

UNIT PANEL AND SYSTEM FOR SOUND BARRIER

TECHNICAL FIELD

[0001] The present application relates to a unit panel and system for sound barrier, which relate to a technical field of improving a noise pollution in an environment.

BACKGROUND

[0002] To solve the noise pollution caused by a travelling of a high-speed train, a large number of systems for sound barrier are used. Currently, the metal unit panels which folded and buckled together are adopted for sound barrier. These metal unit panels are heavy. During installation, merely a thin-walled rubber tube is provided to isolate vibration. However, the thin-walled rubber tube will be permanent deformed upon being compressed, which will lose efficacy. As a result, a back panel will directly bear a pulsating load of the high-speed train, causing a structural fatigue damage. In an inner part of the metal unit panel, a pressure fiber cement panel is used for sound barrier to support a sound-absorbing rock wool. In use, the cement panel will be prone to crack and the rock wool will collapse, resulting in a loss of the sound absorption.

SUMMARY

[0003] A unit panel and system for sound barrier are provided according to embodiments of the present application, which may be widely used in high-speed railway, intercity railway, passenger railway line, rail transit, etc.. The unit panel and system for sound barrier may effectively reduce the pulsating peak load of the train, improve a durability of sound barrier and extend an anti-fatigue life. The structure of the unit panel and system for sound barrier are safe and easy to install. The sound-absorbing material is installed firmly to prevent from loosening and collapsing, which reduces a vibration flexibly. The third rubber strips are firmly fixed, and the fixing of the rubber strip may not affect a reduction of the vibration. The rubber strip is protected by a metal cover, which will not tear during installation, and may have a long service life.

[0004] To achieve at least one of the above, the application discloses the following technical solutions:

[0005] In the first aspect, a sound barrier unit panel is provided according to an embodiment of

the application, which includes a front panel, a back panel, a profile frame, a sound-absorption assembly and a rubber assembly; wherein the profile frame is formed by separated crossbeams and a plurality of longitudinal beams arranged between the crossbeams; the crossbeam is provided with opposite clamping slots to clamp the front panel and the back panel, forming a shell of the unit panel with the front panel and the back panel disposing on opposite sides of the profile frame; the rubber assembly includes a first rubber strip provided between the front panel and each of the crossbeams, and between the back panel and each of the crossbeams; and a second rubber strip provided in a socketing slot of the crossbeam; and the sound-absorption assembly is inserted between adjacent longitudinal beams.

[0006] In an embodiment, the sound-absorption assembly includes a wooden fiberboard for absorbing sound; and a plurality of projections are provided on a side of the wooden fiberboard adjacent to the front panel or the back panel.

[0007] In an embodiment, the sound-absorbing assembly includes a rock wool for absorbing sound, a groove is provided in the rock wool and a rock wool rib is arranged in the groove.

[0008] In an embodiment, the unit panel an end part buckled with the longitudinal beam in the crossbeam, wherein the rubber assembly further includes a third rubber strip arranged between a slot of the end part and a rubber strip cover, wherein the rubber strip cover is covered on the slot of the end part, a rough strip is provided at an outside of the rubber strip cover, and a stopper is provided at an end of the rubber strip cover.

[0009] In an embodiment, a drain hole is arranged on the end part.

[0010] In an embodiment, a wrapping material and a metal protective net are provided on a surface of the rock wool.

[0011] In an embodiment, the unit panel also includes a top cover, which is connected with a crossbeam socket at the top of the profile frame.

[0012] In an embodiment, the unit panel includes a decoupler, wherein the decoupler includes a plurality of vertical arms connected with the crossbeam at a bottom of the profile frame, a downward opening socketing slot with a first decoupling rubber strip is provided on the vertical arm, and a second decoupling rubber strip is arranged between adjacent first decoupling rubber strips to form a decoupling rubber strip.

[0013] In an embodiment, the rock wool rib includes a short arm in arc shape and a long arm in wave shape to form a "T" shaped profile, and the long arm is inserted into the groove.

[0014] In an embodiment, the wrapping material is alkali free hydrophobic glass fiber cloth or polypropylene hydrophobic non-woven cloth; the alkali free hydrophobic glass fiber cloth has a mass per unit area larger than or equal to 80g/m^2 , and the polypropylene hydrophobic non-woven

cloth has a mass per unit area larger than or equal to 40g/m^2 ; the metal protective net includes aluminum panel tensile net, wherein the aluminum panel tensile net is made of aluminum alloy with series 1060, which has thickness larger than or equal to 0.5mm, a diamond mesh with a diagonal size of $2\text{mm} \times 4\text{mm}$, and a width of a fabric larger than or equal to 0.4mm. The first rubber strip and the third rubber strip are made of ethylene propylene diene monomer foam rubber, and the second rubber strip and the decoupling rubber strip are made of ethylene propylene diene monomer rubber

[0015] In the second aspect, a system for barrier sound is provided according to the embodiments of the application, which includes a plurality of sound barrier steel columns arranged apart from each other, and at least one unit panel of any embodiment in the first aspect is arranged between adjacent sound barrier steel columns.

[0016] In an embodiment, a plurality of unit panels are vertically connected between adjacent sound barrier steel columns, and the plurality of the sound barrier unit panels at least include top unit panel, middle unit panel and bottom unit panel, and wherein a top cover is provided on a top of the top unit panel to connect with the crossbeam at a top of the profile frame of the top unit panel, and a decoupler is provided at a bottom of the bottom unit panel to connect with the crossbeam at a bottom of the profile frame of the bottom unit panel.

[0017] A unit panel for sound barrier with a buckle structure is provided according to the embodiments of the application, which may effectively reduce the pulsating peak load of the train, have an excellent sound absorption performance and be easy to install, improving the weather resistance, structural safety and extending anti-fatigue life of the unit panel.

[0018] The above summary is only for the purpose of the specification, and is not intended to be limited in any way. In addition to the schematic aspects, embodiments and features described above, further aspects, embodiments and features of the present application will be easy to understand by referring to the attached drawings and the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] In the drawings, unless otherwise specified, identical reference numerals will be used throughout the drawings to refer to identical or similar parts or elements. The drawings are not necessarily drawn to scale. It should be understood that these drawings depict only some embodiments disclosed in accordance with the present application and are not to be considered as limiting the scope of the present application.

[0020] Fig. 1 is a side view of the unit panels for sound barrier in an assembled state according

to an embodiment of the present application;

[0021] Fig. 2 is a side view of the unit panel for sound barrier according to an embodiment of the present application;

[0022] Fig. 3 is a side view of a sound-absorption assembly of the unit panel for sound barrier according to an embodiment of the present application;

[0023] Fig. 4 is a side view of a top unit panel according to an embodiment of the present application;

[0024] Fig. 5 is a side view of a bottom unit panel according to an embodiment of the present application;

[0025] Fig. 6 is a top view of a middle unit panel according to an embodiment of the present application;

[0026] Fig. 7 is a partial enlarged view of a decoupler of an unit panel for sound barrier according to an embodiment of the present application;

[0027] Fig. 8 is an another partial enlarged view of a decoupler of an unit panel for sound barrier according to an embodiment of the present application; and

[0028] Fig. 9 is a side view of a sound-absorption assembly of the unit panel for sound barrier according to another embodiment of the present application.

[0029] numerical references :

100 middle unit panel	200 top unit panel
300 bottom unit panel	400 sound barrier steel column
1 perforated front panel	2 back panel
3 upper crossbeam of top unit panel	4 crossbeam
5 top cover	6 longitudinal beam
7 rock wool	8 rock wool rib
9 wrapping material, metal protective net	10 first rubber strip
11 second rubber strip	12 lower crossbeam of bottom unit panel
13 decoupling rubber strip	14 connector
15 end part	16 third rubber strip
17 rubber strip cover	
19 crossbeam socketing slot	20 sound-absorption assembly
21 drain hole	22 stopper
23 first "L" type bending edges	
24 second "L" type bending edges	
25 projection	131 first decoupling rubber strip

132 second decoupling rubber strip

1321 hollow ring

1322 connecting arm

133 vertical arm

134 socketing slot

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0030] In the following, only certain exemplary embodiments are briefly described. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present application. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive.

[0031] The disclosure below provides many different embodiments or examples for implementing different structures of present application. In order to simplify the disclosure of the present application, components and settings of particular example are described below. Naturally, they are only examples and are not intended to limit the application. In addition, the present application may repeat reference numbers and/or reference letters in different examples for the purpose of simplification and clarity, which does not indicate the relationship between various embodiments and/or settings discussed. In addition, the present application provides examples of various specific processes and materials, but those skilled in the art may be aware of other processes and/or other materials.

[0032] Embodiment 1

[0033] As shown in Fig. 1, it is a side view of the unit panels for sound barrier in an assembled state, wherein numerical reference 100 represents a middle unit panel, numerical reference 200 represents a top unit panel, numerical reference 300 represents a bottom unit panel, and numerical reference 400 represents a sound barrier steel column. The bottom unit panel 300, the middle unit panel 100 and the top unit panel 200 are successively assembled in a sound barrier steel column 400.

[0034] As shown in Fig. 2, it is a side view of the middle unit panel 100; wherein numerical reference 1 represents a perforated front panel, numerical reference 2 represents a back panel, numerical reference 4 represents a crossbeam, numerical reference 6 represents a longitudinal beam, numerical reference 7 represents a rock wool, numerical reference 8 represents the rock wool rib, numerical reference 9 represents a wrapping material and metal protective net, numerical reference 10 represents a first rubber strip, numerical reference 11 represents a second rubber strip, numerical reference 15 represents an end part, numerical reference 19 represents a crossbeam socketing slot, numerical reference 20 represents a sound-absorption assembly and numerical reference 21

represents a drain hole. According to the middle unit panel 100, the crossbeam 4 (one is provided at the upper side and one is provided at the lower side) and several longitudinal beams 6 are riveted by the connector 14 to form a profile frame of the unit panel. The upper and lower edges of the front panel 1 and the back panel 2 are backward folded as first "L" type bending edges, and the left and right edges of the front panel 1 and the back panel 2 are backward folded as second "L" type bending edges. The first "L" type bending edges 23 are buckled with the clamping slots of the crossbeam 4, and are connected with the profile frame to form a shell of the unit panel. The second "L" type bending edges 24 may enhance the strength of the unit panel. The first rubber strip 10 is provided in the clamping slots of the crossbeam 4 and at both sides of the first "L" type bending edges. This is to say, the first rubber strip 10 is provided between the front panel 1 and each of the crossbeams 4, and between the back panel 2 and each of the crossbeams 4. Thus, a pulsating load of a train may apply to the front panel 1 or the back panel 2, and transmit to the first rubber strip 10, which causes the first rubber strip 10 to deform. Due to the deformation, the pulsating load may be absorbed and consumed, and then transmitted to the crossbeam 4, thus, reducing the pulsating load beard by a main structure of the train. The front panel 1 and back panel 2 are made of aluminum alloy panel with series 3XXX, and the first rubber strip 10 is made of ethylene propylene diene monomer foam rubber with hardness (Shore A) 30. The crossbeam 4 is provided with crossbeam socketing slots 19. The second rubber strip 11 is located between the upper and lower unit panels, and is assembled in the crossbeam socketing slot 19 of the crossbeam 4. The second rubber strip 11 is made of ethylene propylene diene monomer rubber with hardness (Shore A) 60. The second rubber strip 11 may reduce a vibration and a collision between the unit panels, which reduces the noise therebetween. The sound-absorption assembly 20 is inserted between the clamping slots of the adjacent longitudinal beams 6. The front panel 1 is provided with the rectangular fillet holes, and an opening rate of the front panel 1 is 29%. Each end of the unit panel is provided with two end parts 15, and the end parts 15 are disposed at two sides of the unit panel respectively, totally four end parts 15. A drain hole 21 is provided at a lower side of the end part 15, which can prevent water from accumulating in the unit panel.

[0035] As shown in Fig. 3, it is a side view of a sound-absorption assembly 20 of the unit panel for sound barrier. The sound-absorption assembly 20 includes a rock wool 7, a rock wool rib 8, a wrapping material and a metal protective net 9. The rock wool 7 is provided with a groove, and the rock wool rib 8 is inserted into the groove of rock wool 7. The rock wool rib 8 is T-shaped, wherein a short arm of the rock wool rib 8 is arc-shaped, and a long arm of the rock wool rib 8 is wave-shaped. The long arm is inserted into the groove. The rock wool rib 8 is made of aluminum alloy with series 6063. A surface of the rock wool 7 is protected by the wrapping material and the

metal protective net 9. The wrapping material is alkali free hydrophobic glass fiber cloth, with unit area mass of 80g/m^2 . The metal protective net is aluminum panel tensile net with thickness of 0.5mm, and is made of aluminum alloy with series 1060. The diagonal size of a diamond mesh of the metal protective net may be $2\text{mm} \times 4\text{mm}$, and a width of a fabric formed the mesh is 0.4mm.

[0036] As shown in Fig. 4, it is a side view of the top unit panel 200; wherein numerical reference 3 represents upper crossbeam of top unit panel and numerical reference 5 represents a top cover. The top unit panel is provided with a top cover 5, which is connected with the upper crossbeam 3 of the top unit panel. The top cover 5 is made of aluminum alloy with series 6063. The rest structures of the top unit panel 200 are identical with the middle unit panel 100.

[0037] As shown in Fig. 5, it is a side view of the bottom unit panel 300; wherein numerical reference 12 represents a lower crossbeam of bottom unit panel and numerical reference 13 represents a decoupling rubber strip. The bottom unit panel 300 is provided with a decoupler which has a plurality of vertical arms 133 connected with the lower crossbeam 12 of the bottom unit panel, and the vertical arm 133 is provided with a downward opening socketing slot 134. A first decoupling rubber strip 131 is inserted in the socketing slot 134, and the first decoupling rubber strip 131 is connected with another adjacent first decoupling rubber strip 131 through a second decoupling rubber strip 132, thereby forming a decoupling rubber strip 13.

[0038] In an example, as shown in Fig. 7, it is a partial enlarged view of a decoupler of the unit panel for sound barrier. The decoupler includes four vertical arms 133 connected with a lower crossbeam 12 of a bottom unit panel, and each of the vertical arms 133 is provided with a downward opening socketing slot 134. Each socketing slot 134 is provided with a first decoupling rubber strip 131, and the first decoupling rubber strip 131 is shaped as a raised "M" type. The two first decoupling rubber strips 131 on the left side are connected by a second decoupling rubber strip 132 to form one decoupling rubber strips 13. At the right side of Fig. 7, the two first decoupling rubber strips 131 are connected by the second decoupling rubber strip 132 to form another decoupling rubber strip 13. Thus, the decoupler is provided with two decoupling rubber strips 13. The decoupling rubber strip 13 is made of ethylene propylene diene monomer rubber with hardness (Shore A) 60. The rest structures of the bottom unit panel 300 are identical with the middle unit panel 100.

[0039] As shown in Fig. 8, it is a partial enlarged view of a decoupler of the unit panel for sound barrier. The decoupler in Fig. 8 has a similar structure with the decoupler shown in Fig. 7. The difference therebetween is that the second decoupling rubber strip 132 in Fig. 8 includes a hollow ring 1321 and two connecting arms 1322. The hollow ring 1321 is provided between the two connecting arms 1322, and a hollow section of the hollow ring 1321 extends downwards

transversely to the connecting arms 1322. The two connecting arms 1322 are connected to respective first decoupling rubber strips 131. The hollow ring 1321 and the two connecting arms 1322 are formed integrally, and are made of flexible material. In an implementation, the mounting surface, on which the unit panel is settled, may be uneven and have depressions. In this case, the hollow ring 1321 may be deformed to mount into the depressions so that a seal is achieved between the unit panel and the mounting surface.

[0040] As shown in Fig. 6, it is a top view of a middle unit panel; wherein numerical reference 15 represents an end part, numerical reference 16 represents a third rubber strip, numerical reference 17 represents a rubber strip cover, numerical reference 6 represents a longitudinal beam, numerical reference 21 represents a drain hole, and numerical reference 22 represents the stopper. The longitudinal beam 6 and a crossbeam 4 are riveted by the connector 14, and a sound-absorption assembly 20 is connected between the adjacent longitudinal beams 6. Each end of the unit panel 100 is provided with two end parts 15, and the end parts 15 are disposed at two sides of the unit panel 100 respectively, totally four end parts 15. The end part 15 is buckled with the longitudinal beam 6; the third rubber strip 16 is disposed between a slot of the end part 15 and the rubber strip cover 17. The rubber strip cover 17 is wedged into the slot of the end part 15, and a rough strip is provided at an outside of the rubber strip cover 17. The crossbeam 4, the connector 14, the end part 15, the rubber strip cover 17, the longitudinal beam 6 and the stopper 22 are made of aluminum alloy with series 6063. The third rubber strip 16 is ethylene propylene diene monomer foam rubber with hardness (Shore A) 30.

[0041] As shown in Fig. 9, it is a side view of another sound-absorption assembly of the unit panel for sound barrier. A wooden fiberboard is used for absorbing sound in the sound-absorbing assembly 20, and the wooden fiberboard is provided with a plurality of projections 25 on a surface close to a perforated front panel 1 or a back panel 2. Due to a high strength and rigidity of the wooden fiberboard, there is no need to set a wrapping material and metal protective net to cover the wooden fiberboard. And the projections 25 arranged on the wooden fiberboard may effectively absorb the impact force from the front panel 1 or the back panel 2, so that an internal structure of the wooden fiberboard may not be affected by the impact force. Moreover, the projections 25 may also play a role as reinforcing ribs, thereby effectively improving the strength and service life of the wooden fiberboard. The projection 25 may also increase the partial thickness and surface area of the wooden fiberboard, thereby improving the sound absorption effect.

[0042] Embodiment 2

[0043] As shown in Fig. 1, it is a side view of the unit panels for sound barrier an assembled state, wherein numerical reference 100 represents a middle unit panel, numerical reference 200

represents a top unit panel, numerical reference 300 represents a bottom unit panel, and numerical reference 400 represents a sound barrier steel column. The bottom unit panel 300, the middle unit panel 100 and the top unit panel 200 are successively inserted in a sound barrier steel column 400.

[0044] As shown in Fig. 2, it is a side view of the middle unit panel 100; wherein numerical reference 1 represents a perforated front panel, numerical reference 2 represents a back panel, numerical reference 4 represents a crossbeam, numerical reference 6 represents a longitudinal beam, numerical reference 7 represents a rock wool, numerical reference 8 represents the rock wool rib, numerical reference 9 represents a wrapping material and metal protective net, numerical reference 10 represents a first rubber strip, numerical reference 11 represents a second rubber strip, numerical reference 15 represents an end part, numerical reference 19 represents a crossbeam socketing slot, numerical reference 20 represents a sound-absorption assembly and numerical reference 21 represents a drain hole. According to the middle unit panel 100, the crossbeam 4 (one is provided at the upper side and one is provided at the lower side) and several longitudinal beams 6 are riveted by the connector 14 to form a profile frame of the unit panel. The upper and lower edges of the front panel 1 and the back panel 2 are backward folded as first "L" type bending edges, and the left and right edges of the front panel 1 and the back panel 2 are backward folded as second "L" type bending edges. The first "L" type bending edges 23 are buckled with the clamping slots of the crossbeam 4, and are connected with the profile frame to form a shell of the unit panel. The second "L" type bending edges 24 may enhance the strength of the unit panel. The first rubber strip 10 is provided in the clamping slots of the crossbeam 4 and at both sides of the first "L" type bending edges. This is to say, the first rubber strip 10 is provided between the front panel 1 and each of the crossbeams 4, and between the back panel 2 and each of the crossbeams 4. Thus, a pulsating load of a train may apply to the front panel 1 or the back panel 2, and transmit to the first rubber strip 10, which causes the first rubber strip 10 to deform. Due to the deformation, the pulsating load may be absorbed and consumed, and then transmitted to the crossbeam 4, reducing the pulsating load beard by a main structure of the train. The front panel 1 and back panel 2 are made of aluminum alloy panel with series 5XXX, and the first rubber strip 10 is made of ethylene propylene diene monomer foam rubber with hardness (Shore A) 31. The crossbeam 4 is provided with crossbeam socketing slots 19. The second rubber strip 11 is located between the upper and lower unit panels, and is assembled in the crossbeam socketing slots 19 of the crossbeam 4. The second rubber strip 11 is made of ethylene propylene diene monomer rubber with hardness (Shore A) 62. The second rubber strip 11 may reduce a vibration and a collision between the unit panels, which reduces the noise therebetween. The sound-absorption assembly 20 is inserted between the clamping slots of the adjacent longitudinal beams 6. The front panel 1 is provided with the rectangular fillet holes, and an

opening rate of the front panel 1 is 25%. Each end of the unit panel is provided with two end parts 15, and the end parts 15 are disposed at two sides of the unit panel respectively, totally four end parts 15. A drain hole 21 is provided at a lower side of the end part 15, which can prevent water from accumulating in the unit panel.

[0045] Rectangular fillet holes are adopted in the perforated front panel. Compared with the current sound barrier panel, an opening area of the perforated front panel is increased, which improves a sound absorption performance. The upper and lower edges of the front panel 1 and the back panel 2 are backward folded as first "L" type bending edges, and the left and right edges of the front panel 1 and the back panel 2 are backward folded as second "L" type bending edges. The first "L" type bending edges 23 are buckled with the clamping slots of the crossbeam 4, and are connected with the profile frame to form a shell of the unit panel. The second "L" type bending edges 24 may enhance the strength of the unit panel.

[0046] As shown in Fig. 3, it is a side view of a sound-absorption assembly 20 of the unit panel for sound barrier. The sound-absorption assembly 20 includes a rock wool 7, a rock wool rib 8, a wrapping material and a metal protective net 9. The rock wool 7 is provided with a groove, and the rock wool rib 8 is inserted into the groove of rock wool 7. The rock wool rib 8 is T-shaped, wherein a short arm of the rock wool rib 8 is arc-shaped, and a long arm of the rock wool rib 8 is wave-shaped. The long arm is inserted into the groove. The rock wool rib 8 is made of aluminum alloy with series 6063. A surface of the rock wool 7 is protected by the wrapping materials and the metal protective net 9. The wrapping material is polypropylene hydrophobic non-woven fabric, with unit area mass of 40g/m^2 . The metal protective net is aluminum panel tensile net with thickness of 0.5mm, and is made of aluminum alloy with series 1060. The diagonal size of diamond mesh of the metal protective net may be $2\text{mm} \times 4\text{mm}$, and a width of a fabric formed the mesh is 0.5mm

[0047] As shown in Fig. 4, it is a side view of the top unit panel 200; wherein numerical reference 3 represents upper crossbeam of top unit panel and numerical reference 5 represents a top cover. The top unit panel is provided with a top cover 5, which is connected with the upper crossbeam 3 of the top unit panel. The top cover 5 is made of aluminum alloy with series 6063. The rest structures of the top unit panel 200 are identical with the middle unit panel 100.

[0048] As shown in Fig. 5, it is a side view of the bottom unit panel 300; wherein numerical reference 12 represents a lower crossbeam of bottom unit panel and numerical reference 13 represents a decoupling rubber strip. The bottom unit panel 300 is provided with a decoupler, which mainly includes a decoupler strip 13. The lower crossbeam 12 of the bottom unit panel is provided with a crossbar and four vertical arms, wherein each of the vertical beams is provided with a downward opening socketing slot. As shown in Fig. 7, it is a partial enlarged view of the decoupler

of the unit panel for sound barrier. The decoupler includes four vertical arms 133 connected with a lower crossbeam 12 of a bottom unit panel, and each of the vertical arms 133 is provided with a downward opening socketing slot 134. Each socketing slot 134 is provided with a first decoupling rubber strip 131, and the first decoupling rubber strip 131 is shaped as a raised "M" type. The two first decoupling rubber strips 131 on the left side are connected by a second decoupling rubber strip 132 to form one decoupling rubber strips 13. At the right side of Fig. 7, the two first decoupling rubber strips 131 are connected by the second decoupling rubber strip 132 to form another decoupling rubber strip 13. Thus, the decoupler is provided with two decoupling rubber strips 13. The decoupling rubber strip 13 is made of ethylene propylene diene monomer rubber with hardness (Shore A) 62. The rest structures of the bottom unit panel 300 are identical with the middle unit panel 100.

[0049] As shown in Fig. 8, it is a partial enlarged view of a decoupler of the unit panel for sound barrier. The decoupler in Fig. 8 has a similar structure with the decoupler shown in Fig. 7. The difference therebetween is that the second decoupling rubber strip 132 in Fig. 8 includes a hollow ring 1321 and two connecting arms 1322. The hollow ring 1321 is provided between the two connecting arms 1322, and a hollow section of the hollow ring 1321 extends downwards transversely to the connecting arms 1322. The two connecting arms 1322 are connected to respective first decoupling rubber strips 131. The hollow ring 1321 and the two connecting arms 1322 are formed integrally, and are made of flexible material. In an implementation, the mounting surface, on which the unit panel is settled, may be uneven and have depressions. In this case, the hollow ring 1321 may be deformed to mount into the depressions so that a seal is achieved between the unit panel and the mounting surface.

[0050] As shown in Fig. 6, it is a top view of a middle unit panel according to the present application; wherein numerical reference 15 represents an end part, numerical reference 16 represents a third rubber strip, numerical reference 17 represents a rubber strip cover, numerical reference 6 represents a longitudinal beam, numerical reference 21 represents a drain hole, and numerical reference 22 represents the stopper. The longitudinal beam 6 and a crossbeam 4 are riveted by the connector 14, and a sound-absorption assembly 20 is connected between the adjacent longitudinal beams 6. Each end of the unit panel 100 is provided with two end parts 15, and the end parts 15 are disposed at two sides of the unit panel 100 respectively, totally four end parts 15. The end part 15 is buckled with the longitudinal beam 6; the third rubber strip 16 is disposed between a slot of the end part 15 and the rubber strip cover 17. The rubber strip cover 17 is wedged into the slot of the end part 15, and a rough strip is provided at the outside of the rubber strip cover 17. The crossbeam 4, the connector 14, the end part 15, the rubber strip cover 17, the longitudinal beam 6

and the stopper 22 are made of aluminum alloy with series 6063. The third rubber strip 16 is ethylene propylene diene monomer foam rubber with hardness (Shore A) 31.

[0051] As shown in Fig. 8, it is a side section of a sound-absorption assembly of the unit panel for sound barrier according to another embodiment of the present application. A wooden fiberboard is used for absorbing sound in the sound-absorbing assembly 20, and the wooden fiberboard is provided with a plurality of projections 25 on a surface close to a perforated front panel 1 or a back panel 2. Due to a high strength and rigidity of the wooden fiberboard, there is no need to set a wrapping material and metal protective net to cover the wooden fiberboard. And the projections 25 arranged on the wooden fiberboard may effectively absorb the impact force from the front panel 1 or the back panel 2, so that an internal structure of the wooden fiberboard may not be damaged by the impact force. Moreover, the projections 25 may also play a role as reinforcing ribs, thereby effectively improving the strength and service life of the wooden fiberboard. The projection 25 may also increase the local thickness and surface area of the wooden fiberboard, thereby improving the sound absorption effect.

[0052] Embodiment 3

[0053] A unit panel for sound barrier includes a perforated front panel, a back panel, a profile frame, a sound-absorption assembly, a rubber assembly, an end part and other profile auxiliaries. The upper and lower crossbeams and several longitudinal beams are riveted by connectors to form a frame of the unit panel, and the profile frame and the front/back panel are flexibly buckled together to form a shell of the unit panel. The front panel and the back panel are inserted into the upper and lower crossbeams, and the sound-absorption assembly is inserted into the clamping slots of the adjacent longitudinal beams. The end parts are provided at the end of the unit panel shells, and the sound-absorption assembly is disposed in an inner part of the unit panel shell. The rubber assembly include: a first rubber strip assembled the front panel and each of the crossbeams, and between the back panel and each of the crossbeams, a second rubber strip assembled in the socketing slots of the crossbeam, a third rubber strip assembled in a slot of the end part and a rubber strip cover, and a decoupling rubber strip assembled in the lower crossbeam of the bottom unit panel. The sound-absorption assembly is inserted into the clamping slots of two adjacent longitudinal beams, and includes a rock wool, a rock wool rib, and a protective material including a wrapping material and metal protective net. The rock wool is provided with a groove, and the rock wool rib is inserted into the groove. A surface of the rock wool is protected by the wrapping material and the metal protective net. The drain holes are provided at the lower side of the unit panel; and several unit panels are inserted into the steel column for sound barrier. The bottom unit panel includes the decoupler, and the top unit panel includes the top cover.

[0054] In an embodiment, the unit panel includes a perforated front panel, a back panel, a crossbeam, a longitudinal beam, an end part, a rubber strip cover, a stopper, a rock wool, a rock wool rib, a wrapping material, a metal protective net, a first rubber strip, a second rubber strip and a third rubber strip. The upper and lower crossbeams and several longitudinal beams are riveted by connectors to form a frame of the unit panel profile frame, and the front panel and the back panel are flexibly buckled together to form a shell of the unit panel. The front panel and the back panel are inserted into the upper and lower crossbeams, and the sound-absorption assembly is inserted into the clamping slots of the adjacent longitudinal beams. The ends of the unit panel shell are provided with the end parts, and the sound-absorption assembly is disposed in an inner part of the unit panel shell. A first rubber strip is disposed on either side of the bending edge of the front panel (back panel) in the clamping slot. Each end of the unit panel is provided with two end parts, and the end parts are located at two sides of the unit panel, respectively (totally four end parts 15), thereby contacting with the steel column to transfer the force. The end parts are buckled with the longitudinal beam, and fixed on the upper and lower crossbeams with screws to be prevented from moving up and down. The third rubber strip is disposed between a slot of the end part and the rubber strip cover. The rubber strip cover is wedged into the clamping slot of the end part, and a rough strip is provided at the outside of the rubber strip cover. Both ends of the rubber strip cover are provided with stopper to prevent the rubber strip cover from moving up and down.

[0055] In an embodiment, the crossbeam is provided with two clamping slots and two socketing slots, wherein the first rubber strip is assembled in the clamping slot of the crossbeam, and the second rubber strip is assembled in the socketing slot of the lower crossbeam.

[0056] In an embodiment, a drain hole is arranged at a lower side of the end parts of the unit panel.

[0057] In an embodiment, the sound-absorbing assembly includes a rock wool, a rock wool rib, wrapping material and a metal protective net. The sound-absorbing assembly is inserted into the clamping slots of the adjacent longitudinal beams and is fixed firmly. The rock wool rib is inserted into a groove of the rock wool. The wrapping material and the metal protective net are provided at a surface of the rock wool. The wrapping material is alkali free hydrophobic glass fiber cloth or polypropylene hydrophobic non-woven cloth. The rock wool (at a side the where the front panel located) is provided with the metal protective net, and the metal protective net is aluminum panel tensile net.

[0058] In an embodiment, the rock wool rib is provided inside the rock wool, and the wrapping material and the metal protective net are provided outside.

[0059] In an embodiment, the rock wool rib is made of aluminum alloy with series 6063, and is

in shape of "T". The rock wool rib includes a short arm in arc shape and a long arm in wave shape to form a "T" shaped profile.

[0060] In an embodiment, the wrapping material is alkali free hydrophobic glass fiber cloth or polypropylene hydrophobic non-woven cloth; the alkali free hydrophobic glass fiber cloth has a mass per unit area larger than or equal to 80g/m^2 , and the polypropylene hydrophobic non-woven cloth has a mass per unit area larger than or equal to 40g/m^2 .

[0061] In an embodiment, the metal protective net adopts aluminum panel tensile net, wherein the aluminum panel tensile net is made of aluminum alloy with series 1060, which has thickness larger than or equal to 0.5mm, a diamond mesh with a diagonal size of $2\text{mm} \times 4\text{mm}$, and a width of a fabric larger than or equal to 0.4mm.

[0062] In an embodiment, the front panel is provided with a plurality of holes in form of rectangular fillet holes, and an opening rate of the front panel is 25% - 30%.

[0063] In an embodiment, the edges of the front panel and the back panel are bent backward as "L" type bending edges.

[0064] In an embodiment, the first rubber strip, and the third rubber strip are made of ethylene propylene diene monomer foam rubber, and the hardness of ethylene propylene diene monomer foam rubber (Shore A) is 30 ± 5 .

[0065] In an embodiment, the top unit panel is provided with a top cover, and the top cover is socketed with the upper crossbeam of the top unit panel.

[0066] In an embodiment, the lower part of the bottom unit panel is provided with the decoupler. The decoupler mainly includes a decoupling rubber strip, which is assembled in the socketing slot of the lower crossbeam of the bottom unit panel. And four socketing slots are provided on the lower crossbeams of the bottom unit panel. Two "M"-typed rubber strips (the first strip) with projections are connected by a thin strip (the second strip) to form one decoupling strip. There are two decoupling strips in total. The projections of the "M"-typed rubber strip are inserted into four socketing slots of lower crossbeams of the bottom unit panel.

[0067] In an embodiment, the second rubber strip and the decoupling rubber strip are made of ethylene propylene diene monomer rubber with hardness (Shore A) 60 ± 5 .

[0068] In an embodiment, the crossbeam, the longitudinal beam, the end, the top cover, rubber strip cover and the connector are made of aluminum alloy with series 6063, and the front panel and the back panel are made of aluminum alloy with series 3XXX or 5XXX and the thickness thereof is larger than or equal to 1.5mm.

[0069] In an embodiment, a density of the panel is 20kg/m^2 - 40kg/m^2 .

[0070] Embodiment 4

[0071] The embodiment of the application provides a system for sound barrier including plurality of sound barrier steel columns 400 arranged apart from each other, and a unit panel of any of the above embodiments is arranged between adjacent sound barrier steel columns 400.

[0072] In an embodiment, a plurality of unit panels are vertically connected between the adjacent the sound barrier steel columns, and the plurality of the unit panels include top unit panel 200, middle unit panel 100 and bottom unit panel 300. A top cover 5 is provided on the top of the top unit panel 200 to connect with the crossbeam at the top of the profile frame of the top unit panel 200, and a decoupler is provided at the bottom of the bottom unit panel 300 to connect with the crossbeam 4 at the bottom of the profile frame of the bottom unit panel.

[0073] It should be noted that the sound barrier steel column 400, the top unit panel 200, the middle unit panel 100 and the bottom unit panel 300 can adopt the structures, the shapes and the materials of the top unit panel 200, the middle unit panel 100 and the bottom unit panel 300 mentioned in any of the above embodiments.

[0074] In an example, the number of middle unit panels 100 may be selected and adapted as required. For example, one middle unit panel 100 may be provided between the top unit panel 200 and the bottom unit panel 300. For another example, two or three middle unit panels 100 may be arranged between the top unit panel 200 and the bottom unit panel 300. These examples are only used for illustration, and do not specifically limit the number of middle unit panels 100.

[0075] According to an embodiment of the unit panel for sound barrier of the application, upper and lower crossbeams and several longitudinal beams are connected together to form a profile frame bearing a force, and the structural rigidity of the unit panel is greatly enhanced. The profile frame , a front panel and a second panel are flexibly buckled (without any fasteners or connectors) to form a main structure of the unit panel, which may effectively reduce a pulsating wind pressure peak load of a train, and improve the structural safety and anti-fatigue preference of the unit panel.

[0076] According to an embodiment of the unit panel for sound barrier of the application, bending edges of the front panel and the back panel are disposed between two second rubber strips, that is, the two sides of the front panel and the crossbeam are provided with damping, and the two sides of the back panel and the crossbeam are provided with damping, which optimizes the load reduction.

[0077] According to an embodiment of the unit panel for sound barrier of the application, a sound-absorbing material is divided into multiple units and is internally provided with reinforcing ribs. After each part of the sound-absorbing assembly is assembled, the sound-absorbing assembly is inserted in the clamping slots of the adjacent longitudinal beams. The installation of the sound-absorbing assembly is firm, thus, enhancing rigidity. The unit panel of the application does

not need to be supported by a pressure fiber cement panel, which reduces the weight of the unit panel. The use of the metal protective net significantly improves the resistance to wind brush and the weather resistance of the sound-absorbing assembly.

[0078] According to an embodiment of the unit panel for sound barrier of the application, a rubber assembly is firmly fixed, closely bonded with the unit panel, and not easy to tear. The fixing measures do not affect the flexible vibration damping of the rubber strip.

[0079] According to an embodiment of the unit panel for sound barrier of the application, a targeted structural design of a decoupling rubber strip may achieve flexible damping effect, and play a role as caulking to prevent leakage of sound.

[0080] According to an embodiment of the unit panel for sound barrier of the application, holes perforated on the front panel are rectangular fillet holes, which provides a larger opening area and a better sound absorption performance compared with the currently applied sound barrier panels.

[0081] According to an embodiment of the unit panel for sound barrier of the application, a drain hole is arranged at a lower side of the unit panel to prevent water from accumulating in the unit panel.

[0082] According to an embodiment of the unit panel for sound barrier of the application, different from the currently type with folding and buckling the panels, the application adopts an innovative structure, a new design of the sound-absorption assembly and a damping design, which reduces the pulsating peak load of the train, improves the sound absorption performance, structural safety, weather resistance and extends anti-fatigue life.

[0083] According to an embodiment of the unit panel for sound barrier of the application, the third rubber strip is disposed between a slot of an end part and the rubber strip cover. Compared with traditional riveting method, the rubber strip and the unit panel are closely bonded, which will not tear during the construction and installation, and will not affect the flexible vibration damping of the rubber strip, thus, the rubber strip is effectively protected with a long service life.

[0084] In the description of the application, it is to be understood that the terms "center", "longitudinal", "transverse", "length", "width", "thickness", "top", "bottom", "front", "back", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside", "clockwise", "counter clockwise", "axial", "radial", "circumferential" and etc. are indicated the orientation or positional relationship shown in the drawings. The terms are merely to describe the present application and to simplify the description, and does not indicate or imply that the device or component referred to has a specific orientation, and is constructed and operated in a specific orientation, thus, not being construed as limiting the application.

[0085] In the description of the present application, the description with reference to the terms

"an embodiment", "some embodiments", "example", "specific example", or "some examples" and the like means a specific feature described in connection with the embodiment or example. A structure, material or feature is included in at least one embodiment or example of the application. Furthermore, the particular features, structures, materials, or characteristics described may be combined in a suitable manner in any one or more embodiments or examples. In addition, various embodiments or examples described in the application, as well as features of various embodiments or examples, may be integrated and combined.

[0086] In addition, the terms "first" and "second" are used for descriptive purposes only and cannot be understood as indicating or implying relative importance or implying the number of indicated technical features. Thus, a feature defined as "first" or "second" may include at least one such feature, either explicitly or implicitly. In the description of this application, "multiple" means two or more, unless otherwise specified.

[0087] In this application, unless otherwise specified and limited, the terms "install", "connect", "link", "fix" and other terms shall be understood in a broad sense, for example, they can be fixed connected, detachable connected, or integrated; they can be mechanical connected, electrical connected, or communicating connected; they can be directly connected, or through intermediate media; they can be connected between two components or interacted between two components. For those of ordinary skill in the art, the specific meaning of the above terms in the application can be understood according to the specific situation.

[0088] In the present application, unless otherwise specified and defined, the first feature at the "up" or "down" of the second feature may include direct contact of the first and second features, or may include indirect contact of the first and second features through other features between them, instead of direct contact. Moreover, the first feature "above", "over" and "on" the second feature include the first feature directly above and obliquely above the second feature, or only indicate that the level of the first feature is higher than the second feature. The first feature "under", "below" and "down" the second feature includes the first feature directly above and obliquely above the second feature, or only indicates that the horizontal height of the first feature is less than the second feature.

[0089] The above description is only a specific embodiment of the present application, but the scope of protection of the present application is not limited thereto, and within the technical scope disclosed in the present application any person skilled in the art can easily recognize various changes or alternatives covered by the scope of the present application. Therefore, the scope of protection of the present application should be determined by the scope of the claims.

CLAIMS:

What is claimed is:

1. A unit panel for sound barrier, comprising:
a front panel, a back panel, a profile frame, a sound-absorption assembly and a rubber assembly; wherein
the profile frame is formed by separated crossbeams and a plurality of longitudinal beams arranged between the crossbeams;
the crossbeam is provided with opposite clamping slots to clamp the front panel and the back panel, forming a shell of the unit panel with the front panel and the back panel disposing on opposite sides of the profile frame;
the rubber assembly comprises a first rubber strip provided between the front panel and each of the crossbeams, and between the back panel and each of the crossbeams; and a second rubber strip provided in a socketing slot of the crossbeam; and
the sound-absorption assembly is inserted between adjacent longitudinal beams.
2. The unit panel according to claim 1, wherein the sound-absorption assembly comprises a wooden fiberboard for absorbing sound; and a plurality of projections are provided on a side of the wooden fiberboard adjacent to the front panel or the back panel.
3. The unit panel according to claim 1, wherein the sound-absorbing assembly comprises a rock wool for absorbing sound, a groove is provided in the rock wool and a rock wool rib is arranged in the groove.
4. The unit panel according to claim 3, wherein a wrapping material and a metal protective net are provided on a surface of the rock wool.
5. The unit panel according to claim 3, wherein the rock wool rib comprises a short arm in arc shape and a long arm in wave shape to form a "T" shaped profile, and the long arm is inserted into the groove.
6. The unit panel according to claim 4, wherein the wrapping material is alkali free hydrophobic glass fiber cloth or polypropylene hydrophobic non-woven cloth; the alkali free hydrophobic glass fiber cloth has a mass per unit area larger than or equal to 80g/m^2 , and the polypropylene hydrophobic non-woven cloth has a mass per unit area larger than or equal to 40g/m^2 ;

the metal protective net comprises aluminum panel tensile net, wherein the aluminum panel tensile net is made of aluminum alloy with series 1060, which has thickness larger than or equal to 0.5mm, a diamond mesh with a diagonal size of 2mm × 4mm, and a width of a fabric larger than or equal to 0.4mm.

7. The unit panel according to claim 1, further comprising an end part buckled with a longitudinal beam in the crossbeam, wherein the rubber assembly further comprises a third rubber strip arranged between a slot of the end part and a rubber strip cover, wherein the rubber strip cover is covered on the slot of the end part, a rough strip is provided at an outside of the rubber strip cover, and a stopper is provided at an end of the rubber strip cover.

8. The unit panel according to claim 7, wherein the first rubber strip and the third rubber strip are made of ethylene propylene diene monomer foam rubber, and the second rubber strip is made of ethylene propylene diene monomer rubber.

9. The unit panel according to claim 7, wherein a drain hole is provided on the end part.

10. The unit panel according to claim 1, further comprising a top cover, wherein the top cover is inserted with the crossbeam at the top of the profile frame.

11. The unit panel according to claim 1, further comprising a decoupler, wherein the decoupler comprises a plurality of vertical arms connected with the crossbeam at a bottom of the profile frame, a downward opening socketing slot with a first decoupling rubber strip is provided on the vertical arm, and a second decoupling rubber strip is arranged between adjacent first decoupling rubber strips to form a decoupling rubber strip.

12. The unit panel according to claim 11, wherein the second decoupling rubber strip comprises a hollow ring and two connecting arms, wherein the hollow ring is provided between the two connecting arms, and the two connecting arms are respectively connected to the first decoupling rubber strips.

13. A system for sound barrier, comprising a plurality of sound barrier steel columns arranged apart from each other, and at least one unit panel according to any one of claims 1-12 is arranged between adjacent sound barrier steel columns.

14. The system according to claim 13, wherein a plurality of unit panels are vertically connected between adjacent sound barrier steel columns, and the plurality of the sound barrier unit panels at least comprise top unit panel, middle unit panel and bottom unit panel, and wherein a top cover is provided on a top of the top unit panel to connect with the crossbeam at a top of the profile frame of the top unit panel, and a decoupler is provided at a bottom of the bottom unit panel to connect with the crossbeam at a bottom of the profile frame of the bottom unit panel.