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(54) **Floor construction and method of its production**

Fussbodenkonstruktion und Verfahren zu seiner Herstellung

Structure de plancher et son procédé de fabrication

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Description

Field of the invention

[0001] The invention relates to a floor construction of monolithic reinforced concrete, the arrangement of the principal load-bearing elements and the method of its production. The floor construction is made using monolithic technology on formwork and consists of reinforcement, concrete mass and additional expanding material.

Prior art

[0002] When designing and then producing floor constructions (generally, any horizontal constructions where the load is perpendicular to the surface) we are faced with the problem that by increasing the distance between the supporting elements the actual weight of the structure begins to exceed the amount of the load that the construction is supposed to support. Today, reinforced-concrete horizontal (floor) constructions use, without exception, slabs that are solid in cross-section. Increasing the distance between the supporting elements even further results in a rapid increase of the required depth of the horizontal construction and thus the actual weight of the construction. While, for example, the distance between the supports increases by only 25%, the actual weight goes up by up to 50%. The problem of the actual weight is magnified by the so-called concrete creeping of reinforced-concrete structures, where in solid floor slabs from a slab thickness of 200 mm upwards the concrete creeping component contributes by more than fifty percent to the total deformation. In constructions with a depth of around 300 mm the concrete creeping component becomes dominant. As a result designers have been searching for methods of making the constructions lighter while retaining their principal required functions. One alternative solution to the problem is a different arrangement of the load-bearing ribs in combination with empty spaces or materials of a significantly lower density than that of concrete in one or two perpendicular ways. The second alternative is searching for components of the concrete mix that are lighter than natural aggregate.

[0003] In the production of reinforced concrete floor constructions procedures are known whereby, in the first stage, the formwork is made, in the second stage, the reinforcement and expanding components are laid and, in the third stage, the concrete mix itself is cast so that the weight is reduced in the following way:

- empty space between the load-supporting ribs is created by means of traditional wooden formwork, or
- empty space between the load-supporting ribs is created by various plastic elements that are removed together with the wooden formwork when it is dismantled from the floor construction and are ready for further use or may remain in place as part of the floor construction,

- empty space can also be created in the middle of the depth of the floor construction again using plastic elements that are retained as part of the floor construction as they are undercast by concrete at the bottom.

[0004] The first two methods described above form a floor construction with an uneven bottom surface. An even bottom surface is created in the next phase if commanded by the nature of the spanned over room. The third method results in an even bottom surface of the roof construction, however with less weight reduction.

[0005] Czech Patent CZ 184749 describes a procedure whereby boxes of wood-based material are made in advance. However, the procedure does not involve traditional monolithic reinforced-concrete technology as there is no formwork built for the bottom surface of the future construction and the said boxes create the so-called lost formwork. The construction of the boxes allows for only limited possibilities with regards to irregular shapes and supporting the floor constructions or loading the floor construction.

[0006] Materials of very low bulk density cannot be used with the said constructions due to the danger of their floating during concrete casting.

[0007] Patent document AT 398 218 describes a floor structure with a reduced weight whereby expanded elements, made for example of styrol, are arranged between the floor ribs. Nevertheless, the expanded elements are pierced crosswise by multiple wires in order to firmly fix the expanded elements to the top and bottom horizontal wire plane. This is to prevent them from getting beyond control and flowing away during the casting of concrete. The preparation of the roof construction as well as the preparation of the expanded elements before assembly is therefore extremely work-intensive. Moulded formwork plates are used to allow part of the concrete to flow under the expanded element, thus fixing it from the bottom, which on the other hand makes the floor uneven at the bottom as a lug forms at the position where the plate was placed.

[0008] Moreover, DE 22 35924 A1 shows a floor construction according to the preamble of claim 1.

[0009] The aim of the invention is to present a floor construction which features a reduced weight yet is sufficiently stiff and strong and has a smooth bottom surface - all of those qualities created at the same time.

Technical characteristics of the invention

[0010] The above mentioned insufficiencies are up to a considerable degree eliminated by a floor construction according to the invention the subject matter of which is that it consist of a layer of adhesive, through which expanding bodies are laid, around the expanding bodies the reinforcement is arranged so that it forms ribs for the reinforcement in one or multiple ways at different angles while the reinforcement elements run only throughout

part of the whole thickness of the floor construction, and while the space between and above the expanding bodies is filled by concrete mass there is a mesh or other mesh-like diaphragm on the bottom layer of the floor construction and the concrete mass is also passing through the mesh in uncovered areas.

[0011] In a preferred embodiment the expanding bodies are made of a material of lower bulk density than that of the concrete mass or they are hollow elements.

[0012] In another preferred embodiment the expanding bodies are made of expanded polystyrene and are designed as parallelepipeds both with sharp or otherwise modified edges and with flat or otherwise shaped walls.

[0013] In another preferred embodiment the mesh placed at the bottom surface of the construction is made of glass fibres or plastic fibres and can be easily penetrated and washed by an adhesive to fix the expanding bodies.

[0014] In another preferred embodiment the mesh-like diaphragm placed at the bottom surface of the construction is only designed as a supporting layer to fix the position of the expanding bodies. The membrane does not fulfil a load-carrying function to create a suspended ceiling and serves only to stabilise the expanding bodies in the required positions, while it may perform other functions as well.

[0015] The method of the production of the floor construction consists in applying a separator on the floor formwork, after which a mesh or other mesh-like diaphragm is spread on the formwork, the bottom surfaces of the expanding bodies that are in contact with the mesh or other mesh-like diaphragm are joined to the mesh by penetrating an adhesive through the mesh or by being simply glued onto the other mesh-like diaphragm and the reinforcing elements are placed between the expanding bodies, after which, when the expanding bodies are firmly fixed to the mesh or other mesh-like diaphragm, the concrete mass is cast around the expanding bodies and above them.

Description of the figures in drawings

[0016] The invention will be illustrated by means of drawings, on which Fig.1 shows the schematic front view cross-section of the finished floor construction, Fig.2 presents the schematic side view cross-section of the floor construction and Fig.3 shows the top perspective view of the floor construction in accordance with the invention while being finished.

Example of the invention embodiment

[0017] It is clear from Fig.1 and 2 that the floor construction in accordance with the invention consists of load-bearing mesh 2, spread on formwork 1, as well as of polystyrene expanding bodies 3, various types of reinforcement and concrete mass 14. The bottom reinforcement is secured in place by retaining elements 5.

This is overlain by main bottom longitudinal load-bearing reinforcement 6. Next, spatial reinforcement 7 is laid. The two bottom rods of spatial reinforcement 7 reinforce and complement main longitudinal load-bearing reinforcement 6. Both reinforcements 6 and 7 are situated in concrete ribs. This is followed by cross-wise load-bearing reinforcement 9, top retaining elements 8 of top load-bearing mesh 10, additional top reinforcement 12. If required, extra construction reinforcement 13 is added between spatial reinforcement 7. The top bar of spatial reinforcement 7 and top mesh 10 must be joined, e.g. by lashes 11.

[0018] A thin layer of adhesive 4 is employed between the bottom load-bearing mesh 2 (ceiling side) and polystyrene expanding bodies 3. The finished floor construction is sufficiently strong, yet features a suitably reduced weight and includes a ceiling surface as well. This is made up of mesh 2, which is even and ready for an application of the final layer, i.e. the finish, such as plaster.

[0019] Alternatively, mesh-like diaphragm can be used, e.g. a suitable compact cloth which need not be a mesh. This will not fulfil a load-bearing function for building a suspended ceiling, instead it will serve to stabilize expanding bodies 3 in the fixed positions and can perform additional functions, such as fire protection.

[0020] Fig.3 shows the shapes of polystyrene expanding bodies 3, specifically parallelepiped forms, and their arrangement on formwork 1 or mesh 2. Polystyrene expanding bodies 3 can take on any shape, however, the parallelepiped seems to be the optimum solution. It is essential that the surface by which polystyrene expanding bodies 3 are laid on mesh 2, is flat so that they are not undercast by too much concrete.

[0021] The picture clearly illustrates the method of producing the floor construction in accordance with the invention. A flat surface delineated by formwork (the future bottom surface of the floor construction) is treated with a separator on which mesh 2 is spread fixed to which, using a suitable adhesive 4, are expanding elements 3 of parallelepiped form. The parallelepipeds can take on different shapes, however, sufficient space must remain between them to place the load-bearing reinforcement which is necessary to provide the total load-bearing capacity and strength of the floor construction. The arrangement of the expanding parallelepipeds may be different, although it is beneficial if the arrangement forms a network of perpendicular load-bearing ribs. This arrangement is most advantageous for the structural analysis calculations, production, transport and storing of the expanding parallelepipeds, for the laying of load bearing and other reinforcement required for the proper and reliable performance of the finished floor construction. Next, reinforcement is placed between the parallelepipeds fixed as described above and finally the whole construction is concreted whereby the space between expanding bodies 3 and a thin, approx. 8cm thick, layer above the top surface of the parallelepipeds is filled by a concrete mix of suitable consistency. After the concrete

mix has set and the formwork has been removed a floor construction is formed with an even bottom surface ready for an application of thin layers of plaster, which is sufficiently rigid and has a sufficient load-bearing capacity even for long spans between load-bearing horizontal supports.

[0022] For circular floor construction it is beneficial that the expanding parallelepipeds are made as sections of an annulus.

[0023] For mass application it is advantageous that reinforcement is combined from industrially produced spatial reinforcement, straight bars, and steel mesh fabric.

[0024] The bottom mesh used is the type of mesh commonly applied when building thermal barriers on facades and the fixing of expanding parallelepipeds is accomplished using construction adhesives designed specifically for gluing the mesh to polystyrene.

[0025] The invention includes the method of production suitable for mass application the essence of which consists in applying, on the floor formwork, any separator used for separating concrete from formwork, the formwork treated as described above is then spread with commonly used reinforcement façade mesh. An appropriate façade adhesive is employed to fix the expanding parallelepipeds arranged in accordance with the structural analysis project to the surface obtained as explained above. When fixing the expanding parallelepipeds care needs to be taken to ensure that the adhesive penetrates the spread reinforcement mesh as far as the formwork. Neglecting this may in extreme cases lead to the floating of the expanding parallelepipeds during concreting! The main load-bearing reinforcement, related to the bottom face of the floor construction, is then placed into the formed ribs in one way as well as the shear reinforcement of the reinforced ribs. The work is substantially simplified by using spatial reinforcement. The placed reinforcement is supported by retaining elements in accordance with the applicable standards. Only bottom bar reinforcement is placed into the ribs in the other (perpendicular) direction unless the structural engineer prescribes the placing of shear reinforcement as well.

[0026] The spatial reinforcement, and the shear reinforcement if used, must have, after placement into the ribs between the expanding parallelepipeds, its top horizontal edge above the top surface of the expanding parallelepipeds by approx. 25-30 mm. Once all the reinforcement related to the bottom face is in place, including the shear reinforcement, appropriate retaining elements are placed on the top surface of each expanding parallelepiped delimiting a distance of 35mm and a reinforcement mesh 5 to 6 mm in diameter with a 100/100 mm or 150/150 mm mesh size is spread on the elements and fixed to the spatial reinforcement. Finally, reinforcement related to the top face of the floor construction is laid on the mesh. The concreting of the prepared floor construction is made using a high quality concrete mix (B30 concrete and above), with a pumpable consistence in a single process step. It is advantageous to start in advance by

filling the concrete mix into the ribs up to about 2/3 of their height while simultaneously compacting it with a vibration needle and then top up the concrete mix to the required thickness above the top surface of the expanding parallelepipeds, compact it with a vibration needle or bar and finally level up the top surface. When treating the setting concrete mix the physical-mechanical, and when necessary chemical, specifications of the material of which the expanding parallelepipeds are made should be taken into consideration.

Claims

1. Floor construction produced using the monolithic technology on formwork, =consisting of reinforcements, concrete mass and additional expanding material, further comprising a layer of adhesive (4) through which expanding bodies (3) are laid, around the expanding bodies (3) the reinforcement is arranged so that it forms ribs for the reinforcement in one way or multiple ways at different angles while the expanding elements (3) run only throughout a part of the whole thickness of the floor construction, and while the space between and above the expanding bodies (3) is filled by concrete mass (4), **characterized in that** there is a mesh (2) or other mesh-like diaphragm on the bottom layer of the floor construction and that the concrete mass (14) is also passing through the mesh (2) in uncovered areas.
2. Floor construction according to the claim 1, **characterized in that** the expanding bodies (3) being made of a material of lower bulk density than that of the concrete mass with or being hollow elements.
3. Floor construction according to the claims 1 and 2, **characterized in that** the expanding bodies (3) being made of expanded polystyrene or foam glass.
4. Floor construction according to the claims 1 to 3, **characterized in that** the expanding bodies (3) being designed as parallelepiped both with sharp or otherwise modified edges and with flat or otherwise shaped walls.
5. Floor construction according to the claim 1, **characterized in that** the mesh (2) placed at the bottom surface of the construction is made of glass fibres or plastic fibres and can be easily penetrated by an adhesive (4) to fix the expanding bodies.
6. Floor construction according to the claim 1, **characterized in that** the mesh-like diaphragm placed at the bottom surface of the construction is only designed as a supporting layer to fix the position of the expanding bodies (3) and, possibly, as a fire-resistant layer.

7. Method of the production of the floor construction according to the claims 1 to 6, whereby the floor formwork is assembled, **characterized in that** a separator is applied on the floor formwork, afterwards a mesh or other mesh-like diaphragm is spread on the formwork, the bottom surfaces of the expanding bodies that are in contact with the mesh or other mesh-like diaphragm are joined to the mesh by penetrating an adhesive through the mesh or by being simply glued onto the other mesh-like diaphragm and the reinforcing elements are placed between the expanding bodies, after which, when the expanding bodies are firmly fixed to the mesh or other mesh-like diaphragm, the concrete mass is cast around the expanding bodies and above them.

Patentansprüche

1. Deckenkonstruktion, die mit einem monolithischen Verfahren hergestellt und auf Schalung ausgeführt wird, aus Armierungen, Betonmasse und Entlastungskörpern besteht und weiter eine Schicht von Klebstoff enthält, auf der die Entlastungskörper angeordnet sind, wobei um die Entlastungskörper herum die Armierungen so angebracht sind, dass sie die sich in einer Richtung oder mehreren sich schneidenden Richtungen erstreckenden Armierungsrippen bilden und die Entlastungskörper dabei nur mit einem Teil ihrer Dicke in die Deckenkonstruktion eingreifen, wobei der Raum innerhalb und oberhalb der Entlastungskörper mit der Betonmasse ausgefüllt ist, **dadurch gekennzeichnet, dass** auf der unteren Oberfläche der Deckenkonstruktion das Netzgewebe (2) oder eine andere netzartige Membrane angebracht ist und die Betonmasse (14) das Netzgewebe (2) in dessen freien Abschnitten durchdringt.
2. Deckenkonstruktion nach dem Anspruch 1, **dadurch gekennzeichnet, dass** die Entlastungskörper (3) aus einem Material mit niedrigerem Volumengewicht im Vergleich zu der Betonmasse ausgeführt oder als hohle Einzelteile gestaltet sind.
3. Deckenkonstruktion nach dem Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Entlastungskörper (3) aus Styropor oder Schaumglas ausgeführt sind.
4. Deckenkonstruktion nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Entlastungskörper (3) als Prismen ausgeführt sind, und zwar mit scharfen oder anders gestalteten Kanten und mit flachen oder anders ausgeformten Wänden.
5. Deckenkonstruktion nach dem Anspruch 1, **dadurch gekennzeichnet, dass** das auf der unteren Oberfläche der Konstruktion angebrachte Netzge-

webe (2) aus Glas- oder Kunststofffasern ausgeführt ist, wobei es durch den zum Ankleben der Entlastungskörper zu verwendenden Klebstoff (4) gut durchpressbar ist.

6. Deckenkonstruktion nach dem Anspruch 1, **dadurch gekennzeichnet, dass** die auf der unteren Oberfläche der Konstruktion angebrachte netzartige Membrane bloß als eine Zuhaltschicht für die Fixierung der Entlastungskörper (3) und gegebenenfalls als eine Brandschutzschicht ausgeführt ist.
7. Verfahren zur Herstellung der Deckenkonstruktion nach den Ansprüchen 1 bis 6, das den Zusammenbau einer Deckenschalung umfasst, **dadurch gekennzeichnet, dass** auf die Deckenschalung ein Trennmittel aufgetragen wird, anschließend auf die Schalung das Netzgewebe oder eine andere netzartige Membrane verteilt wird, im Anschluss daran die unteren Oberflächen der Entlastungskörper, die im Kontakt mit dem Netzgewebe oder mit der anderen netzartigen Membrane im Kontakt stehen, mit dem Netzgewebe verbunden werden, indem der Klebstoff durch das Netzgewebe durchgepresst wird, oder mit der anderen netzartigen Membrane einfach verklebt werden und unter die Entlastungskörper die Armierungselemente verlegt werden, wonach die Entstehung der festen Verbindung der Entlastungskörper und des Netzgewebes bzw. der anderen netzartigen Membrane abgewartet wird und um die Entlastungskörper herum sowie auf dieselben die Betonmasse aufgetragen wird.

Revendications

1. Structure de plancher fabriqué par la technologie monolithique et conçue sur le coffrage constitué de quadrillage, de masse de béton et d'éléments d'allègement et comportant une couche de masse de colle sur laquelle sont disposés les éléments d'allègement le quadrillage étant structurée autour des éléments de manière à créer l'ossature du quadrillage dans une ou plusieurs différentes directions et sous différents angles. Les éléments d'allègement ne pénètrent qu'à travers une partie de l'épaisseur du squelette du plafond l'espace entre et au-dessus des éléments d'allègement comportant la masse de béton **caractérisée en ce que** sur la surface inférieure de la structure de plancher est un filet (2) ou une membrane en filet et que la masse en béton (14) pénètre le filet (2) sur ses tronçons libres.
2. Structure de plancher selon la revendication 1 **caractérisé en ce que** les éléments d'allègement (3) sont réalisés en matériel dont la masse volumique est inférieure à celle de la masse de béton ou les éléments sont creux.

3. Structure de plancher selon les revendications 1 et 2 **caractérisé en ce que** les éléments d'allégement (3) sont réalisés en mousse de polystyrène ou en verre multicellulaire. 5
4. Structure de plancher selon la revendication 1 **caractérisé en ce que** les éléments d'allégement (3) sont réalisés en forme de prismes avec les arêtes vives ou autres et avec les parois plates ou autres. 10
5. Structure de plancher selon les revendications 1 à 3 **caractérisé en ce que** le filet (2) sur la surface inférieure du squelette est réalisé en fibres de verre ou fibres de matières plastiques et est facilement pénétrable par la masse de colle (4) pour coller les éléments d'allégement. 15
6. Structure de plancher selon la revendication 1 **caractérisée en ce que** la membrane en filet sur de la surface inférieure de la construction est réalisée en tant que couche d'appui pour fixation des éléments d'allégement (3), le cas échéant en tant que couche anti-incendie. 20
7. Procédé de fabrication de la structure de plancher selon les revendications 1 à 6 consiste dans le fait que le coffrage du plafond est réalisé **caractérisé en ce que** le séparateur est appliqué sur le coffrage, puis le filet ou une autre membrane en filet est disposé sur le coffrage, les surfaces inférieures des éléments d'allégement en contact avec le filet ou une autre membrane en filet, sont raccordées par la pénétration de la masse de colle à travers le filet ou collées sur une autre membrane en filet, et les éléments de quadrillage sont posés entre les éléments d'allégement après quoi la masse de béton est appliquée autour et au-dessus des éléments d'allégement après le raccordement des éléments d'allégement et du filet ou d'une autre membrane en filet. 25
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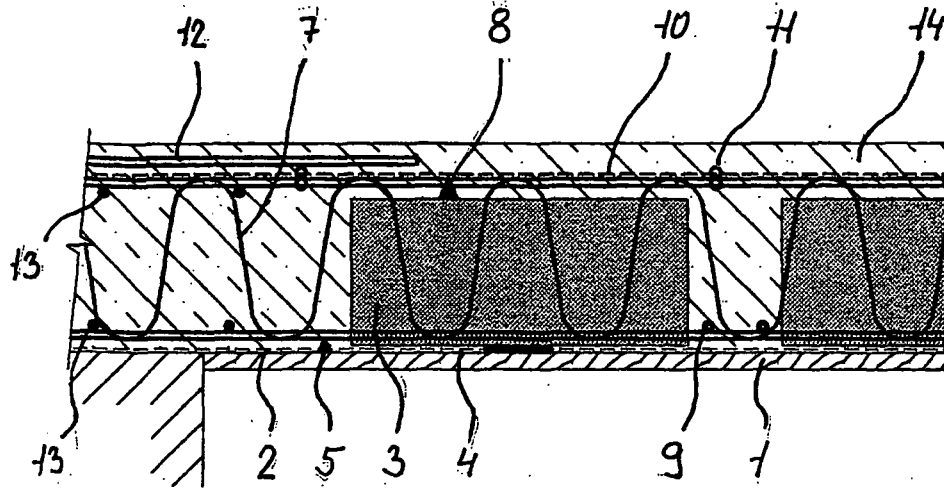


Fig. 1

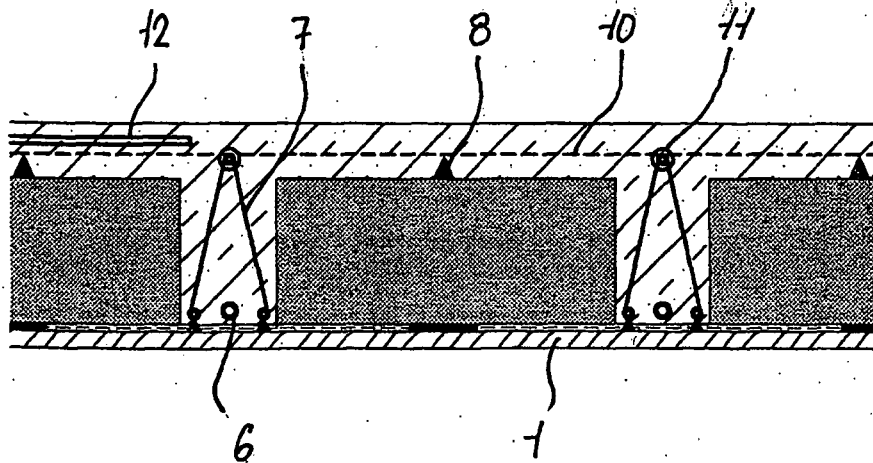


Fig. 2

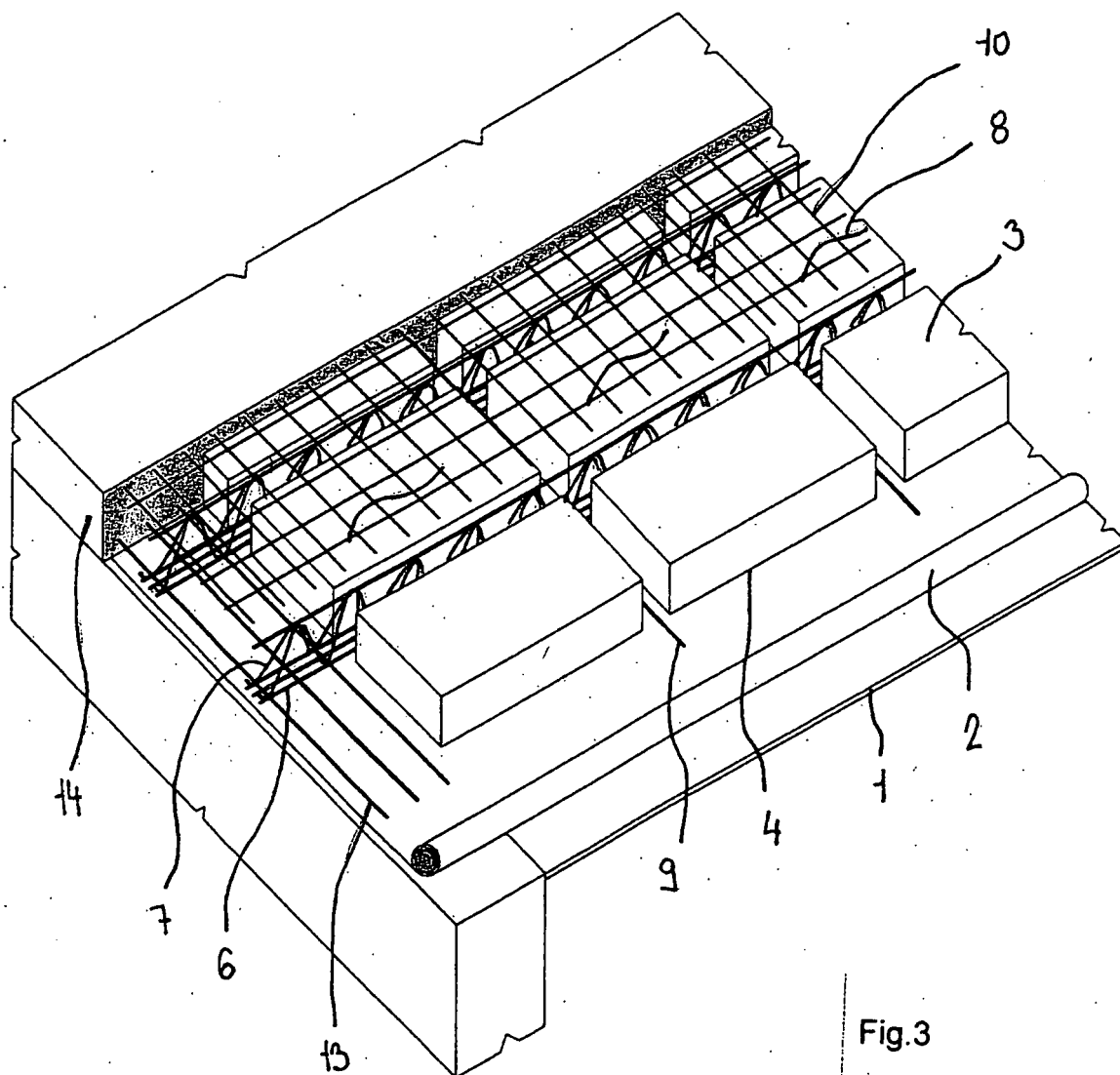


Fig.3

REFERENCES CITED IN THE DESCRIPTION

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