A reusable form for pre-cast building components of U-shaped cross section comprises an adjustable frame (6) having upper horizontal members (24, 26) to which counterbalanced side panels (87, 91°) are hingedly attached. The frame is mounted on castors to be movable to different locations on a base plate (4) at each of which a component can be cast. A hinged end closure door (50, 55) openable together with the side panels (87, 91°) is provided to allow the form to be moved away from a completed casting to a new location on the base plate (4).
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FORM FOR PRE-CAST BUILDING COMPONENTS

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention is concerned with a portable permanent form for rapidly forming multiple precast concrete structures comprising generally U shaped building components of the general type disclosed in my US patents 5,081,805 PRE-CAST CONCRETE BUILDING UNITS AND APPARATUS FOR MANUFACTURE THEREOF and 5,205,943 APPARATUS FOR MANUFACTURE OF PRE-CAST CONCRETE BUILDING UNITS. Such a form may be used for example for rapidly constructing U shaped building components of semi-room size comprising spans of approximately 4 meters wide by 3 meters deep, with parallel side walls or limbs approximately 1.5 meters high which when joined edge to edge form complete rooms. Advantageously the forming apparatus can be operated with only one or two workmen and is adjustable whereby it is not necessary to construct new forms each time a larger or narrower, longer or shorter room is required. The present invention may thus provide a portable form apparatus which is flexible in use.

A further advantage, since it is sturdy and permanent, it produces repetitive and accurately dimensioned units as opposed to units constructed with impermanent forms which often have considerable variations. It is fast and inexpensive and significantly lowers the unit cost of the building components made with it.

2. PRIOR ART

The most pertinent prior art teachings known to me are those disclosed in my foregoing patents.
SUMMARY OF THE INVENTION

The type of semi-room pre-cast building component units described in the foregoing patents are especially suitable for constructing relatively simple and sturdy structures particularly in remote areas and in the absence of skilled labour. It is thus important that the units may be fabricated with a minimum of carpentry or masonry skills. Ideally they should be competitively erected by common labourers with a minimum of training.

The purpose of the present invention is to provide a form or molding apparatus that may be used multiple times. Preferably it is easily adjusted to form different size pre-cast units, and can be operated readily with only one or two unskilled labourers.

In accordance with the present invention there is provided a re-usable form for casting concrete building components of U-shaped cross-section, comprising side panels defining an open-bottomed moulding space, the form including an end opening closable by a movable door whereby, with the door opened, the form may be laterally moved off a completed building component resting on a stationary support surface, the component passing through the end opening.

Using the techniques of the present invention it is possible to remove the forms as soon as the concrete has initially set. The form can be removed readily from the structure just poured and moved a short distance, for example on jack attached wheels, to an immediately adjacent site. Another structural unit can then be poured in a very short period of time, because of the minimal preparation required to carry out each pouring operation. The form can be used on site adjacent to a building project eliminating transport and handling costs and logistical problems associated with off-site prefabricated components.
In its preferred form, it is "weightless", using adjustable counterbalanced hinged side panels, and thereby requires no cranes, electricity, hydraulics or forklifts or many labourers to prepare it for each casting. This results in the use of only one or two workers only and minimal physical effort.

It is opened by rotating about a fixed axis a counterbalance on each side and not totally dismantled after each casting. High accuracy is still achieved with unskilled operators.

Turn around time for each cycle is greatly reduced due to not needing meticulous and careful alignment for each casting. Also there is no need of a crane, fork lift, hydraulic or electrical motors that need maintenance, power source, or calibrations with ensuing labour markups and coordinations.

The form may be adjustable to produce all required room sizes and wall thicknesses.

A preferred form of the present invention has at one end a generally U shaped frame which lies flat on the underlying surface. The underlying surface preferably comprises a flat sheet of metal which serves, in effect, as a portion of the base form surface. In practice the base surface can be a large steel sheet or plate. Since the form is moved from one section to another after each use it would eliminate the necessity of putting in place a second separate sheet as a form part.

The base of the U is comprised of two overlapping hollow channel members so as to be expansible. The upwardly extending arms of the U are formed from adjustable height channel beams. A pair of parallel horizontal frame members
are attached to the top of the uprights and extend to the other end of the form. These frame members are slidably received in sleeves fixed to the top of an adjustable height, inverted U-shaped frame at the other end of the form. In this way the form is adjustable in length and height. The bases of the U-shaped and inverted U-shaped frames are also telescopically adjustable to vary the width of the form. The legs of the inverted U-shaped frame lie outwardly of the central mould space, allowing the form to straddle and move past a completed moulded unit.

Pivoted from each horizontal frame member are opposed pairs of counterbalanced arms. These support side panels of the form. At one end of the horizontal frame members there are longitudinally slidable hanging brackets, from which swings a U-shaped end closure cover of the form. Cylindrical spacers may be provided to keep the side panels the proper distance apart.

The corners of the frame have jacks to jack down an extension on which caster wheels are carried so that when a cast unit is set up the whole frame may be moved to the next base sheet space.

The concrete is poured in each side and in the base over the floor plate up to the desired thickness. Rebars or mesh reinforcing may be utilized as called for in the particular specifications.

This device is simple to construct using basic welding or bolts. There are counterbalanced arms for each wall form. The counter balance arm is threaded so as to receive an adjustable position weight.

Other preferred features of the invention are in the dependent claims or will be apparent from the following description of an illustrative embodiment made with reference
to the drawings.

**BRIEF DESCRIPTION OF THE DRAWINGS**

In the accompanying drawings:-

Fig. 1 is an overall perspective view of the base and frame members forming part of the form or molding apparatus;

Fig. 2 is a similar perspective view with other parts in place, and the width adjusted to a shorter span;

Fig. 3 is a similar perspective view as in Fig. 1 with the other parts in place;

Fig. 4 is similar to Fig. 3 showing the apparatus after concrete has been poured into the form;

Fig. 5 is a perspective view of the apparatus shown in Fig. 4 opened up after the concrete has set;

Fig. 6 is a perspective view of the apparatus open as in Fig. 5 being moved away from the cast unit;

Fig. 7 is a top view of the apparatus of Fig. 2;

Fig. 8 is a top view of the apparatus as shown in Fig. 6 and along lines 8-8 of Fig. 10;

Fig. 9 is an enlarged perspective view, partially in section, of the form walls, base, closure door and counterbalancing weights;

Fig. 10 is an end elevational view taken along lines 10-10 of Fig. 8;

Fig. 11 is a sectional view taken along lines 11-11 of
Fig. 14;

Fig. 12 is a sectional view along lines 12-12 of Fig. 14;

Fig. 13 is a sectional view along lines 13-13 of Fig. 14;

Fig. 14 is a sectional view along lines 14-14 of Fig. 7;

Fig. 15 is an enlarged perspective view of the U section frame showing component parts and adjusting mechanisms;

Fig. 16 is an enlarged perspective of a counterbalanced L form arm;

Fig. 17 is a perspective view of the hinging arrangement of the closure door;

Fig. 18 is an enlarged perspective view of a batten board and spacing disks on the U frame;

Fig. 19 is an enlarged perspective view of the width adjustment of the closure door;

Fig. 20 is an enlarged perspective view, partially in section, of a cylindrical spacing collar and bolts for the side walls;

Fig. 21 is a side elevational view of the collar and bolt shown in Fig. 20 in a section of the side wall;

Fig. 22 is a perspective view of a completed cast building unit; and

Fig. 23 is a perspective view of two units joined end to end with a mortared joint between them.
ILLUSTRATIVE SPECIFIC EMBODIMENT

In the accompanying drawing the counterbalanced or "weightless" form apparatus 2 rests on an underlying steel plate 4 and has a U-shaped frame 6 comprising a base 10 and a pair of uprights 16 and 18. The base 10 is comprised of two box channel beams 12 and 14 joined telescopically. The beam 14 slides within beam 12 and they are provided with transverse apertures 13 and 15 to secure adjustably the length of base 10. One or more bolts or pins 17 (Fig. 2) pass through the channels 12 and 14 to lock them at the desired length. Uprights 16 and 18 also of box beam construction with adjustable height extensions 20 and 22 are joined to the outer ends of beams 12 and 14.

Extending horizontally from the top ends 21 and 23 of uprights 20 and 22 and integral therewith are parallel horizontal beams 24 and 26 running at right angles to base 10 and extending to ends 28 and 30. They are channelled through, and adjustably secured in, box frames 32 and 33 which are welded to the top surfaces of the crossbar 34 of an inverted U frame structure. This arrangement allows the distance between upright U frame 6 and the inverted U frame structure to be readily adjusted depending on the desired size of the component unit being molded.

Crossbar 34 is carried on uprights 38 and 40 at each end which slide telescopically up and down in upright box section beams 41 and 42.

Carried inwardly of the box frames 32 and 33, on beam members 24 and 26 respectively are inverted U shaped brackets 46 and 48 respectively which hingedly carry an end closure door 50 having depending sides 52 and 54 and connecting base member 55.

The brackets 46 and 48 are carried on the top surfaces
25 and 27 of the horizontal beams 24 and 26 and are slidable thereon.

Base member 55 comprises two overlapping boards 57 and 59 (Figs. 7-9 and 19) adjustable lengthwise by means of a bracket 184 secured to board 59 carrying a flexible tab 185 with a pin 186 which is biased to pass through aligned apertures 61 in parts 57 and 59 to lock them at a desired length.

Depending brackets 46 and 48 have apertures 62 and 64 on the sides thereof into which the upper ends 176 and 178 of arms 182 and 183 fit (Figs. 1 and 17). Arms 182 and 183 are each provided with a length adjuster 180 on sides 52 and 54 for raising or lowering the door 50.

Mounted also on the top of the beams 26 and 24 respectively are pairs of brackets 66, 68 and 70, 72 having apertures 74 and 76 therein (Figs. 2-7 and 11).

A rod 78 passes through the apertures in brackets 70 and 72 and a rod 80 through apertures in brackets 66 and 68. Mounted to these rods on the outer side of the frame are inverted L shaped arms 82 and 84 respectively. Secured to the inner faces thereof is a rectangular outer side panel 86, the lower edge 87 of which rests on the sheet 4. A similar inner side panel 91 is mounted to corresponding arms 83.

The upper ends 89 of the arms 82, 83 are threaded as indicated at 90 (Fig. 16). Mounted on the threaded portion 90 is a cylindrical counterbalance weight 92 having a recess 93 therein with internal threads 94 matching the threads 90 of the end 88 of the arms 82, 83.

The rectangular form wall panels 86, 91 are secured to the arms 82, 83 with bolts 99, Fig. 13. The wall panel positions may be adjusted, and different sized panels
substituted for one another, to cast concrete components of various sizes and wall thicknesses. For this purpose the centre of rotation of the arms 82, 83 on the rod 80 may also be adjusted.

The lower end of the arms 83 has a lateral foot 114 extending inwardly of the frame to which is secured a board 116. The inner and outer side panels 86 and 91 are secured in spaced apart relationship by a number of cylindrical collars 124, having studs 126 passing through the interior of the collar and corresponding apertures 122 in the panels 86 and 91. The studs 126 are secured with nuts 130 and washers 126 which are easily removed once the concrete 100 has set (see Figs. 20 and 21).

The upright frame parts 16 and 18 also carry on a pin 133 hooking latches 132 which hook onto pins 134 on the upper frame member to further hold the forms in place together (Fig. 15). The closure door 50 is provided with similar latches 136 (Fig. 4).

At the base of each of the upright members 16, 18, 41, and 42 on the outer face thereof, a hydraulic or mechanical jack 144 (Fig. 6) is secured having an operating handle 146 and an extensible rod 148 extending from the bottom thereof on which is mounted a castor wheel 150.

Shown in Fig. 15 batten boards 154 are provided on the interior edges of the forms in contact with the concrete in order to provide a keyway 172 (Figs. 22 and 23) in the cast units for securing multiple sections 174 and 176 together with grouting 178 after they are formed. Where a batten board 154 is against a frame with overlapping members, wedges 156 as indicated in Figs. 15 and 18 are inserted behind the batten board 154 to align it straight.

Boards 154 are held in place either with bolts into the
adjacent frame member or can be tied to the frame members with wire; or they can be simply laid in place and held against the frame members by the pressure of the wet concrete.

Prior to pouring the concrete, the inner and outer side panels are locked to the uprights 16, 18, 41 and 42 and the swing door 50 is locked to the outer side panels 86, 86' as shown in Fig. 4.

All the mold faces are primed prior to a pour with a mold release oil and mesh or rebar 98 put in place in the usual manner. The concrete is then poured.

Once the concrete is set, the bolts 128 are removed other latches undone and the mold opened up.

The end door 50 is swung to the open position as shown in Fig. 5 and the wall frame members swung open and latched in the open position.

The framework dolly wheels 150 are then jacked down and the device 2 can be moved away from the completed structural unit 200 and then 2 set up again for another pour and unit. During movement, the widely spaced frame uprights 38, 42, 41, 40 straddle the completed unit, allowing the form to be easily removed.

Completed units 174 and 176 are joined with mortar 178 along keyway joints 172.

The apparatus 2 can be assembled in approximately an hour with two common labourers. The parts can all be reused. There is virtually no skilled labour required, other than for cutting the batten board to suitable lengths and backing them up properly.
When desired, the form can be used to mould two or more units end-to-end simultaneously, with batten boards inserted between the inner and outer side panels 86, 91, 86', 91' and across the base plate 4 to separate the different units as the concrete is poured. This achieves maximum mould utilisation and efficiency, as well as more closely matching the volume of cement required in each moulding operation to the volume delivered by a typical mixer truck.

While the invention has been described by reference to an illustrative embodiment, it is not intended that the novel device be limited thereby, but that modifications thereof are intended to be included, falling within the scope of the following claims.
CLAIMS:

1. A re-usable form for casting concrete building components of U-shaped cross-section, comprising side panels defining an open-bottomed moulding space, the form including an end opening closable by a movable door, whereby, with the door opened, the form may be laterally moved off a completed building component resting on a stationary support surface, the component passing through the end opening.

2. A form as claimed in claim 1 wherein the side panels are hingedly suspended from a frame.

3. A form as claimed in claim 2 wherein the side panels are counterbalanced for hinging movement on the frame.

4. A form as claimed in any preceding claim wherein two opposed pairs of the side panels are respectively hingedly suspended in parallel to define moulding surfaces for opposed limbs of the U-shaped component.

5. A form as claimed in any preceding claim which is adjustable to permit the casting of concrete components of various sizes.

6. A form as claimed in any preceding claim which is mounted on wheels.

7. A form as claimed in any preceding claim comprising jacking means operable to raise or lower the form relative to the support surface.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B28B7/22

According to: international Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B28B E04G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>DATABASE WPI Week 8345 Derwent Publications Ltd., London, GB; AN 83-812479 &amp; NL,A,8 201 173 (H. A. VAN STRIEN), 17 October 1983 see abstract</td>
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<td>A</td>
<td>US,A,3 790 321 (R. E. BUNGER) 5 February 1974 see the whole document</td>
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Date of the actual completion of the international search: 11 April 1996

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### INTERNATIONAL SEARCH REPORT

**International Application No.**

PCT/GB 96/00141

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