

21 12 0

2224699

- 1 -

FLAT LOAD-BEARING ELEMENT AND SYSTEM FOR MAKING
A FLAT LOAD-BEARING STRUCTURE

The present invention relates to a flat load-bearing element, particularly for building the deck structures of a ship. The load-bearing element includes a flat, preferably rectangular, load-bearing portion and supporting members for reinforcing or strengthening the load-bearing element.

In the shipbuilding industry, the load-bearing platforms in the cargo holds of ships have previously been produced by using a technique in which a flat load-bearing structure is assembled by welding together the entire load-bearing construction. This type of manufacturing technique requires that a ship being built remains at the dockyard until the entire outfit is completed. Naturally, this is not preferable in terms of efficient operation of a dockyard. For efficient production it is nowadays necessary that as many subassemblies as possible required for a ship outfit could be built as separate manufacturing outside a shipyard simultaneously with the building of a ship's hull and further that only the assembly of such sub-components could be effected at a shipyard. A fixed load-bearing structure assembled by welding is also undesirable in terms of its maintenance and repair work.

An object of the present invention is to provide a flat load-bearing element and a system for making a flat load-bearing structure which achieve a substantial improvement in the above drawbacks. By using a flat load-bearing element and a system for making a flat load-bearing structure in accordance with the invention, it is possible in the shipbuilding industry to cut down the shipyard period of a ship being built and thus to

improve the efficiency of a shipyard. The invention also makes it possible to achieve a lightweight, sturdy and serviceable as well as modifiable system to be employed in the cargo hold of a ship.

According to the present invention there is provided a flat load-bearing element, comprising a flat load-bearing portion and supporting members for strengthening the load-bearing element, in which the load-bearing portion is wood-based and the supporting members are steel-based, the steel-based supporting members which are connected to the wood-based load-bearing portion consist of at least two parallel beams provided with teeth at a bearing surface, said teeth being formed of beam material and engaging said wood-based load-bearing portion, in which each beam is provided with a projecting part extending from the bearing surface, in which a steel based strip is attached to the edge of the load-bearing portion which is parallel to the longitudinal direction of the supporting members so as to enable one element to be joined to another element, and in which the length of each beam is less than the width of the load-bearing portion in the longitudinal direction of each beam.

Also according to the present invention there is provided a system for building a flat load-bearing structure in which the system comprises a plurality of load-bearing elements of the invention, each load-bearing element being laid between two adjacent horizontal beams, connection means being secured to said horizontal beams and to be mounted on said horizontal beams so as to position them at the end of the beam of said flat load-bearing element, said connection means comprising a portion abutting against the horizontal beam and a member associated with said

portion abutting against the horizontal beam, said member being vertically positioned at the end of the beam connected to the load-bearing portion, each said beam of said load-bearing portion being provided with a projecting part extending from the bearing surface and having its end portion adapted to receive said member associated with the connection means.

The present invention will be further illustrated, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 schematically shows obliquely from above a perspective view of one embodiment of a flat load-bearing element in accordance with the present invention;

Fig. 2 shows the flat load-bearing element of Fig. 1 as viewed in direction II in Fig. 1;

Fig. 3 shows a joint between a load-bearing portion and a beam in a section perpendicular to the longitudinal axis of the beam;

Fig. 4 shows a strip on the edge of a load-bearing portion in a section perpendicular to the longitudinal direction of the strip;

Fig. 5 is a perspective view of fastening a reinforcement plate to the beam for reinforcing a hole in the flat load-bearing element;

Fig. 6 shows the arrangement of Fig. 5 fastened to the beam;

Fig. 7 shows the fitting of a hook carried by a

load-securing rope in the hole in a flat load-bearing element;

Fig. 8 is a perspective view of one example of a supporting structure of the invention, whose horizontal beams are provided with connection means;

Fig. 9 is a perspective view of flat load-bearing elements placed upon connection means between the horizontal beams of a supporting structure;

Fig. 10 is a perspective view of one example of a connection means;

Fig. 11 shows the connection means of Fig. 10 placed upon a horizontal beam as viewed in the direction perpendicular to the longitudinal axis of a horizontal beam, two flat load-bearing elements being laid upon said connection means on opposite sides of the horizontal beam;

Fig. 12 shows an embodiment of a connection means for use in connection with a horizontal beam joining the edge of a supporting structure, the beam of a flat load-bearing element being as shown in a third embodiment;

Fig. 13 is a section along line XIII-XIII in Figs. 11 and 12,

Fig. 14 is a cross-section of a second embodiment of the beam;

Fig. 15 shows a second embodiment of a strip included in a flat load-bearing element; and

Fig. 16 is a cross-section of a third embodiment

Figs. 1 and 2 disclose a flat load-bearing element of the invention. A load-bearing portion 1 is flat and preferably shaped as a rectangle. The flat load-bearing element is loaded from the side of the top surface 1a of the load-bearing portion 1. The bottom surface 1b of the load-bearing portion 1 is provided with two beams 2 serving as supporting members. The beams are fastened to the load-bearing portion 1 in such a manner that their longitudinal direction is substantially perpendicular to the longitudinal direction of the horizontal beams of a system supporting structure. The ends of beams 2 at the edges of the load-bearing portion 1 are fitted with reinforcement members 3. One edge of the load-bearing portion 1, which edge is parallel to the longitudinal direction of the beams 2, is provided with a strip 4. In addition, the load-bearing portion 1 is provided with holes 6 aligned with the beams 2.

Fig. 3 illustrates in more detail the construction of one embodiment of each beam 2 and the way same is fastened to the load-bearing portion 1. In this embodiment, said beam 2 comprises a symmetrical, cross-sectionally U-shaped projecting part 2a, 2b, and two parallel bearing surfaces 2c joining with the lateral surfaces of the load-bearing portion 1. From the bearing surface 2c teeth 5 extend perpendicularly to its plane, which teeth 5 are formed of beam material at bearing surfaces 2c and engage the load-bearing portion 1 and protrude in the opening direction of the U-shape of the projecting part 2a, 2b. The load-bearing portion 1 is pressed against the bearing surfaces 2c so that the teeth 5 penetrate into the load-bearing portion 1 and achieve the fastening between said load-bearing portion 1 and the beam 2. In the present embodiment, both bearing surfaces 2c are provided with three rows of

teeth 5a, 5b, 5c side by side. Teeth 5 are preferably studs which are punched and bent off the material forming said bearing surface 2c into a position perpendicular to such bearing surface 2c. Fig. 3 shows also a bracing member 3, positioned inside the U-shape of the projecting part 2a, 2b of the beam 2 so that its top surface bears against the bottom surface of the load-bearing portion 1 and the bottom surface of the bracing member 3 in turn bears against the bottom 2b of the U-shape of the projecting part 2a, 2b. The U-shape of the projecting part is preferably converging towards the bottom 2b, which is preferably flat.

Fig. 4 shows a strip 4 attached to the edge of the load-bearing portion 1 in a section perpendicular to its longitudinal direction. Fig. 4 also shows the junction between two flat load-bearing elements and the function of the strip 4 at such junction. The strip 4 is secured to the bottom surface 1b of the load-bearing portion 1B by means of a bearing surface 4a, such bearing surface being provided with formed teeth 5, in this case two rows of teeth 5d, 5e at prescribed intervals in the longitudinal direction of the strip 4. The stud-shaped teeth 5 are pressed from the side of the bottom surface 1b of the load-bearing portion 1B into such load-bearing portion 1B. The strip 4 further includes an abutment portion 4b, attached to the edge of the load-bearing portion 1B and extending perpendicularly to the main plane of the load-bearing portion 1B, and whose upper edge is, in turn, provided with an extended portion 4c which extends outwards from the edge of the load-bearing portion 1B so that its bottom surface will be level with the top surface 1a of the load-bearing portion 1B. Thus, in Fig. 4, the edge of the right-hand load-bearing portion 1A included in a flat load-bearing element, which edge is not provided

with said strip 4, can be fitted, as shown in Fig. 4, underneath the extended portion 4c of the strip 4 of the left-hand load bearing portion 1B in Fig. 4, the edge of said load-bearing portion 1A coming against abutment portion 4b.

Figs. 5-7 illustrate in more detail the design of holes 6 associated with a flat load-bearing element. The holes 6, in this embodiment one at each beam 2, are provided as shown in Fig. 7 for connecting a hook 7B carried by a load-securing rope 7A to a flat load-bearing element. Fig. 5 is a so-called exploded perspective view showing the connection of a reinforcement plate 9 of the hole 6 with the beam 2. A hole-reinforcing plate 9, made preferably of stainless steel, is rectangular in shape. It includes a central hole 6a as well as two fastening extensions 9a at its two opposite edges. The distance between such edges of the fastening plate 9, at which said fastening extensions are formed, corresponds substantially to the distance between lateral surfaces 2a of the U-shape of the projecting part 2a, 2b of the beam 2 in the direction of the main plane of bearing surfaces 2c at said bearing surfaces 2c. The lateral surfaces 2a of the U-shape of the projecting part 2a, 2b of the beam 2 are provided with slots 10 for securing the fastening extensions and, thus, plate 9 in connection with the beam 2. The load-bearing portion 1 is provided with holes 6b in alignment with a hole 6a in each reinforcement plate 9.

Fig. 6 in particular, shows the disposition of teeth 5 in three rows 5a, 5b, 5c on both bearing surfaces 2c of beam 2. Aligned with each tooth 5, said bearing surfaces 2c are formed with a slot 8 whose size substantially corresponds to that of a tooth. This

bearing surfaces 2c are formed with a slot 8 whose size substantially corresponds to that of a tooth. This results in three parallel rows of slots 8a, 8b, 8c and teeth 5a, 5b, 5c in both bearing surfaces 2c. Slots 8 are elongated in shape and the studs serving as teeth 5 are in each row of teeth formed at the same side edge of a slot. Similarly, in different rows the teeth can be positioned at the opposite side edge of a slot relative to the adjacent row, as seen particularly in Fig. 5.

Fig. 8 is a perspective view of an exemplary embodiment of a supporting structure for a system of the invention. This type of system supporting structure is preferably a steel frame assembled of standard beams by welding. The building of a supporting structure especially e.g. in the cargo hold of a vessel can be effected in a simple and rapid manner. In this example, the supporting structure comprises precisely spaced vertical beams 11 linked together with horizontal beams 12. A corresponding supporting structure 11, 12 (not shown in Fig. 8) is assembled by means of parallel-extending, precisely spaced horizontal beams 13 intended for flat load-bearing elements. In addition, Fig. 8 shows the disposition of connection means 14 in relation to the parallel horizontal beams 13.

Fig. 9 shows also in a perspective view of flat load-bearing elements laid upon horizontal beams 13 and connection means 14 forming a flat load-bearing structure.

Fig. 10 is a perspective view showing the structure of one embodiment of a connection means 14. The connection means 14 is made of steel plate material by cutting and bending as well as by effecting welding for joining the bent sections together. The connection

means 14 has a U-shaped cross-section whereby, as shown especially in Fig. 11, the connection means is positioned so that the horizontal beam 13 fits inside the U-shape, the bottom surface 14a thereof coming against the top surface of the upper horizontal part 13a of the horizontal beam 13 and the lateral sections 14b of U-shape being positioned along the sides of the horizontal beam 13 and abutting against the lateral surfaces of the beam. The horizontal beam 13 shown in Fig. 11 is cross-sectionally an I-beam, the lateral sections 14b of the connection means 14 abutting against the lower horizontal part 13b of the horizontal beam 13.

The lateral surfaces of the connection means 14 are provided with extending members 14c which are substantially parallel to top surface 14a of the connection means 14 and are positioned horizontally when the connection means 14 is connected to the horizontal beam 13. The surfaces serving as member 14c are adapted to receive the end of the beam 2 of a load-bearing element, as shown in Figs. 11-13. The surface serving as member 14c is obtained by bending a bottom surface extension 14d perpendicularly downwards. Member 14c is, in turn, bent into the horizontal direction at the bottom edge of extension 14d. The outer edge of member 14c carries an inclined abutment surface 14e whose bottom edge extends in vertical direction to the level of extension 14d. Triangularly shaped gussets 14f are spot-welded at points 15 together with the edges of sections 14d, 14e and 14f. Sections 14c, 14d and 14f make up the lateral sections 14b of the connection means 14.

Fig. 11 shows the joining of two parallel load-bearing elements by means of the connection means 14 to the horizontal beam 13 in a section perpendicular to its

longitudinal section. Beams 2 are shorter than the width of load-bearing portion in the longitudinal direction of the beams 2. Thus, the load-bearing portions substantially cover horizontal beams 13 with their edge portions. The projecting part 2a, 2b of beam 2 is placed upon member 14g between gussets 14f.

Fig. 12 shows a connection means 14a, having just one lateral section 14b and to be joined with a horizontal beam 13 which is attached to the end or edge of a supporting structure. The top surface 14a is fitted with a hook-shaped cramp 14g, positioned around the edge of the upper horizontal part 13a of horizontal beam 13 at that edge of horizontal beam 13 which is opposite to the location of lateral section 14b.

Fig. 13 further illustrates the structure taken along sections XIII-XIII of Figs. 11 and 12.

Fig. 14 shows an embodiment of the beam 2 having also the U-shaped cross-section of Figs. 1-3 and 5-7. However, teeth 5 are provided on the bottom of U-shape which forms a bearing surface 2c. The lateral surfaces 2a of U-shape and their outward-directed extension surfaces 2b, 2d provide a projecting part. The extension surfaces 2b abut against a connection means 14 and are preferably parallel to the bearing surface 2c forming the bottom of U-shape. The U-shape is upside down in a flat load-bearing element.

Fig. 15 shows an alternative embodiment for the strip 4, having an H-shaped cross-section into which the edges of both load-bearing portions 1A, 1B are fitted from the outward-opening sides of a horizontal H-shape. Strip 4 can be fastened to flat load-bearing portion 1B by means of separate teeth.

Fig. 16, the same as Fig. 12, shows an embodiment of the beam 2 wherein the reinforcement portions 3 comprise elongated corrugations 2e made on the lateral surface 2a of beam 2. In this embodiment two corrugations on both lateral surfaces 2a of beam 2 extending substantially perpendicular to the longitudinal direction of beam 2. The corrugations at the ends of beam 2 reinforce the lateral surfaces and can be used instead of or in addition to the reinforcement members shown in Fig. 3.

Materials for the load-bearing portion 1 are wood-based board materials, such as chipboard or particularly plywood, which are lightweight and at the same time have high strength values for excellent efficiency. A suitable material for reinforcement member 3 is also plywood.

The beams are preferably made of anti-rust treated or stainless steel plate by bending and by effecting at the same time a punching and bending step required by teeth 5.



CLAIMS

1. A flat load-bearing element, comprising a flat load-bearing portion and supporting members for strengthening the load-bearing element, in which the load-bearing portion is wood-based and the supporting members are steel-based, the steel-based supporting members which are connected to the wood-based load-bearing portion consist of at least two parallel beams provided with teeth at a bearing surface, said teeth being formed of beam material and engaging said wood-based load-bearing portion, in which each beam is provided with a projecting part extending from the bearing surface, in which a steel based strip is attached to the edge of the load-bearing portion which is parallel to the longitudinal direction of the supporting members so as to enable one element to be joined to another element, and in which the length of each beam is less than the width of the load-bearing portion in the longitudinal direction of each beam.

2. A flat load-bearing element as claimed in claim 1, in which said projecting part of each beam has a U-shaped cross-section whose lateral surfaces carries at least one bearing surface.

3. A flat load-bearing element as claimed in claim 1 or 2, in which said teeth are studs formed by punching.

4. A flat load-bearing element as claimed in claim 1, 2 or 3, in which the load-bearing portion is rectangular.

5. A flat load-bearing element as claimed in any preceding claim, in which the ends of each beam are



fitted with reinforcement members.

6. A flat load-bearing element as claimed in claim 5, when dependent on claim 2, in which said reinforcement members are fitted inside the U-shaped projecting part of each beam, so that the top surface of reinforcement member abuts against the bottom surface of the load-bearing portion and the bottom surface of the reinforcement member in turn abuts against the bottom or floor of the U-shaped projecting part.

7. A flat load-bearing element as claimed in claims 1 and 3, in which each bearing surface is provided with two or more rows of teeth whereby said teeth are positioned at the opposite side edge of a punched slot relative to the adjacent row in the longitudinal direction of the beam.

8. A flat load-bearing element as claimed in claim 7, in which said teeth which are positioned at the opposite side edges of the slot are in different rows.

9. A flat load-bearing element as claimed in any preceding claim, in which said load-bearing portion is provided with at least one hole and in which the beam is fitted with a reinforcement member at said hole.

10. A flat load-bearing element as claimed in claim 9, in which the load-bearing portion is provided with said at least one hole in alignment with the beam.

11. A flat load-bearing element as claimed in claim 9 or 10, in which said reinforcing member is a reinforcement plate, provided with a hole and fitted with means for fastening said reinforcing plate to each beam and that said hole of reinforcing plate and said



21 12 1

- 14 -

hole of the load-bearing portion are positioned in alignment for providing a hole in the flat load-bearing element.

12. A flat load-bearing element as claimed in claims 9, 10 and 11, in which the attachment of reinforcing plate is effected to the lateral surfaces of each beam, in anchoring holes therein, the reinforcing plate including fastening extensions fitting in said holes.

13. A flat load-bearing element as claimed in any preceding claim, in which the strip has an extension which runs outwards from said edge, the bottom surface of the extension running substantially level with and parallel to the top surface of the load-bearing portion.

14. A flat load-bearing element as claimed in claim 13, in which said strip is secured to the bottom surface of the load-bearing portion by means of teeth formed of strip material by shaping.

15. A flat load-bearing element as claimed in any preceding claim, in which said beam has a substantially U-shaped cross-section, in which teeth are formed on the floor of U-shape, said floor providing a bearing surface, and in which said extended surface is formed as an extension of at least one of the lateral surfaces of U-shape to run parallel to the floor.

16. A flat load-bearing element as claimed in claim 14, in which said strip attached to the edge of the flat load-bearing portion has an H-shaped cross-section.

17. A load-bearing element as claimed in claim 5, in which said reinforcing members are corrugations, which are formed on the projecting part of each beam and



- 15 -

which, in longitudinal direction, are arranged cross-wise to the longitudinal direction of the beam.

18. A flat load-bearing element, substantially as hereinbefore described with reference to the accompanying drawings.

19. A system for building a flat load-bearing structure in which the system comprises a plurality of load-bearing elements as claimed in any preceding claim, each load-bearing element being laid between two adjacent horizontal beams, connection means being secured to said horizontal beams and to be mounted on said horizontal beams so as to position them at the end of the beam of said flat load-bearing element, said connection means comprising a portion abutting against the horizontal beam and a member associated with said portion abutting against the horizontal beam, said member being vertically positioned at the end of the beam connected to the load-bearing portion, each said beam of said load-bearing portion being provided with a projecting part extending from the bearing surface and having its end portion adapted to receive said member associated with the connection means.

20. A system for building a flat load-bearing structure, substantially as hereinbefore described with reference to the accompanying drawings.
