

EXTERIOR WALL MEMBRANE CONSTRUCTION METHOD AND EXTERIOR
WALL MEMBRANE STRUCTURE FOR STACK

TECHNICAL FIELD

5 [0001] The present invention relates to an exterior wall
membrane construction method in which a decorative exterior
wall that surrounds a periphery of a stack has a membrane
structure, instead of the conventional concrete structure,
in order not to impair the scenery, and to an exterior wall
10 membrane structure constructed with this method.

BACKGROUND ART

[0002] A periphery of a stack constructed in cities and
tourist destinations is often surrounded with a decorative
15 exterior wall in order not to impair the scenery (See, for
example, Patent Document 1). Such an exterior wall that
surrounds the periphery of a stack is generally made of
reinforced concrete, lightweight aerated concrete,
prestressed concrete panels, and the like.

20 [0003] However, if the exterior wall is made of
reinforced concrete, and the like, it is difficult to make
a design that gives consideration to the environment, and,
the construction period thereof is also as long as a year.
Moreover, the shape of the exterior wall that is made of
25 reinforced concrete and the like is limited to standard
shapes such as a rectangle, a circle, and a polygon.
Moreover, when the exterior wall requires repair due to
time-related deterioration, there is no way but to repair
only the peripheral portions of the exterior wall as the
30 industrial design applied to the exterior wall cannot be
changed, and, the repair period is also long.

[0004] In the recent years, skeleton stacks in which
steel louvers are arranged on an exterior surface thereof

have been constructed. However, in the case of a skeleton stack, there is a problem that the steel louvers undergo steel corrosion and that the periphery of the stack cannot be divided into compartments.

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PRIOR ART REFERENCES

PATENT REFERENCE

[0005] Patent Document 1: Japanese Patent Application Laid-open No. H06-66051

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SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] The issues that the present invention intends to solve are, when surrounding the periphery of a stack with an exterior wall of reinforced concrete or the like, that it is difficult to make a design that gives consideration to the environment, and, that the construction period is as long as a year. Moreover, the shape of the exterior wall is limited to the standard shapes such as the rectangle, the circle, and the polygon. Moreover, when the exterior wall requires repair due to time-related deterioration, there is no way but to repair only the peripheral portions of the exterior wall as the industrial design applied to the exterior wall cannot be changed, and, the repair period is also long.

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MEANS FOR SOLVING THESE PROBLEMS

[0007] An object of the present invention is to present an exterior wall, which can be used to surround the periphery of a stack, that can be designed by giving consideration to the environment, that can be constructed in a short time, and that can have a complex geometric shape that enhances the design. Moreover, another object

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of the present invention is to present an exterior wall whose industrial design can be changed easily when repairing the time-related deterioration and that can be repaired in a short time.

5 [0008] According to an aspect of the present invention, a method of constructing an exterior wall membrane that surrounds a stack includes surrounding with a membrane member an exterior side of first steel members that are arranged around the stack to support the stack, or second
10 steel members that are arranged on the first steel members, and then fixing a membrane member exterior edge that is an exterior edge of the membrane member and, if required, an appropriate position of the membrane member other than the membrane member exterior edge.

15 [0009] With the above method of constructing an exterior wall membrane around a stack of the present invention, an exterior wall membrane structure that surrounds a membrane member from an exterior side of first steel members that are arranged around the stack to support the stack, or
20 second steel members that are arranged on the first steel members, and fixes a membrane member exterior edge that is an exterior edge of the membrane member and, if required, an appropriate position of the membrane member other than the membrane member exterior edge, can be constructed in a
25 short time.

[0010] In the above exterior wall membrane structure according to the present invention, because the exterior side of the first steel members that support the stack, or the second steel members that are arranged on the first
30 steel members, is surrounded with the membrane member and the membrane member is fixed, a complex geometric shape that enhances the design can be formed.

[0011] Moreover, the industrial design applied to the

exterior wall can be easily changed when repairing the time-related deterioration of the exterior wall, and, this repair can be made in a short time.

5 ADVANTAGEOUS EFFECTS OF THE INVENTION

[0012] According to the present invention, because of the use of the membrane member that is lightweight as compared to concrete or the like, the foundation work can be reduced. Moreover, because the first steel members that support the stack also serve as the support members that support the membrane members, the construction period can be drastically shortened, and the construction cost can be drastically reduced. Furthermore, because the construction work can be carried out from inside of the exterior wall membrane structure, the scaffold becomes unnecessary, and therefore, the construction period can be further shortened, and the construction cost can be further reduced. Moreover, by providing the second steel members in addition to the first steel members that support the stack, construction of structures with shapes having depressions become possible, making it possible to construct an exterior wall having a complex geometric shape that enhances the design.

BRIEF DESCRIPTION OF THE DRAWINGS

25 [0013] FIG. 1 is a schematic diagram of a self-standing stack to which an exterior wall membrane structure according to the present invention has been applied, where (a) is a general perspective view of the stack, (b) is a plan view of the stack when seen from the top, (c) is a horizontal cross-section of an intermediate portion of the stack, and (d) is a horizontal cross-section of a leg portion of the stack.

FIG. 2 is a schematic diagram of an integrated stack

to which the exterior wall membrane structure according to the present invention has been applied in the same manner as FIG. 1.

FIG. 3 is a schematic diagram of a first example of a fixing mechanism used for fixing an exterior edge of a membrane member where (a) shows a situation before completion of fixing as seen from above and (b) shows a situation after completion of fixing as seen from above.

FIG. 4 is a schematic diagram of a second example of a fixing mechanism used for fixing the exterior edge of the membrane member where (a) is a perspective view of a situation after completion of fixing and (b) shows a situation after completion of fixing as seen from above.

FIG. 5 is a schematic diagram of a third example of a fixing mechanism used for fixing the exterior edge of the membrane member and shows a situation after completion of fixing as seen from above.

FIG. 6 is an overall perspective view of an exterior wall membrane structure according to the present invention in which a membrane member is fixed to a self-standing stack by using a fourth example of a fixing mechanism.

FIG. 7(a) is a schematic diagram of a situation after completion of fixing by using the fourth example of a fixing mechanism as seen from a side, (b) is a cross-section along a line A-A shown in (a), and (c) is an enlarged view of a portion B shown in (b).

PREFERRED EMBODIMENT

[0014] The present invention achieves the above object, that is, to present an exterior wall that surrounds the periphery of a stack, that can be designed by giving consideration to the environment, that can be constructed in a short time, and that can have a complex geometric

shape that enhances the design, by constructing a membrane member, which is lightweight as compared to concrete, from inside.

5 EXAMPLE

[0015] Exemplary embodiments of the present invention are explained below while referring to FIG. 1 to FIG. 7.

FIG. 1 is a schematic diagram of a self-standing stack to which an exterior wall membrane structure according to the present invention has been applied. A self-standing stack is the one that is constructed directly on the ground. FIG. 2 is a schematic diagram of an integrated stack to which the exterior wall membrane structure according to the present invention has been applied. An integrated stack is the one that is coupled to an upper part of a building.

[0016] In FIG. 1 and FIG. 2, reference number 1 represents stacks. In this example, two stacks 1 are arranged with a certain distance therebetween. Those two stacks 1 are supported by first steel members 2 (three in the example of FIG. 1 and four in the example of FIG. 2), and flooring members 3. The first steel members 2 are arranged around the stacks 1. The flooring members 3 are attached to the first steel members 2 at predetermined heights and in an appropriate number. The flooring members 3 are supported by beam members 4 that couple and fix the first steel members 2.

[0017] The periphery of the stacks 1 is surrounded with membrane members 5 in order not to impair the scenery.

In the example shown in FIG. 1, the membrane members 5 are arranged so as to surround an exterior periphery of the three first steel members 2. The flooring members 3 are hexagonal and attached to the beam members 4 that couple and fix the first steel members 2. Rib members 11 are

arranged so as to make a circumscribed circle from the three first steel members 2 and the flooring members 3. In a portion where the flooring members 3 are arranged, the membrane members 5 are arranged so as to surround the exterior periphery of the rib members 11.

[0018] In the example shown in FIG. 2, the membrane members 5 are arranged so as to surround an exterior periphery of the four first steel members 2. The flooring members 3 are quadrangular and attached to the beam members 4 that couple and fix the first steel members 2. The rib members 11 are arranged so as to make an internal portion of the building (excluding the left side in FIG. 2(b) to (d)) a curved surface from the four first steel members 2 and the flooring members 3. In a portion where the flooring members 3 are arranged, the membrane members 5 are arranged so as to surround the exterior periphery of the rib members 11. In the example shown in FIG. 2, the flooring members 3 arranged in an upper portion of the structure are trapezoidal, and those arranged in a middle portion and a leg portion are rectangular. Second steel members 6 are arranged so as to protrude out from a central portion of two opposing beam members 4, and the membrane members 5 are arranged so as to surround the tip portions of the second steel members 6.

[0019] In the example shown in FIG. 1, exterior edges of the adjacent membrane members 5, which surround the exterior periphery of the stacks 1 in this manner, are, for example, at the positions of the three first steel members 2, drawn toward the inner side of the structure and fixed to each other. Thus, in the example shown in FIG. 1, three membrane members 5 are arranged in the circumferential direction of the structure.

[0020] On the other hand, in the example shown in FIG. 2,

exterior edges of adjacent membrane members 5 are, at the positions of the second steel members 6, which protrude out from a central portion of two opposing beam members 4, drawn toward inner side of the structure and fixed to each other. Thus, in the example shown in FIG. 2, two membrane members 5 are arranged in the circumferential direction of the structure.

[0021] A fixing mechanism that fixes the exterior edges of the adjacent membrane members 5 that are drawn toward the inner side of the structure at the positions of the first steel members 2 or the second steel members 6 includes a drawing member and a fixing tool. The drawing member is arranged at a position at which the exterior edges of the adjacent membrane members 5 are drawn toward the inner side, and the fixing tool fixes the exterior edges that are drawn in the drawing member. Examples of the fixing mechanism are shown in FIG. 3 to FIG. 5.

[0022] A fixing mechanism 7 shown in FIG. 3 includes a pair of crooked opposing nipping levers 7a. Each of the nipping levers 7a has a base end and a tip end. The tip ends of the nipping levers 7a approach or separate from each other when the nipping levers 7a swing with the base end as a pivot 7aa. A locking tool 7b that locks the exterior edge of the membrane member 5 is attached to each of the nipping levers 7a at a position that is toward the tip end relative to a central bent portion 7ab. Moreover, a swinging and fixing mechanism 7c capable of swinging the tip ends of the nipping levers 7a causing the tip ends to approach or separate from each other is arranged at a position that is toward the base end relative to the central bent portion 7ab of the nipping levers 7a. In the example shown in FIG. 3, the swinging and fixing mechanism 7c includes a screw shaft 7ca arranged across both the

nipping levers 7a, and a nut 7cb that is screwed into the screw shaft 7ca, and the swinging and fixing of the nipping levers 7a is realized by loosening or tightening the nut 7cb.

5 [0023] The locking tool 7b has a hole 7ba and a slit 7bb from which the hole 7ba communicates to the outside. The exterior edge of the membrane member 5 is rolled and made into a closed loop and an edge rope is integrally inserted into the loop of the exterior edge. This exterior edge
10 with the edge rope is then inserted into the hole 7ba via the slit 7bb from vertical cross-sectional direction. In the example shown in FIG. 3, the locking tool 7b is fixed to the respective nipping lever 7a with a tension rod 12.

[0024] In the fixing mechanism 7 shown in FIG. 3, a
15 water sealing rubber 8 can be inserted between the tip ends of the nipping levers 7a when drawing the exterior edges of the membrane members 5 and fixing the exterior edges. The water sealing rubber 8 prevents entry of water inside the structure while the exterior edges of the membrane members
20 5 are being drawn and fixed. In the example shown in FIG. 3, an inner membrane member 9 is arranged between opposing locking tools 7b to surely prevent the entry of water inside the structure after the exterior edges of the membrane members 5 are drawn and fixed.

25 [0025] In the embodiment shown in FIG. 3, the nipping levers 7a and the swinging and fixing mechanism 7c together constitute the drawing member, and the locking tools 7b constitutes the fixing tool.

[0026] The fixing mechanism 7 shown in FIG. 4 includes a
30 pair of pipe members 7d arranged side by side with a gap d1 that allows insertion of the exterior edges of the membrane members 5. The exterior edges of the membrane members 5 that are inserted from the gap d1 between the pipe members

7d are then integrally fixed by using a tightening tool 7e. In the example shown in FIG. 4, the tightening tool 7e includes a pair of membrane fixing plates 7ea that sandwich the exterior edges of the membrane members 5, and a fixing
5 bolt 7eb and a nut 7ec that keep the membrane fixing plates 7ea together. In this tightening tool 7e, the exterior edges of the membrane members 5 are integrally fixed to each other by tightening the nut 7ec.

[0027] It should be noted that, the exterior edges of
10 the membrane members 5 can be integrally fixed to each other by using the locking tool 7b and the tension rod 12 instead of using the tightening tool 7e.

[0028] In the fixing mechanism 7 shown in FIG. 4, the water sealing rubber 8 can be inserted in the gap d1
15 between the pipe members 7d from which the exterior edges of the membrane members 5 that are inserted when drawing the exterior edges of the membrane members 5 and fixing the exterior edges. The water sealing rubber 8 prevents entry of water inside the structure while the exterior edges of
20 the membrane members 5 are being drawn and fixed. In FIG. 4, a reference number 10 represents the edge ropes that are integrated with the exterior edges of the membrane members 5. The exterior edge of the membrane member 5 is rolled and made into a closed loop by thermal welding and the like,
25 and then an edge rope 10 is integrally inserted into the loop of the exterior edge.

[0029] In the embodiment shown in FIG. 4, the pipe members 7d constitute the drawing member, and the tightening tool 7e constitutes the fixing tool.

30 [0030] The fixing mechanism 7 shown in FIG. 5 includes a pair of pipe members 7f arranged with an interval d2 and attached to a tip portion of the first steel member 2 or the second steel member 6, tension rods 7g with base ends

thereof attached to the first steel member 2 or the second steel member 6, and locking tools 7h attached to tip ends of the tension rods 7g. The exterior edges of the membrane members 5 are drawn by turning around the peripheral
5 surfaces of the pipe members 7f and then fixed with the locking tools 7h.

[0031] In the fixing mechanism 7 shown in FIG. 5, a water entry prevention membrane 7i that encloses the tip end of the first steel member 2 or the second steel member
10 6 can be arranged to prevent entry of water inside the structure while the exterior edges of the membrane members 5 are being drawn and fixed. One end of the water entry prevention membrane 7i is attached to the first steel member 2 or the second steel member 6, and the other end
15 thereof is welded to the membrane member 5 by thermal welding and the like.

[0032] In the embodiment shown in FIG. 5, the pair of pipe members 7f attached in a protruding manner to the tip portion of the first steel member 2 or the second steel
20 member 6, and the pair of tension rods 7g attached to the first steel member 2 or the second steel member 6 constitute the drawing member, and the locking tool 7h constitutes the fixing tool.

[0033] In the example shown in FIG. 1, the exterior wall
25 membrane structure according to the present invention includes surrounding the exterior peripheral portions of the first steel members 2 that support the stacks 1 with the membrane members 5 to form a structure that has the first steel members 2 at apices thereof. In the example
30 shown in FIG. 2, the exterior wall membrane structure according to the present invention includes surrounding the exterior peripheral portions of the first steel members 2 to support the stacks 1 and the second steel members 6 with

the membrane members 5 to form a structure that has the first steel members 2 and the second steel members 6 at apices thereof. This work can be carried out from inside eliminating the need to construct a dedicated scaffold on the outside of the first steel members 2 and the second steel members 6.

[0034] Moreover, in the example shown in FIG. 1, the exterior edges of the adjacent membrane members 5 are drawn from the outside to the inside of the structure at the positions of the three first steel members 2, and at the drawn location, those drawn exterior edges are fixed by using the fixing mechanism 7 shown in any one of FIG. 3 to FIG. 5. In the example shown in FIG. 2, the exterior edges of the adjacent membrane members 5 are drawn from the outside to the inside of the structure at the positions of the two steel members 6, and at the drawn location, those drawn exterior edges are fixed by using the fixing mechanism 7 shown in any one of FIG. 3 to FIG. 5. This constitutes the exterior wall membrane construction method according to the present invention.

[0035] According to the present invention having the above-explained structure, because the membrane member 5 that is lightweight as compared to concrete has been used, the foundation work can be reduced. Moreover, because the first steel members 2 that support the stacks 1 also serve as the support members that support the membrane members 5, the construction period can be drastically shortened, and the construction cost can also be drastically reduced.

[0036] Moreover, because the construction work can be carried out from inside of the exterior wall membrane structure, the scaffold becomes unnecessary, and therefore, the construction period can be further shortened, and the construction cost can be further reduced.

[0037] Moreover, by providing more steel members in addition to the first steel members 2 that support the stacks 1, not limited to the shapes shown in FIG. 1 and FIG. 2, shapes having depressions can be dealt with making it possible to construct an exterior wall having a complex geometric shape that enhances the design.

[0038] Moreover, according to the present invention, when there is time-related deterioration of the exterior wall of the stacks 1, the industrial design applied to the exterior wall can be easily changed when repairing the exterior wall, and, this repair can be made in a short time.

[0039] Moreover, as long as the membrane member 5 used in the present invention possesses durability and thermal resistance necessary for the exterior wall of the stacks 1, the material of the membrane member 5 does not matter. For example, glass fiber having a coating of fluororesin can be used for the membrane member 5.

[0040] In addition, if the exteriormost layer of the membrane member 5 is subjected to an anti-smudge treatment, such as coating a photocatalyst layer, then smudge due to time-related change reduces, and maintainability can be improved. Furthermore, if the membrane member 5 that allows passage of light is used, a fantastic environment can be produced in the night time by installing decorative lights on the inner side of the membrane member 5.

[0041] The present invention is by no means limited to the above-explained examples. It is needless to say that the embodiments of the present invention can be appropriately modified as long as the technical idea falls within the scope of the claims.

[0042] For example, the examples shown in FIG. 1 and FIG. 2 assume that a single piece of the membrane member 5 is used in the height direction; however, plural pieces of the

membrane member 5 can be used in the height direction.
Moreover, the membrane member 5 can be wound obliquely.

[0043] Moreover, the exterior wall membrane structure shown in FIG. 1 and FIG. 2 that uses the fixing mechanism 7 shown in FIG. 3 to FIG. 5 has substantially similar structure in the horizontal cross-section taken at any location from the base end to the tip end of the stack. However, as shown in FIG. 6, it is possible to construct an exterior wall membrane structure having an enhanced design in which the horizontal cross-sections taken at different locations from the base end to the tip end of the stack have different structures.

[0044] When the horizontal cross-sections taken at different locations from the base end to the tip end of the stack have different structures, as in the case of the exterior wall membrane structure shown in FIG. 6, the fixing mechanism 7 shown in FIG. 7, for example, can be used.

[0045] The fixing mechanism 7 shown in FIG. 7 includes a locking tool 7j, a U-shaped plate member 7k, and a bolt 7n and a nut 7o that fix the U-shaped plate member 7k to the locking tool 7j. The locking tool 7j includes a hole 7ja and a slit 7jb from which the hole 7ja communicates to the outside. An exterior edge of the membrane member 5 is rolled and made into a closed loop and the edge rope 10 is integrally inserted into this loop. This exterior edge of the membrane member 5 with the edge rope 10 is inserted into the hole 7ja via the slit 7jb from a vertical cross-sectional direction.

[0046] Plural wires 7m are appropriately stretched around the stacks from the base end to the tip end thereof to form a predetermined horizontal cross-sectional shape, and the curved end of the U-shaped plate member 7k is

engaged with one of the wires 7m. The wires 7m can be stretched from, for example, a support member located at an upper part of the stacks (the first steel members 2, the beam members 4, or the second steel members 6) to a support member located at a lower part of the stacks (a foundation of the stacks in case of the self-standing stack shown in FIG. 1, or a support member arranged at an upper part of the building in case of the integrated stack shown in FIG. 2).

10 [0047] When the fixing mechanism 7 shown in FIG. 7 is used, the exterior edges of the membrane members 5 can be fixed by simply stretching the wires 7m at predetermined positions without passing them through steel members. As shown in FIG. 7, the exterior edges of the adjacent
15 membrane members 5 (or separate membrane members attached to those exterior edges by welding) can be attached to a square member 7q that is attached to one of the locking tools 7j via an angle member 7p. This structure insulates the fixing parts from outside and prevents entry of water
20 inside the structure. Moreover, the fixing mechanism 7 shown in FIG. 7 allows fixing of the membrane member 5 at an appropriate position other than the exterior edge of the membrane member 5.

25 EXPLANATIONS OF THE REFERENCE NUMERALS

[0048] 1 stack
2 first steel member
3 flooring member
5 membrane member
30 6 second steel member
7 fixing mechanism
7a nipping lever
7aa pivot

- 7b locking tool
- 7c swinging and fixing mechanism
- 7d pipe member
- 7e tightening tool
- 5 7f pipe member
- 7g tension rod
- 7h, 7j locking tool
- 7k plate member
- 7m wire

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CLAIMS

1. A method of constructing an exterior wall membrane around at least one chimney stack, comprising:

surrounding with a membrane member an exterior side of first steel members that are arranged around the chimney stack to support the stack, or second steel members that are arranged on the first steel members, and then fixing a membrane member exterior edge that is an exterior edge of the membrane member and, if required, an appropriate position of the membrane member other than the membrane member exterior edge.

2. An exterior wall membrane structure capable of being arranged around at least one chimney stack, comprising:

surrounding with a membrane member an exterior side of first steel members that are arranged around the chimney stack to support the chimney stack, or second steel members that are arranged on the first steel members, and fixing a membrane member exterior edge that is an exterior edge of the membrane member and, if required, an appropriate position of the membrane member other than the membrane member exterior edge.

3. The exterior wall membrane structure of the chimney stack according to Claim 2, wherein a fixing mechanism that fixes the exterior edge includes

a drawing member that is arranged at a position of the

shape at which the exterior edge is drawn from outside to inside; and

a fixing tool that fixes the exterior edge drawn in the drawing member.

4. The exterior wall membrane structure of the chimney stack according to Claim 3, wherein the fixing tool includes

a pair of nipping levers having a base end and a tip end, the tip ends of the nipping levers approach or separate from each other by swinging with the base end as a pivot;

a locking tool that is attached to each of the nipping levers and that locks the exterior edge of the membrane member; and

a swinging and fixing mechanism capable of swinging and fixing the nipping levers.

5. The exterior wall membrane structure of the chimney stack according to Claim 3, wherein the fixing tool includes

a pair of pipe members arranged side by side with a gap that allows insertion of the membrane members; and

a tightening tool that integrally fixes the exterior edges of the membrane members that are inserted from the gap between the pipe members.

6. The exterior wall membrane structure of the chimney stack according to Claim 3, wherein the fixing tool includes

a pair of pipe members attached in a protruding manner to a tip portion of the first steel members or the second

steel members with a predetermined interval;

locking tools that lock the exterior edges of the membrane members that are drawn by turning around the peripheral surfaces of the pipe members; and

tension rods that fix the fixing tools to the membrane fixing member.

7. The exterior wall membrane structure of the chimney stack according to Claim 2, wherein a fixing mechanism that fixes the exterior edge of the membrane member and appropriate position of the membrane member other than the membrane member exterior edge includes

a locking tool that locks a locking member arranged at a necessary position of the membrane member; and

a plate member attached to the locking tool,

wherein the membrane member locked with the locking tool is fixed by engaging the plate member to a wire arranged on an exterior side of the chimney stack.