

DESCRIPTION

Title of Invention

CONNECTION STRUCTURE OF COLUMN AND HORIZONTAL MEMBER AND CONNECTING MEMBER

Technical Field

[0001] The present invention relates to a connection structure of a column and a horizontal member and a connecting member.

Background Art

[0002] Patent Literature 1 discloses a traditional connection structure of a column and a horizontal member. A connection structure of the column and a beam described in Patent Literature 1 includes the beam attached between a plurality of columns. The beam is supported by the columns at both ends in a longitudinal direction of the beam, thereby configuring a so-called simple beam.

[0003] By the way, the beam may externally receive downward force from, for example, snow accumulated on a roof of a building described in Patent Literature 1. In this case, the beam described in Patent Literature 1 deflects, and the amount of deflection is desirably further reduced.

Citation List

Patent Literature

[0004] Patent Literature 1: JP 2017-115307 A

Summary of Invention

[0005] In view of the foregoing, it is an object of the present invention to provide a connection structure of a column and a horizontal member and a connecting member, wherein the connection structure and the connecting member are configured to reduce the amount of deflection of the horizontal member.

[0006] A connection structure of column and horizontal member according to one aspect of the

present invention is a connection structure including a column, a horizontal member on an upper end surface of the column, and a connecting member connecting the column and the horizontal member to each other. The connecting member includes at least one first attachment part, a counter part, and at least one second attachment part. The at least one first attachment part faces a side surface of the column and is attached to the side surface. The counter part is provided to the at least one first attachment part and faces a lower surface of the horizontal member. The at least one second attachment part is provided to the counter part, faces a side surface of the horizontal member, and is attached to the side surface of the horizontal member.

[0007] A connecting member of one aspect according to the present invention is configured to fix, to a column, a horizontal member on an upper end surface of the column. The connecting member includes at least one first attachment part, a counter part, and at least one second attachment part. The at least one first attachment part faces a side surface of the column and is attached to the side surface. The counter part is provided to the at least one first attachment part and faces a lower surface of the horizontal member. The at least one second attachment part is provided to the counter part, faces a side surface of the horizontal member, and is attached to the side surface of the horizontal member.

[0008] The connection structure of the column and the horizontal member and the connecting member of the aspects according to the present invention have the advantage that the amount of deflection of the horizontal member can be reduced.

Brief Description of Drawings

[0009] FIG. 1 is a perspective view illustrating a building of an embodiment of the present invention;

FIG. 2 is a layout of the building;

FIG. 3 is a sectional view illustrating a foundation of the building;

FIG. 4A is a vertical sectional view illustrating portions of the foundation and portions of a roof of the building;

FIG. 4B is an enlarged view illustrating part D of FIG. 4;

FIG. 5 is a plan view illustrating a beam of the building;

FIG. 6A is a perspective view illustrating part A of FIG. 5;

FIG. 6B is a side view of FIG. 6A;

FIG. 6C is a perspective view illustrating a first joint member;

FIG. 7A is a perspective view illustrating part B of FIG. 5;

FIG. 7B is a side view of FIG. 7A;

FIG. 7C is a perspective view illustrating a first connecting member;

FIG. 8A is a perspective view illustrating part C of FIG. 5;

FIG. 8B is a side view of FIG. 8A;

FIG. 8C is a perspective view illustrating a second connecting member;

FIG. 8D is a perspective view illustrating a small beam receiving member;

FIG. 9 is a horizontal sectional view illustrating an external corner of the building;

FIG. 10 is a perspective view illustrating a wall panel of the building;

FIG. 11 is a vertical sectional view illustrating an end in a lateral direction of the roof;

FIG. 12 is a perspective view illustrating a variation of a connecting member;

FIG. 13A is a plan view illustrating a beam of a variation; and

FIG. 13B is a plan view illustrating a beam of another variation.

Description of Embodiments

[0010] (1) Embodiment

(1.1) Schema

A connection structure of a column 4 and a horizontal member 5 according to the present embodiment is a structure relating to a continuous beam and is a connection structure at an intermediate supporting point of a plurality of supporting points of the horizontal member 5. As used herein, the “intermediate supporting point” means at least one supporting point of a plurality of supporting points at which the horizontal member 5 is supported except for supporting points at endmost locations in a longitudinal direction of the horizontal member 5, and the “intermediate supporting point” may include one or a plurality of intermediate supporting points. As illustrated in FIG. 8A, the connection structure of the column 4 and the horizontal member 5 includes the column 4, the horizontal member 5, and a connecting member 7.

[0011] The connecting member 7 is a member connecting the column 4 and the horizontal member 5 on an upper end surface of the column 4 to each other. As illustrated in FIG. 8C, the connecting member 7 has a first attachment part 73, a counter part 74, and a second attachment part 75. The first attachment part 73 faces a side surface of the column 4 and is attached to the side surface. The counter part 74 is provided to the first attachment part 73 and faces a lower surface of the horizontal member 5. The second attachment part 75 is provided to the counter part 74 and faces a side surface of the horizontal member 5. The second attachment part 75 is

attached to the side surface of the horizontal member 5.

[0012] Thus, the connection structure of the column 4 and the horizontal member 5 according to the present embodiment enables the amount of deflection of the horizontal member 5 to be reduced by configuring the horizontal member 5 to have a structure relating to a continuous beam as compared to a structure including a plurality of simple beams connected to each other. In addition, the present embodiment enables the connecting member 7 to fix the column 4 at the intermediate supporting point and the horizontal member 5 to each other, thereby suppressing the horizontal member 5 from falling from the upper end surface of the column 4.

[0013] (1.2) Details

The connection structure of the column 4 and the horizontal member 5 according to the present embodiment will be described in detail below. In the present disclosure, a downslope direction of a roof 9 is defined as a “flow direction”, an upper end in the flow direction is defined as an “upstream side”, and a lower end in the flow direction is defined as an “downstream side” as illustrated in FIG. 1. Moreover, a direction orthogonal to the flow direction is defined as a “lateral direction”.

[0014] FIG. 1 is an overall view illustrating a building 1 to which the connection structure of the column 4 and the horizontal member 5 of the present embodiment is applied. The building 1 according to the present embodiment is a plant factory, is relatively large-scale, has a rectangular shape having 10 m or more on a side, for example, when viewed from above (hereinafter referred to as “in plan view”), and has a building area of 120 m² or more.

[0015] In the present disclosure, however, the building 1 does not have to be the plant factory but may be, for example, a non-dwelling building such as a retail establishment, a warehouse, a fabrication plant, a meeting room, or a dwelling building. Moreover, in the present disclosure, the building may have a building area of 120 m² or smaller. Moreover, in the present embodiment, the building 1 is a flat building but may be a two-or-more-story building.

[0016] As illustrated in FIG. 2, the building 1 includes a partition wall 26 in the present embodiment. The partition wall 26 is a wall that partitions the interior of the building 1. The interior of the building 1 is divided by the partition wall 26 into a plant cultivation room 20 and a plurality of rooms other than the plant cultivation room 20. In the present embodiment, the partition wall 26 includes a plurality of sandwich panels.

[0017] The plant cultivation room 20 is a room in which a plurality of cultivation shelves 201 are installed. On the cultivation shelves 201, containers in which plants are planted are placed. The containers placed on the cultivation shelves 201 are aquariums for hydroponic culture in the

present embodiment but may be terrariums for soil culture. Each cultivation shelf 201 according to the present embodiment has an LED lamp attached thereto and configured to emit light to the plants. The light emitted from the LED lamps can effectively cultivate the plants in the cultivation shelves 201 according to the present embodiment. In the present embodiment, the plant cultivation room 20 has no lighting window.

[0018] The building 1 includes a plurality of rooms other than the plant cultivation room 20 (the rooms other than the plant cultivation room 20 are hereinafter referred to as a “plurality of rooms”). In the present embodiment, the plurality of rooms are a changing room 21, an air shower room 22, a front room 23 (a preparation room), and a machine room 24 (administrative room). The changing room 21 is communicated with an exit/entrance 25. The front room 23 is communicated with the plant cultivation room 20 and the changing room 21. In the present embodiment, the total area of the plurality of rooms is smaller than the area of the plant cultivation room 20.

[0019] The building 1 is installed on a foundation 3. As illustrated in FIG. 3, the foundation 3 according to the present embodiment is a so-called mat foundation and includes a plurality of planar parts 31 and rising parts 32 rising from respective outer peripheries of the planar parts 31. The plurality of planar parts 31 correspond to the plant cultivation room 20 and the plurality of rooms. However, in the present disclosure, the foundation 3 is not limited to the mat foundation but may be, for example, a continuous footing.

[0020] In the present embodiment, the building 1 includes a plurality of bases 33 fixed to the foundation 3, a plurality of columns 4, a plurality of horizontal members 5 (FIG. 4A), an outer wall 8 (FIG. 4A), and the roof 9 (FIG. 4A).

[0021] As illustrated in FIG. 4A, each base 33 has a lower surface facing an upper end surface of a corresponding one of the rising parts 32 and is on the corresponding one of the rising parts 32. Each base 33 has a longitudinal direction along a horizontal plane. In the present embodiment, each base 33 has a surface facing in an indoor direction (a surface 331 on an indoor side), the surface being located on the same plane as a surface facing in the indoor direction (a surface 321 on the indoor side) of the corresponding one of the rising parts 32. Each base 33 has a surface facing in an outdoor direction (a surface 332 on an outdoor side), the surface being located on the indoor side of a surface (a surface 322 on the outdoor side) facing in the outdoor direction of the rising part 32.

[0022] Here, the “indoor direction” mentioned in the present disclosure means a direction viewed from an arbitrary outdoor location toward an arbitrary indoor location, the indoor

direction being orthogonal to the outer wall 8. Moreover, the “outdoor direction” means a direction opposite to the indoor direction.

[0023] In the present embodiment, the bases 33 are made of metal. Examples of each base 33 include a carbon steel square or rectangular tube for general structures, a steel channel, and a steel H-beam. Note that in the present disclosure, the bases 33 are not necessarily made of metal but may be made of wood.

[0024] The outer wall 8 includes wall panels 80 having respective lower ends attached to the surfaces 332 on the outdoor side of the bases 33 with fixing members such as drill screws. This fixes the lower ends of the wall panels 80 to the bases 33. The fixing members penetrate, in the indoor direction, the lower ends of the wall panels 80 from surfaces (outer wall surfaces) facing in the outdoor direction of the wall panels 80 and are driven into the bases 33.

[0025] Between the base 33 and the wall panels 80, a panel receiving member 34 and a base water drip 35 are attached. The panel receiving member 34 has an L-shape and supports lower end faces of the wall panels 80. The base water drip 35 is attached between the panel receiving member 34 and the base 33. The panel receiving member 34 and the base water drip 35 are attached to the base 33 with fixing members.

[0026] Each column 4 supports the horizontal member 5 (in this embodiment, a beam 50). Each column 4 has a longitudinal direction parallel to the upward/downward direction. In the present embodiment, each column 4 has a rectangular cross section, is specifically a carbon steel square or rectangular tube for general structures, and is made of metal. However, in the present disclosure, each column 4 may be a steel channel, a steel H-beam, or the like. Each column 4 does not have to be made of metal but may be squared timber or the like.

[0027] Of the plurality of columns 4, columns 4 corresponding to the rising parts 32 are attached to upper surfaces of the bases 33 with fixing members as illustrated in FIG. 3. Moreover, of the plurality of columns 4, columns 4 corresponding to the planar parts 31 are attached to upper surfaces of the planar parts 31 with fixing members such as anchor bolts or the like. In the present disclosure, the columns 4 is attached to the upper surfaces of the bases 33 may be attached to the bases 33 by welding.

[0028] As illustrated in FIG. 5, the plurality of columns 4 include columns (second columns 4b) that support ends in the longitudinal direction of each horizontal member 5 and columns (first columns 4a) that support an intermediate portion in the longitudinal direction of each horizontal member 5. In the present embodiment, the second columns 4b are arranged at four corners of the building 1. Each second column 4b has an upper end located at a higher level

than an upper end of each first column 4a, that is, each second column 4b is taller than each first column 4a.

[0029] As illustrated in FIG. 4A, each horizontal member 5 is a member having a longitudinal direction along the horizontal plane. In the present embodiment, the horizontal member 5 is the beam 50. The “beam 50” mentioned in the present disclosure means a horizontal member that supports the weight of the roof 9 and the like and includes a girder. In the present embodiment, the beam 50 has a rectangular cross section, is specifically a carbon steel square or rectangular tube for general structures, and is made of metal. However, in the present disclosure, the beam 50 may be a steel channel, a steel H-beam, or the like. The column 4 does not have to be made of metal but may be squared timber or the like. Here, FIG. 5 is a plan view illustrating a plurality of beams 50. The building 1 according to the present embodiment includes a plurality of large beams 51 and a plurality of small beams 54 as the plurality of beams 50.

[0030] Each large beam 51 is a beam 50 supported by at least one column 4. In the present embodiment, each large beam 51 has both ends in a longitudinal direction thereof which are supported by the columns 4 (the second columns 4b) or the large beams 51, and each large beam 51 has an intermediate portion in the longitudinal direction which is supported by one or a plurality of columns 4 (the first columns 4a). In sum, the large beams 51 according to the present embodiment form a continuous beam. In the present embodiment, the large beams 51 include a plurality of first beams 52 forming an outer perimeter in plan view and a plurality of second beams 53 disposed on an inner side of the first beams 52.

[0031] Here, “supported” mentioned in the present disclosure includes that an object is directly supported, and in addition, that an object is indirectly supported via another member. For example, the first beam 52 is attached to the column 4 with a first joint member 61, and this structure is included in that the first beam 52 is supported by the column 4.

[0032] Each first beam 52 is a continuous beam which is continuous from one end to the other end of the building 1, wherein both ends in a longitudinal direction of each first beam 52 are supported by columns 4, and at least one part of an intermediate portion of each first beam 52 is supported by a column 4. The plurality of first beams 52 form a rectangular frame shape in plan view. As illustrated in FIG. 6A, the first beam 52 has an end in the longitudinal direction which is attached to a side surfaces of the column 4 with a joint member 6. In the following description, the joint member 6 attached to the side surface of the column 4 is referred to as the “first joint member 61”.

[0033] The first joint member 61 connects the end in the longitudinal direction of the horizontal

member 5 (here, the first beam 52) to an attachment surface (in this embodiment, the side surface of the column 4). In the present embodiment, the first joint member 61 is formed by bending a metal sheet. Note that in the present disclosure, the first joint member 61 may be formed by welding elements. Examples of a material for the first joint member 61 include a steel sheet, or a metal sheet made of, for example, steel, iron, or titanium, or alternatively, the first joint member 61 may be made of a synthetic resin or the like. As illustrated in FIG. 6C, the first joint member 61 in the present embodiment has a fixing part 63, a reception part 64, and a beam attachment part 65.

[0034] The fixing part 63 is a part attached to the attachment surface (in the present embodiment, the side surface of the column 4). The fixing part 63 has a flat plate shape and has one side surface facing the side surface of the column 4. Moreover, the other side surface of the fixing part 63 faces an end surface in a longitudinal direction of the beam 50. In the present embodiment, the fixing part 63 has a plurality of through holes. The fixing part 63 is fixed to the side surface of the column 4 with fixing members such as screws, nails, or bolts.

[0035] The reception part 64 is a part which receives the beam 50. The reception part 64 is provided to a lower end of the fixing part 63. The reception part 64 has a flat plate shape and has an upper surface facing a lower surface of the column 4. The reception part 64 is orthogonal to the fixing part 63. As illustrated in FIG. 6B, a surface (an outdoor-side surface 641) facing in the outdoor direction of the reception part 64 and a surface (an outdoor-side surface 631) facing in the outdoor direction of the fixing part 63 are located on the same plane and are disposed to be flush an outdoor-side surface of the column 4.

[0036] The beam attachment part 65 is a part attached to a surface (an indoor-side surface 520) facing in the indoor direction of the beam 50. The beam attachment part 65 is provided to an indoor-side end of the fixing part 63. The beam attachment part 65 has a flat plate shape having one side surface facing the indoor-side surface 520 of the beam 50. The beam attachment part 65 is continuous to the indoor-side end of the fixing part 63 and is configured to, when receiving a load from the beam 50, directly transmit the load to the fixing part 63. In the present embodiment, the beam attachment part 65 has a plurality of (in the present embodiment, four) through holes. The beam attachment part 65 is attached to the indoor-side surface 520 of the beam 50 with fixing members such as screws, nails, or bolts. The number of through holes is preferably equal to the number of through holes in the fixing part.

[0037] Here, “orthogonal” mentioned in the present disclosure not only means a case where two flat surfaces (or, a flat surface and a straight line, or two straight lines) form 90°

therebetween in a strict sense but also includes an architecturally acceptable range. As mentioned in the present disclosure, an “orthogonal” range may include, for example, a range of $\pm 5^\circ$ from 90° . In the present embodiment, the reception part 64 and the fixing part 63 are preferably orthogonal to each other within a range of $\pm 1^\circ$ from 90° .

[0038] As illustrated in FIG. 6B, attaching the first beam 52 to the first joint member 61 attached to the side surface of the column 4 makes an outdoor-side surface 521 of the first beam 52 flush with the outdoor-side surface (41) of the column 4. Moreover, the first beam 52 has an upper surface flush with the upper end surface of the column 4.

[0039] As mentioned in the present disclosure, “flush” means that two flat surfaces are considered to be at the same plane. For example, “flush” mentioned in the present disclosure refers to a case where two flat surfaces have a level difference of 2 mm or less therebetween and also to a case where a gap of about 5 mm is formed between the two flat surfaces.

[0040] As illustrated in FIG. 5, the first beam 52 has at least one part (in the present embodiment, a plurality of parts) of the intermediate portion in the longitudinal direction, the at least one part being on the upper end surface of the column 4 (the first column 4a). As illustrated in FIG. 7A, the intermediate portion (e.g., B portion of FIG. 5) of the first beam 52 is on the upper end surface of the column 4 (the first column 4a) and is attached to the column 4 (the first column 4a) with the connecting member 7.

[0041] The connecting member 7 connects the column 4 (the first column 4a) to the horizontal member 5 (in the present embodiment, the first beam 52) and fixes the horizontal member 5 to the column 4. More specifically, the connecting member 7 connects the column 4 and the horizontal member 5 to each other with the horizontal member 5 being on the upper end surface of the column 4. As illustrated in FIG. 7C, the connecting member 7 in the present embodiment is formed by bending a metal sheet. Note that in the present disclosure, the connecting member 7 may be formed by welding elements. Examples of a material for the connecting member 7 include a steel sheet, or a metal sheet made of, for example, steel, iron, or titanium, or alternatively, the first joint member 61 may be made of a synthetic resin or the like. The building 1 according to the present embodiment includes two types of connecting members 7: a first connecting member 71 and a second connecting member 72 which are distinguished from each other.

[0042] The first connecting member 71 is a connecting member 7 that connects the intermediate portion of the first beam 52 and the column 4 (the first column 4a) to each other. The second connecting member 72 is a connecting member 7 that connects an intermediate

portion of the second beam 53 and the column 4 to each other, which will be described later. As illustrated in FIG. 7C, the first connecting member 71 has a first attachment part 73, a counter part 74, and a second attachment part 75.

[0043] The first attachment part 73 is a part attached to the side surface of the column 4. The first attachment part 73 has a flat plate shape and has one side surface facing the side surface of the column 4. Moreover, the first attachment part 73 is located under the beam 50. In the present embodiment, the first attachment part 73 has a plurality of through holes. The first attachment part 73 is fixed to the side surface of the column 4 with fixing members such as screws, nails, or bolts.

[0044] As illustrated in FIG. 7A, the counter part 74 is a part that receives the beam 50. The counter part 74 is provided to an upper end of the first attachment part 73. The counter part 74 has a flat plate shape and has an upper surface facing a lower surface of the beam 50. The counter part 74 is orthogonal to the first attachment part 73. As illustrated in FIG. 7B, a surface (an outdoor-side surface 741) facing in the outdoor direction of the counter part 74 and a surface (an outdoor-side surface 731) facing in the outdoor direction of the first attachment part 73 are located on the same plane and are disposed to be flush with the outdoor-side surface of the column 4.

[0045] As illustrated in FIG. 7A, the second attachment part 75 is a part attached to a side surface of the beam 50 (the first beam 52) and is specifically attached to the indoor-side surface 520 of the beam 50. The second attachment part 75 is provided to an indoor-side end of the counter part 74. The second attachment part 75 has a flat plate shape having one side surface facing the indoor-side surface 520 of the beam 50. The second attachment part 75 is orthogonal to the counter part 74. In the present embodiment, the second attachment part 75 has a plurality of through holes. The second attachment part 75 is attached to the indoor-side surface 520 of the beam 50 with fixing members such as screws, nails, or bolts.

[0046] Each second beam 53 is a continuous beam, wherein both ends in a longitudinal direction of each second beam 53 are supported by the first beams 52, and at least one part (in the present embodiment, two parts) of an intermediate portion of each second beam 53 is supported. The second beam 53 has an end in the longitudinal direction which is attached to a side surface of the first beam 52 with the joint member 6. In the following description, the joint member 6 attached to the side surface of the first beam 52 is referred to as a “second joint member 62”.

[0047] As illustrated in FIG. 7A, the second joint member 62 connects the end in the

longitudinal direction of the horizontal member 5 (in the present embodiment, the second beam 53) to an attachment surface (in the present embodiment, the indoor-side surface 520 of the first beam 52). In the present embodiment, the second joint member 62 is formed by bending a metal sheet. Note that in the present disclosure, the second joint member 62 may be formed by welding elements. Examples of a material for the second joint member 62 include a steel sheet, or a metal sheet made of, for example, steel, iron, or titanium, or alternatively, the second joint member 62 may be made of a synthetic resin or the like. In the present embodiment, the second joint member 62 has a fixing part 630 and a pair of beam attachment parts 650 and has a C-shape in plan view.

[0048] The fixing part 630 is a part attached to the attachment surface (in the present embodiment, the indoor-side surface 520 of the first beam 52). The fixing part 630 has a flat plate shape and has one side surface facing the side surface of the first beam 52. Moreover, the other side surface of the fixing part 630 faces an end surface in the longitudinal direction of the second beam 53. In the present embodiment, the fixing part 630 has a plurality of (in the present embodiment, two) through holes. The fixing part 630 is fixed to the side surface of the first beam 52 with fixing members such as screws, nails, or bolts.

[0049] The beam attachment parts 650 are parts attached to side surfaces of the second beam 53. The beam attachment parts 650 are provided to ends in a width direction of the fixing part 630. Each beam attachment part 650 has a flat plate shape and has one side surface facing a corresponding one of the side surfaces of the second beam 53. In the present embodiment, each beam attachment part 650 has a plurality of (in the present embodiment, four) through holes. The beam attachment part 65 is attached to the side surfaces of the second beam 53 with fixing members such as screws, nails, or bolts.

[0050] Attaching the second beam 53 to the second joint member 62 attached to the side surface of the first beam 52 makes an upper surface of the second beam 53 flush with the upper surface of the first beam 52.

[0051] As illustrated in FIG. 5, the second beam 53 has at least one part (in the present embodiment, a plurality of parts) of the intermediate portion in the longitudinal direction, the at least one part being on the upper end surface of the column 4. As illustrated in FIG. 8A, the intermediate portion (e.g., part C of FIG. 5) of the second beam 53 is on the upper end surface of the column 4 and is attached to the column 4 with the second connecting member 72. As illustrated in FIG. 8C, the second connecting member 72 has a first attachment part 73, a counter part 74, and a pair of second attachment parts 75. The first attachment part 73 and the counter

part 74 of the second connecting member 72 have the same configurations as those of the first connecting member 71. In the present embodiment, the second attachment parts 75 which are different from the first connecting member 71 will be mainly described.

[0052] As illustrated in FIG. 8A, the pair of second attachment parts 75 are parts attached to both side surfaces of the beam 50 (the second beam 53). The pair of second attachment parts 75 are attached to the pair of side surfaces of the second beam 53 on a one-to-one basis. The second attachment parts 75 are provided to respective ends in a width direction of the counter part 74 (a direction orthogonal to the longitudinal direction of the second beam 53 and along the horizontal plane). Each second attachment part 75 has a flat plate shape and has one side surface facing a corresponding one of side surfaces of the second beam 53. Each second attachment part 75 is orthogonal to the counter part 74. In the present embodiment, the second attachment part 75 has a plurality of through holes. The second attachment parts 75 are attached to the side surfaces of the beam 50 with fixing members such as screws, nails, or bolts.

[0053] As illustrated in FIG. 5, the plurality of small beams 54 are beams 50 extending over a pair of large beams 51 parallel to each other. Each small beam 54 has a longitudinal direction orthogonal to the longitudinal direction of the second beam 53. As illustrated in FIG. 8A, each small beam 54 is attached to the second beam 53 with a small beam receiving member 66.

[0054] The small beam receiving member 66 connects an end in the longitudinal direction of the small beam 54 to the side surface of the second beam 53. In the present embodiment, the small beam receiving member 66 is formed by bending a metal sheet. Note that in the present disclosure, the small beam receiving member 66 may be formed by welding elements. Examples of a material for the small beam receiving member 66 include a steel sheet, or a metal sheet made of, for example, steel, iron, or titanium, or alternatively, the small beam receiving member 66 may be made of a synthetic resin or the like. As illustrated in FIG. 8D, the small beam receiving member 66 has a fixing plate 661, a backup plate 662, and a pair of attachment plates 663.

[0055] The fixing plate 661 is attached to the side surface of the second beam 53. The fixing plate 661 has a flat plate shape having one side surface facing the side surface of the second beam 53. Moreover, the other side surface of the fixing plate 661 faces the end surface in the longitudinal direction of the small beam 54. In the present embodiment, the fixing plate 661 has a plurality of through holes. The fixing plate 661 is fixed to the side surface of the second beam 53 with fixing members such as screws, nails, or bolts.

[0056] As illustrated in FIG. 8A, the backup plate 662 receives the small beam 54. The

backup plate 662 is provided to a lower end of the fixing plate 661. The backup plate 662 has a flat plate shape and has an upper surface facing a lower surface of the small beam 54. The backup plate 662 is orthogonal to the fixing plate 661 and the attachment plates 663.

[0057] The attachment plates 663 are attached to side surfaces of the small beam 54. The attachment plates 663 are provided to ends in a width direction of the fixing plate 661 and the backup plate 662. Each attachment plates 663 has a flat plate shape and has one side surface facing a corresponding one of the side surfaces of the small beam 54. In the present embodiment, the attachment plates 663 have a plurality of through holes. The attachment plates 663 are attached to the side surfaces of the small beam 54 with fixing members such as screws, nails, or bolts.

[0058] The attachment plates 663 are continuous to the ends in the width direction of the fixing plate 661 and are configured to, when receiving a load from the small beam 54, directly transmit the load to the fixing plate 661.

[0059] As illustrated in FIG. 1, the outer wall 8 is a wall forming the outer perimeter of the building 1. In the present embodiment, the outer wall 8 includes the plurality of wall panels 80. The plurality of wall panels 80 of the outer wall 8 according to the present embodiment are installed by vertical paneling work. Note that in the present disclosure, the outer wall 8 may include a plurality of wall panels 80 installed by horizontal paneling work. In the present embodiment, each wall panel 80 is a bearing wall.

[0060] As illustrated in FIG. 4A, each wall panel 80 is attached to extend from an outer side surface of the beam 50 to an outer side surface of the base 33 with fixing members such as drill screws or the like. In the present embodiment, the wall panels 80 are provided with an eaves gutter 86 attached to upper ends thereof. Here, FIG. 9 shows a horizontal sectional view illustrating an external corner of the building 1. As illustrated in FIG. 9, each wall panel 80 is attached to an outer side surface of the column 4 with fixing members such as drill screws or the like. In sum, each wall panel 80 is attached to the outer side surface of the horizontal member 5, the outer side surface of the base 33, and the outdoor-side surface of the column 4 and thus readily acts as a structure member that transmits a horizontal load.

[0061] Note that between the column 4 and an external corner closing member 87, the wall panel 80 is provided. The external corner closing member 87 includes an underlayer member 871 and an external corner member 872. The underlayer member 871 is attached to an outer surface of a corner formed between the wall panels 80 adjacent to each other. The external corner member 872 is attached to the underlayer member 871. Between each end of the

external corner member 872 and the outer surface of a corresponding one of the wall panels 80, a sealing material 873 is provided.

[0062] As illustrated in FIG. 10, each wall panel 80 in the present embodiment is a sandwich panel. Each wall panel 80 has an engagement projection 81 at one end in a width direction of each wall panel 80 and an engagement recess 82 at the other end in the width direction. Sandwich panels adjacent to each other are paired by fitting the engagement projection 81 of one of the sandwich panels in the engagement recess 82 formed in the other of the sandwich panels.

[0063] Each wall panel 80 is a panel including a pair of metal skins 83 and 84 and a core member 85 sandwiched between the pair of metal skins 83 and 84. In the present embodiment, each wall panel 80 includes a front side metal skin 83, a back side metal skin 84, and the core member 85.

[0064] In the present embodiment, each of the front side metal skin 83 and the back side metal skin 84 has a flat plate shape. The front side metal skin 83 and the back side metal skin 84 are molded products of a metal sheet and are formed by roll-forming of, for example, the metal sheet. Examples of the metal sheet include a steel sheet, a stainless-steel sheet, a galvanized steel sheet, a coated steel sheet, a Galvalume steel sheet (registered trademark), and an SGL (registered trademark) steel sheet. The metal sheet preferably has a thickness of 0.2 mm to 2.0 mm.

[0065] The core member 85 has thermal insulation properties and incombustibility. As used herein, the term “thermal insulation properties” means thermal insulation properties of such an extent as to pass a prescribed thermal insulation test. Moreover, the term “incombustibility” means incombustibility of such an extent as to pass a prescribed incombustibility test. In the present embodiment, the core member 85 is made of an inorganic fiber material such as rock wool or glass wool. However, in the present disclosure, the core member 85 may be resin foam such as urethane foam or phenol foam, or a composite member obtained by combining a plate material such as a plasterboard, a calcium silicate board, or the like and an inorganic fiber material or resin foam. The core member 85 according to the present disclosure may be formed by, for example, layering a plate material and an inorganic fiber material or resin foam. The core member 85 preferably has a thickness of 10 mm to 100 mm.

[0066] The wall panels 80 are in general classified as non-structure members (non-bearing members), but in the present embodiment, the wall panels 80 function as structure members that transmit a horizontal load acting on the building 1 between the column 4 and the beam 50.

[0067] FIG. 11 shows a sectional view illustrating an end in the lateral direction of the building

1. The wall panel 80 has an upper end attached to an outdoor-side surface of the beam 50 with fixing members such as drill screws. The beam 50 has an upper surface facing a lower surface of a roof panel 91 forming the roof 9. A space between the roof panel 91 and the wall panel 80 is covered with a closing member 94. The closing member 94 has a water drip 93 on an outer side thereof.

[0068] As illustrated in FIG. 1, the roof 9 includes a plurality of roof panels 91 and a waterproof sheet 92 covering the plurality of roof panels 91. In the present embodiment, each of the plurality of roof panels 91 has the same structure as the sandwich panel (the wall panel 80) described above. The roof panel 91 is disposed to have a width direction parallel to the flow direction and a length direction parallel to the lateral direction.

[0069] In the building 1 having such a configuration, the horizontal member 5 has a structure relating to a continuous beam, and therefore, the amount of deflection of the horizontal member 5 between the columns 4 to be reduced as compared to a structure including a plurality of simple beams connected to each other. In addition, the present embodiment enables the connecting member 7 to fix the column 4 at the intermediate supporting point and the horizontal member 5 to each other, thereby suppressing the beam 50 from falling from the upper end surface of the column 4.

[0070] (2) Variations

Note that the embodiment described above is only one of various embodiments of the present disclosure and should not be construed as limiting. Various modifications may be made to the embodiment depending on design and the like as long as the object of the present disclosure is achieved. Variations of the embodiment will be described below. Note that the variations to be described below may be adopted in combination as appropriate.

[0071] In the embodiment described above, the connecting member 7 includes a single first attachment part 73, but in the present disclosure, the connecting member 7 may include a plurality of (in this variation, two) first attachment parts 73 as illustrated in FIG. 12. In this case, each of the plurality of first attachment parts 73 faces a side surface of the column 4 and is attached to the side surface. The counter part 74 is on the upper end surface of the column 4.

[0072] The embodiment described above includes beams (the first beams 52) as the large beams 51 forming an outer perimeter in plan view and the plurality of second beams 53 disposed on inner side of the first beams 52, but the embodiment may have a configuration as shown in FIG. 13A. The variation shown in FIG. 13A includes a plurality of large beams 52a as horizontal members 5 extending along the lateral direction and a plurality of small beams 54

connecting the large beams 52a to each other. Each small beam 54 has a longitudinal direction along the flow direction in plan view. Each large beam 52a has both ends attached to second columns 4b. Each large beam 52a has an intermediate part in a longitudinal direction of each large beam 52a, and the intermediate part is on an upper end surface of a first column 4a. In sum, each large beam 52a according to the present variation is three-point support beam and is a two-span continuous beam. Alternatively, as illustrated in FIG. 13B, each large beam 52a may be a four-point support beam and a three-span continuous beam. That is, the connection structure of the column 4 and the horizontal member 5 according to the present disclosure may include a plurality of columns 4 (4a) on which the horizontal member 5 is placed.

[0073] In the embodiment described above, the horizontal member 5 is the beam 50, but the horizontal member 5 of the present disclosure may be a girt and is not limited to the beam 50.

[0074] In the embodiment described above, the counter part 74 is not attached to the horizontal member 5, but in the present disclosure, the counter part 74 may be fixed to the horizontal member 5 with a fixing member.

[0075] (3) Aspects

As described above, a connection structure of column (4) and horizontal member (5) of a first aspect is a connection structure including a column (4), a horizontal member (5) on an upper end surface of the column (4), and a connecting member (7) connecting the column (4) and the horizontal member (5) to each other. The connecting member (7) includes at least one first attachment part (73), a counter part (74), and at least one second attachment part (75). The at least one first attachment part (73) faces a side surface of the column (4) and is attached to the side surface. The counter part (74) is provided to the at least one first attachment part (73) and faces a lower surface of the horizontal member (5). The at least one second attachment part (75) is provided to the counter part (74), faces a side surface of the horizontal member (5), and is attached to the side surface of the horizontal member (5).

[0076] This aspect enables the amount of deflection of the horizontal member (5) to be reduced by configuring the horizontal member (5) to have a structure relating to a continuous beam as compared to a structure including a plurality of simple beams connected to each other. In addition, this aspect enables the connecting member (7) to fix the column (4) at an intermediate supporting point and the horizontal member (5) to each other, thereby suppressing the horizontal member (5) from falling from the upper end surface of the column (4).

[0077] A connection structure of column (4) and horizontal member (5) of a second aspect referring to the first aspect further including the at least one second attachment part (75) includes

a pair of second attachment parts (75). The pair of second attachment parts (75) are attached to a pair of the side surfaces of the horizontal member (5) on a one-to-one basis.

[0078] This aspect enables the horizontal member (5) to be further suppressed from being displaced from the column (4).

[0079] In a connection structure of column (4) and horizontal member (5) of a third aspect referring to the first or second aspect, the at least one first attachment part (73) is orthogonal to the counter part (74).

[0080] This aspect enables manufacturing of the connecting member (7) to be facilitated, and in addition, enables positioning of the connecting member (7) to be performed by bringing a corner formed between the at least one first attachment part (73) and the counter part (74) into contact with an inner corner formed between the column (4) and the horizontal member (5), and thus enables attaching of the connecting member (7) to be further facilitated.

[0081] In a connection structure of column (4) and horizontal member (5) of a fourth aspect referring to any one of the first to third aspects, the counter part (74) is orthogonal to the at least one second attachment part (75).

[0082] With this aspect, placing the counter part (74) along the lower surface of the horizontal member (5) makes the at least one second attachment part (75) face a side surface of the horizontal member (5). Thus, positioning of the second attachment part (75) is easy, and attaching of the connecting member (7) can be facilitated.

[0083] In a connection structure of column (4) and horizontal member (5) of a fifth aspect referring to any one of the first to fourth aspects, the horizontal member (5) is a beam (50).

[0084] This aspect enables the connecting member (7) to be applied to a connection structure of the column (4) and the beam (50).

[0085] A connection structure of column (4) and horizontal member (5) of a sixth aspect referring to any one of the first to fifth aspects further includes a second column (4b) and a joint member (6). The second column (4b) is apart from a first column (4a) as the column (4) and is taller than the first column (4a). The joint member (6) is attached to a side surface of the second column (4b) and supports an end in a longitudinal direction of the horizontal member (5). The second column (4b) has an outdoor-side surface (41) flush with an outdoor-side surface (521) of the horizontal member (5).

[0086] With this aspect, the outdoor-side surface (41) of the second column (4b) is flush with the outdoor-side surface (521) of the horizontal member (5), and therefore, a wall member such as a wall panel (80) is easily attached to extend from the second column (4b) to the horizontal

member (5).

[0087] A connection structure of column (4) and horizontal member (5) of a seventh aspect referring to any one of the first to sixth aspects, further includes a plurality of the columns (4), wherein the horizontal member (5) is on upper end surfaces of the plurality of columns (4).

[0088] This aspect enables the amount of deflection of a horizontal member (5) to be reduced even though the horizontal member (5) may have an increased length.

[0089] The connecting member (7) of an eighth aspect is a connecting member (7) configured to fix, to a column (4), a horizontal member (5) on an upper end surface of the column (4). The connecting member (7) includes at least one first attachment part (73), a counter part (74), and at least one second attachment part (75). The at least one first attachment part (73) faces a side surface of the column (4) and is attached to the side surface. The counter part (74) is provided to the at least one first attachment part (73) and faces a lower surface of the horizontal member (5). The at least one second attachment part (75) is provided to the counter part (74), faces a side surface of the horizontal member (5), and is attached to the side surface of the horizontal member (5).

[0090] This aspect enables a structure relating to a continuous beam to connect the horizontal member (5) and the column (4). This structure enables the connecting member (7) to fix the column (4) and the horizontal member (5) to each other, thereby suppressing the horizontal member (5) from falling from the upper end surface of the column (4).

[0091] The configurations according to the second to fifth aspects are not essential configurations for the connection structure of the column (4) and the horizontal member (5) and may accordingly be omitted.

Reference Signs List

[0092]	4	COLUMN
	4a	FIRST COLUMN
	4b	SECOND COLUMN
	41	OUTDOOR-SIDE SURFACE
	5	HORIZONTAL MEMBER
	50	BEAM
	521	OUTDOOR-SIDE SURFACE
	6	JOINT MEMBER
	7	CONNECTING MEMBER

- 73 FIRST ATTACHMENT PART
- 74 COUNTER PART
- 75 SECOND ATTACHMENT PART

CLAIMS

1. A connection structure of column and horizontal member, the connection structure comprising:

a plurality of columns;

a plurality of horizontal members each of which is disposed on an upper end surface of at least one of the plurality of columns; and

a plurality of connecting members each of which connects one of the plurality of columns and one of the plurality of horizontal members to each other,

the plurality of horizontal members including

a plurality of first beams forming an outer perimeter of a building, and

a plurality of second beams disposed in a region defined by the plurality of first beams,

each of the plurality of first beams being a continuous beam and disposed on upper end surface of at least one of the plurality of columns,

each of the plurality of second beams being a continuous beam and disposed on an upper end surface of at least one of the plurality of columns,

the connection structure further comprising a small beam extending over: one of the plurality of first beams and one of the plurality of second beams parallel to each other; or two of the plurality of second beams parallel to each other,

the plurality of connecting members including

a first connecting member that connects a first one column and a first one first beam, the first one column being one of the plurality of columns, the first one first beam being one of the plurality of first beams, and

a second connecting member that connects a second one column and a first one second beam, the second one column being one of the plurality of columns and being same as or different from the first one column, the first one second beam being one of the plurality of second beams,

the first connecting member having

a first attachment part facing a side surface of the first one column and attached to the side surface of the first one column,

a counter part provided to the at least one first attachment part and facing a lower surface of the first one first beam, and

a second attachment part provided to the counter part, facing an indoor side surface of the first one first beam, and attached to the indoor side surface of the first one first beam, the second connecting member having

one first attachment part facing a side surface of the second one column and attached to the side surface of the second one column,

a counter part provided to the first attachment part of the second connecting member and facing a lower surface of the first one second beam, and

a pair of second attachment parts provided to the counter part of the second connecting member, facing a pair of side surfaces of the first one second beam, and attached to the pair of side surfaces of the first one second beam on a one-to-one basis,

a second one second beam being attached to a side surface of a second one first beam with a joint member, the second one first beam being one of the plurality of first beams and being same as or different from the first one first beam, the second one second beam being one of the plurality of second beams and being same as or different from the first one second beam,

the joint member having

a fixing part fixed to an indoor side surface of the second one first beam, and

a beam attachment part attached to a side surface of the second one second beam,

an end in a longitudinal direction of the small beam being connected to a side surface of a third one second beam with a small beam receiving member, the third one second beam being one of the plurality of second beams and being same as or different from the first one second beam and/or the second one second beam,

the small beam receiving member having

a fixing plate attached to the side surface of the third one second beam,

a backup plate receiving the small beam, and

a pair of attachment plates attached to side surfaces of the small beam.

2. The connection structure of claim 1, wherein the first attachment part is orthogonal to the counter part.

3. The connection structure of claim 1 or 2, wherein
in each of the first connecting member and the second connecting member, the counter part is orthogonal to the second attachment part.
4. The connection structure of any one of claims 1 to 3, wherein
each of the plurality of columns is a first column,
the connection structure further comprises:
a second column taller than the first column, the second column being disposed to be apart from the first column;
a joint member attached to a side surface of the second column and supporting an end in a longitudinal direction of a third one first beam, the third one first beam being one of the plurality of first beams and being same as or different from the first one first beam and/or the second one first beam,
the second column has an outdoor-side surface flush with an outdoor-side surface of the third one first beam.