May 12, 1970 E. RATYCH 3,510,997

BUILDING SYSTEM OF PREFORMED UNITS

Filed Aug. 26, 1968 3 Sheets-Sheet 1

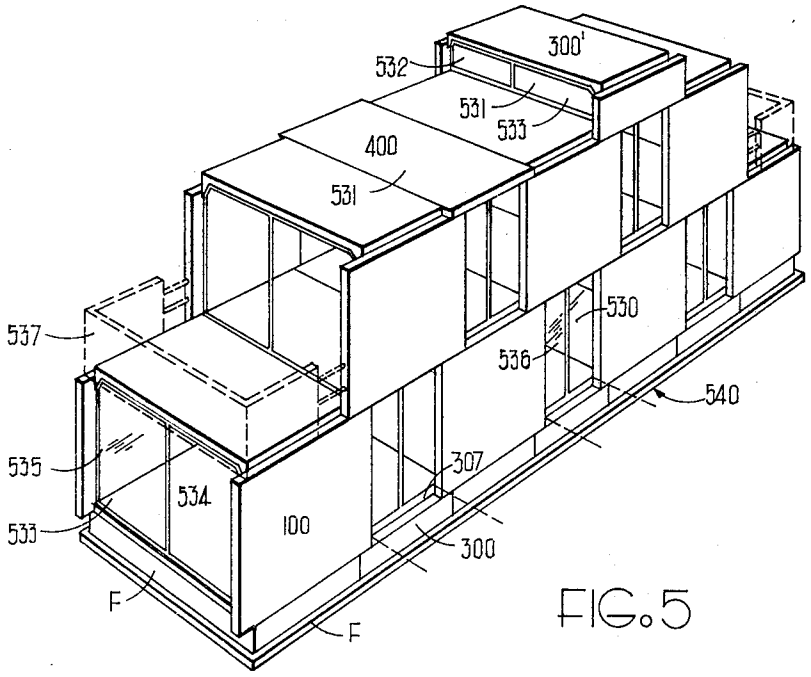


FIG. 5

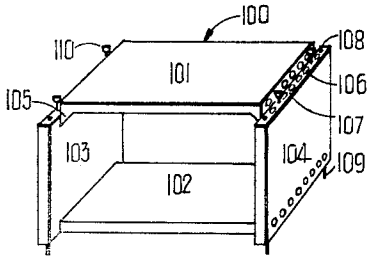


FIG. 1

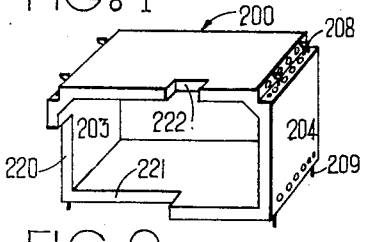


FIG. 2

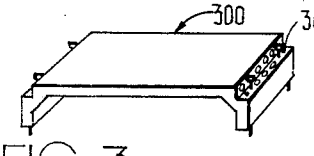


FIG. 3

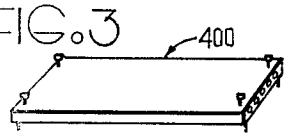


FIG. 4

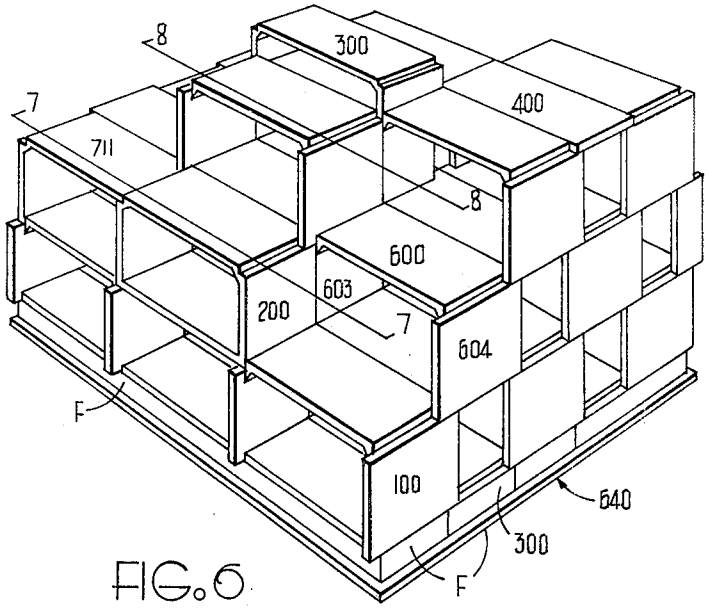


FIG. 6

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BUILDING SYSTEM OF PREFORMED UNITS

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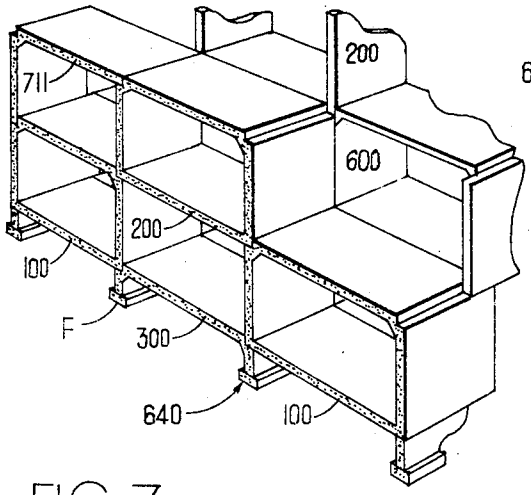


FIG. 7

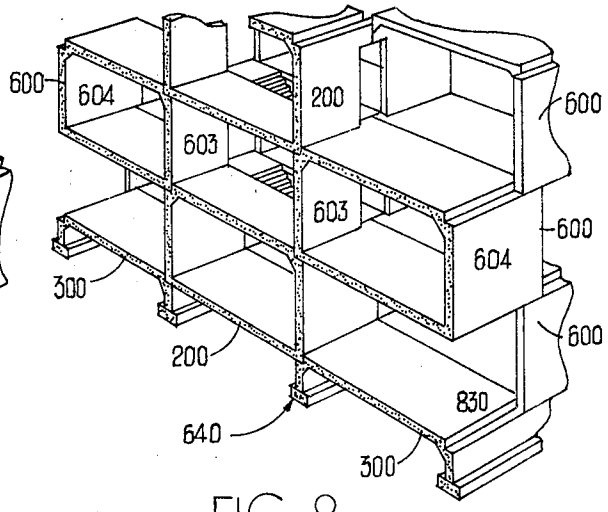


FIG. 8

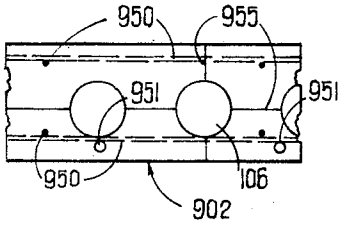


FIG. 9

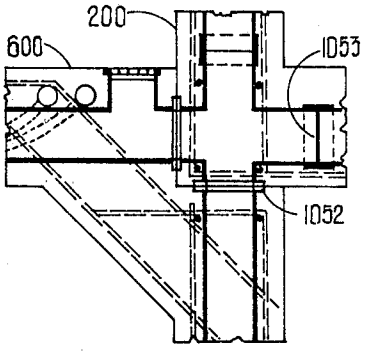


FIG. 10

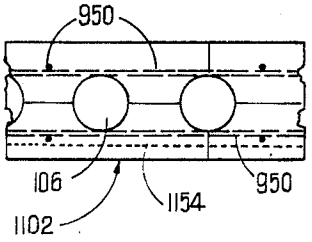


FIG. 11

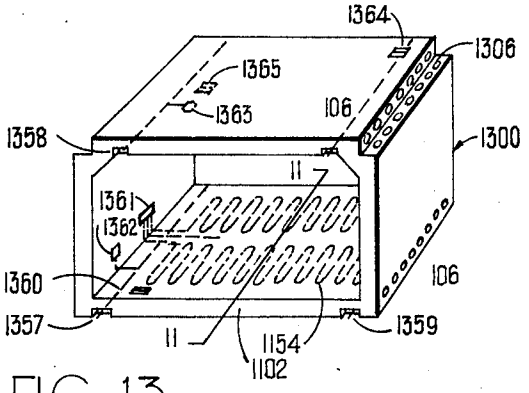


FIG. 13

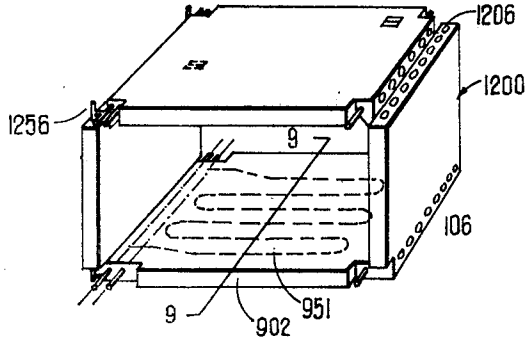


FIG. 12

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BUILDING SYSTEM OF PREFORMED UNITS

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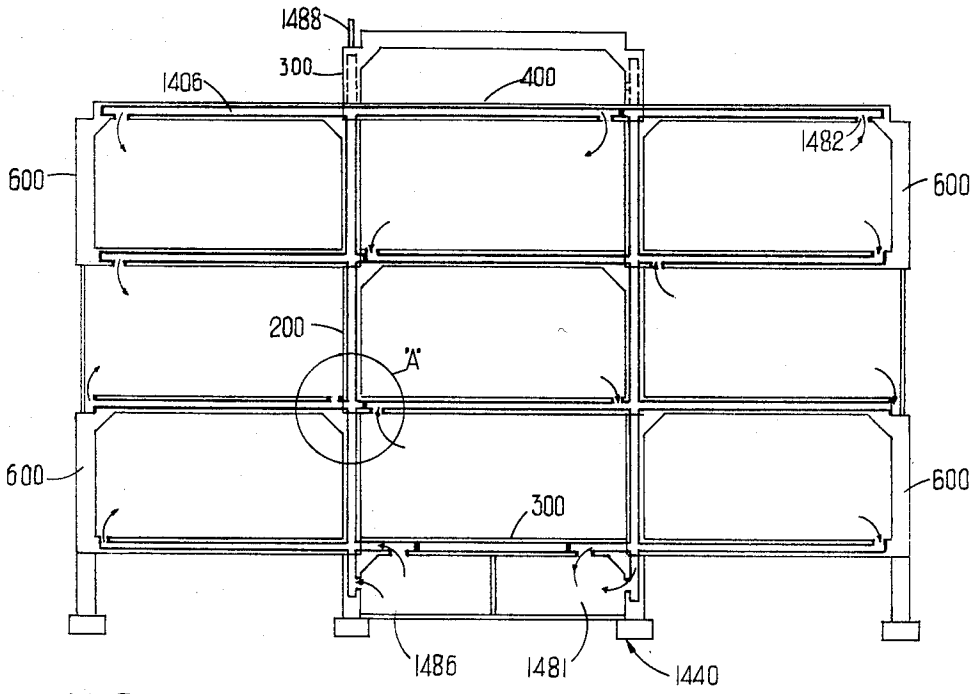


FIG. 14

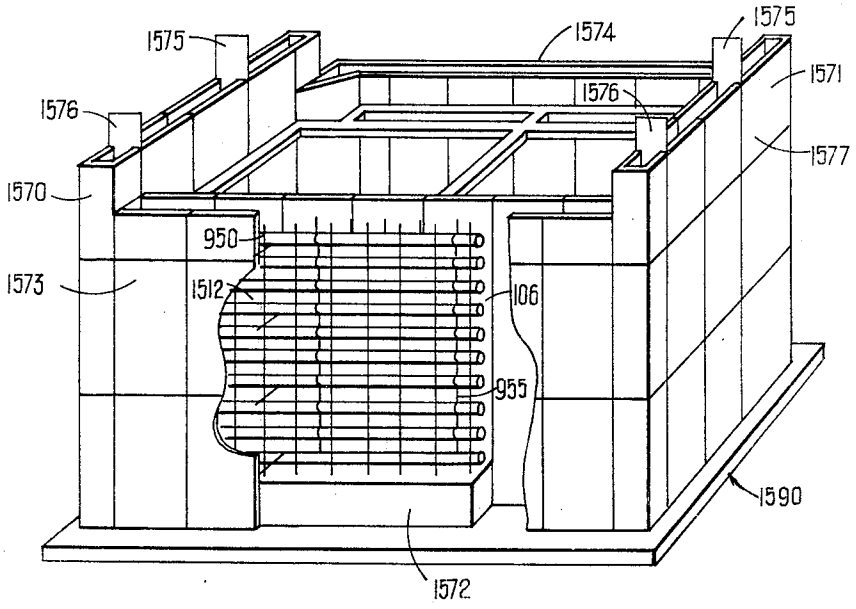


FIG. 15

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BUILDING SYSTEM OF PREFORMED UNITS

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Int. Cl. E04h 1/04, 9/06
U.S. Cl. 52—79 6 Claims

ABSTRACT OF THE DISCLOSURE

Precast, cored concrete building elements of room-size which are dimensioned, and pre-wired and ducted for convenient spaced assembly one to another to form buildings of any desired exterior dimensions, substantially ready, after glazing, for occupancy.

This invention relates generally to building construction, and more particularly to assembly of buildings from room-size or larger pre-cast concrete enclosures of modular construction.

An object of this invention is to provide a system of massive interlocking pre-cast concrete structures which bear matched integral provisions for utilities such as heating ducting, and wiring, so that a plurality of the structures can be assembled to form a single or a multi-story building substantially ready for occupancy following the addition of doors and windows.

Another object of the invention is to provide structures of the type described which are cored for lightness, reinforced for strength, and provided with hoisting eyes, so that they may be readily assembled using commonly available pneumatic-tire cranes.

Still another object of this invention is to provide structures of the type described which may be of height, width and length permitting over-the-highway transportation, without unduly restricting the internal dimensions of the individual structures or the final assembly for human occupancy.

Yet another object of this invention is to provide a building system of the type described in which the individual structures of the system are primarily cellular in style, few in type, simple in design, and adapted for construction using vertical-wall casting.

A further object of this invention is to provide a building system in which the various structures comprising the entire system can be cast using one mold, by selectively isolating parts of the mold before casting.

And a further object of this invention is to provide a building system of the type described in which the individual structures may be assembled in staggered longitudinal, lateral, and vertical array to provide roof and wall apertures, but having continuous flat flooring throughout where desired.

Essence of the invention lies therefore in the provision of pre-cast, lightweight, reinforced concrete units integrally equipped with utilities and specially adapted for spaced, matched assembly on a prepared foundation to comprise a building having unique advantages and substantially ready for occupancy.

These and other objects and advantages of the invention will become more readily apparent from a study of the specification and the drawings in which:

FIG. 1 is a perspective view of a structure made according to this invention, using the full mold provided, for casting:

FIGS. 2, 3 and 4 are perspective views of other structures made using portions of the mold provided;

FIGS. 5, 6, 7 and 8 are perspective views of structures assembled according to this invention, FIGS. 7 and 8 being sections;

FIG. 9 is a typical section through the floor of the structure shown in FIG. 12 viewed in direction of the arrows 9—9;

FIG. 10 is a detail of an interlock between assembled units as indicated at "A" in FIG. 14;

FIG. 11 is a section through the floor of the structure in FIG. 13, viewed in the direction of the arrows 11—11;

FIG. 12 is a perspective view of a structural unit made according to this invention;

FIG. 13 is a perspective view of yet another structural unit;

FIG. 14 is an elevation in section of units assembled according to this invention; and

FIG. 15 is a perspective view of a mold.

Turning now to the drawings in detail, FIG. 1 shows a unitary precast concrete structure, called an extended-side unit, and indicated generally by numeral 100.

The unit consists of integrally affixed substantially flat panels forming a rectangular tube including a roof **101**, floor **102**, and left and right sides **103** and **104** respectively which extend longitudinally beyond the other parts of the structure.

The roof is joined to the sides through integral, coextensive diagonals **105**, which buttress the junctions and make feasible the mode of assembly which will be disclosed. Tubular passages **106** penetrate all panels from end-to-end. As will be seen later, these passages may be stopped short, as required for particular reasons.

Provision for assembly of unit **100** to other structural units includes the extended side panels, notches **107** extending along the roof panel ends, dowel holes **108**, dowels **109**, and hoisting eyes **110**.

Unit **100** is made as a poured reinforced concrete casting in the mold of FIG. 15, which will be described later.

FIGS. 2, 3 and 4 are perspective views of other structures made by casting concrete in selected parts of the mold of FIG. 15, by blocking off or omitting parts of the mold.

Flush-side unit **200** of FIG. 2 is generally similar to unit **100** except for horizontal shortening of the sides **203** and **204** respectively, so that they are flush with the roof and floor. Wall, floor and roof cut-outs **220**, **221** and **222** may be included, as required, for doors, windows, stairs, elevators, and utility connections, as will be seen in FIG. 12. Dowel holes **208** and dowels **209** are relocated as may be required by the structural changes.

FIG. 3 shows base-unit **300** which, on assembly of plural units to make a building, rests directly on a conventional foundation and supports units assembled above it, interlocking to them through notches **307**. This will be discussed in more detail later. Base unit **300** is identical to the upper part of flush-unit **200**, except for any special cutouts found necessary.

FIG. 4 shows flat panel **400** which can serve several purposes on assembly of plural units to comprise a building. This also will be discussed in more detail later. Flat panel **400** is cast in the same mold, and is identical to the lower part of flush unit **200** except for necessary cutouts, and variations in size. Panel **400** can be made longer or shorter as required, by adjusting the pour.

FIGS. 5, 6, 7 and 8 are perspective views of the units of FIGS. 1–4, in building assemblies.

Dimensions of a typical unit are from 8 to 10 feet high, 4 to 12 feet wide, and 16 to 32 feet long, with typical weights being from 6 tons to 35 tons, depending on configuration. It can be seen that the units are easily transported to the job site on a flat-bed semi-trailer, and that assembly is readily accomplished using a pneumatic-tire crane.

FIG. 5 shows seven of the extended-side units **100** assembled in spaced longitudinal relation and in vertical

relation, to comprise a relatively long, narrow building, 540, with flush floors on each level. The building rests on a conventional foundation F. Between the building and the foundation are interposed several units **300**, which provide continuity on the ground floor, and an insulative and crawl space below. Notches **307** serve to interlock the base unit with those above, and serve also as stepped sills for doors, windows, or panels like panel **400** when mounted in the side openings **530** between the units.

The extended side panls of units **100** overlap the spaced base units **300** and support the units **100** at the ground floor level. In like manner, on the second floor the extended side panels of units **100** supportively bridge side openings **530**. Roof apertures **531** between the spaced structures can be closed by fitting panels **400**, or base units **300** used as skydomes. Seams between the units can be calked, or a watertight membrane and insulation covering the entire roof can be installed, using established methods.

Alternatively, the roof apertures **531** can be closed using modified base units **300** with extended side panels, the resultant fore-and-aft openings **532** being glazed as at **533** or otherwise suitably closed. End openings **534** in the units **100** may be closed by glazing **535**, and glazing **536** may be used to close the side openings **530**. Roof overhangs are easily arranged, if desired, by recessing the end closure.

Although only two levels are indicated in FIG. 5, additional stories may be easily and quickly erected as the need for more space becomes apparent. The building may be elongated to any extent necessary as, for example, to serve as an access wing for an air terminal. It is obvious that the structure is easily adaptable for underground installation.

Interior finish may be of any desired type. Insulated wall and ceiling panels such as rigid polyurethane cemented in place and faced with plastic, or wood veneer, will be found especially suitable.

Balcony enclosures **537** are identical with the lower part of the FIG. 2 structure, being cast from the same part of the mold used for that structure, as will be seen.

Vertical access between levels, within the structure, is provided by floor and roof cutouts for stairways or other devices, as indicated in FIG. 2 at **220**, **221** and **222**.

Architectural and habitational advantages of the unique monocoque structure shown in FIG. 5 are readily apparent, including opportunity for flexibility of treatment.

FIG. 6 shows at **640** a variation on the building of FIG. 5 in that it is also laterally extended. Lateral access on each level is provided by cutouts, as shown in FIG. 2. Door, window, and roof treatment is similar to that indicated in reference to FIG. 5.

In order to construct a laterally extended building, as in FIG. 6, an additional variation of the basic unit is required. This new embodiment is shown at **600**. It comprises a unit like **100** of FIG. 1 on the exterior side, in that side **604** is extended, and like unit **200** of FIG. 2 on the interior side, in that side **603** is flush. It will be noted that all interfitted interior sides above the ground floor are of flush design.

FIGS. 7 and 8 are sections taken along **7—7** and **8—8** respectively in FIG. 6 and illustrate the method of assembly employed.

It can be seen in FIG. 7 that on the ground floor base unit **300** is placed first, on foundations F which are prepared in accordance with conventional building practice. Next, units **100** are placed with one side of each resting in a notch of unit **300**, and the other side of each resting on a conventional foundation. Following this, unit **200** is placed in the notches of the units **100**, and the wall of unit **711** is engaged with the notch of a unit **100**, with the roof of unit **711** engaging the notch of unit **200**. Unit **711** is substantially identical with a portion of unit **100**, comprising one wall and the roof, and is fashioned by blocking off appropriate parts of the mold when casting.

In like manner, the balance of the building is assembled. FIG. 8 shows that assembly of the next row is started with two laterally spaced units **300** placed on prepared foundations, followed by one unit **200** placed between them, resting in the notches. The succeeding tier or story is begin by resting the inner sides **603** of units **600** in the notches of the centrally placed unit **200**, with the outer sides **604** extending across the openings **830** between units below. Third story assembly is like that described above for the second story illustrated in FIG. 7.

FIG. 9 is a section as at **9—9**, FIG. 12 of a typical panel **902** of a unit made according to this invention. Tubular passages **106**, which may be of any convenient cross-section and spacing, extend through the panel from edge-to-edge. These passages are formed by casting the concrete of the unit around hollow cores (**1512**, FIG. 15) of metal, cardboard, or other suitable material.

Reinforcing rods **950** of appropriate weight are cast in the panels, spaced and oriented as required by engineering considerations for the particular application, according to methods well-known in the art.

Hot water sinus coils **951** for radiant heating may be encased in the panel adjacent the reinforcing rods **950** on one or both sides, when the panel is cast. For interior panels, such coils are preferably installed on the side of the panel opposite that into which the vertical pour is made, and concrete is then urged around the coils by vibrating the mold on the off-side, to protect the coils.

Retainer wires **955** may be used to tie the cores, forming a mat of tubular passages **106** which can be secured to the mold during pouring.

FIG. 10 illustrates the relation of the reinforcing rods, heating coils, and tubular passages at the intersection of two units **200** and **600**. A resilient inset **1052** of rubber, cork or the like may be inset in the unit to seal the passages together.

Plugs **1053** of metal or other suitable material may be used to block off passages.

FIG. 11 is a section taken at **11—11**, FIG. 13, showing the treatment of electric heating mats **1154** in a panel **1102**. These may be cast into the units in similar manner to that described for the radiant heating coils in reference to FIG. 9.

FIGS. 12 and 13 are perspective views of units **1200** and **1300**. These are basically units **200**, FIG. 2, respectively adapted, as in FIGS. 9 and 11, for radiant heating sinus coils **951** and for electric heating mats **1154**. Conduits of other types may be integrally installed in similar manner to those shown, bearing the same relation to tubular passages **1206** and **1306**. The passages may be provided in number and arrangement to suit the application.

Interconnections **1256** and **1357** for the coils and mats in the two systems are shown in FIGS. 12 and 13 respectively. FIG. 13 also shows typical overhead junction boxes **1358**, floor boxes **1359**, supply lines **1360**, thermal control units **1361**, wall outlets **1362**, ceiling outlets **1363**, floor registers **1364** and ceiling registers **1365**.

FIG. 14, a sectioned elevation of a building **1440**, assembled according to this invention, shows a few of the possible routings of fluid passages within the walls. For example, chilled air from duct **1486** can be passed laterally and upwardly, as required, to reach any exhaust point on any floor by appropriately routing the interconnections between units **600** and **200**. In like manner, the return air can be routed as desired, in order to reach, for example, duct **1481**, ,vents **1482** in tubular passages **1406**, or vent extensions **1488**.

FIG. 15 illustrates a vertical pour mold which may be used to form all the various units. The mold is bolted

together or otherwise assembled so that parts are independently removable, to form a unitary whole, as at **1590.**

The mold may be of metal such as steel, with hollow blocks of steel construction, bolted in place as required for blocking various parts of the mold.

The full heights of the higher walled sections **1570** and **1571** in conjunction with two blocks **1572** for recessing the shorter walled sections **1573** and **1574** at the bottom, are used to form unit **100.** Unit **200** is formed by removing the upper portion **1577** of the mold and pouring to a uniform, limited height. A short pour may be used to produce a short-length unit, allowing openings for doors, stairs, etc. when assembled.

Slides **1575** are used to isolate the far portion of the mold for casting section **300.** In like manner slides **1576** are used to isolate wall **1573** to enable casting of flat panel **400,** and walls **1570, 1571** and **1573** to adapt the mold for casting balcony enclosure unit **537.**

Use of various combinations of slides and blocks as described permits casting the other units depicted in the above disclosure.

What is claimed is:

1. In a building system including plural pre-formed units adapted for interconnected assembly in habitable cellular array, a said unit comprising a vertical side panel and a horizontal roof panel integrally joined thereto with the side panel having longitudinal extension beyond the roof panel, the junction of all said panels having a notch exteriorly coextensive with said junction, said notch having vertical and horizontal faces, and a buttress interiorly arranged at said junction, said buttress being substantially coextensive with the notch and having a surface disposed diagonally to a face of the notch.

2. In a building system as recited in claim **1,** the said unit having a second side panel and a second notch, and a floor panel integrally joined between the respective said

side panels, thereupon forming a rectangular tubular unit.

3. In a building system as recited in claim **2,** all said side panels having longitudinal extension beyond said roof panel.

4. In a building system as recited in claim **2,** a second said unit in spaced tubular alignment therewith, and a third said unit superimposed over said spacing with the said side panel extension engaging respectively notches of the first said and second said units.

5. In a building system as recited in claim **2,** the floor of the third said unit being in contiguous flush alignment with the respective roofs of the first and second said units.

6. In a building system as recited in claim **5,** a fourth said unit having a notch in laterally spaced alignment with the first said spacing, and a side of said super-imposed third unit coextensively engaging the said notch of the fourth unit.

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JOHN E. MURTAGH, Primary Examiner

U.S. Cl. X.R.

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