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(54) **ROOF TRUSS, ROOF STRUCTURE ELEMENT AND ROOF STRUCTURE**

(57) The present disclosure concerns a roof truss (10, 20) comprising a planar portion (12, 22) of a sheet metal plate, a bent portion (11, 12) formed along at least a part of a perimeter of the planar portion (12, 22), and

one or more protruding portions (13, 23, 25). The bent portion (11, 12) and the one or more protruding portions (13, 23, 25) deviate from a plane defined by the planar portion (12, 22).

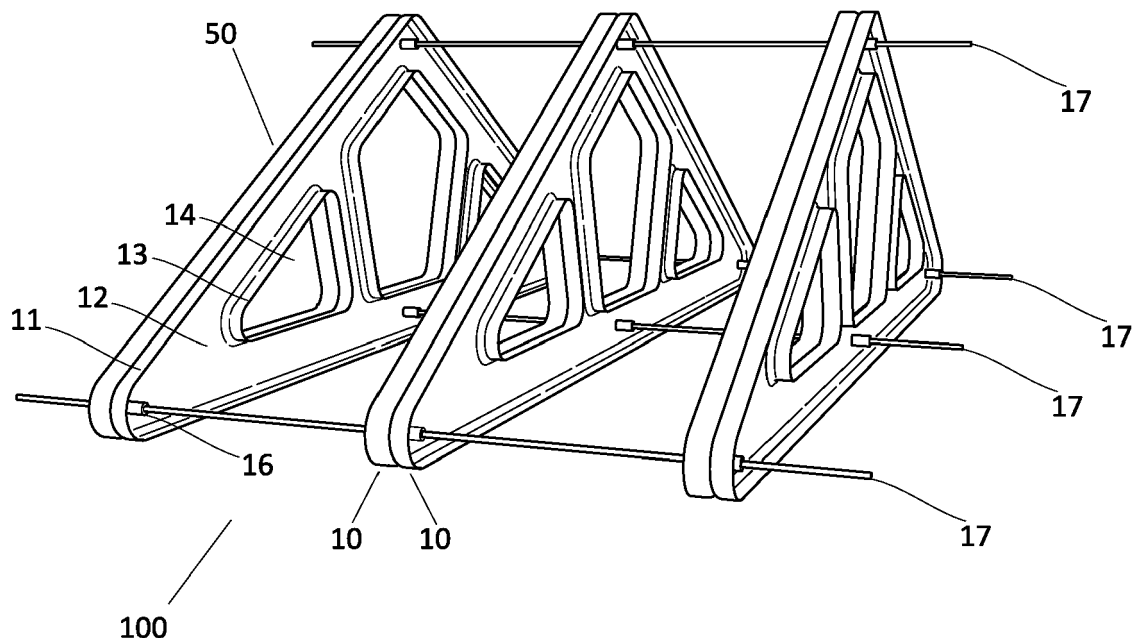


Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to roof trusses, roof structure elements and roof structures.

BACKGROUND OF THE INVENTION

[0002] Timber roof trusses originate from medieval times and are still today used in small houses. Typically these roof trusses are either prefabricated or built on-site. Prefabricated roof trusses are only available in certain dimensions and often one has to choose between available roof trusses with given dimensions and building the roof trusses with desired dimensions on-site. Former restricts freedom to design a roof and latter takes a considerable amount of time. In addition, all timber structures are vulnerable to mold, dry rot and wet rot, and roof trusses do not make an exception.

BRIEF DESCRIPTION OF THE INVENTION

[0003] An object of the present invention is to provide a roof truss, a roof structure element and a roof structure which alleviate or eliminate the problems of the prior art timber roof trusses.

[0004] An aspect of the present invention is a roof truss comprising a planar portion, a bent portion and a protruding portion. The bent portion and the protruding portion deviate from a plane defined by the planar portion.

[0005] The object of the invention is achieved with a roof truss presented in independent claim 1, a roof structure element presented in claim 10 and a roof structure presented in claim 12. Advantageous embodiments are presented in dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] In the following the present invention is described in greater detail by means of preferred embodiments with reference to the accompanying drawings, in which

Figure 1 illustrates a roof structure according to an embodiment of the invention, and

Figure 2 illustrates a roof truss according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0007] Figure 1 shows a perspective view of a roof structure 100 according to an embodiment of the invention. The roof structure 100 consists of roof structure elements 50 and rods 17 connecting the roof structure elements 50 together in order to form the roof structure. Each of the roof structure elements 50 consist of two roof trusses 10. The two roof trusses 10 forming the roof struc-

ture element 50 are preferably fastened to each other by means of welding, soldering, bending or by using an adhesive.

[0008] Figure 1 shows a roof truss 10 according to an embodiment of the invention. The roof truss comprises a planar portion 12. Preferably the roof truss 10 comprises a single continuous planar portion 12, preferably covering majority of a surface area of the roof truss. The thickness of the planar portion is chosen based on load-bearing requirements set for the roof trusses and material of the roof truss 10. Typically thicknesses between 1 mm and 10 mm can be used, and more preferably the thickness is from 2 mm to 6 mm. In some cases the thickness can be more than 10 mm. Materials that can be used for producing the roof trusses include metal, plastic and composites comprising plastics, wood and/or metals. Preferably the roof truss is made of a sheet metal plate.

[0009] The planar portion 12 defines a plane parallel to the planar portion 12. For example the plane can be defined by three separate points on a surface of the planar portion 12. Alternatively, the plane can be defined to be in the middle of two opposite planar surfaces of the planar portion 12. The roof truss 10 preferably has a triangular shape or a triangular projection in the plane defined by the planar portion 12.

[0010] The roof truss 10 also comprises a bent portion 11 formed along at least a part of a perimeter of the planar portion 12. Preferably the bent portion is continuous and extends along the whole perimeter of the planar portion. In some embodiments, it is preferable to cut out corners of the planar portion before the bent portion 11 is formed thereby facilitating the bending procedure and preventing excess stretching of the material. The bent portion 11 is preferably formed on one side of the planar portion, even in a case where the bent portion 11 is not continuous. Preferably the bent portion 11 extends at least 10 mm in a direction perpendicular to the plane defined by the planar portion 12. More preferably the bent portion 11 extends at least 15 mm or at least 20 mm in a direction perpendicular to the plane defined by the planar portion 12.

[0011] The roof truss further comprises one or more protruding portions 13. The roof truss 10 may comprise one or more apertures 14 on the planar portion 12 and at least one of the one or more protruding portions 13 is a second bent portion formed along at least a part of a perimeter of said one or more apertures 14. Preferably the bent portion is continuous, extends along the whole perimeter of the aperture 14 and deviates from the plane defined by the planar portion 12. In some embodiments, it is preferable to cut out corners next to the aperture before the second bent portion 13 is formed thereby facilitating the bending procedure and preventing excess stretching of the material. For example, in Figure 1, there are three apertures 14 and three protrusions which are continuous second bent portions 13 along the whole perimeter of said apertures. The apertures reduce weight of the roof truss and allow for cables, pipes and such to

pass through the roof trusses. The number of apertures can be chosen based on the material of the roof truss 10 and load-bearing requirements set for the roof truss. Preferably the second bent portion 13 extends at least 10 mm in a direction perpendicular to the plane defined by the planar portion 12. More preferably the second bent portion 13 extends at least 15 mm or at least 20 mm in a direction perpendicular to the plane defined by the planar portion 12.

[0012] In an embodiment of the invention, the roof truss 10 comprises one or more protruding portions 13 which all deviate from the plane defined by the planar portion 12 to one side of the plane. This arrangement ensures that the opposite side of the plane is free from protrusions and simple to fasten to corresponding side of another roof truss in order to form a roof structure element 50.

[0013] In an embodiment, the roof truss 10 comprises one or more apertures 14 on the planar portion 12 and one or more protruding portions distant from said one or more apertures 14 on the planar portion 12. The term distant can be understood to mean that said one or more apertures 14 and said one or more protruding portions are surrounded by said planar portion 12 and therefore the apertures 14 and the protruding portions are not in contact with each other. The number of apertures 14 can be for example one, two, three or more than three. The roof truss 10 may comprise a second bent portion 13 formed along at least a part of a perimeter of each or some of the one or more apertures 14. The number of protruding portions 15 distant from said one or more apertures can be for example one, two, three or more than three.

[0014] A roof structure element 50 according to an embodiment of the invention comprises two roof trusses 10, a first roof truss and a second roof truss. The planar portion 12 of the first roof truss is in contact with the planar portion 12 of the second roof truss and said planar portions have been attached to each other by means of welding. Preferably said first roof truss and said second roof truss are symmetric along a plane defined by the contacting planar portions 12 of said first roof truss and said second roof truss.

[0015] Figure 2 shows a roof truss 20 according to an embodiment of the invention. The roof truss comprises a planar portion 22. Preferably the roof truss 20 comprises a single continuous planar portion 22, preferably covering majority of a surface area of the roof truss. The thickness of the planar portion is chosen based on load-bearing requirements set for the roof trusses and material of the roof truss 20. Typically thicknesses between 1 mm and 10 mm can be used, and more preferably the thickness is from 2 mm to 6 mm. In some cases the thickness can be more than 10 mm. Materials that can be used for producing the roof trusses include metal, plastic and composites comprising plastics, wood and/or metals. Preferably the roof truss is made of a sheet metal plate.

[0016] The planar portion 22 defines a plane parallel to the planar portion 22. For example the plane can be

defined by three separate points on a surface of the planar portion 22. Alternatively, the plane can be defined to be in the middle of two opposite planar surfaces of the planar portion 22. The roof truss 20 preferably has a triangular shape or a triangular projection in the plane defined by the planar portion 22.

[0017] The roof truss 20 also comprises a bent portion 21 formed along at least a part of a perimeter of the planar portion 22. Preferably the bent portion is continuous and extends along the whole perimeter of the planar portion. In some embodiments, it is preferable to cut out corners of the planar portion before the bent portion 21 is formed thereby facilitating the bending procedure and preventing excess stretching of the material. The bent portion 21 is preferably formed on one side of the planar portion, even in a case where the bent portion 21 is not continuous. Preferably the bent portion 21 extends at least 10 mm in a direction perpendicular to the plane defined by the planar portion 22. More preferably the bent portion 21 extends at least 15 mm or at least 20 mm in a direction perpendicular to the plane defined by the planar portion 22.

[0018] The roof truss further comprises one or more protruding portions 23, 25. The roof truss 20 may comprise one or more apertures 24 on the planar portion 22 and at least one of the one or more protruding portions 23 is a second bent portion formed along at least a part of a perimeter of said one or more apertures 24. Preferably the bent portion is continuous, extends along the whole perimeter of the aperture 24 and deviates from the plane defined by the planar portion 22. In some embodiments, it is preferable to cut out corners next to the aperture before the second bent portion 23 is formed thereby facilitating the bending procedure and preventing excess stretching of the material. For example, in Figure 2, there are two apertures 24 and two protrusions which are continuous second bent portions 23 along the whole perimeter of said apertures. The apertures reduce weight of the roof truss and allow for cables, pipes and such to pass through the roof trusses. The number of apertures can be chosen based on the material of the roof truss 20 and load-bearing requirements set for the roof truss. Preferably the second bent portion 23 extends at least 10 mm in a direction perpendicular to the plane defined by the planar portion 22. More preferably the second bent portion 23 extends at least 15 mm or at least 20 mm in a direction perpendicular to the plane defined by the planar portion 22.

[0019] The embodiment of Figure 2 also comprises another type of protruding part 25 which is distant from any apertures 24 on the planar portion 22. There are two protruding parts which deviate from the plane defined by the planar portion but which protruding parts 25 are not formed along a perimeter of any surface or aperture. These protruding parts 25 can be formed onto the planar portion e.g. by means of stamping, die stamping, hammering or stretching. Such a protruding part does not affect the weight of the roof truss but it provides stiffness

to the roof truss and reduces unwanted bending of the planar portion under a load. The number of protruding portions can be chosen based on the material of the roof truss 20 and load-bearing requirements set for the roof truss. Preferably said one or more protruding portions 25 extend at least 10 mm in a direction perpendicular to the plane defined by the planar portion 22. More preferably said one or more protruding portions 25 extend at least 15 mm or at least 20 mm in a direction perpendicular to the plane defined by the planar portion 22.

[0020] In an embodiment of the invention, the roof truss 20 comprises one or more protruding portions 23, 25 which all deviate from the plane defined by the planar portion 22 to one side of the plane. This arrangement ensures that the opposite side of the plane is free from protrusions and simple to fasten to corresponding side of another roof truss in order to form a roof structure element.

[0021] In an embodiment, the roof truss 20 comprises one or more apertures 24 on the planar portion 22 and one or more protruding portions 25 distant from said one or more apertures 24 on the planar portion 22. The term distant can be understood to mean that said one or more apertures 24 and said one or more protruding portions 25 are surrounded by said planar portion 22 and therefore the apertures 24 and the protruding portions 25 are not in contact with each other. The number of apertures 24 can be for example one, two, three or more than three. The roof truss 20 may comprise a second bent portion 23 formed along at least a part of a perimeter of each or some of the one or more apertures 24. The number of protruding portions 25 distant from said one or more apertures can be for example one, two, three or more than three.

[0022] A roof structure element according to an embodiment of the invention comprises two roof trusses 20, a first roof truss and a second roof truss. The planar portion 22 of the first roof truss is in contact with the planar portion 22 of the second roof truss and said planar portions have been attached to each other by means of welding. Preferably said first roof truss and said second roof truss are symmetric along a plane defined by the contacting planar portions 22 of said first roof truss and said second roof truss.

[0023] Figure 1 shows a perspective view of a roof structure 100 according to an embodiment of the invention. Similarly, roof trusses 20 as illustrated in Figure 2 and as described in the present disclosure can be used to construct a roof structure element 50 and a roof structure 100. The roof structure 100 consists of roof structure elements 50 and rods 17 connecting the roof structure elements 50 together in order to form the roof structure. Each of the roof structure elements 50 consist of two roof trusses 10. The two roof trusses 10 forming the roof structure element 50 are preferably fastened to each other by means of welding, soldering, bending or by using an adhesive. Roof trusses from any embodiment of the present disclosure, especially the embodiments described in

connection to Figure 2, can be used to form the roof structure element and the roof structure.

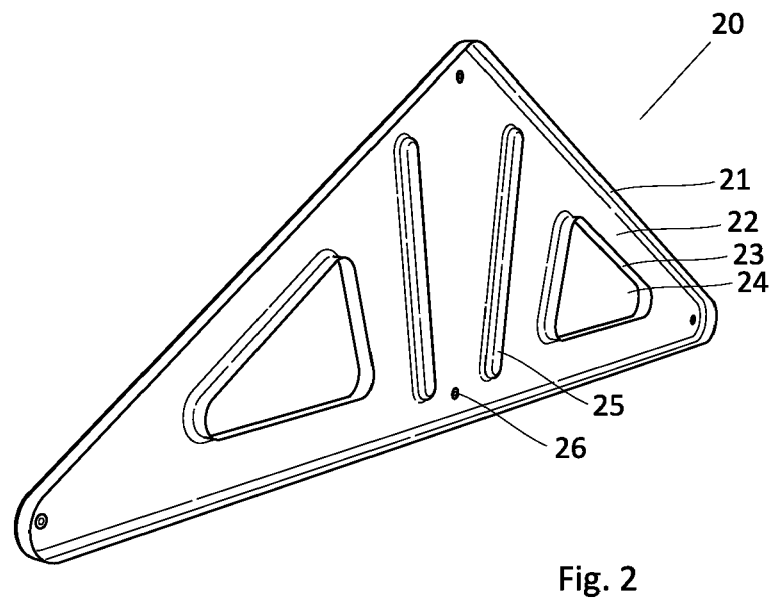
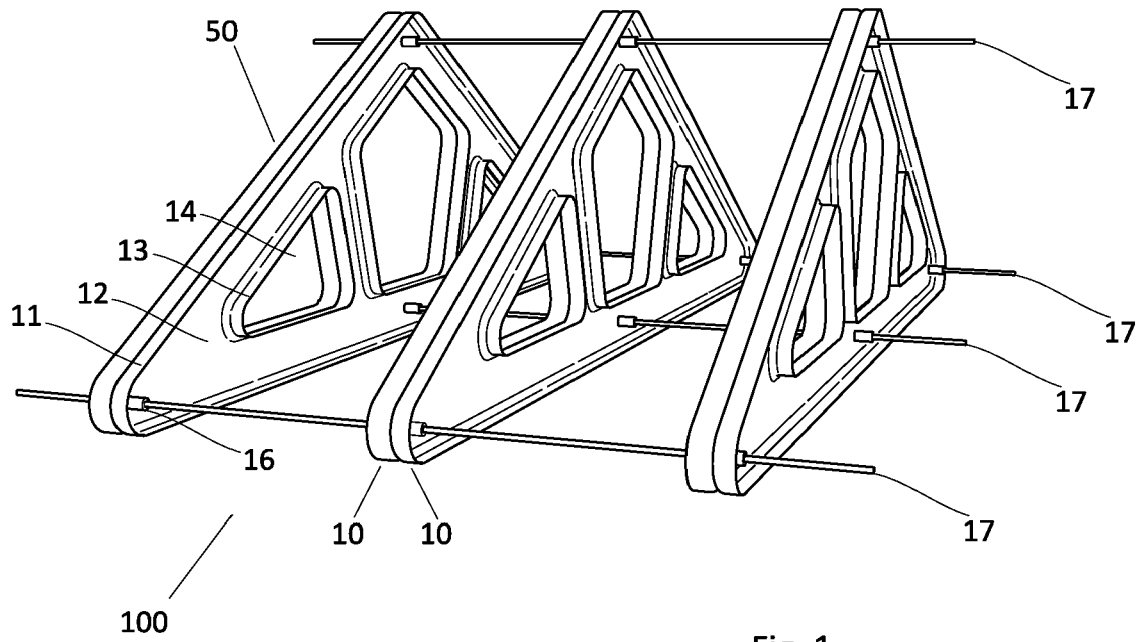
[0024] According to an embodiment of the invention, a roof structure 100 comprises multiple roof structure elements 50 spaced apart from each other. The roof structure further comprises multiple connecting rods 17 extending between the roof structure elements 50 such that each roof structure element 50 is connected to at least two connecting rods 17. In an embodiment the roof structure elements 50 comprise apertures 26 configured to receive the connecting rods 17. Preferably the connecting rods 17 run through the apertures 26 of the roof structure elements 50. The connecting rods 17 are configured to be fastened to the roof structure elements 50 with fasteners 16. Preferably the connecting rods 17 are threaded rods and the fasteners 16 are nuts or sleeves which can be tightened against the roof structure elements 50 on both sides.

[0025] It will be obvious to a person skilled in the art that, as the technology advances, that the inventive concept can be implemented in various ways. The present invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. A roof truss (10, 20) comprising
 - a planar portion (12, 22);
 - a bent portion (11, 21) formed along at least a part of a perimeter of the planar portion (12, 22);
 - and
 - one or more protruding portions (13, 23, 25),
 wherein the bent portion (11, 12) and the one or more protruding portions (13, 23, 25) deviate from a plane defined by the planar portion (12, 22).
2. A roof truss (10, 20) according to claim 1, wherein the bent portion (11, 21) and the one or more protruding portions (13, 23, 25) all deviate from the plane defined by the planar portion (12, 22) to one side of the plane.
3. A roof truss (10, 20) according to claim 1 or 2, wherein the roof truss (10, 20) comprises one or more apertures (14, 24) on the planar portion (12, 22) and at least one of the one or more protruding portions (13, 23) is a second bent portion formed along at least a part of a perimeter of said one or more apertures (14, 24).
4. A roof truss (10, 20) according to any one of claims 1 to 3, wherein at least one of the one or more protruding portions (25) is distant from any apertures (14, 24) on the planar portion (12, 22).

5. A roof truss (10, 20) according to any one of claims 1 to 4, wherein the roof truss (10, 20) comprises one or more apertures (14, 24) on the planar portion (12, 22) and one or more protruding portions (25) distant from said one or more apertures (14, 24) on the planar portion (12, 22). 5
6. A roof truss (10, 20) according to any one of claims 1 to 5, wherein said one or more protruding portions (13, 23, 25) extend at least 10 mm in a direction perpendicular to the plane defined by the planar portion (12, 22). 10
7. A roof truss (10, 20) according to any one of claims 1 to 6, wherein said bent portion (11, 21) extends at least 10 mm in a direction perpendicular to the plane defined by the planar portion (12, 22). 15
8. A roof truss (10, 20) according to any one of claims 1 to 7, wherein the roof truss (10, 20) has a triangular shape or a triangular projection in the plane defined by the planar portion (12, 22). 20
9. A roof truss (10, 20) according to any one of claims 1 to 8, wherein the roof truss (10, 20) is made of a sheet metal plate. 25
10. A roof structure element (50) comprising two roof trusses, a first roof truss and a second roof truss, according to any one of claims 1 to 9, wherein the planar portion (12) of the first roof truss is in contact with the planar portion of the second roof truss and said planar portions have been attached to each other by means of welding. 30
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11. A roof structure element (50) according to claim 10, wherein said first roof truss and said second roof truss are symmetric along a plane defined by the contacting planar portions (12) of said first roof truss and said second roof truss. 40
12. A roof structure (100) comprising multiple roof structure elements (50) according to claim 10 or 11 spaced apart from each other, wherein said roof structure further comprises multiple connecting rods (17) extending between said roof structure elements (50) such that each roof structure element (50) is connected to at least two connecting rods (17). 45
13. A roof structure (100) according to claim 12, wherein the roof structure elements (50) comprise apertures (26) configured to receive the connecting rods (17), wherein the connecting rods (17) are configured to be fastened to the roof structure elements (50) with fasteners (16). 50
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EUROPEAN SEARCH REPORT

Application Number
EP 19 16 6486

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EPO FORM 1503 03.82 (P04C01)

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 19 September 2019	Examiner Tran, Kim Lien
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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