DOORS AND WINDOWS SYSTEM HAVING EARTHQUAKE-RESISTANT PERFORMANCE

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ABSTRACT

A Door or window system having earthquake-resistant performance, comprising: a main frame having two vertical frame members that are separated so as to be mutually parallel to each other, and an upper frame member and a lower frame member connected to the upper and lower end portions of the vertical frame members; a plurality of pillar members that are separated from the vertical frame members and arranged side by side thereto; a support beam, which is fixed to the end portions of the pillar members, extends horizontally, and has both end portions separated from the vertical frame members; and a damper, which is fixed between the support beam and the upper frame member, or between the support beam and the lower frame member, receives a horizontal load applied from the exterior, and is plastically-deformed when yielding to a horizontal load that is more than the tolerated horizontal load.
DOORS AND WINDOWS SYSTEM HAVING EARTHQUAKE-RESISTANT PERFORMANCE

TECHNICAL FIELD

[0001] The present invention relates to a door or window system having earthquake-resistant performance.

BACKGROUND ART

[0002] A door or window system includes a variety of windows or doors installed in an opening, such as a window frame or doorway, to shut an inner space of a building from the outside. Such doors or windows are essential in lighting or ventilating the room in the building and are installed into a quadrangular space, which is provided at a predetermined position of a wall body when the building is constructed.

[0003] The kind, size, installation position, number, and the like of the door or window are appropriately designed in consideration of loads applied to the building as well as air-conditioning, keeping warmth, lighting in the room, and the like. Since the door or window is generally installed to a wall body between columns, a vertical load, which the door or window cannot bear, is not applied to the door or window itself. Columns, bearing walls and the like serve to mainly support the vertical load of the building, and the door or window serves to connect the interior and the exterior.

[0004] In the meantime, when a strong wind strikes a building or an earthquake occurs, a horizontal load is applied to the building. The horizontal load, which shakes the building side to side, makes the building easily destroyed. Destruction of a building, bridge or the like when an earthquake occurs is mostly caused by the horizontal load.

[0005] Also, the aforementioned horizontal load is concentrated on a portion of the door or window of the building, so that the door or window is very easily destroyed. Thus, if the building is destroyed due to the earthquake, the wall body at which the door or window is positioned first collapses, and thus, people trapped in the interior cannot escape.

DISCLOSURE

Technical Problem

[0006] The present invention is conceived to solve the aforementioned problems. An object of the present invention is to provide a door or window system having earthquake-resistant performance, which is plastically deformed by a horizontal load and has stable hysteretic characteristics while a yield strength is continuously increased particularly during the plastic deformation, thereby being capable of maintaining the door or window system to be stable just before fracture; has a damper to absorb earthquake energy, thereby performing functions of preventing a building structure from being damaged and improving earthquake-resistant performance; and also, can be installed newly when the building is constructed or installed at a place where an existing door or window is removed because of having the same constructability as a general door or window system.

Technical Solution

[0007] According to the present invention for achieving the objects, there is provided a door or window system having earthquake-resistant performance, which includes: a quadrangular main frame mounted to a quadrangular space defined in a wall body of a building to install a door or window to the main frame, the main frame having two vertical frame members vertically arranged and parallelly spaced apart from each other, an upper frame member connected to upper ends of the vertical frame members, and a lower frame member connected to lower ends of the vertical frame members; a plurality of pillar members positioned inside of the main frame, the pillar members having ends fixed to the lower frame member or the upper frame member and being in parallel with the vertical frame members to provide a door or window installation space for installing a window therebetween, the pillar members being spaced apart from the vertical frame members; a support beam fixed to the other ends of the pillar members and horizontally extending, the support beam having both ends spaced apart from the vertical frame members; and a damper fixed between the support beam and the upper frame member or between the support beam and the lower frame member, the damper being received a horizontal load applied from the outside, the damper yielding to a horizontal load larger than an allowable horizontal load and being plastically deformed.

[0008] In addition, according to the present invention for achieving the objects, there is provided a door or window system having earthquake-resistant performance, which includes: a main frame mounted to a quadrangular space defined in a wall body of a building to install a door or window to the main frame, the main frame having two vertical frame members vertically arranged and parallelly spaced apart from each other, an upper frame member connected to upper ends of the vertical frame members, a lower frame member connected to lower ends of the vertical frame members, and an intermediate frame member horizontally arranged between the upper frame member and the lower frame member and connecting both the vertical frame members to each other; a plurality of pillar members vertically positioned inside of the main frame, the pillar members being fixed to the upper frame member or the lower frame member and extending toward the intermediate frame member to provide a door or window installation space for installing a window therebetween, the pillar members being spaced apart from the vertical frame members; support beams fixed to extending ends of the pillar members and arranged in parallel with the intermediate frame member, each of the support beams having both ends spaced apart from the vertical frame members; and dampers fixed between the support beams and the intermediate frame member, each of the dampers being received a horizontal load applied from the outside, the damper yielding to a horizontal load larger than an allowable horizontal load and being plastically deformed.

[0009] Also, the pillar members may comprise a plurality of upper pillar members fixed to the upper frame member and extending toward the intermediate frame member, and a plurality of lower pillar members fixed to the lower frame member and extending toward the intermediate frame member, the support beams may be fixed to the extending ends of the upper and lower pillar members and respectively positioned on top and bottom of the intermediate frame member, and the dampers may be respectively arranged between the intermediate frame member and the respective support beams.

[0010] Further, the damper may extend in a longitudinal direction of the support beam, have both widthwise ends fixed to the main frame and the support beam, and be a plate-shaped member having a plurality of slot-shaped holes and having a predetermined thickness and width.
Furthermore, a plurality of the dampers may be arranged in parallel along the longitudinal direction of the support beam, and an escape prevention member for fixing the support beam to the main frame may be further provided between the dampers.

Also, two or more of the dampers may be arranged side by side.

Further, the escape prevention member may be a plate-shaped member having a predetermined thickness, which is arranged perpendicular to the damper.

**Advantageous Effects**

A door or window system having earthquake-resistant performance of the present invention as configured above is plastically deformed by a horizontal load and has stable hysteric characteristics while a yield strength is continuously increased particularly during the plastic deformation, thereby being capable of maintaining the door or window system to be stable just before fracture; and also, can be installed newly when the building is constructed or installed at a place where an existing door or window is removed because of having the same constructability as a general door or window system.

**DESCRIPTION OF DRAWINGS**

FIG. 1 is a view illustrating a door or window system having earthquake-resistant performance according to one embodiment of the present invention.

FIG. 2 is a front view of the door or window system shown in FIG. 1.

FIG. 3 is a graph showing an analysis of an internal stress distribution using FEM (Finite Element Method), which is one of numerical analyses, when a horizontal load is applied to the door or window system having earthquake-resistant performance shown in FIG. 1 in an arrow direction F shown in FIG. 2.

FIG. 4 is a view showing another example of the door or window system having earthquake-resistant performance according to one embodiment of the present invention.

FIG. 5 is a view showing a further example of the door or window system having earthquake-resistant performance according to one embodiment of the present invention.

FIG. 6 is a view showing a still further example of the door or window system having earthquake-resistant performance according to one embodiment of the present invention.

**BEST MODE**

Hereinafter, one embodiment according to the present invention will be described in detail with reference to the accompanying drawings.

FIG. 1 is a view illustrating a door or window system 13 having earthquake-resistant performance according to one embodiment of the present invention, and FIG. 2 is a front view of the door or window system shown in FIG. 1.

As shown in the figures, the door or window system 13 according to this embodiment comprises a main frame 15 mounted to an inner area of a quadrangular hole, which is formed in a framework 11 when a building is constructed, three pillar members 23 provided inside of the main frame 15, a support beam 19 horizontally fixed to an upper end of the pillar members 23, and a plurality of dampers 17 positioned on top of the support beam 19.

The main frame 15 takes the form of a quadrangular frame consisting of two vertical frame members 15a arranged to be spaced apart from and parallel to each other, an upper frame member 15b integrally formed at upper ends of the vertical frame members 15a and horizontally extending, and a lower frame member 15c integrally connected to lower ends of the vertical frame members 15a and parallel to the upper frame member 15b. The vertical frame members 15a may function as columns, and the upper frame member 15b may function as a beam.

The pillar members 23, which are made to stand vertically with their lower ends fixed to the lower frame member 15c, are spaced apart from each other at regular intervals, so that door or window installation spaces 27 are provided between the pillar members 23. The door or window installation spaces 27 are mounted with general windows 29, respectively.

In particular, the pillar members 23 at the left and right sides among the three pillar members 23 are respectively spaced apart from the vertical frame members 15a, so that space portions 25 are defined between the pillar members 23 and the vertical frame members 15a, respectively. Each of the space portions 25 may have a width of about 40 mm to 50 mm although it may vary according to circumstance.

The space portions 25 are buffer regions provided so that the vertical frame members 15a do not collide with the support beam 19 or the pillar members 23 when a horizontal load is applied to the upper frame member 15b in an arrow direction F. If there is not the space portions 25, the horizontal load is exerted directly on the pillar members 23, thereby making the pillar members 23 yield and be plastically deformed.

The window 29 mounted to the door or window installation space 27 is a general window, for example, including a fixed sash type or an openable type. When the window 29 is a fixed sash type, the window 29 consists of a quadrangular window frame 29a fixed to the pillar members 23, the lower frame member 15c, and the support beam 19 and a glass panel 29b fitted into the window frame 29a. Also, the window 29 of an openable type consists of the quadrangular window frame 29a and a window sash 29c openably and closably installed into the window frame 29a. The glass panel 29b may be naturally fitted into the window sash 29c.

Also, although in this embodiment, the pillar member 23 takes the form of a plate having a predetermined width and thickness, the shape of the pillar member 23 may be modified in any degree according to circumstance.

The support beam 19 fixed to the upper ends of the pillar members 23 horizontally extends, and both ends of the support beam 19 are respectively spaced apart from the vertical frame members 15a. Spaces between both ends of the support beam 19 and the vertical frame members 15a are also respectively included in the space portions 25. The support beam 19 is spaced apart from the upper frame member 15b in parallel, and the plurality of dampers 17 are maintained between the support beam 19 and the upper frame member 15b.

Each of the dampers 17 is a plate-shaped member, which has a predetermined width and thickness and extends in a longitudinal direction of the support beam 19. The dampers 17 are made to vertically stand between the support beam 19 and the upper frame member 15b, and both widthwise ends of each damper 17 are respectively coupled to a bottom side of the upper frame member 15b and a top side of the support beam 19.
beam 19. In particular, the damper 17 is formed with a plurality of holes 17a. The plurality of dampers 17 are serially arranged along the longitudinal direction of the support beam 19. The dampers 17 may be formed of the same material, preferably steel, as the main frame 15.

[0032] The hole 17a is a slot-shaped hole, which vertically extends to be elongated, and improves a plastic deformability of the dampers 17. That is, when the horizontal load is applied to the upper frame member 15b in the arrow direction 1' and then a shear force is exerted on the dampers 17, the dampers 17 are plastically deformed due to the shear force. If there is not the holes 17a, the dampers 17 are not plastically deformed, but for example, welded portions of upper and lower ends of the dampers 17 or other portions thereof will be fractured. As described above, the dampers 17 are installed and applied so that the dampers 17 are plastically deformed by the horizontal load, whereby for example even when an earthquake occurs, energy of the earthquake will be absorbed due to the plastic deformation of the dampers. A width w of the hole 17a may vary according to circumstance.

[0033] Also, a plurality of escape prevention members 21 are positioned between the support beam 19 and the upper frame member 15b. The escape prevention members 21, each of which is a plate having a predetermined thickness, are fixed in a direction perpendicular to the dampers 17. Upper and lower ends of the escape prevention members 21 are welded and coupled to upper frame member 15b and the support beam 19, respectively, thereby preventing the support beam 19 from moving in its widening direction with respect to the upper frame member 15b. That is, the escape prevention members 21 prevent the support beam 19 from moving in the widening direction of the support beam 19 and then tumbling to the outside of the main frame 15.

[0034] The installation number or installation positions of the escape prevention members 21 may also vary according to circumstance, and as shown in FIG. 1, the escape prevention members 21 may be positioned between the respective dampers 17 and at both the ends of the support beam 19.

[0035] Reference numeral 31 in FIG. 2 designates an epoxy layer. The epoxy layer 31 bonds the main frame 15 to inner sides of the framework 11 and at the same time functions as a buffer for blocking the propagation of vibration.

[0036] FIG. 3 is a graph showing an analysis of an internal stress Fv of the door or window system 13 having earthquake-resistant performance shown in FIG. 1 using FEM (Finite Element Method), which is one of numerical analyses, when the horizontal load is applied to the door or window system in the arrow direction 1' shown in FIG. 2.

[0037] Referring to FIG. 3, it can be seen that stress is concentrated on the dampers 17 and stress in an elastic range exists in the other portions of the door or window system. The stress in an elastic range is a load to restore an object to its original state when the load is removed from the object.

[0038] Since the stress is concentrated on the dampers 17 as described above, if a strong horizontal load caused by an earthquake is transmitted to the door or window system 13, the dampers 17 are first plastically deformed and absorb energy of the earthquake, thereby being capable of serving to prevent damage of the building structure as well as the door or window system 13.

[0039] FIG. 4 is a view showing another example of the door or window system 13 having earthquake-resistant performance according to one embodiment of the present invention.

[0040] Hereinafter, the same reference numerals as the aforementioned ones are used to designate the same members having the same function.

[0041] In the door or window system 13 shown in FIG. 4, the dampers 17 are serially arranged in pairs. The configuration and function of the damper 17 itself is the same as the one shown in FIG. 1. Since the dampers 17 are fixed in pairs side by side as described above, they can strongly bear the horizontal load applied from the outside. According to circumstance, the dampers 17 may be arranged in sets of three or more side by side.

[0042] FIG. 5 is a view showing a further example of the door or window system having earthquake-resistant performance according to one embodiment of the present invention.

[0043] Referring to FIG. 5, it can be seen that the dampers 17 are fixed to a top side of the lower frame member 15c. To this end, the upper ends of the pillar members 23 are fixed to the upper frame member 15b and extend downward, and the support beam 19 is fixed to the lower ends of the pillar members 23.

[0044] The support beam 19 is arranged above the lower frame member 15c in a parallel spaced relation, and the dampers 17 are positioned between the support beam 19 and the lower frame member 15c. The dampers 17 have the same functions as those shown in FIG. 1.

[0045] FIG. 6 is a view showing a still further example of the door or window system having earthquake-resistant performance according to one embodiment of the present invention.

[0046] As shown in the figure, in the door or window system 13 according to the still further example, the main frame 15 further includes an intermediate frame member 33 between the upper frame member 15b and the lower frame member 15c. The intermediate frame member 33 has both ends fixed to the vertical frame members 15a and is maintained in a horizontal state.

[0047] Also, the plurality of dampers 17 and escape prevention members 21 are fixed to top and bottom sides of the intermediate frame member 33. The dampers 17 and the escape prevention members 21 have the same functions as those described above.

[0048] The support beam 19 is positioned on top of the dampers 17 and escape prevention members 21 arranged on top of the intermediate frame member 33, and a plurality of upper pillar members 23a are positioned on top of the support beam 19.

[0049] The upper pillar members 23a connect the upper frame member 15b and the support beam 19 to each other, and door or window installation spaces 27 are provided therebetween. The windows 29 are naturally installed to the door or window installation spaces 27.

[0050] In addition, lower pillar members 23b are fixed to an upper portion of the lower frame member 15c. The lower pillar members 23b are spaced apart from each other to provide door or window installation spaces 27 therebetween, and the support beam 19, which is further provided in addition to the aforementioned support beam 19, is supported at upper ends of the lower pillar members 23b. The support beam 19 is maintained in a horizontal state while being supported by the lower pillar members 23b, and the dampers 17 and the escape prevention members 21 are held between the support beam 19 and the intermediate frame member 33.

[0051] The dampers 17 fixed to the top and bottom sides of the intermediate frame member 33 are plastically deformed
by the horizontal load applied to the door or window system 13, particularly the intermediate frame member 33, to protect
the door or window system.

[0052] Meanwhile, although the plate-shaped dampers 17
made of steel are employed in this embodiment, the shape or
kind of the dampers may be modified in any degree as long as
the dampers perform their aforementioned functions. For
example, an elastic damper, a viscoelastic damper, a steel
damper, an oil damper, a viscous damper, or the like may be
applied.

[0053] Although the present invention has been described
in detail through the specific embodiments, the present inven-
tion is not limited to the embodiments. It will be apparent that
those skilled in the art can make various modifications and
changes thereto within the scope of the technical spirit of the
present invention.

1. A door or window system having earthquake-resistant
performance, comprising:
a quadrangular main frame mounted to a quadrangular
space defined in a wall body of a building to install a door
or window to the main frame, the main frame having two
vertical frame members vertically arranged and paral-
lellly spaced apart from each other, an upper frame mem-
ber connected to upper ends of the vertical frame mem-
bers, and a lower frame member connected to lower ends
of the vertical frame members;
a plurality of pillar members positioned inside of the main
frame, the pillar members having ends fixed to the lower
frame member or the upper frame member and being in
parallel with the vertical frame members to provide a
door or window installation space for installing a win-
don therebetween, the pillar members being spaced
apart from the vertical frame members;
a support beam fixed to the other ends of the pillar members
and horizontally extending, the support beam having
both ends spaced apart from the vertical frame members;
and
da damper fixed between the support beam and the upper
frame member or between the support beam and the
lower frame member, the damper being received a hori-
zontal load applied from the outside, the damper yield-
ing to a horizontal load larger than an allowable hori-
zontal load and being plastically deformed.

2. A door or window system having earthquake-resistant
performance, comprising:
a main frame mounted to a quadrangular space defined in a
wall body of a building to install a door or window to the
main frame, the main frame having two vertical frame
members vertically arranged and parallelly spaced apart
from each other, an upper frame member connected to
upper ends of the vertical frame members, a lower frame
member connected to lower ends of the vertical frame
members, and an intermediate frame member horizon-
tally arranged between the upper frame member and the
lower frame member and connecting both the vertical
frame members to each other;
a plurality of pillar members vertically positioned inside of
the main frame, the pillar members being fixed to the
upper frame member or the lower frame member and
extending toward the intermediate frame member to pro-
vide a door or window installation space for installing a
window therebetween, the pillar members being spaced
apart from the vertical frame members;
support beams fixed to extending ends of the pillar mem-
bers and arranged in parallel with the intermediate frame
member, each of the support beams having both ends
spaced apart from the vertical frame members; and
dampers fixed between the support beams and the interme-
diate frame member, each of the dampers being received
a horizontal load applied from the outside, the damper
yielding to a horizontal load larger than an allowable
horizontal load and being plastically deformed.

3. The door or window system according to claim 2,
wherein the pillar members comprise a plurality of upper
pillar members fixed to the upper frame member and extend-
ing toward the intermediate frame member, and a plurality of
lower pillar members fixed to the lower frame member and
extending toward the intermediate frame member, the support
beams are fixed to the extending ends of the upper and lower
pillar members and respectively positioned on top and bottom
of the intermediate frame member, and the dampers are
respectively arranged between the intermediate frame mem-
ber and the respective support beams.

4. The door or window system according to claim 1,
wherein the damper extends in a longitudinal direction of the
support beam, has both widthwise ends fixed to the main
frame and the support beam, and is a plate-shaped member
having a plurality of slot-shaped holes and having a predeter-
mined thickness and width.

5. The door or window system according to claim 4,
wherein a plurality of the dampers are arranged in parallel
along the longitudinal direction of the support beam, and an
escape prevention member for fixing the support beam to the
main frame is further provided between the dampers.

6. The door or window system according to claim 5,
wherein two or more of the dampers are arranged side by side.

7. The door or window system according to claim 5,
wherein the escape prevention member is a plate-shaped
member having a predetermined thickness, which is arranged
perpendicular to the damper.

8. The door or window system according to claim 5,
wherein the damper comprises a steel damper, an oil damper,
and a viscous damper.