An exemplary embodiment of the present invention provides a floor panel for a raised floor system, including an upper plate, a lower plate, a reinforcement frame of a polygonal shape disposed between the upper and lower plates, and at least one aluminum reinforcement member disposed in the polygonal shape of the reinforcement frame.
STIFFNESS REINFORCED FLOOR PANEL FOR A RAISED FLOOR SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

[0002] (a) Field of the Invention

[0003] The present invention relates to a floor panel for a raised dry-floor system. More particularly, the present invention relates to a floor panel for a raised floor system having enhanced strength by adopting an aluminum reinforcement member of a rib structure or a hollow space in various schemes.

[0004] (b) Description of the Related Art

[0005] A typical interior room of a house, an office, a computer room, a factory for IT-related electronic products, etc., is applied with a raised floor system in which, for accommodating cables, pipes, etc., floor panels are arranged on equally spaced pedestals as shown in FIG. 2 such that an under-floor space corresponding to a floor height and spacing of the pedestals may become available.

[0006] A typical raised floor system scheme usually involves a relatively heavy material such as a steel support and mineral panel such that it may endure a heavy load. In addition, installation speed is not sufficient, and the speed and quality of the installation depends much on the skill of a worker.

[0007] In the case of Japan, the raised floor system is applied to apartment houses. However, the principal purpose is for providing room for under-floor pipes and reducing light floor impact noises. That is, the reduction capability of heavy floor impact noises is minimal, and depending on the structure of the building, the reduction of impact noise is sometimes deteriorated. Further, soft rubber is adopted in order to maximize the reduction of the floor impact noise, which causes a wave when a person walks on the raised floor system. Such a wave causes an uneasy feeling to people who are accustomed to a hard and rigid floor such as a cement mortar.

[0008] According to a conventional Japanese sound insulation raised dry-floor system, a plurality of pedestals are arranged on a concrete slab floor, and a plurality of floor panels are laid on the pedestals. In this case, when spacing between pedestals is greater (i.e., when the number of pedestals is smaller), the number of trials for horizontal leveling is reduced, installation speed is enhanced, and a cost for the pedestals is reduced. However, when the spacing between pedestals is greater (that is, when each floor panel is larger), stiffness of the floor panel for a raised floor system is decreased and the wave phenomenon caused by walking and a sagging problem may occur.

[0009] Due to such drawbacks, the spacing between pedestals for a conventional raised floor system (i.e., a size of the floor panel) has been realized as 600x455 mm, at best.

[0010] In addition, the conventional floor panel is usually made of a single integral plate of particle board such that it may have a drawback of low absorption of floor impact noise. Furthermore, the high weight of such a floor panel produces a big load on pedestals.

[0011] The feel of walking is one of the important criteria for a material for a raised floor system. When the stiffness of a floor panel is insufficient, the floor panel may wave due to walking thereon, and a person may feel uneasy or uncomfortable. In order to prevent such a phenomenon, the spacing between pedestals may be decreased. However, in this case, installation cost is increased since the number of pedestals required is increased.

[0012] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention, and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY OF THE INVENTION

[0013] The present invention has been made in an effort to provide floor panels for a raised floor system having advantages of high stiffness and light weight so as to provide a stable feel when walking and wide spacing of pedestals.

[0014] An exemplary floor panel for a raised floor system according to an exemplary embodiment of the present invention includes an upper plate, a lower plate, a reinforcement frame of a polygonal shape disposed between the upper and lower plates, and at least one aluminum reinforcement member disposed in the polygonal shape of the reinforcement frame.

[0015] The reinforcement frame may be formed in the same sectional shape as the aluminum reinforcement member.

[0016] The upper plate, the lower plate, and the reinforcement frame may be made of various materials, for example, a single material such as wood, a mineral material, a synthetic resin, steel, aluminum, or a compound material such as a combination of wood and aluminum.

[0017] For example, the upper and lower plates may be made of various materials such as particle board, plywood, oriented strand board (OSB), or mineral board.

[0018] For example, the reinforcement frame may be made of various materials such as aluminum, plywood, oriented strand board (OSB), or wood. When aluminum is used for the reinforcement frame, the floor panel may have better weight and stiffness since both the aluminum reinforcement member and the reinforcement frame are made of an aluminum material.

[0019] For a light weight of the floor panel, at least one hollow space may be formed within at least one of the aluminum reinforcement member and the reinforcement frame along a length direction thereof.

[0020] The at least one hollow space may be formed as a plurality by at least one rib formed in the aluminum reinforcement member.

[0021] The at least one rib may include a wall member, a head formed at a top of the wall member and combined with
the upper plate, and a leg formed at a bottom of the wall member and combined with the lower plate, wherein at least one of the head and the leg is formed in a triangular shape or a hemispherical shape that broadens when approaching a corresponding plate of the upper and lower plates from the wall member.

[0022] The at least one rib may have a uniform thickness over an entire range between the upper and lower plates.

[0023] The at least one hollow space is of an oval shape, a hemispherical shape, a circular shape, or a rectangular shape. Further, the at least one hollow space may be arranged in a single layer or in a plurality of layers.

[0024] At least one of the aluminum reinforcement member and the reinforcement frame may have at least one recess portion at a surface facing the upper plate or the lower plate.

[0025] The floor panel may be formed in an entire thickness of 20 to 70 mm including the upper plate, the lower plate, and the reinforcement member. A thickness of the reinforcement frame and the aluminum reinforcement member (i.e., a gap between the upper and lower plates) may be formed as 3 to 20 mm. When the thickness of the floor panel and/or the reinforcement member is excessively low, a stiffness of the panel may become insufficient. When it is excessively high, weight material cost of the floor panel excessively increases.

[0026] According to an exemplary embodiment of the present invention, in order to achieve an enhanced performance of sound absorption or heat insulation, or in order to achieve an enhanced stiffness of the floor panel, a sound absorbing material or heat insulating material may be inserted in a space between the reinforcement frame and the aluminum reinforcement member.

[0027] The sound absorbing material or heat insulating material may be formed of a synthetic fiber such as glass wool, rockwool, polyethylene terephthalate (PET), etc., or a plastic foam such as expanded polystyrene (EPS), foamed urethane, foamed polyvinyl chloride (PVC), etc.

[0028] According to an exemplary embodiment of the present invention, a high strength sandwich panel is used for the floor panel 20, and thus the pedestals 30 may be arranged with a spacing of at least 400x400 mm (for example, 600x600 mm, 900x900 mm, 800x1,200 mm, 1,200x1,200 mm, or 1,200x1,800 mm). Therefore, better absorption of the floor impact noise and light weight of the floor panel may be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] FIG. 1 is a partially cut-away plan view of a floor panel for a raised floor system according to an exemplary embodiment of the present invention.

[0030] FIG. 2 is a schematic diagram of a raised floor system according to an exemplary embodiment of the present invention.

[0031] FIG. 3A to FIG. 3L are cross-sectional views showing various structures of an aluminum reinforcement member applicable to a floor panel for a raised floor system according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0032] An exemplary embodiment of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

[0033] FIG. 1 is a partially cut-away plan view of a floor panel 20 for a raised floor system according to an exemplary embodiment of the present invention. The floor panel 20 includes an upper plate 21, a lower plate 22, and a reinforcement frame 23 disposed therebetween. The reinforcement frame 23 is formed in a rectangular frame shape that matches edges of the upper and lower plates 21 and 22, and at least one aluminum reinforcement member 24 is disposed in the rectangular shape of the reinforcement frame 23, for enhancing stiffness thereof.

[0034] For lightweight of the floor panel 20, the aluminum reinforcement member 24 is formed as an aluminum bar having at least one hollow space at its interior, or a recess portion. For high stiffness of the floor panel 20, the aluminum reinforcement member 24 has at least one rib 25b-25g formed in its interior in a length direction thereof.

[0035] According to an exemplary embodiment of the present invention, for better sound absorption or heat insulation performance of the floor panel 20 and also for high stiffness of the floor panel 20, a sound absorbing material or heat insulating material is disposed in a space between the reinforcement frame 23 and aluminum reinforcement member 24.

[0036] The sound absorbing material or heat insulating material may be formed of a synthetic fiber such as glass wool, rockwool, polyethylene terephthalate (PET), or by a plastic foam such as expanded polystyrene (EPS), foamed urethane, or foamed polyvinyl chloride (PVC).

[0037] FIG. 2 is a schematic diagram of a raised floor system according to an exemplary embodiment of the present invention, wherein the raised floor system 10 includes a plurality of pedestals 30 that are equally spaced and a floor panel 20 placed on the pedestals 30.

[0038] According to an exemplary embodiment of the present invention, a high strength sandwich panel is used for the floor panel 20, and thus the pedestals 30 may be arranged with a spacing of at least 400x400 mm (for example, 600x600 mm, 900x900 mm, 800x1,200 mm, 1,200x1,200 mm, or 1,200x1,800 mm). Therefore, installation speed thereof may be enhanced, and the installation cost may be reduced by a reduction of the number of required pedestals 30.

[0039] A pedestal 30 used in the raised floor system 10 is generally composed of a head, a height adjustment bolt, and a supporting rubber. In more detail, it includes a plate shaped head, a bolt, and a supporting rubber. The plate shaped head includes a nut disposed at a center thereof and it supports the floor panel 20 of the raised floor system 10. The bolt has a slot-shaped or cross-shaped groove at its top end and is engaged with the nut, such that the vertical position of the head may be adjusted. The supporting rubber is provided with a bolt supporting recess that supports the bolt while permitting rotation of the bolt.

[0040] In order to absorb an impact incident on the floor and to reduce vibration of the floor, the supporting rubber
may be made of a vibration-damping rubber material. The supporting rubber may be formed in various shapes, for example, in a cylindrical shape that is advantageous against a heavy load, in an inverse trapezoidal sectional shape for providing stability, or in an embossed structure for obtaining better performance of floor impact noise reduction.

[0041] FIG. 3A to FIG. 3L are cross-sectional views showing various structures of an aluminum reinforcement member applicable to a floor panel for a raised floor system according to an exemplary embodiment of the present invention. Each of the drawings illustrates a vertical cross-sectional view of the aluminum reinforcement member that has a greater width than thickness. Although each of FIG. 3A to FIG. 3L illustrates that the aluminum reinforcement member has a greater width than thickness, it should not be understood that the scope of the present invention is limited thereto. When wide reinforcement members are used, the number of required reinforcement members may be reduced. However, even if narrow reinforcement members are to be used, effectively the same effect may be achieved by increasing the number of reinforcement members.

[0042] FIG. 3A to FIG. 3L illustrate various aluminum reinforcement members 24a to 24l according to various exemplary embodiments of the present invention.

[0043] Firstly, an aluminum reinforcement member 24a shown in FIG. 3A is formed in a cross-sectional shape of a hollow box without any ribs therein.

[0044] FIG. 3B to FIG. 3G illustrate aluminum reinforcement members 24b to 24g that have hollow interiors but at least one rib 25b to 25g.

[0045] For example, ribs 25b and 25c formed in the aluminum reinforcement members 24b and 24c shown in FIG. 3B and FIG. 3C respectively include wall members 25b1 and 25c1, heads 25b2 and 25c2 formed at tops of the wall members 25b1 and 25c1 and combined with the upper plate 21, and legs 25b3 and 25c3 formed at bottoms of the wall members 25b1 and 25c1 and combined with the lower plate 22. In this case, at least one of the head 25b2 and the leg 25b3 and at least one of the head 25c2 and the leg 25c3 are formed in a triangular shape that broadens when approaching to a corresponding plate of the upper and lower plates 21 and 22 from the wall members 25b1 and 25c1.

[0046] In more detail, cross-sections of the head 25b2 and the leg 25b3 of the aluminum reinforcement member 24b shown in FIG. 3B is formed in a triangular shape that is wide in the lateral direction in the drawing. The two triangular shapes vertically face each other while being connected with each other by a short wall member 25b1.

[0047] Cross-sections of the head 25c2 and the leg 25c3 of the aluminum reinforcement member 24c shown in FIG. 3C are formed in a triangular shape, of which a height is shorter than a height of the rib 25c.

[0048) Ribs 25d and 25e of the aluminum reinforcement member 24d and 24e respectively shown in FIG. 3D and FIG. 3E are formed in a uniform thickness over an entire range between the upper plate 21 and the lower plate 22.

[0049] An aluminum reinforcement member of the present invention may have a plurality of ribs as in the aluminum reinforcement member 24d shown in FIG. 3D, and it may have a single rib as in the aluminum reinforcement member 24e shown in FIG. 3E.

[0050] The aluminum reinforcement member 24f shown in FIG. 3F has the rib 25f in the same shape as the rib 25b of the aluminum reinforcement member 24b shown in FIG. 3B. That is, an aluminum reinforcement member of the present invention may have a plurality of ribs 25b as in the aluminum reinforcement member 24b shown in FIG. 3B, and it may have a single rib 25f as in the aluminum reinforcement member 24f shown in FIG. 3F.

[0051] FIG. 3E and FIG. 3F illustrate detailed specification of the aluminum reinforcement members 24e and 24f assuming that they have only one ribs 25c and 25f. However, such a specification should be understood to be only a preferable example according to exemplary embodiments of the present invention, and it should not be understood that the scope of the present invention is limited thereto.

[0052] The same as the aluminum reinforcement members 24b and 24c shown in FIG. 3B and FIG. 3C, the rib 25g of the aluminum reinforcement member 24g shown in FIG. 3G also includes a wall member 25g1, a head 25g2 formed at a tope of the wall member 25g1 and combined with the upper plate 21, and a leg 25g3 formed at a bottom of the wall member 25g1 and combined with the lower plate 22.

[0053] In this case, the head 25g2 and leg 25g3 are formed in a hemispherical shape that broadens as it becomes closer to a corresponding plate of the upper and lower plates 21 and 22 from the wall member 25g1.

[0054] FIG. 3A to FIG. 3G illustrate that a hollow space within the aluminum reinforcement member is formed in a generally rectangular shape. However, it should not be understood that the scope of the present invention is limited thereto. The shape of the hollow space within the aluminum reinforcement member may be altered to various shapes within the scope of the present invention.

[0055] FIG. 3H to FIG. 3K respectively illustrate aluminum reinforcement members having various hollow spaces.

[0056] Firstly, a hollow space 26b of an aluminum reinforcement member 24h shown in FIG. 3H is formed in an oval shape. FIG. 3H illustrates that a major axis of the oval-shaped hollow space 26b is horizontally formed. However, it should be understood that such a scheme is only an example of various hollow spaces, and the scope of the present invention covers the case that the major axis lays vertically.

[0057] As shown in FIG. 3I, a hollow space 26c of an aluminum reinforcement member 24i may be formed in a hemispherical shape. Although FIG. 3I illustrates that a flat side of the hemispherical shape of the hollow space 26c is located downward, it should not be understood that the scope of the present invention is limited thereto. The flat side of the hemispherical shape may be located upward, or to the left or right.

[0058] As shown in FIG. 3J, a hollow space 26d of an aluminum reinforcement member 24j may be formed in a circular shape.

[0059] As shown in FIG. 3K, an aluminum reinforcement member 24k has a plurality of hollow spaces 26k that are formed in a tetragonal shape. The hollow spaces 26k may be arranged in a plurality of layers.

[0060] Although FIG. 3H to FIG. 3J illustrate that the hollow space is arranged in a single layer structure, it should
not be understood that the scope of the present invention is limited thereto. Hollow spaces of the shapes illustrated in FIG. 3H to FIG. 3J or of a shape altered therefrom may be arranged in a plurality of layers.

[0061] As shown in FIG. 3L, an aluminum reinforcement member 24f according to another exemplary embodiment of the present invention has a plurality of recess portions 27f at a side thereof.

[0062] Although FIG. 3L illustrates that the recess portions 27f are formed on a side of the aluminum reinforcement member 24f facing toward the lower plate 22, it should not be understood that the scope of the present invention is limited thereto. The recess portions 27f may be formed at the aluminum reinforcement member 24f at either or both sides thereof facing either or both the lower and upper plates 22 and 21.

[0063] Hereinafter, structural features of an aluminum reinforcement member according to various embodiments of the present invention have been described. For high stiffness and strength of the floor panel 20, the shape of the rib may be formed wider at a portion contacting the upper and lower plates 22, as shown in FIG. 3B. Better strength and stiffness may be achieved as a greater number of ribs are provided. However, the shape and the number of ribs in the rib arrangement may be designed in consideration of production cost and productivity. It is not that the shape and the number of ribs are not limited to as shown in FIG. 3B to FIG. 3G, and variations thereof may be achieved within the spirit of the present invention. The shape and the number of hollow spaces and recess portions are not limited to the above-described embodiments, and they may also be variously changed within the spirit of the present invention.

[0064] In the above description, the aluminum reinforcement member was focused on. However, the detailed description and cross-sectional shape of such an aluminum reinforcement member may be equivalently applied to a reinforcement frame of the floor panel 20.

[0065] According to an exemplary embodiment of the present invention, since a high stiffness sandwich panel is applied as a floor panel, pedestals may be arranged with a spacing of at least 400×400 mm, for example, 600×600 mm to 1,200×1,800 mm. Furthermore, better absorption of floor impact noise may be achieved and the floor panel is light in weight.

[0066] Hereinafter, exemplary experiment for checking an effect of a floor panel according to an exemplary embodiment of the present invention will be described.

[0067] Floor panels of experiments 1 and 2 are manufactured in the structure shown in FIG. 1 according to an exemplary embodiment of the present invention. In the floor panels of the experiments 1 and 2, particle board is used as the upper and lower plates, and plywood is used as the reinforcement frame 23. Four aluminum reinforcement member 24e and 24f having the ribs 25e and 25f of the specification shown in FIGS. 3E and 3F are disposed in the reinforcement frame, and thus the floor panels of the experiments 1 and 2 are formed in an overall thickness of 38 mm.

[0068] Table 1 shows sagging amounts obtained from floor panels of the experiments 1 and 2. As can be understood from Table 1, a floor panel according to an embodiment of the present invention shows better stiffness in comparison with a compared example only using a plywood reinforcement frame. The sagging amount is measured by a method in which a weight of 100 kg having a circular pressure area with a diameter of 80 mm is laid on a central portion of the floor panel 20 and then the sagging amount is measured from below the floor panel.

<table>
<thead>
<tr>
<th>Item</th>
<th>Sagging Amount (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison example</td>
<td>2.85</td>
</tr>
<tr>
<td>experiment 1</td>
<td>2.14</td>
</tr>
<tr>
<td>experiment 2</td>
<td>1.98</td>
</tr>
</tbody>
</table>

Comparison example only using a plywood reinforcement frame
experiment 1 using an aluminum reinforcement member shown in FIG. 2E
experiment 2 using an aluminum reinforcement member shown in FIG. 3F

[0069] Furthermore, by an application of a high stiffness floor panel 20, spacing of the pedestals 30 could be enhanced up to 800×1,200 mm for a raised floor system 10 shown in FIG. 2. Performance of reducing a floor impact noise (for example, according to a measurement method of KS F 2810-2 and a rating method of KS F 2863-2 of the Korean Standard) is 45 dB(A), which is a satisfactory value.

[0070] As described above, when aluminum reinforcement members of various structures according to exemplary embodiments of the present invention are applied, better stiffness of a floor panel may be achieved than in the case of only using a plywood reinforcement member. Therefore, the feel when walking becomes more stable and pedestals may be arranged with wider spacing. Further, a lightweight floor panel is achieved, and at the same time, enhancement of installation speed and cost are achieved due to wider spacing of pedestals in comparison with a conventional raised floor system. Furthermore, performance in reducing a floor impact noise is found to be satisfactory. Further, performance of sound absorption or heat insulation may be enhanced by inserting a sound absorbing material or a heat insulating material in a space formed between the reinforcement members of the floor panel.

[0071] While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:
1. A floor panel for a raised floor system, comprising:
   - an upper plate;
   - a lower plate;
   - a reinforcement frame of a polygonal shape disposed between the upper and lower plates; and
   - at least one aluminum reinforcement member disposed in the polygonal shape of the reinforcement frame.
2. The floor panel of claim 1, wherein the reinforcement frame is of the same sectional shape as the aluminum reinforcement member.
3. The floor panel of claim 1, wherein at least one hollow space is formed within at least one of the aluminum reinforcement member and the reinforcement frame along a length direction thereof.

4. The floor panel of claim 3, wherein the at least one hollow space is formed as a plurality by at least one rib formed in the aluminum reinforcement member.

5. The floor panel of claim 4, wherein:
   - the at least one rib includes a wall member, a head formed at a top of the wall member and combined with the upper plate, and a leg formed at a bottom of the wall member and combined with the lower plate; and
   - at least one of the head and the leg is formed in a triangular shape or a hemispherical shape that broadens as it becomes closer to a corresponding plate of the upper and lower plates from the wall member.

6. The floor panel of claim 4, wherein the at least one rib has a uniform thickness over an entire range between the upper and lower plates.

7. The floor panel of claim 3, wherein the at least one hollow space is of an oval shape, a hemispherical shape, a circular shape, or a rectangular shape.

8. The floor panel of claim 3, wherein the at least one hollow space is formed in a plurality of layers.

9. The floor panel of claim 1, wherein at least one of the aluminum reinforcement member and the reinforcement frame is an aluminum bar having at least one recess portion at a surface facing the upper plate or the lower plate.

10. The floor panel of claim 1, wherein the reinforcement frame is made of aluminum, plywood, oriented strand board (OSB), or wood.

11. The floor panel of claim 1, wherein a gap between the upper and lower plates is 3 to 20 mm.

12. The floor panel of claim 2, wherein a gap between the upper and lower plates is 3 to 20 mm.

13. The floor panel of claim 3, wherein a gap between the upper and lower plates is 3 to 20 mm.

14. The floor panel of claim 9, wherein a gap between the upper and lower plates is 3 to 20 mm.

15. The floor panel of claim 10, wherein a gap between the upper and lower plates is 3 to 20 mm.

16. The floor panel of claim 1, wherein the upper and lower plates are made of particle board, plywood, oriented strand board (OSB), or mineral board.

17. The floor panel of claim 2, wherein the upper and lower plates are made of particle board, plywood, oriented strand board (OSB), or mineral board.

18. The floor panel of claim 3, wherein the upper and lower plates are made of particle board, plywood, oriented strand board (OSB), or mineral board.

19. The floor panel of claim 9, wherein the upper and lower plates are made of particle board, plywood, oriented strand board (OSB), or mineral board.

20. The floor panel of claim 10, wherein the upper and lower plates are made of particle board, plywood, oriented strand board (OSB), or mineral board.

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