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(11) **EP 1 428 949 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
12.04.2006 Bulletin 2006/15

(51) Int Cl.:
E04B 1/21 (2006.01)

(21) Application number: **03027073.0**

(22) Date of filing: **25.11.2003**

(54) **Precast reinforced concrete column and beam members**

Vorgefertigte Stahlbetonsäule und Stahlbetonträger

Colonnes et poutres préfabriqués en béton armé

(84) Designated Contracting States:
DE FR GB

(30) Priority: **12.12.2002 IT BO20020777**

(43) Date of publication of application:
16.06.2004 Bulletin 2004/25

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EP 1 428 949 B1

Description

[0001] The invention relates to precast vibrated and/or prestressed reinforced concrete column and beam members, which are quickly and easily fitted and have preformed structural continuity in the connecting zones and comprise modular loadbearing structures for buildings constructed using such precast members.

[0002] In the construction of the precast loadbearing structures of buildings using reinforced concrete members the problem of rapid, easy and safe assembly of the columns and the corresponding connecting beams, while at the same time ensuring structural continuity between the two parts in the interconnecting zones, has at present not been resolved, for example to resist to seismic stresses which sometimes are already active during the construction phase of the building. At the present time, in the connecting zones between columns and beams at least one of the two parts are provided with recesses to receive and support a portion of the other part and it is then necessary to resort to metal rods, bolts and/or other means to complete the connection between the parts. This current procedure inevitably has an adverse effect on the strength of the structure in the beam/column connection zones and gives rise to laborious and not always reliable finishing operations.

[0003] Several precast reinforced members and the structures obtained by using the same are known at the state of the art., namely in DE-C-842115, FR-A-705240, FR-A-1241954, FR-A-1111844, US-A-4951438, AU-B-485203, DE-B-1609296, FR-A-538235, US-A-1205465 and US-A-4550536. However, all the structures described in the said documents show a number of drawbacks, particularly referring to the assembling techniques used therein.

[0004] The invention is intended to resolve this major technical problem through column and beam members according to claim 1 and the method according to claim 25. The columns are located on the top of a grid of square or rectangular cells in such a way as to stand alongside each other in pairs, and at the level of the various storeys in the building each column is provided with through windows which are in line with corresponding windows in the other column in the pair. The windows have a cross-section which is suitably larger than that of the interconnecting beams which are placed in position by attaching their middle part to the site crane, which crane, offering up the beam to an outside surface of a column, first inserts one end of the beam into the joining window of the other column and continues to insert it until the other end of the beam reaches the space between the two columns, after which this end is aligned with the corresponding window in that column and the crane reverses the lateral movement to insert this end of the beam into the window of the second column. When connecting the last top beam of the building, that intended to support the roof of the building, for example, the columns are provided with windows which are open at the top, in the shape of a fork,

so that the fitting of this beam is extremely simplified. Once the beams connecting the columns on the various storeys of the future building have been put in place, the beams and columns are preferably firmly connected together at the junction zones for example using pins and/or other mechanical means of connection and/or through filling by welding and/or using expanding mortars poured into the windows of the columns through which the beams pass. For this purpose, and also to assist insertion of the beams, it is preferably provided that the windows of the columns are lined and defined by jackets, for example of stainless steel or other material, which are of one piece with some of the longitudinal reinforcing bars of the column reinforcement. Several loadbearing units of this type are built alongside each other, in a parallel arrangement, and the beams on the various storeys are connected together by precast floor slab members and possibly precast parapet members.

[0005] Further features of the invention and the advantages deriving therefrom will be apparent from the following description of some embodiments of same, illustrated by way of example in the figures of the attached sheets of drawings, in which:

- Figure 1 is a plan view of a loadbearing structure constructed using precast beams and columns according to the invention,
- Figures 2 and 3 illustrate other details of the structure, shown along the cross-sections II-II and III-III in Figure 1 respectively,
- Figure 4 shows a node of the structure as indicated by K in Figure 3 on an enlarged scale,
- Figures 5, 6 and 7 illustrate various stages in the insertion of a beam into a pair of columns according to the invention, seen from above and partly in cross-section,
- Figure 8 is a perspective view showing another embodiment of the columns and beams.

[0006] It will be seen from Figures 1-4 that the invention provides for the construction of vibrated and/or prestressed precast reinforced concrete columns 1, which for the construction of a building of for example three storeys can for example be approximately 12 m long and are preferably of the blade type, having a rectangular cross-section, for example approximately 75 x 25 cm. With a spacing of approximately 375 cm (see above), the columns are provided with rectangular windows 2 (see above) which open in the larger surfaces of the said columns and have for example a width of approximately 30 cm and a height of approximately 75 cm. First lower window 2 has for example a distance between centres of approximately 470 cm from the lower end of the column, for the reasons mentioned above, while the last top window, indicated by 2', which is different from the others and is open at the top in the shape of a fork, is of a lesser height, for example approximately 50 cm, and laterally thereto reinforcing bars 101 of the column project for a

suitable distance. Other features of the columns are provided in the description below.

[0007] From Figure 1 it will be seen that plinths 4, which are for example precast in reinforced concrete, of a cup shape, designed so that the lower ends of corresponding columns 1 of the type described can be fixed to them first by means of wedges and possibly pins or bolts and then using expanding mortars, for example of the type commercially known by the registered name of Emaco® and/or other suitable materials, the said columns facing each other in pairs with their widest surfaces in which windows 2 open, are secured onto the nodes 103 of a foundation 3, which is for example of the grid type, with cells for example of the square type and having a side of for example approximately 750 cm. From Figures 2 and 3 it will be apparent that a precast slab 5 which projects from foundation 3, by for example approximately one metre may be supported on plinths 4 in such a way as to provide an extensive space 6 beneath the building which is useful for the purposes of insulation and may house part of the service plant for the building.

[0008] Once columns 1 have been fitted in place, beams 7, which are also made of vibrated and/or pre-stressed reinforced concrete, which provide connections between the columns, and which as illustrated in Figures 2-4 are approximately 12 m long and are formed of a bottom part 107 of reinforced concrete from which metal reinforcement 207 projects upwards over their entire length, are fitted. Bottom part 107 is for example approximately 25 cm wide and approximately 45 cm high, while upper reinforcement 207 projects for a height of approximately 25 cm, as a result of which beam 7 has an overall height of approximately 70 cm in comparison with the 75 cm height of windows 2 and a width of 25 cm in comparison with the 30 cm of windows 2. Part 207 of the reinforcement, of beams 7 comprises longitudinal bars and some of the transverse bars of the reinforcement, which are for example in the shape of a figure of eight, although said part 207 of the reinforcement is in any event constructed in such a way that the bottom part 107 of the beam and extensive portions of its own upper wall are free, for the reasons mentioned above.

[0009] A pair of transverse through holes 8, constructed for example by providing transverse tubes in the lower reinforcement of the beam, with such holes being for example approximately 2 metres apart, are provided in the middle of bottom part 107 of beams 7 in a symmetrical arrangement. These holes are used so that the carrying sling 9 of the site crane by means of which beams 7 are placed in position one by one using the technique now described with reference to Figures 5 to 7 can be connected to beams 7. From Figure 5 it will be seen that a first manoeuvre comprises placing beam 7 laterally beside a column, abutting one end against a window 2 of the other column and then longitudinally moving the beam to insert it into said window 2 until as illustrated in Figure 6 sling 9 comes alongside the column into which the beam has been inserted and the other end of beam

7 passes beyond the column alongside which it lay and enters the space between the two columns. At this point the other end of beam 7 is also aligned with window 2 of the second column and the beam itself can be moved longitudinally in a direction opposite to the previous direction in order to be inserted into window 2 of the second column, as illustrated in Figure 7. The differences in size between windows 2 and the cross-sections of the beams 7 and the limited depth of windows 2 make it possible to perform the above mentioned operations in an easy and safe manner without ever detaching the beam from the handling crane.

[0010] Suitable means are then preferably provided to ensure correct dimensional location of beams 7 in relation to each pair of supporting columns and between them in order to achieve a secure structural connection between the beam and column before fitting the floor slabs. One or more of the solutions indicated below purely by way of a non-restrictive example may for example be used for this purpose. From Figures 2 and 4 it will be seen that in the portion in which they are housed in windows 2 beams 7 may be provided with one or more transverse holes 10, one above the other, the ends of which are enlarged on the outside to provide a guide, which when the said beams are in position align with corresponding transverse holes 11 in the section of column with window 2, provided on at least one or both sides of the window, which also have ends acting as a guide, into which connecting pins 12 can be fitted. Holes 10 and 11 are constructed by embedding tubes in the beam and column in the same way as in the case of holes 8 already mentioned. To assist correct assembly of beams 7 and to assist alignment between holes 10 and 11, beams 7 may be provided with suitable reference and/or abutting means as recesses or projections against at least one of the two columns in each module, means which are not illustrated here because knowledge of them is intuitive and they can easily be constructed by those skilled in the art. Of course abutting means may be provided in relief only on the length of the beam which is inserted last in the sequence illustrated in Figures 6 and 7. As an alternative to the arrangement described, which may give rise to difficulties when inserting the pins into holes which are only partly visible, provision may be made for only beam 7 to be provided with transverse through holes, which when the beam is in position are located outside window 2 on either side of the column, so that pins or wedges can be threaded into these holes so that their projecting lengths bear against the column, securing it to the beam. According to another arrangement illustrated in Figure 4, windows 2 are lined and are defined by jackets 102, of for example stainless steel, which are of one piece with the longitudinal reinforcing bars 201 of the reinforcement of the column and are suitably flared at the edges to assist the insertion of beams 7 into the said windows in question. The jackets 102 may be used to effect preliminary connection between said beams 7 and column 1, for example by welding said pins 12 which pass

through transverse holes 10 in the beams to the jackets, or through supplementary reinforcing formwork 1 or by securing suitable means of connection and attachment to reinforcement 207 of the beams in any other suitable way. Upper windows 2' are obviously lined and defined by channel sections or upside-down omega sections so as to bear on the top of column 1. In combination or as an alternative to the above mentioned means of attachment, provision may be made for the injection of suitable expanding quick-setting mortars, for example of the Ema-co® type and/or other suitable materials mentioned previously, in suitable small recesses (not shown) made within the corresponding portions of beams 7 opposite windows 2.

[0011] It is obvious that beams 7 can be positioned and secured in place very much more quickly and conveniently in the upper open windows 2' of columns 1.

[0012] Once beams 7 have been secured to columns 1, the edges of precast floor slabs 13, together with their reinforcement 113, are laid on beams 7 (Figures 2, 3, 4) with the conventional structural arrangements in the spaces between the two reinforcements, after which the reinforcements of these floor slabs are connected to those of beams 7 and then corresponding precast parapet modules 14 provided with reinforcement 114 which is connected to that of the beams and which partly projects from the outer portions of floor slabs 13 are positioned side by side on the ends of the various pairs of beams using suitable scaffolding towers providing temporary support, not illustrated, all so that when the concrete slab S completing the floor is cast, as indicated for the top storey in Figure 2, the necessary structural joints are made between the slabs and the beams, the beams and the columns and the parapets and the slabs and the beams.

[0013] Referring to Figure 8 it is noted that according to a further embodiment of the invention, the windows 2" of the columns 1', with the reinforcing jackets 102', have the shape of an isosceles trapezium, with the smaller base directed downwardly. The beams 7' can also present in section the shape of an isosceles trapezium, their side walls can present the same inclination of about 6° - 7° as the sides of the windows 2" and their smaller base can present the same or slightly different width with respect to the corresponding lower base of the window 2". By using windows 2" of a height of for example about 75 cm, with the smaller base of about 15,5 cm and the greater base of about 33 cm, the section of the beams 7' could present for example a smaller base of about 15 cm, a greater base of about 25 cm and a height of about 45 cm. Differently from the precast beams 7 of the previous embodiment, the new beams 7' are not provided originally with an upwardly projecting reinforcement, so that when inserting said beams inside the windows 2" of the columns 1', it is possible to position these beams in the higher portion of the windows 2", which presents a width greater than the section of the said beams and which therefore permits a more easy manoeuvre and

translation of the said beams. When the beams have been correctly inserted in the windows of the opposed supporting columns and they are lowered, the said beams adhere intimately or with a minimum clearance to the lower portion of the windows 2", thus realising a first coupling which is sufficiently precise between the two parts and therefore requesting a lesser quantity of material for the completion of the connection joint between beam and column. According to the present embodiment, the beams 2" can be made of vibrated and/or prestressed reinforced concrete and to their reinforcement bars 307 there can be secured metal bushes 16 threaded at their interior, arranged with their axis vertically along the longitudinal median plane of the beam 7' and which by their upper end are co-planar or slightly projecting from the upper side surface of the said beam, and which are equispaced between them by a suitable pitch, for example about 50 cm. Some of these bushes, arranged in the intermediate portion of the beam, can be used for screwing therein the eyebolts for the hooking to the crane which sets the said beam in position, and the said eyebolts can be left in their sites and connected by means of reinforcement bars to the reinforcement bars 113 of the floor slabs 13, to which there can be also connected additional reinforcement bars 17 which pass through the slotted bushes 116 provided with a threaded pin which is screwed into the above mentioned bushes 16 of the beams 7'. The distance pitch between the bushes 16 is such that, whenever the beam has been positioned, two of said bushes are arranged immediately at the exterior of the windows 2" of the column 1', so that the reinforcement bars 17 anchored to the supplementary bushes 116 associated to these two bushes cooperate with the opposed sides of the column in order to prevent undesired relative movements between the beam and the column. At least two bushes 16' which are equal to the bushes 16, can be provided in the median zone of the lower face of the beam 2", at points of the said beam which be located at the centre of the base of window 2" in order to be able to insert by screwing into some bushes the projecting pins 18 which will engage a corresponding bush 16" provided at the centre of the lower base of each window 2" and/or a corresponding seat provided on the lower base of the jacket 102 of said window.

[0014] Finally, from Figure 8 it is noted that threaded bushes 16''' similar to the above mentioned bushes 16 for the beams 7', can be arranged on at least one surface of the columns 1' on which there open the windows 2", for example on the surfaces which face the ends of the said beams 7', in order to consent the securing onto said surface of the columns, of auxiliary reinforcement columns (not shown), formed for example by metallic beams which are shaped as double - T or as U, which can be used also as upright columns for the passage of services of various types. It appears evident that the structures which have been described with reference to Figure 8, consent the realisation of a building reticulate which

presents high antiseismic features, since the connections between beams and columns are partially active already during the phase of reciprocal association of said components.

Claims

1. Precast reinforced concrete column and beam members with preformed structural continuity in the inter-connection zones, the columns (1) being positioned in pairs side by side with a spacing between them which is less than the length of the interconnecting beams, and windows (2) aligned with each other and of a size suitably greater than the cross-sections of the interconnecting beams (7) are provided in the connection zones to the said beams, **characterized in that** the said beams are provided in their intermediate part with means for connection to a sling (9) of a site crane, the said means comprising a pair of transverse through holes (8) formed in the lower reinforcement of the said beam (7). 5
2. Precast members according to claim 1, in which the said through holes (8) are obtained by providing transverse tubes in the lower reinforcement of the said beam (7). 10
3. Precast members according to claim 1 or 2, in which the said through holes are approximately two meters apart, in the middle of the bottom part (107) of the said beam (7) in a symmetrical arrangement. 15
4. Precast members according to anyone of the preceding claims 1 to 3, in which the columns (1) have open windows (2') in the form of forks at the top, of a size suitably greater than that of the beams (7) which are housed therein and alongside and beyond which the reinforcing bars (101) of the columns project. 20
5. Precast members according to anyone of the preceding claims 1 to 4, in which the columns (1) have a rectangular cross-section and the windows (2, 2') open in the larger sides of the said columns. 25
6. Precast members according to claim 1, in which the windows (2) in the columns are of rectangular shape and are orientated with the largest dimension upward so as to receive connecting beams (7) also having an overall rectangular cross-section of a size suitably less than that of the said windows and formed of a bottom part (107) of reinforced concrete and a top part (207) of only metal reinforcement projecting from the said lower part. 30
7. Precast members according to anyone of the preceding claims 1 to 6, in which intermediate windows (2) and the open windows (2') in the columns (1) are lined, the former with jackets (102) and the latter with channel sections or upside-down omega sections of one piece with the reinforcing bars (201) of the reinforcement of the said columns and made of any suitable material, such as for example stainless steel. 35
8. Precast members according to anyone of the preceding claims 1 to 4, in which the means by which the beams are secured to the columns comprise transverse holes (10) within the lengths of bottom portions (107) of the beams which engage the windows (2, 2') in the columns, in which corresponding transverse holes (11) in the columns open and align with the holes in the beams and have connecting pins (12) placed in them. 40
9. Precast members according to claim 8, in which the said transverse holes (10, 11) of the beams and the columns have outwardly enlarged ends to provide a guide to assist insertion of the connecting pins (12) into them. 45
10. Precast members according to anyone of the preceding claims 1 to 4, in which the means for securing the beams (7) to the columns (1) comprise transverse holes (10) in the bottom part (107) of the said beams (7), which when the beam is in position are located outside window (2) on either side of the column (1), so that pins or wedges can be threaded into these holes (10) so that their projecting lengths bear against the column. 50
11. Precast members according to anyone of the preceding claims 1 to 4, in which the means for securing the beams (7) to the columns (1) comprise additional reinforcing bars (15) and/or other means for attaching and securing the projecting part of the reinforcement (207) of the beams (7) to the metal jackets (102) which line and define the windows (2) in the columns (1), and which are suitably arranged for this purpose, in any suitable way. 55
12. Precast members according to anyone of the preceding claims 1 to 4, in which the means through which the beams (7) are secured to the columns (1) provide for the injection of quick-setting expanded mortars and/or other suitable materials into the empty spaces of the windows (2, 102) into which the corresponding beams (7) have been fitted, through suitable formwork fitted on site.
13. Precast members according to anyone of the preceding claims 1 to 12, in which the beams (7) are provided with reference means which when positioned in relation to the columns indicate the correct relative positioning of the two parts.

14. Precast members according to claim 13, in which the said reference means comprise parts which are coplanar with or recessed into the surface of the beams.
15. Precast members according to claim 13, in which the said reference means comprise parts in relief which abut against the column into which each beam is last fitted during the stage of assembly.
16. Precast members according to anyone of the preceding claims 1 to 15, in which the upper reinforcement (207) of the beams connecting to the columns (1) has any shape so as to leave ample space free above the bottom part (107) of the said beams so that precast floor slabs (13) with corresponding reinforcement (113) which can subsequently be connected on site with the reinforcement of the beams before casting to complete the floor slabs can subsequently be supported on these spaces.
17. Precast members according to anyone of the preceding claims 1 to 16, in which the columns (1) are designed for incorporation below into plinths (4), which are precast plinths of a cup shape fixed on the nodes (103) of a foundation of the grid type, with a square or rectangular mesh, on which a precast floor slab (5) which forms the trafficked surface of the ground floor of the building is supported and is suitably raised from the said foundation (3) so as to form a space (6) which is useful for the purposes of insulation and to house some of the service plant for the building.
18. Precast members according to anyone of the preceding claims 1 to 3, in which the windows (2'') on the columns (1'), have reinforcing jackets (102'), and the shape of an isosceles trapezium with the smaller base directed downwards and the beams (7') also have a shape in section of an isosceles trapezium presenting a height which is smaller than the height of said windows, and the said beams do not present reinforcement members projecting from the upper base, the whole in such a manner that by inserting the beams in the high portion of said windows, there exists an ample clearance between beams and windows which consents an easy setting in place of the said beams.
19. Precast members according to claim 18, in which the beams (7') present an inclination of their oblique sides which is substantially equal to the inclination of the oblique sides of the windows (2'') of the columns (1').
20. Precast members according to claim 19, in which the oblique sides of the beams and of the windows of the columns have an inclination of about 6° - 7°.
21. Precast members according to claim 20, in which the beams (7') are made in prestressed and/or vibrated reinforced concrete and to their inner reinforcement bars (307) there are secured metal bushes (16) internally threaded, arranged by their axes vertically along the longitudinal median plane of the beam (7'), which by their upper end are co-planar or slightly projecting from the upper side surface of the beam and which are equispaced between them by a suitable pitch, there being provided that some of these bushes, arranged in the intermediate portion of the beam, are used for screwing therein eyebolts for the hooking to the crane which sets the said beam in position, and further being provided that the said eyebolts be left in their sites and connected by means of reinforcement bars, to the reinforcement structures (113) of the floor slabs (13), to which there are also connected additional reinforcement bars (17) which pass through slotted bushes (116) provided with a threaded stem to be screwed into the above mentioned bushes (16) of the beams (7').
22. Precast members according to claim 21, in which the distance pitch between the bushes (16) is such that, whenever the beam has been positioned, two of said bushes are arranged immediately at the exterior of the windows (2'') of the columns (1'), so that the reinforcement bars (17) anchored to the supplementary bushes (116) associated to these two bushes cooperate with the opposed sides of the columns in order to prevent undesired relative movements between the beam and the column.
23. Precast members according to claim 21, in which at least two bushes (16') which are equal to the above mentioned bushes (16), can be provided in the median zone of the lower face of the beam (7'), at points of the said beam which be located at the centre of the base of the windows (2'') in order to be able to insert by screwing into some bushes the projecting pins (18) which will engage a corresponding bush (16'') provided at the centre of the lower base of each window (2'') and/or a corresponding seat provided on the lower base of the jacket (102') of said window.
24. Precast members according to claim 21, in which threaded bushes (16''') similar to the above mentioned bushes (16) for the beams (7'), can be arranged on at least one side surface of the columns (1') on which there open the windows (2''), for example on the surfaces which face the ends of the said beams (7'), in order to consent the securing onto said surface of the columns, of auxiliary reinforcement columns, formed for example by metallic beams which are shaped as double - T or shaped as U, which can be used also as upright columns for the passage of services of various types.

25. Method for the assembly of a precast reinforced concrete structure, comprising the precast members according to any one of the preceding claims 1 to 24, comprising the following steps:

- Each beam is, in its turn, secured to the sling of a site crane, by means of appropriated means (8);
- each beam is first offered up to the side of one column (1) and one end is inserted into the connecting window (2) of the other column (1) until the other end of the beam reaches the space between the two columns;
- thereafter the said end is aligned with the corresponding window in the second column and the crane reverses the lateral movement to insert this end of the beam into the window in the second column also until the beam is supported on the two columns in the predetermined way, means being provided for subsequently securing the beams to the columns.

26. Method according to claim 25, in which before casting work (S) is carried out on site to complete the horizontal floor slab structures, using scaffolding towers for temporary support, precast parapet structures (14) fitted with reinforcement (114) which can be connected to that of the said beams and the floor slabs so as to be incorporated and immobilised in the said cast material are placed alongside the ends of the beams (7) in each pair of the said beams (7).

Patentansprüche

1. Vorgefertigte Stahlbetonsäule und Stahlbetonträger mit vorgeformtem strukturellen stetigen Verlauf in den Verbindungszonen, wobei die Säulen (1) paarweise Seite an Seite mit einem Abstand zueinander, der geringer als die Länge der Verbindungsträger ist, positioniert sind, und Fenster (2), die aufeinander ausgerichtet sind und eine Größe haben, die geeigneterweise größer als die Querschnitte der Verbindungsträger (7) ist, in den Verbindungszonen zu Trägern vorgesehen sind, **dadurch gekennzeichnet, dass** die Träger in ihrem Mittelteil mit Mitteln zum Verbinden mit einem Anschlagmittel (9) eines Baustellenkrans versehen sind, wobei die Mittel ein Paar quer verlaufender Durchgangslöcher (8) umfassen, die in der unteren Bewehrung des Trägers (7) ausgebildet sind.
2. Vorgefertigte Elemente nach Anspruch 1, in denen die Durchgangslöcher (8) **dadurch** realisiert werden, dass quer verlaufende Röhren in der unteren Bewehrung des Trägers (7) bereitgestellt werden.
3. Vorgefertigte Elemente nach Anspruch 1 oder 2, in

denen die Durchgangslöcher in einem Abstand von ca. zwei Metern in der Mitte des Unterteils (107) des Trägers (7) symmetrisch angeordnet sind.

4. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 3, in denen die Säulen (1) an ihrem oberen Ende offene Fenster (2') in Form von Gabeln haben, die geeigneterweise größer als die in ihnen aufgenommenen Träger (7) sind und längsseits zu denen und über die hinaus die Bewehrungsstäbe (101) der Säulen vorspringen.
5. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 4, in denen die Säulen (1) einen rechtwinkligen Querschnitt haben und die Fenster (2, 2') sich in den größeren Seiten der Säulen öffnen.
6. Vorgefertigte Elemente nach Anspruch 1, in denen die Fenster (2) in den Säulen eine rechtwinklige Form haben und mit ihrer größten Abmessung nach oben orientiert sind, um Verbindungsträger (7) aufzunehmen, die ebenfalls einen insgesamt rechtwinkligen Querschnitt haben, der geeigneterweise kleiner als der der Fenster ist, und die aus einem Unterteil (107) aus Stahlbeton und einem Oberteil (207) aus reiner Metallbewehrung, der von dem Unterteil vorspringt, bestehen.
7. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 6, in denen Zwischenfenster (2) und die offenen Fenster (2') in den Säulen (1) ausgekleidet sind, und zwar Erstere mit Hüllen (102) und Letztere mit U-Profilen oder kopfstehenden Omegaprofilen, die in einem Stück mit den Bewehrungsstäben (201) der Bewehrung der Säulen ausgebildet sind und aus einem beliebigen geeigneten Material, zum Beispiel rostfreier Stahl, bestehen.
8. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 4, in denen die Mittel, durch die die Träger an den Säulen befestigt sind, Querlöcher (10) innerhalb der Längen von Unterteilen (107) der Träger umfassen, die in die Fenster (2, 2') in den Säulen eingreifen, in denen entsprechende Querlöcher (11) in den Säulen sich öffnen und auf die Löcher in den Trägern ausrichten und in ihnen platzierte Verbindungsbolzen (12) haben.
9. Vorgefertigte Elemente nach Anspruch 8, in denen die Querlöcher (10, 11) der Träger und der Säulen nach außen vergrößerte Enden haben, um eine Führung zur Unterstützung des Einführens der Verbindungsbolzen (12) in die Löcher bereitzustellen.
10. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 4, in denen die Mittel zur Befestigung der Träger (7) an den Säulen (1) Quer-

löcher (10) im Unterteil (107) der Träger (7) umfassen, die sich, wenn sich der Träger in Position befindet, außerhalb des Fensters (2) auf beiden Seiten der Säule (1) befinden, so dass Bolzen oder Keile in diese Löcher (10) einschraubbar sind, so dass ihre vorspringenden Längen gegen die Säule anliegen.

11. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 4, in denen die Mittel zur Befestigung der Träger (7) an den Säulen (1) zusätzliche Bewehrungsstäbe (15) und/oder andere Mittel zum Anbringen und Befestigen des vorspringenden Teils der Bewehrung (207) der Träger (7) an den Metallhüllen (102), die die Fenster (2) in den Säulen (1) auskleiden und bestimmen, umfassen, die diesem Zweck entsprechend auf irgendeine geeignete Art und Weise angeordnet sind.

12. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 4, in denen die Mittel, durch die die Träger (7) an den Säulen (1) befestigt sind, das Einspritzen von schnell abbindenden Expansivmörteln und/oder anderen geeigneten Materialien in die leeren Räume der Fenster (2, 102), in die die entsprechenden Träger (7) eingepasst worden sind, durch geeignete vor Ort errichtete Verschalungen ermöglichen.

13. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 12, in denen die Träger (7) mit Bezugsmitteln versehen sind, die, wenn sie in Bezug auf die Säulen positioniert sind, die korrekte relative Positionierung der beiden Teile anzeigen.

14. Vorgefertigte Elemente nach Anspruch 13, in denen die Bezugsmittel Teile umfassen, die koplanar mit der Oberfläche der Träger sind oder Vertiefungen in dieser bilden.

15. Vorgefertigte Elemente nach Anspruch 13, in denen die Bezugsmittel erhabene Teile umfassen, die an die Säule anstoßen, in die jeder Träger während der Montagephase zuletzt eingepasst wird.

16. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 15, in denen die obere Bewehrung (207) der mit den Säulen (1) verbundenen Träger irgendeine Form hat, die oberhalb des Unterteils (107) der Träger in reichlichem Maße freien Raum lässt, so dass vorgefertigte Fußbodenplatten (13) mit entsprechender Bewehrung (113), die später vor Ort vor dem Fertiggießen der Fußbodenplatten mit der Bewehrung der Träger verbindbar ist, anschließend in diesen Räumen abstützbar sind.

17. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 16, in denen die Säulen (1) so ausgestaltet sind, dass sie unten in Plinthe (4),

die vorgefertigte napfförmige Plinthe sind, die an den Knoten (103) eines netzförmigen Fundaments mit einem quadratischen oder rechteckigen Maschenwerk befestigt sind, integrierbar sind, auf denen eine vorgefertigte Fußbodenplatte (5), die die belebte Oberfläche des Erdgeschosses des Gebäudes bildet, abgestützt und geeigneterweise vom Fundament (3) abgehoben ist, so dass ein Raum (6) gebildet wird, der für Isolierzwecke und für die Unterbringung eines Teils der Versorgungsanlagen des Gebäudes nützlich ist.

18. Vorgefertigte Elemente nach einem der vorangehenden Ansprüche 1 bis 3, in denen die Fenster (2'') an den Säulen (1') Bewehrungshüllen (102') und die Form eines gleichschenkligen Trapezes mit nach unten gerichteter kleinerer Basis haben und die Träger (7') im Querschnitt ebenfalls die Form eines gleichschenkligen Trapezes - mit einer geringeren Höhe als die Höhe der Fenster - haben und die Träger keine Bewehrungselemente haben, die von der oberen Basis vorspringen, wobei das Ganze so ausgestaltet ist, dass während des Einsetzens der Träger in den oberen Bereich der Fenster reichlich Abstand zwischen Trägern und Fenstern besteht, was eine einfache Positionierung der Träger gestattet.

19. Vorgefertigte Elemente nach Anspruch 18, in denen die Träger (7') eine Neigung ihrer schiefen Seiten aufweisen, die im Wesentlichen der Neigung der schiefen Seiten der Fenster (2'') der Säulen (1') entspricht.

20. Vorgefertigte Elemente nach Anspruch 19, in denen die schiefen Seiten der Träger und der Fenster der Säulen eine Neigung von ca. 6° bis 7° haben.

21. Vorgefertigte Elemente nach Anspruch 20, in denen die Träger (7') aus vorgespanntem und/oder eingestülptem Stahlbeton gefertigt sind und an ihren inneren Bewehrungsstäben (307) mit Innengewinde versehene Metallbuchsen (16) befestigt sind, deren Achsen senkrecht entlang der in Längsrichtung verlaufenden Mittelebene des Trägers (7') angeordnet sind und deren obere Enden koplanar mit der oberen Oberfläche des Trägers sind oder geringfügig von dieser vorspringen und die in gleichen, geeigneten Abständen zueinander angeordnet sind, wobei vorgesehen ist, dass einige dieser Buchsen, die im Mittelabschnitt des Trägers angeordnet sind, dazu verwendet werden, dass Augenschrauben zum Anhängen an den Kran, der den Träger in Position bringt, in sie hineingeschraubt werden, und wobei außerdem vorgesehen ist, dass die Augenschrauben an ihrem Platz belassen und mit Hilfe von Bewehrungsstäben mit den Bewehrungsstrukturen (113) der Fußbodenplatten (13) verbunden werden, die auch mit zusätzlichen Bewehrungsstäben (17) verbunden

werden, die durch Schlitzbuchsen (116) verlaufen, die mit einem Gewindezapfen versehen sind, um in die oben erwähnten Buchsen (16) der Träger (7') eingeschraubt zu werden.

22. Vorgefertigte Elemente nach Anspruch 21, in denen der Abstand zwischen den Buchsen (16) so gewählt ist, dass immer dann, wenn der Träger in Position gebracht worden ist, zwei der Buchsen direkt an der Außenseite der Fenster (2'') der Säulen (1') angeordnet sind, so dass die Bewehrungsstäbe (17), die in den Ergänzungsbuchsen (116), die diesen beiden Buchsen zugeordnet sind, verankert sind, mit den gegenüberliegenden Seiten der Säulen zusammenwirken, um unerwünschte relative Bewegungen zwischen dem Träger und der Säule zu verhindern.

23. Vorgefertigte Elemente nach Anspruch 21, in denen mindestens zwei Buchsen (16'), die den oben erwähnten Buchsen (16) entsprechen, in der mittleren Zone der Unterseite des Trägers (7') an Punkten des Trägers, die sich im Zentrum der Basis der Fenster (2'') befinden, vorhanden sein können, um durch Einschrauben in einige Buchsen die vorspringenden Bolzen (18) einführen zu können, die in eine entsprechende Buchse (16'') im Zentrum der unteren Basis jedes Fensters (2'') und/oder in eine entsprechende Aufnahme an der unteren Basis der Hülle (102') des Fensters eingreifen.

24. Vorgefertigte Elemente nach Anspruch 21, in denen Schraubbuchsen (16'''), die den oben erwähnten Buchsen (16) für die Träger (7') ähneln, an mindestens einer Seitenfläche der Säulen (1'), an der die Öffnungen der Fenster (2'') liegen, zum Beispiel an den Oberflächen, die den Enden der Träger (7') zugewandt sind, angeordnet sein können, um die Befestigung von Zusatzbewehrungssäulen, die zum Beispiel durch Doppel-T- oder U-Metallträger gebildet werden und auch als aufrecht stehende Säulen für die Hindurchführung verschiedener Versorgungsleitungen verwendbar sind, an der Oberfläche der Säulen zu gestatten.

25. Verfahren zur Montage einer vorgefertigten Stahlbetonstruktur, die die vorgefertigten Elemente nach einem der vorangehenden Ansprüche 1 bis 24 umfasst, umfassend die folgenden Schritte:

- jeder Träger wird für sich mit Hilfe geeigneter Mittel (8) am Anschlagmittel eines Baustellenkrans befestigt;
- jeder Träger wird zuerst zur Seite einer Säule (1) angehoben und ein Ende wird in das Verbindungsfenster (2) der anderen Säule (1) eingeführt, bis das andere Ende des Trägers den Raum zwischen den beiden Säulen erreicht;
- anschließend wird das Ende auf das entspre-

chende Fenster in der zweiten Säule ausgerichtet und der Kran führt die Seitenbewegung in der Gegenrichtung aus, um auch dieses Ende des Trägers in das Fenster in der zweiten Säule einzuführen, bis der Träger auf den beiden Säulen in der vorgegebenen Art und Weise abgestützt ist, wobei Mittel zur anschließenden Befestigung der Träger an den Säulen bereitgestellt sind.

26. Verfahren nach Anspruch 25, in dem vorgefertigte Brüstungsstrukturen (14), die mit Bewehrungen (114) versehen sind, die mit denen der Träger und der Fußbodenplatten verbindbar sind, um in dem gegossenen Material eingebaut und festgesetzt zu werden, längsseits der Enden der Träger (7) jedes Paares der Träger (7) platziert werden, bevor vor Ort Gießarbeiten (S) zur Vervollständigung der waagerechten Fußbodenplattenstrukturen unter Verwendung von Baugerüsttürmen zum vorübergehenden Abstützen ausgeführt werden.

Revendications

1. Eléments de poteaux et de poutres préfabriqués en béton armé ayant une continuité structurelle dans les zones de liaison, les poteaux (1) étant positionnés par paires, côte à côte, avec un espacement entre eux qui est inférieur à la longueur des poutres de liaison, et des fenêtres (2), alignées les unes avec les autres et d'une dimension supérieure de façon appropriée aux sections transversales des poutres (7) de liaison, étant prévues dans les zones de raccordement aux poutres, **caractérisés en ce que** les poutres sont munies en leur partie intermédiaire de moyens de raccordement à une élingue (9) d'une grue de chantier, les moyens comprenant une paire de trous (8) traversants transversaux, formés dans l'armature inférieure de la poutre (7).
2. Eléments préfabriqués suivant la revendication 1, dans lesquels on obtient les trous (8) traversants, en prévoyant des tubes transversaux dans l'armature inférieure de la poutre (7).
3. Eléments préfabriqués suivant la revendication 1 ou 2, dans lesquels les trous traversants sont sensiblement espacés de deux mètres, au milieu de la partie (107) de fond de la poutre (7), suivant un agencement symétrique.
4. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 3 précédentes, dans lesquels les poteaux (1) ont des fenêtres (2') ouvertes, en forme de fourches à leur sommet, d'une dimension supérieure de façon appropriée à celle des poutres (7) qui y sont logées et le long et au-delà desquelles,

les ronds (101) à béton des poteaux font saillie.

5. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 4 précédentes, dans lesquels les poteaux (1) ont une section transversale rectangulaire et les fenêtres (2, 2') débouchent dans les grands côtés des poteaux. 5
6. Eléments préfabriqués suivant la revendication 1, dans lesquels les fenêtres (2) des poteaux sont de forme rectangulaire et sont orientées en ayant la dimension la plus grande vers le haut, de manière à recevoir des poutres (7) de liaison ayant également une section transversale générale rectangulaire d'une dimension inférieure de façon appropriée à celle des fenêtres et constituées d'une partie (107) de fond en béton armé et d'une partie (207) de sommet seulement en armature métallique faisant saillie de la partie inférieure. 10
7. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 6 précédentes, dans lesquels les fenêtres (2) intermédiaires et les fenêtres (2') ouvertes des poteaux (1) sont garnies, les premières de chemises (102) et les dernières de profilés en U ou de profilés en oméga renversé d'un seul tenant avec les ronds (201) à béton de l'armature des poteaux et constitués de tout matériau approprié, tel que par exemple, de l'acier inoxydable. 15
8. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 4 précédentes, dans lesquels les moyens par lesquels les poutres sont fixées aux poteaux comprennent des trous (10) transversaux à l'intérieur des longueurs des parties (107) de fond des poutres qui coopèrent avec les fenêtres (2, 2') des poteaux, dans lesquels des trous (11) transversaux correspondants dans les poteaux s'ouvrent et s'alignent avec les trous des poutres et ont des goupilles (12) de raccordement qui y sont placées. 20
9. Eléments préfabriqués selon la revendication 8, dans lesquels les trous (10, 11) transversaux des poutres et des poteaux ont des extrémités agrandies vers l'extérieur pour procurer un guidage afin de faciliter l'introduction des goupilles (12) de raccordement en eux. 25
10. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 4 précédentes, dans lesquels les moyens destinés à fixer les poutres (7) aux poteaux (1) comprennent des trous (10) transversaux dans la partie (107) de fond des poutres (7), qui lorsque la poutre est en place, se trouvent à l'extérieur de la fenêtre (2) de chaque côté de le poteau (1), de sorte que des goupilles ou des cales peuvent être engagées dans ces trous (10), de manière à ce que leurs longueurs saillantes soient en appui contre le po- 30

teau.

11. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 4 précédentes, dans lesquels les moyens destinés à fixer les poutres (7) aux poteaux (1) comprennent des ronds (15) à béton supplémentaires et/ou d'autres moyens destinés à relier et à fixer la partie saillante de l'armature (207) des poutres (7) aux chemises (102) métalliques, qui garnissent et définissent les fenêtres (2) dans les poteaux (1) et qui sont disposées de façon appropriée à cet effet, d'une manière appropriée quelconque. 35
12. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 4 précédentes, dans lesquels les moyens à l'aide desquels les poutres (7) sont fixées aux poteaux (1) permettent l'injection de mortiers expansés à prise rapide et/ou d'autres matériaux appropriés, dans les espaces vides des fenêtres (2, 102), dans lesquelles les poutres (7) correspondantes ont été introduites, au moyen d'un coffrage approprié, installé sur place. 40
13. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 12 précédentes, dans lesquels les poutres (7) sont pourvues de moyens de référence qui, une fois positionnés par rapport aux poteaux, indiquent le positionnement relatif correct des deux parties. 45
14. Eléments préfabriqués suivant la revendication 13, dans lesquels les moyens de référence comprennent des parties qui sont coplanaires à ou en creux sur la surface des poutres. 50
15. Eléments préfabriqués suivant la revendication 13, dans lesquels les moyens de référence comprennent des parties en relief qui s'appuient contre le poteau dans laquelle chaque poutre est introduite en dernier, au cours de l'étape d'assemblage. 55
16. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 15 précédentes, dans lesquels l'armature (207) supérieure des poutres reliées aux poteaux (1) est de forme quelconque, de manière à laisser libre un espace ample, au-dessus de la partie (107) de fond des poutres, afin que des dalles (13) de plancher préfabriquées ayant l'armature (113) correspondante qui peut être raccordée sur place ultérieurement à l'armature des poutres, avant le coulage pour achever les dalles de plancher, puissent être soutenues ultérieurement sur ces espaces.
17. Eléments préfabriqués, suivant l'une quelconque des revendications 1 à 16 précédentes, dans lesquels les poteaux (1) sont conçues pour une incorporation dans le bas, dans des soubassements (4) qui sont des soubassements préfabriqués en forme

de coupelle, fixés aux noeuds (103) d'une fondation du type en grille, avec un treillis carré ou rectangulaire, sur laquelle une dalle (5) de plancher préfabriquée qui forme la surface de circulation du rez-de-chaussée du bâtiment, est soutenue et peut être soulevée de façon appropriée de la fondation (3), de manière à former un espace (6) qui est utile à des fins d'isolation et pour loger une partie de l'équipement technique du bâtiment.

18. Eléments préfabriqués suivant l'une quelconque des revendications 1 à 3 précédentes, dans lesquels les fenêtres (2'') sur les poteaux (1') ont des chemises (102') de renfort et ont la forme d'un trapèze isocèle, la base plus petite étant orientée vers le bas, et les poutres (7') ont également une forme en coupe de trapèze isocèle présentant une hauteur qui est inférieure à la hauteur des fenêtres, et les poutres ne comportent pas d'éléments d'armature faisant saillie à partir de la base supérieure, le tout de telle sorte que, lorsque les poutres sont introduites dans la partie haute des fenêtres, il existe un jeu ample entre poutres et fenêtres qui permet une mise en place aisée des poutres.
19. Eléments préfabriqués suivant la revendication 18, dans lesquels les poutres (7') présentent une inclinaison de leurs côtés obliques qui est sensiblement égale à l'inclinaison des côtés obliques des fenêtres (2'') des poteaux (1').
20. Eléments préfabriqués suivant la revendication 19, dans lesquels les côtés obliques des poutres et des fenêtres des poteaux ont une inclinaison d'environ 6° à 7°.
21. Eléments préfabriqués suivant la revendication 20, dans lesquels les poutres (7') sont constituées de béton armé précontraint et/ou vibré et dans lesquels à leurs ronds (307) à béton intérieurs sont fixées des douilles (16) métalliques taraudées, disposées par leurs axes verticalement, le long du plan médian longitudinal de la poutre (7'), douilles qui par leur extrémité supérieure sont coplanaires à la surface latérale supérieure de la poutre ou en dépassent légèrement et qui sont espacées les unes des autres, de façon équidistante, par un pas approprié, certaines de ces douilles disposées dans la partie intermédiaire de la poutre étant utilisées pour visser en leur sein des boulons à oeil pour l'accrochage à la grue qui met en place la poutre, et en outre, les boulons à oeil étant laissés dans leurs emplacements et étant reliés au moyen de ronds à béton aux structures (113) d'armature des dalles (13) de plancher, auxquelles sont également reliés des ronds (17) à béton supplémentaires qui passent dans des douilles (116) fendues, munies d'une tige filetée à visser dans les douilles (16) mentionnées ci-dessus des poutres (7').

22. Eléments préfabriqués suivant la revendication 21, dans lesquels le pas d'écartement entre les douilles (16) est tel qu'à chaque fois que la poutre a été positionnée, deux des douilles sont disposées immédiatement à l'extérieur des fenêtres (2'') des poteaux (1'), de manière à ce que les ronds (17) à béton, ancrés dans les douilles (116) supplémentaires associées à ces deux douilles, coopèrent avec les côtés opposés des poteaux, afin d'éviter des mouvements relatifs peu souhaitables entre la poutre et le poteau.

23. Eléments préfabriqués suivant la revendication 21, dans lesquels au moins deux douilles (16') qui sont égales aux douilles (16) mentionnées ci-dessus, peuvent être prévues dans la zone médiane de la face inférieure de la poutre (7'), à des points de la poutre qui se situent au centre de la base des fenêtres (2''), afin de permettre d'introduire par vissage dans certaines douilles, des goupilles (18) saillantes qui coopéreront avec une douille (16'') correspondante, prévue au centre de la base inférieure de chaque fenêtre (2'') et/ou avec une assise correspondante, prévue sur la base inférieure de la chemise (102') de la fenêtre.

24. Eléments préfabriqués suivant la revendication 21, dans lesquels des douilles (16''') taraudées, similaires aux douilles (16) mentionnées ci-dessus pour les poutres (7'), peuvent être disposées au moins sur une surface latérale des poteaux (1') vers laquelle ouvrent les fenêtres (2''), par exemple, sur les surfaces qui sont orientées vers les extrémités des poutres (7'), afin de permettre la fixation sur la surface des poteaux, de poteaux auxiliaires de renfort, constituées par exemple, de poutres métalliques qui sont en forme de double T ou de U, qui peuvent servir également de poteaux verticales pour le passage d'équipement technique de divers types.

25. Procédé pour l'assemblage d'une structure préfabriquée en béton armé, comprenant les éléments préfabriqués suivant l'une quelconque de revendications 1 à 24 précédentes, comprenant les étapes suivantes :

chacune des poutres l'une après l'autre est fixée à l'élingue d'une grue de chantier, à l'aide moyens (8) appropriés ;

chaque poutre est tout d'abord présentée vers le côté d'un poteau (1) et une extrémité est introduite dans la fenêtre (2) de raccordement de l'autre poteau (1), jusqu'à ce que l'autre extrémité de la poutre atteigne l'espace entre les deux poteaux ;

ensuite, l'extrémité est alignée avec la fenêtre correspondante de la deuxième poteau et la grue inverse le mouvement latéral pour introdui-

re cette extrémité de la poutre dans la fenêtre de la deuxième poteau, également jusqu'à ce que la poutre soit soutenue par les deux poteaux, de la manière déterminée à l'avance, des moyens étant prévus pour fixer par la suite, les poutres aux poteaux. 5

26. Procédé suivant la revendication 25, dans lequel avant que le travail de coulée (S) ne soit effectué sur place pour achever les structures de dalles de plancher horizontales, à l'aide de tours d'échafaudage pour le support temporaire, des structures (14) de parapet préfabriquées, munies d'une armature (114) qui peut être reliée à celle des poutres et des dalles de plancher, de manière à être incorporée à et immobilisée dans le matériau coulé, sont placées le long des extrémités des poutres (7) de chaque paire des poutres (7). 10 15

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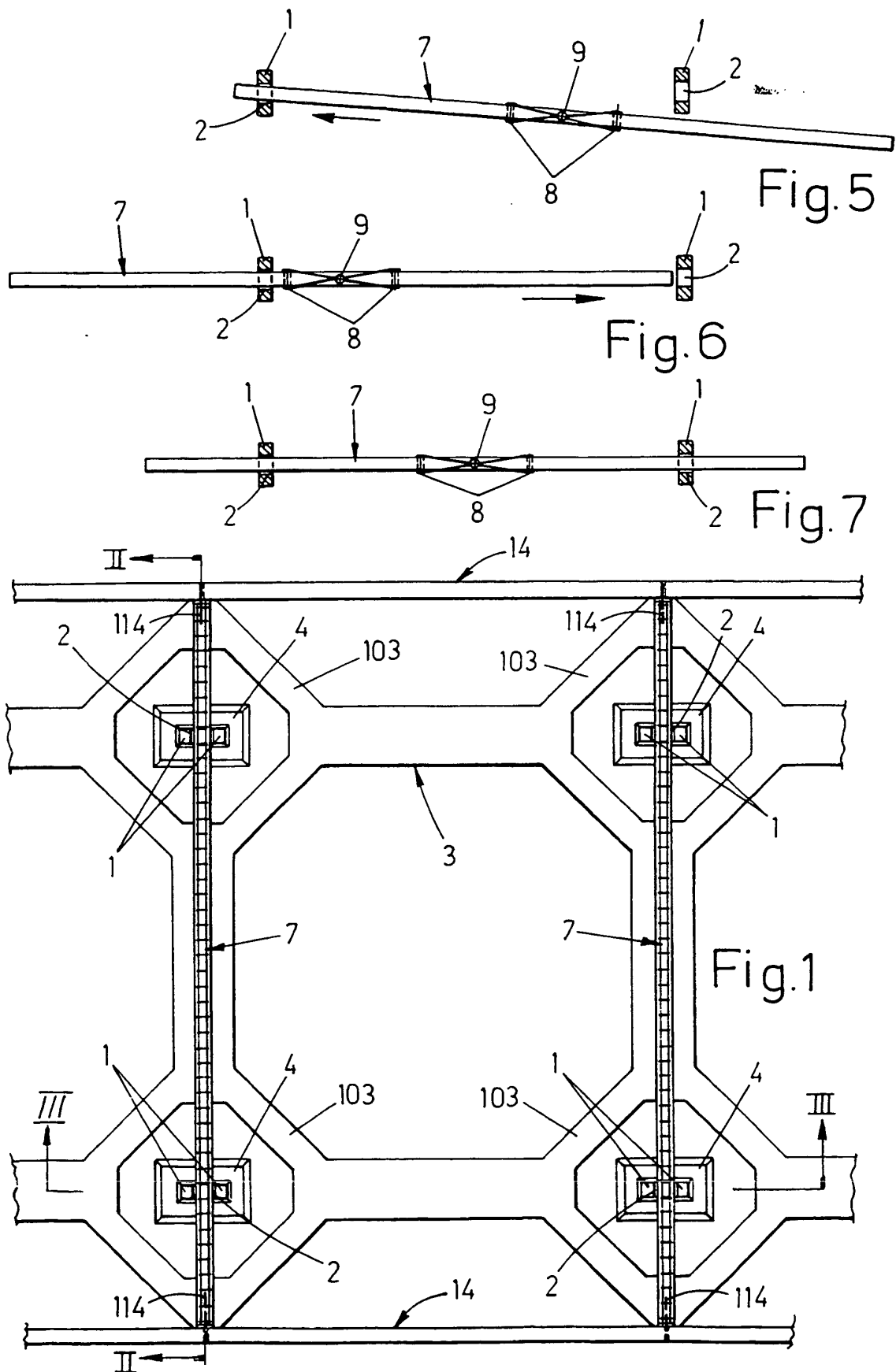
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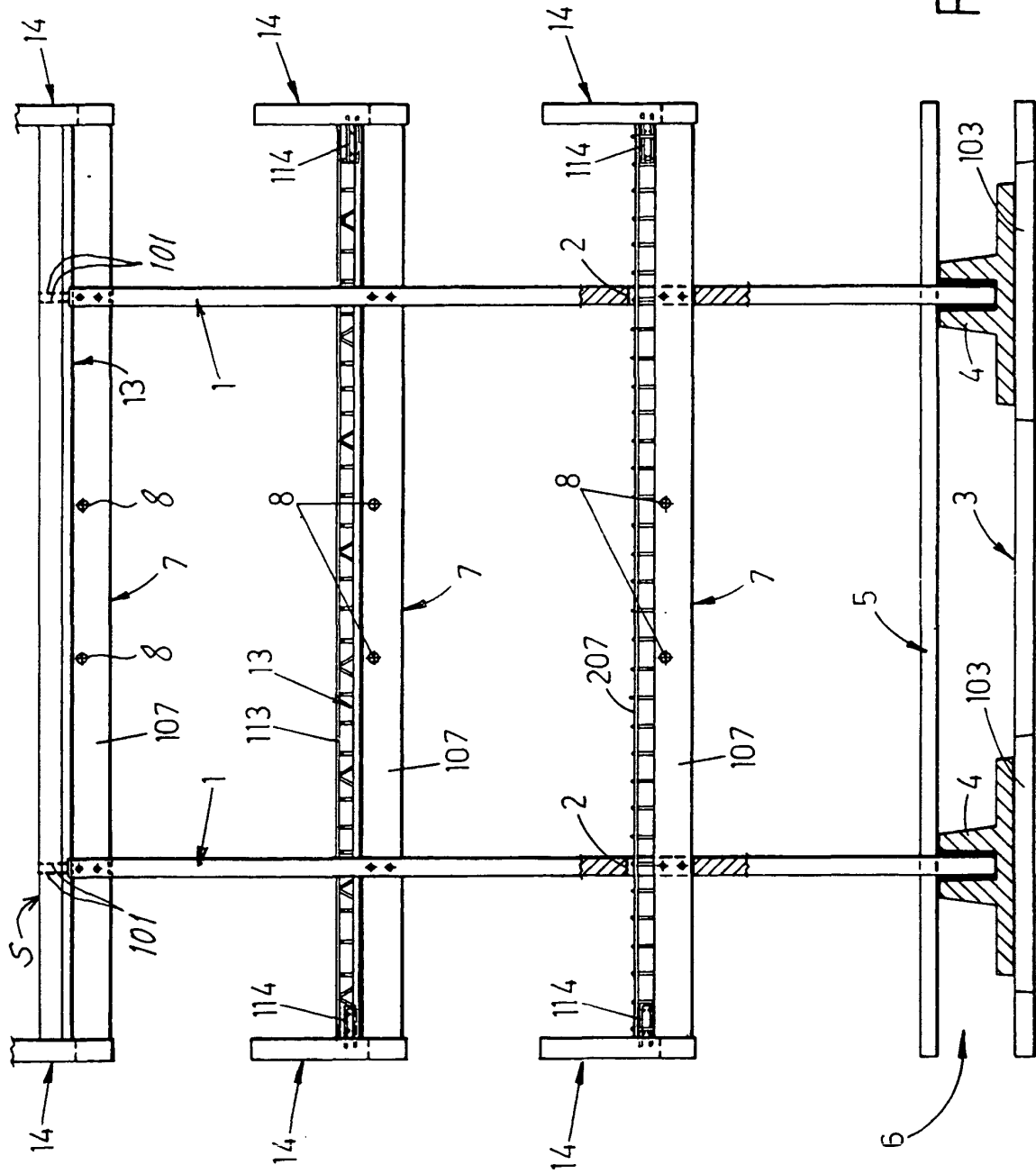
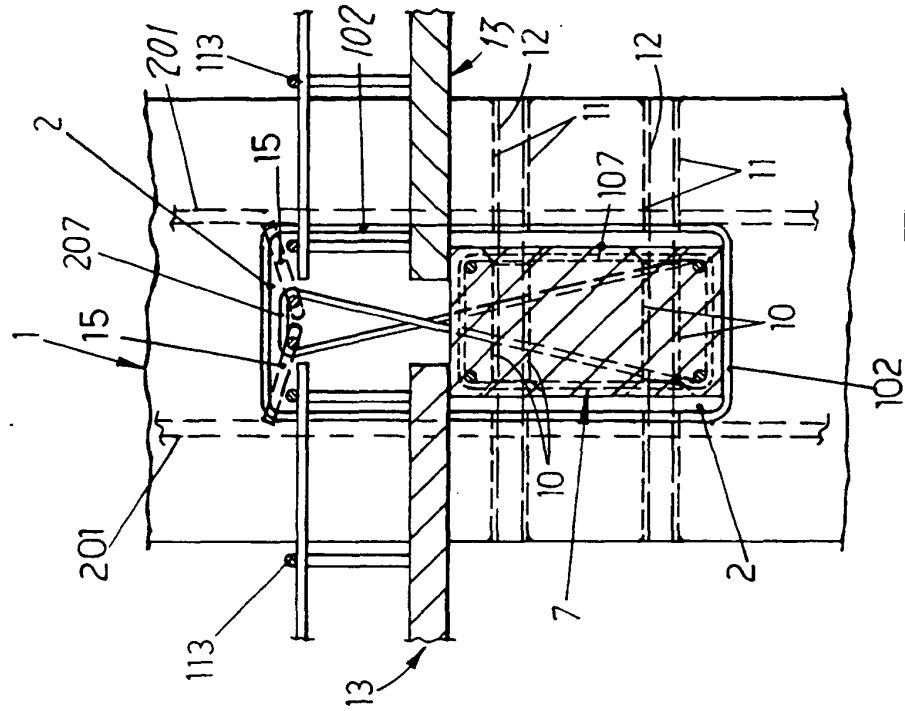
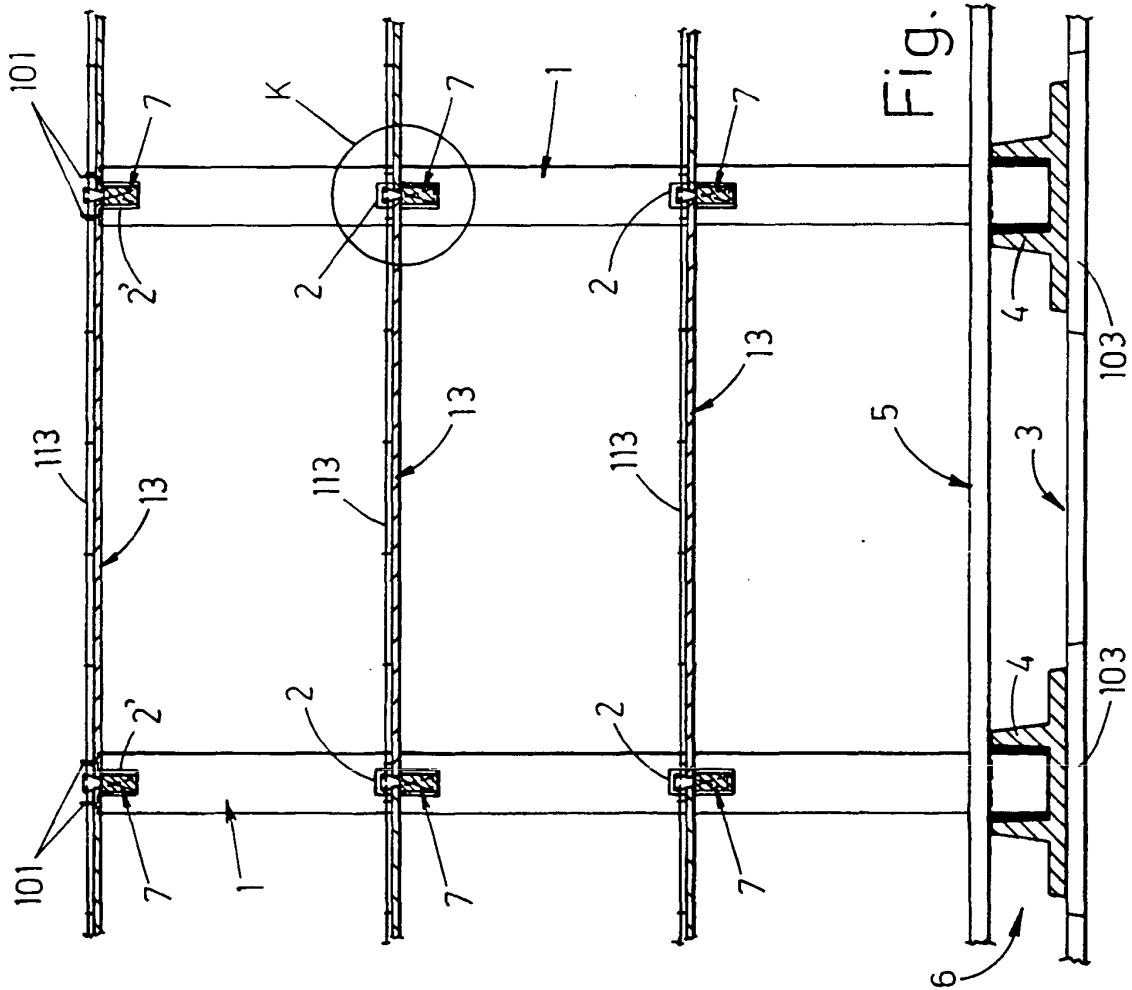


Fig. 2



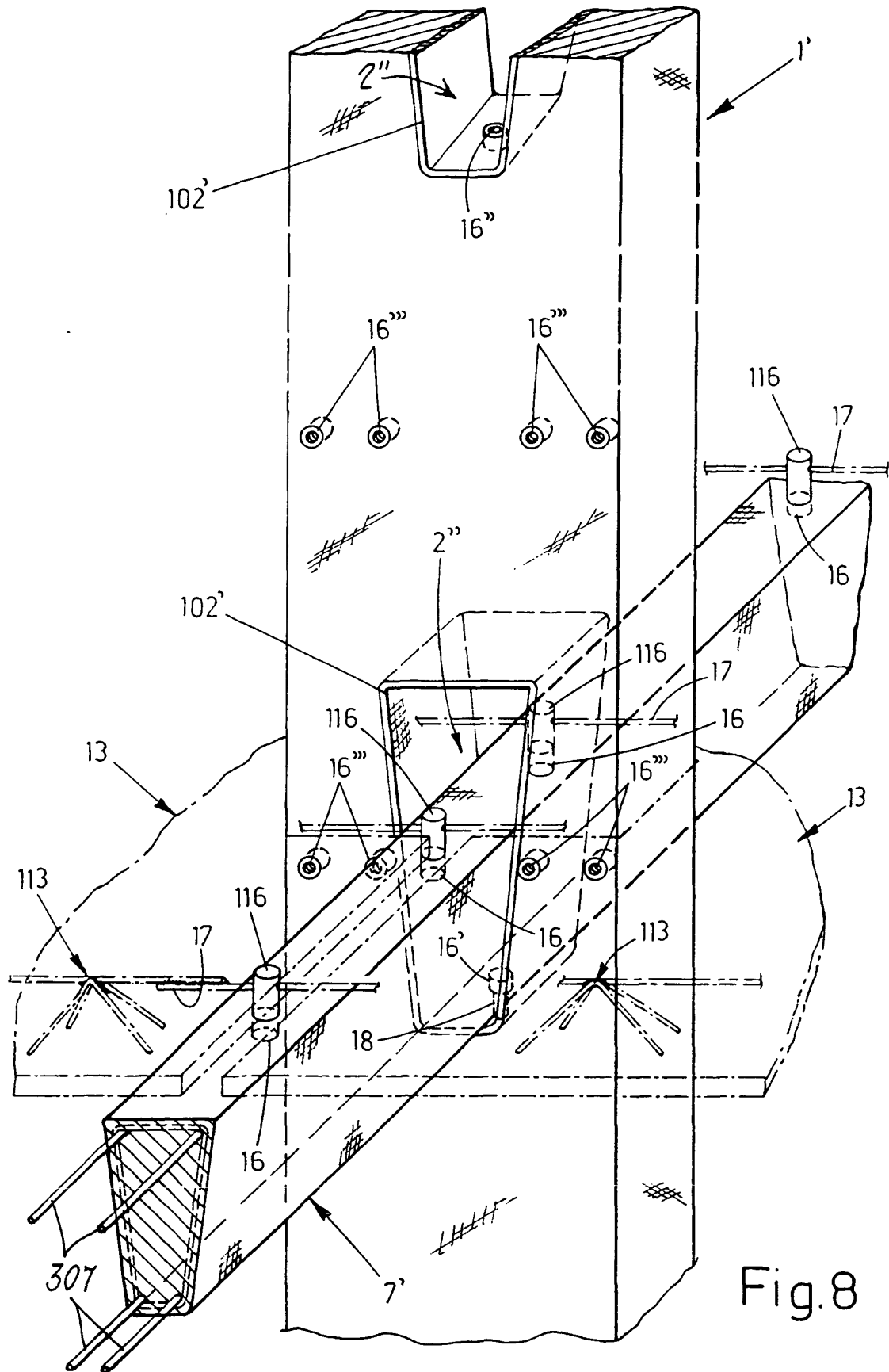


Fig. 8