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(54) METHOD AND KIT FOR REINFORCING A CONCRETE BEAM-COLUMN NODE

(57) Method for reinforcing a reinforced concrete beam-column node (N) comprising the steps of:
a) identifying a beam-column node (N) to be reinforced and detecting dimensional parameters characteristic of said node (N);
b) arranging two steel reinforcement plates (1) at an intervention surface (S) selected from a set of modular plates (1) made of steel according to the characteristic dimension parameters detected, and connecting the two plates (1) to each other so as to make a reinforcement assembly (100), wherein each plate (1) has a main portion (2) mainly developing along a longitudinal direction (Y) and at least two parallel arms (3) branching off from the main portion (2) in the same direction mainly developing along respective transverse directions (X) perpendicular to the longitudinal direction (Y), each arm (3) having a plurality of connecting holes (4);
c) arranging the assembly (100) on the intervention surface (S) and drilling a plurality of holes in the node (N) through selected openings (5), not overlapping in use the reinforcement bars of the node (N), of a plurality of openings (5) made in the central bodies (2) of the respective reinforcement plates (1), each hole extending perpendicularly within the node (N) with respect to the intervention surface (S);
d) fitting a plurality of dry connectors (40) within said plurality of holes through the selected openings (5).

Fig.3

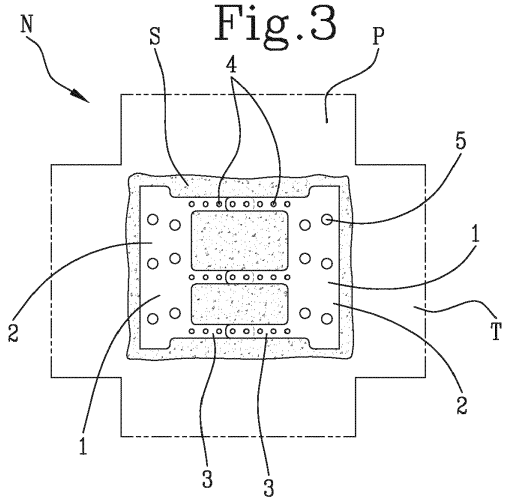
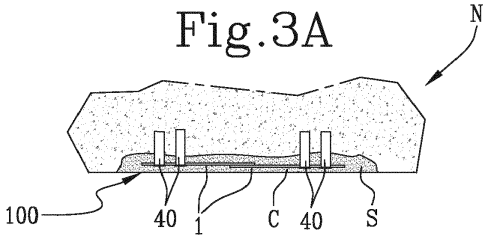


Fig.3A



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Description

FIELD OF APPLICATION

[0001] The present invention relates to a method and a kit for reinforcing a reinforced concrete beam-column node.

[0002] In particular, the present invention relates to a method and a kit for the building and construction industry that can be used for the structural reinforcement of existing building structures at the convergence area between beams and columns.

PRIOR ART

[0003] The beam-column node, i.e. the area of the load-bearing structure where the vertical and horizontal load-bearing partitions converge, represents a particularly critical area in reinforced concrete buildings. This area, in fact, being more subject to loads and stresses, must be monitored and if necessary reinforced in order to adequately resist and guarantee the safety of the building work.

[0004] Nowadays, the reinforcement (or confinement) of the nodes in the concrete structures is usually made by means of composite materials or through metal elements made *ad hoc* with specific dimensions for each node. In the latter, more widespread case, customised metal reinforcement structures are in fact designed and manufactured according to the specific dimensional parameters obtained by the analysis of the node in question. Each reinforcement structure/reinforcement is therefore designed (typically with the support of calculation and analysis software) and manufactured tailor-made for the specific application; this necessarily entails significant construction and installation costs.

[0005] The Applicant has also noted that not all known the node reinforcement techniques to date allow for easy intervention from outside the building, but require breaking elements surrounding the node (e.g.: infills, screeds, secondary partitions).

[0006] The need to break some of the surrounding elements in order to effectively install the reinforcement thus entails a high degree of invasiveness in maintenance operations that is often not acceptable; think for example of residential buildings.

[0007] Furthermore, the use of custom-made metal components requires accurate dimensional surveying and design work, which is often the cause of very long lead times due to the lengthy product design and manufacturing process.

[0008] Furthermore, the Applicant has seen how the use of chemical resins to anchor the connectors for fixing the metal components to the node to be reinforced, requires careful cleaning of the holes, the respect of a specific waiting time necessary for the product to harden, and the use of special equipment to apply the correct tightening torque (necessary to obtain adequate seismic certification of the anchorage) before proceeding with the subsequent works.

[0009] In this context, the technical task underlying the present invention is to propose a method and a kit for reinforcing a reinforced concrete beam-column node that overcomes one or more of the drawbacks of the known technique mentioned above.

[0010] In particular, aim of the present invention is to make available a method for reinforcing a reinforced concrete beam-column node that is practical and efficient, allowing the design and production process to be optimised and the installation process to be made easier and faster.

[0011] A further aim of the present invention is to make available a kit for reinforcing a reinforced concrete beam-column node that is modular, ready-to-use, easy to fabricate and versatile in use, allowing it to be adapted to different applications in a practical and efficient manner, without the need for *ad hoc* sizings.

SUMMARY OF THE INVENTION

[0012] The specified technical task and objects are substantially achieved by a method and a kit for reinforcing a reinforced concrete beam-column node, comprising the technical features set forth in one or more of the appended claims.

[0013] Specifically, in a first aspect, the present invention provides a method for reinforcing a reinforced concrete beam-column node comprising the following steps:

a) identification of a beam-column node to be reinforced and detection of dimensional parameters characteristic of the node.

[0014] In other words, in this step the node is inspected and the necessary information is gathered (e.g. the dimensions of the area to be intervened on and the depth of the concrete cover to be removed, if any) for choosing the correct type of reinforcement assembly to be assembled and subsequently installed.

[0015] Preferably, the method then comprises a step of removing an outer concrete cover layer so as to create an intervention surface wherein the reinforcement bars inside the node are exposed. In fact, every reinforced concrete structure laid in a workmanlike manner provides for a reinforcement consisting of reinforcement bars (longitudinal bars and stirrups) incorporated within a concrete casting, which once cured covers and protects the reinforcement externally (the so-called "concrete cover"). The concrete cover layer, however, tends to detach locally over the years, for various reasons, exposing the reinforcement to external agents that deteriorate it. It is therefore often necessary to remove the deteriorated layer, thus defining an intervention surface that is rearward with respect to the outer edge of the wall of the node, and to restore it with a new one at the end of the reinforcement operation.

[0016] b) Arrangement of two steel reinforcement plates at an intervention surface of the node, preferably having a thickness less than the outer concrete cover layer removed, and connection of the two reinforcement plates to each other so as to make a reinforcement assembly shaped to be arranged at the intervention surface.

[0017] Advantageously, the present invention provides that the two reinforcement plates are to be selected from a predetermined set of modular reinforcement plates made of steel according to the characteristic dimension parameters detected. In other words, it is not necessary to size the plates *ad hoc* but it is sufficient to trace within the already existing set which one might be the most suitable one for the specific node in question.

[0018] Each reinforcement plate has a main portion mainly developing along a longitudinal direction and at least two parallel arms branching off from the main portion in the same direction mainly developing along respective transverse directions perpendicular to the longitudinal direction. In other words, the arms develop perpendicular to the main portion, which will typically be arranged in a vertical position.

[0019] Each arm then has a plurality of connecting holes that serve to carry out the connection between plates.

c) Positioning of the reinforcement assembly on the intervention surface and drilling a plurality of holes in the node through selected openings, not overlapping in use the reinforcement bars of the node (so that the reinforcement bars are not compromised), of a plurality of openings made in the central bodies of the respective reinforcement plates, each hole extending perpendicularly within the node with respect to the intervention surface.

[0020] In other words, the reinforcement plates are used as a template for the holes to be drilled through the openings that are not aligned with the reinforcement bars in the node. d) Fitting a plurality of dry connectors within said plurality of holes through the selected openings.

[0021] Advantageously, the fitting of dry connectors is practical and immediate, optimising the entire reinforcement process.

[0022] Preferably, moreover, the invention may provide, in the case of prior removal of the outer concrete cover layer, the application of a layer of mortar so as to restore the removed outer concrete cover layer, thus incorporating the reinforcement assembly, even more preferably the application of a first layer of bedding mortar on which the reinforcement assembly is laid and a second layer of cover mortar to restore the concrete cover. Once the node has been reinforced by fastening the plates through the connectors, the layer of mortar solidifies the whole covering the plates and the connectors installed in the intervention surface to restore the initial concrete cover and even out the initial encumbrance of the node.

[0023] The invention therefore makes it advantageously possible to operate directly from the outside of the structure to be reinforced, guaranteeing the continuity of use of the building, without using ad hoc metal components with specific dimensions for each node, and envisaging the use of dry connectors that allow for a rapid and simplified installation of the reinforcement.

[0024] Thanks to the present invention, the reinforcement intervention is therefore quick from an execution point of view and simple from a design point of view.

[0025] In a second aspect, the invention provides a kit for reinforcing a reinforced concrete beam-column node comprising:

- a set of modular steel reinforcement plates, preferably having a thickness less than an outer concrete cover layer of the node, wherein each reinforcement plate comprises

  a main portion mainly developing along a longitudinal direction and having a plurality of openings, and

  at least two parallel arms branching off from the main portion in the same direction, mainly developing along respective transverse directions perpendicular to the longitudinal direction, each arm having a plurality of connecting holes;

- connecting means configured to connect two reinforcement plates with each other;
- a plurality of dry connectors that can be fitted into the openings of the central portions.

[0026] The kit proposed by the present invention is therefore ready to use and does not need any ad hoc design, as it can be easily adapted to any node thanks to a set of modular reinforcement plates.

[0027] In addition, the use of dry connectors reduces the number of components needed for laying, ensuring immediacy and simplicity in the installation process.

[0028] The dependent claims herein incorporated for reference, correspond to different embodiments/implementations of the invention.

[0029] Further features and advantages of the present invention will become clearer from the indicative, and therefore non-limiting, description of a preferred, but not exclusive, embodiment/implementation of a method and a kit for reinforcing a reinforced concrete beam-column node, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

Figure 1 shows a set of steel reinforcement plates of a kit for reinforcing a reinforced concrete beam-column node in accordance with the present invention.

Figure 1A is a schematic front view of a steel reinforcement plate of a kit for reinforcing a reinforced concrete beam-column node in accordance with the

present invention.

Figure 2 shows plan views of a set of steel angular plates of a kit for reinforcing a reinforced concrete beam-column node in accordance with the present invention.

Figure 2A is an enlarged schematic perspective view of a steel angular plate, of the type illustrated in Figure 2, of a kit for reinforcing a reinforced concrete beam-column node in accordance with the present invention.

Figure 3 is a schematic frontal view of a beam-column node during a step of laying a reinforcement assembly in accordance with the method for reinforcing a reinforced concrete beam-column node according to the present invention.

Figure 3A is a schematic section of the node in Figure 3 during a subsequent step of fitting a plurality of dry connectors.

Figure 4 is a schematic perspective view of a beam-column angular node during a step of laying a reinforcement assembly comprising a steel angular plate interposed between the two reinforcement plates, in accordance with the method for reinforcing a reinforced concrete beam-column node according to the present invention.

Figure 5 shows an embodiment variant of the assembly in Figure 3, in which the assembly also comprises steel extensions.

Figure 6 shows an embodiment variant of the assembly in Figure 4, in which the assembly also comprises steel extensions.

DETAILED DESCRIPTION

[0031] With reference to the attached figures, N denotes as a whole a reinforced concrete beam-column node at the convergence area between a beam T and a column P, while 100 denotes as a whole a reinforcement assembly that is installed in the node N to reinforce it.

[0032] The method for reinforcing the node N comprises a preliminary step a) of identifying the node N to be reinforced and detecting dimensional parameters characteristic of the node N.

[0033] Preferably, the detection step can be carried out by visual inspection or by means of special instrumentation, e.g. a pacometer.

[0034] Preferably, the dimensional parameters characteristic of the node N may comprise: node N width, node N height, concrete cover thickness and reinforcement bar layout (not visible in the attached figures).

[0035] The method then preferably comprises a step of removing the outer concrete cover layer C so as to create an intervention surface S wherein the reinforcement bars inside node N (not illustrated in the attached figures) are exposed.

[0036] Preferably the removal step comprises a substep of removing a layer of rust from the exposed reinforcement bars, even more preferably by means of brushing or sandblasting.

[0037] Preferably, the removal step is carried out by means of mechanical milling or hydrodemolition.

[0038] It should be noted that in the attached figures, reference is made to an implementation of the method in which the step of removing the concrete cover layer was envisaged, although this step may be considered optional for the implementation of the method in the event that the concrete cover layer is in good condition and therefore does not need to be removed.

[0039] The method then advantageously comprises a step b) of arranging two steel reinforcement plates 1 at an intervention surface (S) of the node (N), preferably having a thickness less than the outer concrete cover layer C removed, if any, so that, after being installed in the node N - as will be clearer from the description that follows - the overall volume of the reinforced N is not altered compared to the initial one (because they are incorporated in the new concrete cover layer).

[0040] In particular, the reinforcement plates 1 are selected from a set of modular steel reinforcement plates 1, illustrated by way of example in Figure 1, based on the characteristic dimension parameters detected.

[0041] In other words, thanks to the present invention, it is possible to choose, within a set of reinforcement plates 1 already carried out, which pair of plates 1 best suits the dimensional characteristics of the node N detected, bearing in mind that the two plates 1 may be connected by simple overlapping or by means of extensions and/or angular profiles, as will be better understood in the continuation of the description.

[0042] In fact, the method envisages the connection/assembly of the two reinforcement plates 1 to each other so as to make the reinforcement assembly 100 shaped to, i.e. suitable to, be arranged at the intervention surface S.

[0043] Preferably the connection is made by means of bolting.

[0044] With reference to Figure 1A, in particular, each reinforcement plate 1 has a main portion 2 mainly developing along a longitudinal direction Y and at least two parallel arms 3 (three in number in the example of Figure 1A) branching off from the main portion 2 in the same direction mainly developing along respective transverse directions X perpendicular to the longitudinal direction Y, each arm 3 having a plurality of connecting holes 4.

[0045] Through the plurality of connecting holes, the connection between the two reinforcement plates 1 can be carried out.

[0046] Preferably step b) comprises a sub-step of arranging a steel angular plate 10, preferably having a thickness less than the outer concrete cover layer C removed, even more preferably equal to the thickness of the reinforcement plates 1.

[0047] In particular, the angular plate 10 is selected from a set of modular steel angular plates 10, illustrated by way of an example in Figure 2, according to the characteristic dimension parameters detected.

[0048] With reference to Figure 2A, the angular plate 10 has an angular portion 11 comprising two side wings 12 that are mutually tilted, preferably by a right angle, mainly developing along a respective longitudinal direction K (parallel in use to the longitudinal direction Y of the main portion 2 of the reinforcement plates 1), and at least two parallel arms 13 (three in number in the example of Figure 2A) branching off from each side wing 12 in the same direction mainly developing along respective transverse directions J perpendicular to the longitudinal direction K (parallel in use to the transverse directions X of the arms 3 of the reinforcement plates 1).

[0049] In particular, each arm 13 has a respective plurality of connecting holes 14 adapted to connect with the respective connecting holes 4 of the arms 3 of the plates 1 by means of bolting to carry out the connection between the two reinforcement plates 1.

[0050] The user selects certain connecting holes 4 of the arms 3 to be connected to respective connecting holes 14 of the arms 13 according to the dimensional parameters characteristic of the node N so that the angular plate 10 is interposed between the two reinforcement plates 1, as illustrated in Figure 4.

[0051] In other words, the arms 13 of one side wing 12 are connected to the arms 3 of a first reinforcement plate 1 and the arms 13 of the other side wing 12 are connected to the arms 3 of a second reinforcement plate 1, so that the transverse directions X, J are parallel.

[0052] Preferably, step b) comprises a sub-step of arranging at least two steel extensions 20, visible in Figures 5 and 6, preferably having a thickness less than the outer concrete cover layer C of the node N, even more preferably equal to the thickness of the reinforcement plates 1 and/or to the thickness of the angular plate 10.

[0053] Each extension 20 has a sequence of connecting holes 21 arranged along a main development direction of the extension (parallel in use to the transverse direction X of the arms 3).

[0054] As illustrated in Figure 5, the connection between the two reinforcement plates 1 can thus be carried out by connecting selected connecting holes 4 of the arms 3 with respective connecting holes 21 of the extensions 20 so that the extensions 20 are interposed between the two reinforcement plates 1.

[0055] In other words, the extension 20 is connected on the one hand to a first reinforcement plate 1 and on the other hand to a second reinforcement plate 1, so that the main development direction of each extension 20 is parallel to the respective transverse directions X of distinct arms 3 of distinct reinforcement plates 1 connected on opposite sides.

[0056] As illustrated in Figure 6, preferably the method can also comprise the step of connecting the extensions 20 on the one hand to the arms 3 of the reinforcement plates 1 and on the other hand to the arms of the angular plate 10. In other words, the extensions 20 can also be used for the angular nodes N, interposing respectively as a connection between the two reinforcement plates 1 and the angular plate 10.

[0057] Preferably, step b) may comprise a sub-step of coupling a steel support plate (not illustrated), preferably having a thickness equal to the steel support plates 1, to the central portion 2 of one of the two support plates 1 so that at least one opening 5 of the central portion 2 is overlapped and aligned with a respective opening of the support plate.

[0058] The support plate can advantageously be used as a compensation thickness for the space between one of the two reinforcement plates 1 and the intervention surface S.

[0059] Once the reinforcement assembly 100 has been assembled, whether it is simply composed of two overlapped plates 1 (as illustrated in Figure 3) or of two plates 1 connected by extensions 20 (as illustrated in Figure 5) or of plates 1 connected by the use of angular plate 10 (as illustrated in Figure 4) or again of two plates connected to the angular plate 10 by means of extensions 20 (as illustrated in Figure 6), the method according to the present invention comprises a subsequent step c) of arranging the reinforcement assembly 100 on the intervention surface S.

[0060] In this step, a plurality of holes, not visible in the attached figures, is drilled in the node N through selected openings 5, not overlapping in use the reinforcement bars of the node N, of a plurality of openings 5 made in the central bodies 2 of the respective reinforcement plates 1.

[0061] In particular, each hole is drilled in the thickness of the node N, developing perpendicularly to its interior with respect to the intervention surface S, so that the holes are perpendicular in use to the reinforcement plates 1. Preferably, drilling is carried out by means of a hammer drill, while the dry anchoring of the connectors by means of an impact wrench.

[0062] Subsequently, the method envisages a step d) in which a plurality of dry connectors 40 are fitted within the plurality of holes drilled and fitting them through the selected openings 5.

[0063] In other words, the connectors 40 are simply fitted into node N to connect the two reinforcement plates 1 to the node N.

[0064] Preferably, the method may then envisage, subsequent to step d), a step of applying a layer of mortar until the outer concrete cover layer C removed is restored and incorporating the reinforcement assembly 100 so as to solidify the whole and restore the initial volume of the node N, as illustrated for example in Figure 3A.

[0065] Preferably the outer concrete cover layer C is at least 15 mm.

[0066] Preferably, moreover, after step c), in which the holes are drilled using the assembly 100 as a template, and before step d), in which the dry connectors 40 are fitted, the method may comprise the steps of:

- temporarily removing the reinforcement assembly 100 from the intervention surface,
- applying a first layer of mortar at the intervention sur-

face at least to cover exposed reinforcement bars, and

- aligning the plurality of holes with the selected openings 5 and fitting the reinforcement assembly 100 at least partially inside the mortar layer.

[0067] In other words, to enable better positioning of the assembly 100 and better adherence/solidification of the assembly 100 on the node N, it is possible to temporarily remove the assembly 100 used as a template for drilling the holes and applying a first layer of mortar.

[0068] The application of the first layer of mortar allows the intervention surface S to be evened out while protecting the exposed reinforcement bars.

[0069] However, the laying of the assembly 100 must be carried out quickly before the layer of mortar hardens.

[0070] The mortar can be applied manually by trowel or by means of spraying machine, paying attention to the setting speed.

[0071] Preferably between the step of removing the assembly 100 and the step of applying the first layer of mortar, the method may provide for a step of cleaning the intervention surface S, and a subsequent step of wetting the intervention surface S to saturation (so-called "completely wetting").

[0072] Cleaning can be carried out, for example, by means of high-pressure cleaner or compressed air, according to known techniques.

[0073] The present invention also relates to a kit for reinforcing a reinforced concrete beam-column node N comprising:

- a reinforcement assembly 100 in accordance with the above, comprising at least one set of modular steel reinforcement plates 1,
- connecting means (preferably bolting), not illustrated, configured to connect two reinforcement plates 1 with each other, and
- a plurality of dry connectors 40 that can be fitted into the openings 5 of the central portions 2 of the reinforcement plates 1 (and possibly within the support plates).

[0074] Preferably, the reinforcement assembly 100 comprises one or more of:

- a set of modular steel angular plates 10 in accordance with the above,
- a plurality of steel extensions 20 in accordance with the above.

[0075] Advantageously, the angular plates 10 and the extensions 20 can be connected to the reinforcement plates 10 by means of the connecting means.

[0076] Preferably the assembly 100 is made of S355 steel and preferably undergoes a protective treatment, such as a hot-dip galvanising treatment. The present invention achieves the proposed aims, overcoming the drawbacks complained about in the known technique, by making available a kit and a method for reinforcing a reinforced concrete beam-column node that envisages using plates and accessories with standardised shapes and dimensions, so that they can be assembled directly in situ, allowing for versatile adaptation to a wide variety of geometries of the nodes, and reducing production-design time and costs.

[0077] The proposed system guarantees an effective application of the reinforcement from the outside of the building without interrupting its use, minimising the invasiveness of the intervention; finally, the dry anchoring (without chemical resins-anchor agents) simplifies and speeds up the entire installation process.

Claims

1. Method for reinforcing a reinforced concrete beam-column node (N) comprising the steps of:

   a) identifying a beam-column node (N) to be reinforced and detecting dimensional parameters characteristic of said node (N);
   b) arranging two steel reinforcement plates (1) at an intervention surface (S) of the node (N), said reinforcement plates (1) being selected from a set of modular reinforcement plates (1) made of steel according to the characteristic dimension parameters detected, and connecting said two reinforcement plates (1) to each other so as to make a reinforcement assembly (100) shaped to be arranged at the intervention surface (S),
   wherein each reinforcement plate (1) has a main portion (2) mainly developing along a longitudinal direction (Y) and at least two parallel arms (3) branching off from the main portion (2) in the same direction mainly developing along respective transverse directions (X) perpendicular to the longitudinal direction (Y), each arm (3) having a plurality of connecting holes (4);
   c) arranging the reinforcement assembly (100) on the intervention surface (S) and drilling a plurality of holes in the node (N) through selected openings (5), not overlapping in use the reinforcement bars of the node (N), of a plurality of openings (5) made in the central bodies (2) of the respective reinforcement plates (1), each hole extending perpendicularly within the node (N) with respect to the intervention surface (S);
   d) fitting a plurality of dry connectors (40) within said plurality of holes through said selected openings (5).

2. Method according to claim 1 comprising, between step a) and step b), a step of removing an outer concrete cover layer (C) so as to create an intervention

surface (S) wherein the reinforcement bars inside the node (N) are exposed,
and after step d), a step of applying a layer of mortar until the outer concrete cover layer (C) removed is restored and incorporating the reinforcement assembly (100).

3. Method according to claim 2, wherein said step of removing the outer concrete cover layer (C) comprises a sub-step of removing a layer of rust from the exposed node reinforcement bars (N), preferably by means of deburring or sandblasting.

4. Method according to claim 2 or 3, wherein said step of removing the outer concrete cover layer (C) is carried out by means of mechanical milling or hydrodemolition.

5. Method according to one of the preceding claims, comprising, after step c) and before step d), the steps of:

- removing the reinforcement assembly (100) from the intervention surface (S),
- applying a first layer of mortar at the intervention surface (S) at least to cover any exposed reinforcement bars of the node (N), and
- aligning the plurality of holes with the selected openings (5) and fitting the reinforcement assembly (100) at least partially inside the mortar layer.

6. Method according to claim 5 comprising, between the step of removing the reinforcement assembly (100) and the step of applying the first layer of mortar, a step of cleaning the intervention surface (S), and a subsequent step of wetting said intervention surface (S) to saturation.

7. Method according to one or more of the preceding claims, wherein said step b) comprises a sub-step of arranging a steel angular plate (10) selected from a set of modular steel angular plates (10) according to the detected characteristic dimension parameters and having an angular portion (11) comprising two side wings (12) that are mutually tilted, preferably by a right angle, manly developing along a respective longitudinal direction (K), and at least two parallel arms (13) branching off from each side wing (12) in the same direction mainly developing along respective transverse directions (J) perpendicular to the longitudinal direction (K), each arm (13) having a respective plurality of connecting holes (14);
and wherein the connection between the two reinforcement plates (1) is carried out by connecting selected connecting holes (14) of the arms (13) of the reinforcement plates (1) with respective connecting holes (4) of the arms (3) of the angular plate (10) so that the angular plate (10) is interposed between the two reinforcement plates (1).

8. Method according to one or more of the preceding claims, wherein said step b) comprises a sub-step of arranging at least two steel extensions (20), each extension (20) having a sequence of connecting holes (21) arranged along a main direction of development of the extension (20), and wherein the connection between the two reinforcement plates (1) is made by connecting selected connecting holes (4) of the arms (3) of the reinforcement plates (1) with respective connecting holes (21) of the extensions (20) so that the extensions (20) are interposed between the two reinforcement plates (1).

9. Method according to claims 7 and 8, comprising the step of connecting said extensions (20) on the one hand to the arms (3) of the reinforcement plates (1) and on the other hand to the arms (13) of the angular plate (10).

10. Method according to one or more of the preceding claims, wherein said step b) comprises a sub-step of coupling a steel support plate to the central portion (2) of one of the two steel reinforcement plates (1) so that at least one opening (5) of the central portion (2) is overlapped and aligned with a respective opening (5) of the support plate.

11. Method according to one or more of the preceding claims, wherein said reinforcement assembly (100) is made of steel S355 and preferably undergoes a protective treatment, such as a hot-dip galvanising treatment.

12. Kit for reinforcing a reinforced concrete beam-column node comprising:

- a reinforcement assembly (100) comprising at least one set of modular steel reinforcement plates (1), wherein each reinforcement plate (1) comprises

  a main portion (2) mainly developing along a longitudinal direction (Y) and having a plurality of openings (5), and
  at least two parallel arms (3) branching off from the main portion (2) in the same direction, mainly developing along respective transverse directions (X) perpendicular to the longitudinal direction (Y), each arm (3) having a plurality of connecting holes (4);

- connecting means configured to connect two reinforcement plates (1) with each other; and
- a plurality of dry connectors (40) that can be fitted into the openings (5) of the central portions

(2).

13. Kit according to claim 12, wherein said reinforcement assembly (100) comprises one or more of:

- a set of modular steel angular plates (10), wherein each angular plate (10) comprises

  an angular portion (11) defined by two side wings (12) that are mutually tilted, preferably by a right angle, mainly developing along a respective longitudinal direction (K), and at least two parallel arms (13) branching off from each side wing (12) in the same direction mainly developing along respective transverse directions (J) perpendicular to the longitudinal direction (K), each arm (13) having a respective plurality of connecting holes (14); and

- a plurality of steel extensions (20), each extension (20) having a sequence of connecting holes (21) arranged along a main development direction of the extension (20).

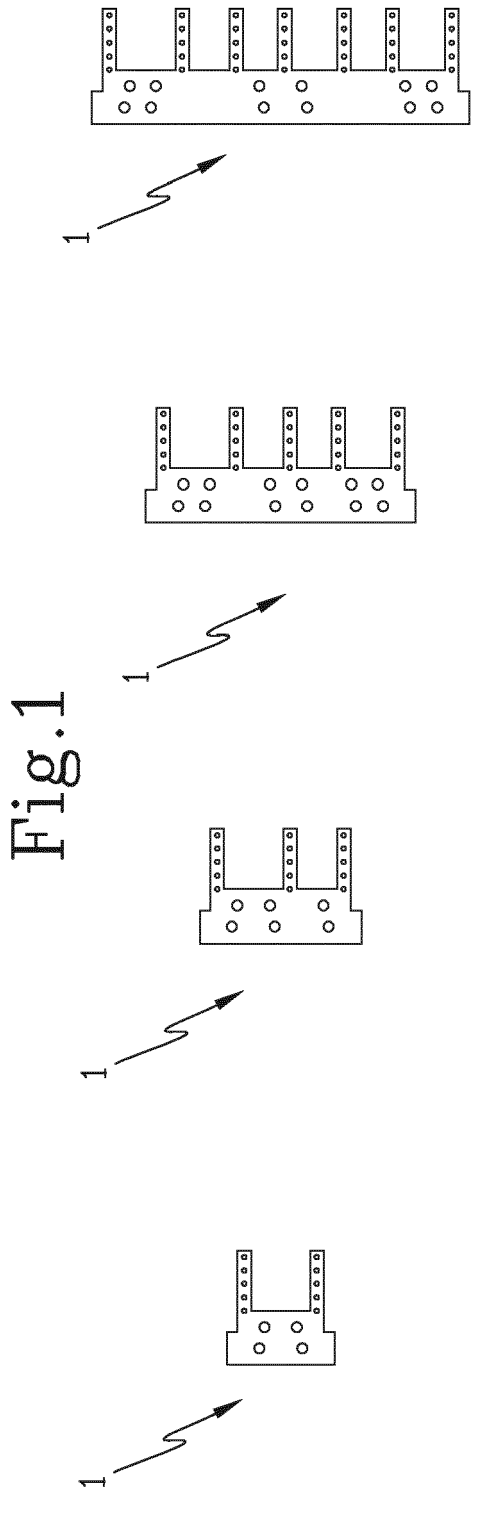

Fig.1

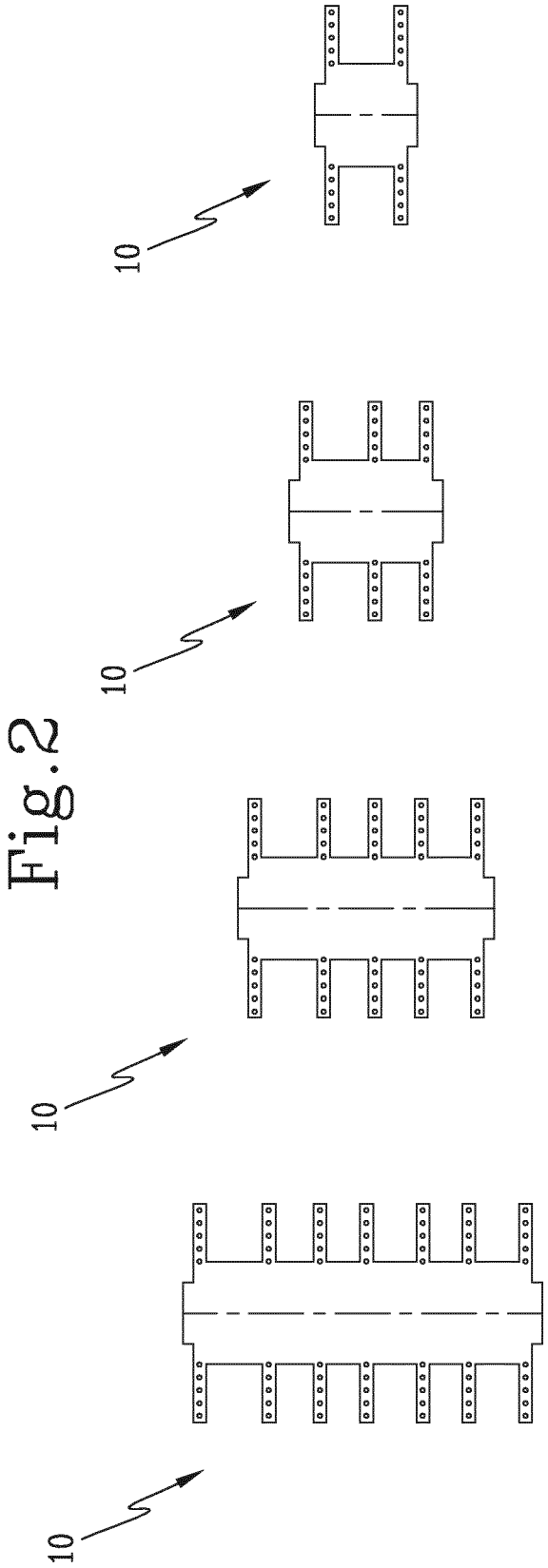

Fig.2

Fig.2A

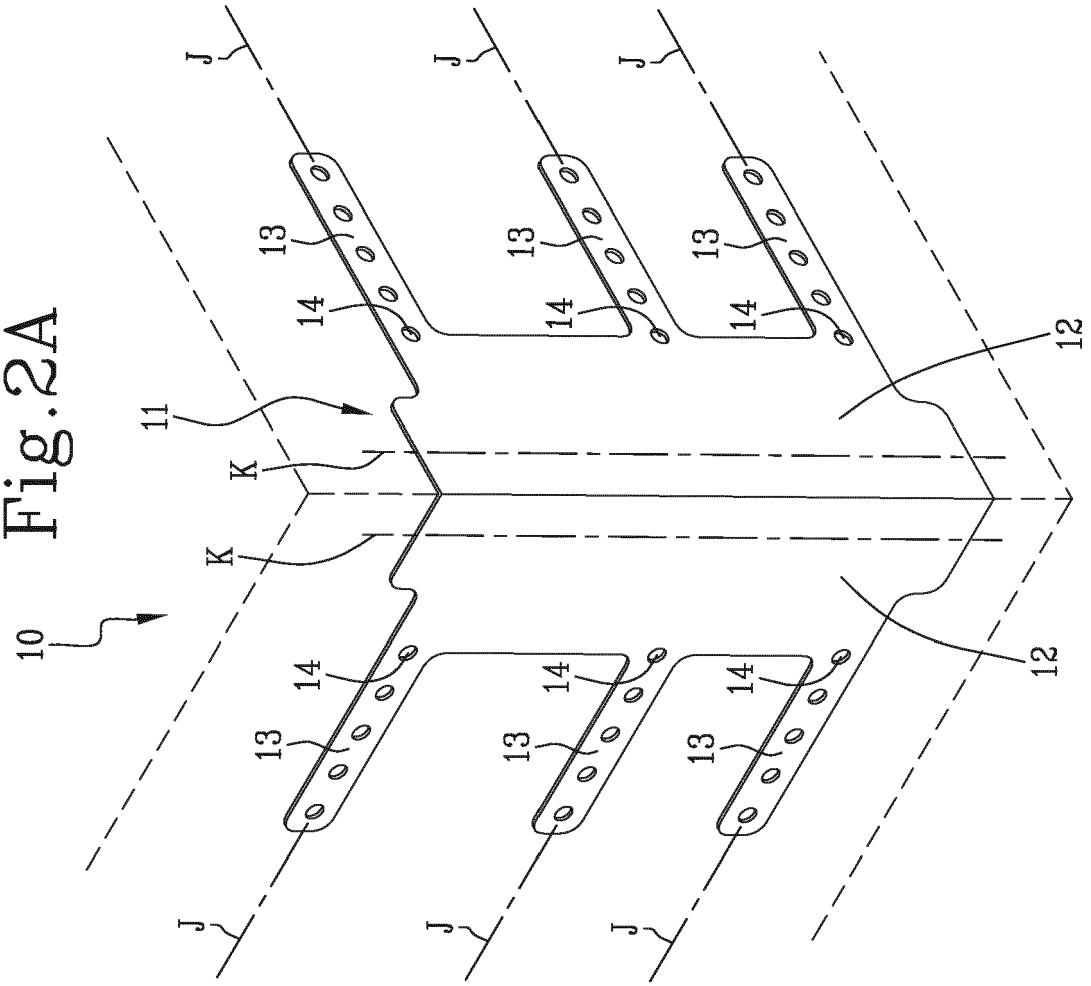

Fig.1A

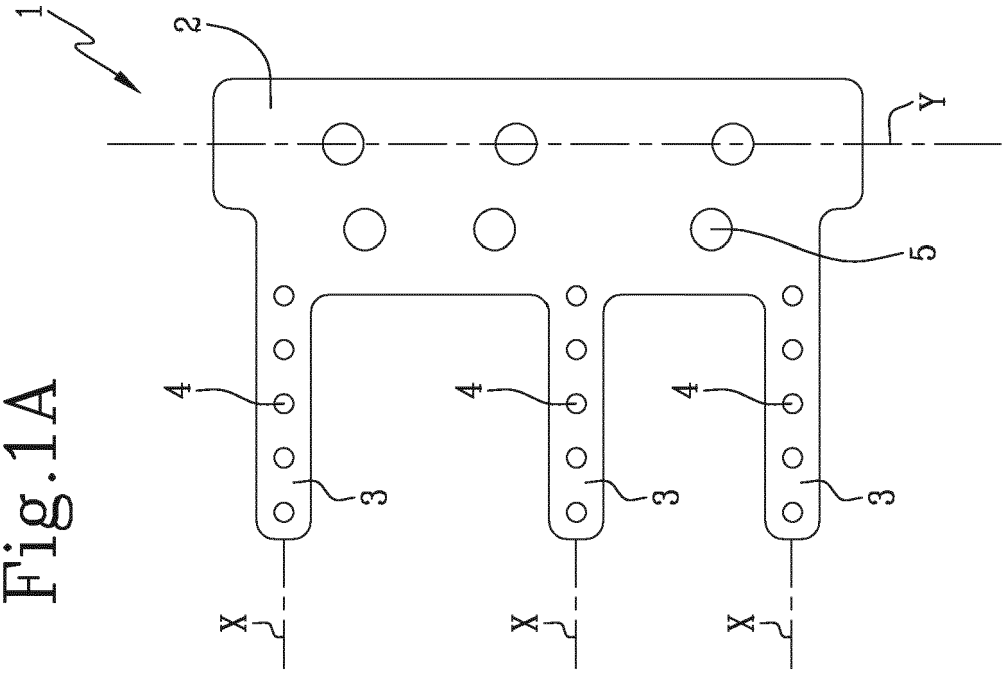

Fig.4

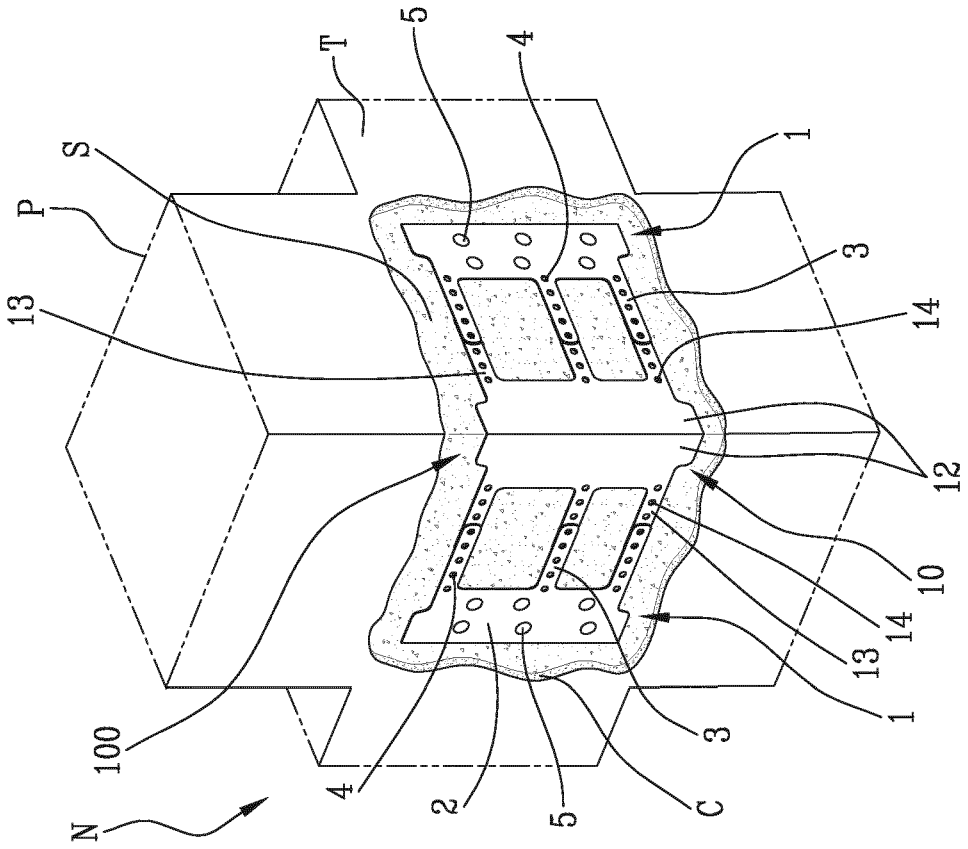

Fig.3

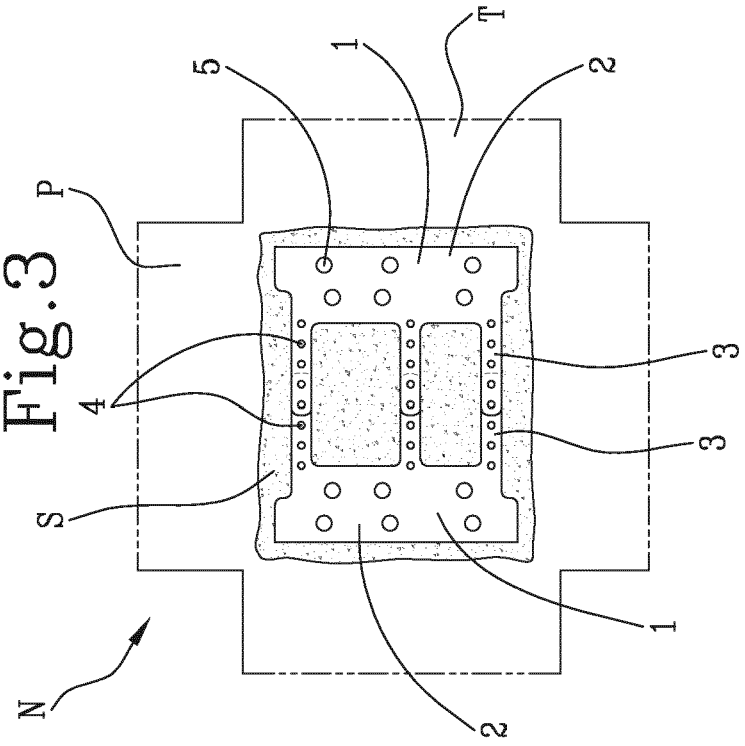

Fig.3A

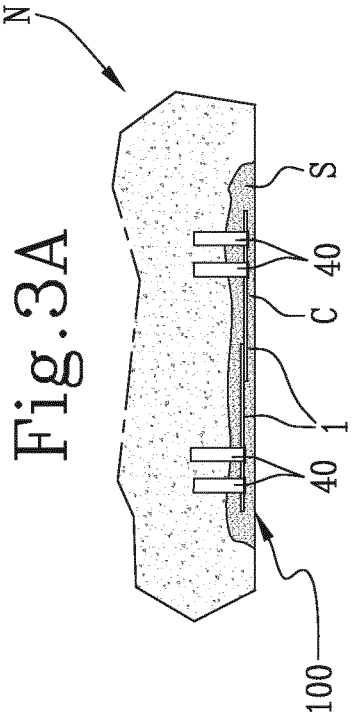

Fig.6

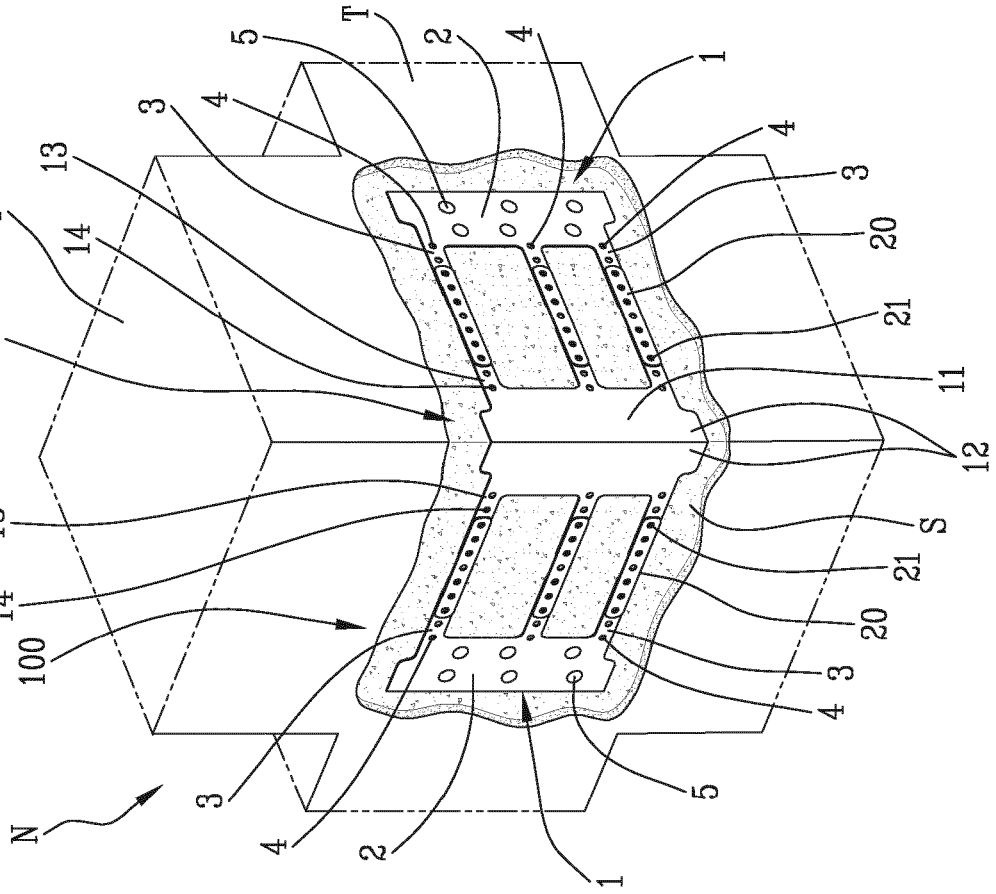
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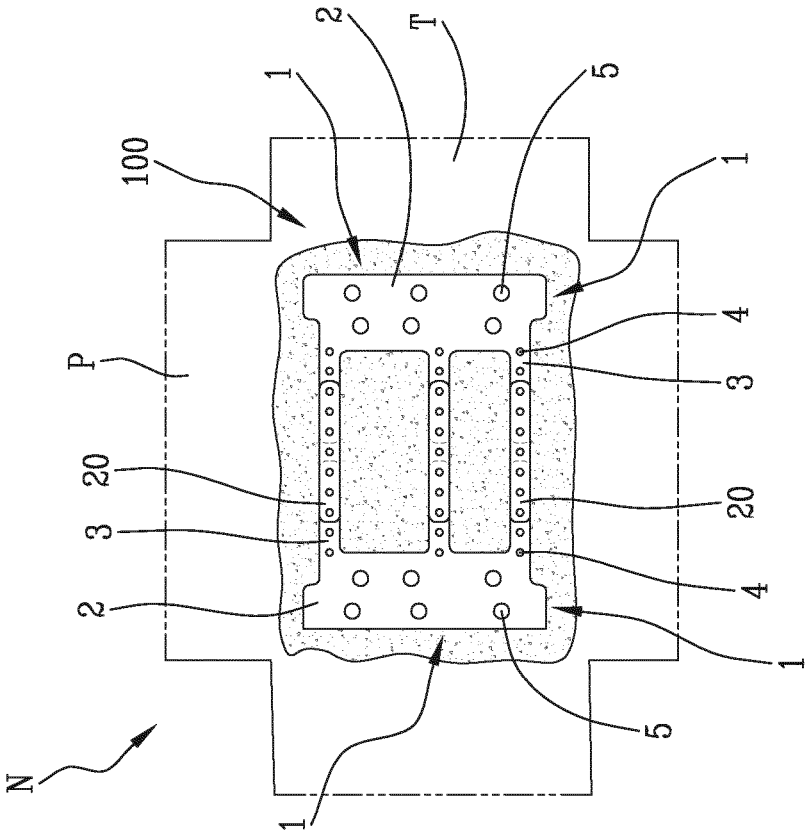
Fig.5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EUROPEAN SEARCH REPORT

Application Number
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A	* Automatic Translation; paragraph [0014] - paragraph [0016]; claim 1; figures 1,2 *	1-11	E04C3/34 E04C5/06
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A	* claim 1; figures 1-7 *	1-11,13	
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A	CN 112 324 178 A (UNIV HUAQIAO) 5 February 2021 (2021-02-05) * figures 1-5 *	1-13	
			TECHNICAL FIELDS SEARCHED (IPC)
			E04G E04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 July 2023	Baumgärtel, Tim

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