FOLDABLE CONSTRUCTION BLOCK

Apparatus and method of construction using foldable building blocks. A first embodiment of the apparatus includes an open top construction block foldable from a flat sheet of material to form a container having downwardly extending interlock tabs, with struts being provided between opposite vertical walls and diagonally opposed vertical joints to control horizontal expansion of the block when a solid material is placed therein. A second embodiment of the apparatus includes a closed top block foldable from a single sheet of material with interlock tabs extending downwardly from one side wall of the block and interlock tab receiving slots provided in the top of the block.

The method includes folding box-shaped containers with downwardly extending interlock tabs from flat sheets of material, filling the containers with available solid material and stacking the containers in courses in overlapping relationship so that the interlock tabs extend downwardly into similar containers in the underlying course.

3 Claims, 6 Drawing Figures
FOLDABLE CONSTRUCTION BLOCK

ORIGIN OF THE INVENTION

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to site formable building blocks and to a method of construction utilizing the blocks.

2. Description of the Prior Art

Frequently in the proposed construction of low cost permanent or semi-permanent static structures suitable for human habitation, the cost of construction using conventional techniques would exceed the value of the proposed structure. This problem is particularly encountered when housing is proposed for remote areas in underdeveloped countries. In many such instances there are no locally available inexpensive building materials and the cost of transporting conventional supplies from an available source is prohibitive. This problem also arises in other situations where a structure is needed for short term use and would have little or no salvage value.

One prior art solution to this problem has been the use of locally available water, clay and binder material such as straw for the on-site preparation of adobe bricks which are, in turn, used for construction of the structure. This solution is only applicable in selected geographical areas where the necessary materials and the climate permit. Even in those instances, a certain minimum of construction tools are required and the preparation process can be lengthy.

An alternate solution frequently adopted in these situations is the use of sand bags or similar containers which may be filled with any available material and stacked to form the walls of the structure. This solution is frequently unsuitable, however, due to the instability of the walls and the inability of the walls to support a roof load.

Neither of the foregoing prior art solutions is suitable when a relatively dust and lint free environment is required within the structure. This problem is frequently encountered when a temporary medical treatment facility must be constructed in a remote area, for example.

SUMMARY OF THE INVENTION

The instant invention includes building blocks which may be assembled by folding a pre-cut flat sheet of material, and a method of construction using the blocks. A first embodiment of the apparatus includes an open top block having downwardly extending interlock tabs, with support struts provided between opposing vertical walls and opposing vertical joints to control horizontal expansion of the block when a solid material is placed therein. A second embodiment of the apparatus of this invention includes a closed top foldable building block having interlock tabs receiving slots provided in the top thereof.

The method includes folding box-shaped containers with downwardly extending interlock tabs from flat sheets of material, filling the containers with available solid material and stacking the containers in overlapping courses so that the interlock tabs extend downwardly into similar containers therebelow.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of an empty folded first embodiment of the invention showing support struts in place.

FIG. 2 is an isometric view showing a partially constructed wall using the blocks of FIG. 1.

FIG. 3 is a layout of the block of FIG. 1.

FIG. 4 is an isometric view of a second embodiment of the apparatus of this invention.

FIG. 5 is an isometric view showing a partially completed wall and corner constructed using the block of FIG. 4.

FIG. 6 is a layout of the block of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and in particular to FIGS. 1-3, a first preferred embodiment of this invention is shown in plan layout in FIG. 3 and in folded isometric in FIG. 1. This form of the invention may be die cut from a blank such as a flat sheet of material in a single die cutting operation following the layout of FIG. 3, and may be folded at the construction site along the indicated broken lines to form the block shown in FIG. 1.

The flat blank shown in FIG. 3 has four substantially rectangular adjoining panels which form the side walls 10, 12 and the end walls 11, 13 of the completed block. Depending from end walls 11 and 13 are bottom closure flaps 14 and 15, respectively, arranged to be folded along fold line 16 to a position perpendicular to walls 11 and 13. The blank is provided with a bottom joint joined to the lower edge of side wall 10, which bottom has a closure tab 18 thereon. Also attached to side wall 10 at the left end thereof is a closure tab extension A, which tab is arranged to be folded along fold line 32 during assembly of this block, as described below.

Extending downwardly from side wall 12, as viewed in FIG.

3, are two interlock tabs 19a, 19b, the function of which is described below, and a triangular bottom closure flap 20 having a closure tab 21 thereon. Flap 20 and closure tab 21 are arranged to be folded along fold lines 16 and 22, respectively, and operate to reinforce the block by retaining bottom joint 17 in a horizontal position when the block is assembled. A slot 23 is provided along fold line 16 intermediate the intersection between side 10 and bottom 17 for receiving closure tab 21 as the block is assembled.

Additionally, sides 10, 12 and ends 11, 13 are provided with strut mounting holes 24 and 25, which holes are spaced to allow retaining struts to be installed between opposite side walls, between opposite end walls and between diagonally opposed vertical joints of the folded block, as described below.

The first step in folding a construction block from the pre-cut blank shown in FIG. 3 is to fold the blank intermediate its opposite ends along fold line 26. Although this fold may be in either direction, the remainder of this discussion will treat the surface of the blank shown in FIG. 3 as the outside surface of the block. For storage and shipment of the blank blocks it would be convenient to make a 180° fold along line 26, with that fold opened to a 90° fold at the time of assembly of the block. After making the 180° fold along line 26, a vertical connection between tab A on side 10 and the right vertical edge of end 13 may be secured, as described below. At the construction site the 180° folds along lines 26 and 32 are opened to 90° and similar 90° outward folds are made along lines 27 and 28, thereby forming the blank into a rectangular open bottomed configuration.

Bottom closure flaps 14 and 15 are then folded inward in partial closure of the block bottom, with bottom flap 17 folded thereover and closure tab 18 then forced inward and upward between flaps 14 and 15 and side wall 12. Bottom closure flap 20 is then folded over bottom flap 17, with closure tab 21 inserted into slot 23. Flap 20 operates to assist in retaining bottom flap 17 in the folded horizontal position. The construction block is now ready for installation of support struts, if required.

This construction block may be formed of any desired sheet material such as sheet steel or plastic, however, waterproofed cardboard is preferred due to its weight, flexibility, and cost. When forming the blank of cardboard, fold lines 16, 22, 26, 27, 28 and 32 may be scored or pressed into the blank during or after the die cutting to form hinges between the various panels. Using cardboard, the connection between tab A on side wall 10 and end wall 13 may be provided in any conventional manner, as by the use of staples through tab A and end 13, or by the use of glue or adhesive tape.

When the blocks are to be constructed of cardboard or other similarly flexible material, it is desirable to use side sup-
port struts 29, end support strut 30, and diagonal support struts 31 to give the block structural rigidity. Struts 29, 30, and 31 as shown in FIG. 1 may be constructed of any suitable material such as steel wire or cable or non-elastic fibreglass rope, and should be provided with suitable end anchors, such as washers, to prevent the struts from pulling out of the block walls.

Although not required, it is also desirable to form the blocks with length b to width a ratio (as shown in FIG. 2) of 2 to 1 so that corners formed with the blocks may conveniently assume an interlocking planar relationship. It has been found that a practical size for the blocks is 16 inches long by 8 inches wide by 8 inches high. Using this size, the blocks, when filled with available solid material, are not too heavy to be moved by one person and yet have sufficient base area and structural rigidity for stacking to wall height. Since the bottom of each block is closed, no substantial problem of rigidity arises upon setting of the material filling each block.

In constructing a wall with the above described construction block, such as the wall illustrated in FIG. 2, a first bottom row or course of blocks filled with solid material is laid with tabs 19a and 19b on each block folded under. Thereafter the second and subsequent rows are laid to overlap two lower blocks so that tabs 19a and 19b project downward into two different blocks on the underlying course. Tabs 19a and 19b provide structural rigidity and vertical alignment of the wall and prevent relative lateral movement of the blocks. The blocks may be stacked with tabs 19a and 19b of all blocks on the same side of the wall, if desired. However, greater structural integrity and better vertical alignment of the wall is achieved when the tab side of the blocks is alternated in each course.

Referring now to FIGS. 4–6, a second embodiment of the apparatus of this invention, preferred by the inventor, is illustrated which likewise may be die cut from a flat sheet of material in a single die cutting operation.

Referring to FIG. 6, the flat blank has four substantially rectangular adjoining panels which form side walls 40 and 42 and end walls 41 and 43, of the completed block. As in the first embodiment, this block is provided with bottom closure flaps 44 and 45 depending from end walls 41 and 43, respectively, arranged to be folded along fold line 46, with a bottom flap 47 having closure tab 48 thereon; with interlock tabs 49a and 49b depending from side wall 42; and with a triangular bottom closure flap 50 having closure tab 51 thereon, which tab is arranged to mate with slot 52 provided on fold line 46 between side wall 40 and bottom flap 47. As described in this second embodiment of the apparatus of this invention is identical to the first embodiment described with reference to FIGS. 1–3 above. This second embodiment is also provided with an extended portion 53 of side wall 40, which extended portion may be folded along fold line 55 and which provides additional strength at the seam between side wall 40 and end wall 43 when the block is assembled.

End walls 41 and 43 of this block are also provided with top closure flaps 57 and 58, respectively, each of which has a length shown by the letter a equal to one-half of the length b of the sides of the block. Flaps 57 and 58 have flap extensions 59 and 60 thereon, respectively, which extensions are arranged for folding along fold lines 61 and 62, respectively.

The hinge between top closure flap 57 and end wall 41 is provided with an interlock tab receiving slot 63, and a similar slot 64 is provided between flap 58 and end wall 43. Each of flaps 57 and 58 is also constructed with an elongate slot 65 and 66, respectively, opening upwardly along the center line thereof.

Side wall 40 of this block is provided with top flap 67 having flap tab 68 thereon with the width e of flap 67 being one-half of the width d of end wall 41. When the block is folded, slots 65 and 66 will be longitudinally aligned and will mate with tab 68 on flap 67 and with tab 70 on flap 69, as described below. The outer edges of flap 67 have notches 67a and 67b thereon, which notches will align with slots 64 and 65, respectively, when the block is assembled and closed, as described below.

Side wall 42 has an upwardly extending generally triangular flap 69 thereon, which flap has a closure tab 70 extending therefrom. Tab 70 is arranged for insertion into slots 65 and 66, along with tab 68, when the block is assembled.

This second embodiment of the apparatus is in a manner similar to that of the first embodiment described above. The blank of FIG. 6 is first folded outward to a 180° angle along fold line 71. Then side 40 is joined to end 43 by folding and lapping portion 53 over the edge of end 43. This seam may be closed by tapping, stapling, or in any other convenient manner. Then bottom closure flaps 44 and 45 are folded inwardly along fold line 46 and bottom flap 47 is folded thereover, with closure tab 48 being forced between the edges of flaps 44 and 45 and side wall 42, closing the bottom of the block. The bottom closure is reinforced by next folding bottom closure flap 50 across the bottom surface of bottom flap 47 and forcing tab 51 into slot 52.

Next, side 40 is joined to end 43 along portions 55 and 56, which seam may be made by tapping, stapling, or in any other convenient manner. Then bottom closure flaps 44 and 45 are folded inwardly along fold line 46 and bottom flap 47 is folded thereover, with closure tab 48 being forced between the edges of flaps 44 and 45 and side wall 42, closing the bottom of the block. The bottom closure is reinforced by next folding bottom closure flap 50 across the bottom surface of bottom flap 47 and forcing tab 51 into slot 52.

As described in this second embodiment, side wall 42 has a triangular flap 69 thereon which extends upwardly from side wall 42, and which flap has a closure tab 70 extending therefrom. Tab 70 is arranged for insertion into slots 65 and 66, along with tab 68, when the block is assembled.

Referring to FIG. 5, a wall may be constructed using the above described blocks by laying a bottom row of blocks in the desired outline configuration and thereafter stacking additional rows thereon to achieve the desired wall height. Since the blocks of this embodiment are provided with closed tops rather than with struts to create structural rigidity, the blocks must be stacked so that tabs 49a and 49b align with the interlock tab receiving slots in the top of the blocks of the underlying row. Therefore, using the block configurations shown in FIGS. 4–6, all blocks would have to be arranged with the interlock tabs 49a and 49b on the outside of the wall. In the alternative, the blocks of this embodiment may be configured to include additional interlock tab receiving slots on top flap 67 parallel and adjacent the hinge joining flap 67 to side wall 40. Using blocks thus modified, all blocks except those used to form wall corners would be laid with tabs 49a and 49b on either the inside or outside of the wall, as desired. The blocks forming wall corners would still have to be laid with tabs 49a and 49b towards the outside of the corner.

The wall construction method of this invention may be practiced using either of the construction blocks described above, or with any other foldable closed bottom container. It is important only that the container used have a closed bottom and have interlock tabs extending downwardly from the lower edge of one wall portion. The method is performed by folding a plurality of such closed bottom containers, filling the containers with available solid material, as described above, and stacking the containers in overlapping interlocking courses. Although the step of filling the containers has been described as preceding the step of stacking the containers, these steps could be performed in reverse order if desired.

It should also be noted that references in the foregoing description and following claims to the dependency of the interlocking tabs 19 and 19 among the bottom surface of respective blocks is only for purposes of consistent orientation. Obviously, tabs 19a and 19b of the FIG. 1–3 embodiment may be made to project above the top surface of the block for inser-
tion into the bottom of vertically adjacent blocks. In the case of the FIG. 4-6 embodiment, it is only necessary to invert the system illustrated.

When used for the purpose of building enclosed structures, it is also obvious that the vertical dimension of some or all composite block side walls intended to face the structure interior may be made smaller than the outer side wall so that the assembly takes a Roman Arc configuration. Quonset type buildings may be erected in this manner. By compounding wall and end dimensional differences, a hemispherical or igloo type structure may be erected.

What is claimed is:

1. A construction block foldable from a single pre-cut flat sheet and which may be filled with available solid material and stacked with other such blocks in staggered interlocking relation, said block comprising:
   a box member having a pair of opposed end walls and a pair of opposed side walls, said end and side walls being hinged at three of the adjacent vertical intersections therebetween;
   means for joining the fourth adjacent vertical intersection between said walls;
   interlock tab means connected to one of said side walls and extending downwardly therefrom, said tab means being arranged for insertion into at least two of said blocks positioned therebelow;
   a bottom hinged to the lower horizontal edge of the other of said side walls;
   flaps hinged to the bottom horizontal edges of each of said end walls and arranged to extend horizontally inward therefrom inside of said bottom;
   a third flap hinged to said one side wall, said third flap being arranged to extend horizontally adjacent said bottom and arranged to assist in retaining said bottom in a horizontal position; and
   strut means for interconnecting opposing walls and for interconnecting diagonally opposed vertical joints to control horizontal expansion of said block when a solid material is placed therein.

2. The invention as claimed in claim 1 wherein:
   said side walls are longer than said end walls.

3. The invention as claimed in claim 2 wherein:
   the ratio of the length of said side walls to said end walls is approximately 2 to 1.