(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 013 998**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **80100417.7**

(22) Date of filing: **28.01.80**

(51) Int. Cl.³: **E 04 B 1/84**, E 04 B 5/19

(30) Priority: **30.01.79 IT 1971679**

(43) Date of publication of application: **06.08.80**
Bulletin 80/16

(84) Designated Contracting States: **BE CH DE FR NL SE**

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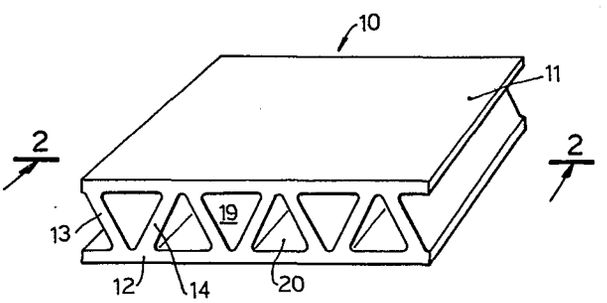
(54) Lost shuttering for making walls or floors for conventional building or factory or yard prefabricated building and process therefor.

(57) The invention provides a shuttering or formwork (10) for conventional or prefabricated building, of the "lost shuttering" or "permanent formwork" type and a process for providing walls with said shuttering. The shuttering has two parallel flat parts (11, 12) and parallel longitudinal internal slots or hollows (19, 20) for receiving the concrete; in cross-section the slots or hollows are of substantially regular triangle shape, the adjacent slots or hollows being of opposing arrangement. For use as floors, the shutterings may have some slots or hollows with longitudinal passages (22) through a flat part to form ribs or joists of concrete. The process contemplates the disposition of reinforcements in the slots or hollows, in the case connecting adjacent slots or hollows with transverse cross stiffening brackets, in case arranging through pins or needles to retain a plaster lath and casting concrete into the slots or hollows.



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LOST SHUTTERING FOR MAKING WALLS OR FLOORS FOR CONVENTIONAL BUILDING OR FACTORY OR YARD PREFABRICATED BUILDING AND PROCESS THEREFOR.

This patent application relates to the field of building constructions.

In order that the construction of buildings be more and more expeditious and industrially achievable, building fabrication processes have been developed in the last years as using so-called lost shutterings or permanent formworks. Unlike the case of conventional building, wherein the shutterings or formworks are essentially used for making up a structure shape and are removed/or recovered upon concrete setting, in addition to making up a form or shape for concrete casting such "lost" shutterings or

formworks may also act as insulation and remain incorporated or built-in in the walls.

Types of lost shutterings at present known would comprise shutterings of compressed wood fiber, formed by two spaced apart facing panels interconnected by spacing partitions, also of wood pulp, so as to provide chambers which are more or less extended along the panel and partially intended for concrete reception.

Such existing elements suffer from the disadvantage of relatively high cost of production and weight requiring the use of lifting means for laying out thereof.

Therefore, it is the object of the present invention to provide lost shutterings that can be produced at a moderate or reduced cost, having a good functional strength, being of lightweight and allowing a highest flexibility in use.

The above proposed objects have been accomplished by a shuttering or formwork according to the present invention, which shuttering comprises a panel having internal hollows or slots parallel arranged in longitudinal direction, having opposing substantially equilateral triangular section, such as to define in cross-section a reticular latticework having inclined rods, preferably at 60° to one another and with respect to the upper and lower booms or parts. Preferably, the thickness of such inclined rods and upper and lower booms is the same or identical. Generally, the shuttering is made of polystyrene, polyurethane

or other synthetic material, but could be made of wood fiber or glass fiber and resin as well.

The novel lost shuttering is for use both for walls and floors. According to the novel process of this invention, it is used by casting concrete into one or more triangular cavities or hollows preset with metal reinforcement in a per se well known manner. The shuttering may be fabricated in a single size or in standard sizes and readily cut to the sizes and shapes as desired for making a wall, or providing a window opening or a door opening. It is lightweight, handy, can be produced at comparatively low costs and has a high mechanical strength to the concrete casting effects due to the opposing arrangement of the triangular hollows or slots, and has an excellent heat insulation in connection with the recent provisions of the law. The new shuttering allows a conventional finish of the wall surface with a plaster coating applied on a supporting wire mesh/or lath. It has the evident advantage of not providing any heat bridge.

The novel shuttering has the further advantage of allowing the installation of technological equipments or plants without any masonry work, as it is only needed to cut away part of the polystyrene to allow for the tube passage. The absence of vertical or horizontal joints in the finished construction is a further advantage. It is another advantage that no special fittings are required for installing the panels. Another advantage is the possibility of carrying out the required

operations or works at very high or very low temperatures without any use of antifreezing or curing agents.

The shuttering may be used for carrying into effect various types of buildings, such as cottages, multi-storey buildings and, for example, also for the building of swimming pools.

A more detailed description of the invention will now be given with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a lost shuttering according to the present application;

Fig. 2 is a cross-sectional view according to line 2-2 of Fig. 1 along the shuttering shown, but with the concrete castings and completion plaster; and

Fig. 3 is a sectional view similar to Fig. 2, showing a shuttering with parts removed for allowing the use as a floor panel.

A shuttering or formwork 10 according to the present application is formed of a single piece and essentially comprises a pair of parallel flat parts or walls 11 and 12 which are interconnected by inclined partitions, such as 13 and 14, so as to define a series of slots or channels or hollows 19 and 20, passing substantially parallel to one another along said shuttering and of triangular shape in cross-section, with the slots or hollows 19 and 20 alternatively of opposing shape.

When considering any cross-section of the shuttering, that is

a section perpendicular to the axes of said slots or hollows, the shuttering has the appearance of a reticular beam or lattice girder, as shown in Fig. 2, in which the lower boom is the section of the flat part or portion 12, the upper boom is the section of the flat portion 11, and the diagonals are the partitions 13 and 14 defining said slots or hollows 19 and 20. The latter are of triangular cross-section, preferably but not necessarily of regular triangle shape with rounded corners. The angle α that each partition 13 (or 14) makes with an adjacent partition 14 (or 13) or with the adjacent flat portion is of about 60°. Particularly from the cross-section, it will be seen that the arrangement of the triangular slots or hollows is alternate, that is to say that one slot or hollow is arranged with the triangle apex at the bottom and then a slot or hollow is arranged with the triangle apex at the top (the terms "at the top" and "at the bottom" are to be understood only as indicative with respect to the drawing). This affords an excellent strength of the shuttering during concrete casting and a considerable rigidity in handling for installation with the least use of material.

A preferred material for the manufacture of the shuttering is polystyrene, but the use is also contemplated of polyurethanes or other plastics materials. Additionally, the shuttering could be also made of wood pulp, glass fiber and resin, etc.

For use as wall element, the shuttering is cut to the desired size and shape (in the case with openings for doors or windows),

for example by means of a thermal knife or a simple ripsaw, and then positioned in place by suitable strutting boards or stulls (shores). According to a known technology for construction with lost shutterings, said slots or hollows 19 and 20 have then functional metal reinforcements inserted therein for structural purposes, such reinforcements being made of standardized latticeworks readily available on the market. Such reinforcements are drawn by mere way of unrestrictive indication on the figures of the accompanying drawings and are designated at 30.

Then, to make bearing walls, connection bars or cross stiffening brackets, such as that shown at 32 of Fig. 2, are prearranged between two opposing adjacent slots or hollows. Thus, when considering the pillarings or small pillars, being formed in said slots or hollows 19 and 20 as a result of the next concrete casting, under a vertical load such pillarings of triangular cross-section would tend to deflect in opposite direction, each of the pillarings having the yielding point towards the part of minor section. The cross stiffening brackets 32, as prearranged at one or more locations along the slot or hollow length, will annul the effect of the point load (combined bending and compressive stress) on the pillarings.

Preferably, such connection bars are inserted between the center line of the triangle base of a slot or hollow and the center line of the triangle base of the adjacent slot or hollow. Then, the so-called "pointing" is prearranged, that is to say that metal pins or needles, for example such as those shown at

34 of Fig. 2, are driven into the polystyrene, preferably to project on both faces of the polystyrene; then concrete is cast into preselected spaced apart slots or hollows 19 and/or 20, to provide a structural assembly of reinforced cement mix, horizontal and/or vertical and interconnected, forming a spatial latticework of close mesh (in the order of 45-60 cm) which is particularly suitable for aseismatic constructions. The vertical wall (and/or the soffit of the horizontal floor or panel) is then plastered (with plaster 38) directly on the lost shuttering with the aid or support of a lath or network 36 previously installed and secured by said pins or needles 34. If required, prior to lath installation, the electrical, heating plants and the like are provided. When desiring to provide non load-bearing or curtain walls, the operations for installing the cross stiffening brackets and pointing may be omitted.

Particularly, for use to make floor panels, the shuttering 10 may be cut, for example as the shuttering 10' of Fig. 3, for the introduction with the shuttering at horizontal attitude of the indicative reinforcements 40 and concrete; or shutterings 10' can be made as preformed with such a shape. As it will be seen, a longitudinal portion has been removed to provide a longitudinal passage 22 for the communication between one slot or hollow 20 at the top apex zone thereof and the outside. Thus, by introducing the metal reinforcement and concrete into the slot or hollow 20 and passage 22, a reinforced concrete bead or joist 21 of excellent strength is provided. Also in this case, pointing pins or needles, lath and plaster (not shown) can be arranged. Of course, a plurality of joists of this type can be provided in

the shuttering for use as floor panel. It is clear that by providing the vertical pillarings more or less near one another in a vertical panel, and by providing the horizontal joists 21 more or less near one another in a horizontal panel a larger or lower vertical load bearing capacity in the walls and a greater or less possibility o overloading in the floors is provided.

In order to provide an increased inertia in the floor and accordingly a larger useful overloading (or a larger span) it will suffice (maintaining the use of a standard panel as a base) to overlap strips of various thickness on the panel upper surface not involved by passages 22 to the required level or height.

Particularly, it should be pointed out that the triangular shape of the slots or hollows has considerable advantages for the wall obtained also from the standpoint of insultation; thus, the thermal wave encounters a thickness of polystyrene which is the sum of the flat parts 11 and 12 only at few positions in the wall extension (as shown by dash and dot line at a), whereas over the entire other extension encounters a thickness which is the sum of the thickness of part 11, part 12 and an oblique length along the partition 13 or 14 (as shown by dash and dot line at b).

Various types of walls provided by panels according to the invention have been made and tested.

EXAMPLE 1

A shuttering according to the invention was used as made of foamed polystyrene, density 20-22 kg/cu.m.; height in net span 3 m; thickness 20 cm; width 1 m (net width 0.96 m). The triangular slots or hollows had in cross-section a base of 13 cm and a height of 14 cm. The flat portions and partitions were 3 cm thick. In the shuttering slots or hollows 8 pillarings were casted reinforced with metal frame work or latticework comprising 3 bars ϕ 8 of ribbed steel FE B 44 each, alternatively diagonally connected by bars of FE B 44; at the foot and at the top the connection was provided by reinforced concrete booms, reinforced with 4 carringated bars ϕ 10 and brackets ø 6 at 20 cm. No plaster was applied.

The test under hydraulic press provided a breakage without deflection or deformation on both sides at 200 tons.

EXAMPLE 2

By means of two-slot shutterings, two pairs of two pillarings each were made, each of the pillarings being reinforced as in Example 1. The two pillarings were connected by cross stiffening brackets or connection bars as in Example 1. For each pair of pillarings, breakage occurred under hydraulic press at 50 tons without deflection or deformation at any side.

EXAMPLE 3

A loading test on simple bearing floor with a net span of 5 m between the bearings was effected.

A shuttering 1 m wide (useful width 0.96 m) was used. The floor panel was obtained with two ribs or joists, with 2 ø 10 of FE B 44 for each rib. It was restrained on the heads with two booms reinforced with four rods or irons. Useful height of the floor: 22 cm. A uniformly distributed load of 800 kg/sq.m. was applied. Upon load release, no stable deformation was observed.

Of course, changes and modifications can be made to the foregoing without departing from the field intended to be covered by the present application.

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C L A I M S

1. A shuttering (form work) for use as lost shuttering for building, having between two substantially flat parts internal slots or hollows parallelly extending to one another throughout the shuttering length, characterized in that said slots or hollows (19, 20) are of triangular shape in cross-section, the adjacent slots or hollows being of opposing arrangement.

2. A shuttering according to Claim 1, wherein said cross-sections are in the form of substantially equilateral triangle and the shape is such as to define in a section perpendicular to the slot or hollow extension a reticular latticework, in which the partitions (13, 14) between said slots or hollows are at about 60° to one another and with respect to the flat parts (11, 12).

3. A shuttering according to Claims 1 and 2, wherein the thickness of the partitions dividing said slots or hollows from one another and the thickness of the flat parts defining the major faces of the shuttering is substantially identical.

4. A shuttering according to Claim 1, characterized by having at least one removed portion (22) along one said longitudinal slot or hollow for longitudinal access to said slot or hollow.

5. A shuttering according to any of the preceding claims, made of a material selected among the group comprising: polystyrene, polyurethane, wood fiber, glass fiber and resin.

6. A process for providing walls with the use of shutterings according to Claim 1, characterized by comprising the operations of: positioning the shuttering(s); inserting metal reinforcements in the shuttering slots or hollows; and casting concrete into the slots or hollows prearranged with the reinforcements.

7. A process according to Claim 6 for providing vertical load-bearing walls, comprising the operation of prearranging diagonal connection bars between two subsequent slots or hollows prior to concrete casting.

8. A process according to Claim 7, wherein said diagonal connection bars are inserted between the center line (in cross-section) of the triangle base, which is the section of a slot

or hollow, and the center line of the triangle base which is the section of the adjacent slot or hollow.

9. A process according to Claim 6, comprising the operations or steps of: prearranging a pointing of pins or needles passing in the shuttening material at the slots or hollows which will be filled with concrete; applying a lath on the shuttering, hook bending over the needles or points of the pointing; and applying a plaster.

10. A process according to Claim 6, for providing floors and comprising the preliminary operation or step of forming longitudinal passages between at least one slot or hollow and the outside.

11. A process according to Claim 10, comprising the operation or step of overlapping strips or additional panels on the shuttering surface not involved by the passages to provide larger heights of the floor.

12. A process according to Claim 6, further comprising the step of providing technological plants subsequently to said concrete casting step.

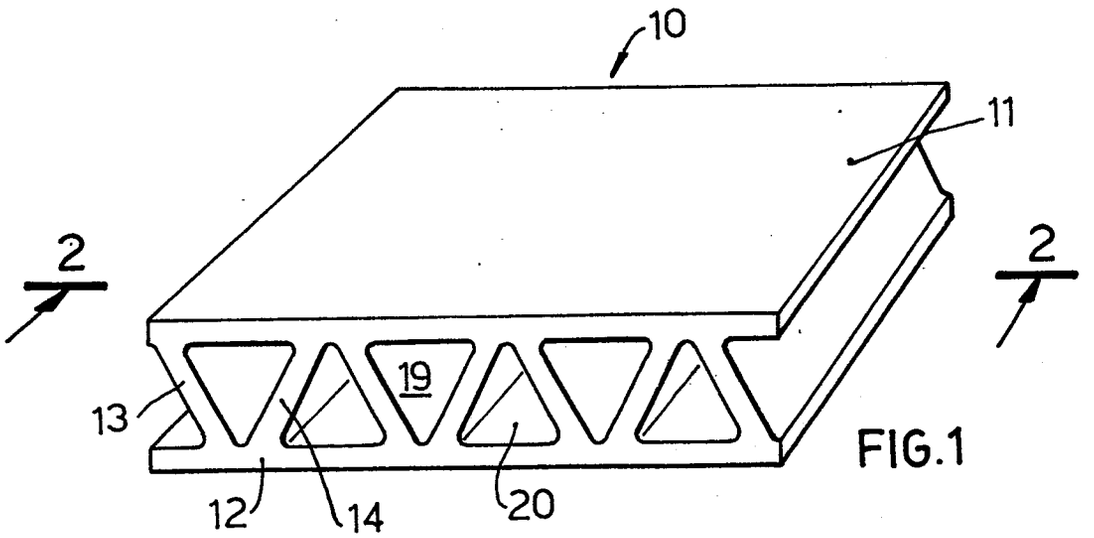
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FIG.1

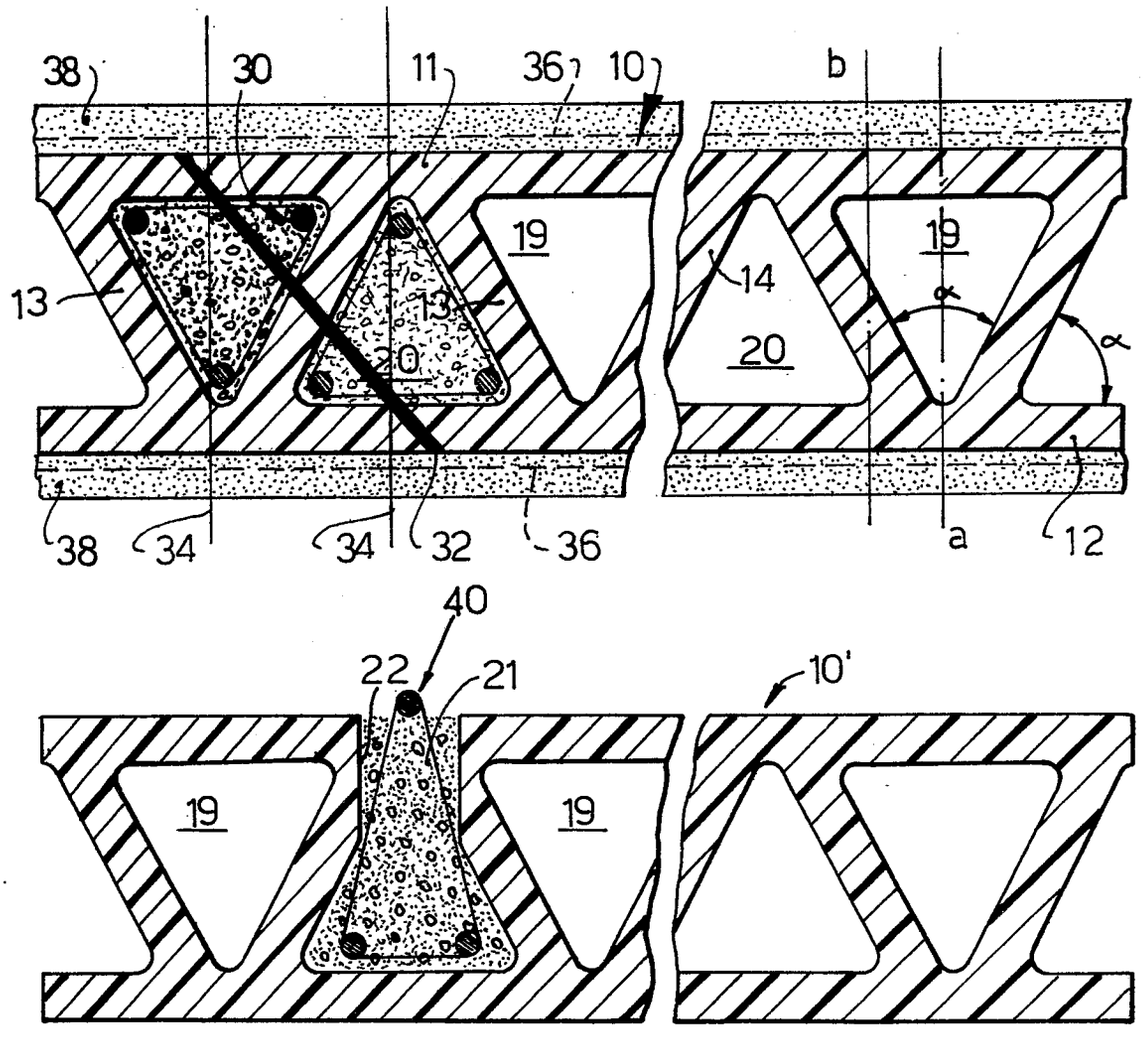
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FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application number
0013998
EP 80 10 0417

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	FR - A - 906 470 (COLOZIER) * Page 1, lines 18-35; figures 1,3-6 *	1-3,5
X	FR - A - 2 318 286 (ANIC) * Page 2, line 40; page 3, lines 1-16; figures 1-4 *	1-5
	FR - A - 1 203 929 (COLOMBEL) * Page 1, column 1, lines 35-40; column 2, lines 1-13; figures 15-18 *	1
	FR - A - 2 335 665 (DECROUX) * Page 2, lines 20-40; page 3, lines 1-9; figures 1-3 *	1,5
	BE - A - 392 402 (TIGNOL) * Page 2, lines 4-26; figures 1, 2 *	4

CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)

E 04 B 1/84
5/19

TECHNICAL FIELDS SEARCHED (Int.Cl. ³)

E 04 B

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12-05-1980	SCHOLS

EPO Form 1503.1 06.78