Disclosed herein is a friction type retrofitting device for steel tower structures. The retrofitting device includes a coupling part which couples an outer column and an inner column of a post of a steel tower to each other using an angle bracket and a bolt. A slot is formed in a portion of the outer column to which the coupling part is coupled. A friction plate is provided to contact an outer circumferential surface of the slot. Thereby, wind energy transmitted to the steel tower is attenuated by friction between the outer circumferential surface of the slot of the coupling part and the friction plate.
BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates generally to a friction type retrofitting device for steel tower structures. More particularly, the present invention relates to a friction type retrofitting device for a steel tower, such as a power-transmission tower that transmits high voltage to a distant place, in which a slot and a friction plate are provided on a coupling part between columns constituting a post of the steel tower, thus attenuating vibrations generated by wind force acting on the steel tower.

[0003] 2. Description of the Related Art

[0004] FIG. 1 is a front view showing a general steel tower, FIG. 2 is a side view showing the steel tower of FIG. 1, when wind acts on the front of the steel tower, FIG. 3 is a detailed view showing part of a post of the steel tower, and FIG. 4 is a view showing the structural change of the conventional post under the condition of FIG. 2.

[0005] As shown in FIG. 1, a general steel tower, especially a power-transmission tower 10 for transmitting high voltage, includes a frame 70 which is set up vertically, arms 20 which are horizontally provided on the upper portion of the frame 70, insulators 30 which hang downwards from ends of the arms 20, and electric wires 40 which are connected to the lower ends of the corresponding insulators 30.

[0006] The frame 70 includes four vertical posts 50, and cross members 60 which are crossed between the vertical posts 50 to be coupled to the vertical posts 50.

[0007] As shown in FIG. 2, when wind 80 blows in all directions, the power-transmission tower 10 is shaken. The part of the power-transmission tower 10 that is moved by the wind 80 is restored to its original position within a predetermined elastic range after the wind 80 dies down.

[0008] As shown in FIG. 3, each post 50 of the power-transmission tower 10 has a cruciform section. The cruciform section is formed by contacting edges of L-shaped columns 52 and 54 with each other and positioning the remaining parts of the columns 52 and 54 to be opposite to each other. Among the two columns 52 and 54, the inner column 52 faces the interior of the power-transmission tower 10 while the outer column 54 faces the exterior of the power-transmission tower 10 and has on predetermined portions thereof coupling parts 90.

[0009] Each coupling part 90 of the conventional power-transmission tower includes first holes 92 and second holes 93 which are formed in the inner column 52 and the outer column 54, respectively, an angle bracket 94 which has an "L"-shaped section and is provided with third holes 96 and fourth holes 99, first bolts 98 which pass through the first holes 92 and the third holes 96, second bolts 100 which pass through the second holes 93 and the fourth holes 99, first nuts 97 which are fastened to the first bolts 98, second nuts 102 which are fastened to the second bolts 100, and washers 88 which are provided in front of the first nuts 97.

[0010] However, the outer column 54 is provided at an outer position relative to the inner column 52. Thus, when the power-transmission tower 10 is moved by the wind, as shown in FIG. 4, the outer column 54 provided at a position facing the wind 80 is extended further than the inner column 52. The outer column 54 provided at the opposite side is compressed more than the inner column 52.

[0011] Thereby, the force applied to the power-transmission tower 10 by the wind is transmitted to each coupling part 90 of FIG. 3, so that a large amount of energy acts on the second bolts 100, the second holes 93, and the fourth holes 99. Thus, the wind repeatedly acting on the power-transmission tower 10 greatly reduces the durability of the coupling part 90.

[0012] Further, in the case where the interval between the coupling parts 90 mounted to each post 50 is large, so that the length of the post is larger than the cross-section thereof, the post is apt to buckle, that is, bend suddenly, when the compressive load acting on both ends of the post reaches a predetermined level.

SUMMARY OF THE INVENTION

[0013] Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a steel tower structure, in which coupling parts are mounted to posts of a steel tower at proper intervals, thus preventing the posts from buckling, a slot is formed in a coupling part of an outer column, and a friction plate is coupled to the coupling part of the outer column, thus absorbing wind energy using friction energy, therefore enhancing durability.

[0014] In order to accomplish the above object, the present invention provides a friction type retrofitting device for steel tower structures, including a coupling part coupling an outer column and an inner column of a post of a steel tower to each other using an angle bracket and a bolt, a slot formed in a portion of the outer column to which the coupling part is coupled, and a friction plate provided to contact an outer circumferential surface of the slot. In this case, wind energy transmitted to the steel tower is attenuated by friction between the slot and the friction plate of the coupling part.

[0015] Further, a horizontal section of the post has a cross shape, and a horizontal section of each of the outer column and the inner column has an L shape. Further, a plurality of coupling parts having the slot in the outer column may be provided on the post, and the friction plate may be provided on one of the coupling parts. A reinforcing plate may be provided on a portion of the outer column to which the coupling part is coupled.

[0016] The present invention provides a friction type retrofitting device for steel tower structures, including an outer column which is arranged to be parallel to an inner column, thus providing a post of a steel tower, and is divided at a predetermined position into two portions, a slot which is formed in one of the divided portions, and a friction plate which is provided to contact an outer circumferential surface of the slot. In this case, wind energy transmitted to the steel tower is attenuated by friction between the slot and the friction plate.

[0017] Further, a horizontal section of the post has a cross shape, and a horizontal section of each of the outer column and the inner column has an L shape. Further, a plurality of coupling parts is provided to couple the outer column to the inner column using an angle bracket and a bolt, with a slot formed in a portion of the outer column to which the coupling part is coupled.
BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and other objects, features and advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0019] FIG. 1 is a front view showing a general steel tower;
[0020] FIG. 2 is a side view showing the steel tower of FIG. 1, when wind acts on the front of the steel tower;
[0021] FIG. 3 is a detailed view showing part of a post of the steel tower;
[0022] FIG. 4 is a view showing the structural change of the conventional post under the condition of FIG. 2;
[0023] FIG. 5 is a detailed view showing a post of a steel tower, according to an embodiment of the present invention;
[0024] FIGS. 6a and 6b are views showing the operation of the post of the steel tower of FIG. 5;
[0025] FIG. 7 is a detailed view showing a post of a steel tower, according to another embodiment of the present invention; and
[0026] FIGS. 8a and 8b are views showing the operation of the post of the steel tower of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] Hereinafter, the preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. Reference now should be made to the drawings, in which the same reference numerals are used throughout the different drawings to designate the same or similar components. For clear description of the present invention, known constructions and functions will be omitted.

[0028] The first embodiment of the present invention is as follows.

[0029] FIG. 5 is a detailed view showing a steel tower, according to an embodiment of the present invention.

[0030] A friction-type retrofitting device for steel tower structures, according to the present invention, includes coupling parts 900 which have slots 930 and friction plates 1000 (see portion D of FIG. 5). The coupling parts 900 couple an outer column 540 and an inner column 520 of each post 530 of the steel tower to each other using angle brackets 940 and bolts 980 and 982. Each slot 925 is formed in a portion of the outer column 540 to which the coupling part 900 is coupled. The friction plate 1000 is provided to contact the outer circumferential surface of the corresponding slot 925.

[0031] Further, the horizontal section of each post 530 has a cross shape, and the horizontal section of each of the outer column 540 and the inner column 520 has an L shape.

[0032] When the length of each post 530 is larger than the sectional area, and compressive load applied to both ends of the post 530 reaches a predetermined level, buckling may occur, that is, the post 530 may suddenly bend. In order to prevent the buckling, a proper number of coupling parts 900 is provided in the longitudinal direction of each post 530. As shown in FIG. 5, when four coupling parts 900 are provided on one post 530, the upper coupling part 900, marked by A, has first holes 920 which are formed in the outer column 540, and second holes 930 which are formed in the inner column 520. Two first reinforcing plates 965 are provided to contact the first holes 920 and the second holes 930. An angle bracket 940 is provided to contact the first reinforcing plates 965.

[0033] Third holes 960 and fourth holes 990 are formed in the angle bracket 940. Fifth holes 962 and sixth holes 992 are formed in the reinforcing plates 965. The angle bracket 940 is provided to the side opposite the angle bracket 940. The angle bracket 940 is provided to one side of the inner column 520, and second washers 882 and second nuts 972 are provided to the side opposite the angle bracket 940.

[0034] The coupling part 900 marked by A is provided with first bolts 980 which sequentially pass through the third holes 960, the fifth holes 962, the first holes 920, and the first washers 880, and are fastened to the first nuts 970. The coupling part 900 marked by A is also provided with second bolts 982 which sequentially pass through the fourth holes 990, the sixth holes 992, the second holes 930, and the second washers 882, and are fastened to the second nuts 972.

[0035] The coupling parts 900 that are marked by B and C and are provided at a middle position have the same structure as the coupling part 900 marked by A except that the slot 925 is formed in the outer column 540 in place of the first holes 920, and a second reinforcing plate 967 is additionally provided in back of the slot 925.

[0036] Meanwhile, the coupling part 900 marked by D and provided at a lower position has the same structure as the coupling parts 900 marked by B and C, except that the first friction plate 1000 is provided between the front of the slot 925 and the angle bracket 940 in place of the first reinforcing plate 965, and a second friction plate 1010 is provided between the back of the slot 925 and the second reinforcing plate 967.

[0037] Further, each of the first and second reinforcing plates 965 and 967 is made of steel having a low frictional coefficient. Each of the first and second friction plates 1000 and 1010 is made of brass having a high frictional coefficient.

[0038] Thus, in brief, a plurality of coupling parts 900 having the slots 925 in the outer column 540 is provided on each post 530. The friction plate 1000 is provided on one of the coupling parts 900, and the reinforcing plate 965 is provided on the outer column 540 of the coupling part 900.

[0039] The operation of the steel tower structure according to the first embodiment of the present invention, which is constructed as described above, will be described below.

[0040] FIGS. 6a and 6b are views showing the operation of the posts of the steel tower of FIG. 5.

[0041] In FIG. 6a, which shows part of the steel tower, the coupling part 900 marked by A is a locking coupling part, the coupling parts 900 marked by B and C are buckling-prevention coupling parts, and the coupling part 900 marked by D is a friction coupling part.

[0042] That is, the coupling part 900 marked by A is a friction locking coupling part which does not have the slot but has only the first holes 920 of FIG. 5. The coupling parts 900 marked by B and C are buckling-prevention coupling parts which have slots 925 in the outer column 540 and are provided with first and second reinforcing plates 965 and 967 each having a low frictional coefficient, thus preventing buckling. The coupling part 900 marked by D is a friction coupling part which has a slot 925 in the outer column 540.
and is provided with the first and second friction plates 1000 and 1010 each having a high frictional coefficient.

[0043] Thus, as shown in FIG. 6b, when wind force 1020 acts on the steel tower, the coupling part 900 marked by A is moved in the state where the outer column 540 and the inner column 520 are fixed. In the coupling parts 900 marked by B and C, the first bolts 980 passing through the slots 925 of the outer column 540 move slightly downwards in the slots 925. At this time, a very small amount of frictional energy is generated between the first and second reinforcing plates 965 and 967 which contact the outer circumferential surface of each slot 925.

[0044] Further, in the coupling part 900 marked by D, the first bolts 980 passing through the slot 925 of the outer column 540 move downwards in the slot 925. The movement of the first bolts 980 of the coupling part 900, marked by D, is the largest, because the coupling part 900 marked by D is the farthest from the fixed coupling part 900 marked by A. At this time, a large amount of frictional energy is generated between the first friction plate 1000 and the second friction plate 1010, which are in close contact with the outer circumferential surface of the slot 925, thus absorbing energy transmitted by the wind force 1020.

[0045] That is, the energy generated by the wind force 1020 transmitted to the steel tower is attenuated by friction generated between the outer circumferential surface of the slot 925 of the outer column 540 of the coupling part 900 marked by D and the first and second friction plates 1000 and 1010 thereof.

[0046] The second embodiment of the present invention will be described below.

[0047] FIG. 7 is a detailed view showing a post of a steel tower, according to another embodiment of the present invention.

[0048] The steel tower structure of the present invention includes an outer column 540 constituting each post 530. The outer column 540 is arranged to be parallel to the inner column 520, and has a division part 1100 which is divided at a predetermined position into two portions.

[0049] The division part 1100 has on an upper portion thereof a slot 1200, and third and fourth friction plates 1300 and 1350 which are provided to contact the front surface and the back surface of the slot 1200, respectively.

[0050] Further, the division part 1100 has on a lower portion thereof seventh holes 1500, and third and fourth reinforcing plates 1400 and 1450 which are provided to contact the outer circumferential surface of the seventh holes 1500.

[0051] Further, a first coupling plate 1460 is provided to contact the third friction plate 1300 and the third reinforcing plate 1400. A second coupling plate 1470 is provided to contact the fourth friction plate 1350 and the fourth reinforcing plate 1450.

[0052] Third bolts 1600 sequentially pass through the first coupling plate 1460, the third friction plate 1300, the slot 1200, the fourth friction plate 1350, and the second coupling plate 1470, and are fastened to third nuts 1700. Fourth bolts 1650 sequentially pass through the first coupling plate 1460, the third reinforcing plate 1400, the seventh holes 1500, the fourth reinforcing plate 1450, and the second coupling plate 1470, and are fastened to fourth nuts 1750.

[0053] The position of the upper structure and the lower structure of the division part 1100 may be changed.

[0054] Meanwhile, the horizontal section of the post 530 has a cross shape, and the horizontal section of each of the outer column 540 and the inner column 520 has an “L” shape.

[0055] Further, a plurality of coupling parts 901, 902, 903, and 904 is provided to couple the outer column 540 to the inner column 520 using angle brackets and bolts. A slot 925 which is equal to the slot 925 of FIG. 5 is formed in the outer column 540, to which each of the coupling parts 902 and 903 is coupled.

[0056] The operation of the steel tower structure according to the second embodiment of the present invention, which is constructed as described above, will be described below.

[0057] FIGS. 8a and 8b are views showing the operation of the post of the steel tower of FIG. 7.

[0058] Among the coupling parts 901, 902, 903, and 904 shown in FIG. 8a, the coupling parts 901 and 904 are the locking coupling part, which is the same as the coupling part 900 marked by A in the first embodiment. The coupling parts 902 and 903 are the buckling-prevention coupling parts, which are the same as the coupling parts 900 marked by B or C in the first embodiment.

[0059] Further, the function of the friction coupling part, which is marked by D in the first embodiment, is achieved by the upper structure of the division part 1100.

[0060] That is, as shown in FIG. 8b, when wind force 1020 acts on the steel tower, the posts 530 are moved. Thus, the distance between the coupling parts 901 and 904 which are the locking coupling part is slightly increased. The lower portion of the division part 1100 maintains a fixed state, while the slot 1200 of the upper portion of the division part 1100 moves upwards. At this time, a large amount of friction is generated between the outer circumferential surface of the slot 1200, the third friction plate 1300, and the fourth friction plate 1350, thus attenuating energy transmitted by the wind force 1020.

[0061] Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims. The present embodiments are therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within bounds of the claims, or equivalents of such bounds, are therefore intended to be covered by the claims.

[0062] As described above, the present invention provides a friction type retrofitting device for steel tower structures, in which coupling parts are appropriately provided on posts of a steel tower, thus preventing the posts from buckling, and a slot and a friction plate are provided on the coupling parts, thus attenuating vibrations generated by wind force, therefore increasing the durability of the steel tower.

What is claimed is:
1. A friction type retrofitting device for steel tower structures, comprising:
a coupling part coupling an outer column and an inner column of a post of a steel tower to each other using an angle bracket and a bolt;
a slot formed in a portion of the outer column to which the coupling part is coupled; and
a friction plate provided to contact an outer circumferential surface of the slot, wherein wind energy transmitted to the steel tower is attenuated by friction between the outer circumferential surface of the slot and the friction plate of the coupling part.

2. The friction type retrofitting device as set forth in claim 1, wherein a horizontal section of the post has a cross shape, and a horizontal section of each of the outer column and the inner column has an I. shape.

3. The friction type retrofitting device as set forth in claim 1, wherein a plurality of coupling parts having the slot in the outer column is provided on the post, the friction plate being provided on one of the coupling parts.

4. The friction type retrofitting device as set forth in claim 2, wherein a plurality of coupling parts having the slot in the outer column is provided on the post, the friction plate being provided on one of the coupling parts.

5. The friction type retrofitting device as set forth in claim 3, wherein a reinforcing plate is provided on a portion of the outer column to which the coupling part is coupled.

6. A friction type retrofitting device for steel tower structures, comprising:

an outer column arranged to be parallel to an inner column, thus providing a post of a steel tower, and divided at a predetermined position into two portions; a slot formed in one of the divided portions; and a friction plate provided to contact an outer circumferential surface of the slot, wherein wind energy transmitted to the steel tower is attenuated by friction between the outer circumferential surface of the slot and the friction plate.

7. The friction type retrofitting device as set forth in claim 5, wherein a horizontal section of the post has a cross shape, and a horizontal section of each of the outer column and the inner column has an I. shape.

8. The friction type retrofitting device as set forth in claim 5, wherein a plurality of coupling parts is provided to couple the outer column to the inner column using an angle bracket and a bolt, with a slot formed in a portion of the outer column to which the coupling part is coupled.

9. The friction type retrofitting device as set forth in claim 6, wherein a plurality of coupling parts is provided to couple the outer column to the inner column using an angle bracket and a bolt, with a slot formed in a portion of the outer column to which the coupling part is coupled.