

DESCRIPTION

DAMPING STRUCTURE HAVING ELASTOPLASTIC/VISCOELASTIC
DAMPER INTEGRATED THEREWITH

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FIELD OF THE INVENTION

The present invention relates to a damping structure having an elastoplastic/viscoelastic damper integrated therewith, applied to a brace or a stud, which can be
10 mainly used for an earthquake-resistant and wind-resistant member for a building. In this connection, the earthquake-resistant and wind-resistant member for a building will be referred to as an earthquake-resistant member in this specification, hereinafter.

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DESCRIPTION OF THE PRIOR ART

The structure of an earthquake-resistant member used for a brace or a stud of a building can be roughly classified into the following type (I) and (II).

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(I) The first type is an elastoplastic damper structure by which energy is absorbed when metal such as steel or lead incorporated into a brace or a stud behaves elastoplastically. A quantity of absorbed energy is shown by an area in Fig. 12(a).

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(II) The second type is a viscoelastic damper structure by which energy is absorbed by viscoelasticity of highly damping rubber, polymer, silicone or oil combined with a brace or a stud. A quantity of absorbed energy is shown by an area in Fig. 12(b).

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The first structure described as the above type (I) is advantageous in that the manufacturing cost is low. However, this structure described as type (I) is disadvantageous in that no energy can be absorbed in an elastic range, so that no effect can be provided by this
35 structure in the case of a medium or small earthquake. Further, the structure described as type (I) is disadvantageous in that problems of low cycle fatigue

tend to occur when it is exposed to a strong wind. The second structure described as the above type (II) is advantageous in that a damping effect can be uniformly provided in the cases of a large, a medium and a small earthquake, and further, a high damping effect can be provided when it is used in a strong wind. However, the second structure described in the above type (II) is disadvantageous in that the manufacturing cost is high. As described above, the structures described in the above types (I) and (II) respectively have both merits and demerits.

A conventional anti-buckling structure, which is used for a brace, of the above type (II), is shown in the conceptual view of Fig. 13, and an example of the arrangement of the conventional anti-buckling structure is shown in Fig. 14. This anti-buckling brace 10 is composed in such a manner that a damping member 3 is filled outside a steel central axial force member 1, and a steel anti-buckling member 2 is bonded outside the damping member 3. The thus composed anti-buckling braces 10 are attached to the beams 5 and 6 of the building 7 as shown in Fig. 14 (a) in which the anti-buckling braces 10 are arranged into a V-shape and also as shown in Fig. 14(b) in which the anti-buckling braces 10 are arranged obliquely.

When the steel central axis force member 1 shown in Fig. 13(a) is given a tension in an earthquake, the steel anti-buckling member 2 is extended as shown in Fig. 13(c). In this case, the axial rigidity of the steel anti-buckling member 2 is much higher than that of the damping member 3. Therefore, axial deformation of the steel anti-buckling member 2 is seldom caused. As a result, the damping members 3 bonded onto both sides of the steel central axis force member 1 are deformed by shear as shown in Fig. 13(b). A quantity of deformation by shear of the damping member 3 is zero at the center, and a quantity of deformation by shearing of the damping

member 3 is half of a quantity of elongation of the steel central axis force member 1 at each end portion of the damping member 3. Therefore, the overall quantity of deformation by shear is small. As a result, the damping effect provided by the damping member 3 is lower than that provided by the present invention described later.

SUMMARY OF THE INVENTION

The present invention has been accomplished to solve the above problems in the prior art. It is an object of the present invention to realize a damping member, the manufacturing cost of which is low, having a high damping effect for a large, a medium and a small earthquake and a strong wind. According to the present invention, the conventional elastoplastic damper described as the above type (I) and the viscoelastic damper described as the above type (II) are organically combined with each other so as to make the most of the merits of both dampers and overcome the demerits of both dampers. According to the present invention, when the anti-buckling member and insulating member described as type (I) are also used as the viscoelastic damper described as type (II), the manufacturing cost of the damping structure can be reduced as compared with the damping structure in which the anti-buckling member and insulating member are manufactured separately from the viscoelastic damper. Further, the anti-earthquake performance can be remarkably enhanced.

In order to accomplish the above object and obtain the excellent anti-earthquake performance, the first characteristic of the present invention is to provide a damping structure having an elastoplastic/viscoelastic damper integrated therewith characterized in that: a steel central axis force member 1 is covered with a damping member 3; an outside of the damping member 3 is covered with a first steel anti-buckling member 2a; the first steel anti-buckling member 2a is covered with the

damping member 3; an outside of the damping member 3 is covered with a second steel anti-buckling member 2b; one end of the first steel anti-buckling member 2a and one end of the steel central axis force member 1 are fixed to each other; one end of the second steel anti-buckling member 2b and the other end of the steel central axis force member 1 are fixed to each other; and the first steel anti-buckling member 2a and the second steel anti-buckling member 2b are viscoelastically integrated via the damping member 3.

The second characteristic of the present invention is to provide a damping structure in which cross-sections of the steel central axis force member 1, the first steel anti-buckling member 2a and the second steel anti-buckling member 2b are flat, and the damping member 3 is filled in a space between the steel central axis force member 1 and the first steel anti-buckling member 2a and also filled in a space between the steel central axis force member 1 and the second steel anti-buckling member 2b in such a manner that the filled damping member 3 can be formed flat.

The third characteristic of the present invention is to provide a damping structure in which cross-sections of the steel central axis force member 1 and the first steel anti-buckling member 2a are flat, and the second steel anti-buckling member 2b, the cross-section of which is rectangular, is arranged in a space between the steel central axis force member 1 and the first steel anti-buckling member 2a and also filled the damping member 3 in the space.

The fourth characteristic of the present invention is to provide a damping structure in which steel members, the cross-section of which is a cross, are fixed to both end portions of steel central axis force member 1.

The fifth characteristic of the present invention is to provide a damping structure in which steel plates are respectively fixed to end portions of the steel central

axis force member 1 and the first steel anti-buckling member 2a, the other end portion of the steel central axis force member 1, and the second steel anti-buckling member 2b.

5 The sixth characteristic of the present invention is to provide a damping structure in which the second steel anti-buckling member 2b is covered with the damping member 3, and the outside of the damping member 3 is covered with the third steel anti-buckling member 2c.

10 BRIEF DESCRIPTION OF THE DRAWINGS

 Figs. 1(a) and 1(b) are schematic illustrations showing a concept of the damping structure of the first embodiment of the present invention, and Fig. 1(c) is a
15 diagram showing a distribution of strain of a damping member used in the first and the second embodiment.

 Fig. 2 is a schematic illustration showing a concept of the damping structure of the second embodiment of the present invention.

20 Fig. 3(a) is a perspective view showing a damping structure of the first embodiment of the present invention. Fig. 3(b) is a schematic illustration showing an arrangement in which the damping structure is used.

 Fig. 4 is a side and a plan view of the damping
25 structure of the second embodiment of the present invention.

 Fig. 5 is a cross-sectional view taken on line C - C in Fig. 4.

30 Fig. 6(a) is a cross-sectional view taken on line B - B in Fig. 4, and Fig. 6(b) is a cross-sectional view taken on line D - D in Fig. 4.

 Fig. 7 is a cross-sectional view taken on line A - A in Fig. 4.

35 Fig. 8(a) is a side view showing a damping structure of the third embodiment of the present invention. Figs. 8(b), 8(c) and 8(d) are respectively cross-sectional views taken on lines D - D, E - E and F - F in Fig. 8(a).

Figs. 9(a), 9(b), 9(c) and 9(d) are schematic illustrations for explaining an arrangement of the damping structure of the embodiment of the present invention.

5 Fig. 10(a) is a perspective view showing a damping structure of the third embodiment of the present invention. Fig. 10(b) is a schematic illustration showing an arrangement in which the damping structure is used.

10 Fig. 11 is a view showing a comparison between the damping effect of the damping structure of the present invention and the damping effect of the damping structure of the prior art.

15 Fig. 12(a) is a view showing a quantity of energy of an earthquake absorbed by an elastoplastic damper, and Fig. 12(b) is a view showing a quantity of energy of an earthquake absorbed by a viscoelastic damper, wherein the quantity of energy is represented by an area.

20 Fig. 13(a) is a conceptual view of a conventional anti-buckling brace before tension is given to it, and Fig. 13(b) is a view showing a distribution of strain of a viscoelastic body after tension has been given. Fig. 13(c) is a conceptual view showing a state after a tension has been given.

25 Figs. 14(a) and 14(b) are schematic illustrations showing an example in which the conventional anti-buckling brace is used.

THE MOST PREFERRED EMBODIMENT

30 Referring to the appended drawings, embodiments of the present invention will be explained as follows.

35 Figs. 1(a) and 1(b) are conceptual views showing a damping structure 8 of the first embodiment of the present invention. This damping structure 8 of the first embodiment of the present invention is composed as follows. The damping structure is characterized in that: a steel central axis force member 1 is covered with a

first damping member 3a of a damping member 3; an outside
of the damping member 3a is covered with a first steel
anti-buckling member 2a; the first steel anti-buckling
member 2a is covered with a second damping member 3b; an
5 outside of the damping member 3b is covered with a second
steel anti-buckling member 2b; one end of the first steel
anti-buckling member 2a and one end of the steel central
axis force member 1 are fixed to each other; and the
first steel anti-buckling member 2a and the second steel
10 anti-buckling member 2b are viscoelastically integrated
with the second damping member 3b. Various viscoelastic
materials such as high damping rubber, acrylic polymer,
rubber asphalt and silicon rubber may be used for the
damping member 3 as long as the stress-strain curve of
15 the material becomes an ellipse. The aforementioned
steel anti-buckling members 2a, 2b may be a shearing
strain generating member.

When both end portions of the steel central axis
force member 1 of the damping structure 8 shown in Fig.
20 1(a) are given a tension caused by an earthquake, the
steel central axis force member 1 is extended. At this
time, elongation of the first steel anti-buckling member
2a and axial rigidity of the second steel anti-buckling
member 2b are much higher than those of the first damping
25 member 3a and the second damping member 3b. Therefore,
shearing deformation is caused in the first 3a and the
second damping member 3b. A total of the quantities of
shearing deformation of the first 3a and the second
damping member 3b, that is, the effect of damping
30 generated by the first 3a and the second damping member
3b is twice to four times as high as that provided by the
damping structure shown in Fig. 13. Therefore, it can be
understood that the first 3a and the second damping
member 3b can be effectively deformed in the mechanism
35 shown in Fig. 1. In this case, strain of the first
damping member 3a contact with the steel central axis
force member 1 is zero at one end (on the root side) and

equal to a quantity of strain of the steel central axis force member 1 at the other end. On the other hand, strain of the second damping member 3b is equal to strain of the steel central axis force member 1 in all regions.

5 The damping effect described referring to Figs. 1(a) and 1(b) is the same as that in a case in which a compressive force is given to the steel central axis force member 1. That is, even when the steel central axis force member 1 is given a compressive force, no
10 buckling is caused because the anti-buckling effect can be provided by the first 2a and the second steel anti-buckling member 2b.

Fig. 2 is a conceptual view showing a damping structure 8a of the second embodiment of the present
15 invention. Different points of this damping structure 8a of the second embodiment from the damping structure 8 of the first embodiment are described as follows. The second steel anti-buckling member 2b is covered with a third damping member 3c in the damping structure 8 of the
20 first embodiment, and an outside of this third damping member 3c is covered with a third steel anti-buckling member 2c. Other points of the damping structure of the second embodiment are the same as those of the damping structure 8 of the first embodiment.

25 In the damping structure 8a shown in Fig. 2, when tension is given to the steel central axis force member 1 by an earthquake and the steel central axis force member 1 is extended, the first 3a, the second 3b and the third damping member 3c are effectively deformed by the same
30 principle as that of the damping structure 8 shown in Fig. 1. Therefore, even if a higher intensity of earthquake is given to the damping structure of this embodiment, the earthquake force can be positively absorbed by the action of the elastoplastic and
35 viscoelastic damper.

EMBODIMENTS

Next, referring to Figs. 3 to 10, embodiments of the present invention will be explained below.

The first embodiment of the present invention is shown in Fig. 3. As shown in Fig. 3, the damping structure 8 is composed as follows. There is provided a steel central axis force member 1, which is mainly made of steel. Also, there are provided first steel anti-buckling members 2a, which is mainly made of steel. The steel central axis force member 1 and the first steel anti-buckling members 2a are arranged in parallel with each other leaving a predetermined interval between them. One end of the steel central axis force member 1 and one end of the first steel anti-buckling member 2a are joined to each other by the first joining steel member 4a. The other end of the steel central axis force member 1 and the other end of the second steel anti-buckling members, which are made of steel, are joined to each other by the second joining steel member 4b. Further, parallel gaps, which are formed between the steel central axis force member 1 and the first steel anti-buckling member 2a and the second steel anti-buckling member 2b, are filled with the first damping member 3a and the second damping member 3b. In this way, the damping structure 8 is composed. As shown in Fig. 3(b), the thus composed damping structures 8 are joined to a building 7 composed of beams 5 and pillars 6, that is, the damping structures 8 are joined to a building 7 being formed into a V-shaped brace.

When a horizontal deformation is caused in the above building in the case of an earthquake, tensile/compression yield is generated in the damping structure 8, so that shearing deformation is caused in the first 3a and the second damping member 3b. As a result, the first damping member 3a and the second damping member 3b absorb energy as shown in Fig. 12(b). When the intensity of this tensile/compression force is high, tensile/compression yield is generated in the steel

central axis force member 1, so that energy can be absorbed as shown in Fig. 12(a). Even if a compressive force is given to the steel central axis force member 1, no buckling is caused because an anti-buckling effect can be provided by the first steel anti-buckling member 2a and the second steel anti-buckling member 2b.

Figs. 4 to 7 are views showing the second embodiment of the present invention.

In the second embodiment, as shown in Fig. 5 which is a cross-sectional view taken on line C - C in Fig. 4, an intermediate portion of the steel central axis force member 1 is flat. As shown in Figs. 6(a), 6(b) and 7 which are respectively cross-sectional views taken on lines A - A, B - B and D - D in Fig. 4, and a reinforcement central axis force member 11 is attached to the plate member and the configuration is formed into a cross-section.

A friction reducing member 26 is bonded outside the steel central axis force member 1, and two parallel third steel anti-buckling members 2c are provided outside the friction reducing member 26 so that the steel central axis force member 2b can be interposed between the two parallel third steel anti-buckling members 2c. As shown in Fig. 6(a) which is a cross-sectional view taken on line B - B, the third steel anti-buckling members 2c are fixed to the steel central axis force member 1 by fixing bolts at one end.

The damping member 3, the thickness of which is predetermined, is arranged outside the third steel anti-buckling member 2c, and the two parallel second steel anti-buckling members 2b are arranged outside the steel anti-buckling member 2c so that the steel anti-buckling member 2c can be interposed between them. At an end portion which is different from the end portion at which the steel anti-buckling member 2c is fixed to the steel central axis force member 1, the steel central axis force member 1 and the steel anti-buckling member 2b are fixed

to each other by bolts 19, 20 via a filler plate 24. This damping structure is composed in such a manner that the damping member 3 is deformed by shearing when the steel central axis force member 1 is extended or contracted in the axial direction. In the steel anti-buckling member 2b, there are provided a C-shaped opening in a portion in which it interferes with the reinforcement central axis force member 11 at both end portions.

The first steel anti-buckling members 2a are arranged on both sides of the second steel anti-buckling member 2b, and the first steel anti-buckling members 2a and the second steel anti-buckling member 2b are connected with each other by the fixing bolts. Due to the foregoing, as shown in Fig. 5 which is a cross-sectional view of the section C - C, a closed section can be formed, so that the effect of preventing the occurrence of buckling can be remarkably enhanced.

In the same manner as that of the first embodiment, in the second embodiment, when a horizontal deformation is caused in a building in the case of an earthquake, tensile/compression yield is caused in the damping structure 8, so that shearing deformation is caused in the first 3a and the second damping member 3b. As a result, the first 3a and the second damping member 3b absorb energy as shown in Fig. 12(b). When an intensity of this tensile/compression force is high, tensile/compression yield is generated in the steel central axis force member 1, so that energy can be absorbed as shown in Fig. 12(a). Even if a compressive force is given to the steel central axis force member 1, no buckling is caused because the anti-buckling effect can be provided by the first 2a and the second steel anti-buckling member 2b.

Figs. 8(a) to 8(b) are views showing the third embodiment of the present invention. In the third embodiment, as shown in Figs. 8(b), 8(c) and 8(d) which

are respectively cross-sectional views taken on lines D - D, E - E and F - F in Fig. 8(a), a section of the steel central axis force member 1 is formed into a substantial cross with respect to the entire length.

5 Outside the steel central axis force member 1, the section of which is formed into a cross, there are provided a first steel anti-buckling member 2a and a second steel anti-buckling member 2b, a first damping member 3a and a second damping member (viscoelastic material) 3b, and a joining steel member 18 by an
10 arranging structure shown by the cross-sectional views of Figs. 8(b), 8(c) and 8(d).

 More specifically, the explanation will be made as follows. At the left end portion of Fig. 8(a), as shown
15 in Fig. 8(b), four steel members 18 used for joining, the sections of which are formed into an L-shape, are arranged outside the central axis force member 1 having a cross section. Outside this steel member 18 used for joining, there are provided four second steel anti-
20 buckling members 2b, the sections of which are formed into an L-shape, via spacers 18. At the wing portions, the central axis force member 1 and the second steel anti-buckling member 2b are connected with each other by the fixing bolts 19 and the nuts 20, which penetrate each
25 member, via the steel members 18 for joining.

 As shown in Fig. 8(d), at the middle portion of Fig. 8(a), outside the central axis force member 1, the cross section of which is formed into a cross, there are provided a thin first damping member 3a, the section of
30 which is an L-shape, a first steel anti-buckling member 2a, a second damping member 3b and a second steel anti-buckling member 2b which are laminated from the inside in this order. The inner and outer layer members are joined to the first damping member 3a and the second damping
35 member 3b.

 As shown in Fig. 8(d), at the right end portion of Fig. 8(a), outside the central axis force member 1, the

section of which is a cross, there is provided a first steel anti-buckling member 2a via a filler plate 24. At the wing portions, both members are joined to each other by the fixing bolts 19 and nuts 20 penetrating each member. A forward end 21 of the second steel anti-buckling member 2b extending from the left end of Fig. 8(a) to the right is stopped at a position close to the step portion 23 of the base end of the second steel anti-buckling member 2b. A forward end 22 of the first steel anti-buckling member 2a extending from the right end of Fig. 8(b) to the left is stopped at a position close to the steel member 18 for joining.

In the same manner as that of the first and the second embodiment, in this third embodiment, when a horizontal deformation is caused in a building in the case of an earthquake, tensile/compression yield is caused in the damping structure 8, so that shearing deformation is caused in the first damping member 3a and the second damping member 3b. As a result, the first damping member 3a and the second damping member 3b absorb energy. When an intensity of this tensile/compression force is high, tensile/compression yield is generated in the steel central axis force member 1, so that energy can be absorbed. Even if a compressive force is given to the steel central axis force member 1, no buckling is caused because the anti-buckling effect can be provided by the first anti-buckling member 2a and the second steel anti-buckling member 2b.

In Fig. 9, there are shown examples of the arrangements of the damping structures 8, 8a of the first and the second embodiment in which the damping structures 8, 8a are arranged in the buildings 7 in such a manner that they are attached to the pillars 6 and beams 5. In the same manner as that of a common brace, in Fig. 9(a), the damping structures are arranged being formed into a V-shape. In Fig. 9(b), the damping structures are arranged being formed into an angle-shape. In Fig. 9(c),

the damping structures are arranged being formed into a diagonal shape in which the right portion rises upward. In Fig. 9(d), the damping structures are arranged being formed into a diagonal shape in which the left portion rises upward. The damping structures 8, 8a are fixed to the pillars 6 and beams 5 in the same manner as that of a common brace. The steel central axis force members 1 incorporated into the damping structures 8, 8a are fixed to the pillars 6 and beams 5 by means of bolts or welding.

Fig. 10 is a view showing the third embodiment of the present invention. As shown in Fig. 10, this damping structure 8 is composed as follows. There are provided a steel central axis force member 1 and first steel anti-buckling members (or shearing strain generating members) 2a, which are arranged in parallel with each other leaving a predetermined interval. The steel central axis force member 1 and the first steel anti-buckling members 2a are joined to each other by the rectangular first joining steel member 17a having a plurality of bolt holes 16. The other end portion of the steel central axis force member 1 and the other end portions of the second steel anti-buckling members (or the shearing strain generating member) 2b are joined to each other by the rectangular second joining steel member 17b having a plurality of bolt holes 16 in the same manner as that described above. Parallel gaps formed between the steel central axis force member 1 and the first steel anti-buckling member 2a and the second steel anti-buckling member 2b are filled with the first damping member 3a and the second damping member 3b made of viscoelastic material. In this way, the damping structure 8 is composed.

Upper and lower ends of the damping structure 8 of the third embodiment are fixed by fixing bolts to the upper and lower beams 5 of the building 7 into which the pillars 6 and beams 5 are incorporated.

In the case of an earthquake, shearing deformation is generated in the steel central axis force member 1 of the damping structure 8 shown in Fig. 10. Since the steel central axis force member 1 is restricted by the first steel anti-buckling member 2a and the second steel anti-buckling member 2b and the first dumping member 3a and the second damping member 3b, no buckling is caused at this time. When a load given to the damping structure 8 exceeds a certain value, shearing yield is caused and it exhibits a restoring force characteristic shown in Fig. 12(a) and absorbs energy. Since shearing rigidity of the first steel anti-buckling member 2a and the second steel anti-buckling member 2b is high, these members are seldom deformed. Accordingly, in the case of an earthquake, relative displacements are generated between the steel central axis force member 1 and the first steel anti-buckling member 2a and also between the steel anti-buckling member first 2a and the second steel anti-buckling member 2b. Therefore, the first 3a and the second damping member 3b are deformed by shearing. As a result, the damping structure exhibits the restoring characteristic shown in Fig. 12(b) and absorbs energy. In this connection, in the third embodiment, the thin damping layer 3a may be omitted.

On Table 1, there is shown a comparison of the manufacturing cost between the damping structure of the present invention and that of the prior art. Also, there is shown a comparison of the performance of reducing the oscillation with respect to a large, a medium and a small earthquake between the damping structure of the present invention and that of the prior art.

Table 1

		Small earth- quake	Medium earth- quake	Large earth- quake	Strong wind	Cost
Present invention	Elastoplasticity + Viscoelasticity	Effec- tive	Effec- tive	Effec- tive	Effec- tive	Inexpen- sive
Compara- tive example	Elastoplastic damper	Effec- tive	A little effec- tive	Effec- tive	Not effec- tive	Inexpen- sive
	Viscoelastic damper	Effec- tive	Effec- tive	Effec- tive	Not effec- tive	Expen- sive

5 In Fig. 11, there is shown a comparison of
performance between the damping structure of the present
invention and that of the prior art. As shown in the
drawing, the elastoplastic damper exhibits a linear
behavior in a strong wind or a medium and small
10 earthquake. Therefore, a quantity of absorbed earthquake
energy is small. However, in the case of a large
earthquake, a large quantity of earthquake energy is
absorbed. On the other hand, the viscoelastic damper can
stably absorb energy at all times in the case of a strong
15 wind, a medium and small earthquake and a large
earthquake. However, the viscoelastic damper is
disadvantageous in that the manufacturing cost is high.
Each embodiment of the present invention makes up for the
disadvantages of the above elastoplastic damper and the
20 viscoelastic damper, and combines the elastoplastic
damper with the viscoelastic damper. Therefore, the
manufacturing cost of the damper structure of each
embodiment of the present can be suppressed, and the
energy absorbing performance can be stably exhibited with
25 respect to a strong wind, a medium and small earthquake
and a large earthquake.

INDUSTRIAL POSSIBILITY

According to the present invention, when the

elastoplastic damper and the viscoelastic damper are organically combined with each other, it becomes possible to make the most of the merits of both dampers and the demerits of both dampers can be overcome. Accordingly, 5 the damping structure of the present invention can provide an oscillation reducing effect with respect to a large, a medium and a small earthquake and a strong wind, and further the manufacturing cost of the damping structure can be decreased. In general, when a building 10 is designed, the positions and number of the damping structures (anti-earthquake structures) are restricted. When the damping structure, in which the viscoelastic damper and the elastoplastic damper are integrated into one body, is used at the above restricted positions, the 15 cost can be reduced and the higher effect can be provided as compared with a case in which the viscoelastic damper and the elastoplastic damper are arranged separately from each other.

What is claimed is:

1. A damping structure having an elastoplastic/viscoelastic damper integrated therewith characterized in that: a steel central axis force member
5 1 is covered with a damping member 3; an outside of the damping member 3 is covered with a first steel anti-buckling member 2a; the first steel anti-buckling member 2a is covered with the damping member 3; an outside of the damping member 3 is covered with a second steel anti-
10 buckling member 2b; one end of the first steel anti-buckling member 2a and one end of the steel central axis force member 1 are fixed to each other; one end of the second steel anti-buckling member 2b and the other end of the steel central axis force member 1 are fixed to each
15 other; and the first steel anti-buckling member 2a and the second steel anti-buckling member 2b viscoelastically come into contact with each other via the damping member 3.

2. A damping structure having an elastoplastic/viscoelastic damper integrated therewith according to claim 1, wherein cross-sections of the steel
20 central axis force member 1, the first steel anti-buckling member 2a and the second steel anti-buckling member 2b are flat, and the damping member 3 is filled in
25 a space between the steel central axis force member 1 and the first steel anti-buckling member 2a and also filled in a space between the steel central axis force member 1 and the second steel anti-buckling member 2b in such a manner that the filled damping member 3 can be formed
30 flat.

3. A damping structure having an elastoplastic/viscoelastic damper integrated therewith according to claim 1, wherein cross-sections of the steel
35 central axis force member 1 and the first steel anti-buckling member 2a are flat, and the second steel anti-buckling member 2b, the cross-section of which is rectangular, is arranged in a space between the steel



central axis force member 1 and the first steel anti-buckling member 2a and also filled the damping member 3 in the space.

4. A damping structure having an
5 elastoplastic/viscoelastic damper integrated therewith according to claim 2 or 3, wherein steel members, the cross-section of which is a cross, are fixed to both end portions of steel central axis force member 1.

5. A damping structure having an
10 elastoplastic/viscoelastic damper integrated therewith according to one of claims 1 or 4, wherein steel plates are respectively fixed to end portions of the steel central axis force member 1 and the first steel anti-buckling member 2a, the other end portion of the steel
15 central axis force member 1, and the second steel anti-buckling member 2b.

6. A damping structure having an
elastoplastic/viscoelastic damper integrated therewith according to one of claims 1 or 5, wherein the second
20 steel anti-buckling member 2b is covered with the damping member 3, and an outside of the damping member 3 is covered with the third steel anti-buckling member 2c.

