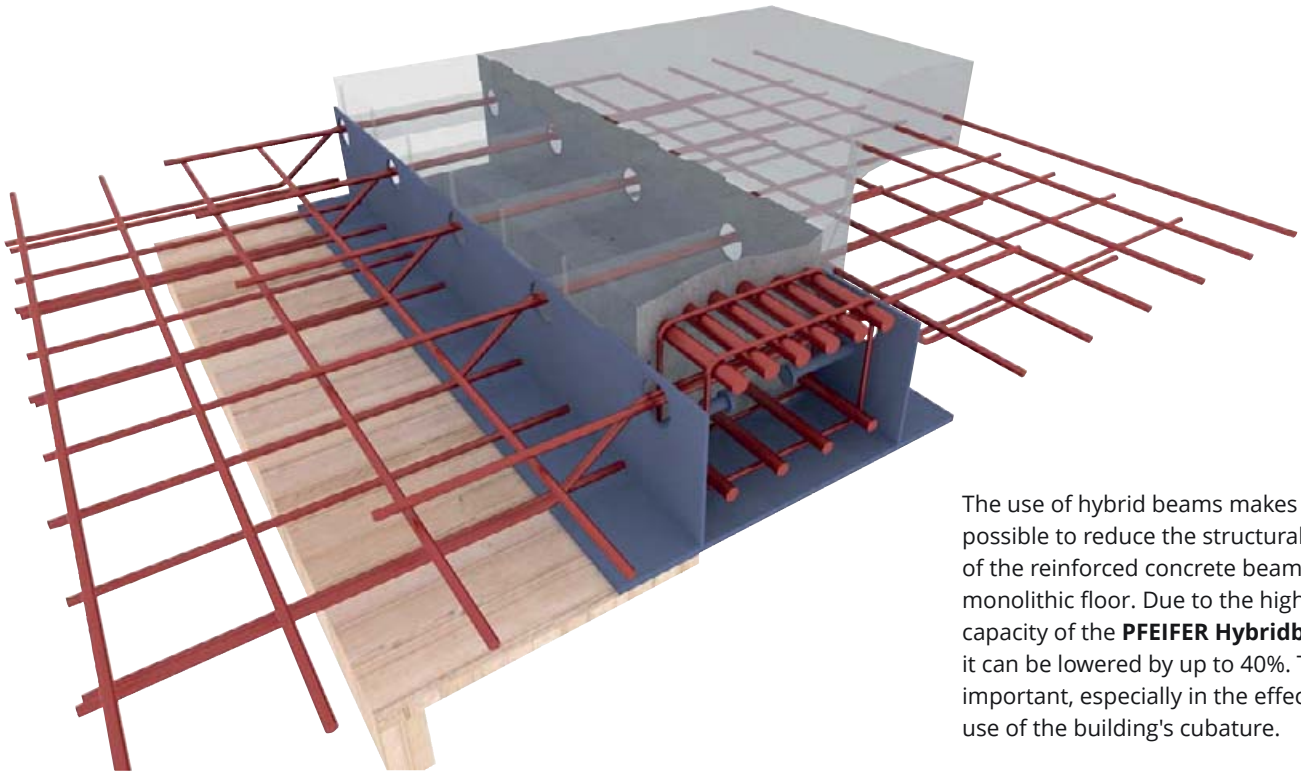




Monolithic ceilings with hybrid beams

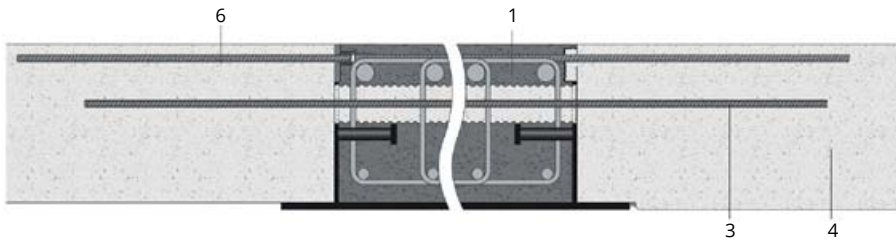
In the construction of monolithic ceilings – beam-slab or the so-called stiffening bands – hybrid beams can be successfully used. Their use often allows to eliminate the problem of pushing the floor in the area of the support (column, wall corner) or to reduce the height of the joist or the thickness of the strip. The combination of a beam with a monolithic floor can be achieved thanks to a variety of connection techniques; from continued reinforcement with the beam cross-section in a bent form, through the use of reinforcement elements or the reinforcement tightened into the concreted cross-section of the beam reinforcement connectors.





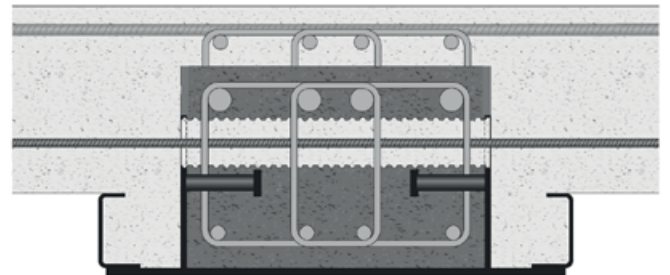
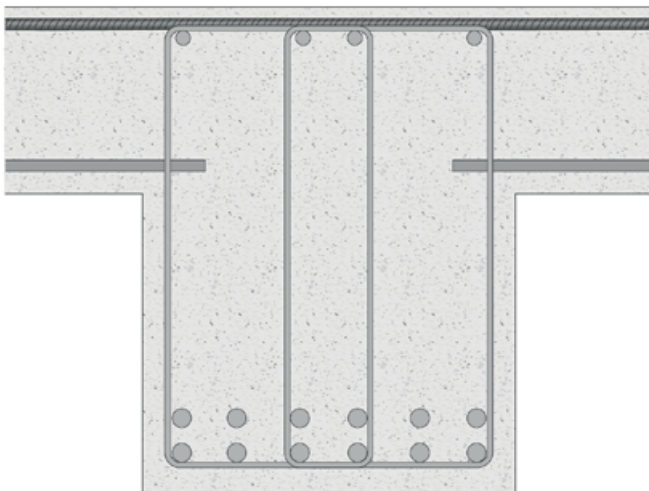
The use of hybrid beams makes it possible to reduce the structural height of the reinforced concrete beam in the monolithic floor. Due to the high load capacity of the **PFEIFER Hybridbeam®**, it can be lowered by up to 40%. This is important, especially in the effective use of the building's cubature.

Monolithic ceiling on the **PFEIFER Hybridbeam®**



Hybrid beam with a monolithic ceiling

- 1 - hybrid beam
- 3 - reinforcement connecting the beam and the ceiling
- 4 - concrete of the ceiling
- 6 - reinforcement screwed in (or bent) at the construction site for continued top reinforcement of the ceiling



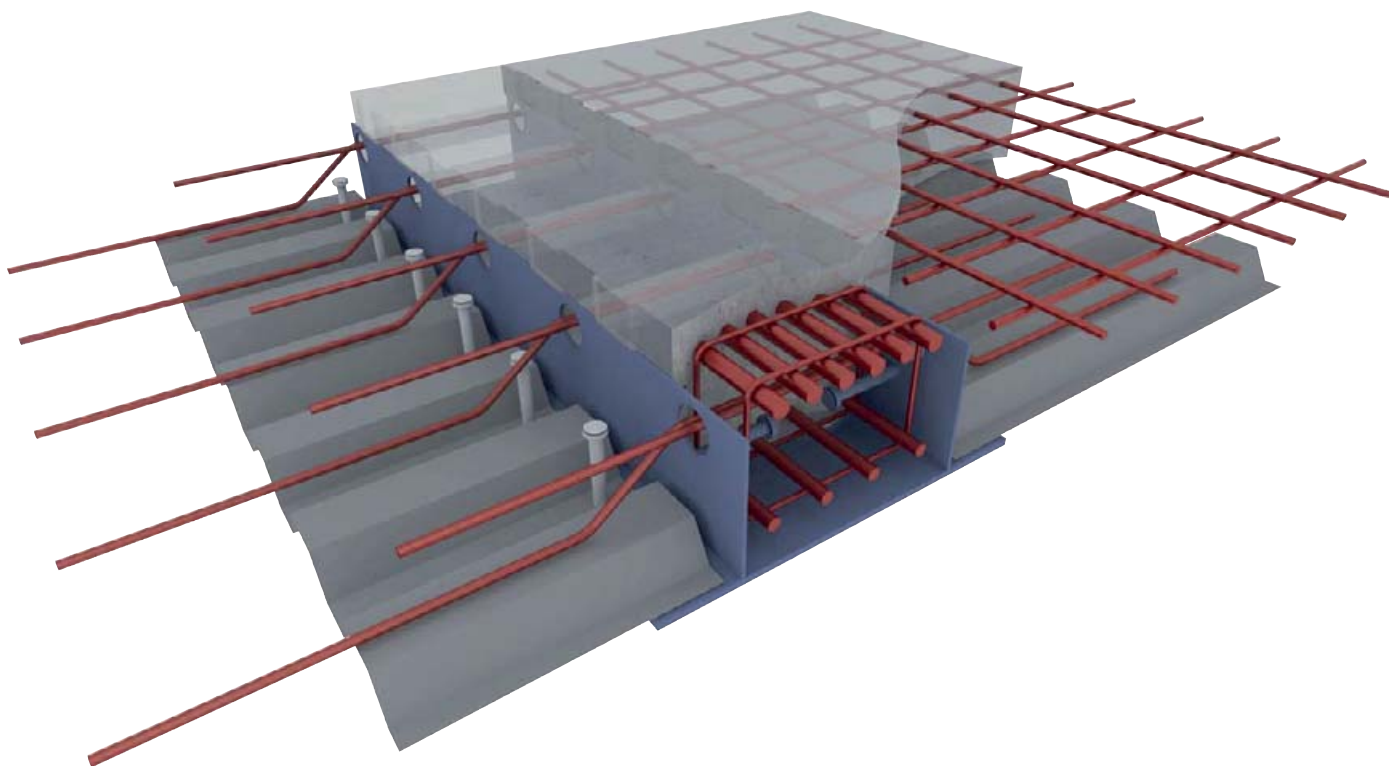
Composite reinforced concrete floors on a trapezoidal sheet on hybrid beams

In search of an effective cross-section of the floor slab, designers reach for concrete floors combined on a sheet with a corrugated or trapezoidal cross section. Thanks to the combination of concrete and steel, ceilings are obtained that combine the advantages of these materials in the most effective way. These ceilings perfectly meet the requirements for fire resistance and provide an appropriate sound barrier between rooms. They enable transferring not only static but also dynamic loads. These ceilings are characterized by a low structure-to-surface parameter (equivalent to densely ribbed ceilings).

In order to obtain the lowest possible construction height of the entire ceiling, it is advisable to use a hybrid beam as a bearing beam – a binding beam. In such a cross-section, the trapezoidal sheet is mounted on the shelves of hybrid beams and, if necessary, supported according to the ceiling guidelines along the length of its span.

The necessary reinforcement of the ceiling is carried out through the structural openings of the hybrid beam or as a continuation of the bent or screw-in reinforcement installed in the beam cross-section. After the floor slab is reinforced, the floor is concreted. Make sure that the floor slab is properly bonded with the lower flange of the beam,

and before concreting, the section should be properly sealed against the leakage of cement wash. The bond with the beam is achieved by means of headed studs welded to the beam flange in the factory. The lower channels of the metal sheets in the supporting areas have openings which the headed studs pass through during the stacking of the sheets.

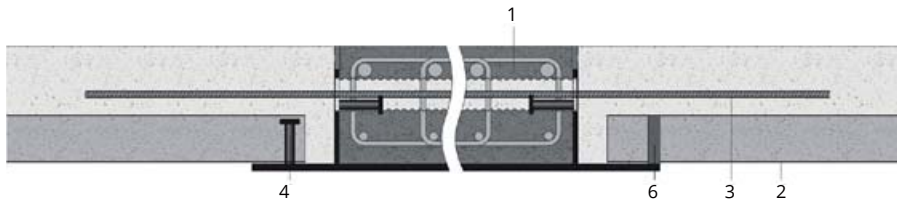


Composite reinforced concrete floor on trapezoidal sheet supported on the **PFEIFER Hybridbeam®**

- 1 – hybrid beam
- 2 – trapezoidal sheet
- 3 – reinforcement connecting the beam and the ceiling built into the construction site
- 4 – head bolts connecting the sheet with the lower flange of the beam
- 5 – reinforcement embedded in the beam joining with concrete
- 6 – gasket for closing channels in a trapezoidal sheet

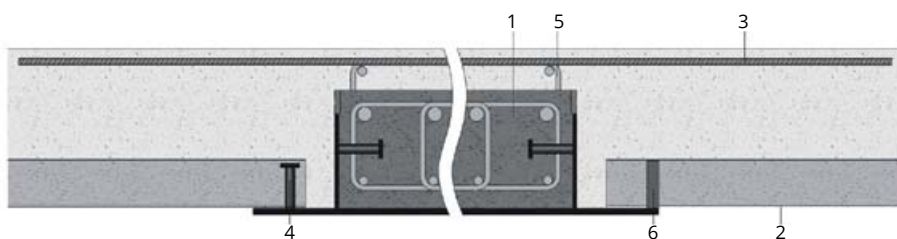


Hybrid beam for composite floor slabs on a trapezoidal sheet with a height equal to the floor slab



In the case of hybrid beams, whose structural height is equal to the structural height of the ceiling, there is the option of continuing the top reinforcement of the slab by bending or tightening the reinforcement to connectors concreted in the beam crosssection. The bottom reinforcement of the slab can be additionally combined with reinforcement in the middle of the crosssection.

Hybrid beam for composite floor slabs on a trapezoidal sheet with a lower height than the floor slab



For hybrid beams with a lower height than the ceiling structure, the implementation of the continuous floor slab pattern is achieved by passing the slab reinforcement over the supporting beam and then filling it with concrete. The combination with the beam is achieved thanks to the stirrups protruding from the beam body.

Interconnection of hybrid beams

The combination of hybrid beams along their length in the so-called Gerber joints

Multi-span - continuous beams are often used in construction. In such a case, "overhanging" beams connected with each other above the support are used. The place of this connection is most often in the so-called Gerber hinge. Depending on the type of connection, they carry:

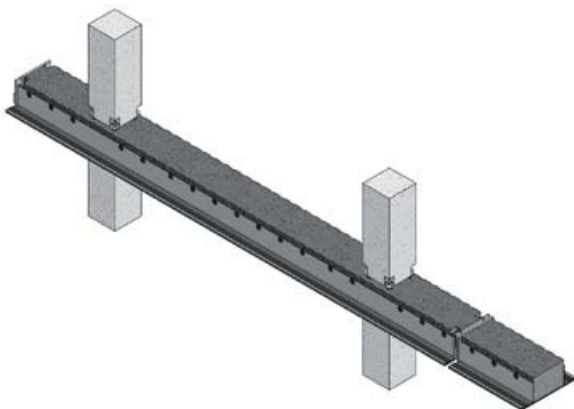
- transverse loads between the beams vertically,
- additionally, tensile loads along the beam axis.

Thanks to the geometry of the transfer plates, the shaped Gerber node also allows to transfer forces transverse trans-

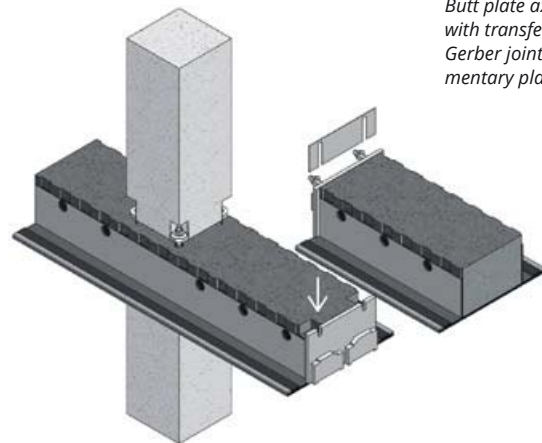
verse to the axis of the beam, arising during assembly from assembly loads. The forces in the connection through the butt plates are transferred to the composite cross-section of the beam through a permanent connection to the bottom flange and beam webs, and possibly additionally by anchoring the plate in the concrete cross-section. This connection is called a precise connection. Small gaps between the butt plate and the transfer plates must be carefully filled before bolting the joint with the appropriate thickness supplementary plates supplied with the beam. In the exploitation phase, these bolts can also transfer some tensile loads in the longitudinal axis of the beams.

Systematics of Gerber hinge connections

Type	To the beam height from [cm]	Maximum shear force and V_{Rd} [kN]
G 20	20	270
G 27	27	360
G 32	32	520
G 40	40	570
G 45	45	660
G 50	50	840



Continuous beam overhanging the support



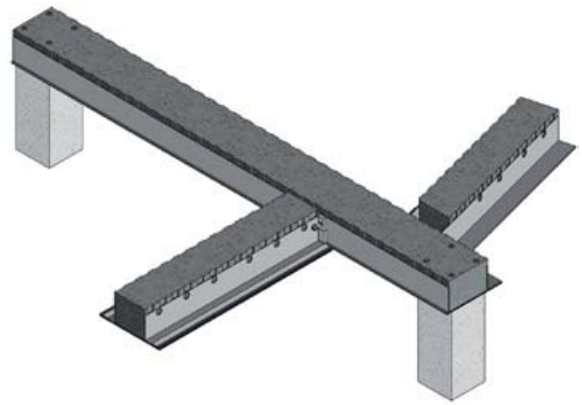
Butt plate axonometry with transfer plates in the Gerber joint with supplementary plates and screws



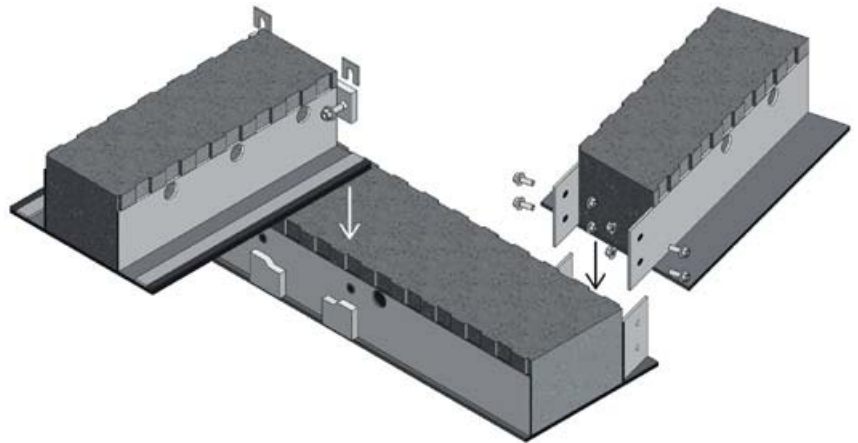
Interconnection of angled beams

In the implementation of the structural system, it is often necessary to connect the beams at different angles. In this case, the shear forces are transferred from the side beam to the main beam supporting it. Simple solutions known from steel structures are used in this case.

Crossbeam at an angle to the supporting beam



Axonomy of the cross connection of hybrid beams



Hybrid beam connections to the structure of the facility – direct support

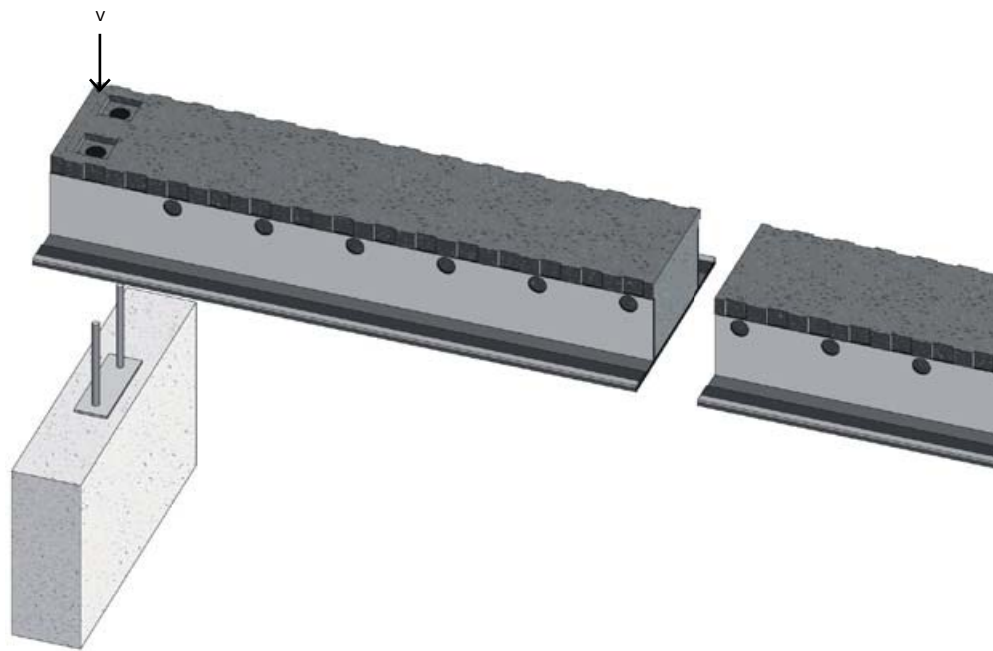
Ceiling beams are one of the basic elements of the building's structure. They transfer the loads from the floors to vertical structural elements such as columns, walls or cross beams. The interconnection of the beams should meet the assumed static structure scheme.

There are many possible solutions for supporting beams on columns or walls. The selection of the appropriate type of support depends on the size of the support forces, design conditions (e.g. the arrangement of vertical reinforcement in the support node, stiffness, etc.), as well as the architectural requirements of the aesthetics of the connection.

When transferring the loads to the structural elements supporting the beam, particular attention should be paid to the stresses in the contacting surfaces caused by this effect. The specific static situation and the beam support surface distinguishes between **direct** and **indirect** support.

The direct support of PFEIFER

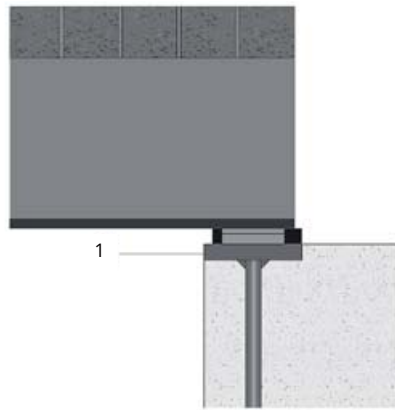
Hybridbeam[®] beams is used wherever, from the structural point of view, it is possible to mount the beam on a support element (wall, column head or column support) - (A). Direct support requires checking the pressure of the beam against the supporting element. The area actively working in absorbing these impacts should be reduced by possible edge surfaces. It must be ensured that these stresses do not damage the edge of the support.



A – Diagram of a beam resting on the column / wall head on one side and on the column support on the other side

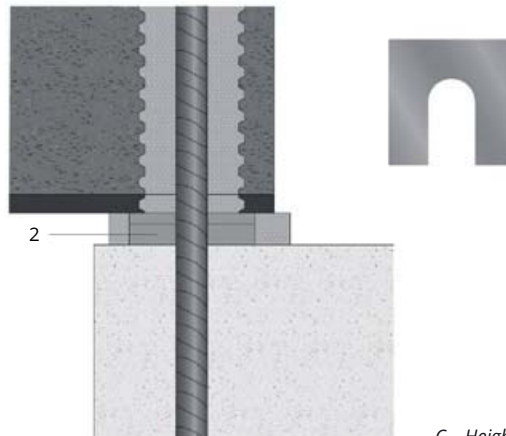


If these stresses exceed the permissible value for the pressure, transfer plates should be used, which effectively increase the load transfer area and enable their redistribution in the place designed by the static engineer. Figure (B) shows exemplary possibilities of implementing such a support.

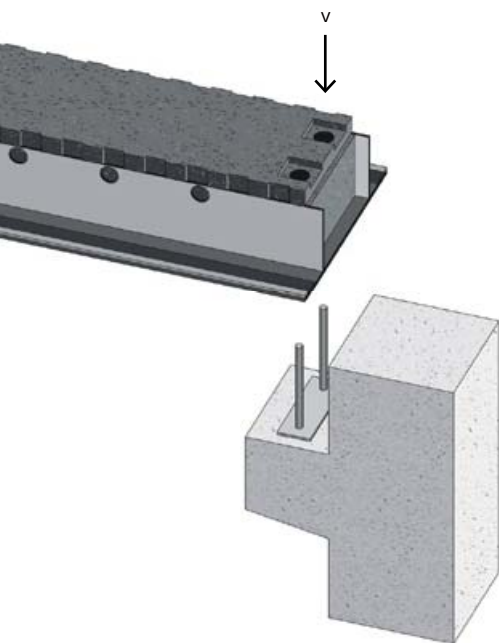


B - Supporting the beam on transfer plates

1 - transfer plate
2 - U-type washer



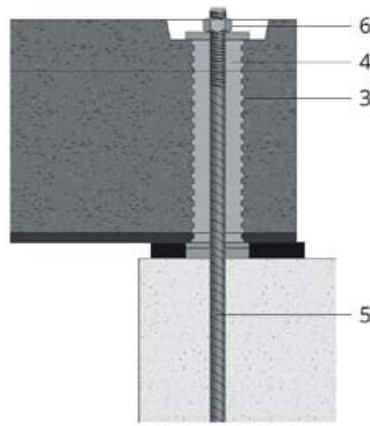
C - Height adjustment on U-type sheets



The supporting structure is made on site in the so-called construction tolerance. Depending on its nature (steel or concrete structure), the upper edge of the supporting element may deviate from the design by 5 to even 20 mm. It should be noted that these should be tolerances in the so-called minus (the level of performance is lower than the projected one). The beam support height is adjusted by means of "U" - (C) type distance plates. These sheets assume the possibility of leading additional elements anchoring the beam through their cross-section.



In order to stiffen the support for assembly purposes or to anchor the beam on the support, threaded connectors or threaded reinforcing bars are used with appropriate washers and nuts – (D). In such a case, an assembly recess is formed at the production stage in the upper part of the beam, which enables appropriate placement of the washer and nut, allowing it to be flush with the edge of the element. Thanks to this connection, sufficient torsional stiffness of the beam is obtained for assembly without the need to support it.

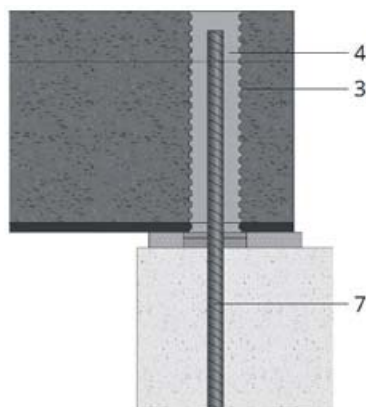


D – Assembly bracing – mechanical tightening of the beam from above; steel through pipe

- 3 – corrugated pipe
- 4 – low-shrink, high-strength mortar
- 5 – anchor bolt or threaded rod
- 6 – nut with washer



In a situation where the assembly of the floor slabs supported on the beams is not carried out at the same time as the assembly of the beams, it is possible to use a simple assembly anchor on the so-called pin. There are recesses in the beam made of corrugated metal pipes. Expose the anchoring reinforcement to the height specified in the design in the supporting element. After the beam is positioned in accordance with the project, the support assembly joint is sealed and the sockets in the corrugated pipes are filled with high-strength, low-shrink mortar. After obtaining the strength of this mortar at the level of 20–25 MPa, a torsional stiffening is obtained in the beam support that is sufficient for assembly.

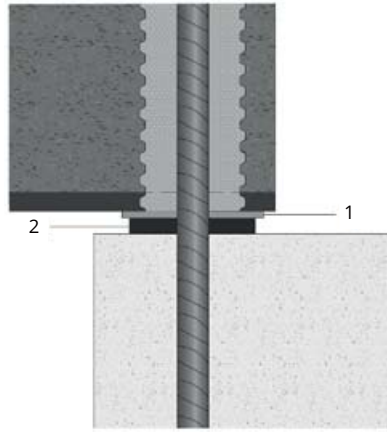


E – Assembly stiffening by pouring in corrugated pipes

- 3 – corrugated pipe
- 4 – low-shrink, high-strength mortar
- 7 – rebar

F – Supporting the beam on an elastomeric bearing

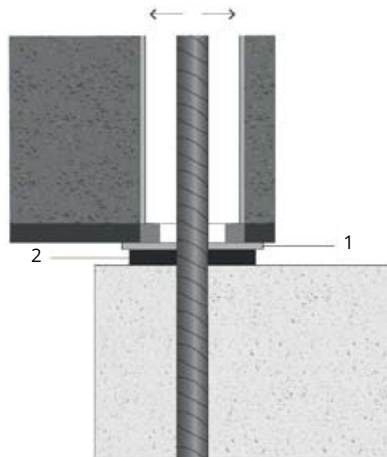
- 1 – adjustable steel washer
- 2 – sliding elastomeric bearing



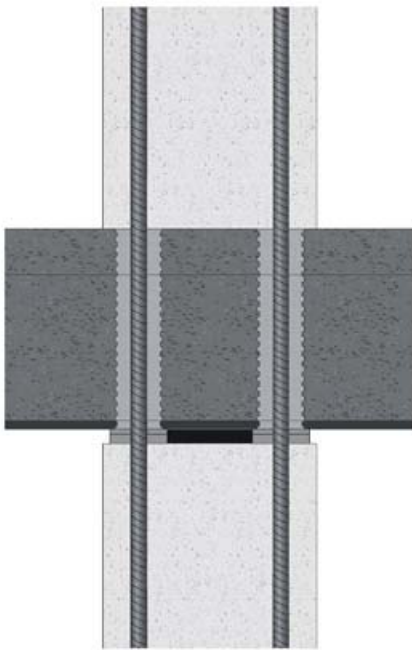
In special cases, it is possible to use hybrid beams with elastomeric bearings with appropriate load capacity to support the beams – (F). The use of an elastomer strip is recommended where the pressure stresses allow it and where the so-called flexible support is. The elastomer is usually placed from the side of the supporting element for possible alignment of the pressed surfaces.

G – Support of the beam on a sliding bearing (expansion joint) in rectangular pipes

- 1 – adjustable steel washer
- 2 – sliding elastomer bearing



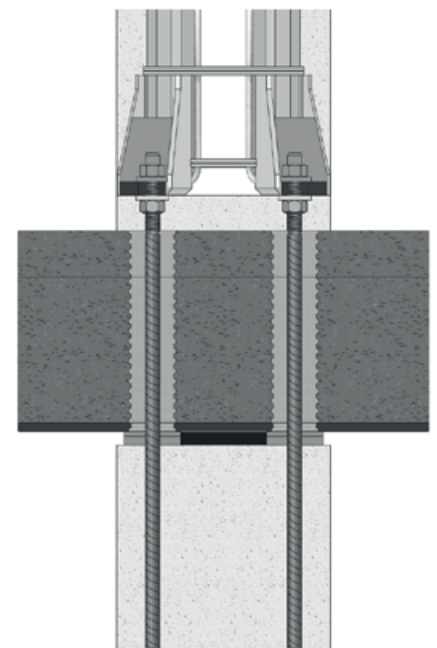
The use of elastomer is especially recommended when it is necessary to move the beam horizontally towards its longitudinal axis – in the so-called dilatation. In such a case, the support should be designed with the use of a sliding elastomer bearing or (if the pressing stress is greater than the design capacity of the elastomeric strip) a bearing made of sheet metal enabling this movement – (G).



H – Continuation of reinforcement to the top monolithic element through or near the beam

← If it is necessary to route the reinforcement from the lower loadbearing structure to the upper, monolithic structural elements, it is possible to lead it through vertical corrugated pipes concreted in the beam or through openings in the lower flange of the beam – (H). This solution enables the production of continuous vertical elements that pass through the beam cross-section.

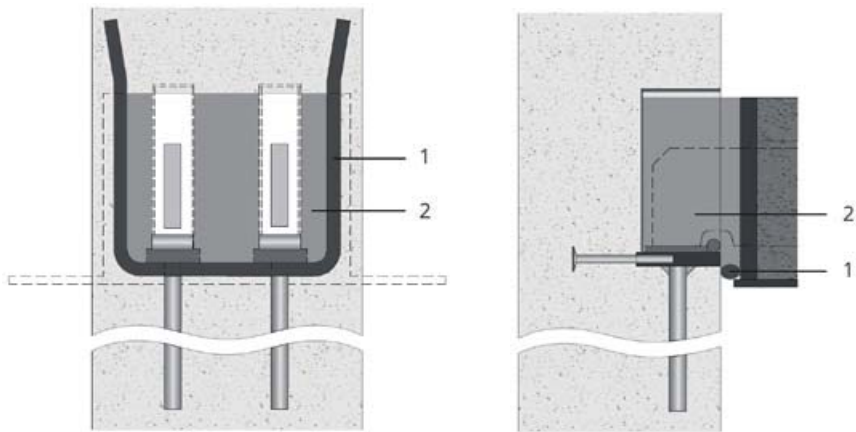
→ For prefabricated elements (e.g. columns) installed above the beams in the area of their support, the construction can be interconnected using PCC PFEIFER column shoes and PGS PFEIFER foundation – (I). This solution prevents the edge of the beam from splitting as a result of torsion on the support, and at the same time saves from grouting.



I – Connection of a prefabricated element above the beam with PCC supports

Hybrid beam connections to the structure of the facility – indirect support

Intermediate supports, also known as hidden connections, make it possible to achieve an aesthetic support. After the assembly works are completed, no support elements are visible to the user; the impression of the interpenetration of the construction elements is achieved. The use of an indirect support is extremely desirable, especially in situations dictated by the architect's requirements, the need for butt assembly of precast beams or the need to carry a large number of vertical bars in the node to continue the reinforcement. Transmission of transverse loads is carried out indirectly through extended and reinforced beam webs or through the so-called hidden fasteners, i.e. steel sheet knives integrated with the beam cross-section. In order to transfer concentrated pressing stresses to the supporting elements, we use **transfer sheets** equipped, if necessary, with **open** or **closed column pockets**.

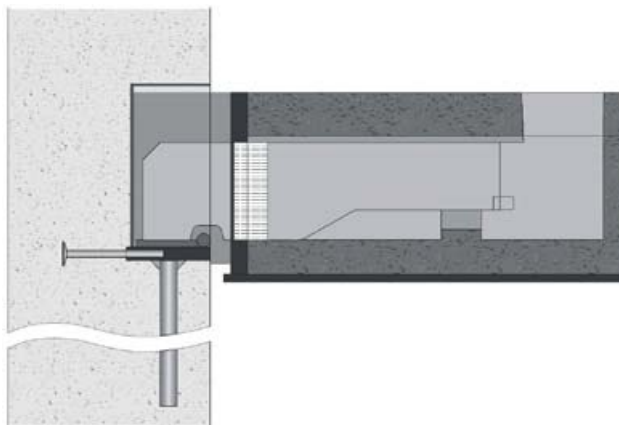


A - Technology of filling the joints with low-shrink mortar

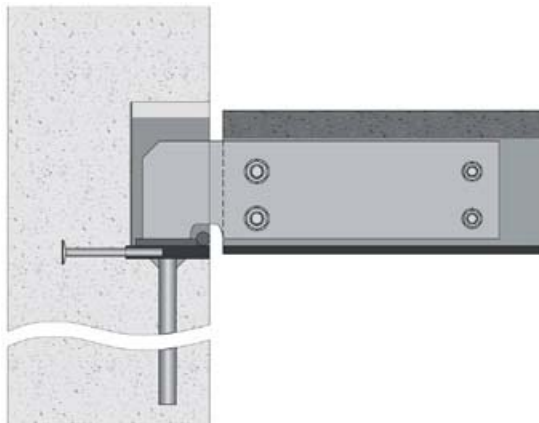
By using pairs of connectors, it is possible to transfer high torque moments in the node without the need to use additional assembly protections. Assembly joints and column pockets are poured over with high-strength, low-shrink concrete – (A). A connection made in this way is capable of transferring loads immediately after completing the installation process.

- 1 - silicone cord
- 2 - low-shrink, high-strength mortar

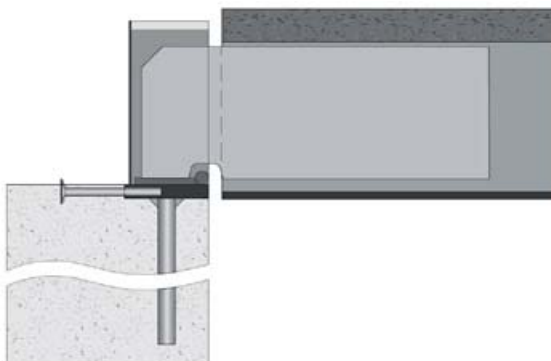




B - Support on knives that slide out of the beam



C - Support on knives screwed onto the beam



D - Support on knives welded onto the web

Closed column pockets are used for butt joints (to a column, wall or beam). For this purpose, extension knives (B) are built into special beam pockets in a hybrid beam. These knives slide into the previously prepared pole pockets after the beam reaches the designed assembly position. After the knives are pulled out, the beam reaches its assembly load capacity. However, further use of the beam for the installation of the ceiling requires the prior pouring of the installation gap with a suitable mortar. The table shows the standard load capacities for an intermediate support with the use of steel knives

Beam type	Maximum action V_{Ed} [kN] on the support
BH 27	600
BH 32	850
BH 40	950
BH 45	1100
BH 50	1400

In some situations, when the cross-section of the supporting element does not allow the use of retractable knives, we can use a mechanical connection by bolting the knives to the cross-section of the beam - (C). For open column pockets it is also possible to use knives welded to the beam web - (D).

Expansion joints on hybrid beams

The ceilings, regardless of the type of structure, can be freely dilated on the lower flange of the hybrid beam or by dilating the beam support itself.

Expansion joints of floor slabs

In order to create a structural expansion joint, the support of the beam in this area is widened so as to ensure its planned width, taking into account the type of ceiling, and leave space for its movement transversely to the beam axis. For channel ceilings, it is recommended to additionally design a reinforced concrete ring beam integrated with the ceiling with a width of min. 120 mm. Other composite ceilings (on prefabricated slabs or on trapezoidal sheet and monolithic ceilings) do not require an additional ring in this area.

For timber ceilings and composite timber / concrete ceilings (on wooden

slabs), a washer is provided directly under the timber slabs. In the case of composite timber-concrete, ribbed ceilings resting on the lower flange, sliding strips should be designed under the timber ribs or – if possible – under the concrete slab extended beyond the face (as for monolithic ceilings).

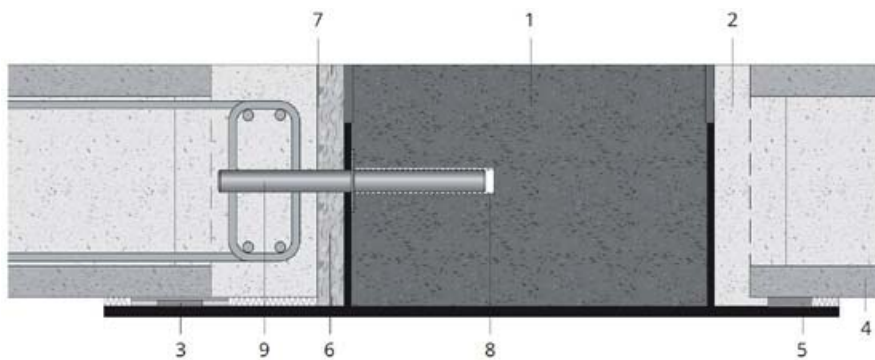
On the lower flange, there is a strip expansion washer with a load-bearing capacity matched to the linear load of the ceiling slab, and to ensure load-bearing capacity in the expansion joint in case of fire - additional expansion pins installed in the beam core. A layer of mineral wool is designed in the gap itself to allow the floor slab to move.

Expansion joints under hybrid beams

In the case of a shift in the ceiling expansion joint with the beams, the expansion pads are designed

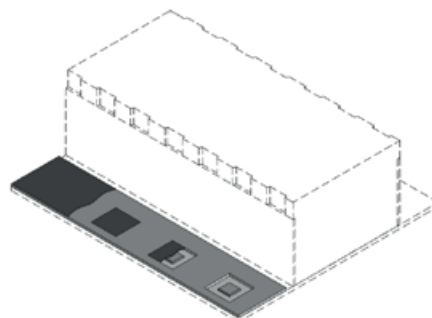
in the place where the beam rests. Depending on the support situation and the size of the support reaction, we use washers with the use of sliding elastomer bearings or with the use of steel bearings.

The direct support of the beams enables the use of a larger support area of the girders. Compressive stresses generally allow the use of an elastomeric sliding bearing strip. On the indirect support, the supporting knives are equipped with perpendicularly welded steel base plate sheet. The surface of these sheets depends on the surface of the support. The shift is made by overcoming the frictional force of the contacting sheets. In this case, it is recommended to lubricate the surface of the sheets.

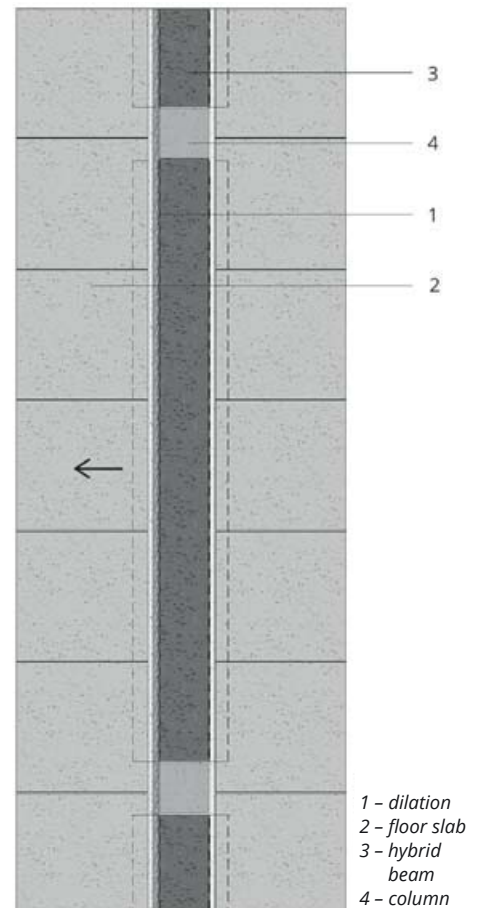


Expansion of the ceiling on hybrid beams

- 1 - hybrid beam
- 2 - pouring concrete
- 3 - sliding bearing strip
- 4 - floor slab
- 5 - elastomer pad 10 Å ~ 50
- 6 - expansion joint (wool filling)
- 7 - edge of the ceiling (for ceilings made of hollow-core slabs, a rim with a width of at least 120 mm)
- 8 - sliding shear connector sleeve
- 9 - sliding shear connector

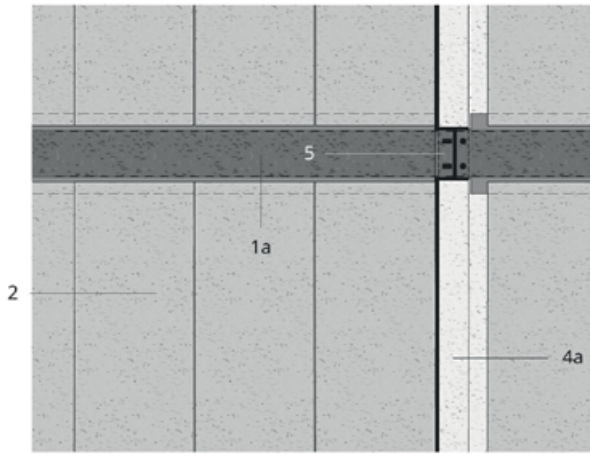


Strip expansion washer

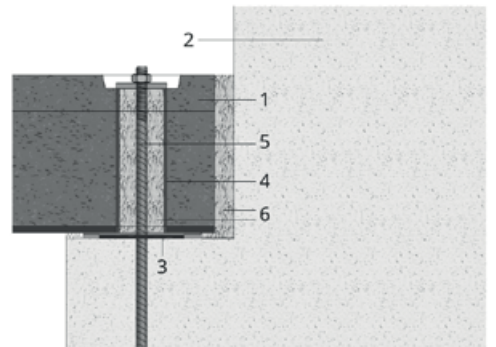
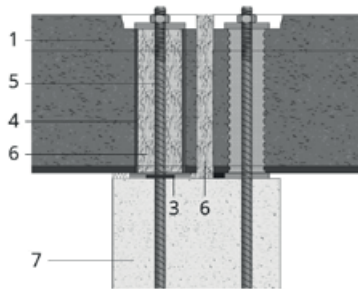
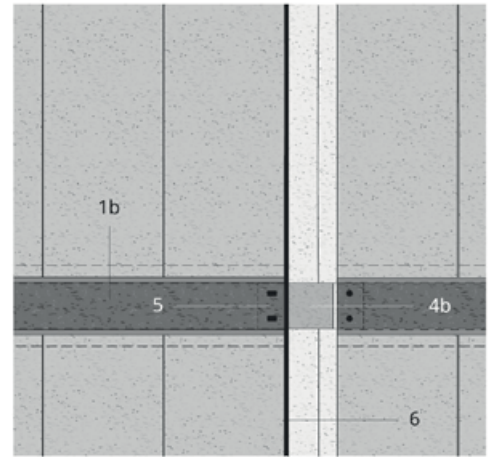


- 1 - dilation
- 2 - floor slab
- 3 - hybrid beam
- 4 - column

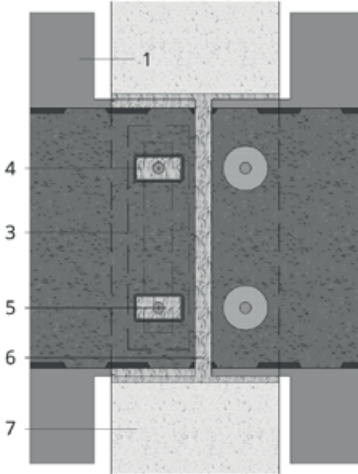
Projection of the dilated ceiling



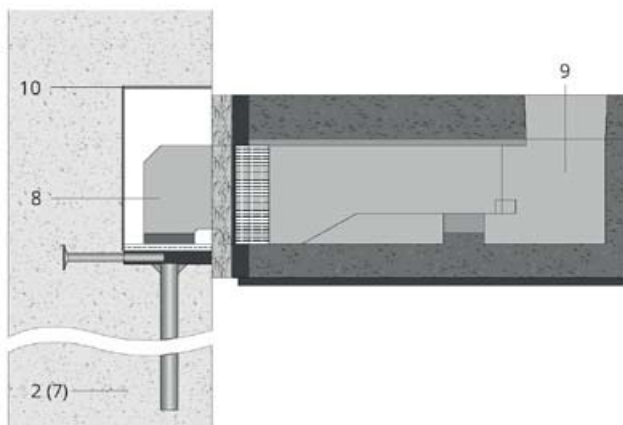
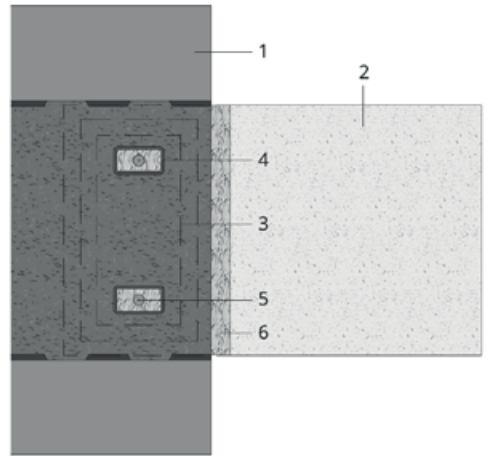
Projection of the ceiling on dilated beams: on the wall (left), on the column (right)



- 1 - hybrid beam
- 2 - column
- 3 - sliding elastomer pad
- 4 - rectangular pipe protecting the assembly
- 5 - anchor bolt
- 6 - wool
- 7 - wall
- 8 - sliding knife with a welded plate
- 9 - mortar
- 10 - closed pocket of the column



Expansion between the beam and the support on the direct support (on the wall - on the left, on the bracket - on the right)



Expansion between the beam and the support on the intermediate support; closed column pockets

Assembly of hybrid beams

The assembly of hybrid beams is similar to the assembly of prefabricated elements and, in some cases, structural steel elements.

Preparation for the installation of hybrid beams

Before beginning the assembly, the structural elements of the facility should be accepted in terms of the proper preparation of assembly points:

- correct level of the upper structural edge,
- compliance with the design of the location of the elements used for supporting (transfer plates, column pockets) or the anchoring of the beams (anchor rods),
- location of reinforcement elements penetrating through the reinforced concrete body of beams.

In the case of finding deviations exceeding the permitted assembly tolerances, it is necessary to introduce corrections leading to the state consistent with the design before assembly, taking into account the

installation tolerance; the support surfaces located too high should be brought to the state of -10 mm in relation to the assembly level by chipping (bush hammering) or grinding (transfer plate surfaces). In the event of a too large reduction in relation to the level of the support, the resulting difference can be compensated by using additional steel washers of appropriate thickness and surface. As standard, hybrid beams are delivered with a package of dedicated mounting plates with a total thickness of 10 mm for a given support. If the built-in elements are placed in a way that prevents the installation of the beams (exceeding the tolerances), it is necessary to carry out work to correct their position, or individually decide on the necessary repairs. After correcting errors in the constructed structural elements, it is recommended to install the spacer plates to the target (design) foundation level just before the assembly itself.

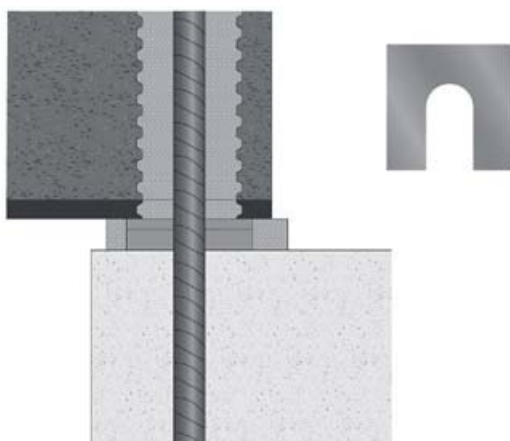
Hybrid beams delivered to the construction site are usually assembled

directly from transport. In the event that they have to be stored on the construction site, the following storage conditions must be observed. The storage location should be pre-balanced and not susceptible to loads resulting from the weight of the element. The beams must not be stored on a substrate whose unevenness exceeds 5–8 cm (they may lead to dirt or damage to the paint coating of the beams). The beams are standardly equipped with so-called transport "wooden spacers" temporarily fixed to the lower shelf, protecting the bottom surface of the beam, while allowing them to be repeatedly rearranged on the construction site. These should be removed during the initial process of lifting the beam to the installation site. Hybrid beams can be stacked on top of each other in multiple levels – the wooden spacers must be positioned above each other – provided that adequate stability and load-bearing capacity of the substrate are guaranteed (e.g. foundation slab, construction site hardened with a concrete layer or





Pouring gaps and assembly connections



Beam rectification using "U" spacer plates

concrete slab, ceiling). It is forbidden to place the beams directly on the ground or directly on top of each other without spacers.

Before beginning assembly, it is necessary to visually check whether the marking of the element complies with the delivery document and the design. Before installing the beams, the assembly holes in the elements must also be checked, and in the event of any dirt, cleaned or unblocked immediately.

In order to perform the assembly efficiently, the following assembly materials and tools should be prepared before starting the assembly:

- wrenches of the appropriate size, in accordance with the production drawing, for tightening the bolts on the support,
- a set of steel washers for rectification with a thickness of 10, 5, 2 and 1 mm,
- concrete / low-shrink mortar (with a strength class not lower than that of the concrete used to make the prefabricated element) for pouring assembly gaps,
- silicone cord to seal filled joints or other sealing material.

Hybrid beam installation

The beam should be lifted with a lifting device, using a sling of appropriate, proven load capacity and length. The beam should be attached to the the lifting loop with the use of special lifting anchor which are embedded into its body by the manufacturer. Beams may only be lifted by qualified assembly personnel.

Any other way of lifting the beams may result in mechanical damage or endanger the safe assembly. Assembly using the so-called transport forks. Transport belts can be used after prior agreement of the method of transport with the supplier.

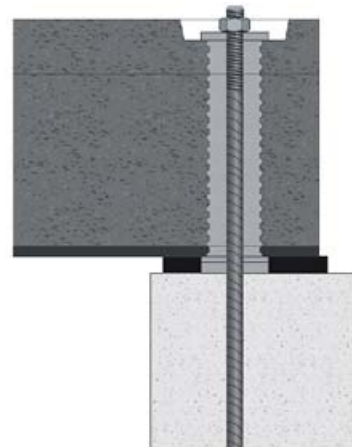
The beam should be carefully lowered onto the support. If the beams are anchored at the support point, the threaded rods led out from the head or support of the structural element should slide into the mounting holes in the beams without colliding. In the upper plane of the beams, appropriate recesses are made above the openings to ensure that the pin, the upper washer and the nut are hidden within the dimensions of the beam. Then - depending on the chosen backrest method - the connectors should be fixed. Further

assembly steps depend on the connectors used. In the case of an indirect support in open column pockets, it is necessary to ensure that the extended webs of the beams are correctly positioned in the sockets. For the butt support, the beam should be directed to the head of the built-in column pockets and the retractable knives built into the beam should be pulled out with the use of a bar, so that they are in the appropriate assembly position and the beam should rest on the knives inserted into the column pockets.

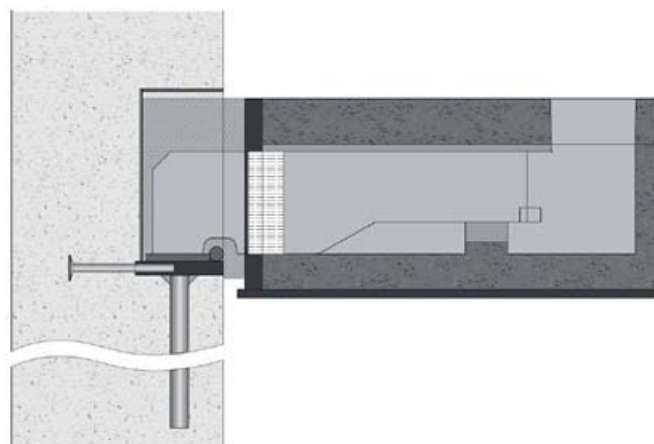
After "dry" installation, the installation joints should be sealed with a silicone cord and filled with a properly prepared mortar / low-shrink concrete according to the manufacturer's instructions.

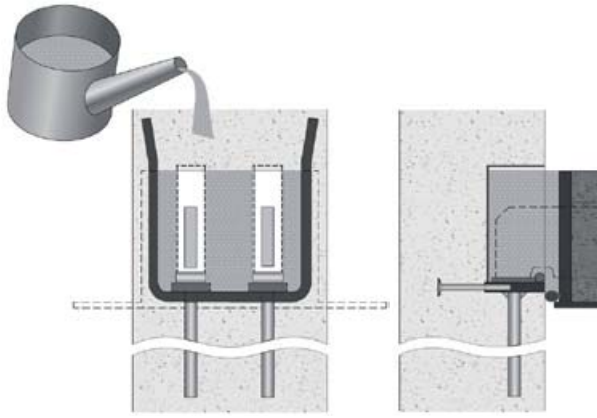
After the beams are laid, rectified and mechanically fastened on the supports or the mortar assembly strength has been obtained in the filled assembly gaps of the intermediate supports, the floor slabs can be laid according to the plan. The standard **PFEIFER Hybridbeam®** composite beams do not require intermediate supports.

Fixed and bolted PFEIFER Hybridbeam® with concrete cast assembly joints



Mounting the beam on retractable knives





*Filling the butt assembly joint
at the hidden connection*



Filling the open pockets in the assembly gap



Corrosion protection of hybrid beams

The **PFEIFER Hybridbeam®** is a composite steel and reinforced concrete prefabricated element. It is used in facilities for various purposes. In the standard version, the beams are offered with the so-called short-term protection of visible steel elements by applying a layer of primer paint with a thickness of 60-80 microns. At the stage of finishing works, the visible steel surface of the bottom flange is covered with paints according to the architect's specifications.

Depending on the needs, the beams can be factory-protected for a different class of environmental aggressiveness.

This applies in particular to damp rooms or places where the aggressive effects of moisture and chemical compounds are evident. This also applies to outdoor facilities where structural elements are exposed to the external environment. These are mainly salt compounds (in coastal zones) or car parks.

PFEIFER – as one of the few companies – offers a corrosion protection solution in the form of hot-dip galvanizing of steel beam surfaces. This solution – especially popular in multi-storey car parks – guarantees long-term protection and resistance to the so-called assembly damage during the installation of beams

in the building structure. If necessary, these elements are additionally covered with paints according to the design specification.

The standard way to protect steel surfaces is to cover them with appropriate paints. The surface of elements prepared to be covered with paint should be properly prepared before painting by e.g. grinding. In this regard, we follow the provisions of the current edition of the EN-ISO 12944 standard. This standard indicates the following aggressiveness classes and areas of their occurrence:

Aggressive class	External structures	Internal structures
C1 – very low	Non applicable	Heated buildings with clean atmospheres
C2 – low	Industrial production facilities with a high degree of humidity	Low pollution atmosphere
C3 – medium	Industrial production facilities with a high degree of humidity	Urban and industrial atmosphere (moderate sulfur (IV) oxide pollution – e.g. in coastal areas with low salinity)
C4 – duża	Chemical plants, swimming pools	Industrial and coastal areas with high salinity
C5 – high (C5-I – industrial, C5-M – marine)	Objects with continuous condensation and high air pollution	Industrial areas with high humidity and aggressive atmosphere, including coastal air
CX – extreme	Industrial buildings with extreme humidity and an aggressive atmosphere	Coastal areas with high salinity, industrial areas with extreme – tropical – humidity



Based on the experience of the manufacturers of anti-corrosion paints, the durability of anti-corrosion coatings can be over 25 years. In practice, we often use durability classification for anticorrosion coatings:

- low (L) – to 7 years,
- medium (M) – 7–15 years,
- high (H) – 15–25 years,
- very high (VH) – over 25 years.

The **PFEIFER Hybridbeam®** is manufactured according to the requirements specified in the project using the surface preparation and painting technology specified in the EN-ISO 12944 standard and the paint manufacturer's guidelines for the durability period expected by the customer.

In specific cases, if there are additional customer expectations, the top layer of the cover is made according to the agreed color, based on the available color template.



Fire resistance of hybrid beams

PFEIFER Hybridbeam® can be successfully used in ceiling constructions with the required fire resistance class of up to 120 minutes. The resistance of the beam structure exposed to fire depends on the temperature of the individual load-bearing elements of the beam during the fire. In the case of fire from above, **PFEIFER Hybridbeam®** composite beams do not require any additional measures related to fire protection due to the use of appropriate cover of the upper load-bearing reinforcement – unlike structures using compressed or decompressed steel sections in this area. The impact of high temperature during a fire may only concern the bottom flange (for middle beams), the bottom flange and the side wall (for edge beams) and the bottom flange of both side walls (for special beams) or beams used for cooperation with ribbed ceilings.

For structures with a fire resistance class of up to 30 minutes, hybrid beams

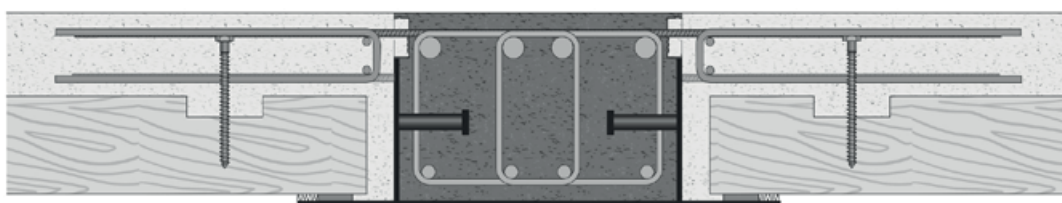
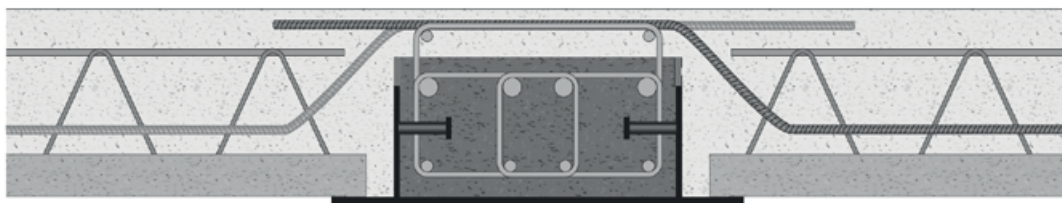
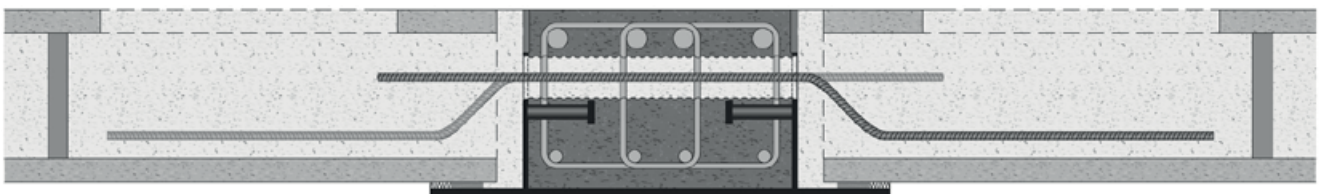
do not require any additional fire protection in the form of additional reinforcement or fire-retardant coating. For higher classes, two methods are used to determine the fire resistance class of the beam cooperating with the floor slab:

A: Dimensioning of the beam cross-section for fire load according to standards:

- PN-EN 1991-1-2:2006. Eurocode 1: Actions on structures. Part 1-2: General actions – Actions on structures exposed to fire.
- PN-EN 1992-1-2:2008. Eurocode 2: Design of concrete structures. Part 1-2: General rules - Design for fire conditions.
- PN-EN 1993-1-2:2007. Eurocode 3: Design of steel structures. Part 1-2: General rules - Calculation of structures due to fire conditions.
- PN-EN 1994-1-2:2008. Eurocode 4: Design of composite steel and

concrete structures. Part 1-2: General rules – Design for fire conditions.

A simplified or an exact method is used during calculation, using temperature isotherms in the beam cross-section, developed on the basis of numerical analyses, depending on the duration of the fire. Depending on the temperature in the cross-section, based on the aforementioned standards, the reduction factors for the yield point of steel can be determined, which in turn allows to determine the load capacity of the beams. In order to obtain the necessary parameters of the load capacity of the beam, additional longitudinal reinforcement is used in the tension zone, replacing the action of the construction steel of the lower flange, which plasticizes under the influence of the temperature load. In this case, in order to transfer the reduced stresses from the support of the floor slab on the beam



during the fire, additional suspension reinforcement (emergency reinforcement) or fasteners appropriately selected for the ceiling structure (e.g. in the case of wooden ceilings) is used. This reinforcement is activated during fire and transfers loads to the beam body.

B: Protection of steel beam surfaces exposed to the floor by using fire retardant coatings or special cladding

Some manufacturers of fire retardant paints have certificates of durability of these coatings that exceed even up to 25 years. The durability of coatings is determined primarily by proper anti-corrosion protection of their base and direct action of harmful atmospheric factors.

We use only products from proven paint suppliers to provide our customer

with the highest quality product and security.

Fire protection of a steel structure brings additional advantages related to its possible reuse after the fire. This is a very important factor in regards to the issue of sustainable development. Protected with a layer of reactive paint, the construction subjected to fire does not undergo changes and deformations that would disqualify its reliable use after repair. It is worth considering this factor when designing the building as it can also reduce the insurance rate for the building.

Structural elements are subject to systematic periodic inspections regulated by separate regulations. This usually takes place during the periodic inspections of the technical condition of the facility. In the case of fire-resistant coatings, the rules of such inspection are

described in the facility's instructions for use. This usually involves observing the fire retardant coating in the indicated reference field based on the given inspection parameters. This is similar to the inspection of the technical condition of other structural elements (observation of cracking of concrete elements or anti-corrosion coating of steel elements). If such a coating is found to be damaged, a plan for technological repair should be agreed on in accordance with the instructions of the coating manufacturer.

In construction conditions, in some cases, contractors use protection of this type of steel surfaces on the construction site by using appropriate mineral linings according to the technology of a given manufacturer.



Additional possible external fire protection (coating or cladding) in class R60-R120 for PFEIFER Hybridbeam®



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