

DESCRIPTION

TITLE OF THE INVENTION: INORGANIC LOAD-BEARING BOARD AND
LOAD-BEARING WALL

5 TECHNICAL FIELD

[0001]

The present disclosure relates to an inorganic
load-bearing board and a load-bearing wall.

10 BACKGROUND ART

[0002]

In order for a wall, such as an exterior wall, a
partition wall, or the like, to have a high coefficient of
effective wall length (Kabe-bairitsu), it is necessary to
15 increase a shear strength (or hardness) of load-bearing
boards constituting the wall. As the load-bearing boards,
there are mainly wooden load-bearing boards and inorganic
load-bearing boards. The wooden load-bearing boards include
structural plywood, medium density fiberboards (MDF),
20 oriented strand boards (OSB), and the like.

[0003]

The inorganic load-bearing boards include cement
boards, calcium silicate boards, and gypsum boards
(including gypsum plates). Compared to the wooden load-
25 bearing boards, the inorganic load-bearing boards excel in
fireproofing, moisture permeation, and dimensional
stability, and therefore the inorganic load-bearing boards
are widely used for walls of wooden structure buildings.
Fasteners, which are used for attaching load-bearing boards
30 to posts or the like, are generally nails as described in
Notification No. 1100 of the Ministry of Construction.

[0004]

For conventional wooden structure buildings,

inorganic load-bearing boards (board material) having a high specific gravity, which is a specific gravity of 1.0 or greater, are used for the purpose of increasing the hardness. However, the inorganic load-bearing board having
5 a high specific gravity is heavy, which makes the inorganic load-bearing board difficult to handle, and has a problem that the inorganic load-bearing board is likely to be cracked when fasteners are driven into the inorganic load-bearing board to fasten the inorganic load-bearing board to
10 a post or a stud.

[0005]

If an attempt is made to use a thin inorganic load-bearing board, for example, having a thickness of approximately 9 mm or less in order to solve the above
15 problems, incombustibility of the inorganic load-bearing board is lowered, and therefore it is hard to say that a mere reduction in thickness of the inorganic load-bearing board is an expedient measure.

[0006]

20 In addition, in order to achieve a high coefficient of effective wall length, it is advantageous to use a load-bearing board having a long strength retention (large ultimate displacement δ_u), such as wooden load-bearing board, rather than a hard inorganic load-bearing
25 board for increasing the maximum load-bearing strength $P_{\max}$ of the inorganic load-bearing board.

[0007]

However, for example, in the case of a gypsum board having a specific gravity of 1.0 (an example of the
30 inorganic load-bearing board, and a gypsum-based board in which outer surfaces of a gypsum core (core material) are covered with gypsum board base paper), it has been known that residual strength is lost by fracturing of the gypsum

core when the maximum load-bearing strength $P_{\max}$ is reached. For example, it is known that the strength decreases at an early stage at the deformation angle of 20×10^{-3} rad or greater, and the strength decreases to $0.8 P_{\max}$ or lower.

- 5 The $0.8 P_{\max}$ is the load-bearing strength when the load-bearing board reaches the ultimate displacement δ_u .

[0008]

- It has been also known that, as the specific gravity of the gypsum board is reduced, the lateral screw
10 resistance decreases, leading to a low maximum load-bearing strength $P_{\max}$. Although the toughness of the gypsum board is slightly increased by reducing the specific gravity of the gypsum board, the strength of gypsum board itself is reduced, which reduces hardness, leading to a problem that
15 a sufficient load-bearing strength cannot be obtained.

[0009]

- As an index for indicating a strength of a wooden structure building against a short-term horizontal load (e.g., seismic force, wind pressure, etc.), a framework
20 length of a load-bearing wall (a length of a wall in an architectural plan view) is generally used. For a calculation of the framework length, a coefficient of effective wall length corresponding to a structure of the load-bearing wall is used. In the present specification,
25 the "coefficient of effective wall length" is an index of seismic performance or load-bearing performance of a load-bearing wall. The larger value of the coefficient of effective wall length means that the load-bearing wall has a greater strength against the seismic force.

- 30 [0010]

The outline of the calculation method of the coefficient of effective wall length will be described as follows. In principle, among the following 4 types of

strength values (1) to (4), the smallest strength value is determined as a short-term reference shear strength P_0 , the short-term reference shear strength P_0 is multiplied by a predetermined reduction coefficient (α) (a coefficient for evaluating a factor of reduction in strength), and the resultant value is determined as a coefficient of effective wall length.

(1) Yield strength P_y

(2) Ultimate strength corrected value P_u' obtained by correcting the ultimate strength P_u based on a ductile factor μ

(3) 2/3 of maximum strength P_{max}

(4) Strength at a shear deformation angle of $1/120$ rad [0011]

Whereas a strength value of a wooden load-bearing board having high toughness is often determined by (1) above, a strength value of an inorganic load-bearing board having low toughness is often determined by (2) above. Specifically, a general inorganic load-bearing board has a small ultimate strength P_u and a small ductile factor μ , and therefore the strength value of the inorganic load-bearing board is determined by the ultimate strength corrected value P_u' . Since the coefficient of effective wall length is determined by the strength value of the inorganic load-bearing board, there is room for improvement in the coefficient of effective wall length calculated based on the low strength value.

[0012]

From the above circumstances, there are demands for an inorganic load-bearing board, which has a low specific gravity and a light weight, and can assure incombustibility, as well as for a load-bearing wall that includes the inorganic load-bearing board and has a high

coefficient of effective wall length.

[0013]

5 A wooden exterior wall structure having a structure in which a board is constructed on an exterior side surface of a wooden frame or wooden framework is proposed in Patent Document 1. This wooden exterior wall structure has a gypsum plate, which is fixed as a load-bearing board on the exterior side surface of the wooden frame member or the wooden framework member. A gypsum core
10 portion of the gypsum plate includes an organopolysiloxane compound as a strength deterioration inhibitor for inhibiting deterioration of strength. The wall body in which the gypsum plate serving as the load-bearing board is fixed on the frame or framework has a coefficient of
15 effective wall length of 2.0 or greater as the strength of the wooden exterior wall against the short-term horizontal load.

PRIOR ART DOCUMENTS

20 PATENT DOCUMENTS

[0014]

Patent Document 1: Japanese Unexamined Patent Application Publication No. 2015-165087

25 SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0015]

30 The wooden exterior wall structure disclosed in Patent Document 1 can achieve a coefficient of effective wall length of 2.0 or greater as the strength of the wooden exterior wall against a short-term horizontal load. However, Patent Document 1 does not disclose an inorganic load-bearing board that solves the above problems,

specifically, i.e., an inorganic load-bearing board that has a low specific gravity and a light weight, and assures incombustibility.

[0016]

5 The present disclosure provides an inorganic load-bearing board, which has low specific gravity and a light weight, and assures incombustibility, and a load-bearing wall, which includes the inorganic load-bearing board and has a high coefficient of effective wall length.

10

MEANS FOR SOLVING THE PROBLEMS

[0017]

 According to one aspect of the present disclosure, an inorganic load-bearing board includes an
15 inorganic fibrous material in a range of 0.3 percent by mass to 6.0 percent by mass, and the inorganic load-bearing board has a low specific gravity, which is a specific gravity in a range of 0.7 to 0.9.

[0018]

20 In addition, according to one aspect of the present disclosure, a load-bearing wall includes a frame and the inorganic load-bearing board fixed on the frame with fasteners. The frame includes vertical members, an upper lateral member connecting upper ends of the vertical
25 members, and a lower lateral member connecting lower ends of the vertical members. The fasteners are screws.

EFFECTS OF THE INVENTION

[0019]

30 According to the present disclosure, there can be provided an inorganic load-bearing board, which has low specific gravity and a light weight, and assures incombustibility, as well as for a load-bearing wall that

includes the inorganic load-bearing board and has a high coefficient of effective wall length.

BRIEF DESCRIPTION OF THE DRAWINGS

5 [0020]

[FIG. 1] FIG. 1 is a front view of an example of a load-bearing wall including an inorganic load-bearing board according to the present embodiment.

[FIG. 2] Fig. 2 is a view as viewed along arrows II-II of
10 FIG. 1, and is a horizontal cross-sectional view of an enlarged region in which the inorganic load-bearing board is fastened to the upper lateral member with screws.

[FIG. 3] FIG. 3 is a diagram depicting an envelope of a
load-deformation angle curve obtained by an in-plane shear
15 test of a wooden structure building and a line graph obtained by converting the envelope into load-deformation angle characteristics of a perfect elastoplastic model.

DETAILED DESCRIPTION OF THE INVENTION

20 [0021]

The inorganic load-bearing board and load-bearing wall according to the present embodiment will be described with reference to attached drawings in detail, hereinafter. In the present specification and drawings, constituent
25 components that are substantially the same are denoted by the same reference numeral, and therefore redundant description may be omitted.

[0022]

[Inorganic load-bearing board and load-bearing
30 wall according to the present embodiment]

One example of the inorganic load-bearing board and load-bearing wall according to the present embodiment will be described with reference to FIGs. 1 and 2. Although

a gypsum board is described as an example of the inorganic load-bearing board, a cement board or calcium silicate board may be used for the inorganic load-bearing board according to the present embodiment. FIG. 1 is a front view
5 of an example of a load-bearing wall including the inorganic load-bearing board according to the present embodiment. FIG. 2 is a view as viewed along the arrows II-II of FIG. 1, and is a horizontal cross-sectional view of an enlarged region in which the inorganic load-bearing
10 board is fastened to the upper lateral member with screws. In addition, FIG. 3 is a diagram depicting an envelope of a load-deformation angle curve obtained by an in-plane shear test of a wooden structure building and a line graph obtained by converting the envelope into load-deformation
15 angle characteristics of a perfect elastoplastic model.
[0023]

The load-bearing wall 70 illustrated in FIG. 1 is a load-bearing wall of a wooden framework construction system, which is formed by fixing a wooden framework on a
20 footing 10 formed of reinforced concrete.
[0024]

On the footing 10, a base 22 (an example of the lower lateral member) extending in a lateral direction (e.g., a horizontal direction) is fixed via anchor bolts
25 11. Two posts 31 (an example of the vertical members) and several (three in the illustrated example) studs 32 (another example of the vertical members), which are disposed between the two posts 31 at predetermined intervals, are fixed on the base 22. A beam 21 (an example
30 of the upper lateral member) extending in a lateral direction (e.g., a horizontal direction) is fixed on the upper ends of these vertical members 30. The base 22, the beam 21, and the vertical members 30 constitute a frame 40.

The load-bearing wall 70 of the illustrated example depicts an example in which the load-bearing wall 70 is formed in a structural plane of the first floor. For the load-bearing wall formed in the structural plane of an upper floor,
5 which is a second floor or higher, both the lower lateral member and the upper lateral member are beams.

[0025]

The base 22, the vertical members 30, and the beam 21 are all formed of wood members (squared timber)
10 used for general wooden structure buildings.

[0026]

The inorganic load-bearing board 50 to be fastened to the frame 40 is a gypsum board. Examples of the gypsum board include a structural gypsum board and a
15 reinforced gypsum board specified in JIS A 6901, a regular gypsum board, and the like. As the load-bearing board, the structural gypsum board or the reinforced gypsum board is preferably used. The gypsum board is a gypsum-based board in which front and back surfaces of a board-like core
20 material formed of a gypsum core 51 (hardened gypsum body) are covered with gypsum board base paper 52.

[0027]

The used gypsum board 50 (short side length t_1 × long side length t_2 × thickness) is formed of an
25 incombustible material in the dimension of 910 mm × 1820 mm (2420 mm, 2730 mm) × 12.5 mm (15 mm, 21 mm, 25 mm) or the like. The width (short side) of the gypsum board can be 606 mm, 1000 mm, 1220 mm, or the like, as well as 910 mm. The length (long side) of the gypsum board can be 2000 mm,
30 3030 mm, or the like, as well as 1820 mm. In actual construction, there is a case where a gypsum board or the like is located, for example, at an edge of wall, and the gypsum board may be cut on site to adjust the size.

Therefore, in addition to the gypsum boards of the above dimensions, a gypsum board cut in a suitable size is also used.

[0028]

5 As described as an example above, the thickness of the gypsum board 50 of the illustrated example is 12 mm or greater. Since the gypsum board 50 having the thickness of 12 mm or greater is used, incombustibility of the gypsum board 50 can be assured.

10 [0029]

The gypsum board 50 is fastened to each of the vertical members 30, the beam 21, and the base 22 with screws 60 (an example of the fasteners) formed of iron or stainless steel.

15 [0030]

The intervals t_3 of the fastening screws 60 can be set in the range of 50 mm to 300 mm, for example, 150 mm.

[0031]

20 As illustrated in FIG. 2, each screw 60 includes a head 61 and a body 62, where the head 61 has a circular shape as viewed in a plan view, the body 62 includes a pointed tip 62a and a male thread on the outer periphery, and the screw 60 is continuous from the head 61 to the body 62 in a curved shape. The screw 60 in the illustrated example is a fully-threaded screw in which the male thread is provided to the entire area of the body 62, but the screw 60 may be a partially-threaded screw in which the male thread is provided from a halfway point of the body to the tip.

30

[0032]

In addition to the material and shapes of the head 61 and the body 62, the screw 60 is defined by a

diameter of the head 61 (head diameter d1), a diameter of the body 62 (body diameter d2), a total length of the screw 60 (length s2), and the like. The head diameter d1 can be set to approximately 7 mm to 9 mm, and for example, is set to 8.2 mm. The body diameter d2 can be set to approximately 3 mm to 4.5 mm, and for example, is set to 3.8 mm. The length s2 can be set to approximately 25 mm to 45 mm, and for example, is set to 28 mm.

[0033]

10 As described above, nails have generally been used as fasteners for fastening a load-bearing board. In the load-bearing wall 70 of the illustrated example, the screws 60 are used as fasteners. Nails, which are merely hammered into the gypsum board 50 to fix the gypsum board 50, need the total length that is approximately 2.5 to 3 times the thickness s1 of the gypsum board 50, whereas the screws 60, which are screwed into the gypsum board 50 to fix the gypsum board 50, have the length s2 that is only approximately 2 times the thickness s1 of the gypsum board.

20 [0034]

 Since the screws 60 are used, fastening force can be increased, compared to nails, due to the male thread provided to each screw 60.

[0035]

25 In addition, an area ratio of an area of the head 61 to a cross-sectional area of the body 62 (the area of the head 61/the cross-sectional area of the body 62) is preferably set in a range of 2.0 to 3.0. Since the area ratio is set in the range of 2.0 to 3.0, a value larger than 1/30 rad can be achieved as an ultimate displacement of the load bearing wall as measured by an in-plane shear test using a load-bearing wall sample having a wall length of 1.82 m.

[0036]

The gypsum core 51 of the gypsum board 50 includes predetermined amounts of an inorganic fibrous material and an organic strength improver, has a low
5 specific gravity, which is the specific gravity in the range of 0.7 to 0.9, has a lateral screw resistance of 500 N or greater, and a compressive strength of 5.5 N/mm² or greater.

[0037]

10 In the present specification, the "low specific gravity" refers to a specific gravity at which, when the screw 60 is driven into the gypsum board 50, the area of the gypsum board 50 in the periphery of the head 61 of the driven screw 60 does not rise. As a typical gypsum-based
15 load-bearing board, a structural gypsum board Type A and a structural gypsum board Type B specified in Notification No. 1100 of the Ministry of Construction are listed. The structural gypsum board Type A of low specific gravity has a specific gravity of around 0.8, and the structural gypsum
20 board Type B of high specific gravity has a specific gravity of around 1.0. Therefore, the specific gravity of around 0.8 can be regarded as a low specific gravity.

[0038]

The lateral screw resistance will be described
25 based on the relationship with the lateral nail resistance. The lateral nail resistance is a shear stress or shear strength of a nailed portion of a board measured by a lateral nail resistance test specified in JIS A 6901. Specifically, a test piece of 150 mm × 75 mm taken from a
30 board to be tested is used, and a through hole having a diameter of 2.6 mm is drilled by a drill at a position on the center line of the test piece, where the drilled position is 12 mm set apart from the upper edge of the

rectangular test piece in a front view in a length
direction (longitudinal direction). A stainless-steel round
rod (diameter of 2.6 mm, length of approximately 40 mm) is
inserted into the through hole, and a structural plane
5 (center plane) of the test piece is maintained
substantially in a vertical state. In addition, the round
rod is maintained in a horizontal state, and the lower end
of the test piece is fixed. Then, the load is applied to
round rod to lift the round rod at the speed of
10 approximately 6 mm/min, and the test piece is allowed to
fracture with the local load acting on the through hole of
the test piece from the round rod due to the upward
displacement of the round rod, thereby measuring the
strength at the time of fracture.

15 [0039]

In contrast with the lateral nail resistance, the
lateral screw resistance is determined by performing the
same test as the lateral nail resistance with various
screws replacing the stainless-steel round rod used in the
20 lateral nail resistance test. However, a screw has various
geometrical features, such as a head diameter, a nominal
diameter, the number of threads, and the like, compared to
a nail. Such geometrical features are reflected in the
test, affecting a resultant shear load-bearing strength or
25 shear strength. Thus, in this test, a test piece of an
example was prepared using a drilling tapping screw (JIS B
1125) having a nominal diameter of 4.2 mm and a length of
41 mm that was a typical screw used for fastening the
gypsum board 50. In addition, applicable screws include, in
30 addition to the above, other screws compatible with the
drilling tapping screw (JIS B 1125), a screw with a cross
hole (JIS B 1112), and the like.

[0040]

The amount of the inorganic fibrous material in the gypsum board 50 is in the range of 0.3 percent by mass to 6.0 percent by mass. Examples of the inorganic fibrous material to be added include glass fibers, carbon fibers, and the like. Among the above examples, the glass fibers are suitable as additives used for an industrial product because the glass fibers are inexpensive compared to carbon fibers, and readily available on the market.

[0041]

In the case where the glass fibers are used, glass fibers having diameters of 5 to 25 μm and lengths of 2 to 25 mm are suitably used.

[0042]

The reasons for specifying the amount of the inorganic fibrous material to the range of 0.3 percent by mass to 6.0 percent by mass include: the strength of the board, such as the lateral screw resistance, the compressive strength, or the like may not be sufficiently exhibited when the amount is less than 0.3 percent by mass; and when the amount is greater than 6.0 percent by mass, sufficient strength as the board has already been secured, and therefore a further increase of the amount of the inorganic fibrous material leads to a high cost and overengineering.

[0043]

In addition, the amount of the organic strength improver in the gypsum board 50 is in the range of 0.05 percent by mass to 4.00 percent by mass. Examples of the added organic strength improver include starches, polyvinyl acetate, polyvinyl alcohol, polyacrylics, and the like. As the starch, either an unprocessed starch or a processed starch can be used. Examples of the processed starch include starches processed by a physical treatment, a

chemical treatment, or an enzymatic treatment. As the starch processed by the physical treatment, pregelatinized starch can be suitably used. As the starch processed by the chemical treatment, oxidized starch, phosphate starch, urea phosphate esterified starch, hydroxypropyl distarch phosphate, hydroxyethylated starch, hydroxypropylated starch, cationic starch, or acetylated starch can be suitably used.

[0044]

Since the amount of the organic strength improver is 0.05 percent by mass to 4.00 percent by mass, the gypsum board 50 can achieve the compressive strength of 5.5 N/mm² or greater, while securing a low specific gravity of 0.7 to 0.9.

[0045]

The organic strength improver is a material effective for achieving the gypsum board 50 having the lateral screw resistance of 500 N or greater in cooperation with the inorganic fibers. In addition, the organic strength improver is a preferable material for improving the lateral screw resistance of the gypsum board 50 considering a fact that the addition of the organic strength improver does not largely affect an overall quality of the gypsum-based load-bearing board, other than the lateral screw resistance.

[0046]

Since the specific gravity of the gypsum board 50 is 0.7 to 0.9, it is possible to reduce the weight of the gypsum board 50 and improve the workability of the gypsum board 50. Since the gypsum board 50 has such a low specific gravity, it is possible to reduce the weight of the gypsum board 50 while ensuring the incombustibility of the gypsum board 50 with the thickness set to 12 mm or greater. In the

case where the gypsum board having a thickness of approximately 9 mm is used for the purpose of reducing the weight of the gypsum board, it is difficult to ensure incombustibility and therefore not preferable.

5 [0047]

With regard to the incombustibility of the gypsum board 50, the present inventors have determined that the total heat release of the gypsum board 50 is 8 MJ/m² or less as measured by a cone calorimeter test, which is one of the evaluation methods for incombustible materials specified by the Building Standards Act, with a heating time of 20 minutes, and have proved that the gypsum board 50 is an incombustible material.

[0048]

15 In addition, the screws 60 are used as the fasteners for fastening the gypsum board 50 in the load-bearing wall 70. If the gypsum board has a high specific gravity, which is the specific gravity of 1.0 or greater, a problem may occur such that a part of the gypsum core in the periphery of the screw rises as the screw is screwed in, that is, swelling of the gypsum core occurs, and the driving of the screw is performed insufficiently. In contrast, since the gypsum board 50 of the illustrated example has a low specific gravity of 0.7 to 0.9, even in 20 the case where the screws 60 are used as fasteners, swelling does not occur, and the gypsum board 50 can be securely fixed to the frame 40.

[0049]

While the above-described various effects are 30 obtained by the low specific gravity of the gypsum board 50, the low specific gravity of the gypsum board 50 is generally likely to reduce a coefficient of effective wall length of the load-bearing wall. However, the load-bearing

wall 70 having the ultimate strength corrected value P_u' of 8.0 kN or greater can be formed because the gypsum board 50 includes the inorganic fibrous material in the amount of 0.3 percent by mass to 6.0 percent by mass and the organic strength improver in the amount of 0.05 percent by mass to 4.00 percent by mass, and the screws 60 are used as fasteners instead of nails.

[0050]

The coefficient of effective wall length will be described with reference to FIG. 3. The perfect elastoplastic model illustrated in FIG. 3 is composed of a straight line of a linear function in the linear elastic region (elastic region) and a straight line in a plastic deformation region (ductile region), which extends parallel to the X-axis from a yield point σ_s . The yield point σ_s represents the elastic limit. The method of converting the envelope into the perfect elastoplastic model is a known method, which is described in the literature, such as "Wooden load-bearing wall and operational procedures of testing and evaluating magnifications and performance thereof" and the like.

[0051]

FIG. 3 depicts the maximum load-bearing strength P_{max} , the 0.8 P_{max} load reduction region, the ultimate strength P_u , the yield strength P_y , the ultimate displacement δ_u , the yield point displacement δ_v , and the yield displacement δ_y . The ultimate displacement δ_u and the yield point displacement δ_v are a shear deformation angle in the 0.8 P_{max} load reduction region and a shear deformation angle at the yield point σ_s , respectively. In addition, the yield displacement δ_y is a shear deformation angle at the time of appearance of the yield strength P_y . Further, the ductile factor μ is a value of δ_u/δ_v .

[0052]

As described in literature, such as pages 63 and 300 of "Allowable Stress Design for Wooden Framework Construction Method Housing [1] (2017 edition)", the
5 coefficient of effective wall length is calculated by calculating a short-term allowable shear strength P_a based on the strength $P_{\max}$, P_u , and P_y , and displacements δ_u , δ_v , and δ_y specified by the perfect elastoplastic model depicted in FIG. 3, and dividing the short-term allowable
10 shear strength P_a with predetermined stress (wall length L (m) $\times$ 1.96 (kN/m)).

[0053]

In the calculation of the coefficient of effective wall length, in principle, the smallest strength
15 value among the following 4 types of strength values (1) to (4) is determined as a short-term reference shear strength P_o , the short-term reference shear strength P_o is multiplied by a predetermined reduction coefficient (α) (a coefficient for evaluating a factor of reduction in
20 strength), and the resultant value is determined as a short-term allowable shear strength P_a . The ultimate strength corrected value P_u' is calculated by $0.2 P_u/D_s = 0.2 P_u \times (2\mu-1)^{1/2}$, and a structural characteristic factor D_s is represented by $D_s = 1/(2\mu-1)^{1/2}$.

- 25 (1) Yield strength P_y
(2) Ultimate strength corrected value P_u' obtained by correcting ultimate strength P_u based on a ductile factor μ
(3) 2/3 of maximum load-bearing strength $P_{\max}$
(4) Strength at a shear deformation angle of 1/120 rad
30 (no-load or load system)

[0054]

Whereas a strength value of a wooden load-bearing board having high toughness is often determined by (1)

above, a strength value of the gypsum board 50 having low toughness is often determined by (2) above. Specifically, the gypsum board has a small ultimate strength P_u and a small ductile factor μ , and therefore the strength value of the gypsum board 50 is determined by the ultimate strength corrected value P_u' . Since a coefficient of effective wall length is determined by this strength value, there is room for improvement in the coefficient of effective wall length.

10 [0055]

In this regard, since the gypsum board 50 has a low specific gravity, and includes the inorganic fibrous material or the organic strength improver, or both, the gypsum board 50 has high toughness, which contributes to an increase in the coefficient of effective wall length.

15 [0056]

Further, since the screws 60 are used as fasteners for fastening the gypsum board 50 to the frame 40, instead of nails, the force of fastening the gypsum board 50 to the frame 40 is increased, a fracture in the fastening region due to punching out is unlikely to occur, and toughness is increased, all of which also contribute to an increase in the coefficient of effective wall length.

20 [0057]

Further, since the area ratio of the area of the head 61 of the screw 60 to the cross-sectional area of the body 62 of the screw 60 is in the range of 2.0 to 3.0, a value of an ultimate displacement δ_u of greater than $1/30$ rad can be achieved as the ultimate displacement of the load-bearing wall as measured by an in-plane shear test using a load-bearing wall test sample having a wall length of 1.82 m, and the strength value can be increased with (2) above, which also contributes to an increase in the

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coefficient of effective wall length.

[0058]

There may be other embodiments, in which other constituent components are combined with the configuration and the like described in the above embodiments, and the present disclosure is not limited to the configurations described here. In this regard, the embodiments described here can be changed without departing from the gist of the present disclosure, and can be appropriately determined according to the application.

[0059]

The present international application claims priority to Japanese Patent Application No. 2023-179477 filed on October 18, 2023, the entire contents of which are incorporated herein by reference.

REFERENCE SIGNS LIST

[0060]

- 10: footing
- 20 11: anchor bolt
- 21: beam (upper lateral member)
- 22: base (lower lateral member)
- 30: vertical member
- 31: post (vertical member)
- 25 32: stud (vertical member)
- 40: frame
- 50: load-bearing board (inorganic load-bearing board, gypsum board)
- 51: gypsum core
- 30 52: based paper for gypsum board
- 60: screw (fastener)
- 61: head
- 62: body

62a: tip

70: load-bearing wall

CLAIMS

[Claim 1]

5 An inorganic load-bearing board, comprising:
 an inorganic fibrous material in a range of 0.3
percent by mass to 6.0 percent by mass,
 wherein the inorganic load-bearing board has a low
specific gravity, which is a specific gravity in a range of
0.7 to 0.9.

10

[Claim 2]

 The inorganic load-bearing board according to
claim 1, further comprising:
 an organic strength improver in a range of 0.05
15 percent by mass to 4.00 percent by mass.

[Claim 3]

 The inorganic load-bearing board according to
claim 2,
20 wherein the inorganic load-bearing board has a
thickness of 12 mm or greater.

[Claim 4]

 The inorganic load-bearing board according to
25 claim 3,
 wherein the inorganic fibrous material is a glass-
fiber material.

[Claim 5]

30 The inorganic load-bearing board according to
claim 4,
 wherein a total heat release of the inorganic load-
bearing board measured by a cone calorimeter test with a

heating time of 20 minutes is 8 MJ/m² or less.

[Claim 6]

5 The inorganic load-bearing board according to
claim 5,
 wherein the inorganic load-bearing board has a lateral
screw resistance of 500 N or greater.

[Claim 7]

10 The inorganic load-bearing board according to
claim 6,
 wherein the inorganic load-bearing board has a
compressive strength of 5.5 N/mm² or greater.

15 [Claim 8]

 The inorganic load-bearing board according to
claim 7,
 wherein the load-bearing board is formed of a gypsum
board.

20

[Claim 9]

 A load-bearing wall, comprising:
 a frame including vertical members, an upper
lateral member connecting upper ends of the vertical
25 members, and a lower lateral member connecting lower ends
of the vertical members; and
 the inorganic load-bearing board of any one of
claims 1 to 8, fixed on the frame with fasteners, the
fasteners being screws.

30

[Claim 10]

 The load-bearing wall according to claim 9,
 wherein the load-bearing wall has an ultimate strength

corrected value P_u' of 8 kN or greater, where the ultimate strength corrected value P_u' is, among physical properties of the load-bearing wall measured by an in-plane shear test, a value obtained by correcting, based on a ductile
5 factor μ , an ultimate strength P_u .

[Claim 11]

The load-bearing wall according to claim 10,
wherein each of the screws includes a head and a body,
10 and an area ratio of an area of the head to a cross-sectional area of the body is 2.0 to 3.0, and
wherein the load-bearing wall has a value of an ultimate displacement δ_u greater than $1/30$ rad, the ultimate displacement δ_u being an ultimate displacement of
15 the load-bearing wall measured by an in-plane shear test using a load-bearing wall sample having a wall length of 1.82 m.