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(54) **On-site mixed flat composite girder structure for unidirectional flat concrete flooring construction**

Flache Verbundträgerstruktur hergestellt auf der Baustelle für unidirektionalen Flachdecken aus Beton

Structure de poutre mixte plane réalisée sur chantier pour la construction de dalles plates unidirectionnelles en béton

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(73) Proprietor: **Mimenza Larracoechea, Ramon**
48960 Galdacano (Vizcaya) (ES)

(72) Inventor: **Mimenza Larracoechea, Ramon**
48960 Galdacano (Vizcaya) (ES)

(74) Representative: **Elosegui de la Pena, Inigo**
ROEB & Co.S.L.,
129, Paseo de la Castellana
28046 Madrid (ES)

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Description

OBJECT OF THE INVENTION

[0001] This invention refers to a mixed structure flat composite girder formed (i.e. concrete laid) on-site, the use of which, is an improvement in unidirectional flat concrete flooring construction using special structures, optionally based on a "T" metal profile combined with a series of oblique connectors attached both to said metal profile and to a round rod acting as a hanger, further including round reinforcement rods and a corresponding mass of concrete also deposited on-site for obtaining the flat composite girder as the base for constructing the unidirectional flat concrete slab, a series of semi-resistant joists, between which the corresponding hollow bricks are positioned, likewise cooperating in the construction.

[0002] The system for constructing flat unidirectional concrete slabs using said flat composite girders means reduced reinforcement and concrete volumes and strength element weights which is nonetheless provided with an appropriate safety and resistance level in regard to bending moment and maximum tangent and grade line shear strength, as foreseen along the length of the corresponding bay with variable inertias.

BACKGROUND OF THE INVENTION

[0003] The execution of the flat reinforced concrete slabs comprising mixed structures, i.e. flat reinforced concrete and unidirectional semi-resistant joists, according to EH-91 and EF-88 requirements, is based on the fact that the concrete girders are formed with corrugated rods wherein the girder's variable width and height correspond to that of the concrete slab edge, the structure being embedded in the slab which constitutes the girder.

[0004] Thus, the fact that the girders and joists are the same height as the concrete slab edge creates complexities in the configuration of the structure which result in an extremely bad function thereof, the solution of which is great concern both to building engineers and to the Standards Commission.

[0005] At present, flat reinforced concrete girders are normally very wide, depending on the structural diversity involving lengths and loads, with widths generally in the order of 50, 60 or 70 cm, and even 1 m or more, resulting in eccentricities between the girder and the corresponding pillars and between the ends of the joist headers and the pillars, through the girder, and countless other complex circumstances which give rise to deformations, particularly in view that calculations are normally performed individually on the girders, on the one hand, and on the concrete semi-resistant joists, on the other, resulting in possible risk of local failure in specific circumstances involving complex structures.

[0006] The document GB L 09026 A , from 1912, represents a traditionally suspended concrete slab and girder structure, not applicable to flat girders, which date from approximately 1970.

DESCRIPTION OF THE INVENTION

[0007] More specifically, the invention's improvements are based on the fact that the flat unidirectional concrete slab is obtained from mixed flat girders produced on-site, which, combined with the unidirectional semi-resistant joists and nerves, provide a technical solution to the problems involving a degree of unsafety and local failure, and also to performance, economy and increased personnel safety features, in addition to other advantages which will be discussed further on in the present description.

[0008] The structure of the flat mixed girders obtained on-site involves a "T" metal profile and a series of connectors and electrically welded corrugated round rods, plus, naturally, the corresponding concrete mass deposited on-site.

[0009] The "T" metal profile is placed in its inverted position, namely with the stem vertically upwards and the wings or horizontal portions at the bottom, in such a manner that on the stem's upper portion or edge, the corrugated round rod connectors are welded at a 45° slant in respect to the horizontal, said connectors being in turn welded at the other end thereof to a corrugated round rod laid along the entire length of the girder, said round rod forming a so-called "hanger".

[0010] In the event that the "T" metal profile is incapable of absorbing the full positive bending moment, a series of reinforcements are foreseen composed of one or two round rods, preferably corrugated, mounted over the horizontal wings of the "T" profile, adjacent the stem, said round rods being electrically welded to both the wing and the stem, their section and length being calculated according to requirements in each case.

[0011] The girders thus obtained are supportingly embedded to a hyperstatic degree in the corresponding reinforced concrete pillars - which can optionally be metal or mixed pillars - fitted at their upper end with round rods, preferably corrugated, which prevent the occurrence of cracks or fissures in the pillar's upper supporting part as a result of the girders being embedded in said pillars, thereby producing a negative bending moment, the girder's section and length being calculated according to requirements in each case, and being provided with continuity.

[0012] In the event that the structure which constitutes the "T" profile and the width of the on-site mixed flat girder stem are incapable of absorbing the full negative bending moment, a widening of the girder stem concrete is called for to form a solid concrete abacus having a width and length calculated according to requirements in each case.

[0013] The purpose of the structure's configuration is to provide a reinforced concrete concentration in one

single tension rod connected to the concrete head by means of round corrugated rods welded to the stem of the tension rod.

[0014] Furthermore, it is noteworthy that the stem section of the mixed flat girder thus obtained is made of gravel concrete throughout the corresponding width, and the flooring semi-resistant joist headers are solidified with concrete in a manner that the mixed metal structure is located between said joist headers in order to cover said area with a corresponding concrete compression layer, thus obtaining a monolithic structure.

[0015] The on-site building of the mixed flat girder is implemented by using the necessary planking for receiving the semi-resistant joist end headers and with the removal of the first hollow bricks at both sides of the concrete slab to achieve the required solidification of said girder ends, the structure of the mixed girder being arranged in the gap between both joist headers. The concrete compression layer is applied in order to achieve the reinforced concrete in the remainder of the slab, thus providing on-site the main element of the mixed flat girder.

[0016] The girder thus formed preferably has a width of 25 cm, so that, bearing in mind that the minimum dimension of the pillar is also 25 cm, both widths will coincide, free of eccentricities, in view that the mixed girder structure lies within the central third of the pillar, thereby providing for great structural safety.

[0017] The construction system based on the above improvements provides a series of advantages, of which the following stand out as the most important:

- Elimination of the concrete normally used for obtaining reinforced concrete girders, resulting in more economical and faster execution.
- Elimination of the planking normally used for the reinforced concrete girder, also resulting in a more economical and faster execution.
- Reduced girder weight, with the consequent cost effectiveness.
- The safety of personnel and workers, who are able to walk on the planking in the course of executing their work or assembling the concrete slab while distributing the semi-resistant joists and installing the hollow bricks on said joists for the subsequent placement of the structure, thus providing the operator with more comfortable and safer working conditions which in turn result in more economical and faster execution of the work.
- Various solutions may be adapted to downspout passages, ventilation ducts, etc., and for lodging the flat mixed girder structures to the side of the pillar, its width being established by a 12 cm half-staff closure to provide for new utilities and cost saving.
- Comfortable and rapid construction and work site installation of the mixed flat girder structure, which is considerably less expensive than currently used reinforced concrete girders.

DESCRIPTION OF THE DRAWINGS

[0018] In order to complement the description being provided and help toward a better understanding of the characteristics of the invention, a set of drawings is attached to this specification, being an integral part thereof, wherein the following is represented within an illustrative, non-limiting character:

Figure 1 shows a side elevation view of the metal structure wherefrom the flat mixed girder is obtained on-site.

Figure 2 shows a larger scale detail in a side elevation view of one of the elements comprising the metal structure connectors shown in the previous figure.

Figure 3 shows a general perspective view of the various components in their assembly position designed to obtain a flat unidirectional concrete slab based on the formation of on-site mixed flat girders.

Figure 4 shows a cross section of the central zone corresponding to the mixed flat girder according to the object of the invention.

Figure 5 shows a cross section of the zone corresponding to the ends of the mixed flat girder also performed according to the object of the invention.

Finally, Figure 6 shows a plan view of a detail corresponding to the reinforced concrete abacus over the supporting pillars, all of which is part of the mixed flat girder performed according to the object of the invention.

PREFERRED EMBODIMENT OF THE INVENTION

[0019] As can be seen from the above figures, and with specific reference to Figure 1, the metal structure of the mixed flat girder which forms part of the object of the invention includes a "T" metal profile (1), although this can also be a double "T" profile, placed in an inverted position wherein the stem (2) is positioned vertically upwards while the wings (3) are arranged horizontally along the bottom. Onto the upper edge of the stem (2) of said profile (1) is welded a series of attachment elements or so-called connectors (4) presenting an extension (5) at an end thereof which determines a foot secured by welding (6) to the upper edge of the stem (2) of profile (1), the upper end also being attached by welding (6) to a round, preferably corrugated rod which forms a hanger (7), said hanger being positioned horizontally along an upper plane.

[0020] Furthermore, Figure 1 shows that the structure also includes a round strengthening rod (8) positioned over the horizontal wing (3) of profile (1), secured by electric welding both to the wing (3) and the stem (2), thereby forming a single mixed structure composite element.

[0021] The connectors (4) are arranged in a slanting position, forming a 45° angle with the horizontal.

[0022] Doubtless, this main basic structure for obtaining a mixed flat girder may allow for other ways of embodiment, such as that wherein the connectors (4) are attached at one end to a lower corrugated round rod, while the other (upper) end is attached to another round rod which forms the hanger itself, or else the connectors (4) may be attached by their lower end to partially overlapping lower corrugated round rods, thus enabling their welding along said overlapping zone, i.e. the basic profile (1) being removed in this case, as the structure is implemented in versions having a lower strength capability.

[0023] Thus, the structure built according to Figure 1 is arranged to lean on its ends over corresponding pillars (9), being embedded therein, which pillars support the planking (10) with widened zones (10') adjacent the pillars (9), said planking being duly propped-up to further support the unidirectional semi-resistant joists (11) of a conventional or other shape or profile, Figure 3 specifically showing three types of joist (11) profiles which are complemented with corresponding strengthening structures to overcome negative bending moments (16).

[0024] Over the planking (10) are placed the semi-resistant joists (11), over which are in turn placed the hollow bricks (14), provided with voids and open on the sides save those installed collateral to the main structure, which are closed on one side.

[0025] In any case, both the semi-resistant joists (11) and the corresponding end hollow brick (14) are spaced from said structure for the purposes discussed hereunder.

[0026] The pillars (9) are fitted with corresponding structures (15) based on corrugated rods, the joists (11) also being provided with corrugated round bars or rods (16) by way of strengthening elements.

[0027] Figure 4 shows a cross section of the central zone of the mixed flat girder obtained on-site, revealing the inverted "T" metal profile (1), the connectors (4), the hollow bricks (14), the semi-resistant joists (11) and the girder stem formed by concrete (17) which also forms the compression layer (18) with the structure (16) based on corrugated round bars located in the upper part to overcome negative bending moments in the concrete slab and the supports of the joists (11) on the girder planking (10) which forms the reinforced concrete (17), said Figure 4 also showing the formation of reinforced concrete transversal nerves (20) with corrugated round rods (21) positioned in the upper, lower and intermediate or buttressing part.

[0028] Figure 5 shows a cross section of the end zone of the mixed flat girder which leans on the pillars, and also shows the widening of the solidified concrete designed to form the corresponding abacus (22) structured with corrugated round rods (23) positioned in the upper part of said abacus (22), close to the girder's (17) negative bending moment influence zone.

[0029] Figure 6 shows a detail of the reinforced concrete abacus (22) on the supporting pillars (9).

[0030] According to the characteristics described, the assembly and construction of the concrete slab is conducted as follows:

[0031] The ends of the metal structure obtained from profile (1) are anchored to the pillars (9) in the form of embedded knot supports having a specific hyperstatic degree and being provided with an adequate abacus (22) structured with the corrugated round rods (23) placed on the upper part of the abacus (22) and in the concrete compression layer (18), which allows for continuity of the girders (17) through the stem in a manner that said corrugated round rods (23) are positioned in the abacus (22) itself adjacent the compression layer (18) and within the area of influence of the girder's (17) negative bending moments.

[0032] Over the pillars (9), the propped-up and counter-attached planking (10) and (10') is arranged to receive the support of the semi-resistant joists (11), allowing for an approximate 11 to 15 cm gap between the joist header ends, leaving a gap between the end hollow bricks (14) and gaging said joists with the hollow bricks so that the separation from the end hollow bricks (14) is at least 25 cm, thereby to form the concrete stem (17) or so-called mixed flat composite girder.

[0033] The transversal nerve wooden planking is further arranged with a conveniently propped-up 15 cm plank to form the transversal nerve (20), allowing a minimum 10 cm separation from the first or end hollow bricks (14), and is subsequently covered with the remaining hollow bricks. The whole assembly is thus ready for installing the structures, first the one based on the "T" profile (1), positioned in the gap between the joist (11) header ends and, naturally, in the gap established by the first or end bricks (14), subsequently arranging the structures (21) of the transversal nerve (20) and the corrugated round rod (16) structure for the joist (11) recesses, leaving the ends of said round rods leaning on a 6 or 8 mm round rod extending lengthwise over the hollow bricks (14) to finish the structure, with the corrugated round rods (23) and the abaci (22) positioned over the pillar (9) heads for overcoming the mixed girder's negative bending moments; the work being thus fully assembled and structured to start the laying of the concrete, as follows:

[0034] First of all, the hollow bricks, the joists and the planking are sufficiently sprayed with water; the concrete laying starts at the girder (17) and nerve (20) recesses stem (17) and over the semi-resistant joists (11), to a height 3 to 4 cm below the upper part of the hollow bricks (14), becoming attached to the concrete compression layer (18) - which is at least 5 cm thick - to cover the assembly simultaneously in order to achieve a monolithic condition in the mixed flat composite girder obtained on-site and of the concrete slab itself; water spraying is continued to achieve a good setting and curing of the reinforced concrete, the cement used for the concrete having the required volume stability to avoid cracks or fissures as a result of setting retraction. The

concrete must have a plastic consistency, and comprise vibrated aggregates having a maximum size of 25 mm.

[0035] In the event that mechanical strength of the mixed structure shown in Figure 1 - in its maximum structured configuration - is insufficient for supporting greater stresses, the use of a pair of structures is called for, bearing in mind that said structures will proportionately adapt to the stress transmitted by each of the concrete slabs leaning on the girder, each structure being placed on each side of the concrete slab and thus establishing the necessary concrete compression head, said compression head being stiffened in regard to sagging by virtue of the reinforced nerves corresponding to the semi-resistant joists.

[0036] Finally, the gaps between the semi-resistant joist (11) header ends are advantageously in the range of 22 to 27 cm and the gap between the hollow bricks is in the range of 37 to 42 cm.

[0037] This description need not be more extensive for an expert on the subject to understand the scope of the invention and the advantages deriving therefrom.

[0038] The materials, shape, size and arrangement of the elements are liable to variation provided the essential nature of the invention is not altered.

[0039] The terms used in this specification must at all times be taken in their broad, non-limiting sense, the extent of the protection being determined by the terms of the claims.

Claims

1. Mixed structure flat composite girder with mixed structures formed on-site, **characterized in that** it comprises a main structure including a "T" metal profile (1), connectors (4), a hanger (7) and corrugated reinforcement rods (8) lying along the "T" metal profile (1), also complemented with a mass of concrete consisting of stem (17) and head (18) poured on-site over said structure to obtain the mixed flat composite girder; wherein the connectors (4) are arranged in a slanting position and welded at the ends thereof to the "T" profile (1) stem and to a round rod which forms a hanger (7) the ends of the mixed flat girder being arranged to lean on and be embedded in the corresponding pillars (9) to a hyperstatic degree, while the header ends of the semi-resistant joists (11) and the first hollow bricks (14)are separated to establish a recess, the concrete filling of which, complemented by the adequate structure, forms the stem (17) of the mixed flat composite girder.

2. Mixed structure flat composite girder formed on-site, according to Claim 1, **characterized in that** the mixed structure formed by the "T" metal profile (1), the connectors (4) and the hanger (7), is positioned between the header ends of the semi-resistant joists (11), of the various rows thereof arranged between the semi-resistant joists (11), said gap determining the width of the mixed flat girder (17) stem, which is complemented by the concrete compression filling layer (18) which originates the continuity between girders.

3. Mixed structure flat composite girder formed on-site, according to Claim 1, **characterized in that** the "T" metal profile (1), being the basic element of the main structure, is arranged in inverted position, with the stem (2) oriented vertically upwards and the wings (3) arranged horizontally at the lower end, said wings (3) determining a means of withstanding tensional stress, while the upper vertical stem (2) constitutes an element to withstand cutting and shearing stresses.

4. Mixed structure flat composite girder formed on-site, according to Claim 1, **characterized in that** the connectors (4) are provided, at the lower end thereof, with an extension (5) forming a foot along which are welded (6) said connectors (4) onto the stem's (2) upper edge corresponding to the "T" metal profile (1), said connectors (4) being adhered to the hanger (7) by their upper end, also through welding (6), whereby the tangent and grade line shear stress capability is increased, the slanting of said connectors (4) forming a 45° angle with the horizontal.

5. Mixed structure flat composite girder formed on-site, according to Claim 1, **characterized in that** the hanger (7), onto which are welded the upper connectors (4) ends, is formed by a corrugated round rod acting as a compression structure and as a support structure (16) for the semi-resistant joist (11) negative bending moments.

6. Mixed structure flat composite girder formed on-site, according to Claim 1, **characterized in that**, over the lower, horizontal wings (3) of the "T" metal profile (1), corrugated round rods (8) are arranged and adhered by means of welding, acting as a means of reinforcement against tension caused by positive bending moments.

7. Mixed structure flat composite girder formed on-site, according to Claim 1, **characterized in that**, under the flat concrete compression layer (18), are provided, at regular intervals, concrete transversal nerves (20) fitted with structural round rods (21) designed to avoid the appearance of longitudinal fissures or cracks in the lower and upper sides of the concrete slab, being complemented with a structure of corrugated round rods (21) and buttressing means (19), concrete being laid throughout the height of the concrete slab, characteristic **in that**

said concrete nerves (20) are arranged between the hollow bricks (14), thereby providing increased resistance to the concrete slab's transversal stiffness in order to withstand the alternate tension and compression stresses caused by the concrete slab's transversal bending and torque moments.

Patentansprüche

1. Ebener Verbundträger in Mischbauweise, wobei die Verbundkonstruktion vor Ort hergestellt wird, **dadurch gekennzeichnet, dass** er eine Hauptkonstruktion umfasst, die ein T-Profil aus Metall (1), Verbindungsstäbe (4), ein Aufhängeelement (7) und entlang des T-Profils aus Metall angeordnete gerippte Verstärkungsstäbe (8) enthält und die ferner durch eine Füllmasse aus Beton ergänzt wird, welche aus einem Steg (17) und einem Gurt (18) besteht, wobei die Masse vor Ort auf die genannte Struktur gegossen wird, um den ebenen Verbundträger in Mischbauweise herzustellen, in welchem die Verbindungsstäbe (4) in geneigter Stellung angeordnet und deren Enden an den Steg des T-Profils (1) und an einen Rundstab, der als Aufhängeelement (7) wirkt, angeschweißt sind, wobei die Enden des ebenen Trägers in Mischbauweise so angeordnet sind, dass sie bis zu einem hyperstatischen Grad auf den entsprechenden Stützen (9) ruhen und in diese einbinden, während die Kopfenden der halbfesten Querträger (11) und die ersten Hohlziegel (14) getrennt voneinander sind, um einen Raum zu schaffen, der durch Auffüllen mit Beton und ergänzt durch die entsprechende Konstruktion den Steg (17) des ebenen Verbundträgers in Mischbauweise bildet.

2. Ebener, vor Ort hergestellter Verbundträger in Mischbauweise nach Anspruch 1, **dadurch gekennzeichnet, dass** sich die aus T-Profil aus Metall (1), Verbindungsstäben (4) und Aufhängeelement (7) bestehende Verbundkonstruktion zwischen den Kopfenden der halbfesten Querträger (11) befindet, angeordnet über mehrere Reihen dieser zwischen den halbfesten Querträgern (11), wobei die genannte Trennung maßgebend für die Breite des Steges (17) des ebenen Verbundträgers in Mischbauweise ist, welcher durch die Druckschicht der Betonfüllung (18) ergänzt wird, welche die Kontinuität zwischen den Trägern bewirkt.

3. Ebener, vor Ort hergestellter Verbundträger in Mischbauweise nach Anspruch 1, **dadurch gekennzeichnet, dass** das T-Profil aus Metall (1), welches das Grundelement der Hauptkonstruktion ist, in umgekehrter Stellung angeordnet ist, mit vertikal nach oben gerichtetem Steg (2) und horizontal am unteren Ende angeordneten Flansch, wobei der genannte Flansch (3) maßgebend für die Zugfestigkeit ist, während der obenliegende vertikale Steg (2) ein wesentliches Element für Kerbschlagwiderstand und Scherfestigkeit ist.

4. Ebener, vor Ort hergestellter Verbundträger in Mischbauweise nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verbindungsstäbe (4) an ihrem unteren Ende mit einer Verlängerung (5) versehen sind, die ein Fußteil bildet, entlang dessen die genannten Verbindungsstäbe (4) am oberen Rand des zu dem T- Profil aus Metall (1) gehörenden Steges (2) angeschweißt (6) sind, wobei die genannten Verbindungsstäbe (4) an ihrem oberen Ende durch eine Schweißnaht (6) mit dem Aufhängeelement (7) verbunden sind, wodurch sich die Scherfestigkeit in tangentialer und geneigter Richtung erhöht, da die genannten Verbindungsstäbe (4) eine Neigung von 45° gegen die Horizontale aufweisen.

5. Ebener, vor Ort hergestellter Verbundträger in Mischbauweise nach Anspruch 1, **dadurch gekennzeichnet, dass** das Aufhängeelement (7), an welchem die oberen Enden der Verbindungsstäbe (4) angeschweißt sind, aus einem gerippten Rundstab gebildet wird, der als Druckglied und tragende Konstruktion (16) für die negativen Biegemomente des halbfesten Querträgers (11) wirkt.

6. Ebener, vor Ort hergestellter Verbundträger in Mischbauweise nach Anspruch 1, **dadurch gekennzeichnet, dass** auf dem unteren horizontalen Flansch (3) des T-Profils aus Metall (1) gerippte Rundstäbe (8) angeordnet sind, verbunden mit diesem durch eine Schweißnaht, welche als Verstärkung gegen die Spannung aus den positiven Biegemomenten wirken.

7. Ebener, vor Ort hergestellter Verbundträger in Mischbauweise nach Anspruch 1, **dadurch gekennzeichnet, dass** unter der Druckschicht der Betonfüllung (18) in regelmäßigen Abständen Querrippen aus Beton (20) ausgebildet werden, die mit konstruktiven Rundstäben (21) versehen sind, welche dafür bestimmt sind, das Auftreten von Spalten und Längsrissen an Unter- und Oberseite der Betonplatte zu vermeiden, Rippen, die durch eine Konstruktion aus gerippten Rundstäben (21), eine Halterung (19) und die Aufbringung von Beton über die gesamte Höhe der Betonplatte ergänzt wird, wobei die genannten Rippen aus Beton (20) **dadurch gekennzeichnet sind, dass** sie zwischen den Hohlziegeln (14) angeordnet werden, um der Betonplatte eine höhere Quersteifigkeit zu verleihen und somit den aus den Querbiege- und Torsionsmomenten der Betonplatte resultierenden wechselnden Beanspruchungen aus Zug und

Druck zu widerstehen.

Revendications

1. Poutre composée plane de structure mixte où les structures mixtes sont formées in situ, **caractérisée en ce qu'**elle comprend une structure principale qui inclut un profil métallique en "T" (1), des connecteurs (4), un élément de suspension (7) et des barres de renfort nervurées (8) situées le long du profil métallique en "T", et intégrant en plus une masse en béton comprenant une âme (17) et une tête (18), masse versée in situ sur la dite structure pour obtenir la poutre composée plane mixte, où les connecteurs (4) sont disposés de façon inclinée et sont soudés à leurs extrémités à l'âme du profil en "T" (1) et à une barre ronde qui forme un élément de suspension (7) ; les extrémités de la poutre plane mixte étant disposées de façon à appuyer et à s'encastrer dans les colonnes correspondantes (9) jusqu'à un degré hyperstatique, car les extrémités des têtes des poutrelles semi-résistantes (11) et les premières briques creuses (14) sont écartées afin d'établir un espace qui, comblé de béton et pourvu de la correspondante structure, forme l'âme (17) de la poutre composée plane mixte.

2. Poutre composée plane de structure mixte formée in situ, selon la revendication 1, **caractérisée en ce que** la structure mixte formée par le profil métallique en "T" (1), les connecteurs (4) et l'élément de suspension (7) se trouvent entre les extrémités des têtes des poutrelles semi-résistantes (11), sur les diverses rangées de ces extrémités disposées sur les poutrelles semi-résistantes (11), et cet écart détermine la largeur de l'âme (17) de la poutre mixte plane intégrant une couche de compression de béton (18) permettant la continuité des poutres.

3. Poutre composée plane de structure mixte formée in situ, selon la revendication 1, **caractérisée en ce que** le profil métallique en "T" (1), élément de base de la structure principale, est disposé en position inverse, l'âme (2) étant orientée verticalement vers le haut et les ailes (3) disposées horizontalement sur l'extrémité inférieure, les dites ailes (3) constituent un moyen de résistance à la force de tension, car l'âme verticale supérieure (2) est un élément de résistance à la force de découpe.

4. Poutre composée plane de structure mixte formée in situ, selon la revendication 1, **caractérisée en ce que** les connecteurs (4) sont pourvus, à leur extrémité inférieure, d'un prolongement (5) qui forme un pied le long duquel sont soudés (6) les dits connecteurs (4), sur le bord supérieur de l'âme (2) correspondante au profil métallique en "T" (1), les dits connecteurs (4) sont soudés à l'élément de suspension (7) par leur extrémité supérieure (6), ce qui permet d'augmenter la résistance à la force de découpe sur la tangente et la pente, et l'inclinaison des connecteurs (4) forme un angle de 45° par rapport à l'horizontal.

5. Poutre composée plane de structure mixte formée in situ, selon la revendication 1, **caractérisée en ce que** l'élément de suspension (7) sur lequel sont soudées les extrémités des connecteurs supérieurs (4) est formé d'une barre nervurée ronde qui agit comme une structure de compression et comme une structure de support (16) pour les moments de flexion négative de la poutrelle semi-résistante (11).

6. Poutre composée plane de structure mixte formée in situ, selon la revendication 1, **caractérisée en ce que**, sur les ailes horizontales inférieures (3) du profil métallique en "T" (1), sont disposées des barres nervurées rondes (8), soudées et qui agissent comme renfort contre la tension créée par les moments de flexion positive.

7. Poutre composée plane de structure mixte formée in situ, selon la revendication 1, **caractérisée en ce que**, sous la couche de compression plane en béton (18), sont disposés, à intervalles réguliers, des nerfs transversaux en béton (20) munis de barres de structure rondes (21) destinés à éviter l'apparition de fissures ou de crevasses longitudinales sur les côtés inférieur et supérieur de la dalle en béton, nerfs complétés par une structure de barres nervurées rondes (21), un moyen de support (19) et l'application de béton sur toute la hauteur de la dalle en béton, les dits nerfs en béton (20) se caractérisant par leur disposition entre les briques creuses (14) pour fournir une plus grande résistance à la rigidité transversale de la dalle en béton afin de supporter la force de tension et de compression en alternance provoquée par les moments de couple et de flexion transversale de la dalle en béton.

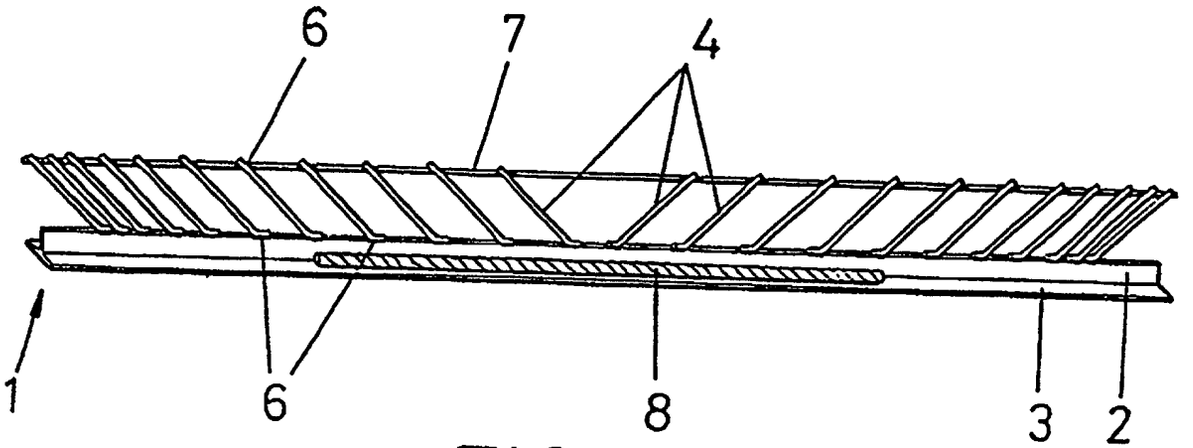

FIG.-1

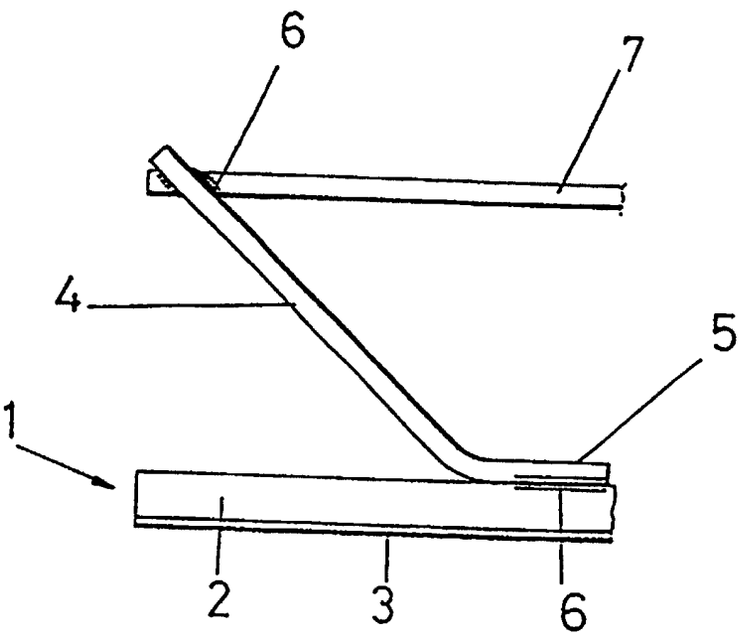

FIG.-2

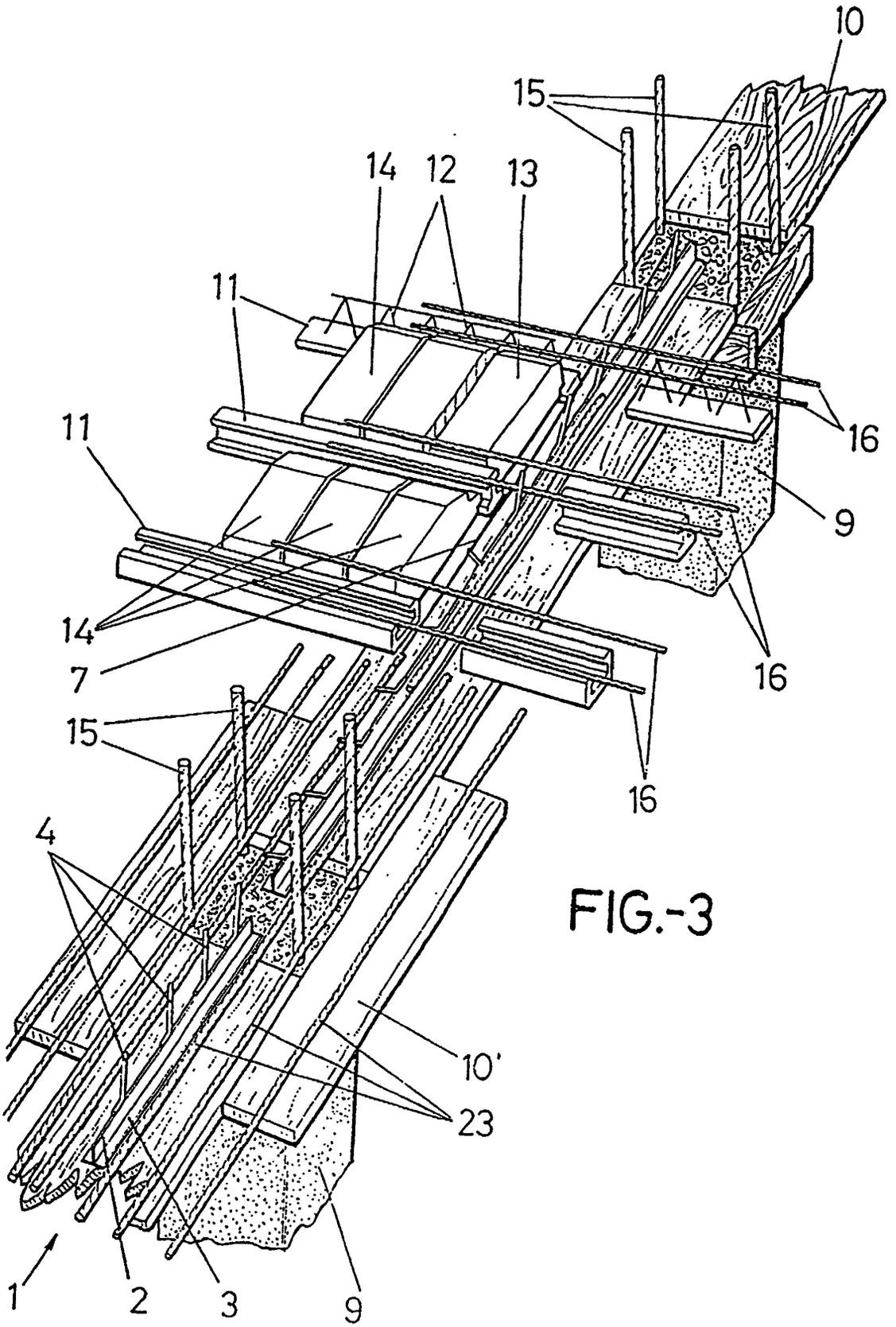

FIG.-3

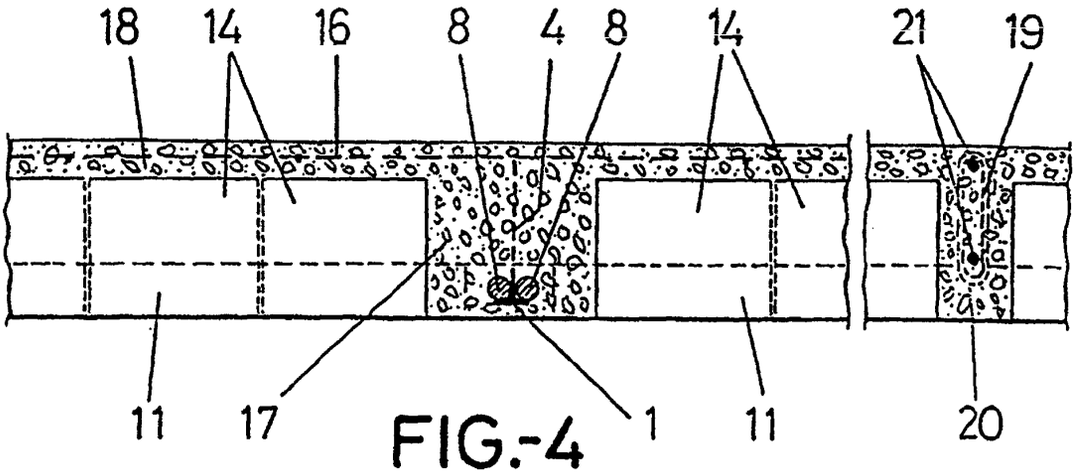

FIG.-4

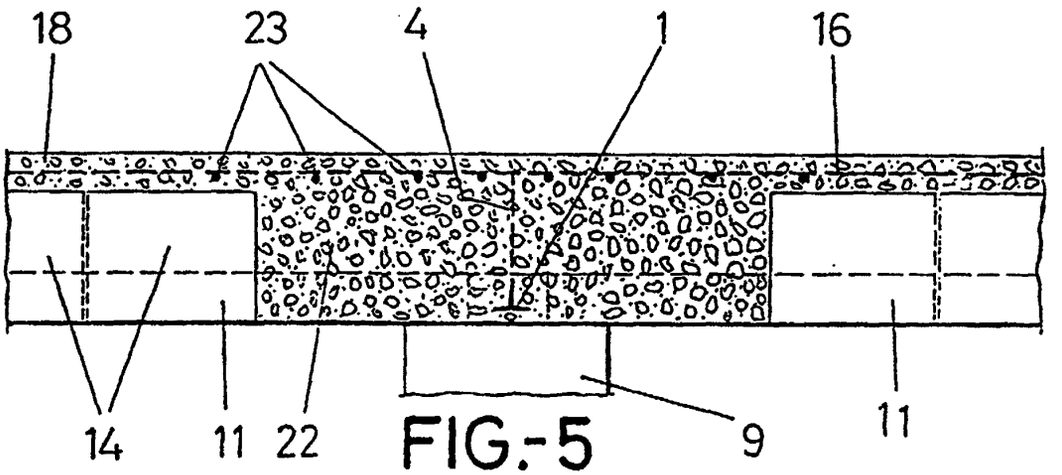

FIG.-5

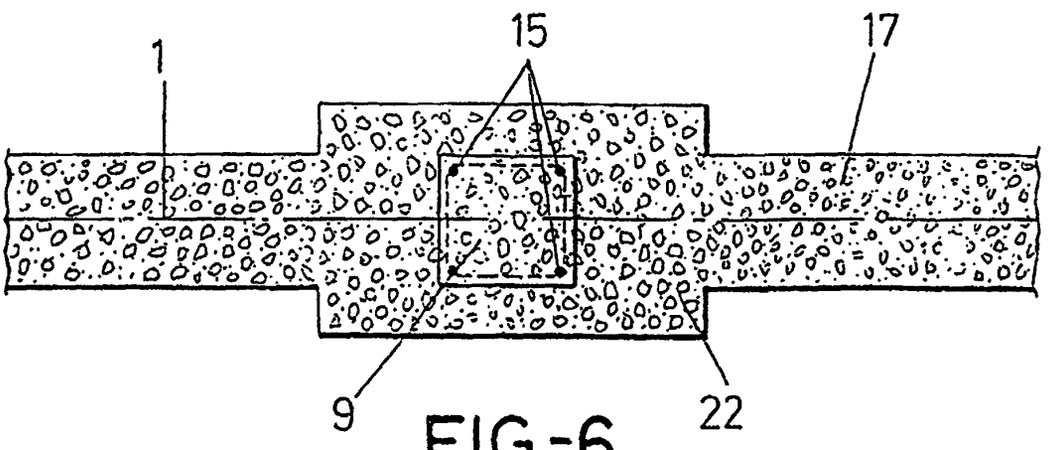

FIG.-6