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(54) **MORTAR-LINE REINFORCEMENT FOR STRENGTHENING BRICK OR BLOCK WALLS**

(57) Reinforcement tie (1) for structural which comprises two longitudinal bars or plates (2) connected by internal bars or plates, ending in a female end (3) and a male end (4) that is narrower than the female one (4). In at least one of the male (5) and female ends (4) the cross section of the corresponding internal bars or plates (3)

is, totally or partially, less than the cross section of the other internal bars or plates, or in at least one of the male (5) and female ends (4), the corresponding internal bars or plates (3) have an area where the bar or plate (3) changes direction, with this area forming an entrance slot (8).

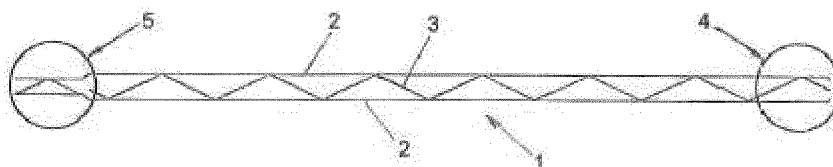


FIG. 6

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Description

Field of the invention

[0001] This invention involves a reinforcement tie for structural use, similar to those which are embedded in prefabricated wall bed joints that already have a pre-designated function related to the mechanical performance of the wall in which they are installed.

Background of invention

[0002] Prefabricated reinforcement ties that are used for embedding in masonry wall bed joints (also known as "bed joint reinforcement ties") and which are intended to improve the mechanical performance of walls, consist of two longitudinal steel bars or plates connected at given distances by other transverse bars or plates, or by a continuous plate forming a triangular lattice.

[0003] The joint reinforcement ties currently on the market come in various geometrical configurations, but their geometry always remains constant throughout the piece, keeping the same position, even at the ends.

[0004] Thus, for example, the applicant's GEOFOR® standard reinforcement tie belongs to the triangular lattice group. The unique characteristic of this arrangement is that the reinforcement tie cannot be deformed in its plane. This provides a crucial advantage for the component's mechanical performance by making it resistant to perpendicular forces from the wall along its plane, regardless of the contribution of the mortar in which it is embedded.

[0005] This unique characteristic of reinforcement ties with triangular lattice shapes remains the same across the entire piece up to the joints at the ends which represent the first and last triangulation. Conversely, in the case of the ends of parts made up of segments of non-triangular bars, their capacity to transmit forces to the system as a whole depends on the mortar that surrounds them. Precisely at the ends of the pieces, and only at their ends, it is necessary for there to be mortar that is properly covered in order to prevent the system from deforming, and to transmit the forces along the length of the wall.

[0006] When reinforcement ties are assigned a structural role in order to increase the mechanical properties of the wall in which they are installed, the possibility of transmitting forces is entrusted to the overlaps of each component they border. Therefore, the end conditions are particularly designed for this purpose. On the other hand, the bars are cut after the steel wire is galvanised, so that the ends of the parts' cut sections are left without proper protection.

[0007] As for the overlaps of the reinforcement ties, it is not possible to superimpose them vertically because the dimensions established for their thickness do not provide for the possibility of properly coating the bars with a suitable mortar that would make it possible to transmit

the forces. Therefore, the overlapping is installed along the same plane, connected to the end of a contiguous component.

[0008] In addition to a decrease in the performance of the overlapping reinforcement tie, the overlapping process also entails a series of drawbacks:

- The need to manipulate the components on site. In order for the overlap to have the minimum required length (around 250 mm), shears need to be used to make at least one diagonal cut at the end of each piece. The cut sections, in turn, represent new unprotected points that run the risk of opening the door to corrosion.
- Decrease in the mortar covering. The set of overlapping bars must be covered with enough mortar between them to properly transmit the forces for which they are designed. This entails a decrease in the nominal covering in comparison to the lateral edge of the wall around the overlap areas. The problem is exacerbated because it is precisely at the overlap areas where the cut sections of the reinforcement ties lie-- where the steel is unprotected. It is important to note here that if the wall reinforcement tie is protected, it suffices to have a 15 mm lateral covering, but if bare steel is used, then standards require a minimum covering of 30 mm from any point on the edge of the wall's exterior.
- Decreased resistance in the wall. In order to adhere to the minimum coverage specified by standards as a protection requirement, the lateral edges of wall reinforcement ties in overlapping areas must have narrower reinforcement tie than what would be viable in a centre area. This entails a proportional decrease in the reinforced wall's resistance to lateral forces.
- The impracticality of meeting the minimum covering requirement in hollow reinforcement tie assemblies. In hollow reinforcement tie assemblies the reinforcement tie must have a minimum width in order to be housed in the external band of the mortar. This situation is incompatible with the minimum coating requirement for reinforcement ties in overlap areas.

[0009] The difficulty in simultaneously meeting the conditions for the overlap length and overlap covering in reinforcement tie overlaps, combined with the geometry and dimensions of the masonry components in use restricts the possibility of assigning structural tasks to the wall reinforcement tie, and this substantially decreases the manufacturer's conditions for protecting the system from external exposure.

Summary of the invention

[0010] The goal of this invention is to create a reinforcement tie for structural use in embedding in masonry wall bed joints that will be able to overcome the drawbacks of the proposals of the prior art, and which will

make it possible to transmit forces properly between each reinforcement tie and its contiguous reinforcement tie--an aspect that is crucial for assigning structural functions to reinforcement ties.

[0011] The invention involves a reinforcement tie for structural use comprising two longitudinal bars or plates connected by internal bars or plates, ending in a female end and a male end that is narrower than the female one. In at least one of the male and female ends the cross section of the corresponding internal bars or plates is, totally or partially, less than the cross section of the other internal bars or plates, or in at least one of the male and female ends, the corresponding internal bars or plates have an area where the bar or plate changes direction, with this area forming an entrance slot.

[0012] This makes it possible to superimpose the reinforcement ties and their contiguous reinforcement ties in different planes without decreasing the upper and lower covering required by standards.

[0013] Another advantage of the invention is that it makes it possible to avoid manipulating the parts during construction, since the geometry of the internal bars is modified during the manufacturing process.

[0014] Other advantageous embodiments of the invention are set out in the dependent claims.

Brief description of the drawings

[0015] The subject of this invention will be illustrated below in a non-restrictive manner, by making reference to the accompanying drawings, in which:

Figure 1 shows a plan view of a triangle lattice wall reinforcement tie designed with the prior art.

Figure 2 shows a plan view of two overlapped triangle lattice wall reinforcement ties designed with the prior art, together with their overlap lengths.

Figure 3 shows a plan view of two overlapped triangle lattice wall reinforcement ties designed with the prior art, with their overlap lengths increased.

Figure 4A shows a plan view of a wall reinforcement tie from the prior art over masonry components, indicating the distance of the reinforcement tie from the lateral side of the wall formed by the components.

Figure 4B shows a plan view of two wall reinforcement ties from the prior art over overlapping masonry components, indicating the distance of the reinforcement ties from the lateral side of the wall in the overlap area.

Figure 5A shows a plan view of a wall reinforcement tie from the prior art in a hollow reinforcement tie assembly, indicating the distance of the reinforcement tie from the lateral side and the lateral bands of the mortar.

Figure 5B shows a plan view of two wall reinforcement ties from the prior art, overlapped in a hollow reinforcement tie assembly, indicating the distance of the reinforcement ties from the lateral side and

the lateral bands of the mortar.

Figure 6 shows a plan view of the reinforcement tie for structural use of the invention.

Figure 7 shows a plan view of the end of a reinforcement tie installed for structural use of the invention, with the end of one of the contiguous reinforcement ties level and superimposed.

Figure 8 shows a detailed perspective of the end of the reinforcement tie installed for structural use of the invention from Figure 7.

Figure 9 shows a detailed perspective of the two contiguous reinforcement ties from Figure 7.

Figure 10 shows a section schematic of the end of the reinforcement tie of the invention in structural use from Figure 7, installed in the wall reinforcement tie located inside the wall.

Figure 11 shows a plan view of the end of a reinforcement tie installed for structural use of the invention, with the end of one of the contiguous reinforcement ties level and superimposed.

Figure 12 shows a detailed perspective of the end of the reinforcement tie installed for structural use of the invention from Figure 11.

Figure 13 shows a detailed perspective of the two contiguous reinforcement ties from Figure 11.

Figure 14 shows a section schematic of the end of the reinforcement tie of the invention in structural use from Figure 11, installed in the wall reinforcement tie located inside the wall.

Figure 15 shows a section schematic of the end of the reinforcement tie of the invention in structural use, installed in the bed reinforcement tie located inside the wall.

Detailed description of the invention

[0016] Figures 1 - 5B show configurations with bed reinforcement tie from the prior art with triangle lattice.

[0017] Figure 1 shows a standard, triangle lattice shaped bed reinforcement tie. Here a triangular area can be seen, the plane of which cannot be deformed. Force is transmitted by the reinforcement tie itself (indicated by the letter 'a'). It has non-triangulated anchor areas and the forces are transmitted by adherence to the mortar (indicated by the letter 'b'). It also shows a series of diagonal segments at the end, which are inert for mechanical performance (indicated by the letter 'c'), and cut sections of the reinforcement tie (indicated by the letter 'd') which are unprotected against corrosion.

[0018] Figure 2 shows a plan view of two overlapped triangle lattice bed reinforcement ties designed with the prior art, together with their overlap lengths. In these figures the overlapping is installed along the same plane, connected to the end of a contiguous component. In this figure, the maximum possible overlap length without cutting the reinforcement ties is marked as 'L'.

[0019] Figure 3 shows a plan view of two overlapped bed reinforcement ties designed with the prior art, with

their overlap length (L) increased. This overlap length is necessary for transmitting forces; therefore, shears are used on site to make at least one diagonal cut at each end of the piece (indicated as 'e' in the figure).

[0020] Figure 4A shows a plan view of a bed reinforcement tie from the prior art on masonry components, indicating the distance (D) of the reinforcement tie from the lateral side of the wall formed by the components. This reinforcement tie is made of protected steel, so a minimum lateral covering of 15 mm is sufficient. The width of the masonry piece is marked as 'A' and the nominal width of the reinforcement tie is marked as 'Z'.

[0021] Figure 4B shows a plan view of two bed reinforcement ties from the prior art, overlapping masonry components, indicating the distance (D) of the reinforcement ties from the lateral side of the wall in the overlap area. These reinforcement ties are made of protected steel, but their cut sections are made of unprotected steel. A minimum lateral covering of 30 mm is therefore needed. The width of the masonry piece is marked as 'A', the nominal width of the reinforcement tie is marked as 'Z', and the unprotected cut section is marked as 'C'. It can also be noted in the figure that in order to adhere to the minimum coverings specified by standards as a protection requirement, the lateral edges of bed reinforcement ties in overlapping areas must have narrower reinforcement tie than what would be viable in a centre area.

[0022] Figure 5A shows a bed reinforcement tie from the prior art in a hollow bed reinforcement tie assembly, indicating the distance from the reinforcement tie to the lateral edge and the lateral bands of mortar, (m). In hollow reinforced walls, the mortar in the reinforcement ties is installed in two bands (m) located alongside the wall faces, and the centre area is left hollow, as can be seen in the figure. The width of the masonry piece is marked as 'A', and the reinforcement tie width compatible with the piece in order for it to enter into the mortar band (m) is marked as 'Z'. Hollow reinforced bed assemblies must have a minimum width for the reinforcement tie to be installed in the outer band of mortar (m). With its two bed reinforcement tie assemblies from the prior art, Figure 5B shows how this situation is incompatible with the minimum coverage reinforcement ties must have in their overlap areas. The required protection width is marked as 'A', which is incompatible with the width of the piece, because it does not fit in the band of mortar (m).

[0023] Figures 6 - 10 show reinforcement tie configuration 1 of the invention.

[0024] Figure 6 shows a plan view of reinforcement tie 1. It can be seen that reinforcement tie 1 comprises two longitudinal bars or plates 2 connected by internal bars or plates 3, ending in a female end 4 and a male end 5, which is narrower than the female end 4. Figures 8 - 10 show that the cross section of internal corresponding bars or plates 3 is less in its ends in a specific area (i.e., partially lower) than the cross section of the other internal bars or plates 3. This reduction in height can be achieved by, for example, local flattening at the overlap points (area

6).

[0025] This configuration would work either at just one end of the reinforcement tie 1, which could be both the female end 4 and the male end 5, or it could be done at both ends at the same time.

[0026] Figure 7 shows a plan view of the end of a reinforcement tie 1 installed for structural use of the invention, with the end of one of the contiguous reinforcement ties 1 level and superimposed.

[0027] Figure 8 shows a detailed perspective of the diagonal bars or wires 3 with the modified geometry. It shows how the wire 3 cross section is changed in the overlap area 6 in order to reduce the height. The section transitions from circular sections to rectangular ones.

[0028] Figure 9 shows a detailed perspective of two reinforcement ties 1, contiguous and overlapping by superimposition, holding one of the longitudinal wires or bars 2 of one of the recesses of the other reinforcement ties 1. This recess makes it possible to position the reinforcement tie 1 correctly along the width of the wall. Figure 10 shows a section schematic of the end of a reinforcement tie 1 for structural use of the invention from Figure 7, installed in the wall reinforcement tie located inside the wall 9. It shows how the height of the diagonal or transversal bar 3 is reduced if necessary, in order to make it possible to superimpose the reinforcement tie 1 contiguously without prejudicing the required covering.

[0029] Figures 11 - 14 show another reinforcement tie configuration 1 of the invention.

[0030] In Figures 12 - 14 it can be seen that in at least one of the male ends 5 and female ends 4, the corresponding internal bars or plates 3 have an area where the bars or plates 3 change direction, forming an entrance slot 7.

[0031] The guide for the bars or wires that make up the diagonal ends changes the plane locally, retaining the same form and dimensions in its cross sections.

[0032] The plane of the wires is changed during the manufacturing process using whichever mechanical procedure is most suitable. This basically consists of modifying the diagonal wire's guide, forming a slot 7 into which the contiguous piece will be inserted.

[0033] This configuration not only allows the reinforcement ties 1 to overlap over each other, but it also ensures that they are correctly located inside the wall 9, because their location is created when the diagonal guide is changed.

[0034] Figure 12 is a detailed perspective of the reinforcement tie 1 with its diagonal modified in the overlap area, forming a slot 7 and retaining its circular cross section and size.

[0035] Figure 13 shows a detailed perspective of two contiguous reinforcement ties overlapping by superimposition, holding one of the longitudinal wires 2 of one of them in the slot 7 created in the other. The slot 7 makes it possible to position the reinforcement tie 1 correctly along the width of the wall 9.

[0036] Figure 14 is a section schematic of the wall re-

inforcement tie 1 with the diagonal guide modified and installed inside the wall 9. The slot 7 created by the wire 3 can be seen, making it possible to house the reinforcement tie 1 contiguously without decreasing the required covering.

[0037] Figure 15 shows another configuration of the reinforcement tie 1 from the invention. It consists of using a cross section of internal bars or plates 3 from at least one of the male 5 and female 4 ends that is less than the section of the other internal bars or plates 3.

[0038] In the case of circular bars or wires, the diameter of the internal bars or wires 3 in the corresponding end(s) must be smaller than that of the other internal bars or wires 3.

[0039] The invention's scope may include any type of prefabricated wall reinforcement ties (wire or plate reinforcement ties) with any type of geometry (ladder joint reinforcement ties or triangle lattice reinforcement ties with internal bars or plates arranged as diagonals), and with any wire (or plate) width or diameter.

[0040] It is preferable for the internal bars or plates 3 to be arranged as a continuous bar or plate, forming a triangle lattice inside the male end 5 and as another continuous bar or plate forming a lattice in the rest of the interior of the reinforcement tie 1.

[0041] Similarly, the internal bars or plates 3 may be arranged in parallel in transversal position (ladder joint reinforcement tie).

[0042] In a preferred embodiment, each one of the male end 5 and the female end 4 comprises two internal bars or plates 3.

[0043] In another preferred embodiment, the longitudinal bars or plates 2 of the female end 4 are folded inward at their free end 8.

[0044] Although some embodiments of the invention have been described and represented, it is clear that modifications comprised in its scope can be introduced and that it must not be considered to be limited to these embodiments, but solely to the contents of the following claims.

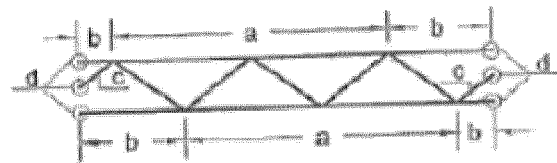
Claims

1. Reinforcement tie (1) for structural use, comprising two longitudinal bars or plates (2) connected by internal bars or plates (3), ending in a female end (4) and a male end (5), which is narrower than the female end (4), **characterized in that:**

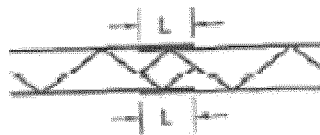
in at least one of the male (5) and female ends (4) the cross section of the corresponding internal bars or plates (3) is, totally or partially, less than the cross section of the other internal bars or plates (3), or in at least one of the male (5) and female ends (4) the corresponding internal bars or plates (3) have an area where the bar or plate (3) changes direction, forming an entrance

slot (7) in this area.

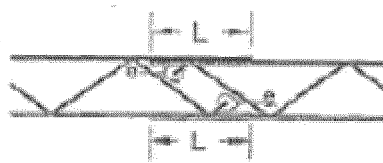
2. Reinforcement tie (1) for structural use, as per claim 1, **characterized in that** the internal bars or plates (3) are arranged as diagonals.
3. Reinforcement tie (1) for structural use, as per claim 2, **characterized in that** the internal bars or plates (3) are arranged as a continuous bar or plate, forming a triangle lattice inside the male end (5), and as another continuous bar or plate forming a lattice in the rest of the interior of the reinforcement tie (1).
4. Reinforcement tie (1) for structural use, as per claim 1, **characterized in that** the internal bars or plates (3) are arranged in parallel in transversal position.
5. Reinforcement tie (1) for structural use, as per any of the above claims, **characterized in that** each one of the male end (5) and the female end (4) comprises two internal bars or plates (3).
6. Reinforcement tie (1) for structural use, as per any of the above claims, **characterized in that** the longitudinal bars or plates (2) of the female end (4) are folded inward at their free end (8).



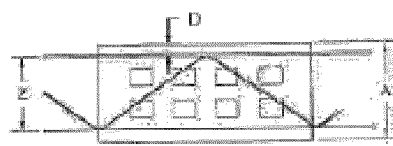
PRIOR ART- FIG. 1



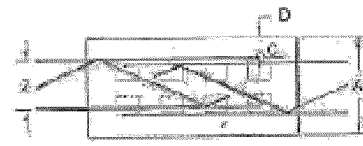
PRIOR ART - FIG. 2



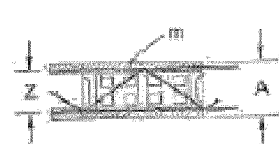
PRIOR ART- FIG. 3



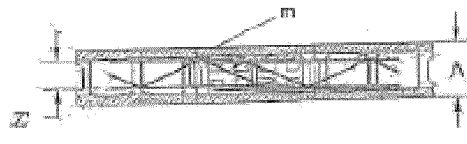
PRIOR ART - FIG. 4A



PRIOR ART - FIG. 4B



PRIOR ART - FIG. 5A



PRIOR ART - FIG. 5B

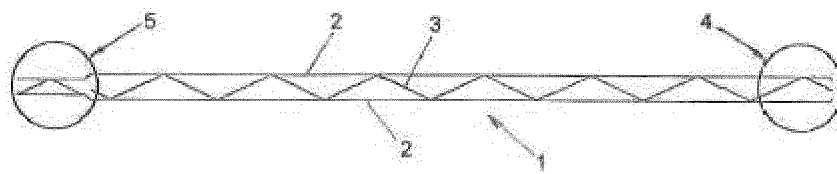


FIG. 6

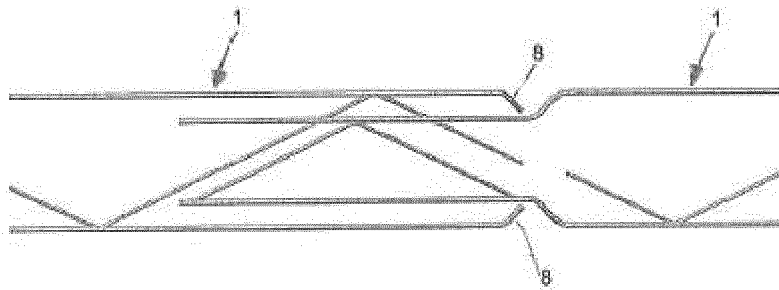


FIG. 7

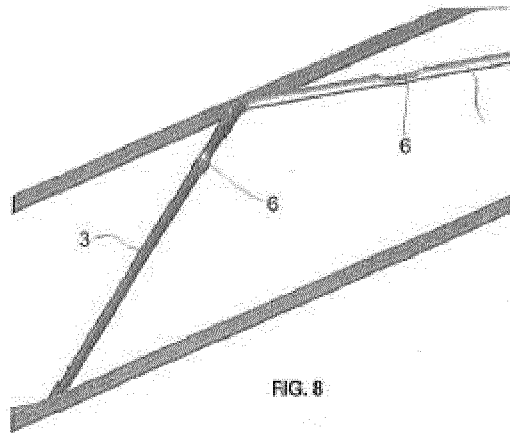


FIG. 8

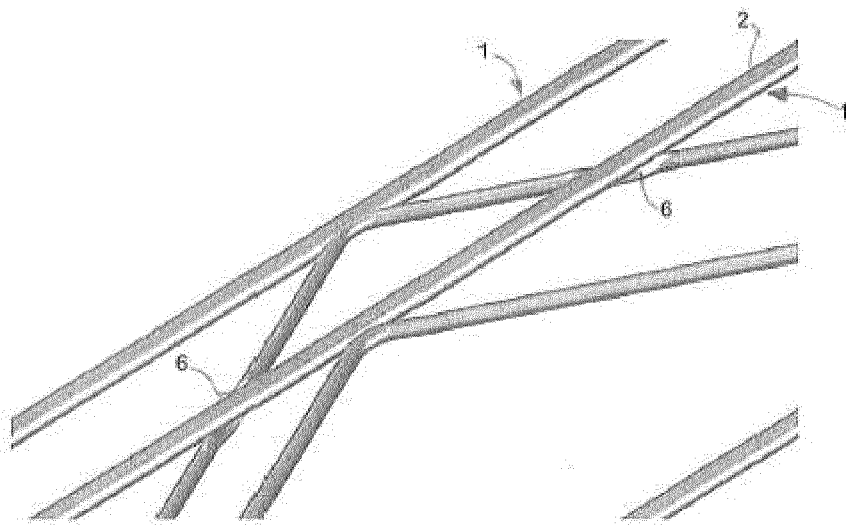


FIG. 9

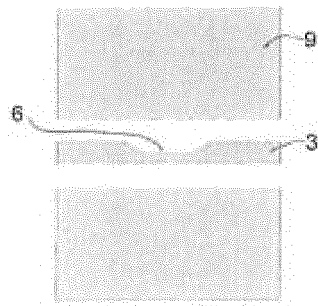


FIG. 10

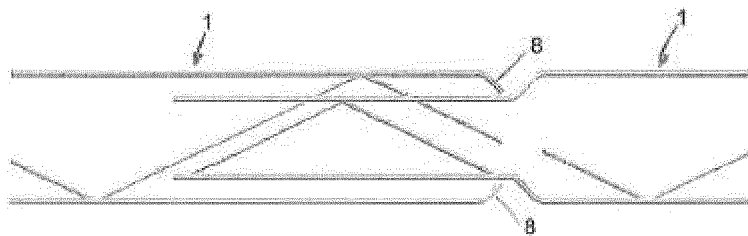


FIG. 11

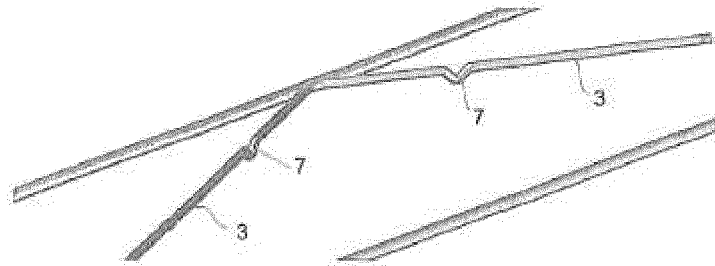


FIG. 12

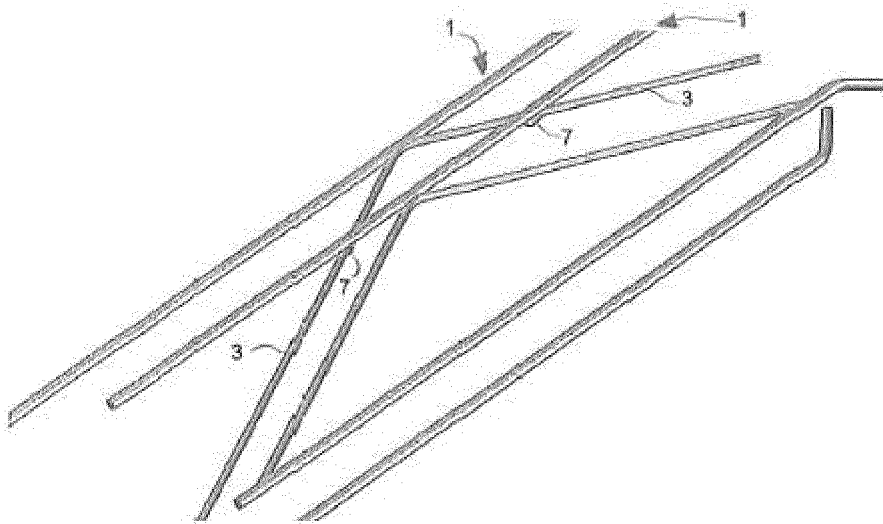


FIG. 13

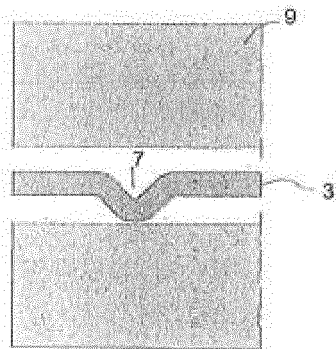


FIG. 14

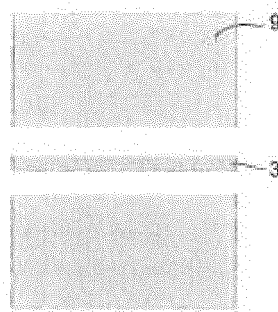


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2011/070864

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04C, E04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7325366 B1 (HOHMANN) 05/02/2008, the whole document.	1,4
A	DE 19808702 A1 (MUELLER J) 09.09.1999 & Abstract from DataBase EPODOC. Retrieved of EPOQUE; AN 1999-509527 [43]	1,4
A	US 2003029123 A1 (PIGNATARO) 13/02/2003, page 4, paragraph [45] - page 6, paragraph[48]; figures.	1,4
A	Manual of montaje del sistema Allwall aplicado a piezas of bloque of hormigón (Allwall Systems) [on line] April 2010, Retrieved from the Internet: <URL:http://www.allwall.es/pdf/2_3_1b_MANUAL_AllWall_MONTAJE_BHH.pdf>	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance.	
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"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search
17/08/2012

Date of mailing of the international search report
(30/08/2012)

Name and mailing address of the ISA/

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Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES2011/070864

Information on patent family members

Patent document cited in the search report	Publication date	Patent family member(s)	Publication date
US7325366 B	05.02.2008	US8096090 B	17.01.2012
DE19808702 A	09.09.1999	NONE	
US2003029123 A	13.02.2003	US6629393 B	07.10.2003

Form PCT/ISA/210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/ES2011/070864

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CLASSIFICATION OF SUBJECT MATTER

E04B1/41 (2006.01)

E04C5/04 (2006.01)

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E04B2/20 (2006.01)

E04B2/48 (2006.01)

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