

TITLE

ROOF STRUCTURE

TECHNICAL FIELD

[0001] The present invention relates to a roof structure.

5 BACKGROUND

[0002] In general, there are many roof structures formed by using roofing materials formed by machining a metallic plate material by, for example, roll molding and press molding, or tiles, in the market.

SUMMARY

10 [0003] Japanese Unexamined Utility Model Publication No. S51-127618 and Japanese Unexamined Utility Model Publication No. S52-034519 disclose a structure in which a wooden roofboard is provided on a frame made of a wooden base, and a roofing material is provided on the roofboard. Japanese Unexamined Patent Publication No. S58-150643 discloses a structure in which an autoclaved lightweight aerated concrete (ALC) plate is provided on a wooden base, and a roofing material (tiles) is provided on the ALC panel. Further, Japanese Unexamined Patent Publication No. H8-068166 discloses a structure in which an autoclaved lightweight aerated concrete panel is provided on a ferroconcrete as a roofboard. However, in the structures disclosed in the Japanese Unexamined Utility Model Publication No. S51-127618 and the Japanese Unexamined Utility Model Publication No. S52-034519, the frame is made of wood. Therefore, strength is not sufficient for shaking such as large-scale earthquakes, and there are dangers of insect damage and decay in a hot and humid region. In the structure disclosed in Japanese Unexamined Patent Publication No. H8-

15

20

25

068166, the frame is made of ferroconcrete. Therefore, it has a sufficient resistance for shaking such as earthquakes, but has problems in costs and workability since the autoclaved lightweight aerated concrete panel is used as the roofboard.

5 [0004] A roof structure according to an aspect of the present invention comprises a truss structure foundation, which corresponds to a roof base, a plurality of lock rails provided on the truss structure foundation, and a thermal insulation roofing material provided on the plurality of lock rails. The thermal insulation roofing material includes
10 a metallic roofing material, a back side material, a thermal insulation material provided between the metallic roofing material and the back side material, and a male joint and a female joint provided at both ends in a flow direction of the thermal insulation roofing material. The plurality of lock rails are arranged from an eave to a ridge at working
15 widths of the thermal insulation roofing material.

[0005] As described thus far, with the roof structure according to an aspect of the present invention, it becomes possible to improve workability of the roof structure.

BRIEF DESCRIPTION OF DRAWINGS

20 [0006] FIGS. 1(a) and 1(b) are cross-sectional views illustrating typical examples of a roof structure according to one embodiment.

[0007] FIG. 2 is a cross-sectional view illustrating a typical example of the roof structure according to one embodiment.

25 [0008] FIGS. 3(a) and 3(b) are cross-sectional views illustrating other examples of a general portion of the roof structure according to one embodiment.

[0009] FIGS. 4(a) to 4(c) are explanatory drawings illustrating typical examples of a thermal insulation roofing material used in the roof structure according to one embodiment.

[0010] FIG. 5(a) is a cross-sectional view illustrating an example of a C-shaped steel material used for the roof structure according to one embodiment.

[0011] FIG. 5(b) is a cross-sectional view illustrating an example of a hat-shaped steel material used in the roof structure according to one embodiment.

[0012] FIG. 5(c) is a cross-sectional view illustrating another example of the hat-shaped steel material used in the roof structure according to one embodiment.

[0013] FIG. 6(a) is a cross-sectional view illustrating an example of an eave member used in the roof structure according to one embodiment.

[0014] FIG. 6(b) is a cross-sectional view illustrating an example of an eave covering material used in the roof structure according to one embodiment.

[0015] FIGS. 7(a) to 7(c) are explanatory drawings illustrating a construction flow of a thermal insulation roofing material used in the roof structure according to one embodiment.

[0016] FIG. 8 is an explanatory drawing illustrating a construction state of the thermal insulation roofing material used in the roof structure according to one embodiment.

[0017] FIG. 9 is an explanatory drawing illustrating a construction state of the thermal insulation roofing material used in the roof structure

according to one embodiment.

[0018] FIG. 10 is an explanatory drawing illustrating the thermal insulation roofing material used in the roof structure according to one embodiment.

5 [0019] FIG. 11 is an explanatory drawing illustrating the thermal insulation roofing material used in the roof structure according to one embodiment.

10 [0020] FIG. 12 is an explanatory drawing illustrating the thermal insulation roofing material used in the roof structure according to one embodiment.

[0021] FIG. 13 is an explanatory drawing illustrating the thermal insulation roofing material used in the roof structure according to one embodiment.

15 [0022] FIG. 14(a) is an explanatory drawing illustrating the construction state of the thermal insulation roofing material used in the roof structure according to one embodiment.

[0023] FIG. 14(b) is an explanatory drawing illustrating a right end portion of the thermal insulation roofing material used in the roof structure according to one embodiment.

20 [0024] FIG. 14(c) is an explanatory drawing illustrating a left end portion of the thermal insulation roofing material used in the roof structure according to one embodiment.

25 [0025] FIGS. 15(a) to 15(c) are explanatory drawings illustrating the thermal insulation roofing material used in the roof structure according to one embodiment.

[0026] FIGS. 16(a) and 16(b) are explanatory drawings illustrating

a construction flow of the thermal insulation roofing material used in the roof structure according to one embodiment.

[0027] FIGS. 17(a) to 17(c) are explanatory drawings illustrating a construction flow of the thermal insulation roofing material used in the roof structure according to one embodiment.

[0028] FIG. 18 is an explanatory drawing illustrating the construction state of the thermal insulation roofing material used in the roof structure according to one embodiment.

[0029] FIGS. 19(a) and 19(b) are explanatory drawings illustrating other examples of the thermal insulation roofing material used in the roof structure according to one embodiment.

[0030] FIGS. 20(a) and 20(b) are explanatory drawings illustrating other examples of the thermal insulation roofing material used in the roof structure according to one embodiment.

[0031] FIGS. 21(a) and 21(b) are explanatory drawings illustrating other examples of the thermal insulation roofing material used in the roof structure according to one embodiment.

[0032] FIGS. 22(a) to 22(i) are explanatory drawings illustrating other examples of a projecting portion provided on the thermal insulation roofing material used in the roof structure according to one embodiment.

[0033] FIGS. 23(a) to 23(f) are explanatory drawings illustrating other examples of a projecting portion provided on the thermal insulation roofing material according to one embodiment.

[0034] FIGS. 24(a) to 24(f) are explanatory drawings illustrating other examples of a projecting portion provided on the thermal

insulation roofing material according to one embodiment.

DETAILED DESCRIPTION

[0035] With reference to the drawings, a roof structure according to one embodiment will be described in detail below. FIGS. 1(a), 1(b), and FIG. 2 are cross-sectional views illustrating typical examples of a roof structure according to one embodiment. FIGS. 3(a) and 3(b) are cross-sectional views illustrating other examples of a general portion of the roof structure according to one embodiment.

[0036] FIGS. 4(a) to 4(c) are explanatory drawings illustrating typical examples of a thermal insulation roofing material A provided with a metallic roofing material B, a thermal insulation material C, and a back side material D used in the roof structure according to one embodiment. In the following description, the term "upstream" means a ridge side in the flow direction, and the term "downstream" means an eave side in the flow direction. As used herein the term "lateral direction" or "left-right direction" means a direction intersecting (orthogonal to) the flow direction, and the terms "left" and "right" mean "left" and "right" when viewed from downstream, respectively. As used herein the term "up-down direction" means a direction intersecting (orthogonal to) the flow direction and the left-right direction, the term "up" means the thermal insulation roofing material side, and the term "down" means the roof base side.

[0037] The roof structure includes a truss structure foundation 1, which corresponds to a roof base α , a plurality of lock rails 2, and a thermal insulation roofing material A. The roof base α is a steel base as illustrated in FIG. 1(a) to FIG. 3(b). The roof base α is formed by

disposing the truss structure foundation 1 made of a C-shaped steel material illustrated in FIG. 5(a) vertically.

[0038] A plurality of lock rails 2 are disposed on the truss structure foundation 1. Each of the lock rails 2 is disposed to extend in the lateral direction (left-right direction). For example, the lock rails 2 made of a hat-shaped steel material as illustrated in FIG. 5(b) is used.

[0039] The plurality of lock rails 2 are arranged on the truss structure foundation 1 at the same intervals (pitch) as the working width of the thermal insulation roofing material A in the flow direction. As used herein the term "working width" is a dimension (distance) between fitting portions of two thermal insulation roofing materials A adjacent to each other in the flow direction. In other words, the working width is a dimension of one thermal insulation roofing material A in the flow direction except for an overlapped portion with another thermal insulation roofing material A adjacent thereto in the flow direction in a state in which the thermal insulation roofing material A is constructed, and is a dimension in the flow direction of a portion actually exposed to the outside.

[0040] The truss structure foundation 1 is a metallic elongated member having a cross section as illustrated in FIG. 5(a). Specifically, the truss structure foundation 1 includes a supporting surface 1a extending in the up-down direction, a pair of fixed surfaces 1b extending in the same direction from upper and lower ends of the supporting surface 1a, and a pair of reinforcing surfaces 1c extending toward each other from distal ends of the pair of fixed surfaces 1b.

[0041] The lock rail 2 is a metallic elongated member having a

cross section as illustrated in FIG. 5(b). The lock rail 2 includes a roofing fixed piece 2a, a pair of elevating pieces 2b suspending downward from both ends of the roofing fixed piece 2a in the flow direction, and a pair of fixed pieces 2c projecting outward away from each other from lower ends of the pair of elevating pieces 2b. It should be noted that the lock rail 2 may have a cross section as illustrated in FIG. 5(c). An eave top member 3 is a member formed at a ceiling portion of the eave. The lock rail 2 may be made of a generally used Light Gauge Steel (LGS) shape steel instead of the hat-shaped steel material.

[0042] As illustrated in FIGS. 4(a) to 4(c), the thermal insulation roofing material A is an elongated plate-shaped member and includes the metallic roofing material B, the thermal insulation material C, and the back side material D. The thermal insulation material C is formed between the metallic roofing material B and the back side material D. As illustrated in FIGS. 4(a) to 4(c), the metallic roofing material B includes a decorative surface 4 having a substantially horizontal surface shape, a back surface 5, a male joint 9, and a female joint 13. The male joint 9 is provided at a downstream end of the thermal insulation roofing material A, and includes a stepped decorative surface 6 and an insertion edge 7. The stepped decorative surface 6 is a portion suspending downward (toward back surface 5 side) from a downstream end of the decorative surface 4. The insertion edge 7 is a portion extending from a distal end of the stepped decorative surface 6 on the indoor side toward the upstream side. The decorative surface 4, the stepped decorative surface 6, and the insertion edge 7 define a hooking

groove 8 having a substantially U-shape and opening on the upstream side.

[0043] The female joint 13 is provided at an upstream end of the thermal insulation roofing material A, and includes a fitting groove 10, a fitting edge 11, and a fixing piece 12. The fitting groove 10 is provided at an upstream end of the decorative surface 4, and is a groove having a substantially U-shape in cross section and opening on the downstream side. The fitting groove 10 fits the insertion edge 7. The fitting edge 11 is an edge extending from the fitting groove 10. The fixing piece 12 is provided on the upstream side of the fitting groove 10, and is used for fixing the thermal insulation roofing material A. It should be noted that the metallic roofing material B further includes a lower joint 14 provided at a right end portion and an upper joint 19 provided at a left end portion. The two thermal insulation roofing materials A adjacent to each other on the left and right are coupled by inserting the upper joint 19 into the lower joint 14 while the lower joint 14 of the thermal insulation roofing material A on the left side and the upper joint 19 of the thermal insulation roofing material A on the right side overlap each other in the up-down direction.

[0044] As illustrated in FIGS. 3(a) and 3(b), a sheet S is provided between the truss structure foundation 1 and the thermal insulation roofing material A. In FIGS. 3(a) and 3(b), the sheet S is indicated by a chain double-dashed line. As illustrated in FIG. 3(a), the sheet S may be provided over an entire surface between the lock rails 2 and the thermal insulation roofing material A. As illustrated in FIG. 3(b), the sheet S may be provided over an entire surface between the truss

structure foundation 1 and the lock rails 2. Examples of the sheet S include an aluminum sheet, an asphalt roofing, and a rubber asphalt roofing. The sheet S may be formed to prevent rainwater or the like from penetrating into the interior side even in case where rainwater or the like penetrates into the interior from between two thermal insulation roofing materials A adjacent to each other. It should be noted that when the aluminum sheet or the aluminum air cap sheet is used as the sheet S, the sheet S can function as a heat shield and a thermal insulation material.

[0045] The eave member E illustrated in FIG. 6(a) is formed (disposed) at the eave at the time of roofing with the thermal insulation roofing material A. The eave member E is an elongated member extending in the lateral direction (left-right direction). The eave member E includes a planar shaped fixed piece E1, an engaging portion E2, a decorative piece E5 suspending downward from a root of the engaging portion E2, and a tongue piece E6 folded back from a lower end of the decorative piece E5 outward (downstream side). The engaging portion E2 includes a rising piece E3 projecting upward from the distal end on an eave side of the fixed piece E1 and an engaging piece E4 folded back from a distal end on an upper side of the rising piece E3 on the eave side.

[0046] An eave covering material F illustrated in FIG. 6(b) is an elongated member. The eave covering material F includes a covering surface F1 extending in the up-down direction, a covering material fixing surface F2 bent inward (upstream side) and extending from an upper end of the covering surface F1, and a supporting surface F3 bent

inward (upstream side) and extending from a lower end of the covering surface F1.

[0047] The eave member E and the eave covering material F each are formed by machining, for example, a metallic plate (color steel plate, a copper plate, an aluminum plate, a titanium plate, a stainless plate, a sandwich steel plate, a clad steel plate, etc.) by, for example, roll molding, press molding, and extrusion.

[0048] The eave member E can function as a covering member for the eave portion, a fixing member for the eave portion of the thermal insulation roofing material A, and a start member for starting roofing.

[0049] The eave covering material F can function as a covering material, a waterproof material, and a reinforcing material for a truss structure foundation 1 of the eave portion. The eave covering material F can also function as a covering material and a supporting material of an eave top member 3 formed at a wall and a ceiling portion of the eave.

[0050] Next, a method of constructing a roof structure according to one embodiment will be described in brief. First, as illustrated in FIG. 7(a), the truss structure foundation 1 made of a C-shaped steel material is disposed vertically on the eave top member 3.

[0051] When the construction of the truss structure foundation 1 is completed, the plurality of lock rails 2 made of a hat-shaped steel material are arranged on the truss structure foundation 1 from the eave toward the ridge at working widths of the thermal insulation roofing material A as illustrated in FIG. 7(a). Each of the lock rails 2 is disposed to extend laterally.

[0052] Thereafter, the eave covering material F illustrated in FIG.

6(b) is fixed by fixtures β to cover the truss structure foundation 1, the lock rails 2, and the eave top member 3 of the eave portion as illustrated in FIG. 7(a). Specifically, the eave covering material F is provided so that the covering surface F1 covers the truss structure foundation 1, the lock rails 2, and the eave top member 3 of the eave portion, and the covering material fixing surface F2 is disposed on the fixed pieces 2c of the lock rails 2 on the downstream side. The fixtures β are driven toward the fixed pieces 2c from the covering material fixing surface F2.

[0053] Next, as illustrated in FIG. 7(b), the eave member E illustrated in FIG. 6(a) is fixed by the fixtures β . Specifically, the eave member E is provided in such a manner that the fixed piece E1 is disposed on the roofing fixed piece 2a of the lock rail 2, the decorative piece E5 extends along the elevating piece 2b of the lock rail 2 on the downstream side, and the tongue piece E6 is disposed on the fixed piece 2c of the lock rail 2. The fixture β is then driven from the fixed piece E1 toward the roofing fixed piece 2a. As illustrated in FIG. 7(c), a plurality of the thermal insulation roofing materials A are disposed from the eave toward the ridge. Specifically, the thermal insulation roofing material A at the eave is disposed first. At this time, by fitting the male joint 9 to the engaging portion E2 of the eave member E, the position of the thermal insulation roofing material A at the eave in the flow direction is determined. The thermal insulation roofing material A is disposed across the two lock rails 2 adjacent to each other in the flow direction, and is fixed to the roofing fixed piece 2a of the lock rail 2 by the fixtures β at the fixing piece 12 of the thermal insulation roofing material A. Another thermal insulation roofing material A is

then disposed on the upstream side of the thermal insulation roofing material A fixed to the lock rails 2. At this time, the female joint 13 of the thermal insulation roofing material A located on the downstream side and the male joint 9 of the thermal insulation roofing material A located on the upstream side are fitted to each other. In this manner, the construction of the roof structure is completed. It should be noted that the construction flow may be changed depending on the site.

[0054] In addition, the thermal insulation roofing material will be described in detail. FIGS. 4(a) to 4(c) are explanatory drawings illustrating typical examples of a thermal insulation roofing material A provided with a metallic roofing material B, a thermal insulation material C, and a back side material D. FIG. 8 and FIG. 9 are explanatory drawings illustrating a construction state of the thermal insulation roofing material A. FIG. 10 to FIG. 13 are explanatory drawings illustrating left and right end portions of the thermal insulation roofing material A. FIG. 14(a) is an end view of a portion a-a in FIG. 8, FIG. 14(b) is an end view of a portion b-b in FIG. 10 and FIG. 14(c) is an end view of a portion c-c in FIG. 11. FIG. 15(a) is a cross-sectional view taken along a line d-d in FIG. 13, FIG. 15(b) is a cross-sectional view taken along a line e-e in FIG. 13, and FIG. 15(c) is a cross-sectional view taken along a line f-f in FIG. 10. In addition, FIGS. 16(a), 16(b) and FIGS. 17(a) to 17(c) are explanatory drawings illustrating the construction flow. FIG. 18 is an explanatory drawing illustrating a construction state. In the drawing, α denotes a roof base, β denotes a fixture, γ denotes a vertical joint, $\gamma 1$ denotes a horizontal joint, K denotes a house, M denotes a window, and Y denotes a roof.

[0055] The metallic roofing material B is formed by machining, for example, a metallic plate (color steel plate, a copper plate, an aluminum plate, a titanium plate, a stainless plate, a sandwich steel plate, a clad steel plate, etc.) by, for example, roll molding, press molding, and extrusion.

[0056] As is further explained, the metallic roofing material B is an elongated plate shape, and includes a decorative surface 4 having a substantially horizontal surface shape, a back surface 5, a male joint 9, and a female joint 13 as illustrated in FIGS. 4(a) to 4(c). The male joint 9 includes the stepped decorative surface 6 and the insertion edge 7. The stepped decorative surface 6 is a portion suspending downward (toward back surface 5 side) from a downstream end of the decorative surface 4. The insertion edge 7 is a portion extending from a distal end of the stepped decorative surface 6 on the indoor side toward the upstream side. The decorative surface 4, the stepped decorative surface 6, and the insertion edge 7 define a hooking groove 8 having a substantially U-shape and opening on the upstream side.

[0057] As illustrated in FIGS. 4(a) to 4(c), the female joint 13 includes the fitting groove 10, the fitting edge 11, and the fixing piece 12. The fitting groove 10 is provided at an upstream end of the decorative surface 4, and is a groove having a substantially U-shape in cross section and opening on the downstream side at a distal end of the decorative surface 4. The fitting groove 10 fits the insertion edge 7. The fitting edge 11 is an edge extending from the fitting groove 10. It should be noted that the metallic roofing material B further includes a lower joint 14 provided at a right end portion and an upper joint 19

provided at a left end portion. The two thermal insulation roofing materials A adjacent to each other on the left and right are coupled by inserting the upper joint 19 into the lower joint 14, while the lower joint 14 of the thermal insulation roofing material A on the left side and the upper joint 19 of the thermal insulation roofing material A on the right side overlap each other.

[0058] Further, as illustrated in FIG. 8 and FIG. 14(b), the lower joint 14 includes a folded piece 15, a recessed portion 16, and projecting portions 18. The folded piece 15 is a portion folded back so as to project inward (leftward) from a right end portion 14a, which is an end edge of the metallic roofing material B in the left-right direction. The recessed portion 16 is formed in the folded piece 15. The recessed portion 16 extends in the flow direction. With the provision of the recessed portion 16, a waterproof void 17 is formed. In other words, the waterproof void 17 is a void formed between the folded piece 15 and the decorative surface 4. The projecting portions 18 are provided on the decorative surface 4 outward (leftward) of a distal end of the folded piece 15 in the left-right direction, and projects from the decorative surface 4. The projecting portions 18 are inclined with respect to the flow direction, and are inclined toward the center of the decorative surface 4 as they go from an upstream end to a downstream end of the projecting portions 18.

[0059] As illustrated in FIG. 11 and FIG. 14(c), the upper joint 19 includes a projecting piece 20, a void prevention piece 22, and a positioning piece 26. The projecting piece 20 is a portion projecting outward (leftward) from a left end portion 19a, which is the other end

edge of the metallic roofing material B in the left-right direction. The projecting piece 20 is provided with a notch 21 formed by cutting the female joint 13. The void prevention piece 22 is a portion folded back inward (toward back surface 5 side) from the distal end of the projecting piece 20. The back surface portion of the projecting piece 20 is provided with a notch 23 where the thermal insulation material C and the back side material D are not provided. A drain hole 24 and a second drain hole 25 are provided in the vicinity of the left end portion 19a of the insertion edge 7. A waterproof void 27 is formed by the projecting piece 20, the projecting portion 18, and the void prevention piece 22.

[0060] As illustrated in FIG. 8, FIG. 9, and FIGS. 14(a) to 14(c), the lower joint 14 is a portion having a waterproof function in cooperation with the upper joint 19 coupled to the lower joint 14.

[0061] The folded piece 15 is formed by folding a right end portion 14a back. When the two thermal insulation roofing materials A adjacent to each other on the left and right are coupled, the folded piece 15 of the left thermal insulation roofing material A comes into abutment with the back surface 5 of the projecting piece 20 of the right thermal insulation roofing material A. Accordingly, waterproof property is enhanced. Further, with the recessed portion 16 formed in the middle of the folded piece 15, the waterproof void 17 is formed in the joint. Accordingly, the waterproof property is further improved.

[0062] As illustrated in FIG. 10, a plurality of projecting portions 18 are formed at regular pitches. Each projecting portion 18 is inclined toward the center of the decorative surface 4 as it goes to the

downstream side. Accordingly, as indicated by dotted arrows in FIG. 8, rainwater and wind which are about to penetrate into the interior, and the like may be discharged to the outside. The projecting portions 18 further improve the waterproof property and the airtightness by the synergistic effect of the folded piece 15, the recessed portion 16, the waterproof void 17, the void prevention piece 22, and the waterproof void 27.

[0063] In the drawing, the angle of inclination r of the projecting portion 18 is 30° . The angle of inclination r indicates the inclination with respect to the flow direction. The projecting portions 18 are formed at positions where the relationship $W > w$ is satisfied, where w is the width (the length in the left-right direction) from a right end portion 14a to a position where the projecting portions 18 are formed (the distal end on the inner side of the projecting portions 18), and W is the width (the length in the left-right direction) from the left end portion 19a to the distal end of the projecting piece 20 as illustrated in FIG. 11. The width W is also the width (the length in the left-right direction) of the notch 23. It should be noted that overlap t may be provided in the vertical direction (the direction of extension of the projecting portion 18) between the two projecting portions 18 adjacent to each other in the flow direction as illustrated in FIG. 10. Accordingly, the waterproof property is further improved. It should be noted that $T \geq 0$ is satisfied where T is the overlap in the vertical direction (flow direction) between the two projecting portions 18 adjacent to each other in the flow direction.

[0064] In this manner, by the formation of the plurality of inclined

projecting portions 18, the metallic roofing material B can be molded with minimum distortion of molding at the end portion. In addition, since no distortion occurs, dimensional accuracy of the metallic roofing material B is improved, and in addition, because of the improvement of the dimensional accuracy, workability and waterproof property are improved.

[0065] As illustrated in FIG. 8, FIG. 9, and FIGS. 14(a) to 14(c), the upper joint 19 is a portion having a waterproof function by being coupled to the lower joint 14.

[0066] The projecting piece 20 is disposed on the lower joint 14 via the notch 21 as illustrated in FIG. 14(a). The left end edge of the projecting piece 20 constitutes the vertical joint γ having the waterproof property. The plurality of waterproof voids 27 are formed by the projecting piece 20, the projecting portions 18, and the void prevention piece 22, so that waterproof property and airtightness are improved.

[0067] The notch 21 is a space formed by cutting away the fitting edge 11 and the fixing piece 12 so that the female joint 13 does not hinder coupling of the two thermal insulation roofing materials A adjacent to each other on the left and right. As a matter of course, the thermal insulation material C and the back side material D do not exist in the notch 21.

[0068] The void prevention piece 22 is a portion folded back from the projecting piece 20 to the back surface 5. When the two thermal insulation roofing materials A adjacent to each other on the left and right are coupled, the void prevention piece 22 prevents formation of a void at the vertical joint γ between the projecting piece 20 of the right

thermal insulation roofing material A and the decorative surface 4 of the left thermal insulation roofing material A, so that the waterproof property is improved. The void prevention piece 22 further improves the design property of the roof structure and is formed to avoid fluttering of the end portion.

[0069] The notch 23 is a space formed by cutting away the thermal insulation material C and the back side material D so as to prevent the thermal insulation material C and the back side material D from becoming obstacles when the two thermal insulation roofing materials A adjacent to each other on the left and right are coupled to each other in the lateral direction (left-right direction).

[0070] A drain hole 24 is provided to drain rainwater to the decorative surface 4 of the thermal insulation roofing material A on the downstream side to prevent rainwater penetrating from the vertical joint γ from penetrating into the interior from the insertion edge 7 when the two thermal insulation roofing materials A adjacent to each other on the left and right are coupled as illustrated in FIG. 8 to FIG. 9.

[0071] A second drain hole 25 is provided to drain rainwater to the decorative surface 4 of the thermal insulation roofing material A on the downstream side as rainwater penetrating from the vertical joint γ is about to penetrate into the interior beyond the drain hole 24 when the two thermal insulation roofing materials A adjacent to each other on the left and right are coupled as illustrated in FIG. 8 to FIG. 9. Further, the positioning piece 26 formed by the second drain hole 25 is a portion for specifying the position where the notch 23 is to be formed. As a matter of course, the positioning piece 26 functions also as a cutting

position of the thermal insulation material C and the back side material D for separating the plurality of continuous thermal insulation roofing materials A having the thermal insulation material C and the back side material D formed thereon from each other at the time of manufacturing the thermal insulation roofing material A.

[0072] The thermal insulation material C can function, for example, as a thermal insulation material, a reinforcing material, an elevating material, an acoustic insulating material, a sound absorbing material, a shock absorbing material, a fire retardant, and a dew preventing material. A synthetic resin foam is used mainly as the thermal insulation material C. Examples of the material for the thermal insulation material C include synthetic resin foams such as styrene foams, polyurethane foams, polyisocyanurate foams, phenol foams, vinyl chloride foams, polyethylene foams, polystyrene foams, and urea foams. The thermal insulation material C is formed by mixing, for example, a stock solution of the resol type phenol, a curing agent and a foaming agent, discharging the mixture to a front side material (metallic roofing material B) or a back surface side of the back side material D, and heating to cause reaction, foaming and hardening.

[0073] In addition, a lightweight aggregate (pearlite grain, glass beads, gypsum slag, talc stone, shirasu balloon, aluminum hydroxide, etc.) and a fibrous substance (e.g., glass wool, rock wool, carbon fiber, and graphite) may be mixed with the thermal insulation material C as various flame-retarding materials. In this case, it is possible to improve the fire resistance and the fire control performance.

[0074] The back side material D is formed by laminating one, two

or more types of the kraft paper, the aluminum evaporated paper, the asphalt felt, the metal foil (Al, Fe, Pb, and Cu), the synthetic resin sheet, the rubber sheet, the cloth sheet, the gypsum paper, the aluminum hydroxide paper, the glass fiber nonwoven fabric, and the like. Alternatively, the back side material D may be formed of a sheet subjected to a waterproof treatment, a flame-retardant treatment, or the like.

[0075] Now, the method of construction of the thermal insulation roofing material will be described. The thermal insulation roofing material A as shown in FIGS. 4(a) to 4(c) is constructed as illustrated in FIGS. 1(a) and 1(b), FIG. 2, and FIG. 16(a) to FIG. 18.

[0076] First, as illustrated in FIG. 1(a) to FIG. 2, the thermal insulation roofing material A on the upstream side is constructed on the thermal insulation roofing material A on the downstream side, and the upper joint 19 of a thermal insulation roofing material A2 on the right side is superposed on the lower joint 14 of the thermal insulation roofing material A1 illustrated in FIG. 16(a) and FIG. 17(a) on the left side, as illustrated in FIG. 16(b) and FIG. 17(b).

[0077] Thereafter, as indicated by an arrow in FIG. 16(b) and FIG. 17(b), the thermal insulation roofing material A2 on the right side is inserted into the thermal insulation roofing material A1 on the left side in a manner of being pushed into the thermal insulation roofing material A1 on the left side, and the fixing piece 12 of the thermal insulation roofing material A2 is fixed to the lock rail 2 by the fixtures β , such as nails as illustrated in FIG. 1. In this manner, construction is performed as illustrated in FIG. 17(c). This process is performed toward the right

and toward the upstream in sequence, so that the construction is completed as illustrated in FIG. 18. As a matter of course, the thermal insulation roofing material A2 on the right side may be inserted into the thermal insulation roofing material A1 on the left side in a manner of being pushed in an inclined direction.

[0078] The above-described is an example of a thermal insulation roofing material according to the present invention only, and the projecting portion 18 may be formed as illustrated in FIG. 19(a) to FIG. 24(f).

[0079] FIG. 19(a) to FIG. 21(b) are plan views illustrating other examples of the projecting portion 18. In particular, in FIG. 19(b) to FIG. 21(b), a thermal insulation roofing material A having waterproof property further enhanced by forming the two projecting portions 18 adjacent to each other in an overlapped manner by a dimension T in the vertical direction (flow direction) is illustrated.

[0080] FIG. 22(a) to FIG. 24(f) are plan views illustrating other examples of the shape of the projecting portion 18. As a matter of course, although the lower joint 14 is formed on the right end portion and the upper joint 19 is formed on the left end portion in the drawing, these left and right coupling members may be formed inversely.

[0081] As described thus far, according to the roof structure of one embodiment, the following effects are achieved. (1) Since the roof base α (truss structure foundation 1) is formed of a lightweight steel frame, it becomes possible to improve the earthquake resistance and durability of the roof structure. (2) Since a lightweight metallic roofing material B is used, the truss structure foundation 1 can be

formed of a more lightweight steel base, and thus it becomes possible to reduce the cost. (3) Since the lock rail 2 serves as scaffolding of the truss structure foundation 1, it becomes possible to improve the workability of the roof structure. (4) Since the roofboard is not required, it becomes possible to improve the workability of the roof structure and to reduce the cost. (5) It becomes possible to improve the waterproof property of the roof structure.

WHAT IS CLAIMED IS:

1. A roof structure comprising:

a truss structure foundation corresponding to a roof base;

a plurality of lock rails provided on the truss structure foundation;

5 and

a thermal insulation roofing material provided on the plurality of lock rails,

wherein

the thermal insulation roofing material includes a metallic roofing material, a back side material, a thermal insulation material provided between the metallic roofing material and the back side material, a male joint and a female joint provided at both ends in a flow direction of the thermal insulation roofing material,

wherein

the plurality of lock rails are arranged from an eave to a ridge at working widths of the thermal insulation roofing material.

2. The roof structure according to claim 1, further comprising a sheet provided over an entire surface between the truss structure foundation and the plurality of lock rails or between the plurality of lock rails and the thermal insulation roofing material.

3. A roof structure characterized in that a truss structure foundation is employed as a roof base, on the truss structure foundation, a thermal insulation material is formed between a metallic roofing material and a back side material, a plurality of lock rails are formed from an eave to a

ridge at working widths of a thermal insulation roofing material including a male joint and a female joint formed at an upper and lower ends, and a thermal insulation roofing material is formed on the lock rails.

5

4. The roof structure according to claim 3, characterized in that a sheet is formed over an entire surface between the truss structure foundation and the lock rails, or between the lock rails and the thermal insulation roofing material.

10