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(54) **BEAM ASSEMBLY FOR COMPOSITE FLOOR**

TRÄGERANORDNUNG FÜR VERBUNDBODEN

ASSEMBLAGE DE POUTRE POUR DALLE COMPOSITE

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Description

BACKGROUND OF THE INVENTION

[0001] Composite floors are constituted of concrete floor boards, prefab or manufactured entirely or partially in situ, and steel girders. The concrete floor boards are supported on the lower flange of the girder, wherein the constructionally wanted connection between floor boards and girder is realized using coupling reinforcing rods that are coupled to the girder or extend through the girder and by filling the open spaces adjacent to and optionally also inside the girder with concrete. The girder is also called an integrated girder.

[0002] The floor boards can for instance be wide slabs or hollow-core slabs. The girders can be designed like a castellated beam having transverse holes in its web, like an I-beam (SFB, IFB) the web of which is a solid web, having two webs that are upright from the lower flange and connected to each other by an upper wall, a Delta-beam or other two-flanged or one-flanged top hat (THQ) beams, like a corrugated web beam, etc.

[0003] In case of a composite floor with hollow-core slabs, the coupling reinforcement rods will be placed at predetermined, regular intermediate distances. The rods may be accommodated in U-grooves between adjacent hollow-core slabs, when the intermediate distance can correspond to the standard 1.2 m slab width. Usually, it requires a denser occupation, for instance 60 cm center-to-center, in which case end sections of for instance two longitudinal voids of a hollow-core slab have been made accessible at the top side beforehand by removing the concrete upper deck over those longitudinal voids. As regards the hollow-core slab, the position of coupling reinforcement is thus fixed.

[0004] The position of the coupling reinforcement in the floor plan having been calculated beforehand has consequences for the girder as well. For girders that have a relatively large hole surface area, wherein the coupling reinforcement can extend through the girder, this will not be very problematic. In solid web beams and in other cases in which the coupling reinforcement needs to be attached to the web of the girder, the coupling location will often be constituted by a nut to be welded to the web, into which nut the coupling reinforcement can be screwed, at that location often reinforced by a transverse plate welded to/in the web. Once the floor plan is known, the coupling locations can be arranged on the web. As a result thereof, the purpose of the girder prepared that way will be fixed, and in the factory, in storage and on site a logistic effort will be required to make sure the correct girder becomes available on time for the correct location in situ. Alterations in the project will then be difficult to implement. Problems may arise if the floors have not been placed in situ exactly in accordance with the floor plan

[0005] The prior art document EP2405070 describes an assembly of a steel girder providing a more efficient

assembly on the construction site between the girder and the floor slabs.

SUMMARY OF THE INVENTION

[0006] It is an object of the invention to provide a girder assembly for composite floors including hollow-core slabs, with which a logistic effort connected to manufacturing, storage and transport can be limited.

[0007] It is an object of the invention to provide a girder assembly for composite floors including hollow-core slabs, which may provide an increased ease of installation.

[0008] It is an object of the invention to provide a girder assembly for composite floors including hollow-core slabs, which to a large extent may provide options for adjustment during installation.

[0009] According to one aspect, the invention provides an assembly of a steel girder for a composite floor including concrete hollow-core slabs, and a coupling device for connecting the hollow-core slabs to the girder, wherein the girder comprises:

- at least one laterally extending lower flange having a support surface for support ends of the hollow-core slabs and
- a web extending upwards from the lower flange,

wherein the coupling device comprises:

- a number of coupling rods which with the one, first end are intended to be accommodated in the respective longitudinal voids of the hollow-core slabs or in joints between the hollow-core slabs and to be secured to them by poured concrete, and at the other, second end are provided with a coupling protrusion projecting transverse from the respective coupling rod,
- at least one coupling rail attached to the web of the girder, which rail extends substantially parallel to the lower flange, and which has a length of at least the width of a hollow-core slab,

wherein the rail defines an accommodation space for the coupling protrusions that is at least partially screened off towards the hollow-core slabs, in a direction away from the web, in horizontal direction by a coupling wall, and is provided with an opening continuing in longitudinal direction for access of the coupling protrusions to the accommodation space,

wherein the coupling protrusions in an insertion position thereof can be introduced through the opening into the accommodation space and can then be moved, in particular are rotatable, in particular are rotatable about a longitudinal axis of the coupling rod, to a coupling position that is oriented so as to deviate from the insertion position in order to engage behind the coupling wall so that the coupling protrusions are kept confined in the accommo-

ation space of the rail in such a way that they cannot move away from the web.

[0010] Providing the rail, having a continuing opening in longitudinal direction, on the web has the advantage that the exact location of the coupling rods in situ no longer matters when manufacturing the girder. Where the coupling rods and the prepared longitudinal voids for coupling rods turn out to be located no longer matters in the - simple - attachment of the coupling protrusions to the girder, as the rail provides a stepless range of positioning options. The girders including coupling rail can be suitable for use at any location in situ, if the girder length is correct. The girders can be produced to be stocked and once the floor thickness is known (but the floor plan still is not) the rails can be attached to the web at the correct height. All this offers considerable logistic advantages, both in the production stage and at the building site.

[0011] Several rails that are in line with each other may be attached to the web. In a simple embodiment, the rail extends along a length of several hollow-core slab widths, preferably along at least almost the full girder length.

[0012] The opening towards the accommodation space may have a normal that is substantially horizontally oriented, in particular is oriented parallel to the lower flange, so that insertion of the coupling protrusions can take place in horizontal sense in a direction opposite to the tensile forces to be absorbed at a later stage.

[0013] The accommodation space can be upwardly bounded by an upper wall and can be downwardly bounded by a bottom wall. The coupling wall can comprise a pending rail flange, which upwardly bounds the opening, and/or comprise an upright rail flange that downwardly bounds the opening. In the coupling position, the coupling protrusion can engage behind the pending rail flange and/or behind the upright rail flange.

[0014] That way the rail can be a U-profile of which both legs with free edge zones are turned towards each other in order to form the said flanges.

[0015] The rail can be situated at a distance of approximately $1/5$ to $2/5$ of the height of the web above the lower flange.

[0016] In one embodiment, in a first direction, transverse to the coupling rod, the coupling protrusion has a dimension that is smaller than the width of the opening and in a second direction, transverse to the coupling rod and at an angle to the first direction, has a dimension that is larger than the width of the opening and preferably corresponds to the internal height of the accommodation space.

[0017] The coupling protrusion can be shaped to tend to the coupling position under the influence of gravity. For instance, the coupling protrusion can be rotatable on the coupling rod and have two arms of unequal weight, so that the coupling protrusion tends to a preferred position in which the heaviest arm hangs down.

[0018] In a simple embodiment the coupling protrusion has a threaded hole and the coupling rod is provided with

a threaded end that can be screwed into said hole. The threaded end of the coupling rod can be screwed through the hole, so that tightening can take place against the web or against the rail bottom (the rail wall opposing the opening), after which by rotating the coupling protrusion onward, after having been rotated into the coupling position, it can be tensioned away from the web or the rail bottom, against the coupling wall of the rail.

[0019] If the girder is an edge girder, supporting the hollow-core slabs will only take place on one side. If it regards a span girder, the girder comprises two lower flanges that extend in opposing lateral directions so as to form a support surface for hollow-core slabs on both longitudinal sides of the girder, wherein on either side of the web a said rail is arranged, or when there is a double web (THQ girder) a rail is arranged on each web, which rails face away from each other.

[0020] In a specific embodiment, the web is designed like a corrugated or zig-zag-shaped wall, with on the one side, first wall sections that are spaced apart from each other in girder direction and on the opposing second side, second wall sections that are spaced apart from each other in girder direction, wherein a rail is each time attached to the first wall sections and/or a rail is attached to the second wall sections. The first wall sections can be situated in one plane with each other, the same applies to the second wall sections. As a rule, such a girder can be used to a limited extent as the web length (for instance the length of the first wall sections) available for the nuts that have been used up until now for the coupling rods is highly limited, even less than $1/3$ of the girder length, due to the corrugated or zig-zag-shape. The $2/3$ of the girder length that have been unavailable up until now, will now be made available indeed by the rail that bridges the spaces between consecutive first wall sections. As a result, such a girder can also easily be used in composite floors including hollow-core slabs, with the other advantages of the invention.

[0021] The web can be designed like a wall having a trapezoidal or sheet-pile wall-shaped course.

[0022] The rail itself can be designed for absorbing and transferring the occurring forces to the web.

[0023] The rail can be made of steel. In case the rail is attached to a flat web, the rail can be welded to the web at many locations, even with a continuous welding joint. That is not possible in case of a corrugated web, and when the loads to be expected require so, attaching one or more dowels to the rail that is attached to the first (or second) wall sections in the area between two consecutive first (or second) wall sections can be opted for, which dowels extend substantially in horizontal direction towards the second (or first, respectively) wall sections. Once the concrete has been poured in and around the girder, the dowels can ensure a local transfer of tensile forces from coupling rods attached in the rail in the vicinity thereof to the concrete, and those forces need not be transferred entirely by the rail itself to the location where the rail is attached to the web.

[0024] According to a further aspect the invention provides a method for manufacturing a composite floor constituted of steel girders with lower flanges and concrete hollow-core slabs supported on the lower flanges of those girders, while using a girder assembly according to the invention, wherein at the location of the longitudinal voids in which the coupling rods are supposed to become positioned, the upper deck of the hollow-core slabs is removed, prior to placing the hollow-core slabs, or subsequent thereto, wherein after supporting the hollow-core slabs on the respective lower flange the first ends of the coupling rods are inserted into the respective longitudinal voids and at their second ends, with the coupling protrusions in the insertion position, are inserted in a horizontal direction towards the rail through the opening of the rail into the accommodation space of the rail, the coupling protrusions are moved, in particular rotated, towards the coupling position, and the coupling rods are kept in the correct position in the longitudinal voids, after which the space around the coupling rods in the longitudinal voids as well as the space between the web of the girder and the hollow-core slabs are filled with concrete.

[0025] The coupling protrusions can be rotated towards the coupling position until the coupling protrusions find rotation-stop against rail walls. The coupling protrusion can be designed double-sided, double relative to the coupling rod, with two opposite edges that find rotation-stop against opposite rail walls.

[0026] Once reaching the rotation-stop, the coupling rods can be rotated onward to be moved with the second end towards the web relative to the coupling protrusion, to stop against a rear wall of the rail or against the web, after which due to onward rotation of the coupling rod, the coupling protrusion is tensioned against the coupling wall.

[0027] According to a further aspect the invention provides a floor assembly comprising a number of concrete hollow-core slabs and an assembly of a steel girder for supporting the hollow-core slabs, and a coupling device for connecting the hollow-core slabs with that girder, in particular an assembly as described above and/or in one or more of the attached claims 1 - 11, the contents of which should be considered inserted here, wherein the girder comprises:

- at least one laterally extending lower flange having a support surface for support ends of the hollow-core slabs and
- a web extending upwards from the lower flange,

wherein the voids of the hollow-core slabs that extend in the longitudinal direction of the hollow-core slab, extend substantially transverse to the girder, wherein the space between the support ends of the hollow-core slabs and the web of the girder is filled with poured concrete,

wherein a coupling device is provided for the connection of the hollow-core slabs and the girder, which coupling device comprises:

- a number of coupling rods that are accommodated with the one, first end in the respective longitudinal voids of the hollow-core slabs, or in joints between the hollow-core slabs and are secured thereto by poured concrete, and with the other second end are secured to the girder by means of a coupling protrusion projecting transverse from the respective coupling rod,
- a coupling rail attached to the web of the girder, which rail extends substantially parallel to the lower flange, and which has a length of at least the width of a hollow-core slab,

wherein the rail defines an accommodation space for the coupling protrusions that is at least partially screened off towards the hollow-core slabs in horizontal direction by a coupling wall, and is provided with an opening continuing in longitudinal direction for access of the coupling protrusions to the accommodation space, wherein the coupling protrusions are confined in the accommodation space of the rail.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The invention will be elucidated on the basis of an exemplary embodiment shown in the attached drawings, in which:

Figure 1 shows an isometric view of an example of a girder according to the invention;

Figures 1A and 1B show a vertical and a horizontal cross-section, respectively, of the girder according to figure 1;

Figures 2A and 2B show a side view and an end view, respectively, of a coupling rod including coupling protrusion for cooperation with the girder according to figure 1;

Figures 3A-E show a vertical cross-section of an arrangement with the girder according to figure 1 and hollow-core slabs supported thereon, a top view of that arrangement, a top view after placing coupling rods, a top view after pouring concrete and a vertical cross-section after pouring concrete, respectively; and

Figures 4A and 4B show details of the coupling rail-coupling rod in the arrangement of figure 3C.

DETAILED DESCRIPTION OF THE DRAWINGS

[0029] The steel girder 1 in figure 1 comprises a bottom plate 2 forming support flanges 2a and 2b to either side, a top plate 4 and a web 3 extending in between them. The web 3 is zig-zag-shaped, in the form of a sheet-pile wall profile, having first wall sections 3a that are posi-

tioned in one individual vertical plane, and second wall sections 3b that are also positioned in one individual vertical plane. The wall sections 3a,3b are connected to each other by means of diagonal wall sections 3c. A steel coupling rail 6 is attached to the first wall sections 3a, by means of top and bottom welds 7. At the location where the rail 6 extends between consecutive first wall sections 3a (or second wall sections 3b) dowels 15 are attached to the rear wall 8 of the rail by means of welds 16 (figure 1B), which dowels extend to the other side of the girder and are provided with an anchor plate 17 at their free ends. The length of the rail 6 may for instance correspond to the width of a hollow-core slab, usually 1.2 m. Several rails 6 may follow each other shortly one after the other along the length of the girder, or there may be one continuous rail 6 along the full girder length.

[0030] As can be seen in figure 1A, each rail 6 is U-shaped with turned legs, so that a rear wall or rail bottom 8, an upper wall 9a, a bottom wall 9b, a downwardly turned upper flange 10a and an upwardly turned lower flange 10b can be distinguished. The flanges 10a and 10b define an opening 11 in between them that is continuous in longitudinal direction. An accommodation space 12 is formed within the rail 6, which space is screened off in a direction away from the web by the flanges 10,10b.

[0031] In figures 2A and 2B the coupling rod 20 is shown, having a straight rod 21 which at a second end is provided with thread 22. Onto said thread 22 a coupling plate 24 is screwed, which for that purpose is provided with a threaded through hole 25. The coupling plate 24 extends transverse from the rod 21 in two opposing directions and is elongated, having a width b that is smaller than the width of the opening 11 of the rail 6. The height h corresponds to the height of the accommodation space 12 of the rail 6. The coupling plate 24 has an upper stop edge 26a and a lower stop edge 26b. The coupling plate 24 furthermore has a stop surface 27 that faces the rod direction. The coupling plate 24 has two arms 24a,24b of unequal length. As a result the coupling plate 24 will tend to a preferred position in which the longest (and as a consequence heaviest) arm 24b is downwardly oriented.

[0032] For the manufacturing of a composite floor including girders such as the one according to figure 1 and including hollow-core slabs, the procedure as illustrated on the basis of figures 3A-E can be followed. Girders such as the one according to figure 1 may have been manufactured in a factory building long before being placed in situ. Due to the rail coupling according to the invention the exact location of the coupling rods to be placed, does not matter.

[0033] In figures 3A and 3B the girder 1 is placed in situ and, on either side of the girder 1, the hollow-core slabs 30 have already been supported with their lower decks 32 on the support flanges 2a, 2b. At the calculated locations, the hollow-core slabs 30 have been prepared for the placement of coupling rods 20 (shown in dashed

lines, as they are not present at that moment), and namely by, at the location of longitudinal voids 33, chopping the upper deck 31 away, so that longitudinal voids 33 close to the girder are accessible from the top for inserting the coupling rods 20. At one end, the opened longitudinal voids 33 have been sealed with plugs 34.

[0034] Placing the coupling rods, figure 3C, can now be done without problems as each time a coupling can be made with the rail where the longitudinal voids 33 are also situated. Reference is furthermore made to figures 4A and 4B. The workman takes a coupling rod 20 and introduces it into the longitudinal void 33, and then passes the coupling rod 20 with the coupling plate 24 in the lead in horizontal direction to near the opening 11 of the rail 6. He then holds the coupling plate 24 horizontally, in order for the width b (figure 2A) to be oriented vertically. He will then be able to pass the coupling plate 24 through the opening 11 into the accommodation space 12. The coupling plate 24 is then free to rotate under the influence of gravity, wherein the heavier arm 24b rotates downwards, until the edges 26a,b are stopped against the interior sides of the upper wall 9a and bottom wall 9b, respectively. When the workman subsequently rotates the rod 20 onwards in the direction A, the rod 21 will be rotated further into the hole 25 until the end face 23 of the rod 21 stops against the rear wall 8. By rotating the rod 21 slightly further still, the coupling plate 24 will be tensioned against the interior side of both flanges 10a and 10b. The coupling rod 21 now extends floating from the rail 6 in the elongated void 33.

[0035] Once all coupling rods 20 have been placed and attached in a similar way to the rail 6, the accommodation spaces can be filled with concrete. The longitudinal voids 33 can easily be filled from the top, and the space between the girder 1 and the hollow-core slabs 30 and within the girder 1 can be filled via the gaps between the upper deck 31 of the hollow-core slabs 30 and the upper wall 4. The composite floor with integrated girder is nearly finished then. The tensile forces on the coupling rods 20 are transferred to the rail 6 and from the rail to the web 3 and/or via the dowels 15 to the concrete.

[0036] It is noted that the cross-section of the rail can be adapted to the vertical orientation of the web, so that in case of an inclined web the opening of the rail can still have a horizontal normal.

[0037] The invention is/inventions are not at all limited to the embodiments discussed in the description and shown in the drawings. The above description is included to illustrate the operation of preferred embodiments of the invention and not to limit the scope of the invention. Starting from the above explanation many variations that fall within the scope of the appended claims are part of the invention.

Claims

1. Assembly of a steel girder (1) for a composite floor

including concrete hollow-core slabs (30), and a coupling device (20) for connecting the hollow-core slabs to the girder, wherein the girder comprises:

- at least one laterally extending lower flange (2) having a support surface for support ends of the hollow-core slabs and
- a web (3) extending upwards from the lower flange,

wherein the coupling device comprises:

- a number of coupling rods (21) which with the one, first end are intended to be accommodated in the respective longitudinal voids (33) of the hollow-core slabs and to be secured to them by poured concrete, and at the other, second end are provided with a coupling protrusion (24) projecting transverse from the respective coupling rod,
- at least one coupling rail (6a,6b) attached to the web of the girder, which rail extends substantially parallel to the lower flange, and which has a length of at least the width of a hollow-core slab,

wherein the rail defines an accommodation space (12) for the coupling protrusions (24) which is at least partially screened off towards the hollow-core slabs in horizontal direction by a coupling wall (10a,10b) and is provided with an opening (11) continuing in longitudinal direction for access of the coupling protrusions to the accommodation space, wherein the opening may have a normal towards the accommodation space that is substantially horizontally oriented,

wherein the coupling protrusions (24) in an insertion position thereof can be introduced through the opening into the accommodation space and can then be moved, in particular are rotatable, to a coupling position that is oriented so as to deviate from the insertion position in order to engage behind the coupling wall (10a,10b).

2. Assembly according to claim 1, wherein the rail (6a,6b) extends along a length of several hollow-core slab widths, wherein, preferably, the rail extends along at least almost the full girder length.
3. Assembly according to claim 1 or 2, wherein the accommodation space (12) is upwardly bounded by an upper wall (9a) and downwardly bounded by a bottom wall (9b).
4. Assembly according to any one of the claims 1-3, wherein the coupling wall comprises a pending rail

flange (10a), which upwardly bounds the opening (11), wherein in the coupling position the coupling protrusion (24) engages behind the pending rail flange and/or wherein the coupling wall comprises an upright rail flange (10b) that downwardly bounds the opening (11), wherein in the coupling position the coupling protrusion (24) engages behind the upright rail flange, wherein, preferably, the rail (6a,6b) is a U-profile of which both legs are turned towards each other with free edge zones.

5. Assembly according to any one of the claims 1-4, wherein the rail (6a,6b) is situated at a distance of approximately 1/5 to 2/5 of the height of the web (3) above the lower flange (2).
6. Assembly according to any one of the claims 1-5, wherein in a first direction, transverse to the coupling rod, the coupling protrusion (24) has a dimension that is smaller than the width of the opening (11) and in a second direction, transverse to the coupling rod and at an angle to the first direction, has a dimension that is larger than the width of the opening and preferably corresponds to the internal height of the accommodation space (12).
7. Assembly according to any one of the preceding claims, wherein under the influence of gravity the coupling protrusion (24) is shaped to tend to the coupling position.
8. Assembly according to any one of the claims 1-7, wherein the coupling protrusion (24) has a threaded hole (25) and the coupling rod (21) is provided with a threaded end (22) that can be screwed into said hole, wherein, preferably, the threaded end of the coupling rod can be screwed through the hole.
9. Assembly according to any one of the claims 1-8, wherein the girder (1) comprises two lower flanges (2a,2b) extending in opposing lateral directions so as to form a support surface for hollow-core slabs (30) on either side of the web (3), wherein on either side of the web a said rail (6a,6b) is arranged, or when there is a double web (THQ girder) a rail (6a,6b) is arranged on each web, facing away from each other.
10. Assembly according to any one of the claims 1-9, wherein the web (3) is designed like a corrugated or zig-zag-shaped wall, with on the one side first wall sections (3a) that are spaced apart from each other in girder direction and on the opposing second side second wall sections (3b) that are spaced apart from each other in girder direction, wherein, preferably, the web is designed like a wall having a trapezoidal or sheet-pile wall-shaped course, wherein a rail (6a,6b) is each time attached to the first wall sections

and/or a rail is attached to the second wall sections, wherein, preferably, the first wall sections are situated in one plane with each other and/or the second wall sections are situated in one plane with each other.

11. Assembly according to claim 10, wherein in the area between two consecutive first wall sections (3a) one or more dowels (15) are attached to the rail (6a) that is attached to the first wall sections, which dowels extend substantially in horizontal direction towards the second wall sections (3b) and/or wherein in the area between two consecutive second wall sections (3b) one or more dowels (15) are attached to the rail (6b) that is attached to the second wall sections, which dowels extend substantially in horizontal direction towards the first wall sections (3a).

12. Floor assembly comprising a number of concrete hollow-core slabs (30) and a girder (1) for supporting the hollow-core slabs, wherein the girder comprises:

- at least one laterally extending lower flange (2) having a support surface for support ends of the hollow-core slabs and
- a web (3) extending upwards from the lower flange up to above the hollow-core slabs,

wherein the voids (33) of the hollow-core slabs that extend in the longitudinal direction of the hollow-core slab, extend transverse to the girder, wherein the space between the support ends of the hollow-core slabs and the web of the girder is filled with poured concrete (41), wherein a coupling device (20) is provided for the connection of the hollow-core slabs and the girder, which coupling device comprises:

- a number of coupling rods (21) that are accommodated with the one, first end in the respective longitudinal voids of the hollow-core slabs, or in joints between the hollow-core slabs and are secured thereto by poured concrete (40), and with the other second end are secured to the girder by means of a coupling protrusion (24) projecting transverse from the respective coupling rod,
- a coupling rail (6a,6b) attached to the web of the girder, which rail extends substantially parallel to the lower flange, and which has a length of at least the width of a hollow-core slab,

wherein the rail defines an accommodation space (12) for the coupling protrusions (24) that is at least partially screened off towards the hollow-core slabs in horizontal direction by a coupling wall (10a,10b), and is provided with an opening (11) continuing in longitudinal direction for access of the coupling protrusions to the accommodation space,

wherein the coupling protrusions are confined in the accommodation space of the rail.

13. Floor assembly according to claim 12, wherein the rail (6a,6b) is situated at a level that corresponds such to the height of the longitudinal voids (33) of the hollow-core slabs that the coupling rod is able to extend freely in there.

14. Method for manufacturing a composite floor constituted of steel girders with lower flanges and concrete hollow-core slabs supported on the lower flanges of those girders, while using an assembly according to any one of the claims 1-11, wherein at the location of the longitudinal voids in which the coupling rods are supposed to become positioned, the upper deck of the hollow-core slabs is removed, prior to placing the hollow-core slabs, or subsequent thereto, wherein after supporting the hollow-core slabs on the respective lower flange the first ends of the coupling rods are inserted into the respective longitudinal voids and at their second ends, with the coupling protrusions in the insertion position, are inserted in a horizontal direction towards the rail through the opening of the rail into the accommodation space of the rail, the coupling protrusions are moved, in particular rotated, towards the coupling position, and the coupling rods are kept in the correct position in the longitudinal voids, after which the space around the coupling rods in the longitudinal voids as well as the space between the web of the girder and the hollow-core slabs are filled with concrete.

15. Method according to claim 14, wherein the coupling protrusions are rotated towards the coupling position until the coupling protrusions find rotation-stop against rail walls, wherein, preferably, the coupling rods, once reaching the rotation-stop are rotated onward to be moved with the second end towards the web relative to the coupling protrusion, to stop against a rear wall of the rail or against the web, after which due to onward rotation of the coupling rod, the coupling protrusion is tensioned against the coupling wall.

Patentansprüche

1. Zusammenbau eines Stahlträgers (1) für einen Verbundboden mit Hohlkernbetonplatten (30) und eines Kupplungsgeräts (20) zum Verbinden der Hohlkernplatten mit dem Träger, wobei der Träger umfasst:

- zumindest einen seitlich verlaufenden, unteren Flansch (2) mit einer Stützfläche zum Stützen von Enden der Hohlkernplatten, und
- einen Steg (3), der vom unteren Flansch nach

oben verläuft,

wobei das Kupplungsgerät umfasst:

- eine Anzahl von Kupplungsstangen (21), die mit dem einen, ersten Ende in den jeweiligen Längshohlräumen (33) der Hohlkernplatten oder in Stoßstellen zwischen den Hohlkernplatten untergebracht und durch Gussbeton daran befestigt werden sollen, und die am anderen, zweiten Ende mit einem Kupplungsvorsprung (24) versehen sind, der querverlaufend von der jeweiligen Kupplungsstange vorsteht,
- zumindest eine Kupplungsschiene (6a, 6b), die am Steg des Trägers angebracht ist, wobei die Schiene im Wesentlichen parallel zum unteren Flansch verläuft, und die eine Länge von zumindest der Breite einer Hohlkernplatte aufweist,

wobei die Schiene einen Unterbringungsraum (12) für die Kupplungsvorsprünge (24) definiert, der zumindest teilweise zu den Hohlkernplatten hin in horizontaler Richtung durch eine Kupplungswand (10a, 10b) abgeschirmt ist und mit einer Öffnung (11) versehen ist, die in Längsrichtung für Zugang der Kupplungsvorsprünge zum Unterbringungsraum fortläuft, wobei die Öffnung eine Normale zum Unterbringungsraum hin aufweist, die im Wesentlichen horizontal ausgerichtet ist, wobei die Kupplungsvorsprünge (24) in einer Einfügungsposition davon durch die Öffnung in den Unterbringungsraum eingeführt werden können und dann zu einer Kupplungsposition bewegt, insbesondere drehbar, werden können, die derart ausgerichtet ist, dass sie von der Einfügungsposition abweicht, um hinter der Kupplungswand (10a, 10b) in Eingriff zu treten.

2. Zusammenbau nach Anspruch 1, wobei die Schiene (6a, 6b) entlang einer Länge von mehreren Hohlkernplattenbreiten verläuft, wobei die Schiene vorzugsweise entlang zumindest nahezu der vollen Trägerlänge verläuft.
3. Zusammenbau nach Anspruch 1 oder 2, wobei der Unterbringungsraum (12) aufwärts durch eine obere Wand (9a) begrenzt ist und abwärts durch eine untere Wand (9a) begrenzt ist.
4. Zusammenbau nach einem der Ansprüche 1 bis 3, wobei die Kupplungswand einen hängenden Schienenflansch (10a) umfasst, der aufwärts die Öffnung (11) begrenzt, wobei der Kupplungsvorsprung (24) in der Kupplungsposition hinter dem hängenden Schienenflansch in Eingriff tritt, und/oder wobei die Kupplungswand einen aufrechten Schienenflansch (10b) umfasst, der abwärts die Öffnung (11) begrenzt, wobei der Kupplungsvorsprung (24) in der

Kupplungsposition hinter dem aufrechten Schienenflansch in Eingriff tritt, wobei die Schiene (6a, 6b) vorzugsweise ein U-Profil ist, dessen beide Schenkel mit freien Kanten zueinander hin gekehrt sind.

5. Zusammenbau nach einem der Ansprüche 1 bis 4, wobei die Schiene (6a, 6b) in einem Abstand von ungefähr 1/5 bis 2/5 der Höhe des Stegs (3) über dem unteren Flansch (2) angeordnet ist.
6. Zusammenbau nach einem der Ansprüche 1 bis 5, wobei, in einer ersten Richtung, quer zur Kupplungsstange verlaufend, der Kupplungsvorsprung (24) eine Abmessung aufweist, die kleiner als die Breite der Öffnung (11) ist, und in einer zweiten Richtung, quer zur Kupplungsstange verlaufend und in einem Winkel zur ersten Richtung, eine Abmessung aufweist, die größer als die Breite der Öffnung ist und vorzugsweise der inneren Höhe des Unterbringungsraums (12) entspricht.
7. Zusammenbau nach einem der vorhergehenden Ansprüche, wobei der Kupplungsvorsprung (24) unter dem Einfluss der Schwerkraft zum Neigen zur Kupplungsposition geformt ist.
8. Zusammenbau nach einem der Ansprüche 1 bis 7, wobei der Kupplungsvorsprung (24) ein Gewinde Loch (25) aufweist und die Kupplungsstange (21) mit einem Gewindeende (22) versehen ist, das in das Loch eingeschraubt werden kann, wobei das Gewindeende der Kupplungsstange vorzugsweise durch das Loch geschraubt werden kann.
9. Zusammenbau nach einem der Ansprüche 1 bis 8, wobei der Träger (1) zwei untere Flansche (2a, 2b) umfasst, die in entgegengesetzten Seitenrichtungen verlaufen, um eine Stützfläche für Hohlkernplatten (30) auf beiden Seiten des Stegs (3) auszubilden, wobei auf beiden Seiten des Stegs eine Schiene (6a, 6b) angeordnet ist, oder, wenn ein Doppelsteg (THQ-Träger) vorliegt, eine Schiene (6a, 6b) auf jedem Steg angeordnet ist, die voneinander abgewandt sind.
10. Zusammenbau nach einem der Ansprüche 1 bis 9, wobei der Steg (3) wie eine gewellte oder zickzackförmige Wand gestaltet ist, mit ersten Wandsektionen (3a) auf der einen Seite, die in Trägerrichtung zueinander beabstandet sind, und zweiten Wandsektionen (3b) auf der gegenüberliegenden zweiten Seite, die in Trägerrichtung zueinander beabstandet sind, wobei der Steg vorzugsweise wie eine Wand mit einem trapezförmigem oder spundwandförmigem Verlauf gestaltet ist, wobei eine Schiene (6a, 6b) jedes Mal an den ersten Wandsektionen angebracht ist und/oder eine Schiene an den zweiten

Wandsektionen angebracht ist, wobei vorzugsweise die ersten Wandsektionen in einer Ebene miteinander angeordnet sind und/oder die zweiten Wandsektionen in einer Ebene miteinander angeordnet sind.

11. Zusammenbau nach Anspruch 10, wobei im Bereich zwischen zwei aufeinanderfolgenden ersten Wandsektionen (3a) ein oder mehr Dübel (15) an der Schiene (6a) angebracht sind, die an den ersten Wandsektionen angebracht ist, wobei die Dübel im Wesentlichen in horizontaler Richtung zu den zweiten Wandsektionen (3b) hin verlaufen, und/oder wobei im Bereich zwischen zwei aufeinanderfolgenden zweiten Wandsektionen (3b) ein oder mehr Dübel (15) an der Schiene (6b) angebracht sind, die an den zweiten Wandsektionen angebracht ist, wobei die Dübel im Wesentlichen in horizontaler Richtung zu den ersten Wandsektionen (3a) hin verlaufen.

12. Bodenzusammenbau für einen Zusammenbau eines Stahlträgers nach Anspruch 1 bis 11, wobei der Bodenzusammenbau eine Anzahl von Hohlkernbetonplatten (30) und einen Träger (1) zum Stützen der Hohlkernplatten umfasst, wobei der Träger umfasst:

- zumindest einen seitlich verlaufenden, unteren Flansch (2) mit einer Stützfläche zum Stützen von Enden der Hohlkernplatten, und
- einen Steg (3), der vom unteren Flansch nach oben bis über die Hohlkernplatten verläuft,

wobei die Hohlräume (33) der Hohlkernplatten, die in der Längsrichtung der Hohlkernplatten verlaufen, quer zum Träger verlaufen, wobei der Raum zwischen den Stützenden der Hohlkernplatten und dem Steg des Trägers mit Gussbeton (41) gefüllt ist, wobei ein Kupplungsgerät (20) zur Verbindung der Hohlkernplatten und des Trägers vorgesehen ist, wobei das Kupplungsgerät umfasst:

- eine Anzahl von Kupplungsstangen (21), die mit dem einen, ersten Ende in den jeweiligen Längshohlräumen der Hohlkernplatten oder in Stoßstellen zwischen den Hohlkernplatten untergebracht und durch Gussbeton (40) daran befestigt sind, und mit dem anderen, zweiten Ende am Träger mittels eines Kupplungsvorsprungs (24) befestigt sind, der querverlaufend von der jeweiligen Kupplungsstange vorsteht,
- eine Kupplungsschiene (6a, 6b), die am Steg des Trägers angebracht ist, wobei die Schiene im Wesentlichen parallel zum unteren Flansch verläuft, und die eine Länge von zumindest der Breite einer Hohlkernplatte aufweist,

wobei die Schiene einen Unterbringungsraum (12) für die Kupplungsvorsprünge (24) definiert, der zu-

mindest teilweise zu den Hohlkernplatten hin in horizontaler Richtung durch eine Kupplungswand (10a, 10b) abgeschirmt ist und mit einer Öffnung (11) versehen ist, die in Längsrichtung für Zugang der Kupplungsvorsprünge zum Unterbringungsraum fortläuft, wobei die Kupplungsvorsprünge im Unterbringungsraum der Schiene eingeschlossen sind.

13. Bodenzusammenbau nach Anspruch 12, wobei die Schiene (6a, 6b) auf einem Niveau angeordnet sind, das der Höhe der Längshohlräume (33) der Hohlkernplatten derart entspricht, dass die Kupplungsstange imstande ist, frei dort zu verlaufen.

14. Verfahren zum Herstellen eines Verbundbodens, der aus Stahlträgern mit unteren Flanschen und Hohlkernbetonplatten gebildet ist, welche auf den unteren Flanschen dieser Träger gestützt sind, unter Benutzung eines Zusammenbaus nach einem der Ansprüche 1 bis 11, wobei an der Stelle der Längshohlräume, in denen die Kupplungsstangen positioniert werden sollen, das obere Deck der Hohlkernplatten entfernt wird, vor dem Anordnen der Hohlkernplatten oder im Anschluss daran, wobei, nach dem Stützen der Hohlkernplatten auf dem jeweiligen unteren Flansch, die ersten Enden der Kupplungsstangen in die jeweiligen Längshohlräume eingefügt werden und an ihren zweiten Enden, mit den Kupplungsvorsprüngen in der Einfügungsposition, in einer horizontalen Richtung zur Schiene hin durch die Öffnung der Schiene in den Unterbringungsraum der Schiene eingefügt werden, wobei die Kupplungsvorsprünge zur Kupplungsposition hin bewegt, insbesondere gedreht, werden und die Kupplungsstangen in der korrekten Position in den Längshohlräumen gehalten werden, wonach der Raum um die Kupplungsstangen in den Längshohlräumen sowie der Raum zwischen dem Steg des Trägers und den Hohlkernplatten mit Beton gefüllt wird.

15. Verfahren nach Anspruch 14, wobei die Kupplungsvorsprünge zur Kupplungsposition hin gedreht werden, bis die Kupplungsvorsprünge Drehanschlag an den Schienenwänden erreichen, wobei die Kupplungsstangen vorzugsweise, sobald sie den Drehanschlag erreichen, weiter gedreht werden, um mit dem zweiten Ende weiter zum Steg hin bezüglich des Kupplungsvorsprungs bewegt zu werden, zum Anschlagen an einer Rückwand der Schiene oder am Steg, wonach aufgrund der Weiterdrehung der Kupplungsstange der Kupplungsvorsprung an der Kupplungswand gespannt wird.

Revendications

1. Ensemble de poutre en acier (1) pour un plancher

composite comprenant des dalles à noyau creux en béton (30), et un dispositif de couplage (20) pour connecter les dalles à noyau creux à la poutre, dans lequel la poutre comprend:

- au moins une semelle inférieure s'étendant latéralement (2) qui présente une surface de support pour supporter les extrémités des dalles à noyau creux, et
- une âme (3) qui s'étend vers le haut à partir de la semelle inférieure,

dans lequel le dispositif de couplage comprend:

- un certain nombre de tiges de couplage (21) qui avec ladite une première extrémité sont destinées à être reçues à l'intérieur des vides longitudinaux respectifs (33) des dalles à noyau creux ou à l'intérieur des joints entre les dalles à noyau creux et à être fixées à celles-ci en utilisant du béton coulé, et qui au niveau de l'autre, seconde extrémité sont pourvues d'une saillie de couplage (24) qui se projette transversalement à partir de la tige de couplage respective,
- au moins un rail de couplage (6a, 6b) qui est attaché à l'âme de la poutre, ledit rail s'étendant sensiblement parallèlement à la semelle inférieure, et présentant une longueur qui est égale à au moins la largeur d'une dalle à noyau creux,

dans lequel le rail définit un espace de réception (12) pour les saillies de couplage (24) qui est au moins partiellement cloisonné en direction des dalles à noyau creux dans une direction horizontale par une paroi de couplage (10a, 10b) et qui est pourvu d'une ouverture (11) qui continue dans une direction longitudinale dans le but d'offrir aux saillies de couplage un accès à l'espace de réception, dans lequel l'ouverture présente une normale en direction de l'espace de réception qui est orientée sensiblement horizontalement,

dans lequel les saillies de couplage (24) dans une position d'insertion de celles-ci peuvent être introduites à travers l'ouverture dans l'espace de réception et peuvent ensuite être déplacées, en particulier peuvent être tournées, jusque dans une position de couplage qui est orientée de telle manière qu'elles soient déviées à partir de la position d'insertion dans le but de s'engager derrière la paroi de couplage (10a, 10b).

2. Ensemble selon la revendication 1, dans lequel le rail (6a, 6b) s'étend le long d'une longueur de plusieurs largeurs de dalle à noyau creux, dans lequel, de préférence, le rail s'étend le long d'au moins pratiquement la totalité de la longueur de la poutre.
3. Ensemble selon la revendication 1 ou 2, dans lequel

l'espace de réception (12) est délimité vers le haut par une paroi supérieure (9a) et est délimité vers le bas par une paroi inférieure (9b).

4. Ensemble selon l'une quelconque des revendications 1 à 3, dans lequel la paroi de couplage comprend un patin de rail pendant (10a), qui délimite l'ouverture (11) vers le haut, dans lequel, dans la position de couplage, la saillie de couplage (24) s'engage derrière le patin de rail pendant, et/ou dans lequel la paroi de couplage comprend un patin de rail montant (10b) qui délimite l'ouverture (11) vers le bas, dans lequel, dans la position de couplage, la saillie de couplage (24) s'engage derrière le patin de rail montant, dans lequel, de préférence, le rail (6a, 6b) est un profilé en U dont les deux branches sont tournées l'une vers l'autre avec des zones de bord libres.
5. Ensemble selon l'une quelconque des revendications 1 à 4, dans lequel le rail (6a, 6b) est situé à une distance qui est égale à approximativement de 1/5 à 2/5 de la hauteur de l'âme (3) au-dessus de la semelle inférieure (2).
6. Ensemble selon l'une quelconque des revendications 1 à 5, dans lequel, dans une première direction, qui est transversale à la tige de couplage, la saillie de couplage (24) présente une dimension qui est plus petite que la largeur de l'ouverture (11) et, dans une seconde direction, qui est transversale à la tige de couplage et qui présente un certain angle par rapport à la première direction, présente une dimension qui est plus grande que la largeur de l'ouverture et qui correspond de préférence à la hauteur interne de l'espace de réception (12).
7. Ensemble selon l'une quelconque des revendications précédentes, dans lequel, sous l'influence de la gravité, la saillie de couplage (24) est configurée de manière à tendre vers la position de couplage.
8. Ensemble selon l'une quelconque des revendications 1 à 7, dans lequel la saillie de couplage (24) comporte un trou fileté (25) et la tige de couplage (21) est pourvue d'une extrémité filetée (22) qui peut être vissée dans ledit trou, dans lequel, de préférence, l'extrémité filetée de la tige de couplage peut être vissée à travers le trou.
9. Ensemble selon l'une quelconque des revendications 1 à 8, dans lequel la poutre (1) comprend deux semelles inférieures (2a, 2b) qui s'étendent dans des directions latérales opposées de manière à former une surface de support pour les dalles à noyau creux (30) de part et d'autre de l'âme (3), dans lequel sur chacun des deux côtés de l'âme un rail (6a, 6b) de ce type est agencé ou, lorsque l'âme est une âme

double (poutre THQ), un rail (6a, 6b) est agencé sur chaque âme, en se tournant le dos mutuellement.

10. Ensemble selon l'une quelconque des revendications 1 à 9, dans lequel l'âme (3) est conçue sous la forme d'une paroi de forme ondulée ou en zigzag, avec sur le premier côté des premières sections de paroi (3a) qui sont espacées les unes des autres dans la direction de la poutre, et sur le second côté opposé des secondes sections de paroi (3b) qui sont espacées les unes des autres dans la direction de la poutre, dans lequel, de préférence, l'âme est conçue sous la forme d'une paroi qui présente une étendue de forme trapézoïdale ou en forme de rideau de palplanches, dans lequel un rail (6a, 6b) est chaque fois attaché aux premières sections de paroi, et/ou un rail est attaché aux secondes sections de paroi, dans lequel, de préférence, les premières sections de paroi sont situées dans un plan les unes avec les autres et/ou les secondes sections de paroi sont situées dans un plan les unes avec les autres.

11. Ensemble selon la revendication 10, dans lequel, dans la région qui est située entre deux premières sections de paroi consécutives (3a), une ou plusieurs cheville(s) (15) est (sont) attachée(s) au rail (6a) qui est attaché aux premières sections de paroi, lesdites chevilles s'étendant sensiblement dans une direction horizontale en direction des secondes sections de paroi (3b), et/ou dans lequel, dans la région entre deux secondes sections de paroi consécutives (3b), une ou plusieurs cheville(s) (15) est (sont) attachée(s) au rail (6b) qui est attaché aux secondes sections de paroi, lesdites chevilles s'étendant sensiblement dans une direction horizontale en direction des premières sections de paroi (3a).

12. Ensemble de plancher pour un ensemble de poutre en acier selon les revendications 1 à 11, l'ensemble de plancher comprenant un certain nombre de dalles à noyau creux en béton (30) et une poutre (1) pour supporter les dalles à noyau creux, dans lequel la poutre comprend:

- au moins une semelle inférieure s'étendant latéralement (2) qui présente une surface de support pour supporter les extrémités des dalles à noyau creux, et
- une âme (3) qui s'étend vers le haut à partir de la semelle inférieure jusqu'au-dessus des dalles à noyau creux,

dans lequel les vides (33) des dalles à noyau creux qui s'étendent dans la direction longitudinale de la dalle à noyau creux s'étendent transversalement à la poutre,

dans lequel l'espace entre les support extrémité des dalles à noyau creux et l'âme de la poutre est rempli

avec du béton coulé (41),

dans lequel un dispositif de couplage (20) est prévu pour réaliser la connexion entre les dalles à noyau creux et la poutre, ledit dispositif de couplage comprenant:

- un certain nombre de tiges de couplage (21) qui sont reçues avec ladite une première extrémité à l'intérieur des vides longitudinaux respectifs des dalles à noyau creux, ou à l'intérieur des joints entre les dalles à noyau creux, et qui sont fixées à celles-ci en utilisant du béton coulé (40), et qui avec l'autre seconde extrémité sont fixées à la poutre par l'intermédiaire d'une saillie de couplage (24) qui se projette transversalement à partir de la tige de couplage respective,
- un rail de couplage (6a, 6b) qui est attaché à l'âme de la poutre, ledit rail s'étendant sensiblement parallèlement à la semelle inférieure, et présentant une longueur qui est égale à au moins la largeur d'une dalle à noyau creux,

dans lequel le rail définit un espace de réception (12) pour les saillies de couplage (24) qui est au moins partiellement cloisonné en direction des dalles à noyau creux dans une direction horizontale par une paroi de couplage (10a, 10b), et qui est pourvu d'une ouverture (11) qui continue dans une direction longitudinale dans le but d'offrir aux saillies de couplage un accès à l'espace de réception, dans lequel les saillies de couplage sont confinées à l'intérieur de l'espace de réception du rail.

13. Ensemble de plancher selon la revendication 12, dans lequel le rail (6a, 6b) est situé à un niveau qui correspond à la hauteur des vides longitudinaux (33) des dalles à noyau creux de telle sorte que la tige de couplage soit capable de s'étendre librement à l'intérieur de ceux-ci.

14. Procédé de fabrication d'un plancher composite constitué de poutres en acier pourvues de semelles inférieures et de dalles à noyau creux en béton supportées sur les semelles inférieures de ces poutres, en utilisant un ensemble selon l'une quelconque des revendications 1 à 11, dans lequel, à l'endroit des vides longitudinaux à l'intérieur desquels les tiges de couplage sont supposées aller se positionner, le tablier supérieur des dalles à noyau creux est enlevé, avant la mise en place des dalles à noyau creux, ou après cette opération,

dans lequel, après le support des dalles à noyau creux sur leur semelle inférieure respective, les premières extrémités des tiges de couplage sont insérées à l'intérieur des vides longitudinaux respectifs et, au niveau de leurs secondes extrémités, avec les saillies de couplage dans la position d'insertion, sont insérées dans une direction horizontale en direction

du rail à travers l'ouverture du rail dans l'espace de réception du rail, les saillies de couplage sont déplacées, en particulier tournées, en direction de la position de couplage, et les tiges de couplage sont maintenues dans la position correcte à l'intérieur des vides longitudinaux, à la suite de quoi l'espace autour des tiges de couplage à l'intérieur des vides longitudinaux ainsi que l'espace entre l'âme de la poutre et les dalles à noyau creux sont remplis avec du béton.

15. Procédé selon la revendication 14, dans lequel les saillies de couplage sont tournées en direction de la position de couplage jusqu'à ce que les saillies de couplage parviennent à un arrêt de rotation contre les parois de rail, dans lequel, de préférence, une fois l'arrêt de rotation atteint, les tiges de couplage sont tournées en avant de manière à être déplacées avec la seconde extrémité en direction de l'âme par rapport à la saillie de couplage, dans le but de s'arrêter contre une paroi arrière du rail ou contre l'âme, à la suite de quoi, en raison de la rotation en avant de la tige de couplage, la saillie de couplage est serrée contre la paroi de couplage.

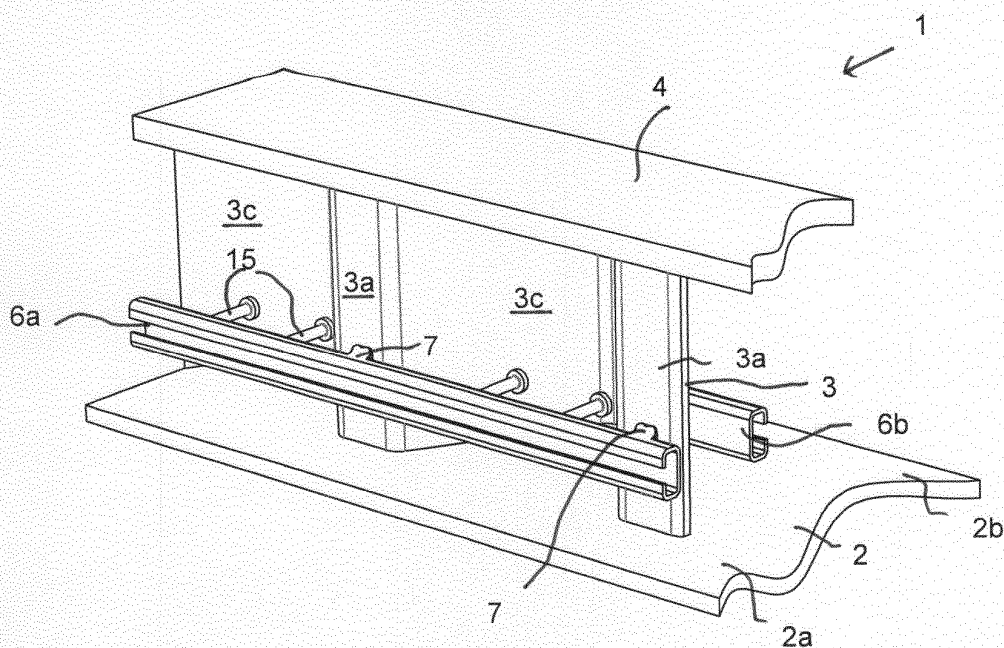


Fig. 1

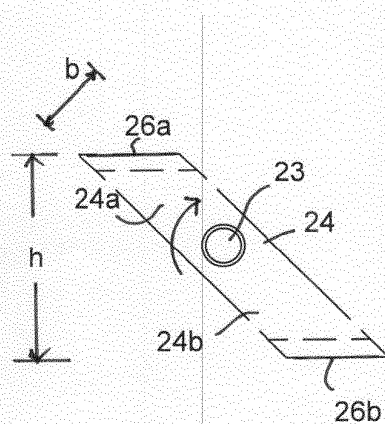


Fig. 2A

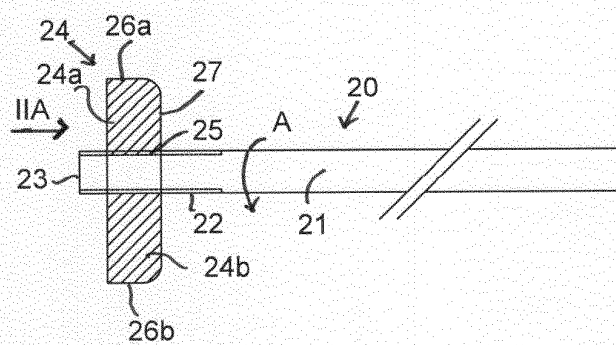


Fig. 2B

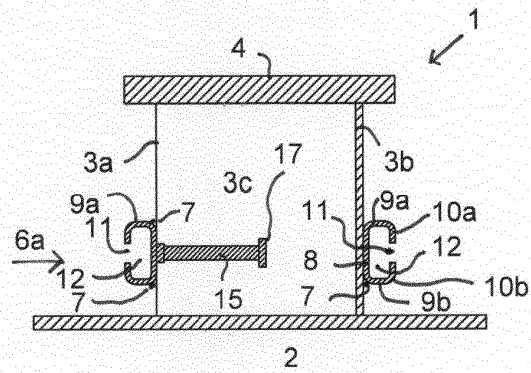


Fig. 1A

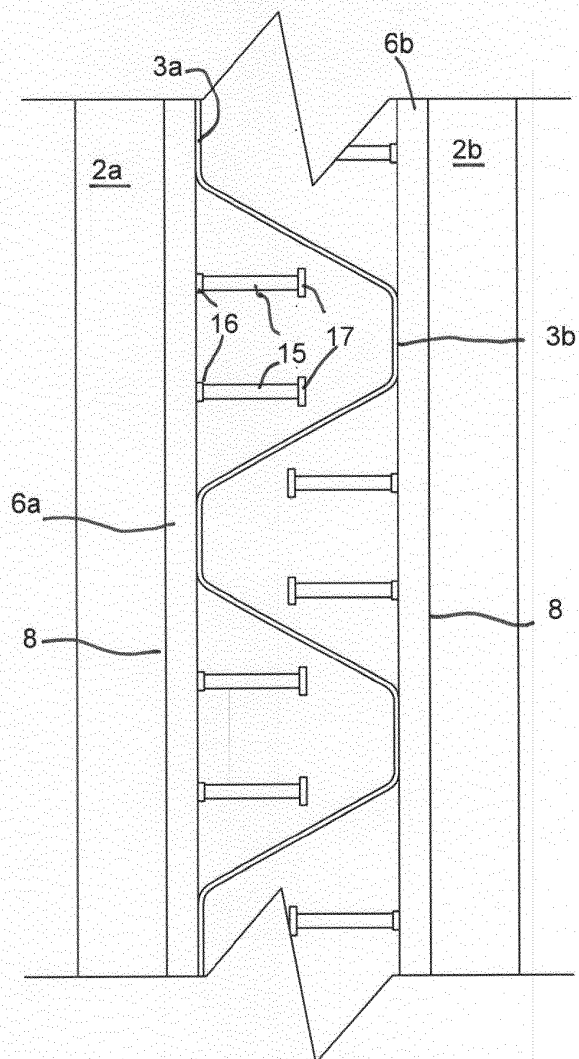


Fig. 1B

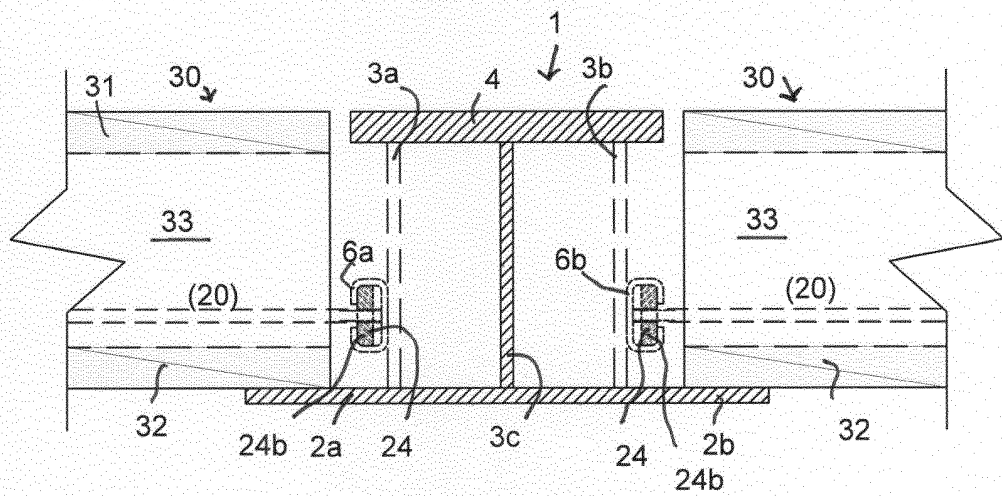


Fig. 3A

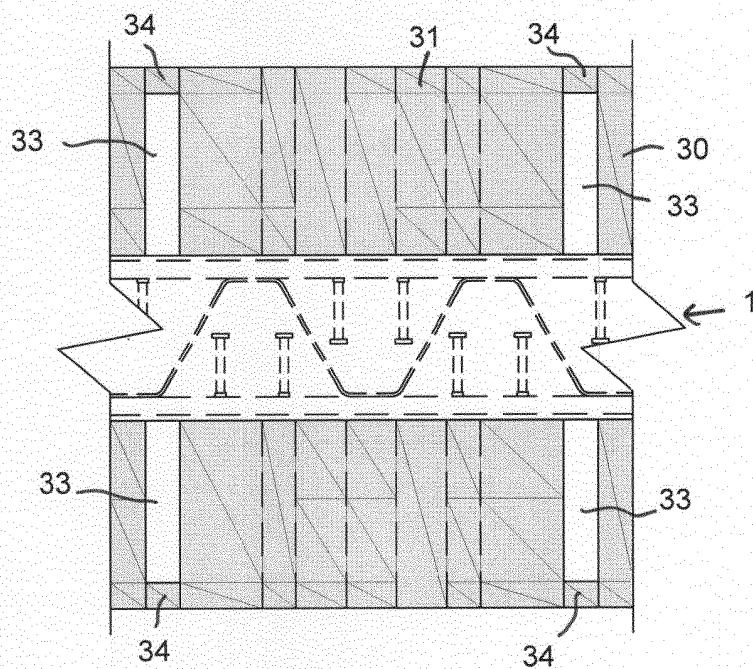


Fig. 3B

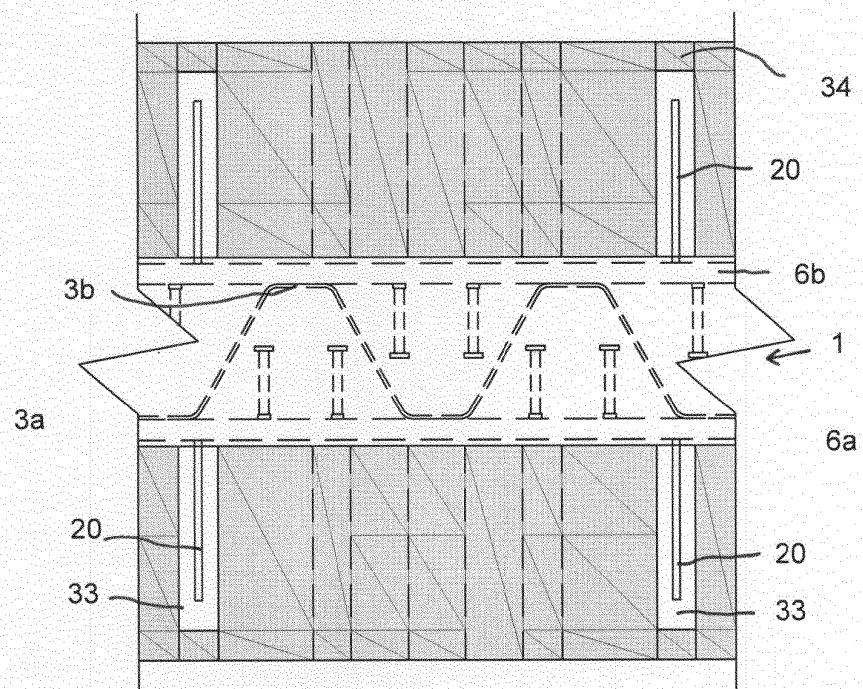


Fig. 3C

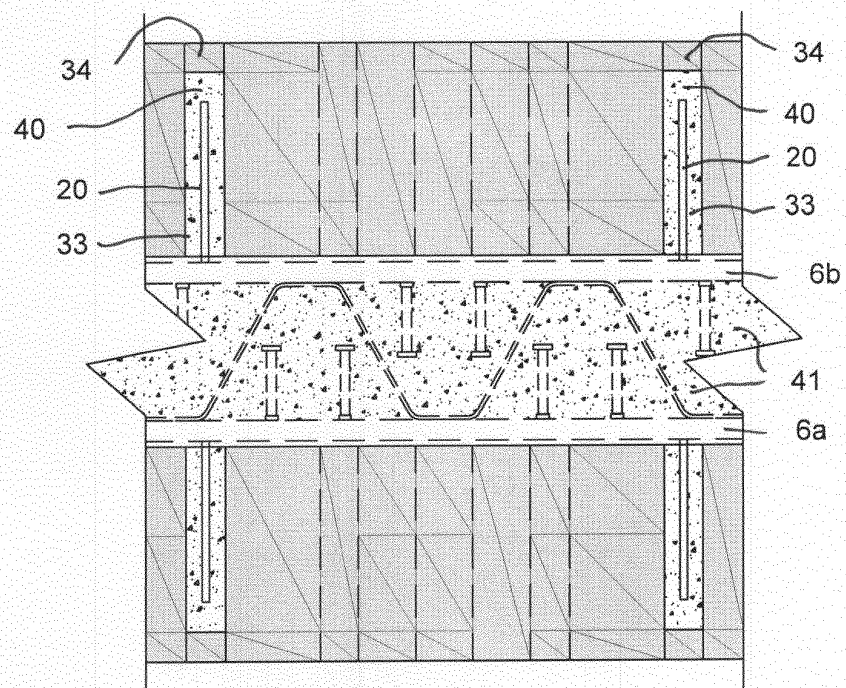


Fig. 3D

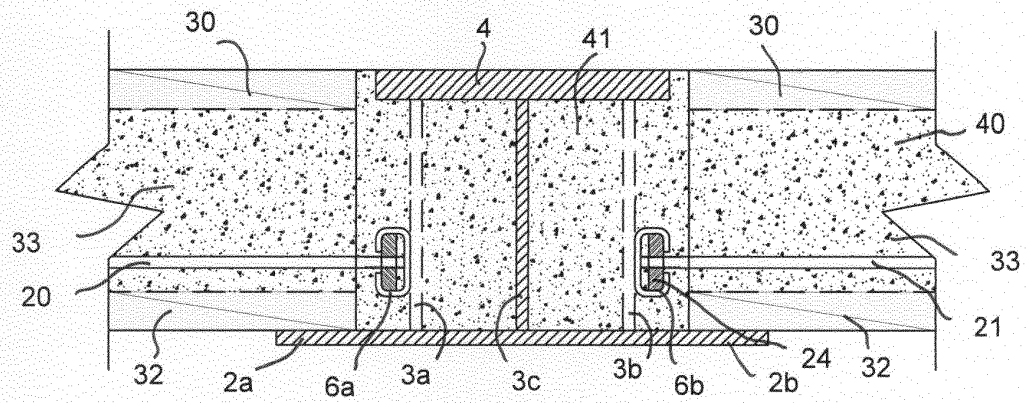


Fig. 3E

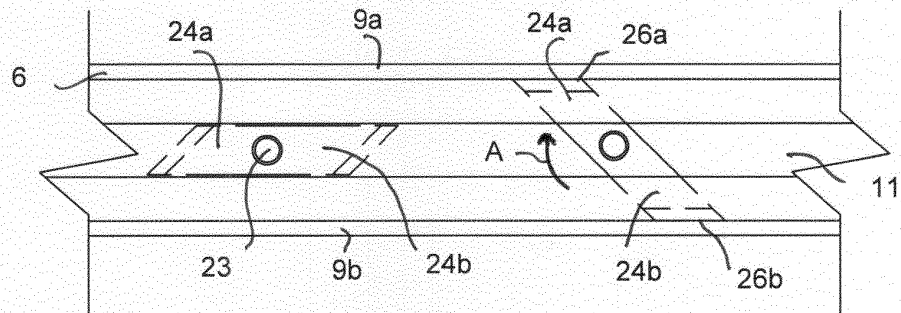


Fig. 4A

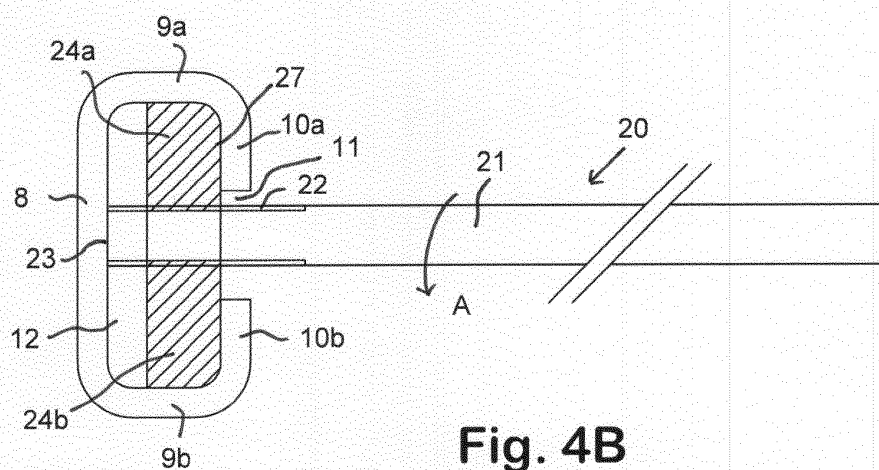


Fig. 4B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2405070 A [0005]