

STEEL COLUMN ASSEMBLY, PREFABRICATED STEEL COLUMN MODULE, STEEL STRUCTURE, SHEAR WALL, AND MODULAR BUILDING

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Chinese Patent Application No. 202310801806. X filed on June 30, 2023, the contents of which are hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present application relates to the field of modular assembled buildings, and more particularly to a steel column assembly, a prefabricated steel column module, an assembled steel structure, a prefabricated shear wall, and a modular building.

BACKGROUND

[0003] In the related art, each of an upper floor and a lower floor of a modular assembled building includes a steel structure, and the steel structures of the upper floor and the lower floor are connected to each other in an inserting manner. Generally, connecting ends of the steel structures are designed as insertion structures that are convenient for insertion. The steel structures of the upper floor and the lower floor are connected to each other by the insertion structures at the ends thereof. After the steel structures of the upper floor and the lower floor are connected to each other by the insertion structures, cement is poured into the steel structures. After the cement solidifies, a stable and firm connection is achieved.

[0004] In order to enhance the pullout resistance between the insertion structures of the steel structures of the upper floor and the lower floor at the ends thereof after the cement is poured, pullout resistance members can be added to the insertion structures of the steel structures at the ends thereof. An existing method is as follows. Solders are accumulated at an outer side of a protruding core column at a top end of the steel structure of the lower floor to form a strip-shaped protrusion, and solders are accumulated at an inner wall of a bottom end of the steel structure of the upper floor to form a strip-shaped protrusion.

[0005] However, since the bottom end of the steel structure of the upper floor has a narrow internal space, it is extremely inconvenient to weld the pullout resistance members,

and the speed at which solders are accumulated is slow, which leads to a reduction of production efficiency and is not conducive to the realization of an automatic production.

SUMMARY

- [0006]** In order to solve the above problem, a purpose of embodiments of the present application is to provide a steel column assembly, a prefabricated steel column module, an assembled steel structure, a prefabricated shear wall, and a modular building.
- [0007]** According to a first aspect, an embodiment of the present application provides a steel column assembly. The steel column assembly includes a first steel column and a second steel column. The first steel column is a hollow columnar structure. The first steel column includes a plurality of lateral beams extending along a preset direction. The second steel column is a hollow columnar structure. A side wall of the second steel column is provided with a plurality of welding grooves extending along the preset direction. The first steel column is embedded into the second steel column, the plurality of welding grooves correspond to at least a part of the plurality of lateral beams, and the first steel column and the second steel column are fixed to each other at the plurality of welding grooves by welding.
- [0008]** Further, the first steel column further includes a plurality of vertical beams, the plurality of vertical beams extend along an axial direction, each of the plurality of lateral beams is arranged between two respective adjacent vertical beams of the plurality of vertical beams and connects the two respective adjacent vertical beams, and the plurality of vertical beams and the plurality of lateral beams form the hollow columnar structure. An angle is formed between the axial direction and the preset direction.
- [0009]** Further, multiple lateral beams are arranged between any two adjacent vertical beams of the plurality of vertical beams, and are successively spaced apart from each other along the axial direction.
- [0010]** Further, the multiple lateral beams arranged between the any two adjacent vertical beams are evenly spaced apart from each other, and a spacing between any two adjacent lateral beams is greater than or equal to a width dimension of each lateral beam.
- [0011]** Further, the plurality of welding grooves extends along the preset direction.
- [0012]** Further, each side wall of the second steel column is provided with multiple welding grooves, the multiple welding grooves located on a same side wall are successively spaced apart from each other along the axial direction, and each of the plurality of welding

grooves corresponds to a respective one of the plurality of lateral beams of the first steel column.

[0013] Further, a cross-sectional shape of the first steel column is the same as a cross-sectional shape of the second steel column, and each of the cross-sectional shape of the first steel column and the cross-sectional shape of the second steel column is rectangular.

[0014] Further, a cross-sectional maximum length dimension of the first steel column is less than a cross-sectional minimum length dimension of the second steel column, and a cross-sectional maximum width dimension of the first steel column is less than a cross-sectional minimum width dimension of the second steel column.

[0015] Further, a spacing between an outer side wall of the first steel column and an inner side wall of the second steel column is greater than or equal to 1 mm and less than or equal to 5 cm.

[0016] Further, an end of the first steel column and an end of the second steel column are fixed to each other by welding.

[0017] Further, an end outer side wall of the first steel column is chamfered and/or an end inner side wall of the second steel column is chamfered.

[0018] Further, the first steel column is a rectangular steel plate, and the rectangular steel plate is provided with a plurality of through grooves extending along the preset direction, so that each of the plurality of lateral beams is formed between two respective adjacent through grooves of the plurality of through grooves. The rectangular steel plate is sequentially bent multiple times along the preset direction, and after bending, the rectangular steel plate is welded from end-to-end to form a hollow columnar structure.

[0019] Further, each of the plurality of lateral beams is a bent structure, a wavy structure, an arc structure, or a strip-shaped linear structure; accordingly, each of the plurality of welding grooves is a bent structure, a wavy structure, an arc structure, or a strip-shaped linear structure.

[0020] According to a second aspect, an embodiment of the present application further provides a prefabricated steel column module, including a steel column body, an inner core column, and the steel column assembly described above.

[0021] The steel column body includes a bottom end and a top end opposite to each other, the steel column assembly is fixedly connected to the bottom end of the steel column body, the inner core column is fixedly connected to the top end of the steel column body, the inner core column protrudes from the top end of the steel column body, a cross-sectional

maximum length dimension of the inner core column is less than a cross-sectional minimum length dimension of the first steel column, and a cross-sectional maximum width dimension of the inner core column is less than a cross-sectional minimum width dimension of the first steel column.

[0022] Further, a protruding rib extending along the preset direction is arranged on an outer side wall of the inner core column.

[0023] Further, the steel column assembly and the bottom end of the steel column body is fixedly connected to each other by welding, and a welding location after welding is flat.

[0024] According to a third aspect, an embodiment of the present application further provides an assembled steel structure, including at least two prefabricated steel column modules described above. The at least two prefabricated steel column modules includes a lower steel column module and an upper steel column module, the steel column assembly of the upper steel column module is arranged around the inner core column of the lower steel column module, and the steel column assembly of the upper steel column module abuts against the top end of the steel column body of the lower steel column module.

[0025] Further, a protruding rib extending along the preset direction is arranged on an outer side wall of the inner core column, and an outermost dimension of the inner core column provided with the protruding rib is less than an innermost dimension of the steel column assembly.

[0026] According to a fourth aspect, an embodiment of the present application further provides a prefabricated shear wall, including a shear wall body and two prefabricated steel column modules.

[0027] The shear wall body is provided with an accommodation cavity.

[0028] Each of the two prefabricated steel column modules is fixedly connected to a respective one of two sides of the shear wall body along a length direction, the shear wall body and the two prefabricated steel column modules form a wall body cavity into which concrete is poured on site.

[0029] Further, the shear wall body includes an inner formwork and an outer formwork arranged opposite to each other and parallel to each other, and the inner formwork, the outer formwork and the two prefabricated steel column modules form the wall body cavity.

[0030] Further, the prefabricated shear wall further includes a shear wall steel frame arranged in the wall body cavity and fixedly connected to the wall body cavity. Each of two ends of the shear wall steel frame is fixedly connected to a respective one of the two

prefabricated steel column modules.

[0031] Further, each of the two prefabricated steel column modules is fixedly connected to the respective one of the two sides of the shear wall body along the length direction, and is located in the accommodation cavity.

[0032] According to a fifth aspect, an embodiment of the application further provides a modular building, including the steel column assembly described above, or the prefabricated steel column module described above, or the assembled steel structure described above or the prefabricated shear wall described above.

[0033] The present application provides the following beneficial effects.

[0034] In the solution provided by the first aspect of the embodiment of the present application, each of the first steel column and the second steel column is a hollow columnar structure, the first steel column includes a plurality of lateral beams, and the second steel column is provided with a plurality of welding grooves. The first steel column is inserted into the second steel column, and after inserting, the plurality of lateral beams of the first steel column correspond to the plurality of welding grooves of the second steel column. The plurality of lateral beams of the first steel column and the second steel column are fixed to each other at the plurality of welding grooves by welding from the outside of the second steel column, thereby achieving the fixation of the first steel column and the second steel column. With respect to the second steel column, the plurality of lateral beams of the first steel column protrude from an inner side wall of the second steel column to form a pullout resistant structure, which is beneficial to improving the pullout resistance performance between end insertion portions of an upper steel structure and a lower steel structure after cement is poured. This structure is convenient to operate. After the first steel column is inserted into the second steel column and a position of the first steel column corresponds to a position of the second steel column, the welding is performed from the outside of the second steel column, which leads to a convenient welding, improves a welding speed and production efficiency, and is beneficial to achieving automated production of the modular building.

[0035] In the solution provided by the second aspect of the embodiment of the present application, the prefabricated steel column module has the beneficial effects of the steel column assembly described above.

[0036] In the solution provided by the third aspect of the embodiment of the present application, the assembled steel structure has the beneficial effects of the steel column

assembly described above.

[0037] In the solution provided by the fourth aspect of the embodiment of the present application, the prefabricated shear wall has the beneficial effects of the prefabricated steel column module described above.

[0038] In the solution provided by the fifth aspect of the embodiment of the present application, the modular building has the beneficial effects of the steel column assembly described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] The accompanying drawings described herein are intended to provide a further understanding of the present application, and constitute a part of the present application. The schematic embodiments of the present application and the description thereof are intended to explain the present application, and do not constitute an undue limitation of the present application.

[0040] FIG. 1 shows a schematic diagram of a steel column assembly according to an embodiment of the present application.

[0041] FIG. 2 shows a schematic exploded view of a steel column assembly according to an embodiment of the present application.

[0042] FIG. 3 shows a schematic diagram of a first structure of a first steel column in a steel column assembly according to an embodiment of the present application.

[0043] FIG. 4 shows a cross-sectional view of a steel column assembly according to an embodiment of the present application.

[0044] FIG. 5 shows a schematic diagram of a second structure of a first steel column in a steel column assembly according to an embodiment of the present application.

[0045] FIG. 6 shows a schematic diagram of a prefabricated steel column module according to an embodiment of the present application.

[0046] FIG. 7 shows a schematic diagram of an assembled steel structure according to an embodiment of the present application.

[0047] FIG. 8 shows a cross-sectional view of a connection portion between an upper steel column module and a lower steel column module in an assembled steel structure according to an embodiment of the present application.

[0048] FIG. 9 shows a schematic diagram of a first structure of a prefabricated shear wall according to an embodiment of the present application.

[0049] FIG. 10 shows a schematic diagram of a second structure of a prefabricated shear wall according to an embodiment of the present application.

[0050] List of reference symbols: 100-steel column assembly; 001-preset direction; 003-axial direction; 005-first steel column; 007-lateral beam; 009-vertical beam; 010-through groove; 013-second steel column; 015-welding groove; 200-prefabricated steel column module; 021-steel column body; 023-inner core column; 025-protruding rib; 300-assembled steel structure; 031-upper steel column module; 033-lower steel column module; 500-prefabricated shear wall; 510-shear wall body; 515-wall body cavity; 5102-inner formwork; 5104-outer formwork; 530-shear wall steel frame.

DETAILED DESCRIPTION

[0051] In order to make technical solutions and advantages in embodiments of the present application more clear, the exemplary embodiments of the present application will be further described in detail below with reference to the accompanying drawings, and it is apparent that the described embodiments are only a part of the embodiments of the present application, and are not exhaustive of all the embodiments. It should be noted that the embodiments and features in the embodiments in the present application may be combined with each other without conflict.

[0052] In the description of the present application, it should be understood that orientation or positional relationships indicated by the terms “vertical”, “horizontal”, “inner”, “outer”, “upper”, “lower”, “front”, “back”, “left”, “right”, “center”, “longitudinal”, “lateral”, “length”, “width”, “thickness”, and the like are based on orientation or positional relationships shown in the accompanying drawings and are merely for convenience of describing the present application and simplification of the description, and do not indicate or imply that the referred device or element must have a particular orientation and must be constructed and operated in a particular orientation, and therefore cannot be construed as a limitation of the present application.

[0053] Furthermore, the terms “first” and “second” are used merely for descriptive purposes, and are not to be construed as indicating or implying relative importance thereof or implicitly specifying the number of indicated technical features. Thus, the features defined as “first” and “second” may explicitly or implicitly mean that one said feature or a plurality of said features are included. In the description of the present application, “a plurality of” means two or more than two, unless explicitly and specifically defined

otherwise.

[0054] In the present application, unless otherwise explicitly specified and defined, the terms “mount”, “couple”, “connect”, “fix” and the like should be understood in a broad sense. For example, “connection” may be a fixed connection or a detachable connection or an integral connection; “connection” may be a mechanical connection or an electrical connection; “connection” may be a direct connection or an indirect connection through an intermediate medium; and “connection” may be an internal communication of two elements. Those skilled in the art can understand specific meanings of the above terms in the present application according to specific circumstances.

[0055] The embodiment of the present application provides a steel column assembly 100. Referring to FIG. 1 and FIG. 2 together. FIG. 1 shows a schematic diagram of the steel column assembly 100, and FIG. 2 shows a schematic exploded diagram of the steel column assembly 100.

[0056] The steel column assembly 100 includes a first steel column 005 and a second steel column 013, each of the first steel column 005 and the second steel column 013 is a hollow columnar structure, and the first steel column 005 includes a plurality of lateral beams 007 extending along a preset direction 001. A side wall of the second steel column 013 is provided with a plurality of welding grooves 015, and the plurality of welding grooves 015 also extend along the preset direction 001.

[0057] During mounting, the first steel column 005 is embedded into the second steel column 013, and an axial direction of the first steel column 005 is the same as an axial direction of the second steel column 013. The plurality of welding grooves 015 of the second steel column 013 correspond to at least a part of the plurality of lateral beams 007 of the first steel column 005, and then the plurality of lateral beams 007 and the second steel column 013 are fixed to each other at the plurality of welding grooves 015 by welding from the outside of the second steel column 013, thereby achieving the fixation of the first steel column 005 and the second steel column 013.

[0058] When an upper steel structure and a lower steel structure of the modular building are connected to each other by end insertion portions, after cement is poured into the interior of the steel structures, the structure formed by the first steel column and the second steel column can enhance a pullout resistance between end insertion portions of the upper steel structure and the lower steel structure. The first steel column 005 and the second steel column 013 in the form of two hollow columnar structures are adopted, the first steel

column 005 includes the plurality of lateral beams 007, the plurality of welding grooves 015 are formed on the side wall of the second steel column 013. In this way, the first steel column 005 is embedded into the second steel column 013, the plurality of lateral beams 007 of the first steel column 005 correspond to the plurality of welding grooves 015 of the second steel column 013, and then the plurality of lateral beams 007 and the second steel column 013 are fixed to each other at the plurality of welding grooves 015 by welding from the outside of the second steel column 013. After welding, the plurality of lateral beams 007 of the first steel column 005 protrude from an inner side wall of the second steel column 013 to form a pullout resistant structure with a concave-convex shape. The steel column assembly 100 provided by the embodiment of the present application is convenient to operate, simple in structure and ingenious in design, greatly improves the convenience of welding, improves a welding speed and production efficiency on the premise of meeting pullout resistance performance, and is conducive to achieving automatic production.

[0059] It can be understood that in order to improve the pullout resistance performance, an angle is formed between an extension direction of the pullout resistance structure arranged on the steel column assembly 100 and an axial direction of the steel column assembly 100. That is, in a use state of the steel column assembly 100, the plurality of lateral beams 007 are not arranged along the vertical direction, but extends along a horizontal direction or an oblique direction.

[0060] Hereinafter, the steel column assembly 100 provided by the embodiment of the present application will be described in detail.

[0061] Referring to FIG. 3, a schematic diagram of a first structure of the first steel column 005 is shown.

[0062] Specifically, the first steel column 005 further includes at least one vertical beam 009, the at least one vertical beam 009 intersects with the plurality of lateral beams 007 and is connected to the plurality of lateral beams 007, and the at least one vertical beam 009 and the plurality of lateral beams 007 form a hollow columnar structure.

[0063] Specifically, the vertical beam 009 extend along an axial direction 003, the first steel column includes a plurality of vertical beams 009, and the plurality of vertical beams 009 are parallel to each other but are not located in the same plane. Each lateral beam 007 is arranged between two respective adjacent vertical beams 009 of the plurality of vertical beams 009 and connects the two respective adjacent vertical beams 009, the two respective adjacent vertical beams 009 and said lateral beam 007 located between the two respective

adjacent vertical beams 009 form a plane, and a plurality of planes form a hollow columnar structure. The vertical beam 009 extends along the axial direction 003, the lateral beam 007 extends along the preset direction 001, and an angle is formed between the axial direction 003 and the preset direction 001.

[0064] Further, multiple lateral beams 007 are arranged between any two adjacent vertical beams 009, and the multiple lateral beams 007 between any two adjacent vertical beams 009 are successively spaced apart from each other along the axial direction 003.

[0065] As shown in FIG. 3, the number of vertical beams 009 is four, the four vertical beams 009 are arranged parallel to each other, and each lateral beam 007 is arranged between two respective adjacent vertical beams 009 and connects the two respective adjacent vertical beams 009 to form a rectangular frame structure. Any two adjacent vertical beams 009 and multiple lateral beams 007 arranged between any two adjacent vertical beams 009 form a side wall, the multiple lateral beams 007 on each side wall extend along the preset direction 001, and the multiple lateral beams 007 are successively spaced apart from each other along the axial direction 003.

[0066] Optionally, the preset direction 001 and the axial direction 003 may be perpendicular to each other, that is, in the structure shown in FIG. 3, in the use state, all the lateral beams 007 extend along the horizontal direction, and all the vertical beams 009 extend along the vertical direction.

[0067] In an optional embodiment of the present application, the multiple lateral beams 007 arranged between any two adjacent vertical beams 009 are evenly spaced apart from each other.

[0068] In order to improve the pullout resistance between the end insertion portions of the upper steel structure and the lower steel structure, a gap between any two adjacent lateral beams 007 on each side wall of the steel column assembly 100 should not be too small, and optionally, a spacing between any two adjacent lateral beams 007 is greater than or equal to a width dimension of each lateral beam 007.

[0069] Referring to FIG. 1 again, the number of welding grooves 015 formed on a side wall of the second steel column 013 may be a plurality of welding grooves, and the plurality of welding grooves 015 extend along the preset direction 001. The plurality of welding grooves 015 are arranged on the side wall of the second steel column 013, and welding is performed at the plurality of welding grooves 015, which not only facilitates the welding operation, but also facilitates the improvement of welding strength.

- [0070]** Optionally, the plurality of welding grooves 015 may be located on the same side wall or may be located on different side walls.
- [0071]** For example, the plurality of welding grooves 015 are formed on each side wall of the second steel column 013, or the plurality of welding grooves 015 are formed on the same side wall of the second steel column 013, or the plurality of welding grooves 015 are formed on two opposite side walls of the second steel column 013, or the plurality of welding grooves 015 are formed on two adjacent side walls of the second steel column 013.
- [0072]** In the present application, specific positions of the plurality of welding grooves 015 are not limited, as long as the lateral beams 007 of the first steel column 005 and the second steel column 013 may be fixed to each other at the positions of the plurality of welding grooves 015 by welding.
- [0073]** Preferably, each side wall of the second steel column 013 is provided with multiple welding grooves 015, and the multiple welding grooves 015 located on the same side wall are successively spaced apart from each other along the axial direction 003, and each of the multiple welding grooves 015 corresponds to a respective one of the multiple lateral beams 007 of the first steel column 005. It is convenient to perform welding of the corresponding lateral beam 007 at the position of each welding groove 015 from the outside of the second steel column 013.
- [0074]** Referring to FIG. 1 and FIG. 4 together, FIG. 4 is a cross-sectional view of the steel column assembly 100.
- [0075]** In an optional embodiment of the present application, a cross-sectional shape of the first steel column 005 is the same as a cross-sectional shape of the second steel column 013, and each of the cross-sectional shape of the first steel column 005 and the cross-sectional shape of the second steel column 013 is rectangular. Each side wall of the second steel column 013 is provided with multiple welding grooves 015 evenly arranged, the number of welding grooves 015 is the same as the number of lateral beams 007, and the multiple welding grooves 015 and the multiple lateral beams 007 are arranged in one-to-one correspondence. By welding at the welding grooves 015, each lateral beam 007 is fixed to the second steel column 013, which improves the strength of the steel column assembly 100 while satisfying the pullout resistance performance.
- [0076]** In order to facilitate embedding of the first steel column 005 into the second steel column 013, a cross-sectional maximum length dimension a_1 of the first steel column 005 should be less than a cross-sectional minimum length dimension a_2 of the second steel

column 013, and a cross-sectional maximum width dimension b_1 of the first steel column 005 should be less than a cross-sectional minimum width dimension b_2 of the second steel column 013.

[0077] In order to ensure the welding quality, optionally, a spacing between an outer side wall of the first steel column 005 and an inner side wall of the second steel column 013 may be greater than or equal to 1 mm and less than or equal to 5 cm. That is, “ a_2-a_1 ” is greater than or equal to 1 mm and less than or equal to 5 cm, and “ b_2-b_1 ” is greater than or equal to 1 mm and less than or equal to 5 cm. That is, a gap between the first steel column 005 and the second steel column 013 should not be too large, and when the gap is too large, not only it is not conducive to welding fixation, but also the stability after welding is not easily guaranteed. Certainly, the gap between the first steel column 005 and the second steel column 013 should not be too small, and when the gap is too small, the first steel column 005 is not easily embedded into the second steel column 013. The present application does not limit the spacing between the first steel column 005 and the second steel column 013, as long as the first steel column 005 can be embedded into the second steel column 013, and the lateral beams 007 of the first steel column 005 and the second steel column 013 can be fixed to each other by welding from the outside of the second steel column 013.

[0078] In order to further improve the connection stability between the first steel column 005 and the second steel column 013, in addition to the fixation by welding at the positions of the welding grooves 015, the fixation may be performed by welding at an end of the first steel column 005 and an end of the second steel column 013.

[0079] Optionally, in order to facilitate welding, a weld seam is arranged at a connection position of an end outer side wall of the first steel column 005 and an end inner side wall of the second steel column 013. That is, the end outer side wall of the first steel column 005 is chamfered and/or the end inner side wall of the second steel column 013 is chamfered.

[0080] By chamfering at the connection position of the end of the first steel column 005 and the end of the second steel column 013 to form a weld seam, the fixation by welding is facilitated.

[0081] Referring to FIG. 5, a schematic diagram of a second structure of the first steel column 005 is shown.

[0082] Specifically, the first steel column 005 is a rectangular steel plate, and the rectangular steel plate is provided with a plurality of through grooves 010 extending along the preset direction 001 to allow the lateral beams 007 to be formed between any two

adjacent through grooves of the plurality of through grooves 010 . The rectangular steel plate is sequentially bent multiple times along the preset direction 001, and after bending, the rectangular steel plate is welded from end-to-end to form a hollow columnar structure.

[0083] A hollow rectangular column structure can be formed by bending a rectangular steel plate provided with the plurality of through grooves 010, for example, bending three times, forming a right angle between any two adjacent surfaces after bending, and welding the first surface to the fourth surface from end-to-end.

[0084] Then, the first steel column 005 is embedded into the second steel column 013, and the welding grooves 015 formed on the second steel column 013 is misaligned with the through grooves 010 formed on the first steel column 005, that is, the welding grooves 015 correspond to the lateral beams 007. The lateral beams 007 and the second steel column 013 are welded to each other at the positions of the welding grooves 015 from the outside of the second steel column 013.

[0085] In the embodiments described above, optionally, a shape of the lateral beam 007 of the first steel column 005 is not limited, and the lateral beam 007 of the first steel column 005 may be a bent structure, a wavy structure, an arc structure, a strip-shaped linear structure, a strip-shaped diagonal structure, or the like. Accordingly, the welding groove 015 arranged on the second steel plate may be a bent structure, a wavy structure, an arc structure, a strip-shaped linear structure, a strip-shaped diagonal structure, or the like.

[0086] The present application does not limit the specific shape of the lateral beams 007, as long as the positions of the welding grooves 015 correspond to the lateral beams 007. When the first steel column 005 provided with the lateral beams 007 is welded to the second steel column 013, the lateral beams 007 of the first steel column 005 protrude with respect to an inner side wall of the second steel column 013, and an angle is formed between the extension direction of the lateral beams 007 and the axial direction of the second steel column 013, so that the inner side wall of the second steel column 013 forms a concave-convex structure and has a pullout resistance effect.

[0087] A forming method and a working principle of the steel column assembly 100 provided by the embodiment of the present application are as follows, and the first steel column 005 shown in FIG. 1 is taken as an example for description.

[0088] A first steel column 005 and a second steel column 013 are respectively formed, in which a plurality of lateral beams 007 extending along a preset direction 001 are formed on the first steel column 005, and a plurality of welding grooves 015 extending along the

preset direction 001 are formed on a side wall of the second steel column 013.

[0089] The first steel column 005 is embedded into the second steel column 013, the plurality of lateral beams 007 of the first steel column 005 correspond to the plurality of welding grooves 015 of the second steel column 013, and an end of the first steel column 005 and an end of the second steel column 013 are welded to each other by spot welding, to achieve a preliminary fixation.

[0090] The plurality of lateral beams 007 and the second steel column 013 are welded to each other by full penetration welding at the plurality of welding grooves 015 from the outside of the second steel column 013, so that the first steel column 005 and the second steel column 013 are integrally fixed to each other.

[0091] In the steel column assembly 100 provided in the embodiment of the present application, “welding a pullout resistant member on an inner side wall of the first steel column 013” is converted as follows. Two steel columns, i.e., one large steel column and one small steel column (i.e., a first steel column 005 and a second steel column 013), are connected to each other by arranging the large steel column around the small steel column, the inner steel column (the first steel column 005) is provided with a plurality of lateral beams 007 extending along the preset direction 001, and the outer steel column (the second steel column 013) is provided with a plurality of welding grooves 015 extending along the preset direction 001. After the two steel columns are connected to each other by arranging the large steel column around the small steel column, the plurality of welding grooves of the outer steel column correspond to the plurality of lateral beams 007 of the inner steel column, and the plurality of lateral beams 007 of the inner steel column and the outer steel column are welded to each other at the positions of the plurality of the welding grooves 015, so that the second steel column 013 is fixed to the first steel column 005 provided with the plurality of lateral beams 007, and the plurality of lateral beams 007 with pullout resistance performance is indirectly welded to the inner side wall of the second steel column 013. The steel column assembly 100 has a simple structure and convenient operation, facilitates processes such as inserting and welding, can improve a welding speed and production efficiency, and is beneficial to further achieve automated production.

[0092] An embodiment of the present application also provides a prefabricated steel column module 200. Referring to FIG. 6, a schematic diagram of the prefabricated steel column module 200 is shown.

[0093] Specifically, the prefabricated steel column module 200 may include a steel

column body 021, an inner core column 023, and the steel column assembly 100 described above. The steel column body 021 is a hollow strip-shaped structure including a bottom end and a top end opposite to each other. The steel column assembly 100 is fixedly connected to the bottom end of the steel column body 021, the inner core column 023 is fixedly connected to the top end of the steel column body 021, and the inner core column 023 protrudes from the top end of the steel column body 021.

[0094] A cross-sectional maximum length dimension of the inner core column 023 is less than a cross-sectional minimum length dimension of the first steel column 005 in the steel column assembly 100, and a cross-sectional maximum width dimension of the inner core column 023 is less than a cross-sectional minimum width dimension of the first steel column 005 in the steel column assembly 100. In addition, a cross-sectional length dimension of the inner core column 023 is less than a cross-sectional length dimension of the steel column body 021, and a cross-sectional width dimension of the inner core column 023 is less than a cross-sectional width dimension of the steel column body 021. A cross-sectional length dimension of the second steel column 013 of the steel column assembly 100 is the same as a cross-sectional length dimension of the steel column body 021, and a cross-sectional width dimension of the second steel column 013 is the same as a cross-sectional width dimension of the steel column body 021. The steel column assembly 100 and the bottom end of the steel column body 021 can be fixedly connected to each other by welding, and a welding location after welding is flat.

[0095] Optionally, in order to further improve the pullout resistance between an end insertion portion of the upper steel structure and an end insertion portion of the lower steel structure, a protruding rib 025 extending along the preset direction may be arranged on an outer side wall of the inner core column 023.

[0096] When the prefabricated steel column modules 200 in an upper layer and a lower layer are inserted into each other and poured with cement, the protruding ribs 025 arranged on the outer side wall of the inner core column 023 and the lateral beam 007 arranged on the inner side wall of the steel column assembly 100 form a pullout resistance structure, which can effectively improve the pullout resistance performance of the steel structure.

[0097] The prefabricated steel column module 200 has the beneficial effects of the steel column assembly 100 described above, and will not be described here.

[0098] An embodiment of the present application also provides an assembled steel structure 300. Referring to FIG. 7 and FIG. 8 together, FIG. 7 is a schematic diagram of an

assembled steel structure 300, and FIG. 8 is a cross-sectional view of a connection portion between an upper steel column module 031 and a lower steel column module 033.

[0099] The assembled steel structure 300 includes at least two prefabricated steel column modules 200 described above, and the at least two prefabricated steel column modules 200 include a lower steel column module 033 and an upper steel column module 031.

[0100] After installation, the steel column assembly 100 of the upper steel column module 031 is arranged around the inner core column 023 of the lower steel column module 033, and the steel column assembly 100 of the upper steel column module 031 abuts against the top end of the steel column body 021 of the lower steel column module 033. After the installation is completed, cement is poured into the assembled steel structure 300 from above, and the cement solidifies to form an integrated structure.

[0101] For example, the assembled steel structure 300 includes two prefabricated steel column modules 200, which are a lower steel column module 033 and an upper steel column module 031 respectively. The steel column assembly 100 of the lower steel column module 033 is located at the bottom end, and the inner core column 023 of the lower steel column module 033 is located at the top end. During installation, the steel column assembly 100 of the upper steel column module 031 is arranged around the inner core column 023 of the lower steel column module 033, and the steel column assembly 100 of the upper steel column module 031 cooperates with and abuts against the steel column body 021 of the lower steel column module 033.

[0102] Further, a protruding rib 025 extending along the preset direction 001 is arranged on an outer side wall of the inner core column 023, and an outermost dimension of the inner core column 023 provided with the protruding rib 025 is less than an innermost dimension of the steel column assembly 100, so that the inner core column 023 is smoothly inserted into the steel column assembly 100. After the insertion is completed, cement is poured, and the protruding rib 025 arranged on the outer side wall of the inner core column 023 correspond to the lateral beam 007 arranged on the inner side wall of the steel column assembly 100 to form a pullout resistant structure, which is beneficial to improving the pullout resistance performance after the cement is poured.

[0103] The assembled steel structure 300 has the beneficial effects of the steel column module described above, and will not be described here.

[0104] An embodiment of the present application also provides a prefabricated shear wall 500. Referring to FIG. 9, a schematic diagram of the prefabricated shear wall 500 is shown.

[0105] Specifically, the prefabricated shear wall 500 may include a shear wall body 510 and the prefabricated steel column module 200 described above. The shear wall body 510 is provided with an accommodation cavity. There are two prefabricated steel column modules 200, each of the two prefabricated steel column modules 200 is fixedly connected to a respective one of two sides of the shear wall body 510 along a length direction thereof, and the shear wall body 510 and the two prefabricated steel column modules 200 form a wall body cavity 515 into which concrete is poured on site.

[0106] The shear wall body 510 includes the accommodation cavity, and the shear wall body 510 and the two prefabricated steel column modules 200 located at two ends thereof form the wall body cavity 515. The wall body cavity 515 is configured to accommodate concrete poured into the prefabricated shear wall 500 at the construction site, such that the shear wall body 510 and the prefabricated steel column modules 200 may be formed as a shear wall. After concrete is poured into the wall body cavity 515 and the concrete is solidified, the shear wall may be formed.

[0107] As shown in FIG. 9, each of the two prefabricated steel column modules 200 is fixedly connected to a respective one of the two sides of the shear wall body 510 along the length direction thereof, and is located in the accommodation cavity of the shear wall body 510. The two sides of the shear wall body 510 along the length direction in the above descriptions refer to left and right sides of the shear wall body 510 in a mounting/use state, and a geometric shape of the prefabricated shear wall 500 is defined by the shear wall body 510.

[0108] Further, the shear wall body 510 may include an inner formwork 5102 and an outer formwork 5104 that are arranged opposite to each other and are parallel to each other. The inner formwork 5102, the outer formwork 5104 and the two prefabricated steel column modules 200 form the wall body cavity 515. That is, the inner formwork 5102, the outer formwork 5104 and the two prefabricated steel column modules 200 are enclosed from four directions, i.e., front, back, left and right directions, to form the wall body cavity 515.

[0109] Referring to FIG. 9, in the embodiment of the application, each of the two prefabricated steel column modules 200 is fixedly connected to a respective one of the two sides of the shear wall body 510 along the length direction thereof, and is located in the accommodation cavity. A side surface of the prefabricated steel column module 200 close to the inner formwork 5102 is fixedly connected to the inner formwork 5102, and a side surface of the prefabricated steel column module 200 close to the outer formwork 5104 is

fixedly connected to the outer formwork 5104. For example, manners of fixed connection may include welding, bolt connection, or self-tapping screw connection or the like, the above manners of fixed connection are not specifically limited in the embodiment of the application, and are specifically determined according to actual requirements.

[0110] Further, the prefabricated shear wall 500 may further include a shear wall steel frame 530.

[0111] Specifically, the shear wall steel frame 530 is arranged in the wall body cavity 515 and fixedly connected to the wall body cavity 515, and each of two ends of the shear wall steel frame 530 along a lateral direction thereof is fixedly connected to a respective one of the two prefabricated steel column modules 200.

[0112] Optionally, a side of the shear wall steel frame 530 along a thickness direction thereof is fixedly connected to the inner formwork 5102 through a first connection member, and another side of the shear wall steel frame 530 along the thickness direction is fixedly connected to the outer formwork 5104 through a second connection member. The shear wall steel frame 530 may be connected to the inner formwork 5102 and the outer formwork 5104 through the first connection member and the second connection member respectively, such that the shear wall body 510 forms a "sandwich" structure. That is, a side of the shear wall steel frame 530 is connected to the inner formwork 5102 through the first connection member, and another side of the shear wall steel frame 530 is connected to the outer formwork 5104 through the second connection member, to form an integral structure with a non-removal formwork.

[0113] Optionally, the first connection member and the second connection member may include self-tapping screws, angle steels, channel steels, or flat steel plates, etc.

[0114] A length direction of the shear wall steel frame 530 is a lateral extension direction of the shear wall body 510. Two ends of the shear wall steel frame 530 extending along the length direction are fixedly connected to the prefabricated steel column modules 200 in a vertical direction, and the two ends of the shear wall steel frame 530 in the length direction may be fixedly connected to surfaces of the prefabricated steel column modules 200 by welding.

[0115] Referring to FIG. 10, a schematic diagram of a second structure of the prefabricated shear wall 500 is shown.

[0116] The prefabricated shear wall having this structure has the same basic structure as the prefabricated shear wall having the above structure, a difference there-between lies in

that each of two prefabricated steel column modules 200 is fixedly connected to a respective one of two sides of the shear wall body 510 along the length direction, however, the prefabricated steel column modules 200 are not located in the accommodation cavity of the shear wall body 510, that is, the prefabricated steel column modules 200 are fixedly connected to ends of the shear wall body 510 along the length direction.

[0117] As shown in FIG. 10, the shear wall body 510 includes an inner formwork 5102 and an outer formwork 5104. Each of the two prefabricated steel column modules 200 is fixedly connected to a respective one of two ends of the shear wall body 510. The inner formwork 5102, the outer formwork 5104 and the two prefabricated steel column modules 200 at left and right sides are enclosed from four directions, i.e., front, back, left and right directions, to form the wall body cavity 515. The shear wall steel frame 530 is arranged in the wall body cavity 515 and fixedly connected to the wall body cavity 515, and each of two ends of the shear wall steel frame 530 along a lateral direction is fixedly connected to a respective one of the two prefabricated steel column modules 200.

[0118] In summary, for the prefabricated shear wall 500 having the above two structures, in case that a shear wall formed by pouring concrete into the prefabricated shear wall 500 is an exterior wall of a building, the inner formwork 5102 of the shear wall body 510 is located at a side of the shear wall facing indoors, and the outer formwork 5104 of the shear wall body 510 is located at a side of the shear wall facing outdoors. The inner formwork 5102 and the outer formwork 5104 are arranged opposite to each other and parallel to each other, and the wall body cavity 515 is formed by the inner formwork 5102, the outer formwork 5104 and the prefabricated steel column modules 200 at two sides. That is, at the construction site, the concrete poured into the prefabricated shear wall 500 will be poured between the inner formwork 5102, the outer formwork 5104 of the shear wall body 510 and the two prefabricated steel column modules 200.

[0119] Based on a fact that the inner formwork 5102 and the outer formwork 5104 included in the shear wall body 510 may be used as the wall side plates in the module production and hoisting stages and as the formworks in the construction stage, usage of a prefabricated room module provided in the embodiment of the application may not only improve rigidity of the module at production and transportation stages, but also remove operations of binding steel bars on the wall body of the shear wall and supporting and arranging the formwork on site, thereby saving construction operations and construction personnels.

[0120] An embodiment of the application further provides a modular building, the modular building includes the steel column assembly described above, or the prefabricated steel column module described above, or the assembled steel structure described above. The modular building has the beneficial effects of the steel column module described above, and will not be described here.

[0121] Although preferred embodiments of the present application have been described, additional variants and modifications may be made to these embodiments once the underlying inventive concepts have become aware of those skilled in the art. Accordingly, the appended claims are intended to be construed as including the preferred embodiments and all variants and modifications falling within the scope of the present application.

[0122] It will be apparent that those skilled in the art can make various variants and modifications to the present application without departing from the spirit and scope of the present application. Thus, the present application is intended to include such variants and modifications to the extent that they fall within the scope of the claims and their equivalents of the present application.

CLAIMS

1. A steel column assembly, comprising:

a first steel column, the first steel column being a hollow columnar structure, the first steel column comprising a plurality of lateral beams extending along a preset direction; and

a second steel column, the second steel column being a hollow columnar structure, a side wall of the second steel column is provided with a plurality of welding grooves extending along the preset direction,

wherein the first steel column is embedded into the second steel column, the plurality of welding grooves correspond to at least a part of the plurality of lateral beams, and the first steel column and the second steel column are fixed to each other at the plurality of welding grooves by welding.

2. The steel column assembly according to claim 1, wherein the first steel column further comprises a plurality of vertical beams, the plurality of vertical beams extend along an axial direction, each of the plurality of lateral beams is arranged between two respective adjacent vertical beams of the plurality of vertical beams and connects the two respective adjacent vertical beams, and the plurality of vertical beams and the plurality of lateral beams form the hollow columnar structure, wherein an angle is formed between the axial direction and the preset direction.

3. The steel column assembly according to claim 2, wherein multiple lateral beams are arranged between any two adjacent vertical beams of the plurality of vertical beams, and are successively spaced apart from each other along the axial direction.

4. The steel column assembly according to claim 3, wherein the multiple lateral beams arranged between the any two adjacent vertical beams are evenly spaced apart from each other, and a spacing between any two adjacent lateral beams is greater than or equal to a width dimension of each lateral beam.

5. The steel column assembly according to claim 2, wherein the plurality of welding grooves extend along the preset direction.

6. The steel column assembly according to claim 5, wherein each side wall of the second steel column is provided with multiple welding grooves, the multiple welding grooves located on a same side wall are successively spaced apart from each other along the axial direction, and each of the plurality of welding grooves corresponds to a respective one of the plurality of lateral beams of the first steel column.

7. The steel column assembly according to claim 1, wherein a cross-sectional shape of the first steel column is the same as a cross-sectional shape of the second steel column, and each of the cross-sectional shape of the first steel column and the cross-sectional shape of the second steel column is rectangular.

8. The steel column assembly according to claim 7, wherein a cross-sectional maximum length dimension of the first steel column is less than a cross-sectional minimum length dimension of the second steel column, and a cross-sectional maximum width dimension of the first steel column is less than a cross-sectional minimum width dimension of the second steel column.

9. The steel column assembly according to claim 7, wherein a spacing between an outer side wall of the first steel column and an inner side wall of the second steel column is greater than or equal to 1 mm and less than or equal to 5 cm.

10. The steel column assembly according to claim 1, wherein an end of the first steel column and an end of the second steel column are fixed to each other by welding.

11. The steel column assembly according to claim 10, wherein an end outer side wall of the first steel column is chamfered and/or an end inner side wall of the second steel column is chamfered.

12. The steel column assembly according to claim 1, wherein the first steel column is a rectangular steel plate, and the rectangular steel plate is provided with a plurality of through grooves extending along the preset direction, so that each of the plurality of lateral beams is formed between two respective adjacent through grooves of the plurality of through grooves, wherein the rectangular steel plate is sequentially bent multiple times along the preset direction, and after bending, the rectangular steel plate is welded from end-to-end to form a hollow columnar structure.

13. The steel column assembly according to any one of claims 1 to 12, wherein each of the plurality of lateral beams is a bent structure, a wavy structure, an arc structure, or a strip-shaped linear structure,

wherein each of the plurality of welding grooves is a bent structure, a wavy structure, an arc structure, or a strip-shaped linear structure.

14. A prefabricated steel column module, comprising a steel column body, an inner core column, and the steel column assembly according to any one of claims 1 to 13,

the steel column body comprises a bottom end and a top end opposite to each other, the steel column assembly is fixedly connected to the bottom end of the steel column body, the inner core column is fixedly connected to the top end of the steel column body, the inner core column protrudes from the top end of the steel column body, a cross-sectional maximum length dimension of the inner core column is less than a cross-sectional minimum length dimension of the first steel column, and a cross-sectional maximum width dimension of the inner core column is less than a cross-sectional minimum width dimension of the first steel column.

15. The prefabricated steel column module according to claim 14, wherein a protruding rib extending along the preset direction is arranged on an outer side wall of the inner core column.

16. The prefabricated steel column module according to claim 14, wherein the steel column assembly and the bottom end of the steel column body is fixedly connected to each other by welding, and a welding location after welding is flat.

17. An assembled steel structure, comprising at least two prefabricated steel column modules according to any one of claims 14 to 16, the at least two prefabricated steel column modules comprising a lower steel column module and an upper steel column module, the steel column assembly of the upper steel column module is arranged around the inner core column of the lower steel column module, and the steel column assembly of the upper steel column module abuts against the top end of the steel column body of the lower steel column module.

18. The assembled steel structure according to claim 17, wherein a protruding rib extending along the preset direction is arranged on an outer side wall of the inner core column, and an

outermost dimension of the inner core column provided with the protruding rib is less than an innermost dimension of the steel column assembly.

19. A prefabricated shear wall, comprising:

a shear wall body, provided with an accommodation cavity; and

two prefabricated steel column modules according to any one of claims 14 to 16, each of the two prefabricated steel column modules being fixedly connected to a respective one of two sides of the shear wall body along a length direction, the shear wall body and the two prefabricated steel column modules form a wall body cavity into which concrete is poured on site.

20. The prefabricated shear wall according to claim 19, wherein the shear wall body comprises an inner formwork and an outer formwork arranged opposite to each other and parallel to each other, and the inner formwork, the outer formwork and the two prefabricated steel column modules form the wall body cavity.

21. The prefabricated shear wall according to claim 19, further comprising a shear wall steel frame arranged in the wall body cavity and fixedly connected to the wall body cavity, wherein each of two ends of the shear wall steel frame is fixedly connected to a respective one of the two prefabricated steel column modules.

22. The prefabricated shear wall according to claim 19, wherein each of the two prefabricated steel column modules is fixedly connected to the respective one of the two sides of the shear wall body along the length direction, and is located in the accommodation cavity.

23. A modular building, comprising the steel column assembly according to any one of claims 1 to 13, or the prefabricated steel column module according to any one of claims 14 to 16, or the assembled steel structure according to claim 17 or 18, or the prefabricated shear wall according to any one of claims 19 to 22.