

DESCRIPTION

Title of Invention

ROOFING MATERIAL AND ROOF STRUCTURE INCLUDING THE SAME

Technical Field

[0001] The present invention relates to a roofing material and a roof structure including the roofing material.

Background Art

[0002] US 5,642,596 (hereinafter referred to as Document 1) discloses a known roof structure. The roof structure described in Document 1 includes a plurality of rafters, a plurality of battens attached to the plurality of rafters, a plurality of roofing materials attached to the plurality of battens. The plurality of rafters each extend in a ridge-eaves direction (a direction extending from the eaves towards the ridge of the roof) and are disposed at intervals in a direction (hereinafter referred to as an eaves direction) orthogonal to the ridge-eaves direction and along the horizontal plane. Each of the plurality of battens extends in the eaves direction and is disposed at intervals in the ridge-eaves direction.

[0003] Each roofing material bridges the plurality of battens. The plurality of roofing materials are aligned in the eaves direction. With respect to a roofing material (hereinafter referred to as an eaves-side roofing material), a roofing material located on a ridge side (hereinafter referred to as a ridge-side roofing material) is arranged such that an eaves-side end of the ridge-side roofing material is mounted on a ridge-side end of the eaves-side roofing material. Moreover, ends of ridge-side roofing materials neighboring in the eaves direction are directly mounted on a central section of the eave-side roofing material.

Summary of Invention

[0004] In the roof structure described in Document 1, the ridge-side end of the roofing material is directly mounted on the batten. Since the roofing material has a lower surface which is a flat surface, the roofing material comes into contact directly with an upper surface of the batten with the entire length in the eaves direction of a back surface of the roofing material. Thus, if the back surface of the roofing material does not have a flat shape due to a production error or the like, the roof surface may become uneven. Moreover, in order to reduce the weight of the

roofing material, unnecessary parts of the roofing material may be removed.

[0005] For these reasons, the back surface of the roofing material may be provided with a plurality of leg sections each having a convex shape. The leg sections preferably extend in the ridge-eaves direction so as to maintain the strength of the roofing material in the ridge-eaves direction and are preferably separated from each other in the eaves direction so as to be stably supported on the batten.

[0006] However, when stress is applied to a front side of the roofing material provided with such leg sections, the roofing material may be broken. That is, when the stress is applied to the front side of the roofing material, the batten located on a rear side of the roofing material deforms to have a downwardly convex shape, and a gap is formed between the batten and an intermediate section in the eaves direction of the roofing material. As a result, the intermediate section in the eaves direction of the roofing material is easily displaced downwardly, and the intermediate section is more likely to be broken.

[0007] In view of the foregoing, it is an objective of the present invention to provide a roofing material and a roof structure including the roofing material which reduce breakage of the roofing material when stress is applied to a front side of the roofing material.

[0009] Moreover, a roofing material of one aspect of the present invention is a roofing material to be directly or indirectly attached to two or more of a plurality of battens which extend in an eaves direction and are disposed at intervals in a ridge-eaves direction. The roofing material includes: a pair of supporting parts provided on a lower surface of the roofing material, separated in the eaves direction, and to be placed on one of the two or more battens; and a contact section provided between the pair of supporting parts and configured to come into contact with the one of the two or more battens so as to follow a deformation of the one of the two or more battens.

[0010] Furthermore, a roof structure of one aspect of the present invention includes: an upper roofing row including a plurality of the roofing materials aligned in an eaves direction; and a lower roofing row provided on an eaves side, neighboring the upper roofing row, and including a plurality of the roofing materials aligned in the eaves direction in parallel to the upper roofing row and different from the plurality of roofing materials in the upper roofing row. A central section of a ridge-side edge of each of the plurality of roofing materials in the lower roofing row is disposed at a position overlapping one of both ends of an eaves-side edge in the eaves direction of each of the plurality of roofing materials in the upper roofing row.

Brief Description of Drawings

[0011] FIG. 1 is a perspective view illustrating a residential building having a roof structure according to an embodiment of the present invention;

FIG. 2A is an exploded perspective view illustrating the roof structure, and FIG. 2B is an enlarged view illustrating part A of FIG. 2A;

FIG. 3 is a perspective view illustrating a roofing material included in the roof structure;

FIG. 4A is a plan view illustrating the roofing material, FIG. 4B is a back view illustrating the roofing material, FIG. 4C is a front view illustrating the roofing material, FIG. 4D is a left side view illustrating the roofing material, FIG. 4E is a right side view illustrating the roofing material, and FIG. 4F is a bottom view illustrating the roofing material;

FIG. 5 is a perspective view illustrating a plurality of the roofing materials which are stacked;

FIG. 6A is a sectional view illustrating the roof structure, and FIG. 6B is a sectional view illustrating a roof structure of a reference example;

FIG. 7 is a perspective view illustrating a roof of the residential building of the embodiment, wherein shading of the roof is expressed by grayscale coloring;

FIG. 8 is a perspective view illustrating a main part of the roof structure;

FIG. 9 is a plan view illustrating the roof structure;

FIG. 10 is a perspective view illustrating a roofing material of a variation;

FIG. 11 is a partially cutaway perspective view illustrating a variation in the case that trusses and battens are used; and

FIG. 12 is a graph illustrating gloss retention of an example.

Description of Embodiments

[0012] An embodiment of the present invention will be described below with reference to the attached drawings.

[0013] A residential building 1 (building) of the present embodiment includes a roof structure 11. The roof structure 11 is disposed on, for example, a top end of the residential building 1. The roof structure 11 includes a roof base 2 (FIG. 2) and a roof 3 having a roof surface 31. The roof structure 11 has a ridge 12 which is the highest section of the roof 3 and eaves 13 which is the lowest section of the roof 3. The roof surface 31 is an upper surface of the roof 3 and inclines down from the ridge 12 toward the eaves 13. In the following description, a direction along the inclination of the roof surface 31 is defined as a ridge-eaves direction, a direction orthogonal to the ridge-eaves direction and along the horizontal surface is defined as an eaves

direction. Moreover, the normal direction of the roof surface 31 is defined as an upward and downward direction.

[0014] As illustrated in FIG. 2, the roof base 2 is a structure formed below the roof 3 to support the roof 3. The roof base 2 is formed, for example, on the top end of the residential building 1. The roof base 2 includes a plurality of purlins 21, a plurality of rafters 22, and a plurality of battens 23. Note that the roof base 2 of the present embodiment is provided with no roof underlayment.

[0015] The plurality of purlins 21 are arranged at intervals in the ridge-eaves direction and are parallel to each other. Each purlin 21 extends in the eaves direction, that is, the longitudinal direction of the purlin 21 is parallel to the eaves direction. Each of the plurality of purlins 21 is located at a higher position than another purlin 21 which is in the plurality of purlins 21 and located closer to the eaves 13 than the purlin 21 is. That is, the closer to the ridge 12 the purlin 21 is located, the higher the position of the ridge 12. Each purlin 21 is fixed to, for example, top ends of a plurality of roof struts, and the height level of each purlin 21 depends on the length of the roof struts in the upward and downward direction. The purlins 21 are made of, for example, wood but may be made of steel. Moreover, each purlin 21 of the present embodiment has a cross section which is a quadrangle with four angles of 90° , for example, a square or a rectangle but may have a square cylindrical shape, a circular cylindrical shape, a C-shaped cross section, or the like.

[0016] The plurality of rafters 22 are mounted on and fixed to the plurality of purlins 21. The plurality of rafters 22 are disposed at intervals in the eaves direction and are parallel to each other. Each rafter 22 extends in the ridge-eaves direction, that is, the longitudinal direction of the rafter 22 is parallel to the ridge-eaves direction. Each rafter 22 is made of, for example, U shaped steel but may be made of lip channel steel or wood having a cross section which is a quadrangle with four angles of 90° , for example, a square or a rectangle.

[0017] The plurality of battens 23 are members which directly support a plurality of roofing materials 4. The plurality of battens 23 are mounted on and fixed to the plurality of rafters 22. The plurality of battens 23 are disposed at intervals in the ridge-eaves direction and are parallel to each other. Each batten 23 extends in the eaves direction, that is, the longitudinal direction of the batten 23 is parallel to the eaves direction. Each of the plurality of battens 23 is located at a higher position than another batten 23 which is in the plurality of battens 23 and located closer to the eaves 13 than the batten 23 is. That is, the closer to the ridge 12 the batten 23 is located, the higher the position of the batten 23.

[0018] As illustrated in FIG. 2B, each batten 23 includes a top board section 231, a pair of side board sections 232 downwardly extending from both end of the top board section 231 in the width direction, and a pair of flange pieces 233 extending from lower ends of the pair of side board sections 232 in a direction away from each other. The pair of flange pieces 233 is in the same plane and is mounted in surface contact with upper surfaces of the plurality of rafters 22.

[0019] The roof 3 is formed above the roof base 2 having such a configuration. The roof 3 is a part which partitions the building into a room space and a space above the room space. The roof 3 is supported by the roof base 2. The roof 3 includes a plurality of roofing materials 4. Each roofing material 4 has a ridge-side end and an eaves-side end. A pair of battens 23 facing each other in the ridge-eaves direction includes a ridge-side batten 23 and an eaves-side batten 23. The ridge-side end of each roofing material 4 is to be directly mounted on the ridge-side batten 23. The eaves-side end of each roofing material 4 is to be indirectly mounted on the eaves-side batten 23 with another roofing material 4 being provided on an eaves side. That is, each roofing material 4 is attached to the pair of battens 23 facing each other in the ridge-eaves direction so as to bridge the battens 23. As illustrated in FIG. 3, each roofing material 4 includes a roofing material body 5 and a connection section 9. Note that for the sake of description, in the following description of the roofing material 4, the right and left direction is defined as illustrated in FIG. 3.

[0020] The roofing material body 5 has a shape which is a quadrangle with four angles of 90°, for example, a square or a rectangle when viewed from above (hereinafter referred to as in planar view) and has a plate shape. The roofing material body 5 has an upper surface which has a ridge-side end. The ridge-side end has a support surface 7 which is a section on which another roofing material 4 on a ridge-side is to be mounted. The upper surface of the roofing material body 5 has an area which is located closer to the eaves 13 than the support surface 7 is and which is provided with an exposed surface 51 having a shape which is a quadrangle with four angles of 90°, for example, a square or a rectangle in planar view. The exposed surface 51 is upwardly exposed in a state where the roofing material 4 is installed on the roof base 2, and the exposed surface 51 forms the roof surface 31.

[0021] The exposed surface 51 includes a plurality of slopes 52, 53, 54, and 55 sectioned by a plurality of border lines 56, 57, and 58. The roofing material 4 of the present embodiment includes four slopes but may include more than four slopes or may include less than four slopes. The plurality of slopes 52, 53, 54, and 55 are inclined with respect to a plane (hereinafter referred to as a reference surface) parallel to the support surface 7 at different angles. Each

slope 52, 53, 54, and 55 has a planar or curved surface. In the roofing material 4 of the present embodiment, the plurality of slopes are defined as a first slope 52, a second slope 53, a third slope 54, a fourth slope 55 from the left end to the right end of the roofing material 4.

[0022] As illustrated in FIG. 4A, the plurality of border lines 56, 57, and 58 extend along the ridge-eaves direction. Here, “the border lines extend along the ridge-eaves direction” includes not only that the border lines are parallel to the ridge-eaves direction in planar view, but also that the border lines are slightly inclined with respect to the ridge-eaves direction in planar view. Here, “the border lines are slightly inclined with respect to the ridge-eaves direction in planar view” means that the angle with respect to the ridge-eaves direction is smaller than or equal to 45°.

[0023] The exposed surface 51 has a ridge-side edge and an eaves-side edge, and each border line 56, 57, 58 continuously extends from the ridge-side edge to the eaves-side edge. Moreover, the plurality of border lines 56, 57, and 58 are disposed in the exposed surface 51 at intervals in the eaves direction. The roofing material 4 of the present embodiment includes a first border line 56, a second border line 57, and a third border line 58 as the plurality of border lines from the left in planar view.

[0024] The first border line 56 is a border line between the first slope 52 and the second slope 53. The first slope 52 inclines down toward the first border line 56. The second slope 53 inclines down toward the first border line 56. That is, the first border line 56 is a valley line (valley fold line).

[0025] The second border line 57 is a border line between the second slope 53 and the third slope 54. The second slope 53 inclines upward toward the second border line 57. The third slope 54 inclines upward toward the second border line 57. That is, the second border line 57 is a ridge line (mountain fold line, arris).

[0026] As illustrated in FIG. 4A, the second border line 57 has a ridge-side end, and the ridge-side end is located on the left of the center in the eaves direction of the ridge-side edge of the exposed surface 51. The second border line 57 has an eaves-side end, and the eaves-side end is located on the right of the center in the eaves direction of the eaves-side edge of the exposed surface 51. Here, the eaves-side edge of the exposed surface 51 includes a left end 61, a central section 62, and a right end 63. Each of the left end 61, the central section 62, and the right end 63 has a size of 1/3 of the eaves-side edge of the exposed surface 51. Thus, the eaves-side end of the second border line 57 is located in the central section 62 of the eaves-side edge of the exposed surface 51. Thus, the ridge-side end of the second border line 57 extends

from the ridge-side edge of the exposed surface 51 toward the central section 62 of the eaves-side edge of the exposed surface 51.

[0027] The third border line 58 is a border line between the third slope 54 and the fourth slope 55. The third slope 54 inclines down toward the third border line 58. The fourth slope 55 inclines down toward the third border line 58. That is, the third border line 58 is a valley line.

[0028] As described above, the valley lines and the ridge lines are alternately formed in the eaves direction. In particular, in the roofing material 4 of the present embodiment, the ridge line is disposed between two valley lines. Moreover, in the roofing material 4 of the present embodiment, the first border line 56 has an eaves-side end, and the eaves-side end is located in the left end 61 of the eaves-side edge of the exposed surface 51. Moreover, the third border line 58 has an eaves-side end, and the eaves-side end is located in the right end 63 of the eaves-side edge of the exposed surface 51.

[0029] Moreover, as illustrated in FIG. 3, each roofing material 4 has an upper surface having a mounting section 64 located at a higher level than the exposed surface 51. When a plurality of roofing materials 4 are stacked (i.e., at the time of stacking), an upper one of the roofing materials 4 is mounted on the mounting section 64 of a lower one of the roofing materials 4. The mounting section 64 is located outside the exposed surface 51 in the right and left direction. In other words, the mounting section 64 is formed of both ends of the roofing material 4 in the eaves direction. The entire exposed surface 51 including the second border line 57 (ridge line) is located at a lower level than an upper surface of the mounting section 64.

[0030] Thus, as illustrated in FIG. 5, it is possible to prevent the exposed surface 51 of the lower roofing material 4 from interfering with a lower surface of the upper roofing material 4 even when the plurality of roofing materials 4 are stacked. As a result, for example, it is possible to reduce breakage in the exposed surface 51 during transportation.

[0031] Note that as described above, the mounting section 64 may be formed of only both ends of the roofing material 4 in the eaves direction or may include a section which is located closer to the ridge 12 than the exposed surface 51 is in addition to the both ends of the roofing material 4 in the eaves direction.

[0032] As illustrated in FIG. 3, the exposed surface 51 has a support surface 7 provided on a ridge side. The support surface 7 is a section on which an eaves-side end of a neighboring roofing material 4 on the ridge side is to be mounted. The support surface 7 has a flat surface. The support surface 7 has a plurality of grooves 71 separated from each other in the eaves direction. Each groove 71 extends in the ridge-eaves direction. Any one of the plurality of

grooves 71 is longer than the other grooves 71 in the ridge-eaves direction. The groove 71 serves as a positioning mark 72 showing a position for a neighboring roofing material 4 on the-ridge side, the description of which will be given later.

[0033] The ridge-side end of the roofing material 4 has a position which is located closer to the ridge 12 than the support surface 7 is, and in this position, a positioning section 73 is provided. The positioning section 73 upwardly protrudes beyond the support surface 7. The positioning section 73 has an eave-side end which faces an eaves-side end (a front leg 83 which will be described later) of a neighboring roofing material 4 on the ridge side in a state where the eaves-side end is mounted on the support surface 7. In this way, the positioning section 73 restricts displacement of the neighboring roofing material 4 on the ridge side toward the ridge 12.

[0034] Moreover, the positioning section 73 has a plurality of recesses 74. The plurality of recesses 74 are formed along a ridge-side edge of the upper surface of the roofing material 4. The plurality of recesses 74 are separated from each other in the eaves direction. Each recess 74 extends in the eaves direction, and the longitudinal direction of the recess 74 is parallel to the eaves direction.

[0035] Moreover, as illustrated in FIG. 4F, the roofing material 4 has a back surface provided with a plurality of projections 84 which are capable of inserting into the plurality of recesses 74 on a one-to-one basis. The plurality of projections 84 are provided along a ridge-side edge of the lower surface of the roofing material 4. When the plurality of roofing materials 4 are stacked, the plurality of projections 84 are inserted into the plurality of recesses 74 on a one-to-one basis. In this state, displacement of an upper roofing material 4 toward the eaves 13 with respect to a lower roofing material 4 is restricted, and displacement of the upper roofing material 4 in the eaves direction is restricted.

[0036] As illustrated in FIG. 4F, the roofing material body 5 has a lower surface provided with a leg section 8. The leg section 8 is to be mounted on one batten 23 of the plurality of battens 23. The leg section 8 has a rear leg 80 and a front leg 83. The rear leg 80 includes a pair of supporting parts separated in the eaves direction and placed on the batten 23 and a contact section provided between the pair of supporting parts. The roofing material 4 of the present embodiment includes a pair of outer legs 81 as the pair of supporting parts and an intermediate leg 82 as the contact section.

[0037] The outer legs 81 in the pair are separated in the eaves direction and are configured to support the roofing material body 5. Moreover, the pair of outer legs 81 is arranged along a

ridge-side edge of the back surface of the roofing material 4. Each outer leg 81 extends in the ridge-eaves direction. Each outer leg 81 is a projection downwardly protruding from the lower surface of the roofing material 4. Note that the pair of outer legs 81 may be formed at portions except for the central section 62 of the roofing material 4 in the eaves direction or may be formed in the central section 62.

[0038] The intermediate leg 82 is formed between the outer legs 81 in the pair and is to be in contact with the batten 23. The intermediate leg 82 is formed at a position aligned with the pair of outer legs 81 in the eaves direction. The intermediate leg 82 extends in the ridge-eaves direction. The intermediate leg 82 is a projection downwardly protruding from the lower surface of the roofing material 4. The intermediate leg 82 is formed at the center of the roofing material body 5 in the eaves direction. When force is exerted on the upper surface of the roofing material 4, the batten 23 warps downwardly, and an intermediate portion of the roofing material body 5 also warps. At this time, the intermediate leg 82 remains in contact with the batten 23. That is, the intermediate leg 82 can touch the batten 23 so as to follow a deformation of the batten 23.

[0039] Here, as illustrated in FIG. 2, the roofing materials 4 neighboring each other in the ridge-eaves direction are arranged so as to be shifted in the eaves direction by a half of the size of the roofing material body 5 of the roofing material 4 in the eaves direction. Thus, neighboring ends of a pair of roofing materials 4 neighboring each other in the eaves direction are arranged at the center of a neighboring roofing material 4 on an eaves side. Thus, in planar view, the intermediate leg 82 is arranged at a position overlapping the neighboring ends of the pair of roofing materials 4 neighboring each other in the eaves direction.

[0040] For example, when the worker or the like climbs on the roofing materials 4 to perform work, if the worker rides on the neighboring ends of the roofing materials neighboring each other in the eaves direction, the neighboring ends warp downwardly, and therefore, stress is likely to be concentrated on the center of an eaves-side roofing material. Thus, as illustrated in FIG. 6B, in the roof structure having a roofing material provided with only a pair of outer legs 81a, breakage of the eaves-side roofing material at its center may occur (the breakage is referred to as a step-crack).

[0041] In contrast, in the roof structure of the present embodiment, as illustrated in FIG. 6A, the intermediate leg 82 is provided on the lower surface of the roofing material 4 at the center between the outer legs 81. Thus, even when a worker rides on the neighboring ends of the roofing materials 4 neighboring each other in the eaves direction and the stress is concentrated

on the center of an eaves-side roofing material 4, the stress can be transferred to the batten 23 via the intermediate leg 82. Thus, according to the roofing material 4 of the present embodiment, step-cracks can be effectively reduced.

[0042] In particular, the roofing material 4 of the present embodiment has the positioning mark 72 which determines the position of the end of a roofing material 4 arranged on a ridge side. The positioning mark 72 enables a relative positional relationship between the ridge-side roofing material 4 and an eaves-side roofing material 4 in the eaves direction to be determined by, at the time of installation, matching the position of an outer edge of the connection section 9 of the ridge-side roofing material 4 and the position of the positioning mark 72 with each other in planar view. The relative positional relationship in the eaves direction is a positional relationship according to which an end of the front leg 83 in the eaves direction of the ridge-side roofing material 4 overlaps the intermediate leg 82 of the eaves-side roofing material 4 in planar view. That is, the positioning mark 72 of the present embodiment is formed at a position corresponding to the intermediate leg 82.

[0043] As illustrated in FIG. 4F, the front leg 83 extends through the entire length in the eaves direction of an eaves-side end of the roofing material body 5. The front leg 83 protrudes downwardly from the lower surface of the roofing material body 5. The front leg 83 is configured to be mounted on the top board section 231 of the batten 23 or on the support surface 7 of another neighboring roofing material 4 on an eaves side.

[0044] As illustrated in FIG. 3, the connection section 9 is formed on a left end face of the roofing material body 5. The connection section 9 is a section which lies under another neighboring roofing material 4 in the eaves direction. The connection section 9 protrudes from the left end face of the roofing material body 5 in the eaves direction. The connection section 9 has an upper surface having a water receiving section 91. The water receiving section 91 is recessed downwardly from the upper surface of the connection section 9. Moreover, the water receiving section 91 has an eaves-side end, and the eaves-side end is open to the eaves 13. Thus, the water receiving section 91 can receive rainwater entering a gap between the roofing materials 4 neighboring each other in the eaves direction and can discharge the received rainwater along the water receiving section 91 to the upper surface of the eaves-side roofing material 4.

[0045] The roofing material 4 having such a configuration is installed as described below. As illustrated in FIG. 2, a worker installs a plurality of roofing materials 4 to bridge a pair of battens 23 of the battens 23 aligned in the ridge-eaves direction, the pair of battens 23 are located closest

to the eaves 13. The worker installs the plurality of roofing materials 4 on the pair of batten 23 sequentially in the eaves direction (a set of the plurality of roofing materials 4 aligned in the eaves direction is referred to as a lower roofing row). Note that between the batten 23 located closest to the eaves 13 and the roofing materials 4, a spacer for adjusting the height level may be provided.

[0046] Then, the worker installs new roofing materials 4 between a batten 23 which is located closer to the ridge 12 than the pair of battens 23 is and the support surfaces 7 of the roofing materials 4 which have been installed. These roofing materials 4 are also installed to be aligned parallel to the plurality of roofing materials 4 which have been installed (a set of the plurality of roofing materials 4 aligned in the eaves direction is referred to as an upper roofing row). Here, the worker installs the roofing materials 4 of the upper roofing row so that an outer edge of the connection section 9 of each roofing material 4 of the upper roofing row matches the positioning mark 72 of the lower roofing row. Thus, each neighboring end in the upper roofing row overlaps at the center of a corresponding one of the roofing materials 4 of the lower roofing row in planar view.

[0047] FIG. 7 shows the plurality of roofing materials 4 installed on the roof base 2. The roof structure 11 has the roofing materials 4 each having the plurality of slopes 52, 53, 54, and 55. Thus, when the roof structure 11 is irradiated with, for example, sunlight, the shading of the roof surface 31 is not monotonous, but complex shading is formed. Thus, the appearance of the roof surface 31 changes depending on the position of the sun, and the roof surface 31 provides a high design quality.

[0048] Moreover, as shown in FIG. 8, rainwater entering the gap between the roofing materials 4 neighboring each other in the eaves direction is received by the water receiving section 91 of the connection section 9. The rainwater received in the water receiving section 91 is discharged along the water receiving section 91 to the upper surface of the eaves-side roofing material 4.

[0049] Moreover, as illustrated in FIG. 9, rainwater flowing on the exposed surface 51 leaves the ridge line (second border line 57), approaches the valley lines (first border line 56 and third border line 58) in planar view, and flows down toward the eaves 13. Under the valley line of the roofing material 4, the exposed surface 51 of the eaves-side roofing material 4 is positioned, and thus, rainwater is less likely to flow in the gap between the neighboring ends in the eaves direction. As a result, the rainwater flowing on the exposed surface 51 flows from the exposed surface 51 of the ridge-side roofing material 4 toward the exposed surface 51 of the eaves-side roofing material 4 and can be discharged to an end of the eave.

[0050] Applications

In the roofing material 4 of the embodiment, the exposed surface 51 includes a plurality of slopes, but the configuration of the exposed surface 51 is not limited to this embodiment. For example, as illustrated in FIG. 10, the exposed surface 51 may include a planar surface parallel to the reference surface. In this variation, the exposed surface 51 and the support surface 7 are flush with each other. Note that the configuration of the leg section 8 and the configuration of the connection section 9 are the same as those in the embodiment.

[0051] The embodiment includes one intermediate leg 82 but may include a plurality of intermediate legs 82.

[0052] The contact section of the embodiment is formed of the intermediate leg 82 which is a projection extending in the ridge-eaves direction, but the configuration of the contact section is not limited to this embodiment. This contact section is required only to have a shape which can touch the batten 23 so as to the downwardly deformation of the batten 23. The contact section may be, for example, formed of a laterally elongated projection extending in the eaves direction. This laterally elongated projection has a lower surface which is curved between the outer legs 81 from one outer leg 81 to the other outer leg to have a downwardly convex shape, and the laterally elongated projection can touch the batten 23 so as to follow the downwardly deformation of the batten 23.

[0053] Note that the contact section does not have to be continuously in contact with the batten 23 but may come into contact with the batten 23 during an initial phase of warping of the roofing material 4 to restrict further warping of the roofing material 4.

[0054] The roof structure 11 of the embodiment is a structure on top of the residential building 1, but the application of the roof structure 11 is not limited to this embodiment. The roof structure 11 may be applied to a roof 3 between a first floor part and a second floor part of a two-story building or may be applied to overhangs.

[0055] The roof structure 11 of the embodiment is the roof structure 11 of a gable roof but may be a roof structure of a hip roof or a roof structure of a shed roof, and the roof structure 11 is not limited to the structure of the embodiment. Note that in the case of the roof structure of the shed roof, a highest section is referred to as the ridge 12. Moreover, in the case of a building having no section protruding from an outer wall surface, a lowest section of a roof of the building is referred to as the eaves 13.

[0056] Moreover, in the embodiment, the battens 23 are disposed on a structure including the purlins 21 and the rafters 22, but the battens 23 is not limited to one in this embodiment. For

example, as illustrated in FIG. 11, the battens 23 may be disposed on a truss structure 30.

[0057] The truss structure 30 is a queen post truss but may be a truss of another shape such as a king post truss in consideration of loading conditions of a roof. The truss structure 30 includes a pair of top chords 35, one bottom chord 32, and a plurality of (three) webs 33. The top chords 35 are members having a gradient and constituting the roof surface. The bottom chord 32 is a horizontally disposed member. The webs (including diagonal members) 33 are members constituting the interior of the truss structure 30 and connect the top chords 35 to the bottom chord 32. Each of the top chords 35, the bottom chord 32, and the webs 33 has a C-shaped cross section but may have a rectangular cross section, a square cylindrical shape, or a circular cylindrical shape.

[0058] A plurality of the truss structures 30 are disposed in the eaves direction. The plurality of battens 23 are disposed to extend across the plurality of truss structures 30. The flange piece 233 of each batten 23 is fixed to the top chord 35, and the plurality of battens 23 are aligned along the inclination direction of each top chord 35.

[0059] A heat shield sheet 34 may be provided between the truss structure 30 and the battens 23. The heat shield sheet 34 is a sheet which easily shields heat. For example, a sheet obtained by vapor-depositing aluminum onto a resin film is adopted as the heat shield sheet 34. The heat shield sheet 34 is disposed to cover the plurality of truss structures 30 aligned in the eaves direction, and the battens 23 are disposed on the heat shield sheet 34 and are fixed to the top chords 35.

[0060] The configuration of the embodiment may be accordingly modified in design without departing from the spirit of the present invention.

[0061] [Coating Film Configuration]

The roofing material 4 includes a base material and a coating film constituent body. The base material is a ceramic base material containing cement as a main component. The coating film constituent body is disposed on a surface of the base material, essentially includes an undercoat layer and a topcoat layer, and optionally includes a sealing layer (sealer). Such a coating film configuration provides long-term weather durability to the roofing material 4.

[0062] [Base Material]

As the base material, any material used for, for example, an exterior material made of cement may be adopted. For example, the base material is produced by: blending an inorganic filler, a fibrous material, and the like with hydraulic glue serving as a raw material of the inorganic hardened body to obtain a molding material; molding the molding material into a

molded body; and then hardening the molded body by curing. The hydraulic glue is not particularly limited, but as the hydraulic glue, one kind or a plurality of kinds of materials selected from Portland cement, Portland blast-furnace slag cement, blast furnace slag, calcium silicate, gypsum, and the like may be adopted. As the inorganic filler, fly ash, microsilica, silica sand, and the like may be used alone or in combination. As the fibrous material, inorganic fiber such as pulp, synthetic fiber, and asbestos and metallic fiber such as steel fiber may be used alone or in combination. Molding may be performed by extrusion molding, cast molding, fiber molding, press molding, or the like, and after the molding, the molded body is subjected to autoclave curing, steam curing, or room temperature curing as necessary so that the strength of the base material is sufficiently developed, thereby producing the base material.

[0063] [Undercoat Layer]

The undercoat layer is a coating film of an undercoat material. The undercoat material is an organic resin-based coating material and may contain an acrylic emulsion resin as an organic resin. The acrylic emulsion resin is obtained by, for example, emulsion polymerization of an unsaturated monomer mixture of a combination of an ethylenically unsaturated carboxylic acid monomer and one element or two or more elements selected from a group consisting of alkyl acrylate or alkyl methacrylate ester, a vinyl aromatic compound, acrylonitrile, methacrylonitrile, saturated carboxylic acids vinyl ester, vinyl halide, butadiene, and ethylene in the presence of an emulsifier.

[0064] The acrylic emulsion resin contained in the undercoat material preferably contains a silyl group. Such a silyl group-containing acrylic emulsion resin is obtained by, for example, emulsion polymerization of a mixture in the presence of an emulsifier, the mixture being obtained by further adding one element or two or more elements selected from a group consisting of an unsaturated monomer containing a silyl group such as γ -methacryloxypropyl methyldimethoxysilane, γ -methacryloxypropyl methyltrimethoxysilane, γ -methacryloxypropyl methyldiethoxysilane, γ -methacryloxypropyl methyltriethoxysilane and a silane coupling agent containing a glycidyl group or an amino group such as γ -glycidoxypropyl trimethoxysilane, γ -glycidoxypropyl methyldiethoxysilane, γ -glycidoxypropyl triethoxysilane, N- β (aminoethyl) γ -aminopropyl methyldimethoxysilane, N- β (aminoethyl) γ -aminopropyl methyltrimethoxysilane to the unsaturated monomer mixture of a combination of an ethylenically unsaturated carboxylic acid monomer and one element or two or more elements selected from a group consisting of alkyl acrylate or alkyl methacrylate ester, a vinyl aromatic compound, acrylonitrile, methacrylonitrile, saturated carboxylic acids vinyl ester, vinyl halide,

butadiene, and ethylene.

[0065] [Topcoat Layer]

The topcoat layer is a coating film made of a topcoat material. The topcoat material is a coating material containing an inorganic resin. Examples of the coating material containing the inorganic resin forming the topcoat layer may be, but is not limited to, topcoat materials 1 to 5 described below.

[0066] (Topcoat Material 1)

The topcoat material includes topcoat materials containing component (A), component (B), and component (C) listed below. The component (A) is an organic inorganic composite resin aqueous dispersion obtained by neutralizing a hydrolytic condensation reactant of substance (a) and substance (b) with a neutralizer and then adding water to the hydrolytic condensation reactant. The substance (a) is 100 parts by mass of organosilane and/or a partially hydrolytic condensation product thereof. The organosilane is represented by general formula $R^1_nSi(OR^2)_{4-n}$, where R^1 is an organic group containing 1 to 8 carbon atoms, R^2 is an alkyl group containing 1 to 5 carbon atoms, and n is 1 or 2. The substance (b) is 5 parts by mass to 200 parts by mass of silyl group-containing vinyl-based resin. The silyl group-containing vinyl-based resin contains a hydrolyzable silyl group or a silyl group having a silicon atom bonded to a hydroxyl group. The silyl group-containing vinyl-based resin has an acid number of 20 mg KOH/g to 150 mg KOH/g. The component (B) is hydrolytic condensation reactive alkoxysilane containing an amino group. The component (C) is a compound containing an epoxy group which is reactive with the amino group of component (B) and which is in a molecule of the compound.

[0067] (Topcoat Material 2)

A silicone-based coating agent (disclosed in JP 3242442 B2) contains components (A), (B), and (C) as essential components. The component (A) is a silica dispersion oligomer solution of organosilane obtained by partially hydrolyzing hydrolyzable organosilane in colloidal silica dispersed in an organic solvent or water under conditions that 0.001 mol to 0.5 mol water are used with respect to X1 mol. The hydrolyzable organosilane is represented by general formula (1): $R^1_nSiX_{4-n}$. In formula (1), R^1 is a monovalent hydrocarbon group containing 1 to 8 carbon atoms of the same or different types and is selected from a group consisting of an alkyl group, a cycloalkyl group, an alkenyl group, a halogen-substituted hydrocarbon group, a γ -methacryloxypropyl group, a γ -glycidoxypropyl group, a 3,4-epoxy cyclohexyl ethyl group, and a γ -mercapto propyl group, n is an integer from 0 to 3, and X is a hydrolyzable group

selected from a group consisting of an alkoxy group, an acetoxy group, an oxime group, an enoxy group, an amino group, an aminoxy group, and an amide group. The component (B) is polyorganosiloxane represented by average composition formula (2): $R^2_aSi(OH)_bO_{(4-a-b)/2}$. In formula (2), R^2 is a monovalent hydrocarbon group containing 1 to 8 carbon atoms of the same type or different types and is selected from a group consisting of an alkyl group, a cycloalkyl group, an alkenyl group, a halogen-substituted hydrocarbon group, a γ -methacryloxypropyl group, a γ -glycidoxypropyl group, a 3,4-epoxy cyclohexyl ethyl group, and a γ -mercapto propyl group, a is a value satisfying the relationship $0.2 \leq a \leq 2$, b is a value satisfying the relationship $0.0001 \leq b \leq 3$, and a and b satisfies the relationship $a + b < 4$. The R^2 group in the component contains 1 mol% to 30 mol% phenyl group with respect to all the R^2 groups. The component (C) is a catalyst for promoting condensation reaction between the component (A) and the component (B). The silicone-based coating agent contains 5 wt% to 95 wt% silica as a solid content in the component (A), and at least 50 mol% of the hydrolyzable organosilane is organosilane of $n = 1$, and 99 parts by weight to 1 part by weight of the component (B) is blended with 1 part by weight to 99 parts by weight of the component (A).

[0068] (Topcoat Material 3)

A silicone-based coating agent (disclosed in JP 3193832 B2) contains components D, E, and F. The component D is silicone diol-containing fine particle oxide dispersion oligomer obtained by blending a silicone diol component at 5 wt% to 30 wt% with a substance. The substance is obtained by partially hydrolyzing hydrolyzable organosilane represented by general formula (3): $R^1_nSiX_{4-n}$. In formula (3), R^1 is a substituted or unsubstituted monovalent hydrocarbon group containing 1 to 8 carbon atoms of the same or different types, n is an integer from 0 to 3, and X is a hydrolyzable group. The partial hydrolyzation is performed under conditions that fine particles of oxide are dispersed so as to have a fine particle diameter of 0.2 μm to 3 μm and that 0.001 mol to 0.5 mol water with respect to X1 mol are used. The 5 wt% to 30 wt% silicone diol component has a weight-average molecular weight of 10000 or less. The silicone diol component is represented by general formula (4): $OH(R^2_2SiO)_mH$. In formula (4), R^2 is a substituted or unsubstituted monovalent hydrocarbon group containing 1 to 8 carbon atoms of the same or different types, and m is larger than or equal to 1. The component E is polyorganosiloxane represented by average composition formula (5): $R^3_aSi(OH)_bO_{(4-a-b)/2}$. In formula (5), R^3 is a substituted or unsubstituted monovalent hydrocarbon group containing 1 to 8 carbon atoms of the same or different types, a is a value satisfying the relationship $0.2 \leq a < 2.0$, b is a value satisfying the relationship $0.0001 \leq b \leq 3$, and a and b satisfy the relationship $a + b <$

4. The component E contains a silanol group in a molecule. The component F is a catalyst.
[0069] (Topcoat Material 4)

A silicone-based coating agent (disclosed in JP H09-249822 A1) is obtained by blending an UV absorber with a silicon alkoxide-based coating agent. The silicon alkoxide-based coating agent contains a silicon compound and/or a partial hydrolysate thereof as main component(s). The silicon compound is represented by general formula (6): $(R^1)_mSi(OR^2)_{4-m}$. In formula (6), each R^1 is a methyl group, an ethyl group, or a phenyl group, each R^2 is an alkyl group containing 1 to 8 carbon atoms, and m is 0, 1, or 2.

[0070] The silicon alkoxide containing the silicon compound represented by general formula (6) and/or a partial hydrolysate thereof as main component(s) can be obtained by diluting a mixture by an appropriate solvent and by adding a required amounts of hardener and catalyst to cause hydrolysis and condensation polymerization. The mixture contains compounds described in (i), (ii), and (iii) listed below as main components. The silicon alkoxide preferably has a polystyrene-equivalent weight-average molecular weight M_w of 500 to 3000, and a molecular weight distribution M_w/M_n (M_n is number average molecular weight) of 1.1 to 3.0. More preferably, M_w is 600 to 3000, and M_w/M_n is 1.2 to 1.8. When the weight-average molecular weight and the molecular weight distribution are smaller than these ranges, the cure shrinkage during the condensation polymerization is large, and cracks are likely to be formed in the coating film after the baking. When the weight-average molecular weight and the molecular weight distribution are larger than these ranges, the reaction is too slow for hardening, or even when the layer is hardened, the silicon-based coating agent may results in a soft coating film, and the leveling property of the coating film tends to be very low.

(i): Twenty to two hundred parts by weight of the silicon compound represented by general formula (6), where $m = 0$, and colloidal silica

(ii): A hundred parts by weight of silicon compound represented by general formula (6), where $m = 1$

(iii): Zero to eighty parts by weight of silicon compound represented by general formula (6), where $m = 2$

[0071] As these silicon compounds, alkoxyasilanes represented by formula (7) described below may be adopted. Moreover, as the colloidal silica of the component (i), a resultant obtained by dispersing fine particles of a silica component in water, an organic solvent such as methanol, or a combined solvent thereof is adopted, but as long as silica is colloidal, the particle size and the types of the solvent are not particularly limited. Note that the blended amount of colloidal

silica in component (i) corresponds to parts by weight inclusively of a dispersion medium.

[0072] (Topcoat Material 5)

A silicone-based coating agent (disclosed in JP H09-249822) contains a silicon alkoxide-based coating agent and an UV absorber blended with the silicon alkoxide-based coating agent. The silicon alkoxide-based coating agent contains three components (G), (H), and (I) as essential components. The component (G) is a silica dispersion oligomer solution containing organosilane. The silica dispersion oligomer solution is obtained by partially hydrolyzing hydrolyzable organosilane in colloidal silica obtained by dispersing silica particles in an organic solvent and/or water. The hydrolyzable organosilane is represented by general formula (7): $(R^3)_nSiX_{4-n}$. In formula (7), each R^3 is substituted or unsubstituted monovalent hydrocarbon group containing 1 to 8 carbon atoms, X is a hydrolyzable group, and n is an integer 0 to 3. The compound (H) is polyorganosiloxane represented by average composition formula (8): $(R^4)_dSi(OH)_eO_{(4-d-e)/2}$. In formula (8), each R^4 is a substituted or unsubstituted monovalent hydrocarbon group containing 1 to 8 carbon atoms, d is a value satisfying the relationship $0.2 \leq d \leq 2.0$, e is a value satisfying the relationship $0.0001 \leq e \leq 3$, and d and e satisfies the relationship $d + e < 4$. The compound H contains a silanol group in a molecule. The compound (I) is a hardening catalyst.

[0073] [Formation of Coating Film]

A sealing agent is applied to a surface of a base material as necessary to form a sealing layer. Then, an organic resin-based coating material is applied to the sealing layer and is hardened by being dried, thereby forming an undercoat layer. Thereafter, a coating material containing an inorganic resin is applied to the undercoat layer and is hardened by being dried, thereby forming a topcoat layer. A roofing material 4 can thus be obtained. The sealing layer is formed to reduce the occurrence of efflorescence and/or discoloration during curing and hardening in the fabrication of the base material. The sealing agent may be an agent containing a water-soluble acrylic resin and at least one of acrylic emulsion (acrylic resin emulsion) and acrylic silicone emulsion (acrylic silicone resin emulsion).

[0074] Each of the coating materials can be applied by various methods including a brush coating method, an immersion method, a spray coating method, a roll coating method, a bell method, a flow coating method, a curtain coating method, and a knife coat method. In order to easily obtain a coating film having a uniform thickness, the application is preferably performed by the spray coating method, the roll coating method, or the bell method adopting a rotary cup. As described above, the coating film is formed to have a uniform thickness, and thereby the

ultimate extension of a uniform coating film can be obtained. Moreover, the film thickness of each coating film is not particularly limited, but the film thickness of the undercoat layer is preferably 10 μm or larger and 200 μm or smaller, and the film thickness of the topcoat layer is preferably 2 μm or larger and 15 μm or smaller.

[0075] [Example]

An example is specifically described below. Note that in the example, “part(s)” and “%” respectively correspond to “part(s) by mass” and “mass%”.

[0076] <Preparation of Acrylic Emulsion Coating Material 1>

To 80 parts of acrylic emulsion resin having a gel fraction of 80% and a glass transition temperature of 75°C, 2 parts of film formation auxiliary agent (2,2,4-trimethyl-1,3-pentane diol monoisobutyrate), 12.4 parts of water, 0.5 parts of neutralizer (water solution of 50% dimethylaminoethanol), 5 parts of thickener (Primal ASE-60 which is an alkali swelling thickener available from Rohm and Haas Japan K.K.) water solution, and 0.1 parts of antifoam agent (Foamaster VL which is a silica silicone-based antifoam agent available from SAN NOPCO LIMITED) were added with the acrylic emulsion resin being stirred and were stirred for 30 minutes to obtain a mixture, and a colorant was further added to the mixture at a proportion of 1% to color the mixture, thereby obtaining an acrylic emulsion coating material 1.

[0077] Note that the colorant was obtained in such a way that 17.7 parts of ion exchanged water, 0.2 parts of thickener (Natrosol 250HR available from Hercules Japan Inc.), 5 parts of dispersant (OROTAN731DP available from Rohm and Haas Japan K.K.), 0.5 parts of wet dispersant (Neonoigen 140A available from DKS Co. Ltd.), 9 parts of carbon black (Asahi #50 available from ASAHI CARBON CO.,LTD.), 10 parts of titanium dioxide (Tipaque CR-97 available from ISHIHARA SANGYO KAISHA, LTD.), 57.5 parts of barium sulfate (settleable barium sulfate #100 available from SAKAI CHEMICAL INDUSTRY CO.,LTD.), and 1 part of antifoam agent (Nopco 8034 available from SAN NOPCO LIMITED) were mixed, and then 30 parts of glass beads were further added to obtain a mixture, and the mixture was agitated until the glass beads became 20 μm or smaller when the glass beads was measured by a grind meter.

[0078] <Preparation of Silyl Group-Containing Vinyl-Based Resin Solution>

Into a reactor including a reflux condenser and a stirrer, 50 parts of diethylene glycol monobutyl ether and 50 parts of n-butanol were added, and heated to 100°C while being stirred. Next, a mixed solution containing 50 parts of isobutyl methacrylate, 31.5 parts of 2-ethyl hexyl methacrylate, 8.5 parts of γ -methacryloxypropyl trimethoxysilane, 10.5 parts of acrylate, and 2.5 parts of t-butylperoxy 2-ethyl hexanoate was dropped at 100°C for three hours, and then, the

temperature was increased to 105°C, and the temperature was maintained at 105°C for two hours, and then, the reaction was terminated. In an obtained silyl group-containing vinyl-based resin solution, the acid number of the resin was 65 mg KOH/g, and the number average molecular weight of the resin was 10000 when the solid content concentration of the silyl group-containing vinyl-based resin solution was 50%.

[0079] <Preparation of Organic Inorganic Composite Resin Coating Material> (Enamel Coating Material)

Into a reactor including a reflux condenser and a stirrer, 23 parts of partial hydrolytic condensation product of methyltrimethoxysilane which is component (a), 8 parts of methyltrimethoxysilane, 1.7 parts of dimethyldimethoxysilane, 25 parts of silyl group-containing vinyl-based resin solution corresponding to component (b) obtained in the preparation of the silyl group-containing vinyl-based resin solution, and 10 parts of isopropanol were added, and these were mixed to obtain a mixture. Then, 3.0 parts of ion exchanged water and 0.05 parts of 1N hydrochloric acid were further added to the mixture, and reaction was caused at 60°C for three hours. Next, 0.3 parts of monoacetylacetonate bis (ethyl acetoacetate) aluminum and 0.8 parts of ion exchanged water were added, and reaction was further caused at 60°C for three hours. Then, 0.55 parts of dimethylaminoethanol and 37 parts of water were added and stirred at 50°C for 1 hour, and then, desolvation was performed under a reduced pressure (1.3×10^4 Pa). Thereafter, adjustment by dilution with water was performed so as to achieve a solid content concentration of 35%, thereby preparing an organic inorganic composite resin aqueous dispersion.

[0080] To 100 parts of the thus obtained organic inorganic composite resin aqueous dispersion, a colorant (the same as the colorant adopted in the preparation of the acrylic emulsion coating material 1) was added at a concentration of 15% of the solid content to color the organic inorganic composite resin aqueous dispersion. With this organic inorganic composite resin aqueous dispersion, 1 part of amino group-containing alkoxysilane compound and 2.4 parts of epoxy group-containing alkoxysilane compound immediately before application to prepare an organic inorganic composite resin coating material.

[0081] <Example>

A sealing agent was applied to a surface of a cement base material and was dried, thereby forming a sealing layer. Then, the acrylic emulsion coating material 1 as an undercoat material was applied to a surface of the sealing layer by a flow coater and dried by a jet furnace dryer. Thereafter, the temperature of the cement base material was increased to 60°C at a rate

of 20°C per hour for initial curing and was kept at 60°C for 5 hours, and was then cooled to room temperature to cure the cement base material. The organic inorganic composite resin coating material as a topcoat material was applied to the cement base material by a flow coater and was dried by a jet furnace dryer, thereby producing a roofing material. The roofing material was evaluated by the following method.

[0082] <Gloss Retention>

In Examples 1 to 4, initial gloss values were measured. The gloss values were measured by a gloss meter “MULTI GLOSS 268” manufactured by Konica Minolta, Inc. at a measured angle (incidence angle and acceptance angle) of 60°.

[0083] Next, accelerated weathering tests were performed with 300 hours, 600 hours, 900 hours, 1200 hours, and 1800 hours (corresponding to 30 years of actual exposure) of UV irradiation by a super UV accelerated weathering tester.

[0084] Then, gloss values after the accelerated weathering test were measured in the same manner as used to measure the initial gloss values.

[0085] The proportion of the gloss values after the accelerated weathering test to the initial gloss values was defined as gloss retention.

[0086] The example meets the requirement that the gloss retention is 50% or higher (see Table 1 and FIG. 12).

[0087] <Surface Hardness>

Based on JIS K5600-5-4 (pencil hardness measurement method), the surface hardness of the roofing material was measured. That is, in an ascending order of the pencil hardness, the coating film on the surface of the topcoat layer of the roofing material was rubbed at an angle of 45°, and the hardness with which no scratch was formed in the coating film was measured. Note that the coating film made of the resin coating material has a pencil hardness of F to H, a coating film made of the baked coating material has a pencil hardness of 2H to 3H, and a coating film made of a ceramic coating material has a pencil hardness of 4H or higher.

[0088] In the example, the pencil hardness was 3H, which is a hardness substantially as high as the hardness of normal baking finish, and the example also has flexibility, and therefore, the example is highly resistant to expansion and contraction.

[0089] <Gloss Value>

In the example, the gloss value of a normal section (a section without surface cutting) and the gloss value of a flat section (a section with surface cutting) were measured. The gloss values were measured at measured angles (angles of incidence and acceptance angles) of 20°,

60°, and 85° by a gloss meter “MULTI GLOSS 268” manufactured by Konica Minolta, Inc. From the gloss values in Table 2, it can be seen that the expression of both of the normal section and the flat section (that is, the expression of the surface of the roofing material) changes depending on the incidence angle of light and surfaces which are seen. That is, the gloss values of both of the normal section and the flat section change depending on the measured angles. Moreover, the gloss value of the normal section and the gloss value of the flat section differ from each other even with an identical measured angle. Thus, a roofing material having a plurality of slopes with different inclination directions and different inclination angles (see, for example, FIG. 4A) has an exterior which appears differently depending on angles at which the roofing material 4 is seen, and thus, the design property of the roofing material 4 is excellent.

[0090] Note that the example meets all the requirements including basic properties of the roofing material, and thus, no problem is found in adhesiveness.

[0091] [Table 1]

Gloss Retention

Irradiation Time (hr)	0	300	600	900	1200	1500	1800
Gloss Value	3.2	3.2	3.2	3.0	2.9	3.0	2.8
Gloss Retention (%)	100	100	100	93.75	90.625	93.75	87.5

[0092] [Table 2]

Gloss Value

Measured Angle	20°	60°	85°
Normal Section	0.2	1.7	1.4
Flat Section	0.2	2.1	1.7

[0093] Effects

As described above, the roofing material 4 of each of the embodiment and the variation includes the cement base material, the undercoat layer, and the topcoat layer, the undercoat layer and the topcoat layer being sequentially disposed on the cement base material. The undercoat layer is made of the organic resin-based coating material. The topcoat layer is made of the coating material containing the inorganic resin, the topcoat layer having a surface having a gloss retention of 50% or higher after 1800 hours of irradiation in an accelerated weathering test.

[0094] With this configuration, the gloss of the roofing material 4 is less likely to be degraded by irradiation with UV rays or the like, and the roofing material 4 has long-term weather durability.

[0095] Moreover, in the roofing material 4 of each of the embodiment and the variation, the topcoat layer preferably has a surface hardness of 3H or higher based on JIS K 5600-5-4.

[0096] With this configuration, a scratch is less likely to be formed in the surface of the roofing material 4, and damage such as peeling of the topcoat layer is less likely to occur.

[0097] Moreover, in the roofing material 4 of each of the embodiment and variation, the surface of the topcoat layer has a gloss value of larger than or equal to 0.1 and smaller than or equal to 2.5 before the accelerated weathering test.

[0098] With this configuration, the roofing material 4 has a wide range of gloss values, the exterior of the roofing material 4 appears differently depending on angles at which the roofing material 4 is seen, and thus, the design property of the roofing material 4 is excellent.

[0099] The roofing material 4 of each of the embodiment and the variation is a roofing material 4 to be directly or indirectly attached to two or more of a plurality of battens 23 which extend in an eaves direction and are disposed at intervals in a ridge-eaves direction. The roofing material 4 includes a pair of supporting parts (in the embodiment, outer legs 81) and a contact section (in the embodiment, an intermediate leg 82). The pair of supporting parts is provided on a lower surface of the roofing material 4, are separated in the eaves direction, and are to be placed on one of the two or more battens 23. The contact section is provided between the pair of supporting parts and is configured to come into contact with the one of the two or more battens 23 so as to follow a deformation of the one of the two or more battens 23.

[0100] With this configuration, the contact section remains in contact with the batten 23 when the batten 23 deforms, and thus, it is possible to reduce downward displacement of an intermediate portion of the roofing material 4 when stress is applied to the roofing material 4 from above, thereby reducing breakage at the intermediate portion of the roofing material 4.

[0101] Moreover, the roofing material 4 of each of the embodiment and the variation has the following additional configuration. That is, a positioning mark 72 is provided on an upper surface of the roofing material 4 of the present embodiment, wherein the positioning mark 72 is used for positioning of the other roofing material 4 disposed on a ridge side in a state where the other roofing material 4 is mounted on the upper surface.

[0102] With this configuration, when to one roofing material 4 which has been installed, the other roofing material 4 on a ridge side is to be attached, the other roofing material 4 on the ridge

side can be easily disposed at an appropriate position.

[0103] Moreover, the roofing material 4 of each of the embodiment and the variation has the following additional configuration. That is, the positioning mark 72 of the present embodiment is provided at a position corresponding to the contact section.

[0104] With this configuration, the contact section can receive stress applied from the roofing material 4 on the ridge side a roofing material 4 on an eaves side by simply installing the roofing material 4 on the ridge side so as to match with the positioning mark 72.

[0105] Moreover, the roofing material 4 of the embodiment has the following additional configuration. That is, each of the pair of supporting parts and the contact section of the present embodiment is a downward projection.

[0106] With this configuration, each of the pair of supporting parts and the contact section has a simple configuration.

[0107] Moreover, the roofing material 4 of the embodiment has the following additional configuration. That is, the roofing material 4 of the present embodiment has an exposed surface 51 provided on an upper surface of the roofing material 4, forming a roof surface 31, and having a rectangular shape in planar view. The exposed surface 51 includes a plurality of slopes sectioned by at least one border line extending along the ridge-eaves direction, the plurality of slopes being aligned in the eaves direction. Each of the plurality of slopes inclines upward or down toward the at least one border line.

[0108] With this configuration, irradiating the exposed surface 51 of the roofing material 4 after installation with sunlight or the like can form shading.

[0109] Moreover, the roofing material 4 of the embodiment has the following additional configuration. That is, the at least one border line includes a plurality of border lines. The plurality of border lines include at least one ridge line and at least one valley line alternately formed in the eaves direction.

[0110] With this configuration, neighboring slopes have different angles, and therefore, it is possible to form more complex shading of the roof surface 31. Moreover, this configuration enables rainwater on the exposed surface 51 to flow along the valley line, and therefore, a flow of the rainwater can be easily controlled.

[0111] Moreover, the roofing material 4 of the embodiment has the following additional configuration. That is, the at least one valley line included in the three or more border lines includes two or more valley lines.

[0112] With this configuration, rainwater flowing toward the eaves 13 can be distributed to two

or more sites without concentrating the rainwater on one site.

[0113] Moreover, the roofing material 4 of the embodiment has the following additional configuration. That is, in the roofing material 4 of the present embodiment, each of the two or more valley lines extend from a ridge-side edge of the exposed surface 51 to an eaves-side edge of the exposed surface 51. The at least one ridge line is formed between the two or more valley lines and extends from the ridge-side edge of the exposed surface 51 toward a central section 62 of the eaves-side edge of the exposed surface 51.

[0114] With this configuration, the rainwater on the exposed surface 51 flows along the valley lines on both sides of the central section 62 down to the eaves-side roofing material 4. This prevents when roofing materials 4 neighboring each other in the ridge-eaves direction are attached to be shifted to each other in the eaves direction, rainwater from flowing into a gap between neighboring roofing materials 4 on an eaves side.

[0115] Moreover, the roofing material 4 of the embodiment has the following additional configuration. That is, the roofing material 4 of the present embodiment includes a mounting section 64. The mounting section 64 is located at a higher level than the exposed surface 51 and on which an upper roofing material 4 is to be mounted at a time of stacking of a plurality of the roofing materials.

[0116] This configuration reduces interference of the exposed surface 51 with the lower surface of the upper roofing material 4 when a plurality of roofing materials 4 are stacked, thereby reducing breakage of the roofing material.

[0117] Moreover, a roofing structure of the embodiment has the following configuration. That is, the roofing structure of the present embodiment includes an upper roofing row including a plurality of the roofing materials 4 aligned in the eaves direction and a lower roofing row provided on an eaves side and neighboring the upper roofing row. The lower roofing row includes a plurality of the roofing materials 4 aligned in the eaves direction in parallel to the upper roofing row and different from the plurality of roofing materials in the upper roofing row. A central section 62 of a ridge-side edge of each of the plurality of roofing materials 4 in the lower roofing row is disposed at a position overlapping one of both ends of an eaves-side edge of each of the plurality of roofing materials 4 in the upper roofing row.

[0118] With this configuration, rainwater flowing from the upper roofing row is prevented from flowing to the gap between the roofing materials 4 neighboring each other in the lower roofing row in a concentrated manner.

Reference Signs List

[0119]	11	Roof Structure
	2	Roof Base
	23	Batten
	4	Roofing Material
	51	Exposed Surface
	62	Central Section
	64	Mounting Section
	72	Positioning Mark
	81	Outer Leg (Supporting Part)
	82	Intermediate Leg (Contact Section)

CLAIMS

1. A roofing material to be directly or indirectly attached to two or more of a plurality of battens which extend in an eaves direction and are disposed at intervals in a ridge-eaves direction, the roofing material comprising:

a pair of supporting parts provided on a lower surface of the roofing material, separated in the eaves direction, and to be placed on one of the two or more battens; and

a contact section provided between the pair of supporting parts and configured to come into contact with the one of the two or more battens so as to follow a deformation of the one of the two or more battens.

2. The roofing material according to claim 1, further comprising:

a positioning mark on an upper surface of the roofing material, wherein

the positioning mark is used for positioning of the other roofing material to be disposed on a ridge side in a state where the other roofing material is mounted on the upper surface, and the positioning mark is provided at a position corresponding to the contact section.

3. The roofing material according to claim 1 or 2, wherein

each of two or more valley lines extend from a ridge-side edge of an exposed surface to an eaves-side edge of the exposed surface, and

at least one ridge line is formed between the two or more valley lines and extends from the ridge-side edge of the exposed surface toward a central section of the eaves-side edge of the exposed surface.

4. The roofing material according to any one of claims 1 to 3, further comprising:

a mounting section which is located at a higher level than an exposed surface and on which an upper roofing material is to be mounted at a time of stacking of a plurality of the roofing materials.

5. A roof structure comprising:

an upper roofing row including a plurality of the roofing materials according to any one of claims 1 to 4 aligned in an eaves direction; and

a lower roofing row provided on an eaves side, neighboring the upper roofing row, and

including a plurality of the roofing materials according to any one of claims 1 to 4 aligned in the eaves direction in parallel to the upper roofing row and different from the plurality of roofing materials in the upper roofing row, wherein

a central section of a ridge-side edge of each of the plurality of roofing materials in the lower roofing row is disposed at a position overlapping one of both ends of an eaves-side edge in the eaves direction of each of the plurality of roofing materials in the upper roofing row.