April 17, 1951 N. GABO 2,549,189

BUILDING CONSTRUCTION UNIT

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Fig. 1

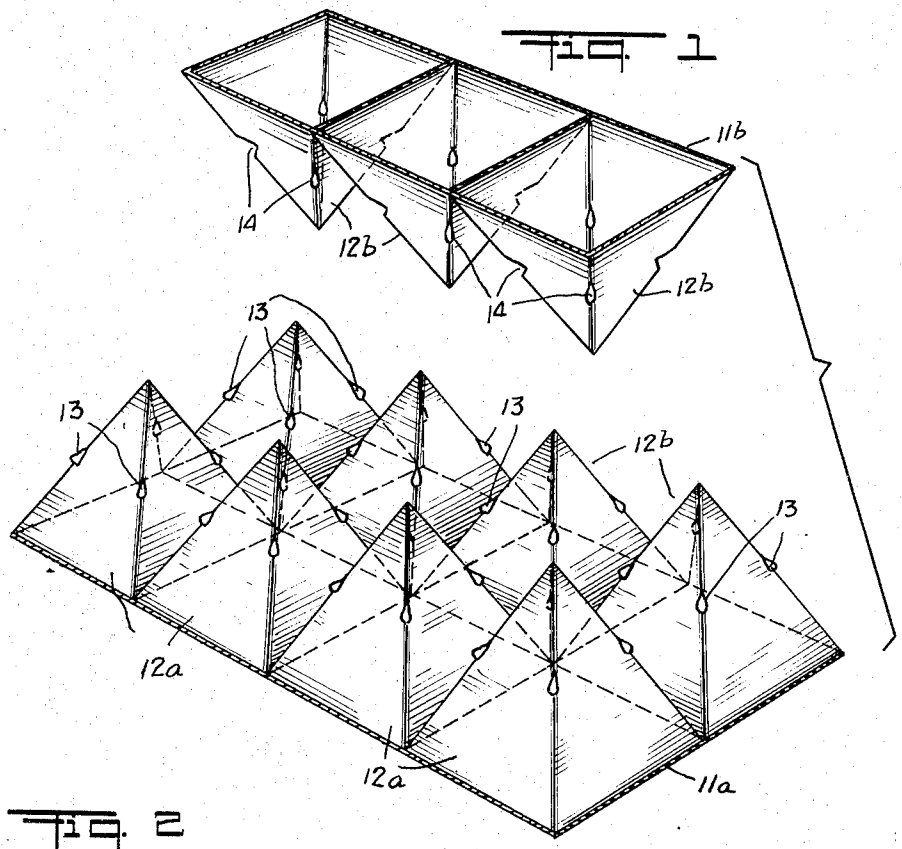
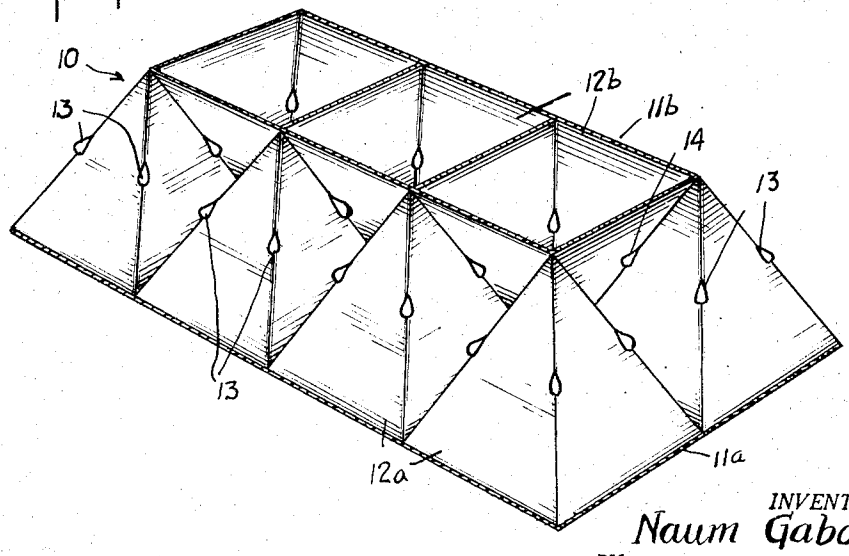


Fig. 2



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BUILDING CONSTRUCTION UNIT

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Fig. 3

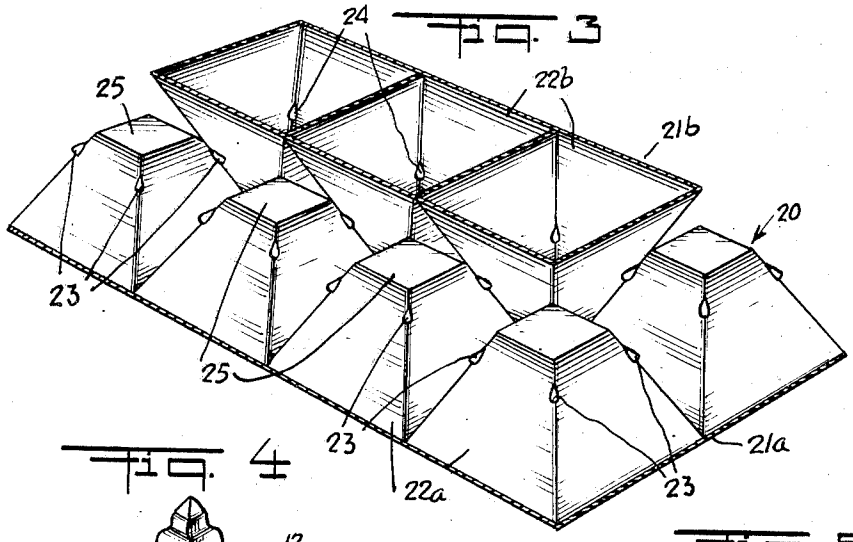


Fig. 4

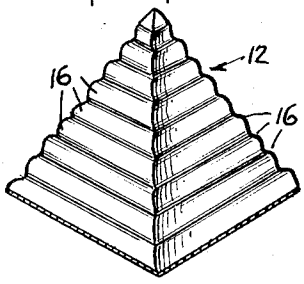


Fig. 5

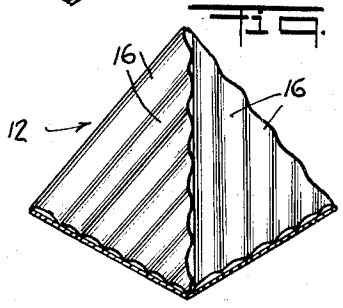


Fig. 6

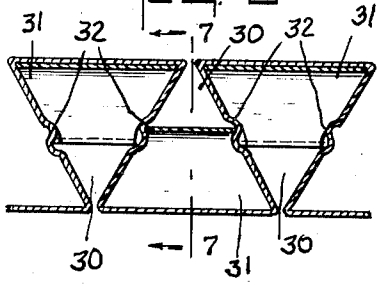
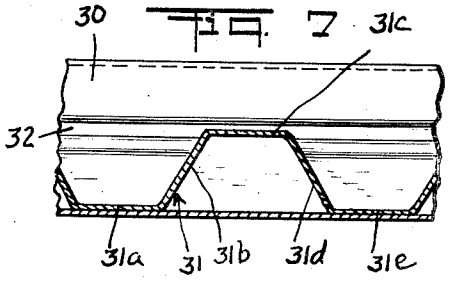


Fig. 7



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BUILDING CONSTRUCTION UNIT

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Fig. 4

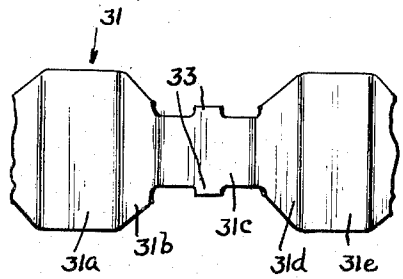
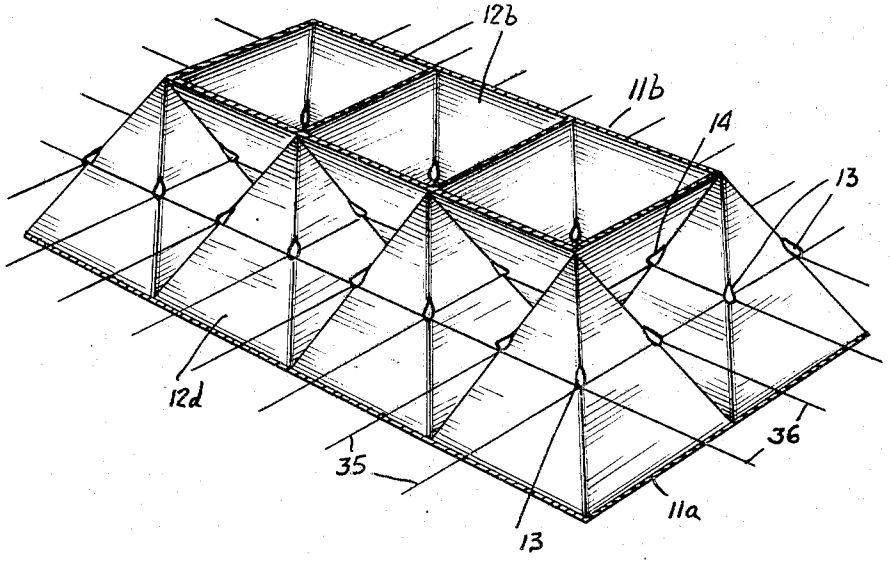


Fig. 5



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Patented Apr. 17, 1951

2,549,189

UNITED STATES PATENT OFFICE

2,549,189

BUILDING CONSTRUCTION UNIT

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Application February 7, 1947, Serial No. 727,137
In Great Britain January 23, 1945

6 Claims. (Cl. 154—45.9)

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This invention relates to construction units suitable for roofs, ceilings, walls and the like and has as its primary object the provision of construction units which combine strength and light weight so as to enable large areas of such units to be incorporated in a building construction without requiring auxiliary beams or supports.

A further object of the invention is the provision of construction units of the character indicated which, in addition to conserving weight and being self-supporting, will possess excellent heat and sound insulating properties.

The construction units of my invention may be considered in general terms as comprising a plate-like element having a series of deformations or corrugations, arranged in rows, and a second similar plate element associated therewith, the deformations or corrugations of the second plate element extending transversely of their counterparts on the first plate element, the deformations or corrugations of each plate being so disposed and interrelated as to accommodate the deformations or corrugations of the other plate. The pair of plate elements are assembled together in relatively inverted positions so that the total thickness of the unit is not substantially more than the space occupied by either plate element. It will be readily seen that each plate comprises rows of deformations or tapering projections, each pair of plates being assembled in such a manner that the deformations or projections of one plate are interfitted and intercalated with those of the other plate, the abutting edges of surfaces of the projections on each plate being secured together to prevent relative displacement.

The deformations or projections on each plate element may take a variety of geometrical forms. For example, they may take the form of a square-based rectangular pyramid. However, the projections may take other forms, such as cones, hemispheres or polyhedrons having any desired number of sides.

According to one feature of the invention each plate element has its projections, in the form of pyramids or other geometrical shapes, provided with interlocking means to prevent separation after assembly of a pair of such elements. The interlocking means may take the form of projecting lugs or flanges on the projections of each plate element which are adapted to interengage one behind the other to prevent separation of the plate elements, or alternatively, lugs extending from the projections of either element may engage in cooperating recesses in the projections of the other element.

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According to another feature of the invention, a construction unit of the character described may be reinforced by a net or mesh-like member engaging the lugs on each element, each strand passing between pairs of cooperating interlocking lugs or between pairs of cooperating interengaged lugs and recesses.

The foregoing objects and features of the invention together with additional objects and advantages will readily appear in the course of the following description taken in connection with the accompanying drawings which illustrate several embodiments of the invention, and wherein:

Fig. 1 is an exploded perspective view showing a pair of plate elements embodying the features of the invention prior to their assembly to form the construction unit.

Fig. 2 is a perspective view of the construction unit formed by the assembly of the pair of plate elements of Fig. 1.

Fig. 3 is a perspective view of a modified form of construction unit.

Figs. 4 and 5 are perspective views of a flat-sided pyramid which may be incorporated in the structure of the construction unit and which has corrugated sides for increasing the strength of the unit.

Fig. 6 is a sectional view in a plane normal to the general plane of the construction unit showing another modification thereof.

Fig. 7 is a sectional view taken on line 7—7 of Fig. 6.

Fig. 8 is a detail view of a portion of the construction unit shown in Figs. 6 and 7, and

Fig. 9 is a perspective view of a construction unit similar to that shown in Fig. 1, but reinforced by a net or mesh-like member.

Referring first to Figs. 1 and 2 of the drawing, the construction unit which is indicated by numeral 10 comprises two plates or elements 11*a* and 11*b* which are similar to one another and may be made of any suitable material such as metal, plywood, synthetic plastics or the like. Each element 11*a* and 11*b* is formed as a series of square-based pyramids 12 arranged in rows with their bases in abutment. The manner of fabricating elements 11*a* and 11*b* will depend upon the material used. In some instances the elements may be made by deformation or pressing from a flat plate. In other cases the elements may be molded easily, as with synthetic plastic materials. Alternatively the individual geometrical forms, such as the pyramids 12 may

be secured together by welding or any other suitable method.

As clearly shown in Fig. 1, elements 11a and 11b are similar to one another and are assembled to form the construction unit 10 by inverting one of them, 11b and inserting or intercalating its pyramids 12b between the pyramids 12a of elements 11a in such a manner that each pyramid 12b is located symmetrically between a group of pyramids 12a of element 11a, the pyramids 12a and 12b being in abutment along the sloping, lateral edges thereof.

Cooperating interlocking means are provided on the pyramids 12a and 12b to prevent separation between elements 11a and 11b. This means may take the form of a lug or abutment at some point, preferably the midpoint, along each edge of each pyramid of one element which engages either in a cooperating recess or behind a similar lug or abutment formed on a corresponding pyramid of the other element. Fig. 1 illustrates the interlocking lug and recess combination on corresponding pyramids, the pyramids 12a of element 11a having a lug 13 along each edge thereof and the pyramids 12b of element 11b having along each edge a cooperating recess 14. In assembling elements 11a and 11b with lugs 13 in engagement with corresponding recesses 14, a slight bending of said elements will be sufficient to achieve the desired interlocked relationship, the dimensions of lugs 13 and recesses 14 being relatively small with respect to the intercalated pyramids 12a and 12b.

Referring to Fig. 3 the construction unit 20 is formed by assembling elements 21a and 21b which are similar to the elements 11a and 11b but which have pyramids 22a and 22b truncated as at 25 in a plane parallel to the base of said pyramids so that the pyramids abut one another for only a portion of the length of their lateral sloping edges. As in the case of the previous modification, the pyramids 22a may be formed with lugs 23 for interlocking engagement within recesses 24 on pyramids 22b to prevent separation of the elements 21a and 21b. Alternatively pyramids 22b may be provided with lugs similar to the lugs 23 on pyramids 22a, said lugs engaging one behind the other in interlocking relationship to form the unit 20 and prevent separation of elements 21a and 21b.

Each of the four-sided pyramidal projections illustrated in Figs. 1, 2 and 3 makes only a line contact along its sloping edges with its cooperating pyramid when the pair of elements 11a and 11b or 21a and 21b are assembled, as would also be the case with conical projections. Where the projections which comprise the elements are hemispheres, there would be theoretically only point contact between each hemispherical projection on one element and the associated group of hemispherical projections on the other element. It is desirable for reasons of greater strength and practical fabrication to form the projections of each element so that there is an area of contact between corresponding projections of assembled pairs of elements rather than line or point contact. The provision of an area of contact is particularly advantageous when the elements are secured together by a welding process or a similar method.

Greater stiffness, rigidity and strength may be imparted to the assembled construction unit by corrugating the projections which comprise the elements from which it is formed, particularly when said projections are flat-sided pyramids. According to this feature of the invention the flat-sided pyramid 12 is formed with corrugations 16 on each flat-side extending parallel to the base thereof, said corrugations being in the form of small waves or steps, as shown in Fig. 4. Fig. 5 illustrates an alternative arrangement wherein the corrugations 16 on each side of the pyramid extend parallel to one of the side edges of the pyramid. Locking means similar to the cooperating lugs 13 and recesses 14 described for the previous embodiments may be provided, although these have been omitted in Figs. 4 and 5.

Figs. 6, 7 and 8 illustrate an alternative modification of construction unit assembled from a pair of elements which are not similar to one another in the manner described for the previous embodiments. One element is formed from a plate bent into a series of parallel dovetailed, triangular channels or grooves 30 symmetrical on both sides of the element. As shown in Fig. 6, grooves 30 are closed at their apices to form substantially triangular channels disposed adjacent each other with their apices alternatively in opposite directions. Each of the grooves 30 receives an element 31 formed in the following manner. A short portion of element 31 designated 31a has parallel sides and has a width between said parallel sides equal to the maximum width of the grooves 30; the next portion 31b has sloping sides gradually reducing to a width suitable to fit within the narrow part of triangular groove 30, the next portion 31c is parallel sided at this minimum width, the next portion 31d has sloping sides gradually increasing to the same width as portion 31a and terminating in portion 31e which is also parallel sided. This formation is duplicated along the entire length of element 31.

Element 31 is then shaped or corrugated in such a manner that the parallel sided broad portions 31a and 31e are located along the base of triangular groove 30, the tapering portions 31b and 31d extending upwardly toward the narrow part of said groove and the parallel sided narrow portions 31c abutting the sides of groove 30 at a level above the base thereof. This configuration is repeated along the entire length of element 30 so that when said element is inserted within triangular groove 30, said element is in contact with the base thereof at spaced intervals and abuts the sloping sides of said groove at the tapering edges of portions 31b and 31d and at the parallel sides of narrow portions 31c. Element 31 is similarly disposed in the next adjacent triangular channel 30 but in inverted position. This disposition of elements 31 within adjacent triangular channels 30 having their apices alternately in opposite directions provides a pyramidal construction unit equivalent to the construction unit illustrated in Figs. 1 and 2 with the distinction in the present modifications that opposite pairs of sides of each pyramid are formed in different elements of the unit, namely elements 30 and 31, each pyramid being also truncated by the omission of the apex thereof. Element 31 may be modified by the omission of narrow, parallel sided portions 31c, so that it comprises a series of alternately inverted triangles. With this modification the assembled unit will comprise complete pyramids without truncation of the apices thereof.

The sloping walls of triangular channels 30 may be corrugated as at 32 longitudinally to form recesses for the reception of cooperating abutments or lugs 33 formed integrally with por-

tions 31c of element 31. Lugs 33 are automatically received within the recesses or corrugations 32 when elements 31 are inserted within the triangular channels 30. Any suitable auxiliary means, such as welding, may be employed to further secure elements 31 within grooves 30, if desired.

The construction units may be reinforced by the use of a net or mesh-like element between the pyramidal or other projections of the component elements, as shown in Fig. 9 which illustrates one form of reinforcing element applied to a construction unit having square based pyramidal projections similar to those shown in Figs. 1 and 2. As has been previously pointed out, interlocking lugs 13 and recesses 14 are located at approximately the mid-points of the sloping edges of each pyramid and the reinforcing net element may comprise two parallel sets of strands of a suitable material 35, 36 which intersect at right angles and are spaced apart to provide square openings equal in size to the cross-section of pyramidal projections 12 at the level of the interlocking lugs 13 and recesses 14, which is at approximately one-half the altitude of said pyramidal projections. When the net element is placed in position over element 11*a* strands 35 and 36 will assume a position on the pyramids determined by the size of the openings defined by said strands, which position should be immediately below lugs 13 on pyramids 12*a*. When the second element 11*b* is assembled in position on element 11*a* to form the construction unit 10, pyramids 12*b* will enter the net openings and recesses 14 will be brought into interlocking engagement with lugs 13 with strands 35 and 36 of the net element lying between said lugs and said recesses. Strands 35 and 36 therefore give additional stability to the assembled construction unit and further prevent separation between its component elements 11*a* and 11*b*. When certain other geometrical projections, such as hemispherical projections, are employed in the structure of the assembled units, instead of the pyramidal projections illustrated in the drawings, there may be only point contact between contiguous projections. In these cases the presence of a reinforcing net element 35, 36 is particularly advantageous.

As has been previously pointed out the construction units may be fabricated in various ways depending upon the characteristics of the material employed. One method contemplates the use of individual projections, such as the pyramidal projections of the drawings, secured together at their abutting edges by welding or other means. Alternatively, a tongue and groove construction might be used to inter-engage the projections, with or without auxiliary means such as welding or adhesives.

The construction units of my invention may be enclosed in planar or curved sheet members so that the air spaces within the units will be completely enclosed not only to impart greater strength to the units but also to improve the heat and sound-insulating properties thereof. If curved sheet members are used to enclose the construction units, the units may be employed in the construction of curved or dowel roofs or other curved structural elements.

Since certain modifications may be made in the construction units of my invention without departing from the scope thereof, it is intended that all matter contained in the foregoing description and shown in the accompanying drawings be interpreted merely as illustrative and not in a limiting sense.

The form of construction herein shown, instead of being used themselves as roofing elements, may in perforated form be used as construction elements in which they will serve as a reinforcement for the overlaying concrete. The size and number of perforations may be varied at will.

I claim:

1. A building construction unit comprising a pair of rigid plate-like elements, each element comprising a plurality of substantially closed geometrical projections of identical predetermined shape arranged in rows and having bases which are continuous with said element around the entire periphery thereof, each of said projections having four identical triangular panels each interconnected along its sides to the next and forming together a square open base, said elements being disposed in relatively inverted position with the projections of one element symmetrically intercalated between the corresponding projections of the other element, said projections being formed with interlocking means to prevent separation of said pair of elements after assembly.

2. A building construction unit comprising a pair of rigid plate-like elements, each element comprising a plurality of geometrical projections of identical predetermined shape arranged in rows, and having said elements being disposed in relatively inverted position with the projections of one element symmetrically intercalated between the corresponding projections of the other element, each of said projections having four identical triangular panels each interconnected along its sides to the next and forming together a square open base, said projections being formed with interlocking means to prevent separation of said pair of elements after assembly, and a reinforcing net-like member engaging said interlocking means externally of each element on the projections of each element, and encompassing each element.

3. A building construction unit comprising a pair of rigid plate-like elements, each element comprising a plurality of geometrical projections of identical predetermined shape arranged in rows and said elements being disposed in relatively inverted position with the projections of one element symmetrically intercalated between the corresponding projections of the other element, each of said projections having four identical triangular panels each interconnected along its sides to the next and forming together a square open base, said projections of either element having a lug midway of each pair of adjoining edges of said panels, said projections of the other element having recesses cooperating with said lugs to prevent separation of said pair of elements after assembly, and a reinforcing net-like member engaged between said cooperating lugs and recesses externally of each element on the corresponding projections of said pair of elements, and encompassing each element.

4. A building construction unit comprising a pair of rigid plate-like elements, each element comprising a plurality of pyramidal projections arranged in rows, and having bases which are joined to each other, each of said projections having four identical triangular panels each interconnected along its sides to the next and forming together a square open base, said ele-

ments being disposed in relatively inverted position with the pyramidal projections of one element symmetrically intercalated between the corresponding pyramidal projections of the other element, said projections being formed with interlocking means to prevent separation of said pair of elements after assembly.

5. A building construction unit comprising a pair of rigid plate-like elements, each element comprising a plurality of pyramidal projections arranged in rows, each of said projections having four identical triangular panels each interconnected along its sides to the next and forming together a square open base, said elements being disposed in relatively inverted position with the pyramidal projections of one element symmetrically intercalated between the corresponding pyramidal projections of the other element, said projections being formed with interlocking means to prevent separation of said pairs of elements after assembly, and a reinforcing net-like member engaging said interlocking means externally of each element on the projections of each element, and encompassing each element.

6. A building construction unit comprising a pair of plate-like elements, each element comprising a plurality of pyramidal projections arranged in rows, each of said projections having four identical triangular panels each interconnected along its sides to the next and forming together a square open base, said elements being disposed in relatively inverted position with the pyramidal projections of one element symmetrically intercalated between the corresponding

pyramidal projections of the other element, said projections being formed with interlocking means to prevent separation of said pair of elements after assembly, and a reinforcing net-like member engaging said interlocking means on the projections of each element, each pyramidal projection on each element having corrugations formed in the faces thereof extending parallel to the base of said pyramidal projection, to provide greater rigidity and strength to the assembled unit.

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