

Description

Title of Invention : DECK PLATE AND DRY ROOF

Technical Field

[0001] The present invention relates to a deck plate and a dry roof.

Background Art

[0002] Roofs and rooftops of single-story buildings and medium- to low-rise buildings are constructed by a dry roof with external thermal insulation, in which a heat insulation material and a waterproofing material are provided on a deck plate, in some cases. A dry roof does not require concrete to be placed on the upper surface of the deck plate, and thus is lightweight and has a short construction period and excellent workability (refer to Patent Literature 1, for example).

Document List

Patent Literature

[0003]

Patent Literature 1: Japanese Patent Application Publication No. 2016-928

Summary of Invention

Technical Problem

[0004] In a dry roof, the deck plate has certain fire-resistant performance, but it is difficult to enhance fire-resistant performance with the deck plate alone since no concrete is placed.

Meanwhile, there is a demand for enhancing thermal insulation performance of dry roofs, but if the heat insulation material provided on the deck

plate is increased, the heat insulation material encumbers heat release to the outside of the deck plate in the case of a fire, and as a result, heat accumulates in the deck plate, degrading fire-resistant performance, and thus an allowable span needs to be shortened under design standards.

Furthermore, leaving the lower surface of the deck plate exposed to an interior space on the lower side leads to poor appearance and concerns about dew condensation on the surface of the deck plate due to low specific heat, and for such reasons, finishing treatment is often applied to the lower surface of the deck plate.

In addition, the waterproofing material, the heat insulation material, and the like provided in a dry roof need to be fixed to the deck plate again when replaced, and during such fixing work, powder dust and the like fall into the lower side of the deck plate, in other words, the interior space, and thus protective covering needs to be provided on the lower side of the deck plate.

As such, enhancement of thermal insulation performance and enhancement of fire-resistant performance, which conflict each other, are required for a deck plate for a dry roof, and also, enhancement of structural performance, enhancement of appearance, enhancement of sound insulation, and a comfortable residential environment without dew condensation or the like are required under regular conditions, which results in increase in the number of treatments applied to the deck plate, and consequently, protective covering work when the waterproofing material or the like is repaired is burdensome.

[0005] Thus, the present invention is made in view of the above-described problem and intended to provide a technology that can simplify treatment applied to a deck plate in a dry roof while enhancing fire-resistant performance and structural performance of the deck plate in the dry roof, as well as enhancing residential environment performance such as appearance, thermal insulation,

and sound insulation, and can eliminate protective covering work when a waterproofing material or the like is repaired.

Solution to Problem

[0006] To solve the above-described problem, an aspect according to the present invention is a deck plate that is used for a dry roof and to which a member that improves performance is attached on an upper surface, the deck plate being characterized by including a wooden part provided on a lower surface side of the deck plate and covering at least a lower surface side of an attachment position of the member.

[0007] It is preferable that the wooden part have a thickness calculated as a product of an additional fire-resistant time and a carbonization rate of the wooden part.

[0008] It is preferable that the wooden part be subjected to flame-retardant treatment providing fireproof performance for a predetermined time, and the wooden part have a thickness calculated as a product of a time obtained by subtracting the predetermined time from the fire-resistant time and a carbonization rate of the wooden part.

[0009] It is preferable that a deck plate body part have fire-resistant performance for a predetermined time.

[0010] It is preferable that the wooden part be formed of a design-purpose finishing material or the like.

[0011] It is preferable that a deck plate body part be formed with a plurality of ridge parts and valley parts alternately, the wooden part be attached to the valley parts, and a space be formed between the wooden part and the ridge parts.

[0012] To solve the above-described problem, an aspect according to the present invention is a dry roof characterized by including the above-described

deck plate and a heat insulating part provided on the upper surface of the deck plate.

[0013] It is preferable that the dry roof include a waterproofing part covering the heat insulating part.

[0014] It is preferable that the dry roof include a sheathing part provided between the deck plate and the heat insulating part.

[0015] It is preferable that the dry roof include a fixing member for fixing the heat insulating part to the deck plate, and the fixing member be fixed to the sheathing part, a deck plate body part, or the wooden part.

Effects of Invention

[0016] According to an aspect of the present invention, it is possible to simplify treatment applied to a deck plate in a dry roof while enhancing fire-resistant performance and structural performance of the deck plate in the dry roof, as well as enhancing residential environment performance such as appearance, thermal insulation, and sound insulation, and to eliminate protective covering work when a waterproofing material or the like is repaired.

Brief Description of Drawings

[0017]

[Fig. 1] Fig. 1 is a perspective view illustrating part of a dry roof.

[Fig. 2] Fig. 2 is a perspective view of a deck plate.

[Fig. 3] Fig. 3 is a diagram of the dry roof when viewed in a transverse direction.

[Fig. 4] Fig. 4 is a diagram of the dry roof when viewed in a longitudinal direction.

[Fig. 5] Fig. 5 is a table for description of the relation between the thickness of a wooden part and a fire-resistant time.

[Fig. 6] (a) is a diagram for description of a space formed in a conventional deck plate; and (b) is a diagram for description of a space formed in a deck plate including the wooden part.

[Fig. 7] (a) is a diagram for description of thermal insulation performance of the conventional deck plate; and (b) is a diagram for description of thermal insulation performance of the deck plate including the wooden part.

[Fig. 8] Fig. 8 is a diagram for description of effects of the deck plate including the wooden part.

[Fig. 9] Fig. 9 is a diagram for description of a structure for attaching a mounting base to the deck plate.

[Fig. 10] Fig. 10 is a diagram for description of a structure for attaching the mounting base to the deck plate.

Description of Embodiments

[0018] An embodiment of the present invention will be described below with reference to the accompanying drawings. Note that, in the following description, drawings are schematic, and for example, dimensional relations and proportions of elements may be different from those in reality. Among the drawings, there may be portions in which, for example, dimensional relations and proportions differ from one another.

[0019] <Dry roof>

FIG. 1 is a perspective view illustrating part of a dry roof. FIG. 3 is a diagram of the dry roof when viewed in a transverse direction. FIG. 4 is a diagram of the dry roof when viewed in a longitudinal direction.

As illustrated in FIGS. 1, 3, and 4, a dry roof 1 is used for the roof or rooftop of a building and is a roof structure for which no concrete is used.

The dry roof 1 includes, for example, a deck plate 10, a sheathing part 40, a heat insulating part 50, a waterproofing part 60, and a fixing part 70.

The dry roof 1 is disposed such that, in a state of being bridged across support beams B, the deck plate 10, the sheathing part 40, the heat insulating part 50, and the waterproofing part 60 are stacked in this order from bottom. Accordingly, the lower surface of the deck plate 10 is exposed to the interior space when the dry roof 1 is bridged between the support beams B. Note that the support beams B are not limited to a steel material but may be, for example, reinforced concrete, lumber, or a wood-based material. The deck plate 10 and the support beams B are fixed by welding or the like. The fixation method is not limited to welding but may be, for example, screws or nails, or the fixation may be omitted. The deck plate 10 is also fixed, by the same method as to the support beams B, to beams (not illustrated) disposed in a direction orthogonal to the support beams B, and to intermediate beams (not illustrated) disposed between the support beams B. Note that this fixation method does not necessarily need to be the same as to the support beams B.

[0020] In the following description, a direction in which the deck plate 10 is bridged across the support beams B of a building is referred to as a longitudinal direction (length direction) L of the deck plate 10, a direction in which the deck plate 10 extends intersecting the longitudinal direction L is referred to as a transverse direction (width direction) W, and a direction in which the deck plate 10 is placed on the support beams B is referred to as a height direction H of the deck plate 10.

[0021] (Deck plate)

FIG. 2 is a perspective view of the deck plate 10. FIG. 3 is a diagram of the dry roof when viewed in the transverse direction. FIG. 4 is a diagram of the dry roof when viewed in the longitudinal direction.

As illustrated in FIGS. 2 to 4, the deck plate 10 includes a deck plate body part 10a and a wooden part 20.

The deck plate body part 10a is a corrugated steel plate formed by roll forming or the like of a thin steel plate subjected to surface treatment such as zinc plating. Note that the deck plate body part 10a does not necessarily need to be subjected to surface treatment such as plating. The deck plate body part 10a includes a ridge part 11, a valley part 13, and an inclined part 15. The deck plate body part 10a is formed with a plurality of ridge parts 11 and valley parts 13 alternately, with each pair of adjacent ridge part 11 and valley part 13 being connected by an inclined part 15. The deck plate body part 10a has a corrugated shape in which the ridge parts 11 and the valley parts 13 extending in the longitudinal direction L are continuous with each other in the transverse direction W through the inclined parts 15.

[0022] The deck plate body part 10a includes, for example, two ridge parts 11, one valley part 13, and two pairs of inclined parts 15, and is formed in a corrugated shape at a section in the transverse direction W. Note that only one ridge part 11 may be provided at one deck plate body part 10a, depending on the dimension of the deck plate 10 in the transverse direction W. When one deck plate 10 is coupled to another deck plate 10 in the transverse direction W, a coupling part between the deck plates 10 functions as a valley part 13. In this case, the coupling part between the deck plates 10 may be joined by screws or the like. Since such joining can improve fire-resistant performance, structural performance, and the like, joining specifications, including whether to perform the joining, can be selected as necessary. The deck plate 10 may be subjected to end-closing fabrication at both end portions in the longitudinal direction L.

[0023] The ridge parts 11 are parts formed flat and positioned on the upper side with respect to the support beams B in a state (hereinafter also referred to as

a "bridged state") in which the deck plate 10 is bridged across the support beams B, and are plate-shaped parts extending in the longitudinal direction L.

Each ridge part 11 includes a groove 12. The groove 12 is formed so as to be recessed toward the lower surface side of the deck plate 10. The groove 12 extends in the longitudinal direction L, and when there is only one groove 12, the groove 12 is provided near the center in the transverse direction W.

The groove 12 of each ridge part 11 improves the strength of the ridge part 11. The groove 12 is not limited to being formed only once in each ridge part 11, and a plurality of grooves 12 may be formed. The grooves 12 may be intermittently formed in the longitudinal direction L. Note that the grooves 12 do not necessarily need to be formed.

[0024] The valley parts 13 are parts that are parallel or substantially parallel to the ridge parts 11 and are formed flat and placed on the support beams B in the bridged state. The valley parts 13 are plate-shaped parts extending in the longitudinal direction L. The valley parts 13 do not overlap the ridge parts 11 in the transverse direction W. Note that the grooves 12 formed in the ridge parts 11 may be formed in the valley parts 13.

Each valley part 13 includes a protruding part 14. The protruding part 14 is formed so as to protrude toward the upper surface side of the deck plate 10. The protruding part 14 extends in the longitudinal direction L, and when there is only one protruding part 14, the protruding part 14 is provided near the center in the transverse direction W.

The protruding part 14 of each valley part 13 improves the strength of the valley part 13. The protruding part 14 is not limited to being formed once in each valley part 13, and a plurality of protruding parts 14 may be formed. The protruding parts 14 may be intermittently formed in the longitudinal direction L. Note that the protruding parts 14 do not necessarily need to be formed.

[0025] Each inclined part 15 is a part connecting a ridge part 11 and a valley part 13 and is a plate-shaped part extending in the longitudinal direction L. The inclined part 15 extends obliquely from a side edge of the ridge part 11 in the transverse direction W toward a side edge of the valley part 13. The inclined part 15 is inclined so as to form at a predetermined angle relative to the ridge part 11 and the valley part 13, for example, an obtuse angle. Note that the grooves 12 formed in the ridge parts 11 may be formed in the inclined parts 15.

[0026] Each inclined part 15 includes an engagement portion 16. The engagement portion 16 is a protruding part formed so as to protrude from the surface of the inclined part 15 toward the upper surface side of the deck plate 10. The engagement portion 16 is formed by, for example, embossing, and a plurality of engagement portions 16 are provided at predetermined intervals in the extending direction (longitudinal direction L) of the inclined part 15. The engagement portion 16 increase the strength of the inclined part 15. The engagement portion 16 may extend in the longitudinal direction L.

[0027] A bulging part 17 is formed at each transition part between a valley part 13 and an inclined part 15. Each bulging part 17 is one of parts protruding toward mutually opposite sides at a pair of inclined parts 15 at one ridge part 11. Specifically, bulging parts 17 at a pair of inclined parts 15 facing each other with a valley part 13 interposed therebetween are formed so as to face each other and bulge in directions approaching each other. Each bulging part 17 is positioned on the valley part 13 side of the corresponding engagement portion 16. The bulging parts 17 may be intermittently formed in the longitudinal direction L.

[0028] A groove 18 is formed at each transition part between a bulging part 17 and a valley part 13. The groove 18 is formed as an engaging groove (dovetail groove) extending in the longitudinal direction L. A section of the groove 18 in the transverse direction W is formed so as to be curved. The grooves 18 are

formed in directions approaching each other at a pair of inclined parts 15 at one ridge part 11. Specifically, the grooves 18 are formed so as to face each other at a pair of inclined parts 15 continuous with valley parts 13 of the deck plate 10 and are curved in directions departing from each other. The grooves 18 may be intermittently formed in the longitudinal direction L.

[0029] The wooden part 20 is provided on the lower surface side of the deck plate 10 (lower surface side of the deck plate body part 10a). The wooden part 20 is, for example, a wooden board formed in a plate shape and is fixed to the lower surface side of the valley parts 13 by using screws or the like. The wooden part 20 may not be only a wood panel formed by bonding lumber or sliced veneers in the width direction but may be also a wood-based material, such as what is called engineered wood, including laminated wood or LVL, in which strength or fire resistance and flame-retardancy, or both are improved by, for example, chemical treatment or resin addition, may be a material with improved resistance to mold or wood-decay fungi, or may be a board, panel, or sheet such as wood wool cement board or gypsum board. Furthermore, when the wooden part 20 is formed as a unit in the width direction, its width may be the same as the width of the deck plate 10 or may be larger or smaller than the width of the deck plate 10. Furthermore, joints between the wooden parts 20 may or may not coincide with fitting parts between the deck plates 10. Note that, in a case where joints between the wooden parts 20 do not coincide with joints between the deck plates 10, fire-resistant performance is improved as compared to a case where they coincide with each other. In addition, attachment of the wooden part 20 to the deck plate body part 10a is not limited to screws, but the attachment may be performed by adhesive or other means, and the attachment method is not limited. Fire-resistant performance, structural performance, and the like can be improved by the attachment method, and thus the attachment method can be selected in

accordance with design specifications. The wooden part 20 is not limited to being attached so as to directly contact the lower surfaces of the valley parts 13 of the deck plate body part 10a, but the wooden part 20 may be attached in a state of being spaced apart from the lower surfaces of the valley parts 13 of the deck plate body part 10a through a member such as a pipe member or a steel material. In other words, in the deck plate 10, the wooden part 20 may be directly or indirectly attached to the lower surface side of the deck plate body part 10a by any means. Note that screws coupling the deck plate body part 10a and the wooden part 20 may be shared with the fixing part 70, or screws different from those for the fixing part 70 may be used.

The wooden part 20 is a design-purpose finishing material that covers the lower surface of the deck plate 10, which is exposed in the interior space between the support beams B in a state in which the deck plate 10 is placed on the support beams B, and improves appearance.

The wooden part 20 is formed so as to have a thickness calculated as a product of a fire-resistant time (fire-resistant performance) to be added to the deck plate 10 and the carbonization rate of the wooden part 20.

[0030] FIG. 5 is a table for description of the relation between the thickness of the wooden part 20 and the fire-resistant time.

Specifically, as illustrated in FIG. 5, when the carbonization rate of a wood material forming the wooden part 20 is 0.65 mm/min and it is desired to impart 30 minutes of fire-resistant time to the deck plate 10, the thickness of the wooden part 20 may be set to $0.65 \text{ mm/min} \times 30 \text{ min} = 19.5 \text{ mm}$.

Similarly, as illustrated in FIG. 5, the thickness of the wooden part 20 may be set to 19.5 to 39.0 mm when it is desired to impart 30 to 60 minutes of fire-resistant time to the deck plate 10, the thickness of the wooden part 20 may be set to 39.0 to 78.0 mm when it is desired to impart 60 to 120 minutes of fire-resistant

time to the deck plate 10, and the thickness of the wooden part 20 may be set to 78.0 to 117.0 mm when it is desired to impart 120 to 180 minutes of fire-resistant time to the deck plate 10. Note that the carbonization rate of the wood material does not necessarily need to be 0.65 mm, and the thickness of the wooden part 20 varies in accordance with the carbonization rate.

[0031] The deck plate 10 constituting the dry roof 1 has fire-resistant performance for a predetermined time even in an uncoated state in which no coating treatment is applied to the deck plate body part 10a and no wooden part 20 is provided. For example, when the deck plate body part 10a has a fire-resistant time (fire-resistant performance) of 30 minutes in the uncoated state, the fire-resistant performance of the deck plate 10 can be ensured for a fire-resistant time of 90 minutes, which is the sum of 30 minutes of fire-resistant time of the deck plate body part 10a and 60 minutes of fire-resistant time of the wooden part 20, by providing the wooden part 20 with a thickness of 39 mm on the lower surface of the deck plate 10. When the deck plate 10 is desired to have a fire-resistant time of 130 minutes, the wooden part 20 may be formed to have a thickness of 65 mm, which is necessary for the remaining 100 minutes of fire-resistant performance after subtracting 30 minutes of fire-resistant time of the deck plate body part 10a.

[0032] The wooden part 20 may be subjected to flame-retardant treatment that provides fireproof performance for a predetermined time. For example, when a wooden board forming the wooden part 20 is subjected to treatment (such as chemical solution treatment) to impart incombustibility (for ensuring 20 minutes of flame-retardant time), quasi-incombustibility (for ensuring 10 minutes of flame-retardant time), and flame-retardancy (for ensuring 5 minutes of flame-retardant time), the wooden part 20 can be thinned by thicknesses corresponding to products of these flame-retardant times with the carbonization rate.

Specifically, when it is desired to impart fire-resistant performance of 120 minutes of fire-resistant time to the deck plate 10 and the wooden part 20 is subjected to treatment for incombustibility (for ensuring 20 minutes of flame-retardant time), the wooden part 20 may have a thickness for 100 minutes of fire-resistant time, in other words, $0.65 \text{ mm/min} \times 100 \text{ min} = 65.0 \text{ mm}$, which is obtained by subtracting 20 minutes of flame-retardant time of the treatment for incombustibility from 120 minutes of fire-resistant time.

[0033] Since the wooden part 20 is provided on the lower surface of the deck plate 10 as described above, the wooden part 20 is first heated in a case of fire. Thus, by forming the wooden part 20 to a thickness corresponding to a fire-resistant time to be imparted to the dry roof 1 with consideration of the carbonization rate of the wooden part 20, the deck plate body part 10a is hardly affected by heat until the wooden part 20 burns out.

Note that the wooden part 20 may be any wood material with any quality, but the thickness of the wooden part 20 needs to be adjusted in accordance with the kind of the wood material since the carbonization rate differs in accordance with the kind of the wood material or the like.

In this manner, by utilizing a property that a wooden board exhibits a covering effect until it is lost due to carbonization under heating during a fire, fire-resistant performance (non-damage property and thermal insulation) of the dry roof 1 and the deck plate 10 can be improved by providing the wooden part 20 on the lower surface of the deck plate 10. Moreover, since the thickness of the wooden part 20 can be determined in accordance with a carbonization rate based on the quality of the wood material forming the wooden part 20 and a fire-resistant time to be imparted to the deck plate 10, the wooden part 20 can be formed to an optimal thickness, and optimal selection of functionality and cost is possible without any excess or deficiency in fire-resistant performance. In other

words, by forming the wooden part 20 to an optimal thickness, the wooden part 20 can be completely burned by heat of a fire, heating of the wooden part 20 does not end before the wooden part 20 burns out, and the wooden part 20 does not continue to burn as smoldering material after the fire is extinguished. Moreover, the fire-resistant performance (fire-resistant time) of the deck plate 10 can be easily adjusted only by adjusting the thickness of the wooden part 20.

[0034] The effect of improving thermal insulation of the deck plate 10 including the wooden part 20 will be described below with reference to FIG. 6.

When a deck plate has a structure including no wooden part as in a conventional dry roof illustrated in FIG. 6 (a), only a space S1 surrounded by a valley part 13, inclined parts 15, and the sheathing part 40 of a deck plate 10A is a space layer, which improves thermal insulation, but since the ridge parts 11 and the sheathing part 40 of the deck plate 10A directly contact, a space as a space layer is not formed in this region, and heat of a fire is easily transmitted from the deck plate 10A to the sheathing part 40, thereby degrading fire-resistant performance. Furthermore, temperature in the interior space is likely to externally flow out from the region even under regular conditions, thereby degrading thermal insulation performance.

However, in the deck plate 10 including the wooden part 20 as in a dry roof illustrated in FIG. 6 (b), the wooden part 20 is provided in the longitudinal direction L and the transverse direction W so as to cover the lower surface of the deck plate body part 10a exposed in the interior space on the lower side, and is fixed to the deck plate body part 10a in a state of being in contact with the valley parts 13 of the deck plate body part 10a. Accordingly, as illustrated in FIGS. 4 and 6 (b), not only the space S1 surrounded by a valley part 13, inclined parts 15, and the sheathing part 40 of the deck plate body part 10a is a space layer, but also a space S2 surrounded by a ridge part 11, inclined parts 15, and the upper surface

of the wooden part 20 is a space layer since gaps are formed between the ridge parts 11 of the deck plate body part 10a and the wooden part 20. Thus, the spaces S1 and S2 can be formed in a substantially entire range between the wooden part 20 and the sheathing part 40, and fire resistance and thermal insulation of the deck plate 10 can be improved as compared to the conventional deck plate 10A.

[0035] The performance of the dry roof is compared in terms of thermal transmittance by using a thermal resistance R illustrated in FIG. 7. The thermal transmittance means the amount of heat that passes through 1 m² of a wall in one hour when there is a temperature difference of 1°C between indoor and outdoor air, and is a value obtained by dividing one by a sum R of the thermal resistance, and the thermal insulation performance is higher as the value decreases.

In a conventional dry roof using the deck plate 10A including no wooden part, the thermal resistance R in a region A1 of the space S1 is 2.729 (m²K/W), the thermal resistance R in a region B1 in which the space S1 does not exist is 2.639 (m²K/W), and the area ratio of the region A1 and the region B1 when the deck plates 10A are laid out is 1:1. Thus, a thermal transmittance U_a (W/m·K) of the dry roof is given by the following value.

$$U_a = 1/(2.729 \times 0.5 + 2.639 \times 0.5) = 0.373$$

However, in the dry roof 1 using the deck plate 10 including a wooden part, the thermal resistance R is 2.937 (m²K/W) and the thermal transmittance U_a (W/m·K) of the dry roof is given by the following value.

$$U = 1/2.937 = 0.340$$

In this manner, it can be understood that the thermal insulation performance of the deck plate 10 including the wooden part 20 is improved as compared to thermal insulation performance of the conventional deck plate 10A.

[0036] On the lower surface of the deck plate body part 10a exposed in the interior space on the lower side, the wooden part 20 may be provided on the deck

plate body part 10a such that the lower surface of the deck plate body part 10a is exposed in a partial region of the dry roof 1, or may be provided so as to cover the entire lower surface of the deck plate body part 10a.

Specifically, in a case where the dry roof 1 is reinforced in the vicinity of the support beams B on which the deck plate 10 is placed, the deck plate body part 10a may not be covered with the wooden part 20 to expose the lower surface of the deck plate body part 10a in an area (reinforced region) in which the reinforcement is effective. The reinforcement is, for example, strength improvement by joining the deck plate 10 and the support beams B with screws or the like. For example, as illustrated in FIGS. 1 and 3, end portions of the wooden part 20 in the longitudinal direction of the deck plate 10 are positioned at places separated from the support beams B by a predetermined distance. In other words, near the end portions in the longitudinal direction of the deck plate 10, the wooden part 20 is not provided in partial regions other than regions in which the deck plate 10 is placed on the support beams B, and the end portions of the wooden part 20 in the longitudinal direction of the deck plate 10 face flanges of the support beams B with gaps therefrom. Accordingly, the wooden part 20 is formed such that its length in the longitudinal direction of the deck plate 10 is shorter than the distance between the support beams B across which the deck plate 10 is bridged. In this configuration, between the end portions of the wooden part 20 in the longitudinal direction of the deck plate 10 and the flanges of the support beams B, the deck plate body part 10a is not covered with the wooden part 20, and the lower surface of the deck plate body part 10a may be exposed in the interior space.

For example, on the lower surface of the dry roof 1 (on a side where the wooden part 20 is provided), when there is decorative finish for partition walls (wall materials) or beams, a region of the dry roof 1 where other finishing

members are attached may be reinforced, the wooden part 20 may not be provided in the region whereas the other region may be covered with the wooden part 20, and the entire region may be covered with the wooden part 20 when there are no interfering objects such as finishes. Note that, even without reinforcement, when certain fire-resistant performance is ensured due to the effect of the surrounding wooden part 20 or the like, the wooden part 20 may not be provided in regions that are not reinforced, as well.

[0037] The following describes an area where the lower surface of the deck plate body part 10a is not covered by the wooden part 20 in the reinforced region of the dry roof 1. The area not covered by the wooden part 20 changes with the degree of reinforcement. Here, an example when reinforcement near the support beams B is targeted is described.

When no reinforcement is provided near the support beams B in the dry roof 1, the distance from the flange of each support beam B to the corresponding end portion of the wooden part 20 (exposure length of the deck plate body part 10a) is preferably, for example, 0 to 150 mm.

When reinforcement is provided near the support beams B in the dry roof 1, the distance from the flange of each support beam B to the corresponding end portion of the wooden part 20 (exposure length of the deck plate body part 10a) is preferably, for example, 150 to $(L_x/4)/2$ mm, where L_x represents the length of the dry roof 1 in the transverse direction. Specifically, when the length L_x of the dry roof 1 in the transverse direction is 3600 mm, the distance from the flange of each support beam B to the corresponding end portion of the wooden part 20 (exposure length of the deck plate body part 10a) is 150 to 450 mm (approximately 150 to 500 mm for simplicity).

When relatively large reinforcement is provided near the support beams B in the dry roof 1, the distance from the flange of each support beam B to

the corresponding end portion of the wooden part 20 (exposure length of the deck plate body part 10a) is preferably, for example, 450 to $(L_x/4)$ mm, where L_x represents the length of the dry roof 1 in the transverse direction. Specifically, when the length L_x of the dry roof 1 in the transverse direction is 3600 mm, the distance from the flange of each support beam B to the corresponding end portion of the wooden part 20 (exposure length of the deck plate body part 10a) is 450 to 900 mm (approximately 500 to 1000 mm for simplicity).

[0038] (Sheathing part)

The sheathing part 40 improves fire resistance, sound insulation and thermal insulation of the dry roof 1 and can prevent damage such as cracking of the heat insulating part 50 when walking on the roof during construction or maintenance of the dry roof or the like, and is provided on the upper surface of the deck plate 10 disposed on the support beams B. The sheathing part 40 may or may not be fixed to the deck plate 10 in addition to the fixing part 70.

The sheathing part 40 is formed of, for example, a high-density wood wool cement board. Three kinds of wood wool cement boards are standard wood wool cement boards, medium-density wood wool cement boards, and high-density wood wool cement boards (JIS A5404 "wood cement board"), and the defined value of moisture content ratio of the boards is set to 20% or lower (at the time of shipment) by a large number of manufacturers. Accordingly, the moisture content of high-density wood wool cement boards with high "bulk density" is highest among the three kinds.

When a high-density wood wool cement board is used as the sheathing part 40 of the dry roof 1, its high moisture content delays temperature rise in the roof structure during a fire and suppresses the rate of temperature rise, thereby lowering temperature inside the roof as compared to cases where other kinds of wood wool cement boards (medium-density or standard) are used. Thus,

softening, carbonization, and contraction of the wood wool cement board can be delayed.

Moreover, it is possible to delay heat transfer to the upper side, thereby suppressing increased roof deflection and ignition of a heat insulation material, which are caused by decrease in surface rigidity due to softening, carbonization, and contraction of the heat insulation material, and as a result, the fire-resistant performance of the roof is improved. Furthermore, it is also effective in passing judgement in a "fire-resistant performance test" of the roof for performance evaluation. By using a high-density wood wool cement board as the sheathing part 40, it is possible to improve sound insulation, workability, and thermal insulation performance.

By using a wood wool cement board as the sheathing part 40, sound insulation is improved, and particularly, high-density wool wood cement boards provide higher sound insulation effect than standard and medium-density wood wool cement boards.

Moreover, by using a high-density wood wool cement board as the sheathing part 40, thermal insulation performance can be improved as compared to gypsum boards and standard concrete.

In addition, by using a high-density wood wool cement board as the sheathing part 40, stepping through or cracking of the heat insulating part 50 during construction can be prevented, and thus workability can be improved.

Note that a high-density wood chip cement board may be used in place of a high-density wood wool cement board.

[0039] (Heat insulating part)

The heat insulating part 50 is provided to improve thermal insulation of the dry roof 1 and disposed on the upper surface of the sheathing part 40.

As illustrated in FIG. 1, the heat insulating part 50 is formed of, for example, an organic thermal insulation board such as polyethylene foam, polystyrene foam, poly urethane foam, or phenol foam. The heat insulating part 50 is formed to have, for example, a thickness of 0 and 2000 mm. As the heat insulating part 50, for example, one thermal insulation board having a thickness of 150 mm may be used, or three stacked thermal insulation boards each having a thickness of 50 mm may be used.

[0040] (Waterproofing part)

The waterproofing part 60 prevents intrusion of rainwater and the like into the dry roof 1 and is provided on the upper surface of the heat insulating part 50.

As illustrated in FIG. 1, the waterproofing part 60 is formed by using an asphalt waterproofing method, a modified asphalt sheet waterproofing method, a vinyl chloride resin sheet waterproofing method, a rubber sheet waterproofing method, a liquid-applied waterproofing method, or the like. The waterproofing part 60 is disposed so as to completely cover the upper surface of the heat insulating part 50 without gaps.

[0041] (Fixing part)

The fixing part 70 fixes the sheathing part 40, the heat insulating part 50, and the waterproofing part 60 to the deck plate body part 10a and is formed of, for example, a screw. As illustrated in FIGS. 1 and 4, the fixing part 70 is locked to the wooden part 20 by placing the sheathing part 40, the heat insulating part 50, and the waterproofing part 60 in this order on the upper surface of the deck plate 10 and then causing its distal end to penetrate, from above the waterproofing part 60 in a direction orthogonal to its plane direction, the waterproofing part 60, the heat insulating part 50, the sheathing part 40, and the ridge parts 11 of the deck plate body part 10a through a fixation disk 71. In other

words, the deck plate 10 (the deck plate body part 10a and the wooden part 20), the sheathing part 40, the heat insulating part 50, and the waterproofing part 60 are integrally coupled and fixed by the fixing part 70. Note that the fixing part 70 does not necessarily need to be fixed to the wooden part 20 as long as it is fixed to the deck plate 10, and does not necessarily need to be fixed to the deck plate 10 nor the wooden part 20 as long as it is fixed to the sheathing part 40.

[0042] According to the deck plate 10 and the dry roof 1 as described above, by utilizing a property that a wood material exhibits a covering effect until it is lost through carbonization under heating during a fire, fire-resistant performance (non-damage property and flame shielding) of the deck plate 10 and the dry roof 1 can be improved by providing the wooden part 20 on the lower surface of the deck plate 10. Moreover, since the thickness of the wooden part 20 can be determined in accordance with a carbonization rate based on the quality of the wood material forming the wooden part 20 and a fire-resistant time desired to be imparted to the dry roof 1, the wooden part 20 can be formed to an optimal thickness, and optimal selection of functionality and cost is possible without any excess or deficiency in fire-resistant performance. In other words, by forming the wooden part 20 to an optimal thickness, the wooden part 20 can be completely burned by heat of a fire, heating of the wooden part 20 does not end before the wooden part 20 burns out, and the wooden part 20 does not continue to burn as smoldering material after the fire is extinguished. Moreover, the fire-resistant performance (the fire-resistant time) of the dry roof 1 can be easily adjusted only by adjusting the thickness of the wooden part 20.

The deck plate body part 10a has a fire-resistant performance of 30 minutes under design standards even in the uncoated state in which the wooden part 20 is not provided. Thus, if a fire-resistant time of 30 minutes is sufficient for the deck plate 10 including the wooden part 20, the allowable span of the deck

plate 10 bridged across the support beams B can be increased by fire-resistant performance improved by the wooden part 20, thereby increasing designing flexibility. Moreover, the improvement in the fire-resistant performance of the deck plate 10 makes it possible to reduce the thickness of the deck plate body part 10a and lower deck corrugation height (height from a valley part 13 to a ridge part 11). Note that the reinforcement effect by the wooden part 20 is not limited to fire-resistant performance, but improvement in load-bearing capacity against vertical or horizontal loads can also be expected by structural performance, and various advantages can be obtained such as increase in the allowable span, reduction in specifications of the deck plate, or omission of brace materials that bear horizontal loads. For example, as for improvement of in-plane shear force, the deck plate has a function to bear in-plane shear force due to earthquake or wind, and the presence of the wooden part 20 can improve the function, and as a result, the load-bearing capacity can be improved without changing the configuration of the deck plate or its mutual connections. If performance equivalent to a deck plate without the wooden part 20 is necessary, the presence of the wooden part 20 makes it possible to appropriately omit or simplify the deck plate and its configuration such as the height or thickness of the deck plate, mutual connection, horizontal brace materials, and the like, or to increase the span or load of a slab.

Other advantages include, for example, improvement in structural performance, and the presence of the wooden part 20 can improve the function to support vertical loads during construction of the deck plate or upon completion of a deck structure slab. If performance equivalent to that of a deck plate or deck structure slab without the wooden part 20 is necessary, the presence of the wooden part 20 makes it possible to simplify the configuration of the deck

plate or deck structure slab, such as the height or thickness of the deck plate, or joining specifications with beams or purlins, and allows increase in span or load.

Although the attachment of the wooden part 20 results in increase in cost of the deck plate 10, further cost reduction can be achieved through various rationalization and labor saving due to improvement in the fire-resistant performance of the deck plate 10.

[0043] For example, when only the vicinity of the support beams B in the dry roof 1 is reinforced, the center of the dry roof 1 that is not reinforced is a weak point. When fire-resistant covering (the wooden part 20) is provided on the entire lower surface of the deck plate 10, the weak point remains at the center of the dry roof 1, but when covering is deliberately omitted only in the vicinity of the support beams B where reinforcement is performed, the weak point in terms of fire resistance is the vicinity of the support beams B.

Thus, in accordance with specifications of reinforcement applied to the dry roof 1, the lower surface of the deck plate body part 10a is exposed by not providing the wooden part 20 for a predetermined length from the flange of each support beam B. Accordingly, during a fire, if a finishing member (decorative material) is burned away, the deck plate body part 10a is intensively heated in the vicinity of the support beams B, where the wooden part 20 is not present, and accordingly, buckling due to thermal expansion and the like occur, but decrease in structural strength of the dry roof 1 can be minimized since reinforcement is applied.

Even after the wooden part 20 is lost, thermal expansion further concentrates at the buckled place, and this extension can be absorbed. Specifically, at a place where the deck plate 10 is intensively heated, thermal expansion of the deck plate 10, which is unnecessary additional force, can be absorbed without causing damage to other regions, and thus thermal expansion

does not occur in a region of the deck plate 10 where the wooden part 20 was provided, and the broad area of this region is not damaged by thermal expansion.

[0044] In this manner, for example, even if the vicinity of the support beams B is deliberately made a weak point of the dry roof 1, it will not become a weak point that directly leads to collapse of the dry roof 1 as long as reinforcement is provided in the vicinity of the support beams B. Furthermore, depending on design conditions, the vicinity of the support beams B does not immediately collapse even without reinforcement. Thus, by deliberately not covering the deck plate body part 10a in the vicinity of the support beams B, thermal expansion of the deck plate 10 can be concentrated in the vicinity of the support beams B. Then, as a fire progress and all of the wooden part 20 are burned away, the entire surface of the deck plate 10 is heated in the same manner as in a normal dry roof, but by that time, the deck plate 10 in the vicinity of the support beams B is already buckled and absorbs thermal expansion, thereby preventing damage on a broad area of the dry roof 1.

Thus, with the dry roof 1, damage due to thermal expansion of the deck plate 10, which would be otherwise accumulated in the vicinity of the center of a normal dry roof 1, can be prevented by thermal expansion in the vicinity of the support beams B with high strength, and the fire-resistant performance of the dry roof 1 can be significantly improved. Moreover, increase in cost of various reinforcement applied to a normal dry roof can be compensated and reduced by minimizing a covered area.

[0045] The wooden part 20 also functions as a design-purpose finishing material that hides the lower surface of the deck plate body part 10a, and thus, by only providing the wooden part 20 on the deck plate 10, the dry roof 1 can have both a fire-resistant covering function to block heat input to the deck plate 10 and the function of a decorative finish, and while simplifying treatment

applied to the deck plate 10, it is possible to achieve improvement of the fire-resistant performance and appearance of the deck plate 10 and the dry roof 1, dew condensation prevention through improvement of thermal insulation performance, and residential environment improvement such as sound insulation improvement.

Note that the reinforcement effect by the wooden part 20 is not limited to fire-resistant performance, but improvement in load-bearing capacity against vertical or horizontal loads can also be expected by structural performance, and various advantages can be obtained such as increase in the allowable span, reduction in specifications of the deck plate, or omission of brace materials that bear horizontal loads. For example, as for improvement of in-plane shear force, the deck plate has a function to bear in-plane shear force due to earthquake or wind, and the presence of the wooden part 20 can improve the function, and as a result, the load-bearing capacity can be improved without changing the configuration of the deck plate or its mutual connections. If performance equivalent to a deck plate without the wooden part 20 is necessary, the presence of the wooden part 20 makes it possible to appropriately omit or simplify the deck plate and its configuration such as the height or thickness of the deck plate, mutual connection, horizontal brace materials, and the like, or to increase the span or load of a slab.

Other advantages include, for example, improvement in structural performance, and the presence of the wooden part 20 can improve the function to support vertical loads during construction of the deck plate or upon completion of a deck structure slab. If performance equivalent to that of a deck plate or deck structure slab without the wooden part 20 is necessary, the presence of the wooden part 20 makes it possible to simplify the configuration of the deck

plate or deck structure slab, such as the height or thickness of the deck plate, or joining specifications with beams or purlins, and allows increase in span or load.

By only precasting the wooden part 20 into the valley parts 13 of the deck plate body part 10a, decorative finishing and fire-resistant performance can be imparted to the deck plate 10, and thus underlaying work and ceiling finishing of the dry roof 1 can be collectively and simultaneously performed by only installing the deck plate 10 onto the support beams B at the site, thereby reducing on-site labor and lowering construction cost.

By subjecting the wooden part 20 to fire-resistant treatment that provides fire-resistant performance for a predetermined time, it is possible to reduce a necessary thickness of the wooden part 20 for required fire-resistant performance.

By applying fire-resistant performance for a predetermined time to the dry roof 1, it is possible to reduce a necessary thickness of the wooden part 20 for required fire-resistant performance.

Since the spaces S1 and S2 are formed between the lower surface of the deck plate body part 10a and the wooden part 20, a space layer can be formed in the dry roof 1 to increase thermal insulation so that heat transfer to the upper surface side (roof back side) of the dry roof 1 can be suppressed. Cost can be lowered through, for example, reduction of a heat insulating part on the upper surface side for improvement in thermal insulation performance. Accordingly, a time required to reach ignition temperature of combustible materials outside the building can be extended.

Since the wooden part 20 is also provided on the lower surfaces of the ridge parts 11 of the deck plate body part 10a, the wooden part 20 functions as a receptacle for powder dust D generated from components by threading of the fixing part 70, thereby preventing the powder dust D from falling into the interior

space, when the deck plate body part 10a, the sheathing part 40, the heat insulating part 50, and the waterproofing part 60 are fixed by the fixing part 70 as illustrated in FIG. 8. Accordingly, it is possible to omit protective covering work during attachment of the heat insulating part 50 and the like. Moreover, even when the heat insulating part 50 is added or the waterproofing part 60 is replaced during repair work, the powder dust D during construction does not affect the interior space, and the interior space can be used as usual.

When the heat insulating part 50 or the like is attached to the deck plate 10, it is possible to improve attachment strength of components by locking the fixing part 70 to the wooden part 20 and lower cost through reduction of fixing members or the like.

Even when requested fire-resistant performance is changed during major repair of the building, the wooden part 20 can be retrofitted from the interior space, which increases construction flexibility.

[0046] <Other>

Although the preferable embodiments of the present invention are described above, the present invention is not limited to the above-described embodiment but includes any aspect included in the concept and claims of the present invention. Configurations may be selectively combined as appropriate so as to achieve at least part of the above-described problem and effects. For example, the shape, material, disposition, and size of each constituent component in the above-described embodiment may be changed as appropriate depending on a specific use aspect of the present invention.

For example, when the vicinity of the center of the dry roof 1 is already reinforced, the vicinity of the center may not be covered with the wooden part 20. In other words, in the dry roof 1, a reinforced region or a region with higher strength than others may not be covered with the wooden part 20 by a

predetermined range in accordance with specifications of reinforcement, thereby forming the region with higher strength as a weak point in terms of fire resistance.

The specifications of reinforcement are not limited to the above-described specifications, but an area where the lower surface of the deck plate body part 10a is not covered with the wooden part 20 can be set in accordance with each specification or in a case where a designed function is satisfied without reinforcement.

A fire-resistant member with fire-resistant performance, such as a gypsum board may be provided in place of the wooden part 20 attached to the deck plate body part 10a. In this case, the gypsum board is preferably provided with decorative finish in advance.

[0047] As illustrated in FIGS. 9 and 10, even when a mounting base 200 is attached to the deck plate 10, attachment strength of the mounting base 200 can be increased by locking a fixing member 210 of the mounting base 200 to the wooden part 20 of the deck plate 10 as well. The mounting base 200 is attached to the deck plate 10 and serves as a base for installing, on the roof of the building, a facility including an instrument such as a solar power generation facility, a hot-water unit for water heating, or an outdoor unit of an air conditioner, a signage, or the like. The mounting base 200 includes an attachment board 220 attached to the deck plate 10, and a coupling device 230 for coupling a facility or the like.

Specifically, as illustrated in FIG. 9, when the coupling device 230 is to be provided above the valley parts 13 of the deck plate body part 10a, the flat plate-shaped attachment board 220 is provided across adjacent ridge parts 11 of the deck plate body part 10a, and the deck plate body part 10a, the wooden part 20, and the attachment board 220 are coupled by using the fixing member 210 such as screws. Then, the coupling device 230 is erected on the attachment board 220 and fixed by screws or the like.

As illustrated in FIG. 10, when the coupling device 230 is to be provided above the ridge parts 11 of the deck plate body part 10a, the plate-shaped attachment board 220 formed to conform to the shape of a ridge part 11 is provided from the entire range of one ridge part 11 to adjacent valley parts 13, and the deck plate body part 10a, the wooden part 20, and the attachment board 220 are coupled by using the fixing member 210 such as screws. Then, the coupling device 230 is erected on the attachment board 220, and the coupling device 230 is fixed to the attachment board 220 by using screws or the like.

In any case, since the mounting base 200 can be coupled and fixed not only to the deck plate body part 10a but also to the wooden part 20, the attachment strength of the mounting base 200 can be improved.

List of Reference Signs

[0048]

- 1 dry roof
- 10 deck plate
- 10a deck plate body part
- 11 ridge part
- 12 groove
- 13 valley part
- 14 protruding part
- 15 inclined part
- 16 engagement portion
- 17 bulging part
- 18 groove
- 20 wooden part
- 40 sheathing part

50 heat insulating part

60 waterproofing part

70 fixing part

S1, S2 space

Claims

1. A deck plate that is used for a dry roof and to which a member that improves performance is attached on an upper surface, the deck plate being characterized by comprising a wooden part provided on a lower surface side of the deck plate and covering at least a lower surface side of an attachment position of the member.

2. The deck plate according to claim 1, characterized in that the wooden part has a thickness calculated as a product of an additional fire-resistant time and a carbonization rate of the wooden part.

3. The deck plate according to claim 2, characterized in that the wooden part is subjected to flame-retardant treatment that provides fire-resistant performance for a predetermined time, and the wooden part has a thickness calculated as a product of a time obtained by subtracting the predetermined time from the fire-resistant time and a carbonization rate of the wooden part.

4. The deck plate according to any one of claims 1 to 3, characterized in that a deck plate body part has fire-resistant performance for a predetermined time.

5. The deck plate according to any one of claims 1 to 3, characterized in that the wooden part is formed of a design-purpose finishing material or the like.

6. The deck plate according to any one of claims 1 to 3, characterized in that

a deck plate body part is formed with a plurality of ridge parts and valley parts alternately,

the wooden part is attached to the valley parts, and

a space is formed between the wooden part and the ridge parts.

7. A dry roof characterized by comprising:

the deck plate according to claim 1; and

a heat insulating part provided on the upper surface of the deck plate.

8. The dry roof according to claim 7, characterized by comprising a waterproofing part covering the heat insulating part.

9. The dry roof according to claim 7 or 8, characterized by comprising a sheathing part provided between the deck plate and the heat insulating part.

10. The dry roof according to claim 9, characterized by comprising a fixing part for fixing the heat insulating part to the deck plate, and in that the fixing part is fixed to the sheathing part, a deck plate body part, or the wooden part.