TITLE

WALL MEMBER JOINT STRUCTURE AND WALL MEMBER JOINING METHOD

TECHNICAL FIELD

[0001] The present disclosure relates to a wall member joint structure and a wall member joining method.

BACKGROUND

[0002] There has been known a technique of joining together concrete members. For example, Japanese Unexamined Patent Publication No. 2018-123644 discloses a technique of joining together end surfaces of precast concrete wall members.

[0003] In addition, Japanese Unexamined Patent Publication No. 2018-123644 discloses a technique of joining an end surface of a precast concrete wall member to a side surface of a precast concrete column member.

[0004] By the way, in recent years, a construction method called pre-fabricated pre-finished volumetric modular construction (PPVC) is performed. In the PPVC, for example, a building is constructed by manufacturing the frames and interiors of parts equivalent to rooms of a residence or the like as units at a factory, and transporting and piling (assembling) the units on top of each other at a work site. In the PPVC, it is necessary to join together wall surfaces of wall members of a pair of the assembled units at a required strength in a state where the wall surfaces of the wall members face each other. For this reason, there is desired a technique of joining together the wall surfaces of the pair of wall members at a desired strength.

SUMMARY

[0005] Hereupon, an object of the present disclosure is to provide a wall member joint structure and a wall member joining method in which wall surfaces of a pair of wall members are joined together at a desired strength.

[0006] According to an aspect of the present disclosure, there is provided a wall member joint structure comprising a first wall member having a first wall surface; a second wall member having a second wall surface facing the first wall surface; a first protrusion member having a first protrusion portion which has protruded from the first wall surface; a second protrusion member having a second protrusion portion which has protruded from the second wall surface; and a filling material with which a gap between the first wall surface and the second wall surface is filled.

[0007] According to this configuration, in the wall member joint structure comprising the first wall member having the first wall surface and the second wall member having the second wall surface facing the first wall surface, the first protrusion portion of the first protrusion member protrudes from the first wall surface, the second protrusion portion of the second protrusion member protrudes from the second wall surface, and the gap between the first wall surface from which the first protrusion portion protrudes and the second wall surface from which the second protrusion portion protrudes is filled with the filling material. For this reason, a force to pull the first wall member and the second wall member apart from each other, and a force to shear the first wall member and the second wall member in a direction along the first wall

surface and the second wall surface are transmitted via the first protrusion member, the filling material, and the second protrusion member. Therefore, it is possible to join together the first wall surface of the first wall member and the second wall surface of the second wall member at a desired bearing force, and it is possible to join together the wall surfaces of a pair of the wall members at a desired bearing force.

[0008] In the wall member joint structure of the present disclosure invention described above, the first protrusion portion maybe a steel plate having a first through-hole portion passing therethrough sideways, and the second protrusion portion maybe a steel plate having a second through-hole portion passing therethrough sideways.

[0009] According to this configuration, the first protrusion portion of the first protrusion member and the second protrusion portion of the second protrusion member are steel plates having the first through-hole portion and the second through-hole portion passing therethrough sideways, respectively, and the first through-hole portion and the second through-hole portion which penetrate sideways are filled with the filling material. For this reason, a force is more reliably transmitted via the filling material with which the first through-hole portion and the second through-hole portion are filled. Therefore, it is possible to improve the bearing force against the force to pull the first wall member and the second wall member apart from each other, and against the force to shear the first wall member and the second wall member in the direction along the first wall surface and the second wall surface.

[0010] In addition, the wall member joint structure may further comprise an insertion member inserted between the first wall surface

and the second wall surface, and in a side view where the gap between the first wall surface and the second wall surface is viewed, the first protrusion portion and the insertion member have parts overlapping each other, respectively, and the second protrusion portion and the insertion member have parts overlapping each other, respectively.

[0011] According to this configuration, the wall member joint structure further comprises the insertion member inserted between the first wall surface and the second wall surface, and in the side view where the gap between the first wall surface and the second wall surface is viewed, the first protrusion portion and the insertion member have the parts overlapping each other, respectively, and the second protrusion portion and the insertion member have the parts overlapping each other, respectively. For this reason, a force is more reliably transmitted via the filling material and the insertion member between the first protrusion portion and the second protrusion portion. Therefore, it is possible to further improve the bearing force against the force to pull the first wall member and the second wall member apart from each other, and against the force to shear the first wall member and the second wall member in the direction along the first wall surface and the second wall surface.

[0012] In addition, the wall member joint structure may further comprise an insertion member inserted between the first wall surface and the second wall surface, the insertion member has a third through-hole portion passing therethrough sideways and a fourth through-hole portion passing therethrough sideways, wherein in a side view where the gap between the first wall surface and the second wall

surface is viewed, the first through-hole portion and the third through-hole portion have parts overlapping each other, respectively, and the second through-hole portion and the fourth through-hole portion have parts overlapping each other, respectively, further comprising a reinforcement steel inserted into the first through-hole portion and the third through-hole portion, and a reinforcement steel inserted into the second through-hole portion and the fourth through-hole portion.

[0013] According to this configuration, since the wall member joint structure comprises the reinforcement steel inserted into the first through-hole portion of the first protrusion member and the third through-hole portion of the insertion member, and the reinforcement steel inserted into the second through-hole portion of the second protrusion member and the fourth through-hole portion of the insertion member, it is possible to further improve the bearing force against a force to pull the first wall member and the second wall member apart from each other, and against a force to shear the first wall member and the second wall member in the direction along the first wall surface and the second wall surface.

[0014] In addition, in a side view where the gap between the first wall surface and the second wall surface is viewed, the first protrusion portion and the second protrusion portion may have parts overlapping each other, respectively.

[0015] According to this configuration, in the side view where the gap between the first wall surface and the second wall surface is viewed, the first protrusion portion and the second protrusion portion have the parts overlapping each other, respectively. For this reason, a force is more

reliably transmitted via the filling material between the first protrusion portion and the second protrusion portion. Therefore, it is possible to further improve the bearing force against the force to pull the first wall member and the second wall member apart from each other, and against the force to shear the first wall member and the second wall member in the direction along the first wall surface and the second wall surface.

[0016] In addition, in a side view where the gap between the first wall surface and the second wall surface is viewed, the wall member joint structure may further comprise a reinforcement steel inserted into the first through-hole portion and the second through-hole portion.

[0017] According to this configuration, since the wall member joint structure includes the reinforcement steel inserted into the first through-hole portion of the first protrusion portion and the second through-hole portion of the second protrusion portion, it is possible to further improve the bearing force against a force to pull the first wall member and the second wall member apart from each other, and against a force to shear the first wall member and the second wall member in the direction along the first wall surface and the second wall surface.

[0018] Meanwhile, according to the present disclosure, there is provided a wall member joining method in which after a first wall member having a first wall surface and a second wall member having a second wall surface are disposed such that the first wall surface and the second wall surface face each other, a gap between the first wall surface and the second wall surface is filled with a filling material, in which the first wall member has a first protrusion member including a first protrusion portion which has protruded from the first wall surface, and

in which the second wall member has a second protrusion member including a second protrusion portion which has protruded from the second wall surface.

[0019] According to the wall member joint structure and the wall member joining method of the present invention, it is possible to join together wall surfaces of a pair of wall members at a desired strength.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1A is a plan view illustrating a state where in a wall member joining method according to a first embodiment, a first wall member and a second wall member are disposed such that a first wall surface and a second wall surface face each other, and a gap between the first wall surface and the second wall surface is not filled with a filling material.

FIG. 1B is a longitudinal cross-sectional view taken along a line α of FIG. 1A.

FIG. 2A is a plan view illustrating a wall member joint structure according to the first embodiment.

FIG. 2B is a longitudinal cross-sectional view taken along a line β of FIG. 2A.

FIG. 3 is a plan view illustrating a wall member joint structure according to a second embodiment.

FIG. 4A is a plan view illustrating a wall member joint structure according to a third embodiment.

FIG. 4B is a longitudinal cross-sectional view taken along a line γ of FIG. 4A.

FIG. 5A is a plan view illustrating a wall member joint structure

according to a fourth embodiment.

FIG. 5B is a longitudinal cross-sectional view taken along a line δ of FIG. 5A.

FIG. 6A is a plan view illustrating a wall member joint structure according to a fifth embodiment.

FIG. 6B is a longitudinal cross-sectional view taken along a line ε of FIG. 6A.

FIG. 7A is a plan view illustrating a wall member joint structure according to a sixth embodiment.

FIG. 7B is a longitudinal cross-sectional view taken along a line ζ of FIG. 7A.

FIG. 8A is a plan view illustrating a wall member joint structure according to a seventh embodiment.

FIG. 8B is a longitudinal cross-sectional view taken along a line η of FIG. 8A.

DETAILED DESCRIPTION

[0021] Hereinbelow, embodiments will be described with reference to the drawings. As illustrated in FIGS. 1A, 1B, 2A, and 2B, a wall member joint structure 1A according to a first embodiment comprises a first wall member 10A having a first wall surface 11 extending in a vertical direction, and a second wall member 20A having a second wall surface 21 that extends in the vertical direction and faces the first wall surface 11. Each of the first wall member 10A and the second wall member 20A is formed of, for example, a reinforced concrete. As illustrated in FIGS. 2A and 2B, the wall member joint structure 1A comprises a filling material 60 such as mortar with which a gap between

the first wall surface 11 and the second wall surface 21 is filled.

[0022] For example, in the PPVC, when a building is constructed by assembling and integrating units, which are factory-produced as precast concrete structures, at a work site, the wall member joint structure 1A and a wall member joining method of the present embodiment are applied so as to join together wall surfaces of wall members in a state where the wall surfaces of the wall members of a pair of the assembled units face each other. Therefore, for example, the first wall member 10A and the second wall member 20A form walls of the units in the PPVC.

[0023] Firstly, for the purposes of description, description will be given mainly with reference to FIGS. 1A and 1B illustrating a state where the gap between the first wall surface 11 and the second wall surface 21 is not filled with the filling material 60. As illustrated in FIGS. 1A and 1B, the first wall surface 11 has a first recessed portion 12 recessed from the other part of the first wall surface 11, and the second wall surface 21 has a second recessed portion 22 recessed from the other part of the second wall surface 21. The first recessed portion 12 extends in a vertical direction of the first wall surface 11, and the second recessed portion 22 extends in a vertical direction of the second wall surface 21. The first wall surface 11 has a plurality of the first recessed portions 12 arranged sideways, and the second wall surface 21 has a plurality of the second recessed portions 22 arranged sideways. The plurality of first recessed portions 12 face the plurality of second recessed portions 22, respectively.

[0024] Incidentally, the part of the first wall surface 11 other than the

first recessed portion 12 and the part of the second wall surface 21 other than the second recessed portion 22 may be separate from each other by a predetermined gap, or may be in contact with each other. In addition, if the first wall surface 11 and the second wall surface 21 are separate from each other by a predetermined gap, the first recessed portion 12 and the second recessed portion 22 may be omitted, and the first wall surface 11 and the second wall surface 21 may be flat surfaces.

[0025] The wall member joint structure 1A comprises a first protrusion portion 33A of a first protrusion member 30A that has protruded from the first recessed portion 12 of the first wall surface 11, and a second protrusion portion 43A of a second protrusion member 40A that has protruded from the second recessed portion 22 of the second wall surface 21. The first protrusion member 30A has a base portion 31 embedded in the first wall member 10A, and the second protrusion member 40A has a base portion 41 embedded in the second wall member 20A. The base portion 31 is a steel plate having front and back surfaces parallel to the first wall surface 11, and the base portion 41 is a steel plate having front and back surfaces parallel to the second wall surface 21. Incidentally, the first protrusion member 30A and the second protrusion member 40A may have parts embedded in and parts (the first protrusion portion 33A and the second protrusion portion 43A) protruding from the first wall member 10A and the second wall member 20A, respectively, and the shapes thereof are not limited. The first protrusion member 30A and the second protrusion member 40A may be, for example, plate-shaped or T-shaped members.

[0026] The first protrusion portion 33A is a steel plate having front and

back surfaces perpendicular to the first wall surface 11, and extends in the vertical direction in a range of part from an upper end portion to a lower end portion of the first wall surface 11. The second protrusion portion 43A is a steel plate having front and back surfaces perpendicular to the second wall surface 21, and extends in the vertical direction in a range of part from an upper end portion to a lower end portion of the second wall surface 21. Incidentally, the first protrusion portion 33A may extend in the vertical direction in the entire range from the upper end portion to the lower end portion of the first wall surface 11, and the second protrusion portion 43A may extend in the vertical direction in the entire range from the upper end portion to the lower end portion of the second wall surface 21.

[0027] The lengths of the first protrusion portion 33A and the second protrusion portion 43A are not specifically limited. However, a tip end 33t of the first protrusion portion 33A may be positioned inside the first recessed portion 12, and a tip end 43t of the second protrusion portion 43A may be positioned inside the second recessed portion 22. Namely, in a side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed as illustrated in FIG. 1B, the tip end 33t of the first protrusion portion 33A and the tip end 43t of the second protrusion portion 43A do not protrude from the part of the first wall surface 11 other than the first recessed portion 12 and the part of the second wall surface 21 other than the second recessed portion 22, respectively.

[0028] The wall member joint structure 1A comprises a plurality of the first protrusion portions 33A that have protruded from an upper end

portion and a lower end portion of each of the plurality of first recessed portions 12, and a plurality of the second protrusion portions 43A that have protruded from an upper end portion and a lower end portion of each of the plurality of second recessed portions 22. The wall member joint structure 1A may comprise the first protrusion portion 33A that has protruded from parts of the first recessed portion 12 other than the upper end portion and the lower end portion, for example, from a central portion of the first recessed portion 12, and the second protrusion portion 43A that has protruded from parts of the second recessed portion 22 other than the upper end portion and the lower end portion, for example, from a central portion of the second recessed portion 22. The first protrusion portion 33A of the first protrusion member 30A faces the second protrusion portion 43A of the second protrusion member 40A. Incidentally, the position of the first protrusion portion 33A and the position of the second protrusion portion 43A may be slightly offset from each other due to construction errors or the like.

[0029] The first protrusion portion 33A has a first through-hole portion 34 passing therethrough sideways, and the second protrusion portion 43A has a second through-hole portion 44 passing therethrough sideways. In the example of FIG. 1B, the first protrusion portion 33A has two first through-hole portions 34 disposed in the vertical direction, and the second protrusion portion 43A has two second through-hole portions 44 disposed in the vertical direction. However, each of the first protrusion portion 33A and the second protrusion portion 43A may have one or three or more through-hole portions. Incidentally, the position of the through-hole portion is not limited.

[0030] The wall member joint structure 1A comprises an insertion member 50 inserted between the first recessed portion 12 of the first wall surface 11 and the second recessed portion 22 of the second wall surface 21. In the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, the first protrusion portion 33A of the first protrusion member 30A and the insertion member 50 have parts overlapping each other, respectively, and the second protrusion portion 43A of the second protrusion member 40A and the insertion member 50 have parts overlapping each other, respectively. The insertion member 50 may be a steel plate having front and back surfaces substantially perpendicular to the first wall surface 11 and the second wall surface 21. The insertion member 50 extends from the upper end portion to the lower end portion of each of the first recessed portion 12 and the second recessed portion 22. The insertion member 50 is disposed substantially parallel to the front and back surfaces of each of the first protrusion portion 33A and the second protrusion portion 43A.

[0031] In the present embodiment, the insertion member 50 is separate from the first protrusion portion 33A and the second protrusion portion 43A by an arbitrary gap approximate to the steel plate thickness of the first protrusion portion 33A, the second protrusion portion 43A, or the insertion member 50. Incidentally, the insertion member 50 may be a member which is divided into a plurality of pieces between from the upper end portions to the lower end portions of the first recessed portion 12 and the second recessed portion 22 such that the first protrusion portion 33A of the first protrusion member 30A and the insertion

member 50 have parts overlapping each other, respectively, and the second protrusion portion 43A of the second protrusion member 40A and the insertion member 50 have parts overlapping each other, respectively.

[0032] In the present embodiment, the insertion member 50 has a third through-hole portion 51 passing therethrough sideways and adjacent to the first wall surface 11, and a fourth through-hole portion 52 passing therethrough sideways and adjacent to the second wall surface 21. In the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, the first through-hole portion 34 of the first protrusion portion 33A and the third through-hole portion 51 of the insertion member 50 have parts overlapping each other, respectively, and the second through-hole portion 44 of the second protrusion portion 43A and the fourth through-hole portion 52 of the insertion member 50 have parts overlapping each other, respectively.

[0033] When the wall member joint structure 1A described above is formed, by the wall member joining method of the present embodiment, as illustrated in FIGS. 1A and 1B, the first wall member 10A and the second wall member 20A are disposed such that the first recessed portion 12 of the first wall surface 11 and the second recessed portion 22 of the second wall surface 21 face each other. After the first wall member 10A and the second wall member 20A have been disposed, the insertion member 50 is inserted between the first recessed portion 12 and the second recessed portion 22, for example, from the upper end portions of the first recessed portion 12 and the second recessed portion 22. As illustrated in FIGS. 2A and 2B, after the insertion member 50

has been inserted, the gap between the first wall surface 11 and the second wall surface 21 is filled with the filling material 60 such as mortar. The filling material 60 is solidified, and thus the wall member joint structure 1A in which the first wall member 10A is joined to the second wall member 20A is formed.

[0034] According to the present embodiment, in the wall member joint structure 1A comprising the first wall member 10A having the first wall surface 11 and the second wall member 20A having the second wall surface 21 facing the first wall surface 11, the first protrusion portion 33A of the first protrusion member 30A protrudes from the first wall surface 11, the second protrusion portion 43A of the second protrusion member 40A protrudes from the second wall surface 21, and the gap between the first wall surface 11 from which the first protrusion portion 33A protrudes and the second wall surface 21 from which the second protrusion portion 43A protrudes is filled with the filling material 60. For this reason, a force to pull the first wall member 10A and the second wall member 20A apart from each other, and a force to shear the first wall member 10A and the second wall member 20A in a direction along the first wall surface 11 and the second wall surface 21 are transmitted via the first protrusion member 30A, the filling material 60, and the second protrusion member 40A. Therefore, it is possible to join together the first wall surface 11 of the first wall member 10A and the second wall surface 21 of the second wall member 20A at a desired bearing force, and it is possible to join together the wall surfaces of a pair of the wall members at a desired bearing force.

[0035] In addition, in the present embodiment, the first protrusion

portion 33A of the first protrusion member 30A and the second protrusion portion 43A of the second protrusion member 40A are steel plates having the first through-hole portion 34 and the second through-hole portion 44 passing therethrough sideways, respectively, and the first through-hole portion 34 and the second through-hole portion 44 which penetrate sideways are filled with the filling material 60. For this reason, a force is more reliably transmitted via the filling material 60 with which the first through-hole portion 34 and the second through-hole portion 44 are filled. Therefore, it is possible to improve the bearing force against the force to pull the first wall member 10A and the second wall member 20A apart from each other, and against the force to shear the first wall member 10A and the second wall member 20A in the direction along the first wall surface 11 and the second wall surface 21.

[0036] In addition, in the present embodiment, the wall member joint structure 1A further comprises the insertion member 50 inserted between the first wall surface 11 and the second wall surface 21, in the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, the first protrusion portion 33A of the first protrusion member 30A and the insertion member 50 have the parts overlapping each other, respectively, and the second protrusion portion 43A of the second protrusion member 40A and the insertion member 50 have the parts overlapping each other, respectively. For this reason, a force is more reliably transmitted via the filling material 60 and the insertion member 50 between the first protrusion member 30A and the second protrusion member 40A. Therefore, it is possible to further

improve the bearing force against the force to pull the first wall member 10A and the second wall member 20A apart from each other, and against the force to shear the first wall member 10A and the second wall member 20A in the direction along the first wall surface 11 and the second wall surface 21.

[0037] In addition, in the present embodiment, in the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, even though the first protrusion portion 33A of the first protrusion member 30A and the second protrusion portion 43A of the second protrusion member 40A do not have parts overlapping each other, respectively, if the first protrusion member 30A and the insertion member 50 have parts overlapping each other, respectively, and the second protrusion member 40A and the insertion member 50 have parts overlapping each other, respectively, since a force is transmitted via the insertion member 50 between the first protrusion member 30A and the second protrusion member 40A, it is possible to shorten the protrusion length of the first protrusion portion 33A of the first protrusion member 30A from the first wall surface 11, and the protrusion length of the second protrusion portion 43A of the second protrusion member 40A from the second wall surface 21. It is also possible to position the tip end 33t of the first protrusion portion 33A inside the first recessed portion 12, and to position the tip end 43t of the second protrusion portion 43A inside the second recessed portion 22. Therefore, it is possible to reduce the possibility that the first protrusion portion 33A or the second protrusion portion 43A becomes an obstacle to a work such as building the units, it is possible to easily build the units, and it is

possible to improve workability when joining the first wall member 10A to the second wall member 20A.

[0038] In addition, in the present embodiment, in the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, the first through-hole portion 34 of the first protrusion portion 33A and the third through-hole portion 51 of the insertion member 50 have the parts overlapping each other, respectively, and the second through-hole portion 44 of the second protrusion portion 43A and the fourth through-hole portion 52 of the insertion member 50 have the parts overlapping each other, respectively. For this reason, the filling material 60 enters the first through-hole portion 34 and the third through-hole portion 51 overlapping each other, and the filling material 60 enters the second through-hole portion 44 and the fourth through-hole portion 52 overlapping each other. Therefore, it is possible to further improve the bearing force against the force to pull the first wall member 10A and the second wall member 20A apart from each other, and against the force to shear the first wall member 10A and the second wall member 20A in the direction along the first wall surface 11 and the second wall surface 21.

[0039] Hereinbelow, other embodiments of the present invention will be described. Incidentally, in FIGS. 3 to 8B, for the purposes of description, the description of the filling material 60 will be omitted. Firstly, hereinbelow, a second embodiment of the present invention will be described. As illustrated in FIG. 3, in a wall member joint structure 1B of the second embodiment, the insertion member 50 is in contact with the first protrusion portion 33A and the second protrusion portion

43A. The others except the item described above are the same as those in the first embodiment. Similarly to the wall member joint structure 1A of the first embodiment, also the wall member joint structure 1B of the second embodiment has a bearing force against a force to pull the first wall member 10A and the second wall member 20A apart from each other, and against a force to shear the first wall member 10A and the second wall member 20A in the direction along the first wall surface 11 and the second wall surface 21.

[0040] Hereinbelow, a third embodiment of the present invention will be described. As illustrated in FIGS. 4A and 4B, a wall member joint structure 1C of the third embodiment comprises a reinforcement steel 71 that has an end part embedded in the first recessed portion 12 of a first wall member 10B and extending sideways and a tip end inserted into the first through-hole portion 34 of the first protrusion member 30A and the third through-hole portion 51 of the insertion member 50. In addition, the wall member joint structure 1C comprises a reinforcement steel 72 that has an end part embedded in the second recessed portion 22 of a second wall member 20B and extending sideways and a tip end inserted into the second through-hole portion 44 of the second protrusion member 40A and the fourth through-hole portion 52 of the insertion member 50.

[0041] When the wall member joint structure 1C described above is formed, after the first wall member 10B and the second wall member 20B has been disposed similarly to the first embodiment, like the insertion member 50 illustrated by the broken line in FIG. 4A, the insertion member 50 is inserted between the first recessed portion 12

and the second recessed portion 22 at a position separate sideways from the first protrusion member 30A and the second protrusion member 40A. After the insertion member 50 has been inserted between the first recessed portion 12 and the second recessed portion 22, as illustrated in by the arrow in FIG. 4A, the insertion member 50 is brought close to the first protrusion member 30A and the second protrusion member 40A such that the reinforcement steel 71 is inserted into the third through-hole portion 51 of the insertion member 50 and the reinforcement steel 72 is inserted into the fourth through-hole portion 52 of the insertion member 50. The others except the item described above are the same as those in the first embodiment.

[0042] In the present embodiment, since the wall member joint structure 1C comprises the reinforcement steel 71 inserted into the first through-hole portion 34 of the first protrusion member 30A and the third through-hole portion 51 of the insertion member 50, and the reinforcement steel 72 inserted into the second through-hole portion 44 of the second protrusion member 40A and the fourth through-hole portion 52 of the insertion member 50, it is possible to further improve the bearing force against a force to pull the first wall member 10B and the second wall member 20B apart from each other, and against a force to shear the first wall member 10B and the second wall member 20B in the direction along the first wall surface 11 and the second wall surface 21.

[0043] In addition, in the present embodiment, when the insertion member 50 is inserted between the first recessed portion 12 and the second recessed portion 22, since the reinforcement steels 71 and 72 are

already embedded in the first recessed portion 12 and the second recessed portion 22, respectively, and are already inserted into the first through-hole portion 34 of the first protrusion member 30A and the second through-hole portion 44 of the second protrusion member 40A, respectively, it is possible to easily insert the reinforcement steel 71 into the third through-hole portion 51 of the insertion member 50, and the reinforcement steel 72 into the fourth through-hole portion 52 of the insertion member 50.

[0044] Hereinbelow, a fourth embodiment of the present invention will be described. As illustrated in FIGS. 5A and 5B, a first protrusion member 30B of a wall member joint structure 1D of the fourth embodiment has a pair of a first protrusion portion 33B and a first protrusion portion 33C which have protruded from the first recessed portion 12 of the first wall surface 11 of a first wall member 10C while being spaced sideways from each other by a gap. In addition, a second protrusion member 40B of the wall member joint structure 1D has a pair of a second protrusion portion 43B and a second protrusion portion 43C which have protruded from the second recessed portion 22 of the second wall surface 21 of a second wall member 20C while being spaced sideways from each other by a gap.

[0045] The configurations of the first protrusion portion 33B and the first protrusion portion 33C are the same as the configuration of the first protrusion portion 33A of the first embodiment, and the configurations of the second protrusion portion 43B and the second protrusion portion 43C are the same as the configuration of the second protrusion portion 43A of the first embodiment. The insertion member 50 is inserted

between the pair of the first protrusion portion 33B and the first protrusion portion 33C and between the pair of the second protrusion portion 43B and the second protrusion portion 43C. The others except the item described above are the same as those in the first embodiment.

[0046] In the present embodiment, since the insertion member 50 is inserted between the pair of the first protrusion portion 33B and the first protrusion portion 33C and between the pair of the second protrusion portion 43B and the second protrusion portion 43C, when the insertion member 50 is inserted between the first recessed portion 12 and the second recessed portion 22, it is easy to determine the position of the insertion member 50. In addition, it is possible to further improve the bearing force against a force to pull the first wall member 10C and the second wall member 20C apart from each other, and against a force to shear the first wall member 10C and the second wall member 20C in the direction along the first wall surface 11 and the second wall surface 21.

[0047] Hereinbelow, a fifth embodiment of the present invention will be described. As illustrated in FIGS. 6A and 6B, a first protrusion member 30C of a wall member joint structure 1E of the fifth embodiment has a first protrusion portion 33D and a first protrusion portion 33E which have protruded from the first recessed portion 12 of the first wall surface 11 of a first wall member 10D while being spaced sideways from each other by a gap. In addition, a second protrusion member 40C of the wall member joint structure 1E has a second protrusion portion 43D and a second protrusion portion 43E which have protruded from the second recessed portion 22 of the second wall surface 21 of a second wall member 20D while being spaced sideways

from each other by a gap.

[0048] The configuration of the first protrusion portion 33D is the same as the configuration of the first protrusion portion 33A of the first embodiment, and the configuration of the second protrusion portion 43D is the same as the configuration of the second protrusion portion 43A of the first embodiment. Meanwhile, the protrusion length of the first protrusion portion 33E from the first recessed portion 12 may be shorter than the protrusion length of the first protrusion portion 33D, and may be a length where the tip end 33t of the first protrusion portion 33E is in contact with a side edge portion of the insertion member 50. In addition, the first protrusion portion 33E does not have the first through-hole portion 34. Similarly, the protrusion length of the second protrusion portion 43E from the second recessed portion 22 may be shorter than the protrusion length of the second protrusion portion 43D, and may be a length where the tip end 43t of the second protrusion portion 43E is in contact with a side edge portion of the insertion member 50. In addition, the second protrusion portion 43E does not have the second through-hole portion 44.

[0049] Each of the first protrusion portion 33D and the first protrusion portion 33E has a guide portion 33p which is a protrusion protruding from each of facing surfaces of the first protrusion portion 33D and the first protrusion portion 33E, and which guides the insertion member 50 to be inserted between the first recessed portion 12 of the first wall surface 11 and the second recessed portion 22 of the second wall surface 21. Similarly, each of the second protrusion portion 43D and the second protrusion portion 43E has a guide portion 43p which is a

protrusion protruding from each of facing surfaces of the second protrusion portion 43D and the second protrusion portion 43E, and which guides the insertion member 50 to be inserted between the first recessed portion 12 of the first wall surface 11 and the second recessed portion 22 of the second wall surface 21.

[0050] A pair of the guide portions 33p are provided in the vicinity of the tip end 33t of each of the first protrusion portion 33D and the first protrusion portion 33E and in the vicinities of an upper end portion and a lower end portion of each of the first protrusion portion 33D and the first protrusion portion 33E. In addition, a pair of the guide portions 43p are provided in the vicinity of the tip end 43t of each of the second protrusion portion 43D and the second protrusion portion 43E and in the vicinities of an upper end portion and a lower end portion of each of the second protrusion portion 43D and the second protrusion portion 43E. However, the disposition and the number of the guide portions 33p and the guide portions 43p are arbitrary.

[0051] In addition, it is not necessarily necessary for the guide portions 33p and 43p to be always in contact with the insertion member 50, and may be capable of guiding the insertion member 50 while being properly in contact with the insertion member 50 to be inserted between the first recessed portion 12 and the second recessed portion 22. In addition, it is not necessary for the first protrusion portion 33D and the first protrusion portion 33E to have different shapes, and it is not necessary for the second protrusion portion 43D and the second protrusion portion 43E to have different shapes. For example, the guide portions 33p and 43p may be provided in the first protrusion

portion 33B having the same shape and the like, such as the first protrusion portion 33B, the first protrusion portion 33C, the second protrusion portion 43B, and the second protrusion portion 43C of the fourth embodiment. In addition, the guide portions 33p and 43p may have any shape capable of guiding the position of the insertion member 50 when the insertion member 50 is inserted, for example, may have a bar shape or a plate shape or may not be a protrusion. In addition, the guide portion 33p may be provided only in either one of the first protrusion portion 33D and the first protrusion portion 33E, and the guide portion 43p may be provided only in either one of the second protrusion portion 43D and the second protrusion portion 43E. Namely, the guide portions 33p and 43p may be partially provided in the first protrusion portions 33D and 33E and the second protrusion portions 43D and 43E. The others except the item described above are the same as those in the first embodiment.

[0052] In the present embodiment, since the insertion member 50 to be inserted between the first recessed portion 12 and the second recessed portion 22 is guided by the guide portions 33p and 43p which are provided in the first protrusion portion 33D, the first protrusion portion 33E, the second protrusion portion 43D, and the second protrusion portion 43E, respectively, when the insertion member 50 is inserted between the first recessed portion 12 and the second recessed portion 22, it is easy to determine the position of the insertion member 50.

[0053] Hereinbelow, a sixth embodiment of the present invention will be described. As illustrated in FIGS. 7A and 7B, a wall member joint structure 1F of the sixth embodiment does not comprise the insertion

member 50. The tip end 33t of a first protrusion portion 33F of a first protrusion member 30D is positioned outside the first recessed portion 12, and the tip end 43t of a second protrusion portion 43F of a second protrusion member 40D is positioned outside the second recessed portion 22. For this reason, in a side view where a gap between the first wall surface 11 of a first wall member 10E and the second wall surface 21 of a second wall member 20E is viewed as illustrated in FIG. 7B, the first protrusion portion 33F of the first protrusion member 30D and the second protrusion portion 43F of the second protrusion member 40D have parts overlapping each other, respectively.

[0054] Similarly to the first protrusion portion 33A and the second protrusion portion 43A of the first embodiment, as illustrated in FIGS. 7A and 7B, the first protrusion portion 33F has the first through-hole portion 34, and the second protrusion portion 43F has the second through-hole portion 44. In the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, the first through-hole portion 34 of the first protrusion portion 33F and the second through-hole portion 44 of the second protrusion portion 43F have parts overlapping each other, respectively. The others except the item described above are the same as those in the first embodiment. Incidentally, similarly to the first embodiment, the wall member joint structure 1F may comprise the insertion member 50. If the wall member joint structure 1F comprises the insertion member 50, in the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, the first through-hole portion 34 of the first protrusion portion 33F, the second through-hole portion 44 of

the second protrusion portion 43F, and the through-hole portion of the insertion member 50 have parts overlapping each other, respectively. The first protrusion portion 33F and the second protrusion portion 43F may be in contact with each other, or may be separate from each other.

[0055] In the present embodiment, in the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, the first protrusion portion 33F and the second protrusion portion 43F have the parts overlapping each other, respectively. For this reason, a force is more reliably transmitted via the filling material 60 between the first protrusion member 30D and the second protrusion member 40D. Therefore, it is possible to further improve the bearing force against a force to pull the first wall member 10E and the second wall member 20E apart from each other, and against a force to shear the first wall member 10E and the second wall member 20E in the direction along the first wall surface 11 and the second wall surface 21.

[0056] In addition, in the present embodiment, in the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, the first through-hole portion 34 of the first protrusion portion 33F and the second through-hole portion 44 of the second protrusion portion 43F have the parts overlapping each other, respectively. For this reason, the filling material 60 enters the first through-hole portion 34 and the second through-hole portion 44 overlapping each other. Therefore, it is possible to further improve the bearing force against the force to pull the first wall member 10E and the second wall member 20E apart from each other, and against the force to shear the first wall member 10E and the second wall member 20E in the

direction along the first wall surface 11 and the second wall surface 21.

[0057] In addition, in the present embodiment, since the first protrusion portion 33F of the first protrusion member 30D and the second protrusion portion 43F of the second protrusion member 40D have the parts overlapping each other, respectively, it is possible to enlarge the first through-hole portion 34 and the second through-hole portion 44 by increasing the protrusion length of the first protrusion portion 33F from the first wall surface 11 and the protrusion length of the second protrusion portion 43F from the second wall surface 21. For this reason, a force is more reliably transmitted via the filling material 60 with which the first through-hole portion 34 and the second through-hole portion 44 which are large are filled. Therefore, it is possible to further improve the bearing force against the force to pull the first wall member 10E and the second wall member 20E apart from each other, and against the force to shear the first wall member 10E and the second wall member 20E in the direction along the first wall surface 11 and the second wall surface 21.

[0058] Hereinbelow, a seventh embodiment of the present invention will be described. As illustrated in FIGS. 8A and 8B, a wall member joint structure 1G of the seventh embodiment comprises a reinforcement steel 73 inserted into the first through-hole portion 34 of the first protrusion portion 33F and the second through-hole portion 44 of the second protrusion portion 43F in the first wall member 10E and the second wall member 20E of the wall member joint structure 1F of the sixth embodiment. When the wall member joint structure 1G described above is formed, similarly to the first embodiment, after the

first wall member 10E and the second wall member 20E have been disposed, the reinforcement steel 73 is inserted into the first through-hole portion 34 and the second through-hole portion 44 from side via a gap between the first wall surface 11 and the second wall surface 21. The others except the item described above are the same as those in the first embodiment.

[0059] In the present embodiment, since the wall member joint structure 1G includes the reinforcement steel 73 inserted into the first through-hole portion 34 of the first protrusion portion 33F and the second through-hole portion 44 of the second protrusion portion 43F, it is possible to further improve the bearing force against a force to pull the first wall member 10E and the second wall member 20E apart from each other, and against a force to shear the first wall member 10E and the second wall member 20E in the direction along the first wall surface 11 and the second wall surface 21.

[0060] The embodiments of the present invention have been described above, and the present invention is not limited to the embodiments described above. For example, it is possible to properly change the shapes, the dispositions, and the number of the first protrusion members 30A, 30B, 30C, and 30D, the second protrusion members 40A, 40B, 40C, and 40D, and the insertion members 50. For example, the first protrusion portions 33A, 33B, 33C, 33D, 33E, and 33F may not face the second protrusion portions 43A, 43B, 43C, 43D, 43E, and 43F, respectively. In addition, in the side view where the gap between the first wall surface 11 and the second wall surface 21 is viewed, the first through-hole portion 34 and the third through-hole portion 51 may not

have parts overlapping each other, respectively, the second through-hole portion 44 and the fourth through-hole portion 52 may not have parts overlapping each other, respectively, and the first through-hole portion 34 and the second through-hole portion 44 may not have parts overlapping each other, respectively.

REFERENCE SIGNS LIST

[0061] 1A, 1B, 1C, 1D, 1E, 1F, 1G: wall member joint structure, 10A, 10B, 10C, 10D, 10E: first wall member, 11: first wall surface, 12: first recessed portion, 20A, 20B, 20C, 20D, 20E: second wall member, 21: second wall surface, 22: second recessed portion, 30A, 30B, 30C, 30D: first protrusion member, 31: base portion, 33A, 33B, 33C, 33D, 33E, 33F: first protrusion portion, 33t: tip end, 33p: guide portion, 34: first through-hole portion, 40A, 40B, 40C, 40D: second protrusion member, 41: base portion, 43A, 43B, 43C, 43D, 43E, 43F: second protrusion portion, 43t: tip end, 43p: guide portion, 44: second through-hole portion, 50: insertion member, 51: third through-hole portion, 52: fourth through-hole portion, 60: filling material, 71, 72, 73: reinforcement steel.

WHAT IS CLAIMED IS:

1. A wall member joint structure comprising:

a first wall member having a first wall surface;

a second wall member having a second wall surface facing the first wall surface;

a first protrusion member having a first protrusion portion which has protruded from the first wall surface;

a second protrusion member having a second protrusion portion which has protruded from the second wall surface; and

a filling material with which a gap between the first wall surface and the second wall surface is filled.

2. The wall member joint structure according to claim 1,

wherein the first protrusion portion is a steel plate having a first through-hole portion passing therethrough sideways, and the second protrusion portion is a steel plate having a second through-hole portion passing therethrough sideways.

3. The wall member joint structure according to claim 1 or 2, further comprising:

an insertion member inserted between the first wall surface and the second wall surface,

wherein in a side view where the gap between the first wall surface and the second wall surface is viewed, the first protrusion portion and the insertion member have parts overlapping each other, respectively, and the second protrusion portion and the insertion member have parts overlapping each other, respectively.

4. The wall member joint structure according to claim 2, further

comprising:

an insertion member inserted between the first wall surface and the second wall surface,

the insertion member has a third through-hole portion passing therethrough sideways and a fourth through-hole portion passing therethrough sideways,

wherein in a side view where the gap between the first wall surface and the second wall surface is viewed, the first through-hole portion and the third through-hole portion have parts overlapping each other, respectively, and the second through-hole portion and the fourth through-hole portion have parts overlapping each other, respectively,

further comprising a reinforcement steel inserted into the first through-hole portion and the third through-hole portion, and a reinforcement steel inserted into the second through-hole portion and the fourth through-hole portion.

5. The wall member joint structure according to claim 1 or 2,

wherein in a side view where the gap between the first wall surface and the second wall surface is viewed, the first protrusion portion and the second protrusion portion have parts overlapping each other, respectively.

6. The wall member joint structure according to claim 2,

wherein in a side view where the gap between the first wall surface and the second wall surface is viewed,

further comprising a reinforcement steel inserted into the first through-hole portion and the second through-hole portion.

7. A wall member joining method in which after a first wall

member having a first wall surface and a second wall member having a second wall surface are disposed such that the first wall surface and the second wall surface face each other, a gap between the first wall surface and the second wall surface is filled with a filling material,

wherein the first wall member has a first protrusion member including a first protrusion portion which has protruded from the first wall surface, and

wherein the second wall member has a second protrusion member including a second protrusion portion which has protruded from the second wall surface.