

REINFORCING STRUCTURE AND REINFORCING METHOD FOR REINFORCEMENT CAGE

FIELD OF THE INVENTION

[0001] The present invention relates to a reinforcing structure and a reinforcing method for a reinforcement cage for avoiding the reinforcement cage from being deformed while being lifted.

BACKGROUND OF THE INVENTION

[0002] It is well known that a column or a foundation pile is built at a building site by casting concrete over a reinforcement cage that is in a vertical attitude.

Such a reinforcement cage has a number of steel reinforcements (hereinafter called main bars) that linearly extend in parallel with each other, and a number of annular steel reinforcements (hereinafter called hoops) that are arranged at intervals in the longitudinal direction of the main bars so as to surround the main bars. The main bars and the hoops are connected to each other with a thin metal wire at intersections therebetween.

[0003] The reinforcement cage is assembled in a factory or at a building site, and placed in a horizontal attitude, for example, on the ground, at the building site. Then, when needed, the reinforcement cage is lifted by a crane and carried to a place where a column or a foundation pile is to be built.

[0004] The construction procedures is disclosed in Japanese Patent Publication No. 4137173).

[0005] The reinforcement cage is normally lifted by one crane. Describing more in detail, a suspension device hanging from an end of a boom of the crane holds the reinforcement cage at off-center, and lifts the reinforcement cage in this state. By this operation, the reinforcement cage is raised from the initial horizontal attitude to an inclined attitude and eventually to a vertical attitude, and then, separated from the ground.

[0006] When the reinforcement cage is in the inclined attitude as described above, the reinforcement cage is placed in a state in which one end thereof is in contact with the ground. The main bars of the reinforcement cage are arranged in a mutually spaced manner, and only one ends of the lowermost main bars are in contact with the ground. Each of the other main bars is subjected to a force in the longitudinal direction thereof caused by its own weight, and therefore, is displaced in the longitudinal direction relative to the lowermost main bars. The displacements of the uppermost main bars are the largest. Along with the displacements of the main bars, the hoops change their state from a perpendicular state to an inclined state relative to the main bars, and thus, the vertical dimension of a cross-sectional shape of the reinforcement cage (i.e. distance between the lowermost main bars and the uppermost main bars) decreases. Such a deformation of the reinforcement cage poses a problem in connection between upper and lower reinforcement cages.

[0007] Further, in the state in which the reinforcement cage is inclined, only one ends of the lowermost main bars are subjected to a large reaction force caused by the weight of the reinforcement cage from the ground and are dragged while being in contact with the ground. As a result, the one ends of the lowermost main bars are deformed and/or damaged.

[0008] The overall deformation of the reinforcement cage and the deformation of the one ends of the lowermost main bars as described above are more prone to occur as a length of the reinforcement cage increases and as the weight of the reinforcement cage increases.

For that reason, when the reinforcement cage is long and heavy-weighted, a number of reinforcing bars are incorporated into the reinforcement cage so as to avoid the overall deformation of the reinforcement cage. However, these internal reinforcing bars do not contribute to improvement in strength of columns or the like after being embedded in the concrete, thus being wasteful. Furthermore, the internal reinforcing bars are not effective for prevention of the deformation and/or damage of the one ends of the lowermost main bars described above.

[0009] In order to avoid the above-described disadvantages, there is practiced a method in which, by using a sub-crane in addition to the main crane, the reinforcement cage is changed in attitude from the horizontal attitude to the vertical attitude while being separated from the ground. However, this method requires skilled crane operation.

SUMMARY OF THE INVENTION

[0010] In order to solve the above-described problems, the present invention provides a structure for reinforcing a reinforcement cage including a number of linear main bars that are in parallel with each other in a process of changing the attitude of the reinforcement cage from a horizontal attitude to an inclined attitude with one end of the reinforcement cage in contact with the ground and further to a vertical attitude by lifting the reinforcement cage, the reinforcement cage including a number of linear main bars that are in parallel with each other, and the reinforcing structure comprising: a reinforcing bar that connects an end of a lowermost main bar of the main bars to an end of an uppermost main bar of the main bars at the one end of the reinforcement cage.

[0011] With the structure described above, in the state in which the reinforcement cage is inclined, the reinforcing bar connects the end of the lowermost main bar to the end of the uppermost main bar. Therefore, the uppermost main bar is not displaced in the longitudinal direction relative to the lowermost main bar, and thus, the overall deformation of the reinforcement cage can be prevented. As a result, the internal reinforcing bars for preventing the overall deformation of the reinforcement cage can be eliminated or reduced in number. Because the reinforcement cage is lifted while the one end thereof is kept in contact with the ground, no complicated crane operation is required.

Moreover, because the reaction force from the ground can be received not only by the lowermost main bar but also by the uppermost main bar, the end of the lowermost main bar can be avoided from being deformed.

[0012] It is preferable that the reinforcing bar includes a linear main portion and a pair of connecting end portions that are continuous from both ends of the main portion

and extend perpendicularly to the main portion; and the pair of connecting end portions are detachably connected to the end of the lowermost main bar and the end of the uppermost main bar, respectively.

With this arrangement, the reinforcing bar can be removed and reused, and thus, a waste of material can be eliminated. The reinforcing bar can be easily connected to and removed from the ends of the main bars via the pair of connecting end portions.

[0013] It is preferable that a coupler having a cylindrical shape be further provided at each of the pair of connecting end portions of the reinforcing bar, and the end of the main bar of the reinforcement cage and the connecting end portion of the reinforcing bar be inserted in the coupler so as to form a straight line.

With this arrangement, a connection operation of the reinforcing bar can be made easier.

[0014] It is preferable that at least the one end of each of the lowermost and the uppermost main bars of the reinforcement cage is formed, on an outer periphery thereof, with an external thread; at least the pair of connecting end portions of the reinforcing bar are each formed, on an outer periphery thereof, with an external thread; the coupler is formed, on an inner periphery thereof, with an internal thread; and the end of the main bar and the connecting end portion of the reinforcing bar are threaded into the coupler.

With the connections via threads described above, the connection operation can be made further easier, and a removal operation is also made easy. In addition, because the connection strength between the reinforcing bar and the main bar is high, a reinforcing effect of the reinforcement cage can be enhanced.

[0015] According to another aspect of the present invention, a reinforcing method for a reinforcement cage including a number of linear main bars that are in parallel with each other, the method comprising: in a state in which the reinforcement cage is in a horizontal attitude, using a reinforcing bar to connect an end of a lowermost main bar of the main bars to an end of an uppermost main bar of the main bars at one end of a reinforcement cage; holding the reinforcement cage at a location deviated from the center in the longitudinal direction of the reinforcement cage toward the other end of the

reinforcement cage and lifting the reinforcement cage, so that the reinforcement cage is placed in an inclined attitude with the one end thereof in contact with the ground and subsequently further placed in a vertical attitude and separated from the ground; and after the reinforcement cage is separated from the ground, removing the reinforcing bar from the lowermost and uppermost main bars.

[0016] According to the present invention, by using a reinforcing bar, a reinforcement cage can be prevented from being deformed while being lifted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIGS. 1A and 1B are schematic side views of a reinforcement cage for use in a column according to an embodiment of the present invention, with FIG. 1A showing a state immediately before a crane lifts the reinforcement cage that is reinforced at an end thereof and is laid in a horizontal attitude, and FIG. 1B showing a state in which the reinforcement cage is lifted to be inclined;

FIG. 2 is a view on arrow II-II in FIG. 1A;

FIG. 3 is a cross-sectional view on arrow III-III in FIG. 1A;

FIG. 4 is an enlarged view showing the reinforcement cage of FIG. 1A in a partially omitted manner;

FIG. 5 is an enlarged view showing the reinforcement cage of FIG. 1B in a partially omitted manner;

FIGS. 6A to 6D are side views showing the reinforcement cage in vertically suspended states, with FIG. 6A showing a state in which a reinforcing bar is mounted at a lower end thereof, FIG. 6B showing a state in which the reinforcing bar is removed, FIG. 6C showing a state in which the lower end is positioned at an upper end of a reinforcement cage for a column of a lower floor, and FIG. 6D showing a state in which the lower end is connected to the upper end of the reinforcement cage of the lower floor; and

FIG. 7 is a cross-sectional view showing a further enlarged view of the reinforcing structure of one end of the reinforcement cage that is the essential part of FIG. 1A.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0018] An embodiment of the present invention will be described below with reference to the accompanying drawings. FIGS. 1A and 4 show a reinforcement cage 10 that has been produced in a factory or at a building site for use in a column (vertical structure). The reinforcement cage 10 is provided with a number of linearly extending steel reinforcements 11 (hereinafter called main bars), and a number of annular steel reinforcements 12 (hereinafter called hoops).

[0019] The main bars 11 are arranged with intervals at corners and sides of a quadrangle, as shown in FIG. 3, while extending in parallel with each other. The main bars 11 may be additionally arranged inside of the quadrangle.

The hoops 12 each form a quadrangle so as to surround the main bars 11, and are arranged at intervals in the longitudinal direction of the main bars 11.

The hoop 12 intersects with the main bars 11 at a right angle, and is connected to the main bar 11 with a thin metal wire (not shown) at this intersection.

[0020] In the present embodiment, a so-called "threaded steel bar" is used as the main bar 11. The "threaded steel bars" is a steel bar that is formed with an external thread over the entire length thereof in a rolling process. As shown in only FIG. 7, the external thread 11a is composed of a number of thread-shaped nodes formed over an angular range of less than 180° in each of two elongated regions 11x facing each other in a radial direction of the main bar 11. No thread-shaped nodes are formed in regions 11y between the two regions 11x.

The hoop 12 may or may not be a threaded steel bar.

[0021] As shown in FIGS. 1A and 4, all one ends of the main bars 11 are each equipped with a coupler 13 at one end, that is, at the right end, of the reinforcement cage 10. Each of the couplers 13 has a cylindrical shape and is formed on an inner circumference thereof with an internal thread 13a, as shown in FIG. 7. The external thread 11a at the one end of the main bar 11 is threaded to the internal thread 13a.

[0022] As shown in FIGS. 1A, 2, and 4, at the one end of the reinforcement cage 10,

lowermost ones of the main bars 11 (that is, the main bars 11 located at a lower side of the quadrangular cross-sectional shape of the reinforcement cage 10) are all connected to corresponding uppermost ones of the main bars 11 with reinforcing bars 14 having a U-shape.

[0023] As shown in FIG. 7, the reinforcing bar 14 is composed of a threaded steel bar in the same manner as the main bar 11, and has the external thread 14a over the entire length thereof. The reinforcing bar 14 is obtained by cutting a straight threaded steel bar, which is obtained by rolling, to a predetermined length, and then bending the vicinities of both ends of the bar. The reinforcing bar 14 has a main portion 14x that extends linearly, and a pair of short connecting end portions 14y that are continuous from both ends of the main portion 14x and linearly extend perpendicularly to the main portion 14x.

[0024] As shown in FIGS. 1A, 2, 4, and 7, the pair of connecting end portions 14y of the reinforcing bar 14 are connected to the upper and lower main bars 11, respectively, via the couplers 13. This connection operation will be described below.

Before the connection, the couplers 13 of the lowermost and the uppermost main bars 11 are threaded to the main bars 11 over the entire length of the couplers in the same manner as the couplers 13 of the other main bars 11 in the intermediate positions. In this state, the end of the main bar 11 is flush with or slightly protruding from an end face of the coupler 13.

[0025] The pair of connecting end portions 14y of the reinforcing bar 14 are located on the same straight line as the upper and the lower main bars 11 and brought close thereto. Then, the couplers 13 are moved toward the connecting end portions 14y while being rotated. By these operations, one halves of the couplers 13 are threaded around the ends of the main bars 11, and the other halves thereof are threaded around the connecting end portions 14y, as shown in FIG. 7. As a result, the respective connecting end portions 14y of the reinforcing bar 14 are detachably connected to the one ends of the corresponding main bars 11 via the couplers 13.

[0026] A reinforcing structure S of the reinforcement cage 10 according to the present invention is composed of all of the reinforcing bars 14 and the couplers 13 that

connect the pair of connecting end portions 14y of the reinforcing bars 14 to the one ends of the corresponding main bars 11.

[0027] Next, the working of the thus composed reinforcing structure S in a lifting process of the reinforcement cage 10 will be described. As shown in FIGS. 1A and 4, the reinforcement cage 10 is placed horizontally on the ground via square logs 20.

[0028] On the other hand, a crane cable 30 is hanging from an end of a boom of a crane (not shown), and a supporting device 31 (schematically shown in FIG. 1A) such as a hook is fixed to a lower end of the cable.

[0029] A suspension device 40 is attached to the supporting device 31. As best shown in FIG. 3, the suspension device 40 has a balance bar type supporting bar 41. The center of the supporting bar 41 is connected to the supporting device 31 via a first cable 42. Pulleys 44 are rotatably supported at both ends of the supporting bar 41 via respective second cables 43 having small lengths. Third cables 45 are hung, at intermediate parts thereof, over the respective pulleys 44, and clamps 46 are fixed to both ends of each of the third cables 45.

[0030] As shown in FIG. 3, the clamps 46 detachably hold the four main bars 11 located at the corners of the quadrangular cross-sectional shape of the reinforcement cage 10. The holding positions of the clamps are deviated from the center in the longitudinal direction of the reinforcement cage 10 to the side that is away from the reinforcing structure S, as shown in FIG. 1A.

[0031] Next, the crane is operated to lift the reinforcement cage 10. While being lifted, the reinforcement cage 10 is raised to an inclined attitude such that the one end thereof is in contact with the ground, as shown in FIGS. 1B and 5. In this state, because the lowermost main bars 11 and the uppermost main bars 11 are connected to each other by the reinforcing bars 14, the uppermost main bars 11 are prevented from being displaced in the longitudinal direction thereof relative to the lowermost main bars 11. The main bars 11 in the intermediate positions are also prevented from being displaced in the longitudinal direction because they are connected to the lowermost and the uppermost main bars 11 via the hoops 12. As a result, an overall deformation of the reinforcement

cage 10 is prevented.

[0032] A reaction force from the ground caused by the weight of the reinforcement cage 10 is applied not only to the one ends of the lowermost main bars 11 but also to the one ends of the upper main bars 11 via the reinforcing bars 14. As a result, the reaction force received by the lowermost main bars 11 can be halved, and thus, the deformation thereof can be prevented.

[0033] When the reinforcement cage 10 is in an inclined attitude, the ends of the lowermost main bars 11 do not directly contact the ground, but curved portions (i.e. portions where the main portions 14x continue to one of the connecting end portions 14y) of the reinforcing bars 14 contact the ground. Therefore, the one ends of the lowermost main bars 11 are not damaged even if the reinforcement cage 10 is dragged along the ground.

[0034] When the reinforcement cage 10 is further lifted, the reinforcement cage 10 is placed in a vertical attitude as shown in FIG. 6A. When the reinforcement cage 10 is still further lifted, the reinforcement cage 10 leaves the ground. In this state, the reinforcing bars 14 are removed as shown in FIG. 6B. The removal operation of the reinforcing bars 14 can be achieved by moving the corresponding couplers 13 upward along the main bars 11 while rotating the couplers. The removed reinforcing bars 14 can be reused.

[0035] Next, the reinforcement cage 10 is moved to directly above a reinforcement cage 10' of a lower floor as shown in FIG. 6C. The reinforcement cage 10' of the lower floor that has the same structure as that of the lifted reinforcement cage 10 includes a number of main bars 11' and a number of hoops 12', and is embedded in concrete 50 except an upper end portion.

[0036] In a process shown in FIG. 6C, the main bars 11 of the suspended reinforcement cage 10 are positioned so as to be located on the same straight lines as the main bars 11' of the reinforcement cage 10' of the lower floor, and the main bars 11 and 11' are made close to each other.

[0037] Next, as shown in FIG. 6D, all of the couplers 13 of the reinforcement cage 10 are rotated to be moved down and threaded to the main bars 11' of the reinforcement

cage 10' of the lower floor by half length. By this operation, the main bars 11 and 11' of the upper and the lower reinforcement cages 10 and 10' are respectively connected to each other by the couplers 13. Note that an injection port (not shown) may be formed in the middle of the coupler 13 and grout such as mortar injected from the injection port so that the connection strength of the main bars is increased.

[0038] As can be understood from the description given above, in the present embodiment, the couplers 13 for mutually connecting the main bars 11 and 11' of the upper and lower reinforcement cages 10 and 10' are also used for connecting the main bars 11 to the reinforcing bars 14. Thus, only the reinforcing bars 14 are required as components additionally used for the reinforcing structure S of the reinforcement cage 10. Accordingly, cost for reinforcement can be suppressed.

[0039] The present invention is not limited to the above-described embodiment and can employ various modes. For example, although the threaded steel bar having the external thread formed by rolling is used as a main bar and a reinforcing bar in the above-described embodiment, ordinary deformed steel bars may be used as the main bar and the reinforcing bar, and the external threads may be formed by cutting only one end of the main bar and the pair of the connecting end portions of the reinforcing bar.

[0040] In the above-described embodiment, the one end of the main bar and the connecting end portion of the reinforcing bar are threaded to the coupler; however, they may be detachably connected by a method other than the connection via threads. For example, in the state in which the one end of the main bar and the connecting end portion of the reinforcing bar are simply inserted in a coupler having a cylindrical shape, the one end of the main bar and the connecting end portion of the reinforcing bar may be detachably fixed to the coupler by a clamp jig. In this case, ordinary deformed steel bars may be used as the main bar and the reinforcing bar.

Alternatively, rather than using a coupler, the one end of the main bar and the connecting end portion of the reinforcing bar may be detachably connected to each other by a clamp jig with the one end of the main bar and the connecting end portion of the reinforcing bar located on one straight line.

Further alternatively, the one end of the main bar and the connecting end portion of the reinforcing bar may be adjacently arranged in parallel with each other and detachably connected to each other with a clamp jig or a thin metal wire.

The one end of the main bar and the connecting end portion of the reinforcing bar may be inseparably connected to each other by welding or the like.

[0041] In the above-described embodiment, all of the lowermost main bars are connected to the corresponding uppermost main bars with the reinforcing bars. However, only selected one or ones of the lowermost main bars may be connected to the corresponding uppermost main bar or bars. In this case, the ends of the main bars that are not connected to any reinforcing bar are separated from the ground when the reinforcement cage is raised to an inclined attitude.

[0042] The present invention is mainly applied to a reinforcement cage for a vertical structure such as a column or a pile, but can be applied to a case in which a reinforcement cage for another structure is lifted and carried.

[0043] The device for lifting the reinforcement cage is not particularly limited. For example, a cable having clamps at both ends may simply be hung, at an intermediate part thereof, on a hook provided at the lower end of the crane cable.

[0044] The present invention can be used in order to prevent deformation of a reinforcement cage for use in, for example, a column or a pile when the reinforcement cage is lifted.

What is claimed is:

1. A structure for reinforcing a reinforcement cage including a number of linear main bars that are in parallel with each other in a process of changing the attitude of the reinforcement cage from a horizontal attitude to an inclined attitude with one end of the reinforcement cage in contact with the ground and further to a vertical attitude by lifting the reinforcement cage, the reinforcement cage including a number of linear main bars that are in parallel with each other, and the reinforcing structure comprising:

a reinforcing bar that connects an end of a lowermost main bar of the main bars to an end of an uppermost main bar of the main bars at the one end of the reinforcement cage.

2. The reinforcing structure according to claim 1, wherein the reinforcing bar includes a linear main portion and a pair of connecting end portions that are continuous from both ends of the main portion and extend perpendicularly to the main portion; and

the pair of connecting end portions are detachably connected to the end of the lowermost main bar and the end of the uppermost main bar, respectively.

3. The reinforcing structure according to claim 2, further comprising a coupler having a cylindrical shape provided at each of the pair of connecting end portions of the reinforcing bar; wherein

the end of the main bar of the reinforcement cage and the connecting end portion of the reinforcing bar are inserted in the coupler so as to form a straight line.

4. The reinforcing structure according to claim 3, wherein at least the one end of each of the lowermost and the uppermost main bars of the reinforcement cage is formed, on an outer periphery thereof, with an external thread;

at least the pair of connecting end portions of the reinforcing bar are each formed, on an outer periphery thereof, with an external thread;

the coupler is formed, on an inner periphery thereof, with an internal thread; and

the end of the main bar and the connecting end portion of the reinforcing bar are threaded into the coupler.

5. A reinforcing method for a reinforcement cage including a number of linear main bars that are in parallel with each other, the method comprising:

in a state in which the reinforcement cage is in a horizontal attitude, using a reinforcing bar to connect an end of a lowermost main bar of the main bars to an end of an uppermost main bar of the main bars at one end of the reinforcement cage;

holding the reinforcement cage at a location deviated from the center in the longitudinal direction of the reinforcement cage toward the other end of the reinforcement cage and lifting the reinforcement cage, so that the reinforcement cage is placed in an inclined attitude with the one end thereof in contact with the ground and subsequently further placed in a vertical attitude and separated from the ground; and

after the reinforcement cage is separated from the ground, removing the reinforcing bar from the lowermost and uppermost main bars.