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(54) FLEXIBLE HANGING TYPE MODULE BUILDING STRUCTURE

FLEXIBLE HÄNGEMODULBAUSTRUKTUR

STRUCTURE DE CONSTRUCTION DE MODULE DE TYPE À SUSPENSION FLEXIBLE

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Description

TECHNICAL FIELD

[0001] The present invention belongs to the field of civil engineering technologies, and more particularly, to flexibly suspended modular building structure.

BACKGROUND

[0002] A module building is a prefabricated assembly-type three-dimensional box unit, one unit generally has 1 to 3 rooms, the module unit is usually manufactured by steel structure, the module manufacturing and equipment installation account for 90% of the total construction quantity, and are both finished on the assembly line of the factory, which has high mechanization and industrialization degrees, and reduces the pollutant discharge. The manufacturer integrates the external wall, decoration, furniture, equipment, etc. in the box unit (module) and delivers them to the site for lifting and assembling, which not only has convenient construction in structure part, but also omits the decoration and other work in a later stage.

[0003] Compared with other prefabricated assembly structures, the module building has the advantages on the following aspect mainly: due to high integration, the subsequent decoration, equipment and pipeline installation and other procedures are omitted, which further shortens the construction time and saves the human resources on site; each module forms a structure system itself; no matter the transportation and lifting, or the positioning does not need additional supporting or bracing parts, and relatively convenient piling in place can be used; moreover, the decoration and equipment installation conducted by the factory assembly-line further improve the indoor quality, which better complies with the market requirements on commercial houses.

[0004] On the basis of the advantages on the aspects above, the module building is applied to but is not limited to the following occasions: a project with an urgent construction period, such as school dormitories where the new student needs to move in on schedule; a project that is short of manpower, such as the construction with scale in remote regions; a project under challenging weather conditions, such as winter construction; and a project having special requirements on the decoration quality, such as starred hotel, etc.

[0005] Moreover, limited by the space requirement, connecting convenience requirement and self-weight, the members in the module have limited size, which cannot reach a very high level of horizontal bearing capacity. Therefore, in the practical engineering application at current, multi-story and high-rise module buildings need to be externally added with an anti-lateral structure which can be a concrete core tube or other forms to help the module buildings to bear lateral loads. The module delivers the horizontal load to the core tube through effective connection, and the module itself only bears the vertical load and little horizontal load. Therefore, in the high-rise module building case, the structure form of module + concrete core tube is generally used, an anti-horizontal seismic force system only has one defense line (the core tube), which is a relatively unreasonable structure form. overlarge horizontal load delivering from the module to the core tube usually causes great material consumption. On the other hand, in the high-rise module building case, the self-weight of the module is directly delivered downwardly, the module at the bottom bears overlarge vertical load, which increases the size of the internal members of the module, and further increases the self-weight of the structure, so as to affect the use function.

[0006] The relevant state of the art is represented by DE 3325783 C1, which discloses the features of the preamble of claim 1.

SUMMARY

[0007] The present teaching provides a flexibly suspended modular building structure as detailed in claim 1. Advantageous features are provided in the dependent claims.

[0008] Object of the invention: in order to overcome the defects in the prior art, the present invention provides a flexibly suspended modular building structure.

[0009] Technical solution: in order to solve the technical problem above, a flexibly suspended modular building structure according to the present invention comprises a vertically arranged concrete core tube structure, wherein a transfer story is arranged at the upper end of the core tube structure, the transfer story is formed by a steel truss, effectively connected to the concrete core tube, and cantilevered outside the core tube structure, multiple modules with certain spaces reserved therebetween are hung below the transfer story, the modules adjacent in the vertical direction are connected through a set of hanging rod members, the upper end of each hanging rod member is movably connected to a ceiling beam located in the upper module, the lower end of each hanging rod member is pin- connected to a ceiling beam located in the lower module, the hanging rod member arranged on the uppermost module is pin- connected to the transfer story, and dampers are arranged between all the modules and the core tube structure at their floor levels. The flexible connection refers to "hinging", "flexible connection" and "the connection in hanging rod members without bending moment".

[0010] A limiting buffer device is arranged between the modules adjacent in the vertical direction, and the limiting buffer device is used for avoiding the modules adjacent in the vertical direction from vertical colliding when the horizontal relative displacement is relatively large.

[0011] The limiting buffer device comprises two connected rod members, the free end of each rod member is respectively connected to the modules adjacent in the vertical direction, wherein one rod member is connected

to a base angle located at the upper module, and the other rod member is connected to a top angle located at the lower module and adjacent to the upper module in the vertical direction, a steel wire rope is connected between the two rod members, and when the position between the rod members is in an initial state, the steel wire rope is in a relaxed state.

[0012] The ceiling beam of each module is provided with an extended section outside a beam column node, the end portion of the hanging rod member is connected to a universal joint, the universal joint is connected to a web of a T-shaped connecting steel plate, and a flange of the T-shaped connecting steel plate is welded to the extended section of the ceiling beam of the module.

[0013] A slideable prefabricated floorslab is arranged between each module and the core tube structure, one end of the prefabricated floorslab is connected to the beam column node at the floor of the module, and the other end of the prefabricated floorslab is placed on a floorslab of the core tube structure.

[0014] Channel steel is pre-buried in the prefabricated floorslab, the channel steel is connected to a connecting steel plate bolt, the connecting steel plate is welded with the beam column node at the floor of the module, the other end of the prefabricated floorslab is placed on a groove of the floor of the core tube structure, and the two sides of a contact surface for placing are provided with a pre-buried contact steel plate; the vertical end face of the groove is provided with a pre-buried anti-collision steel plate, and the contact steel plate and the anti-collision steel plate are welded on a pre-buried anchor bar of the prefabricated floorslab.

[0015] A module inter-story damper is arranged between two modules adjacent in the vertical direction, the two ends of the module inter-story damper are respectively connected to the beam column node of the floor of the upper module and the beam column node of the ceiling of the lower module. The object of setting the inter-story damper is that in case of a rare earthquake, when other dampers are damaged because of exceeding the stroke and then are retreated from working, the module inter-story damper is still in the operating stroke due to little relative movement, which continuously provides a necessary energy dissipation way for the structure.

[0016] A module group consisting of multiple modules piled up from bottom to top is arranged on a ground base set with a core tube structure, the multiple modules piled up are mutually connected, the modules located at the ground base are connected to the ground base, and the modules piled up are no more than four stories.

[0017] Beneficial effects: the flexible hanging type module building structure according to the present invention has the following beneficial effects.

1. By means of a suspended structure vibration control technology, the horizontal loads inputted by the modules to the core tube structure are remarkably reduced, and the material consumption of the core tube structure is saved.
2. The module building allows substructure inter-story displacement, prevents non-structural elements from damage, and extends the limit value of the substructure inter-story displacement, thus improving the energy dissipation and shock absorption efficiency.
3. A universal joint flexible hanging solution is used, the horizontal stiffness is only provided by the damper and the axial force of a hanging part, the hanging part only suffers an axial force when it is horizontally displaced to keep the elasticity; and relative to other flexible hanging solutions, the solution has a certain stiffness in the vertical direction in case of a vertical earthquake, so that the vertical response will not be excessively enlarged
4. Through the combination of the creative limiting buffer device, the relative movement between the modules is rationally controlled, so as to avoid collision.

BRIEF DESCRIPTION OF DRAWINGS

[0018]

Fig. 1 is a schematic diagram of the overall facade layout of a flexibly suspended modular building structure according to the present invention;
Fig. 2 is a schematic diagram of a module inter-story structure as shown in Fig. 1;
Fig. 3 is a schematic diagram of a limiting buffer device in the inter-story structure as shown in Fig. 2;
Fig. 4 is a schematic diagram of a connecting structure of a hanging rod member of the structure as shown in Fig. 1;
Fig. 5 is a schematic diagram of a preferred solution of the inter-story structure with a slideable prefabricated floorslab and a module inter-story damper as shown in Fig. 2;
Fig. 6 is a schematic diagram of setting the slideable prefabricated floorslab according to the preferred solution as shown in Fig. 5;
Fig 7 is a schematic diagram of a preferred solution of partial module piling of the structure as shown in Fig. 1;
Fig. 8 is a schematic diagram of an implementation solution of the dislocation piling in place of the structure as shown in Fig. 1; and
Fig. 9 is a schematic diagram of an implementation solution of the overhanging in place of the structure as shown in Fig. 1.

[0019] In the drawings, 1 refers to core tube structure, 2 refers to transfer story, 3 refers to module, 4 refers to hanging rod member, 5 refers to damper, 6 refers to diagonal supporting member, 7 refers to limiting buffer device, 8 refers to rod member, 9 refers to steel wire rope, 10 refers to ceiling beam, 11 refers to module column,

12 refers to stiffening rib, 13 refers to universal joint, 14 refers to T-shaped connecting steel plate, 15 refers to prefabricated floorslab, 16 refers to module inter-story damper, 17 refers to core tube floorslab, 18 refers to high-strength bolt, 19 refers to connecting steel plate, 20 refers to pre- buried channel steel, 21 refers to pre-buried contact steel plate, 22 refers to pre-buried anti-collision steel plate, 23 refers to pre-buried anchor bar, 24 refers to module group, 25 refers to lifting platform, and 26 refers to pre-buried connecting member.

DETAILED DESCRIPTIONS

[0020] The present invention is further described hereinafter with reference to the drawings.

[0021] A flexibly suspended modular building structure as shown in Fig. 1 to Fig. 3 comprises a vertically arranged concrete core tube structure 1, wherein the core tube structure 1 is a key system to bear all horizontal loads and vertical loads of the whole structure, a transfer story 2 is arranged at the upper end of the core tube structure 1, multiple modules 3 with certain spaces reserved therebetween are hung below the transfer story 2, the modules 3 adjacent in the vertical direction are connected through a set of hanging rod members 4, the upper end of each hanging rod member 4 is pin- connected to a ceiling beam 5 located in the upper module 3, the lower end of each hanging rod member is pin-connected to a ceiling beam 5 located in the lower module 3, and the ceiling beam 5 is the beam located at the top surface of the module 3; and the hanging rod member 4 arranged on the uppermost modules 3 is pin- connected to the transfer story 2, dampers 5 are arranged between floors of all the modules 3 and the core tube structure, all the dampers 5 play a role of energy dissipation when the modules 3 and the core tube structure 1 move relatively, and the dampers 5 also have certain elastic stiffness to provide horizontal stiffness for the structure of the modules 3. A limiting buffer device 7 is arranged between the modules 3 adjacent in the vertical direction, and the limiting buffer device 7 is used for avoiding the modules 3 adjacent in the vertical direction from vertical colliding when the horizontal relative displacement is relatively large. Specifically, as shown in Fig. 3, the limiting buffer device 7 comprises two mutually connected rod members 8, the free end of each rod member 8 is respectively connected to the modules 3 adjacent in the vertical direction, wherein one rod member 8 is connected to a base angle located at the upper module 3, and the other rod member 8 is connected to a top angle located at the lower module 3 and adjacent to the upper module 3 in the vertical direction. A steel wire rope 9 is arranged between the two rod members 8, when the position between the rod members 8 is in an initial state, the steel wire rope 9 is in a relaxed state, the two rod members 8 and the steel wire rope 9 in a relaxed initial state form an "A-shaped" device, this A-shaped rod member group plays a role of leverage, which aims at reducing the elongation of the steel wire rope by scale to avoid the steel wire rope from being ruptured too early. The floor of each module 3 is connected to the core tube structure 1 through the damper 5, the damper 5 plays a main role of energy dissipation when the modules 3 and the core tube structure 1 move relatively, and the damper 5 has certain elastic stiffness to provide horizontal stiffness for the structure of the modules 3. In addition, when there is only a wind loading effect, since the damper plays a role of slide loading effect; the damper 5 does not slide, and can directly deliver the wind load to the core tube structure 1. As shown in Fig. 4, the ceiling beam 10 of the module is provided with an extended section outside a beam column node, the ceiling beam is provided with a stiffening rib 12 at a corresponding position, the hanging rod member 4 is a hollow circular steel tube generally, the end portion of the hanging rod member is connected to a universal joint 13, the universal joint 13 is connected to a web of a T-shaped connecting steel plate 14 through a bolt, a flange of the T-shaped connecting steel plate 14 is welded to the extended section of the ceiling beam 10 of the module, and the welding is conducted according to the requirement on rigid connection. The extended section of the ceiling beam of the module plays a role of allowing the hanging rod member 4 to swing in a certain range without collision. Each module 3 is internally provided with a diagonal supporting member 6, and the diagonal supporting member 6 strengthens the structure of the module from the interior. As shown in Fig 5, a slideable prefabricated floorslab 15 is arranged between each module 3 and the core tube structure 1, so as to keep the access of personnel while the module and the core tube structure move relatively. Channel steel 20 is pre-buried in the prefabricated floorslab 15, the Channel steel 20 before being pre-buried is connected to a connecting steel plate 19 through a high-strength bolt 18, the connecting steel plate 19 is welded to the beam column node at the floor of the module on site, the other end of the prefabricated floorslab 15 is placed on a groove of a core tube floorslab 17, and the two sides of a contact surface for placing are both provided with a pre-buried contact steel plate 21, which can form friction sliding. The vertical end face of the groove is provided with a pre-buried anti-collision steel plate 22, and all the pre-buried members above have a pre-buried anchor bar 23 welded thereon. A module inter-story damper 16 is also arranged between two modules 3 adjacent in the vertical direction, the two ends of the module inter-story damper 16 are respectively connected to the beam column node of the floor of the upper module 3 and the beam column node of the ceiling beam 5 of the lower module 3.

[0022] As shown in Fig. 6, as another preferred embodiment, a module group 24 piled up from bottom to top is arranged on a ground base set with a core tube structure mainly for the purpose of adjusting suspended mass ratio, the multiple modules piled up are mutually connected, the modules located at the ground base are mutually connected to the ground base, and the modules piled up

are no more than four stories.

[0023] In order to provide exemplary embodiments, three installation methods of hanging section modules are described as follows:

First method: aligned piling in place:

1. For the installation in place of a bottom platform: the function of the platform is to bear temporary vertical loads of modules on the platform. If the bottom of the structure is provided with a piling module, then the bottom module is directly installed.
2. After the module or the platform on a lower story is installed, a temporary block is installed, and the function of the temporary block is to reserve a vertical space, so that the module is not contacted in a vertical direction in a system formed finally; and after the temporary block is installed and leveled, the module of this story is lifted in place.
3. After the module of each story is installed in place subsequently, the hanging rod member and the limiting buffer device are installed, then the damper between the core tube structure and the module is installed, and other pipelines are connected.
4. The temporary block is withdrawn from the top to bottom, and the bottom platform is removed finally.

Second method: dislocation piling in place, as shown in Fig. 7:

1. For the installation in place of a lifting platform 25: the platform has a lifting device, and can be steadily and entirely lifted, with a small stroke required. The distance between the lifting platform 25 and the hanging transfer story is slightly larger than the height of the overall hanging section by subtracting the sum of the vertical space between the modules. That is to say, according to the solution that the modules are tightly piled up in the vertical direction without the temporary block, a distance with the transfer story is reserved as the operation space.
2. After the module or the platform on the lower story is installed, the module of this story is lifted in place, and the hanging rod member is connected. The modules at two storys are tightly piled up in the vertical direction to form certain dislocation in the horizontal direction, and the distance of the dislocation is determined according to the standard that the hanging rod member can be accurately connected.
3. After the module at each story is installed in place subsequently, the hanging rod member at the top story is installed, and then the lifting device of the bottom platform is used, so that the platform can decline steadily, until the module at the hanging end is naturally suspended. Then the platform is withdrawn.
4. The limiting buffer device is installed, the damper between the core tube structure and the module is installed, and other pipelines are connected.

Third method: hanging in place, as shown in Fig. 8:

1. The corresponding position of the core tube structure shall be provided with a pre-buried member 26, so that the module is temporarily suspended outside the core tube. The position of the pre-buried member at the top story is determined according to the standard that the pre-buried member can be accurately connected to the hanging rod member with the transfer story, and the position of the pre-buried member is calculated from top to bottom in sequence according to the standard.
2. The module is lifted by using the transfer story, the module at the top story is firstly lifted and installed, and is connected to the pre-buried member, and then the hanging rod is installed to form temporary fixation.
3. Step "2" is repeated in sequence from top to bottom.
4. The temporary fixation between the hanging modules and the pre-buried members at the top two stories is released to form a mechanism, so that the hanging modules and the pre-buried members are in place automatically under the effect of gravity, i.e., swinging to the corresponding positions horizontally. The limiting buffer device and the damper of the module at the top story are installed after being in place.
5. The temporary fixation of the modules of one story is released gradually from top to bottom, and after the modules are in place, the limiting buffer device and the damper of the module of the story above this story are installed.
6. The limiting buffer device and the damper of the module at the bottom story are installed, and other pipelines are connected.

[0024] The contents above are only preferred embodiments of the invention. It shall be pointed out that those skilled in the art can make a plurality of improvements and polishing without departing from the scope of the appended claims.

Claims

1. A flexibly suspended modular building structure, comprising a vertically arranged concrete core tube

structure (1), wherein a transfer story (2) is arranged at the upper end of the concrete core tube structure (1), the transfer story (2) is formed by a steel truss, connected to the concrete core tube structure (1), and cantilevered outside the concrete core tube structure (1), multiple modules (3) with certain spaces reserved therebetween are hung below the transfer story, the modules (3) adjacent in the vertical direction are connected through a set of hanging rod members (4), the upper end of each hanging rod member (4) is pin-connected to a ceiling beam (10) located in the upper module, the lower end of each hanging rod member (4) is pin-connected to a ceiling beam (10) located in the lower module, the hanging rod member (4) arranged on the uppermost module is pin-connected to the transfer story (2), and dampers (5) are connected from the floors of all the modules (3) to the concrete core tube structure (1) adjacent the floors of all the modules; **characterized in that** a limiting buffer device (7) is arranged between the modules (3) adjacent in the vertical direction, and the limiting buffer device (7) is used for avoiding the modules (3) adjacent in the vertical direction from vertical colliding when the horizontal relative displacement is relatively large.

2. The flexibly suspended modular building structure according to claim 1, wherein the limiting buffer device (7) comprises two mutually connected rod members (8), the free end of each rod member (8) is respectively connected to the modules (3) adjacent in the vertical direction, wherein one rod member (8) is connected to a base corner of the upper module (3), and the other rod member is connected to a top corner of the lower module (3), a steel wire rope (9) is arranged between the two rod members (8), and when the position between the rod members (8) is in an initial state, the steel wire rope (9) is in a relaxed state.

3. The flexibly suspended modular building structure according to claim 1, wherein the ceiling beam (10) of each module (3) is provided with an extended section outside a beam column joint , the end portion of the hanging rod member (4) is connected to a universal joint (13), the universal joint (13) is connected to a web of a T-shaped connecting steel plate (14), and a flange of the T-shaped connecting steel plate (14) is welded with the extended section of the ceiling beam of the module (3).

4. The flexibly suspended modular building structure according to claim 1, wherein a slideable prefabricated floorslab (15) is arranged between each module (3) and the concrete core tube structure (1), one end of the prefabricated floorslab (15) is connected to the beam column node at the floor of the module, and the other end of the prefabricated floorslab (15) is placed on a floor (17) of the concrete core tube structure (1).

5. The flexibly suspended modular building structure according to claim 4, wherein channel steel (20) is pre-buried in the prefabricated floorslab (15), the box iron is connected to a connecting steel plate (19) through a bolt (18), the connecting steel plate (19) is welded with the beam column joint at the floor level of the module (3), the other end of the prefabricated floorslab (15) is placed on a groove of the floor of the concrete core tube structure (1), and the two sides of a contact surface are provided with a pre-buried contact steel plate (19); the vertical end face of the groove is provided with a pre-buried anti-collision steel plate (22), and the contact steel plate (19) and the anti-collision steel plate (22) are welded on a pre-buried anchor bar (23) of the prefabricated floorslab (15).

6. The flexibly suspended modular building structure according to claim 1, wherein a module interlayer damper is connected between two modules (3) adjacent in the vertical direction, the two ends of the module interlayer damper are respectively connected to the beam column joint of the floor of the upper module (3) and the beam column joint of the ceiling of the lower module (3).

7. The flexibly suspended modular building structure according to claim 1, wherein a module group (24) consisting of multiple modules piled up from bottom to top is arranged on a ground base, the multiple modules piled up are mutually connected, the modules located at the ground base are connected to the ground base, and the modules piled up are no more than four stories.

Patentansprüche

1. Flexibel aufgehängte modulare Baustruktur, die eine vertikal angeordnete Rohrstruktur (1) mit Betonkern umfasst, wobei eine Transferetage (2) an dem oberen Ende der Rohrstruktur (1) mit Betonkern angeordnet ist, wobei die Transferetage (2) von einem Stahlträger gebildet ist, der mit der Rohrstruktur (1) mit Betonkern verbunden ist, und außerhalb der Rohrstruktur (1) mit Betonkern auskragend ist, wobei mehrere Module (3) mit bestimmten Räumen, die dazwischen belegt sind, unter der Transferetage hängen, wobei die Module (3), die in vertikaler Richtung angrenzen, durch einen Satz von hängenden Stabelementen (4) verbunden sind, wobei das obere Ende eines jeden hängenden Stabelements (4) über einen Stift mit einem Deckenbalken (10), der in dem unteren Modul positioniert ist, verbunden ist, wobei das hängende Stabelement (4), das an dem obers-

ten Modul angeordnet ist, über einen Stift mit der Transferetage (2) verbunden ist, und Dämpfer (5) von den Böden aller Module (3) mit der Rohrstruktur (1) mit Betonkern, die an die Böden aller Module angrenzt, verbunden sind; **dadurch gekennzeichnet, dass**
eine begrenzende Puffervorrichtung (7) zwischen den Modulen (3), die in vertikaler Richtung angrenzen, angeordnet ist, und die begrenzende Puffervorrichtung (7) zur Verhinderung verwendet wird, dass die Module (3), die in vertikaler Richtung angrenzen, vertikal kollidieren, wenn die horizontale relative Verschiebung relativ groß ist.

2. Flexibel aufgehängte modulare Baustruktur nach Anspruch 1, wobei die begrenzende Puffervorrichtung (7) zwei gegenseitig verbundene Stabelemente (8) umfasst, wobei das freie Ende eines jeden Stabelements (8) jeweils mit den Modulen (3), die in vertikaler Richtung angrenzen, verbunden ist, wobei ein Stabelement (8) mit einer Basisecke des oberen Moduls (3) verbunden ist, und wobei das andere Stabelement mit einer oberen Ecke des unteren Moduls (3) verbunden ist, wobei ein Stahldrahtseil (9) zwischen den beiden Stabelementen (8) angeordnet ist, und wenn die Position zwischen den Stabelementen (8) in einem Anfangszustand ist, das Stahldrahtseil (9) im entspannten Zustand ist.

3. Flexibel aufgehängte modulare Baustruktur nach Anspruch 1, wobei der Deckenbalken (10) eines jeden Moduls (3) mit einem erweiterten Abschnitt außerhalb einer Balkensäulenverbindung versehen ist, wobei der Endabschnitt des hängenden Stabelements (4) mit einem Universalgelenk (13) verbunden ist, wobei das Universalgelenk (13) mit einem Netz einer T-förmigen Verbindungsstahlplatte (14) verbunden ist, und ein Flansch der T-förmigen Verbindungsstahlplatte (14) mit dem erweiterten Abschnitt des Deckenbalkens des Moduls (3) verschweißt ist.

4. Flexibel aufgehängte modulare Baustruktur nach Anspruch 1, wobei eine verschiebbare vorgefertigte Bodenplatte (15) zwischen jedem Modul (3) und der Rohrstruktur (1) mit Betonkern angeordnet ist, wobei ein Ende der vorgefertigten Bodenplatte (15) mit dem Balkensäulenknoten am Boden des Moduls verbunden ist, und das andere Ende der vorgefertigten Bodenplatte (15) auf einem Boden (17) der Rohrstruktur (1) mit Betonkern platziert ist.

5. Flexibel aufgehängte modulare Baustruktur nach Anspruch 4, wobei U-Stahl (20) vorab in die vorgefertigte Bodenplatte (15) eingebettet ist, das Kasteneisen mit einer Verbindungsstahlplatte (19) durch einen Bolzen (18) verbunden ist, die Verbindungsstahlplatte (19) mit der Balkensäulenverbindung auf Bodenhöhe des Moduls (3) verschweißt ist, das andere Ende der vorgefertigten Bodenplatte (15) auf einer Nut des Bodens der Rohrstruktur (1) mit Betonkern platziert ist, und die beiden Seiten einer Kontaktfläche mit einer vorab eingebetteten Kontaktstahlplatte (19) versehen sind; wobei die vertikale Endfläche der Nut mit einer vorab eingebetteten Antikollisions-Stahlplatte (22) versehen ist, und die Kontaktstahlplatte (19) und die Antikollisions-Stahlplatte (22) an einen vorab eingebetteten Ankerstab (23) der vorgefertigten Bodenplatte (15) geschweißt sind.

6. Flexibel aufgehängte modulare Baustruktur nach Anspruch 1, wobei ein modularer Zwischenschichtdämpfer zwischen zwei Modulen (3), die in vertikaler Richtung angrenzen, verbunden ist, wobei die beiden Enden des modularen Zwischenschichtdämpfers jeweils mit der Balkensäulenverbindung des Bodens des oberen Moduls (3) und der Balkensäulenverbindung der Decke des unteren Moduls (3) verbunden sind.

7. Flexibel aufgehängte modulare Baustruktur nach Anspruch 1, wobei eine Modulgruppe (24), die aus mehreren Modulen besteht, die von unten nach oben gestapelt sind, auf einer Grundbasis angeordnet ist, wobei die mehreren Module, die gestapelt sind, gegenseitig verbunden sind, wobei die Module, die an der Grundbasis positioniert sind, mit der Grundbasis verbunden sind, und die Module, die gestapelt sind, nicht mehr als vier Etagen betragen.

Revendications

1. Structure de construction modulaire à suspension flexible, comprenant une structure de tube centrale en béton disposée verticalement (1), un étage de transfert (2) étant disposé à l'extrémité supérieure de la structure de tube centrale en béton (1), l'étage de transfert (2) étant formé par une poutre à treillis en acier, relié à la structure de tube centrale en béton (1), et en porte-à-faux à l'extérieur de la structure de tube centrale en béton (1), de multiples modules (3) avec certains espaces réservés entre eux étant suspendus sous l'étage de transfert, les modules (3) adjacents dans la direction verticale étant reliés par l'intermédiaire d'un ensemble d'éléments de tige de suspension (4), l'extrémité supérieure de chaque élément de tige de suspension (4) étant reliée par broche à une poutre de plafond (10) située dans le module supérieur, l'extrémité inférieure de chaque élément de tige de suspension (4) étant reliée par broche à une poutre de plafond (10) située dans le module inférieur, l'élément de tige de suspension (4) disposé sur le module le plus haut étant relié par broche à l'étage de transfert (2), et des amortisseurs (5) étant reliés à partir des planchers de tous les

modules (3) à la structure de tube centrale en béton (1) adjacente aux planchers de tous les modules ; **caractérisée par le fait qu'**un dispositif tampon de limitation (7) est disposé entre les modules (3) adjacents dans la direction verticale, et le dispositif tampon de limitation (7) est utilisé pour empêcher les modules (3) adjacents dans la direction verticale d'entrer en collision verticale lorsque le déplacement relatif horizontal est relativement grand.

2. Structure de construction modulaire à suspension flexible selon la revendication 1, dans laquelle le dispositif tampon de limitation (7) comprend deux éléments de tige mutuellement reliés (8), l'extrémité libre de chaque élément de tige (8) est respectivement reliée aux modules (3) adjacents dans la direction verticale, un élément de tige (8) est relié à un coin de base du module supérieur (3), et l'autre élément de tige est relié à un coin supérieur du module inférieur (3), un câble en acier (9) est disposé entre les deux éléments de tige (8) et, lorsque la position entre les éléments de tige (8) est dans un état initial, le câble en acier (9) est dans un état relâché.

3. Structure de construction modulaire à suspension flexible selon la revendication 1, dans laquelle la poutre de plafond (10) de chaque module (3) comporte une section étendue à l'extérieur d'un joint de colonne de poutre, la partie d'extrémité de l'élément de tige de suspension (4) est reliée à un joint universel (13), le joint universel (13) est relié à une âme d'une tôle d'acier de liaison en forme de T (14), et une bride de la tôle d'acier de liaison en forme de T (14) est soudée à la section étendue de la poutre de plafond du module (3).

4. Structure de construction modulaire à suspension flexible selon la revendication 1, dans laquelle une dalle de plancher préfabriquée coulissante (15) est disposée entre chaque module (3) et la structure de tube centrale en béton (1), une extrémité de la dalle de plancher préfabriquée (15) est reliée au nœud de colonne de poutre au niveau du plancher du module, et l'autre extrémité de la dalle de plancher préfabriquée (15) est placée sur un plancher (17) de la structure de tube centrale en béton (1).

5. Structure de construction modulaire à suspension flexible selon la revendication 4, dans laquelle de l'acier en U (20) est pré-enfoui dans la dalle de plancher préfabriquée (15), le fer creux est relié à une tôle d'acier de liaison (19) par l'intermédiaire d'un boulon (18), la tôle d'acier de liaison (19) est soudée avec le joint de colonne de poutre au niveau du plancher du module (3), l'autre extrémité de la dalle de plancher préfabriquée (15) est placée sur une rainure du plancher de la structure de tube centrale en béton (1), et les deux côtés d'une surface de contact comportent une tôle d'acier de contact pré-enfouie (19) ; la face d'extrémité verticale de la rainure comporte une tôle d'acier anticollision pré-enfouie (22), et la tôle d'acier de contact (19) et la tôle d'acier anticollision (22) sont soudées sur une barre d'ancrage pré-enfouie (23) de la dalle de plancher préfabriquée (15).

6. Structure de construction modulaire à suspension flexible selon la revendication 1, dans laquelle un amortisseur inter-couche de module est relié entre deux modules (3) adjacents dans la direction verticale, les deux extrémités de l'amortisseur inter-couche de module sont respectivement reliées au joint de colonne de poutre du plancher du module supérieur (3) et au joint de colonne de poutres du plafond du module inférieur (3).

7. Structure de construction modulaire à suspension flexible selon la revendication 1, dans laquelle un groupe de modules (24) constitué de multiples modules empilés de bas en haut est disposé sur une base de sol, les multiples modules empilés sont mutuellement reliés, les modules situés au niveau de la base de sol sont reliés à la base de sol, et les modules empilés ne sont pas plus de quatre étages.

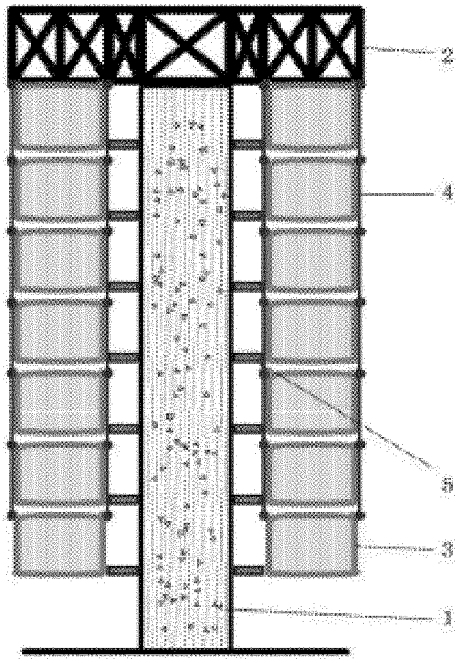

Fig. 1

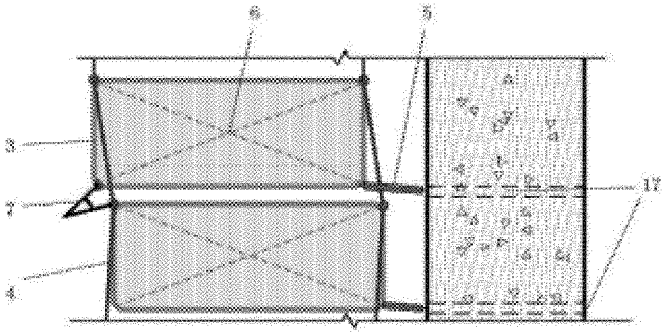

Fig. 2

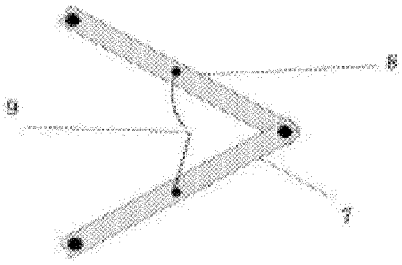

Fig. 3

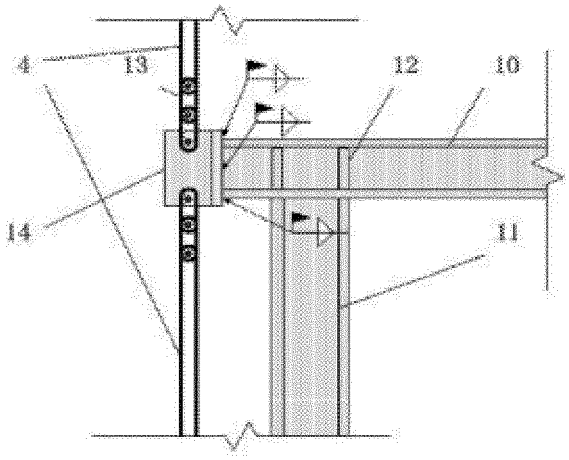

Fig. 4

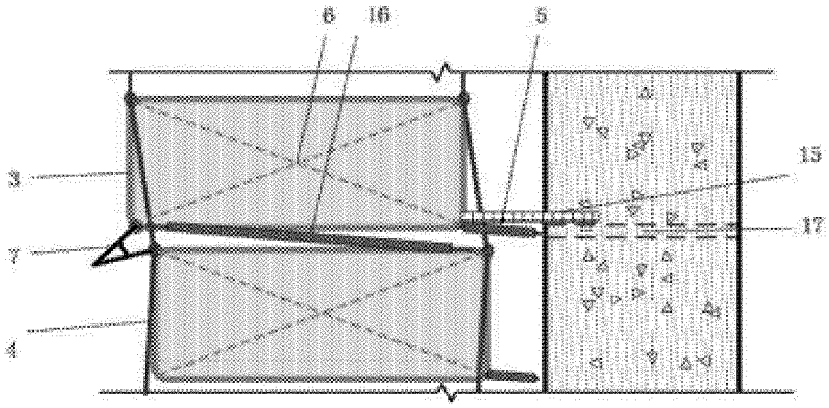

Fig. 5

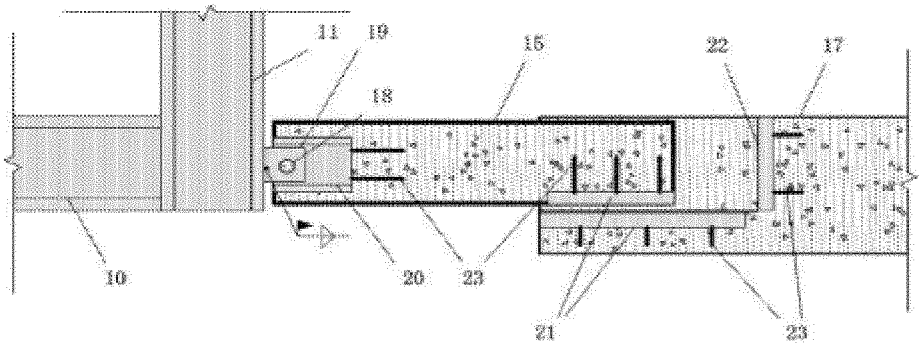

Fig. 6

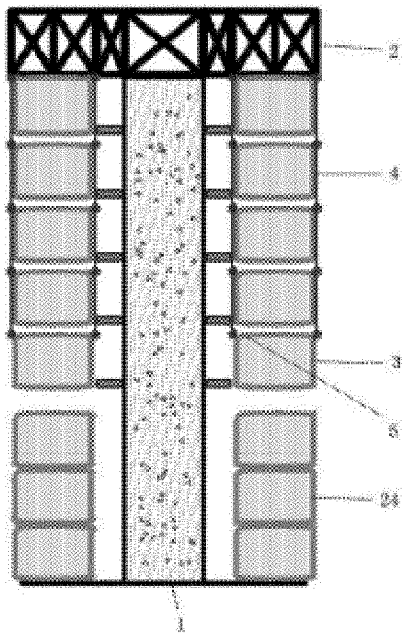

Fig. 7

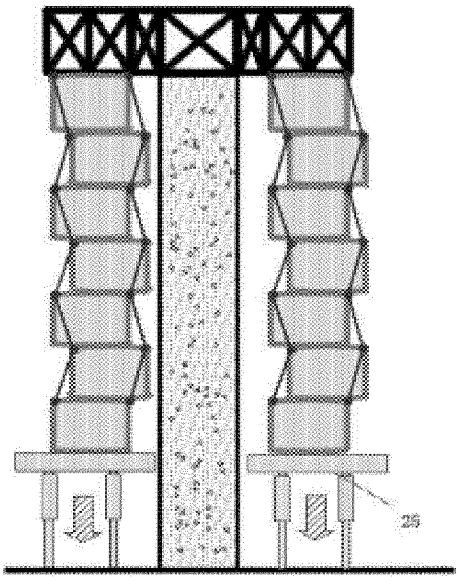

Fig. 8

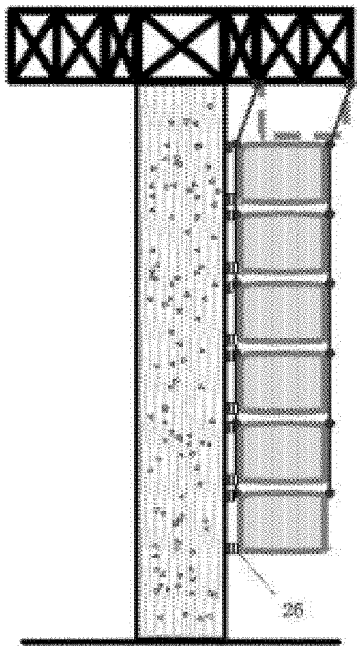

Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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