(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 693 518 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.08.2020 Bulletin 2020/33

(51) Int Cl.:
E04B 1/04 *(2006.01)* ***E04C 5/01*** *(2006.01)*
E04B 1/21 *(2006.01)*

(21) Application number: **20155948.1**

(22) Date of filing: **06.02.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **07.02.2019 NL 2022529**

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(54) **CONNECTION ELEMENT FOR CONNECTING A FLOOR ELEMENT TO A VERTI-CAL SUPPORT ELEMENT**

(57) The present invention is in the field of an improved connection element for connecting a floor element to a vertical support element, a horizontal floor/ceiling element comprising in at least one corner thereof said connecting element, and a multi-storey building comprising said detachable connecting element and/or said detachable floor/ceiling element, and detachable vertical supporting elements.

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Description

FIELD OF THE INVENTION

[0001] The present invention is in the field of an improved connection element for connecting a floor element to a vertical support element, a horizontal floor/ceiling element comprising in at least one corner thereof said connecting element, and a multi-storey building comprising said detachable connecting element and/or said detachable floor/ceiling element, and detachable vertical supporting elements.

BACKGROUND OF THE INVENTION

[0002] The invention relates to a multi-storey building of prefabricated elements comprising a number of pillars distributed over the surface of the building and pillar panels supported by the pillars, and stability arrangements between at least part of the pillars for receiving horizontal loads on the building.

[0003] Such buildings constructed of prefabricated elements may consist, for example, of offices, schools, hospitals, industrial buildings and the like, but also houses can be realized in this way. A well-known from practice for the Nutz-Zweckbau, the so-called CD 20 system, is an example of a building system, with the appropriate and solid way buildings can be built. Especially in view of buildings that are considered temporary, such as schools in recently developed neighborhoods, it is an advantage that such a building can be demounted, or re-used for a different purpose by redesigning a layout thereof. Also in view of recycling and reduction of carbon dioxide reuse is important.

[0004] In such a building, when more than two storeys are used, one or more cores are formed in the building as a stability precaution. A cores may consist of a number of pillars in the middle of the building, connected, for example, in a rectangle or in a double U-shape by concrete hoops. In these cores, for example, a staircase, an elevator or a vertical pipe feedthrough can be arranged.

[0005] Further on the pillars or likewise supporting elements floors or ceilings are provided, typically made of concrete, which may be prestressed or not, and may be reinforced or not. The ceiling or floor elements can be positioned on supports, but typically require a connecting element in at least one, and typically all, corners. The prior art connecting elements, such as those of CD20, may typically suffice for lighter floors and ceilings, but are found not robust enough for heavier floors and ceilings.

[0006] The invention is based on the object to further develop such a building and to provide a building according to the invention, in which such stability precautions are realized that a very high degree of freedom of design in the spatial distribution of the floors is effected. Details of this invention can be found in Dutch Patent NL8901783A, which contents are incorporated by reference.

[0007] Prior art connecting elements are however to some extend difficult to produce, especially in case of thicker and heavier floor or ceiling elements. Also government requirements, such as European requirements, have become more stringent and therefore connecting elements need to be further improved.

[0008] Incidentally the following prior art is referred to. DE 89 117 10 U1 recites a construction element for the construction of buildings with at least one panel which is horizontal in the position of use and is provided with a reinforcement, and with support elements provided in the corner regions of the panel and extending transversely to the panel plane, the reinforcement being constructed as a space support structure and at least the partial region of the reinforcement 1n facing the upper side of the panel in the position of use being embedded in an upper embedding region extending over the panel plane, characterised in that the reinforcement has edge ribs extending along the panel edges and intersecting diagonal ribs. DE 91 143 29 U1 recites a connecting part for connecting components, which is non-detachably connected to one of the components to be connected and can be detachably connected to at least one further component, with webs provided between a head plate and a foot plate and extending transversely thereto, between which there is at least one through-opening extending between opposite sides of the head and foot plate, characterised in that the webs have a stiffening cross-sectional shape. They are not suitable for introducing the forces from a slender prefabricated slab floor with smaller point-shaped supports, etc. NL7900922A recites a vertical stack of roof of floor panels is located via the junctions between vertical pillars used at the corners of each panel. The lower concrete pillar is fitted on its top end by an anchor plate containing four anchor rods that cast into the pillar. A similar anchor plate is used on the bottom end of the next highest concrete pillar. The system can be used in the construction of multi-storey buildings. This principle no longer complies with the current requirements and regulations, according to NEN ISO EN-1992.

[0009] The present invention relates to an improved connection element which overcomes one or more of the above disadvantages, without jeopardizing functionality and advantages.

SUMMARY OF THE INVENTION

[0010] The present invention relates in a first aspect to an improved connection element for connecting a floor element

to a vertical support element, a horizontal floor/ceiling element comprising in at least one corner thereof said connecting element, and typically also radial and tangential oriented force absorbers, and a multi-storey building comprising said detachable connecting element and/or said detachable floor/ceiling element, and detachable vertical supporting elements. The invention provides a modular system which can be detachably mounted. The system complies with government regulations, such as S235 of ISO/Eurocode. Also thicker, and heavier, floor and ceiling elements can now be supported and attached in a safe and stable manner. In addition production is easier and a yield of production is increased. Production typically involves making the present connecting element, providing a casing and placing the present connecting elements in corners thereof, and adding concrete. Optionally reinforcement may be provided, and floor and ceiling panels may be pre-stressed. The present floor or ceiling elements can be supported on a corner thereof in a point-like manner. As a consequence the present modular system can be applied in more and in a larger variety of applications, such as houses, hotels, apartments, schools, and so on. The present multi-storey building, such as a 2-10 storey building, can be mounted and constructed by using prefabricated elements under all weather conditions. Possible inserts can be filled with cementitious material in order to improve stability of a building.

[0011] The present connection element for connecting a floor element to a vertical support element comprises a bottom plate 1, a top plate 2, two L-shaped side plates 3,4, which are also referred to as steel angles, each individually connecting the bottom plate with the top plate, at least one opening 5 for receiving a location fixator from the vertical support element, wherein the opening is provided in a centre of the top plate, or wherein the opening is provided in a corner of the connection element, at least one anchor attached to the bottom 11 or top plate 12, characterized in the area of the bottom plate 1 is 50-300% larger than the area of the top plate 2, such as 100-200% larger. As a consequence of the different sized bottom and top plate, opening 5 is typically provided eccentric in the bottom plate. L-shaped side plates may also be formed of two plates, attached to one and another in a L-shape. In addition side plate 4 may also relate to a hollow shaped beam structure. By providing said connection element the above advantages, and further advantages as indicated throughout the description, are obtained and the drawbacks of the prior art are overcome. In particular more anchors can be provided to the bottom plate.

[0012] Contrary to the prior art, a different principle is applied in the present invention. In an example a connection with a larger heavier base plate is used to create a point-shaped support with an angle line and a top plate to which the bent or straight anchors of B500B steel are welded in accordance with NEN EN ISO 17660-1. As a result, the transverse forces are largely absorbed by the bottom plate and the tensile forces are absorbed by the anchors in the knot with the welded anchors on the bottom plate and top corner lines. With a transverse force calculation and collapse analysis it has been shown that the forces and stresses in the concrete comply safely with NEN ISO EN-1992 (Eurocode 2), even with larger spanning, solid, and thicker floor plates.

[0013] In a second aspect the present invention relates to a horizontal floor/ceiling element comprising in at least one corner thereof the present connecting element. The floor/ceiling element typically comprises 2-5 tangential force absorbers, and 5-20 radial force absorbers. Further these elements are typically reinforced, such as reinforce concrete.

[0014] In a third aspect the present invention relates to a multi-storey building comprising a detachable connecting element according to the invention and/or a detachable floor or ceiling element according to the invention, and detachable vertical supporting elements, wherein the vertical support element comprises at least one pin adapted to the opening 5 of the connecting element.

[0015] Thereby the present invention provides a solution to one or more of the above mentioned problems.

[0016] Advantages of the present description are detailed throughout the description. References to the figures are not limiting, and are only intended to guide the person skilled in the art through details of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0017] The present invention relates in a first aspect to
a connecting element according to claim 1.

[0018] In an exemplary embodiment of the present connecting element the bottom plate 1 may be 50-200% thicker than the top plate 2, such as 80-150% thicker.

[0019] In an exemplary embodiment of the present connecting element the bottom plate may comprise 1-5 anchors 11a-e, and wherein the top plate may comprise 1-3 anchors 12a-c, wherein each anchor 11,12 may extend in a direction substantially perpendicular to a side plate 3. Also the anchors extend substantially parallel to the other side of plate 3.

[0020] In an exemplary embodiment of the present connecting element at least one first anchor 11,12 may extend in a first direction, and at least one second anchor 11,12 may extend in a second direction substantially perpendicular to the first direction.

[0021] In an exemplary embodiment of the present connecting element at least one anchor 11,12 may comprise a curved section 13, such that the anchor may extend more inwardly, wherein the curved section is attached to a side plate 3.

[0022] In an exemplary embodiment of the present connecting element the bottom plate may comprise two recesses 21a,b, wherein each recess has a surface area of 1-8% of the bottom plate area, such as 2-5% thereof, and wherein

the recesses may be provided at a corner section opposite and parallel to side plates 3.

[0023] In an exemplary embodiment of the present connecting element at least one side of plate 3 may comprise a side opening 8,9 for filling the connection element, such as with cementitious material. The opening is preferably provided near the top plate.

[0024] In an exemplary embodiment of the present connecting element the at least one anchor 11,12 may be welded to the respective bottom or top plate to withstand a pressure of > 500 N/mm^2, such as > 650 N/mm^2.

[0025] In an exemplary embodiment of the present connecting element a weld of the anchor to bottom/top plate may have a thickness of 5-8 mm, such as 6-7 mm, and/or wherein a weld may be made from a NiCr metal, preferably wherein the weld is a MIG/TIG weld.

[0026] In an exemplary embodiment of the present connecting element may have a total height of 5-30 cm, preferably 10-25 cm, such as 15-20 cm.

[0027] In an exemplary embodiment of the present connecting element a bottom plate may have a thickness of 10-30 mm, such as 12-20 mm.

[0028] In an exemplary embodiment of the present connecting element a top plate may have a thickness of 5-20 mm such as 7-12 mm.

[0029] In an exemplary embodiment of the present connecting element a bottom plate may have a surface area of 150-300 cm^2, preferably 200-250 cm^2.

[0030] In an exemplary embodiment of the present connecting element a top plate may have a surface area of 80-150 cm^2, 100-120 cm^2.

[0031] In an exemplary embodiment of the present connecting element a bottom plate may extend 0-10 mm outwardly, such as 2-7 mm.

[0032] In an exemplary embodiment of the present connecting element a bottom plate may be substantially square.

[0033] In an exemplary embodiment of the present connecting element a top plate may be substantially square.

[0034] In an exemplary embodiment of the present connecting element a top plate may extend 0-10 mm outwardly, such as 2-7 mm.

[0035] In an exemplary embodiment of the present connecting element at least one side plate 3 comprises at least one hole 31.

[0036] In an exemplary embodiment of the present connecting element at least one side plate 3 may have a thickness of 3-10 mm, such as 5-8 mm.

[0037] In an exemplary embodiment of the present connecting element at least one side plate 3 may have a width 1-30% larger than a width of a bottom or top plate, preferably 2-20% larger, such as 5-12% larger.

[0038] In an exemplary embodiment of the present connecting element a side plate may be attached to a bottom and/or top plate by a weld at at least one side thereof.

[0039] In an exemplary embodiment of the present connecting element a side plate/bottom c.q. top plate weld may have a thickness of 3-6 mm, such as 4-5 mm.

[0040] In an exemplary embodiment of the present connecting element a side plate/bottom c.q. top plate weld may have a length of 40-120 mm, such as 50-100 mm.

[0041] In an exemplary embodiment of the present connecting element each anchor individually may have a cross section of 10-25 mm, such as 15-20 mm.

[0042] In an exemplary embodiment of the present connecting element each anchor individually may have a length of 100-750 mm, preferably 200-500 mm.

[0043] In an exemplary embodiment of the present connecting element each anchor individually may be made from steel, such as Fe500B HWL, or Bst500.

[0044] In an exemplary embodiment of the present connecting element each anchor individually may comprise ribs, such as 1-5 mm thick ribs, preferably 3-4 mm.

[0045] In an exemplary embodiment of the present connecting element each anchor individually may be attached to a bottom or top plate respectively at a distance of 50-100 mm from a side, such as 60-80 mm.

[0046] In an exemplary embodiment of the present connecting element each anchor individually may be attached to a bottom or top plate respectively by two welds at either side thereof.

[0047] In an exemplary embodiment of the present connecting element each anchor/plate weld may extend 40-75 mm, such as 50-60 mm.

[0048] In an exemplary embodiment of the present connecting element each anchor/plate weld may have a thickness of 5-8 mm, such as 6-7 mm.

[0049] In an exemplary embodiment of the present connecting element a curved anchor may extend 5-30 mm inwardly, such as 10-20 mm.

[0050] In an exemplary embodiment of the present connecting element plates 1-4 are made from steel, such as FE 360.

[0051] In an exemplary embodiment of the present connecting element plates 1-4 may be welded together.

[0052] In an exemplary embodiment of the present connecting element openings 5,8,9 each individually may have a

cross section of 20-40 mm, such as 25-36 mm.

[0053] In an exemplary embodiment of the present connecting element openings 5 may be provided in a bottom and top plate.

[0054] In an exemplary embodiment of the present connecting element a space in between bottom and top plate openings may be void of material.

[0055] In an exemplary embodiment of the present connecting element a weld, each individually, may be a MIG/TIG weld.

[0056] In an exemplary embodiment of the present connecting element a weld, each individually, may be over-dimensioned, typically 30-70% over-dimensioned, such that these can be stressed with 20-50% of a maximum allowable steel stress. Also in view thereof the bottom plate and welds have increased in size.

[0057] In an exemplary embodiment the present floor or ceiling may have 3-8 connecting elements, such as in rectangular shape, a trapezoid shape, a triangular shape, a hexangular shape, a circular shape, an ellipsoidal shape, and combinations thereof.

[0058] In an exemplary embodiment of the present building the vertical support element may be selected from a column and a wall segment. Therewith the present floor or ceiling elements can both be supported by a column and a wall, whatever is applicable.

[0059] In an exemplary embodiment of the present building each vertical support can received 1-6 connecting elements.

[0060] Various exemplary embodiments of the present connecting element are detailed below.

[0061] The invention is further detailed by the accompanying figures and examples, which are exemplary and explanatory of nature and are not limiting the scope of the invention. To the person skilled in the art it may be clear that many variants, being obvious or not, may be conceivable falling within the scope of protection, defined by the present claims.

SUMMARY OF FIGURES

[0062] Figures 1-2 show an example of the present connection element.

DETAILED DESCRIPTION OF FIGURES

[0063] In the figure:

100	connection element
1	bottom plate
2	top plate
3	first L-shaped side-plate
4	second L-shaped side-plate
5	opening
8	side opening
9	side opening
11a-e	bottom plate anchor
12a-c	top plate anchor
13	curved section
21a,b	recess
31	hole

[0064] Figures 1 shows an example of the present connection element. The figure has been detailed throughout the description.

[0065] Figure 2 shows outside view of the present connection element of figure 1.

[0066] The figure has been detailed throughout the description.

EXAMPLES/EXPERIMENTS

[0067]

Table 1.

	Floor Bottom Plate	200 mm 25mm	anchor 16mm	anchor 1100 mm
Force kN	33,4	71,2	105,4	112,8
Size m^2	10,0	21,4	31,6	22,9

Table 2.

	Floor Bottom Plate	300 mm 30mm	anchor 16mm	anchor 1750 mm
Force kN	52,5	88,8	121,8	176,9
Size m^2	12,9	21,8	30,0	43,5

[0068] Tables 1 and 2 are examples of strength calculations. It shows that for relatively large floor plates the present connecting element can withstand sufficient forces. Typically per mm anchor about 0.1 kN force can be absorbed. The welds used are typically over-dimensioned by a factor, such as a factor >5, and typically > 5.

[0069] In the floor plate itself, in addition to the present connection element, typically two tangential force absorbers and 4-20 radial force absorbers, with a length of 500-2000 mm, and a thickness of 5-10 mm, are provided, in every corner thereof. An area covered by the present anchors and force absorbers typically largely overlaps. The floor, including the present connection elements, can withstand large forces, as indicated in the tables.

[0070] The invention although described in detailed explanatory context may be best understood in conjunction with the accompanying figures.

[0071] It should be appreciated that for commercial application it may be preferable to use one or more variations of the present system, which would similar be to the ones disclosed in the present application and are within the spirit of the invention.

Claims

1. Connection element (100) for connecting a floor element to a vertical support element, wherein the connecting element comprises
a bottom plate (1),
a top plate (2),
a first L-shaped side plate (3) connecting the bottom plate with the top plate,
at least one opening (5) for receiving a location fixator from the vertical support element,
a second L-shaped side plate (4) connecting the bottom plate with the top plate and substantially enclosing opening (5),
at least one anchor attached to the bottom (11) or top plate (12),
characterized in
the area of the bottom plate (1) is 50-300% larger than the area of the top plate (2).

2. Connection element according to claim 1, wherein the bottom plate (1) is 50-200% thicker than the top plate (2).

3. Connection element according to any of claims 1-2, wherein the opening (5) is provided in a centre of the top plate, or is provided eccentric in the top plate, such as in a corner thereof.

4. Connection element according to any of claims 1-3, wherein the bottom plate comprises 1-5 anchors (11a-e), and wherein the top plate comprises 1-3 anchors (12a-c), wherein each anchor (11,12) extends in a direction substantially perpendicular to a side of plate (3).

5. Connection element according to any of claims 1-3, wherein at least one first anchor (11,12) extends in a first direction, and at least one second anchor (11,12) extends in a second direction substantially perpendicular to the first direction.

6. Connection element according to any of claims 1-5, wherein at least one anchor (11,12) comprises a curved section (13), such that the anchor extends more inwardly, wherein the curved section is attached to a side plate (3).

7. Connection element according to any of claims 1-6, wherein the bottom plate comprises two recesses (21a,b), wherein each recess has a surface area of 1-8% of the bottom plate area, and wherein the recesses are provided at a corner section opposite and parallel to side plates (3).

8. Connection element according to any of claims 1-7, wherein at least one side of plate (3) comprises a side opening (8,9) for filling the connection element.

9. Connection element according to any of claims 1-8, wherein the at least one anchor (11,12) is welded to the respective bottom or top plate to withstand a pressure of > 500 N/mm^2, such as > 650 N/mm^2, and/or wherein a weld of the anchor to bottom/top plate has a thickness of 5-8 mm, and/or wherein a weld is made from NiCr metal.

10. Connection element according to any of claims 1-9, having a total height of 5-30 cm, and/or
wherein a bottom plate has a thickness of 10-30 mm,
and/or
wherein a top plate has a thickness of 5-20 mm, and/or
wherein a bottom plate has a surface area of 150-300 cm^2, and/or
wherein a top plate has a surface area of 80-150 cm^2, and/or
wherein a bottom plate extends 0-10 mm outwardly, and/or
wherein a bottom plate is substantially square, and/or
wherein a top plate is substantially square, and/or
wherein a top plate extends 0-10 mm outwardly, and/or
wherein at least one side plate (3) comprises at least one hole (31), and/or
wherein at least one side plate (3) has a thickness of 3-10 mm, and/or
wherein at least one side plate (3) has a width 1-30% larger than a width of a bottom or top plate, and/or
wherein a side plate is attached to a bottom and/or top plate by a weld at at least one side thereof, and/or
wherein a side plate/bottom or top plate weld has a thickness of 3-6 mm, and/or
wherein a side plate/bottom or top plate weld has a length of 40-120 mm, and/or
wherein each anchor individually has a cross section of 10-25 mm, and/or
wherein each anchor individually has a length of 100-750 mm, and/or
wherein each anchor individually is made from steel, such as Fe500B HWL, and/or
wherein each anchor individually comprises ribs, such as 1-5 mm thick ribs, and/or
wherein each anchor individually is attached to a bottom or top plate respectively at a distance of 50-100 mm from a side, and/or
wherein each anchor individually is attached to a bottom or top plate respectively by two welds at either side thereof, and/or
wherein each anchor/plate weld extends 40-75 mm, and/or
wherein each anchor/plate weld has a thickness of 5-8 mm, and/or
wherein a curved anchor extends 5-30 mm inwardly, and/or
wherein plates (1-4) are made from steel, such as FE 360, and/or
wherein plates (1-4) are welded together, and/or
wherein openings (5,8,9) each individually have a cross section of 20-40 mm, and/or
wherein openings (5) are provided in a bottom and top plate, and
wherein a space in between bottom and top plate openings is void of material, and/or
wherein a weld is a MIG/TIG weld.

11. Horizontal floor/ceiling element comprising in at least one corner thereof a connecting element according to any of claims 1-10, such as a concrete floor, preferably comprising 2-5 tangential force absorbers, and 5-20 radial force absorbers.

12. Multi-storey building comprising a detachable connecting element according to any of claims 1-10 and/or a detachable floor or ceiling element according to embodiment 11, and detachable vertical supporting elements, wherein the vertical support element comprises at least one pin adapted to the opening (5) of the connecting element.

13. Building according to claim 12, wherein the vertical support element is selected from a column and a wall segment.

14. Building according to any of claims 12-13, wherein each vertical support can received 1-6 connecting elements.

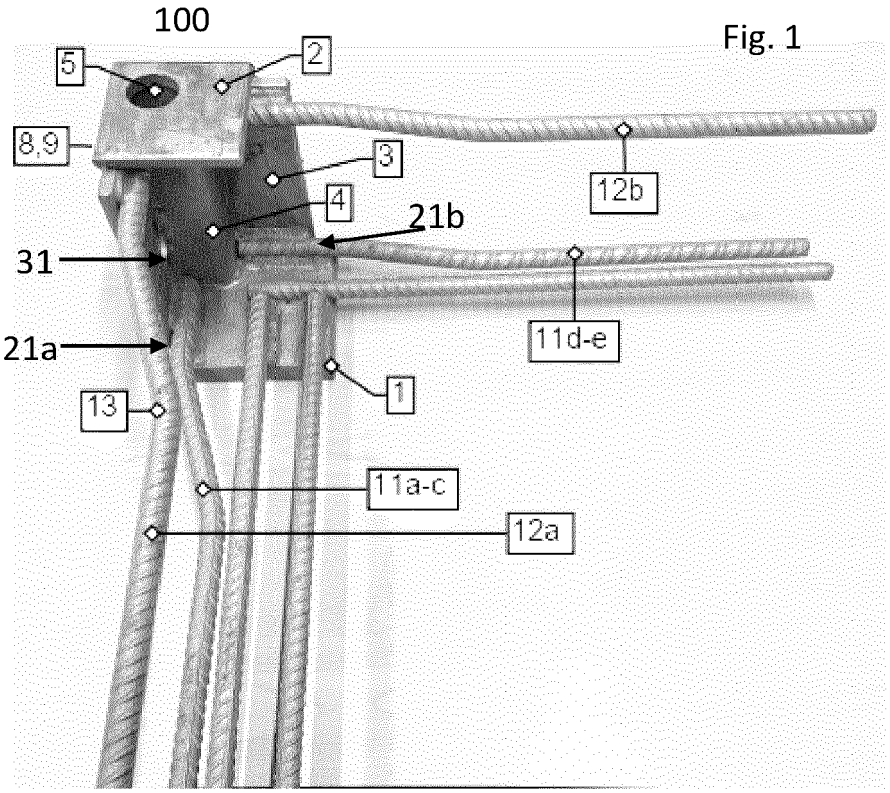

Fig. 1

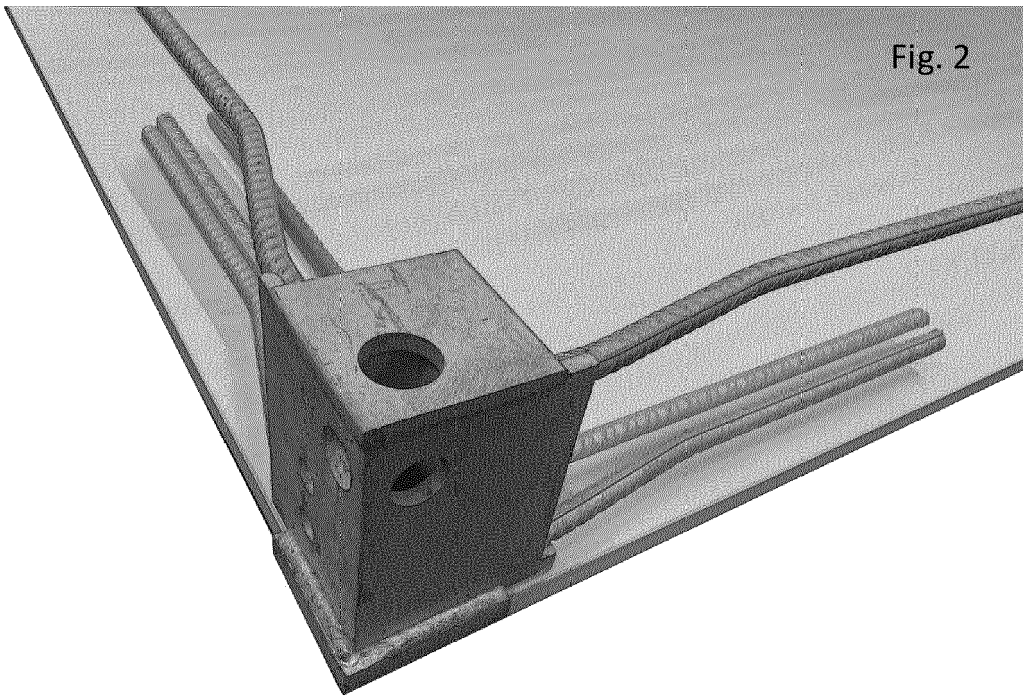

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 20 15 5948

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	DE 89 11 710 U1 (REICHARTZ PAUL) 30 November 1989 (1989-11-30) * page 6, line 17 - page 7, line 6; figures 1-3 *	1-14	INV. E04B1/04 E04C5/01 ADD. E04B1/21
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Y	DE 91 14 329 U1 (IBS GES. FÜR INTEGRIERTES BAUEN MBH) 16 January 1992 (1992-01-16) * page 3, line 25 - page 4, line 19; figures 1, 2 *	1-14	

TECHNICAL FIELDS SEARCHED (IPC)
E04B
E04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 June 2020	Galanti, Flavio

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 15 5948

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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08-06-2020

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- DE 8911710 U1 **[0008]**
- DE 9114329 U1 **[0008]**
- NL 7900922 A **[0008]**