

[54] CONSTRUCTION ELEMENT

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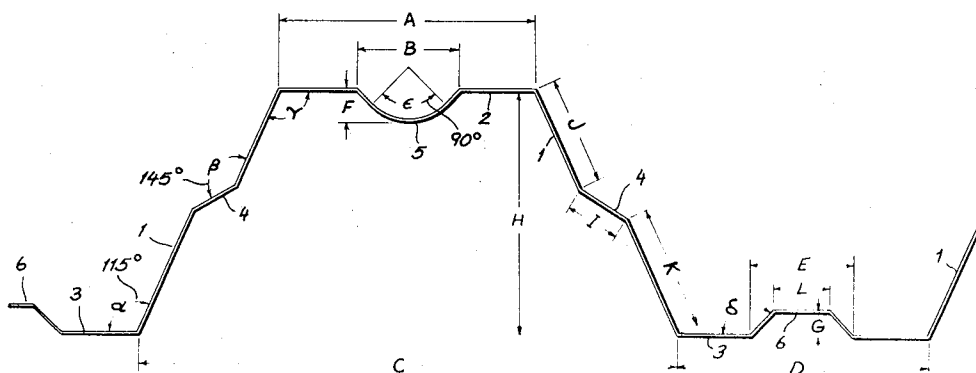
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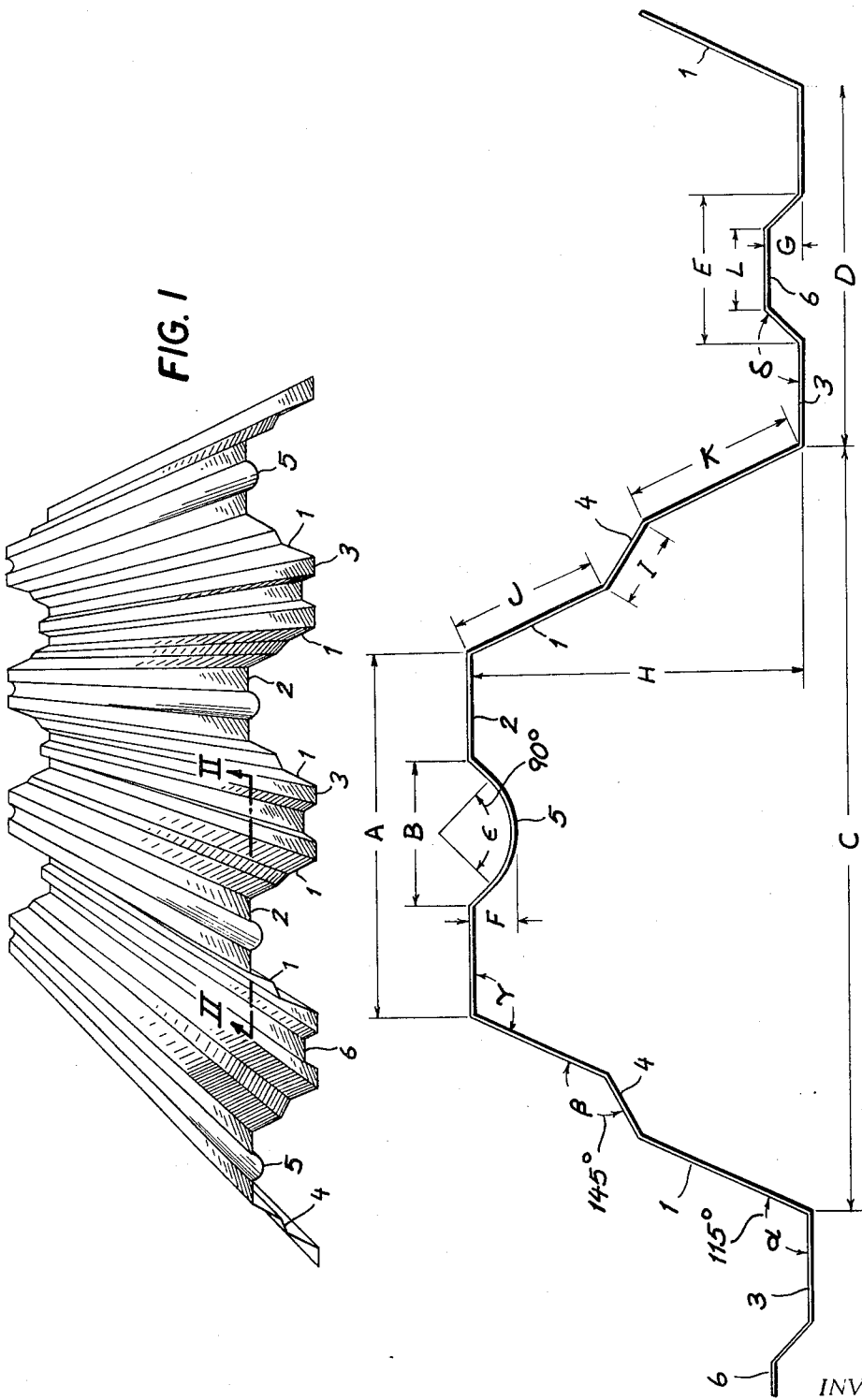
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[57] **ABSTRACT**

A load-supporting construction element, for spanning a pair of spaced-apart supports and adapted to form a wall, floor, deck or roofing structure or a support for a wall, floor, deck or roofing surface which consists of a sheet-metal plate of generally rectangular-plan configuration and a plurality of troughs and crests in alternating relationship and of trapezoidal cross-section. The apices of the troughs and/or crests are provided with integral (unitary) ridges concave in the direction in which the corrugation bulges and of trapezoidal or arcuate cross-section. The flanks of the trapezoidal corrugations are stepped.

7 Claims, 2 Drawing Figures





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CONSTRUCTION ELEMENT

FIELD OF THE INVENTION

The present invention relates to a construction element and, more particularly, to a load-supporting, support-spanning, structural member of rectangular-plan configuration and adapted to be used as wall, floor, deck or roof member and/or as a sheathing for any structure and/or as a partition member, alone or in combination with a planar or other supported surface.

BACKGROUND OF THE INVENTION

In the construction field, considerable effort has been made to design lightweight, low-cost, high-strength flat space-covering members which can be used without, or even in place of, supporting means, girders, studs, troughs, columns and the like. For example, prior to the advent of sheet-metal or synthetic-resin structural elements or sheets of the character described, construction generally made use a load-supporting or load-transmitting members of a well-defined profile as beams, girders and the like, which were spanned by the covering members, e.g. flooring built up from wood, slabs, cast *in situ* or prefabricated of concrete, or boards, plates or sheets of a variety of materials adapted to rest upon the supporting members and designed to span large areas. In a refinement of these construction techniques, structural elements having a generally flat configuration and intended to span large areas were integrally or unitarily provided with stiffening formations intended to increase the load-supporting capacity of the body and to replace girders, beams and separate supports which otherwise were required to extend along the flat web of the structural element. Typical of systems of the latter type were concrete slabs cast with trapezoidal ribs to form a monolithic body in which the ribs served as beams and the web between the ribs as the covering portion of the structural element.

While the aforescribed systems were found to be convenient and satisfactory for many purposes, they were unduly complex, expensive and massive. Attention has turned, for many construction purposes, to lightweight material of sheet metal and synthetic resin in an effort to find structural elements which are more convenient to handle, are lightweight and are of high stiffness and resistance to deformation. For example, corrugated sheet metal and synthetic-resin sheets have been provided heretofore, the corrugations being of arcuate or trapezoidal cross-section and merging smoothly from one crest to the adjacent trough. These systems have only limited stiffness and can be used to span relatively small distances. They seldom can be employed as a substitute for horizontal load-carrying supports and frequently must be used in conjunction with them. Attempts to use sheet-metal and synthetic-resin sheets having spaced-apart ridges unitarily deformed from the plane of the sheet and of rectangular cross-section, have also proved to be unsuccessful because the structural element had only limited antibuckling strength or load-supporting capability. It should be noted that another problem involved with existing corrugated materials or materials provided with profile-stiffening members has been the inability to stack the structural elements efficiently and conveniently. Finally, it should be pointed out that corrugated sheets of metal or synthetic resin, in which each corrugation is

of arcuate cross-section, are relatively expensive to produce.

OBJECTS OF THE INVENTION

It is the principal object of the present invention to provide a low-cost, high-strength, space-covering structural element designed to obviate the aforementioned disadvantages and to simplify and improve the construction of load-supporting members.

Another object of the invention is to provide a generally flat or sheet-like structural element which may be used as a load-supporting member without girders, beams or the like, i.e. which provides the compression and tension flanges upon loading in an integral or unitary manner.

It is another object of the invention to provide an improved construction element adapted to span large areas, and suitable for use as a wall-forming, roof-forming, deck-forming, or roof, wall or deck-supporting member in substantially any phase of building construction including sheathing, partitioning and facing a structure.

Still another object of the invention is to provide a generally flat, load-supporting construction element with increased load-bearing capacity without increases in thickness of the material and with satisfactory stacking ability.

SUMMARY OF THE INVENTION

These objects and other which will become apparent hereinafter are attained in accordance with the present invention, in a generally flat structural element having a rectangular-plan configuration and composed of sheet metal or a synthetic resin, the structural element being of constant wall thickness throughout and unitarily formed with corrugations opening alternately on opposite sides of the structural member and of generally trapezoidal configuration. The stiffening ribs of generally trapezoidal cross-section, according to the present invention, comprise flanks or side walls which converge alternately upwardly and downwardly to a crest or trough which, according to the present invention, is provided with a longitudinally extending unitarily formed profile rib which is concave in the direction in which the corrugation bulges and which has a transverse width equal to at least a substantial fraction of the width of the flattened crest or trough in which it is formed. The structural element which can be used as a roofing plate, a wall plate, a sheath plate or the like, or for any of the other purposes previously described, also is provided along the flanks of the trapezoidal cross-section with longitudinally extending steps such that a transition is formed between a slender trapezoid in the region of the small side of the trapezoidal corrugation and an enlarged trapezoid close to the broad base thereof. This combination of a step in each flank and a rib or channel in each crest or trough has been found to impart substantially greater stiffness and antibuckling resistance to the construction element than has been attainable with existing corrugated plates and furthermore permits the plate to take up shear stresses and bending moments in the transverse direction with greater effectiveness.

According to an important feature of the invention, the width of the flattened crest or trough is substantially equal to the height of the flanks or walls of the corrugation and the altitude thereof.

The alternating corrugations of the plate constitute the compression and tension flanges of the structural element when the latter is a load-supporting body in accordance with the present invention and the crest ribs and flank steps have been found to enable the altitude of the corrugations to be relatively high. As a consequence, the compression and tension flanges can effectively be removed from a median plane through the plate to a much greater extent than has been possible heretofore. The stacking properties of the plate are thereby improved as is the load-carrying capability for a given sheet thickness.

According to another feature of the invention, the crest rib is formed of arcuate cross-section along the upper portions of the plate and of trapezoidal cross-section along the downwardly facing portion of the plate, in both cases the crest rib being dimensioned to correspond to at least 90° of circular arc. The side walls preferably include angles of about 115° with horizontal flanges of the plate while the angle of the step is advantageously about 145°.

DESCRIPTION OF THE DRAWING

The above and other objects, features and advantages of the invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is a perspective view of a structural element according to the present invention; and

FIG. 2 is a detailed view of a portion thereof in end elevation corresponding to the region viewed along line II — II of FIG. 1.

SPECIFIC DESCRIPTION

The generally flat structural element illustrated in the drawing is preferably round from sheet metal or extruded from a synthetic resin using a round extruder and in most cases will be composed of a sheet metal such as aluminum or steel which may be coated with anticorrosion layers or the like. In general the plate is of rectangular plan-configuration and is formed with corrugations 1, 2, 3, extending in the longitudinal direction and alternately open upwardly and downwardly. Each corrugation is defined between a pair of flanks or side walls which converge upwardly to a flattened crest 2 or downwardly to a flattened trough 3. The plate is generally employed as a roof, wall or sheath member.

As can be seen from FIG. 2, the side walls or flanks 1 are provided with longitudinally extending steps 4 inclined in an angle of substantially 145° to the wall or flank which, in turn, includes an angle of 115° to the horizontal portions 2 and 3 extending therefrom. The steps 4 are located approximately midway of the height of each wall or flank 1. The crests 2 of the upwardly bulging corrugations are formed with reinforcing ribs 5 of arcuate cross-section, the ribs 5 defining a concavity open in the direction in which its corrugation bulges. Correspondingly, ribs 6 are formed in the trough floor 3 and open in the direction in which their corrugations bulge, i.e. downwardly. Preferably the formations 5 and 6 extend in cross-section over substantially a quadrant of a circle, i.e. about 90°, as shown at ϵ in FIG. 2. The altitude G of rib 6 is approximately 125 mm in the preferred case and has abroad base E substantially twice as wide as its narrow base L. E may be about 3 G. The thickness of the plate is preferably about 1 mm. Struc-

tural elements of this type have been found to be satisfactory for spanning large distances and carrying considerable loads.

According to an important feature of this invention, the transverse width A or D of the flattened crest 2 or trough 3 of the respective corrugation is approximately equal to the altitude H thereof. The width of the channel formed by the rib 5 or 6 is represented at B or E, respectively, and $A/2 \leq B \approx E \leq A/4$ and preferably $B \approx E \approx A/3$.

It has also been found to be desirable to dimension the corrugation such that the broad base $C \approx 2A$, while $D \approx 2A$ and $B \approx E$. The altitude $F \approx G$ of the formations 5 and 6 may be defined by the relationship $B/4 \leq F \leq B/2$ so that in the preferred state $F \approx B/3$. The step of each flank 1 may have a width $I \approx H/4$ or $\approx K/2$ wherein J and K are respectively with widths of the portions of the side walls flanking the step 4. The angle α between the flank K and the floor 3 of a trough is about 115° as previously described while the angle β between the portions of the side wall 1 and the step 4 formed therein may be 145°. Similarly, the angle γ between the side wall and crest 2 is approximately 115° while the angle δ of the flank of the rib 6 is about 135°.

We claim:

1. A construction element which comprises a generally planar plate of rectangular plan configuration unitarily formed with alternately upwardly and downwardly bulging corrugation of generally trapezoidal cross-section, said corrugations being formed with generally flat flanks converging to flattened crests and troughs respectively, said flanks being formed with longitudinally extending steps and said crests and troughs being formed unitarily with longitudinally extending rib profiles deformed therein and concave in the direction in which the respective corrugation bulges, said corrugations having altitudes approximately equal to the transverse widths of said flattened troughs and crests, said steps being formed substantially midway along said flanks, and said flanks including angles of about 115° with said flattened troughs and crests and said steps include angles of substantially 145° with said flanks.

2. The element defined in claim 1 wherein said rib profiles are provided substantially in the middle of the respective flattened trough and crest.

3. The element defined in claim 1 wherein said rib profiles extend approximately over a quadrant of a circle in cross-section.

4. The element defined in claim 3 wherein the rib profiles on the upwardly bulging corrugations are of arcuate cross-section and the rib profiles on the downwardly bulging corrugations are of trapezoidal cross-section.

5. The element defined in claim 4 wherein said flattened crests and troughs have transverse widths A and D respectively, said corrugations have altitudes H, said rib profiles have widths B and E for the arcuate and trapezoidal cross-sections respectively, and respective altitudes F and G and said corrugations have broad bases of widths C, the values A, B, C, D, E, F and G being related as follows: $A/2 \leq B \approx E \leq A/4$, $C \approx 2A \approx 2D$, and $B/2 \approx E/2$.

6. The element defined in claim 5 wherein $F \approx G \approx B/3 \approx E/3$.

7. The element defined in claim 6 wherein $B \approx A/3$.

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