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A SHELTER FOR PROVIDING PROTECTION

FIELD OF THE INVENTION

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The present invention relates to a shelter for providing protection, for example, to pedestrian walkways from falling objects.

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BACKGROUND

As buildings age, there is an increased risk of external fixtures (such as, for example, architectural
15 claddings, plaster, tiles, clothes drying racks, windows and sun shades) breaking away from the building. Such falling objects are hazards and can cause injury to pedestrians and damage to property near the base of the building. There is similarly a concern of items (such as
20 flower pots and air conditioning units) that are installed or placed on window sills or balconies.

There is a need to reduce the risk of injury or damage caused by falling objects to pedestrians and other
25 property near the base of the building.

SUMMARY OF THE INVENTION

30 According to one aspect of the present invention, there is provided a shelter for providing protection from falling objects, the shelter comprising:

a roof section having an upper layer, a lower layer



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and a plurality of spring elements, each spring element extending between the upper and lower layers; and

a plurality of columns attached to a ground surface, each supporting the roof section above the ground surface.

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In one embodiment, one of the upper layer and lower layer is provided with one or more elongate ridges that extend between two edges of the roof section.

10 In another embodiment both the upper layer and lower layer are provided with one or more elongate ridges that extend between two edges of the roof section. The elongate ridges on the upper layer may be arranged parallel with the elongate ridges on the lower layer. The
15 elongate ridges on the upper layer may be adjacent to the ridges on the lower layer. Furthermore, each of the elongate ridges on the upper layer may be connected to one or more of the of the elongate ridges on the lower layer.

20 The elongate ridges may have a V-shaped profile. Similarly, the elongate ridges may have a V-shaped profile.

In one embodiment, each of the plurality of spring
25 elements is disposed between two adjacent elongate ridge and elongate ridge pairs, or is disposed between one of the edges of the roof section and an elongate ridge and elongate ridge pair.

30 The shelter may further comprise a suspension system disposed between the roof section and a free end of each column that is remote from the ground surface, such that

the roof section is movable along a first direction that is tangential to the free end of each of the columns.

In one embodiment, the suspension system comprises,
5 at each column:

a guide assembly for constraining movement of the roof section to the first direction relative to the respective column; and

a spring element disposed between the free end of the
10 column and the roof section.

The guide assembly may further comprise one or more shafts extending from the free end of the respective column in the movement direction, and one or more sleeves
15 that are each connected to the roof section, each sleeve slidably receives a respective one of the shafts.

Each of the shafts may be provided with a limit stop to prevent the respective sleeve from separating from the
20 shaft.

The limit stop can comprise an internally threaded element that is received on an external thread provided on a portion of the respective shaft.
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In one embodiment, the upper layer comprises a mesh having a plurality of apertures therein. Further, in one embodiment, the lower layer can comprise a mesh having a plurality of apertures therein.
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In one embodiment, each of the columns is resiliently deformable in response to a load applied transversely to the column.

In one embodiment, each column comprises at least three elongate rods extending from the ground surface, and an elongate winding that extends about the at least three rods.

The elongate winding can be a helical coil spring.

In one preferred form, each column comprises four elongate rods.

According to a second aspect of the present invention, there is provided a column for supporting a structure above a ground surface, the column comprising at least three elongate rods extending from the ground surface, and an elongate winding that extends about the at least three rods.

The elongate winding may comprise a helical coil spring.

In one embodiment, the column is provided with four elongate rods.

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BRIEF DESCRIPTION OF THE DRAWINGS

In order that the present invention may be more easily understood, an embodiment will now be described, by way of example only, with reference to the accompanying drawings, in which:

- Figure 1: is a side elevation view of two protective shelters in accordance with an embodiment of the present invention;
- 5 Figure 2: is a plan view of one of the protective shelters of figure 1;
- Figure 3: is a cross sectional view of the protective shelter, as seen along the line A-A in figure 2;
- 10 Figure 4: is a cross sectional view of the protective shelter, as seen along the line B-B in figure 2;
- Figure 5: is a view the protective shelter showing detail C of figure 2;
- 15 Figure 6: is an exploded side view of a column cap and roof section of the protective shelter of figure 1;
- Figure 7: is a side view of the column footing of the protective shelter of figure 1;
- 20 Figure 8: is a cross sectional view of a column, as seen along the line D-D of figure 3; and
- Figure 9: is a schematic view illustrating the deflection of the protective shelter of figure 1 under an impact load.

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DETAILED DESCRIPTION

Figures 1 to 8 show a protective shelter 10 in accordance with an embodiment of the present invention.

30 The protective shelter 10 has a roof section 12, which is supported by columns 14. In this embodiment, there are four columns 14. It will be appreciated that there may be

more or less columns depending on the size of the roof section 12.

5 The roof section 12 has an upper layer 16 and a lower layer 18. In the embodiment shown in the figures, each of the upper and lower layers 16, 18 are formed of a metal mesh. As shown in figure 4, the upper layer 16 is provided with a plurality of parallel, elongate ridges 20 that each have a generally V-shape profile. The lower
10 layer 18 is provided with a plurality of parallel, elongate ridges 22 that each have a generally V-shape profile. The ridges 20 and ridges 22 are arranged in complementary pairs, such that each ridge 20 in the upper layer 16 is parallel with a ridge 22 in the lower layer
15 18. Accordingly, the vertex of each ridge 20 is adjacent the vertex of each ridge 22.

 The edges 26 of the upper layer 16 that are generally parallel with the ridges 20 are each folded such that
20 there are two vertices; a first vertex forming a right angle, and a second vertex forming a reflex angle. Similarly, the edges 28 of the lower layer 18 that are generally parallel with the ridges 22 are each folded such that there are two vertices; a first vertex forming a
25 right angle, and a second vertex forming a reflex angle. The second vertex on the edges 26, 28 of each of the upper and lower layers 16, 18 are parallel and adjacent one another.

30 In some embodiments, the vertex of each ridge 20 and the vertex of the adjacent ridge 22 are connected, for example by welding. Similarly, the second vertex on the

edges 26, 28 of each of the upper and lower layers 16, 18 can also be connected, for example by welding.

The roof section 12 is further provided with a
5 plurality of spring elements such as helical springs 24, that each extend between the upper layer 16 and the lower layer 18. The helical springs 24 are disposed either between adjacent corresponding pairs of ridges 20 and ridges 22, or between the edges 26, 28 and the adjacent
10 ridge 20 and ridge 22. Each spring 24 is attached, for example by welding, at one end to the upper layer 16 and also at the other end to the lower layer 18.

In this embodiment, each column 14 has a footing
15 plate 30, which is attached to the ground surface G. Four steel rods 32 are attached to, and extend generally vertically from, the footing plate 30. A top plate 34 is attached to the upper most end of the steel rods 32. Each of the footing plate 30 and top plate 34 is provided with
20 gussets 35 that extend between the respective plate and each of the steel rods 32.

As shown in figure 8, the four rods 32 are arranged on the vertices of an imaginary square I. A winding,
25 which in this embodiment is a generally helically wound steel spiral 36, extends about the four steel rods 32, between the footing plate 30 and the top plate 34. The internal diameter of the spiral 36 is approximately equal to the largest internal dimension of the imaginary square.
30 The spiral 36 is attached to both the top plate 34 and the footing plate 30. It will be appreciated that the spiral 36 may be attached at intervals along its length to one or more of the steel rods 32. The spiral 36 acts to

constrain the movement of the steel rods 32; that is, each of the rods 32 is not able to move outside the inner diameter of the spiral 36.

5 As shown in figure 6, each of the columns 14 is provided with a guide assembly, which in this embodiment is in the form of four stub shafts 38 that extend generally vertically from the top plate 34. The guide assembly also has four sleeves 40 that are attached (for
10 example, by welding) to both the upper and lower layers 16, 18 of the roof section 12 to locate the roof section 12 on each of the columns 14. Each sleeve 40 slidably receives one of the stub shafts 38.

15 The protective shelter 10 is further provided with a suspension system such that the roof section 12 is supported above the top plate 34 at each column 14. The suspension system has spring elements, in the form of helical springs 42, that are provided between the upper
20 layer 16 and the top plate 34 of each of the columns 14. As can be seen in figure 6, the natural length of the helical spring 42 is greater than the separation of the upper and lower layers 16, 18. The helical spring 42 establishes an equilibrium position for the roof section
25 12 that is spaced above the top plate 34. Clearly, the distance between the equilibrium position and the top plate 34 is dependent on the self weight of the roof section 12 that is supported by the respective column 14, and the spring constant of the helical spring 42. The
30 roof section 12 is able to move in a direction parallel to the stub shafts 38 (as indicated by arrows V) about the equilibrium position and relative to the top plate 34.

In some embodiments, the end of one or more of the stub shafts 38 of each column 14 that is remote from the top plate 34 is provided with a limit stop to prevent the roof section 12 moving beyond the end of the stub shafts 38 and dissociating from the respective column 14. Each limit stop can be in the form of an internally threaded fasteners, such as a nut 46, that is received on a complementary element, such as an external thread 44 provided on the end of the stub shaft 38.

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Figure 9 illustrates schematically the behaviour of the protective shelter 10 when subjected to a vertical load in the form of an impact load. The impact load is generated by a falling object 100, which strikes the roof section 12, and in particular the upper layer 16. The broken lines in figure 9 indicate the shape of the protective shelter 10 following the initial impact. The impact load causes the roof section 12 to deform into a concave shape, with the direction of concavity being in the direction of the falling object 100. Each of the columns 14 is deformed such that the top plate 34 is moved away from the vertical line. Each column 14 acts in a similar manner to a single leaf spring that is cantilevered from the ground surface G.

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In addition, each of the helical springs 42 in the suspension system is compressed and absorbs a portion of the impact load. The impact load is also distributed from the upper layer 16 through the vertex of each ridge 20 to vertex of the adjacent ridge 22 of the lower layer 18, thus distributing the impact load. The helical springs 24 also absorb a portion of the impact load. Accordingly, the movement of the falling object 100 is arrested by the

deformation of the protective shelter 10. Any people and/or property beneath the protective shelter 10 is protected. Due to the absorption of the kinetic energy of the falling object, rebound of the object following the initial impact may be minimized. Accordingly, the collision of the falling object onto the protective shelter can be largely inelastic.

To minimize the rebound of a falling object, the material characteristics of the roof structure 12 and the columns 14 must be carefully selected such that the protective shelter, as a whole, acts to minimize the rebound of a falling object after impact with the protective shelter.

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The protective shelter in accordance with the invention has the advantages of being light weight, and can be readily installed and dismantled on site. In addition, a substantial amount of light is allowed through the roof structure. However, it will be understood that the size of apertures in either the upper and lower layers 16, 18 can be selected such that objects of a minimum dimension will not pass through the roof section 12.

It will be understood to persons skilled in the art of the invention that many modifications may be made without departing from the scope of the invention. For example, a protective shelter may be provided with columns of alternative designs or structure. In some embodiments, the columns may have a wire or cable arrangement rather than a helical spring. In such an embodiment, the wire/cable is wound in a spiral fashion around the steel rods.

In addition, the structure of the columns may be more rigid such that the columns undergo minimal deformation under load. In such an embodiment, the roof section is
5 then required to support any impact load and absorb a substantial portion of the energy of the falling object.

Alternatively or additionally, spring elements other than helical springs may be used instead of the helical
10 springs 24 and/or the helical spring 42. For example, air springs in the form of bellows may be used.

Alternatively, each column may be formed of a substantially solid material that is resilient when a
15 transverse load is applied to the top of the column. Such a column can exhibit similar behaviour under load to the column 14 described in connection with the accompanying drawings.

20 It will be appreciated that ridges in the upper layer and/or ridges in the lower layer can have other profiles such as round, ovoid, trapezoid or square.

It will be appreciated that the ground surface may be
25 an elevated surface, such as a walk way.

In some embodiments, the upper and or lower layers may be a substantially contiguous surface, such as sheet metal. Alternatively or additionally, one or both of the
30 upper and lower layers may be in the form of a moulded plastics material, such as, for example, polypropylene, high density polyethylene (HDPE), and fibre reinforced plastics, or a combination of such materials or the like.

CLAIMS:

1. A shelter (10) for providing protection from falling objects, the shelter (10) comprising:
 - 5 a roof section (12) having an upper layer (16), a lower layer (18) and a plurality of spring elements (24), each spring element (24) extending between the upper layer (16) and the lower layer (18); and
 - 10 a plurality of columns (14) attached to a ground surface (G), each supporting the roof section (12) above the ground surface (G).
2. A shelter (10) according to claim 1, wherein one of the upper layer (16) and lower layer (18) is provided with
15 one or more elongate ridges (20, 22) that extend between two edges of the roof section.
3. A shelter (10) according to claim 1, wherein both the upper layer and lower layer are provided with one or more
20 elongate ridges that extend between two edges of the roof section.
4. A shelter (10) according to claim 3, wherein the elongate ridges (20) on the upper layer (16) are arranged
25 parallel with the elongate ridges (22) on the lower layer (18).
5. A shelter (10) according to claim 3, wherein the elongate ridges (20) on the upper layer (16) are adjacent
30 to the elongate ridges (22) on the lower layer (18).
6. A shelter (10) according to claim 3, wherein each of the elongate ridges (20) on the upper layer (16) are

connected to one or more of the elongate ridges (22) on the lower layer (18).

7. A shelter (10) according to claim 2, wherein the
5 elongate ridges (20) have a V-shaped profile.

8. A shelter (10) according to claim 2, wherein the elongate ridges (22) have a V-shaped profile.

10 9. A shelter (10) according to claim 3, wherein each of the plurality of spring elements (24) is disposed between adjacent elongate ridges (20, 22), or is disposed between one of the edges (26, 28) of the roof section and an elongate ridge (20, 22).

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10. A shelter (10) according to claim 1, further comprising a suspension system disposed between the roof section (12) and a free end of each column (14) that is remote from the ground surface (G), such that the roof
20 section (12) is movable along a first direction (V) and relative to the columns (14) along a line that is tangential to the free end of each of the columns (14).

11. A shelter (10) according to claim 10, wherein the
25 suspension system comprises, at each column:

a guide assembly for constraining movement of the roof section (12) to the movement direction (V); and

a spring element (42) disposed between the free end of the column (14) and the roof section (12).

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12. A shelter (10) according to claim 11, wherein the guide assembly further comprises one or more shafts (38) extending from the free end of the respective column (12)

in the first direction (V), and one or more sleeves (40) that are each connected to the roof section (12), each sleeve (40) slidably receives a respective one of the shafts (38).

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13. A shelter (10) according to claim 12, wherein each of the shafts (38) is provided with a limit stop to prevent the respective sleeve (40) from separating from the shaft (38).

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14. A shelter (10) according to claim 13, wherein the limit stop comprises an internally threaded element (46) that is received on an external thread (44) provided on a portion of the respective shaft (38).

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15. A shelter (10) according to claim 1, wherein the upper layer (16) comprises a mesh having a plurality of apertures therein.

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16. A shelter (10) according to claim 1, wherein the lower layer (18) comprises a mesh having a plurality of apertures therein.

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17. A shelter (10) according to claim 1, wherein each of the columns (14) is resiliently deformable in response to a load applied transversely to the column (14).

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18. A shelter (10) according to claim 17, wherein each column (14) comprises at least three elongate rods (32) extending from the ground surface (G), and an elongate winding that extends about the at least three rods (32).

19. A shelter (10) according to claim 18, wherein the elongate winding comprises a helical coil spring (36).

20. A shelter (10) according to claim 18, wherein each
5 column (14) comprises four elongate rods (32).

21. A column (14) for supporting a structure above a ground surface (G), the column comprising at least three elongate rods (32) extending from the ground surface (G),
10 and an elongate winding that extends about the at least three rods (32).

22. A column (14) according to claim 21, wherein the elongate winding comprises a helical coil spring (36).
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23. A column (14) according to claim 21, wherein the column (14) comprises four elongate rods (32).