Sept. 22, 1964 M. WHEELER-NICHOLSON 3,149,437

BUILDING CONSTRUCTION

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FIG. 1

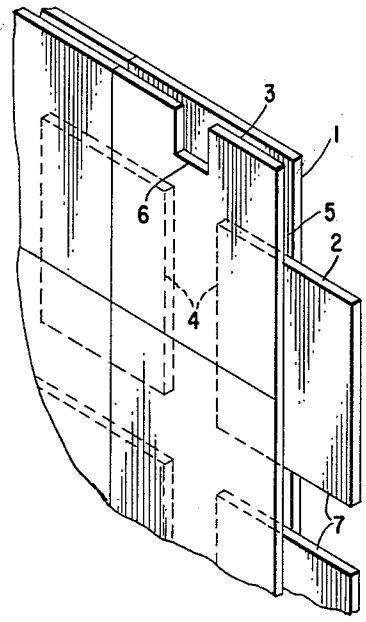

FIG. 2

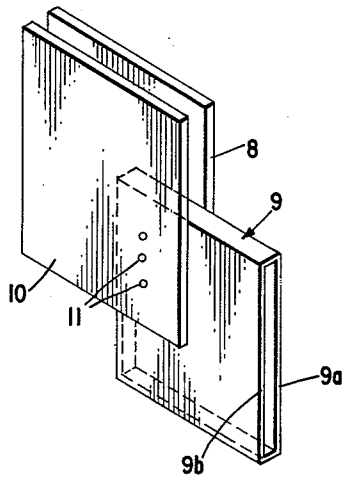

FIG. 3

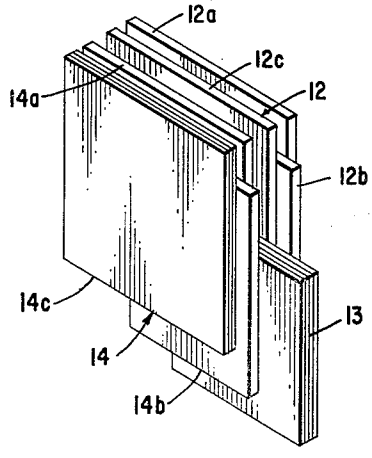

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FIG. 4

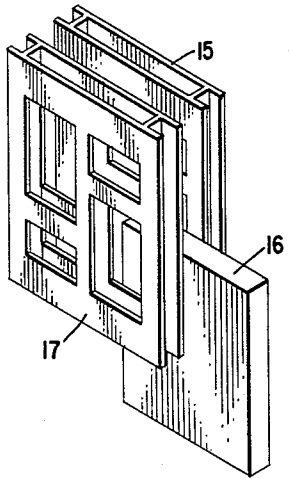

FIG. 5

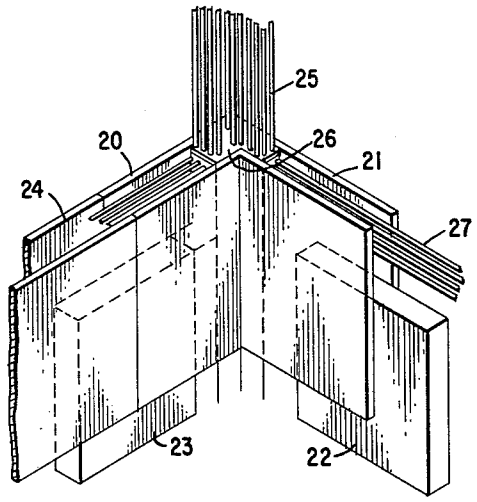

FIG. 6

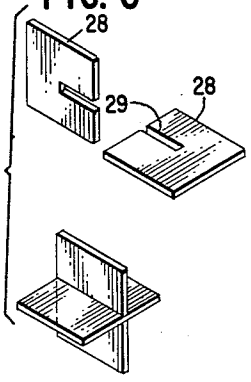

FIG. 7

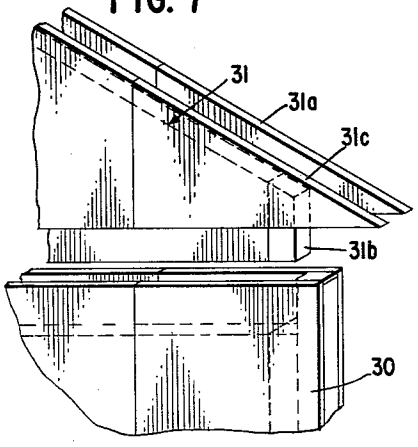

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FIG. 8

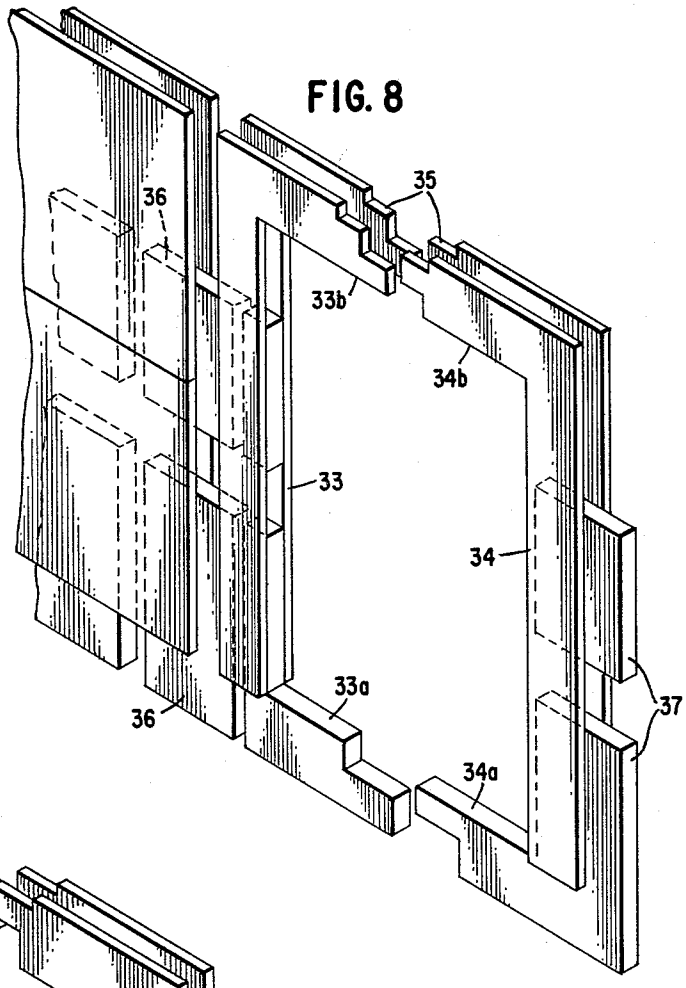

FIG. 9

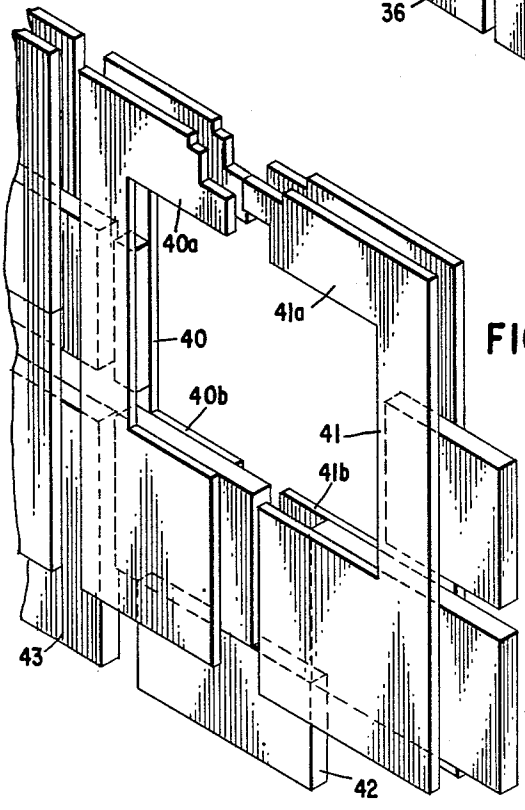

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FIG. 12

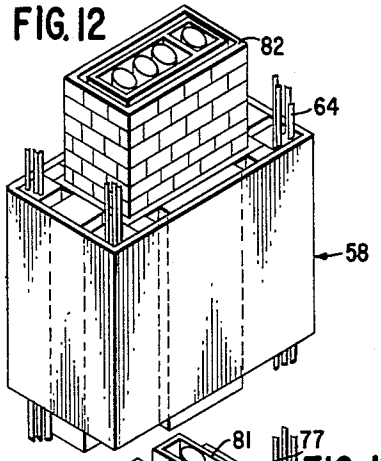


FIG. 13

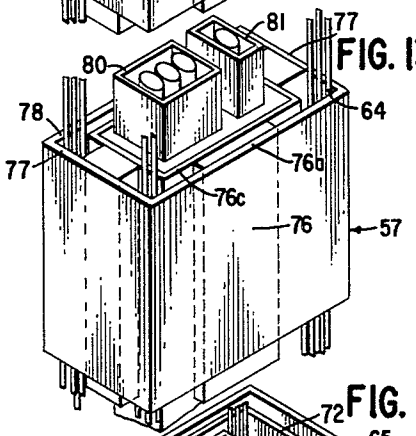


FIG. 14

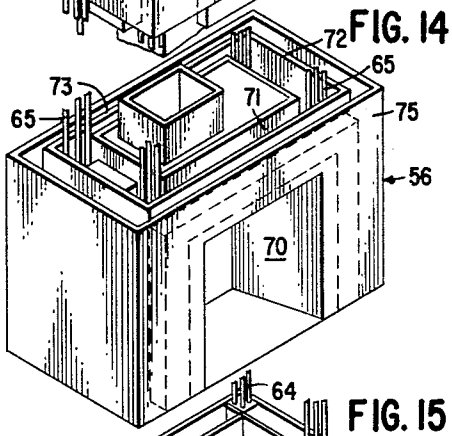


FIG. 15

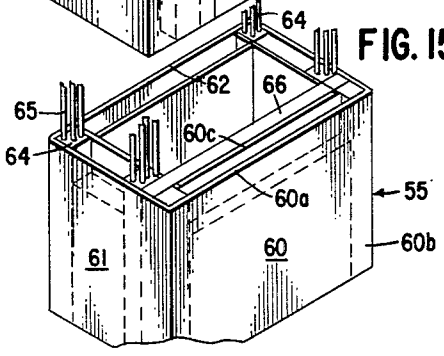


FIG. 10

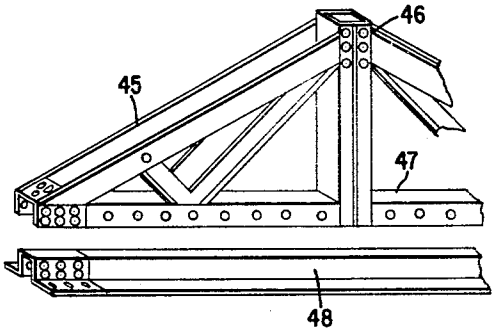
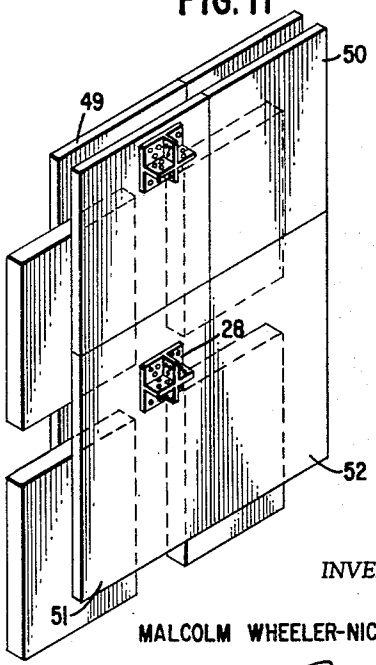


FIG. 11



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BUILDING CONSTRUCTION

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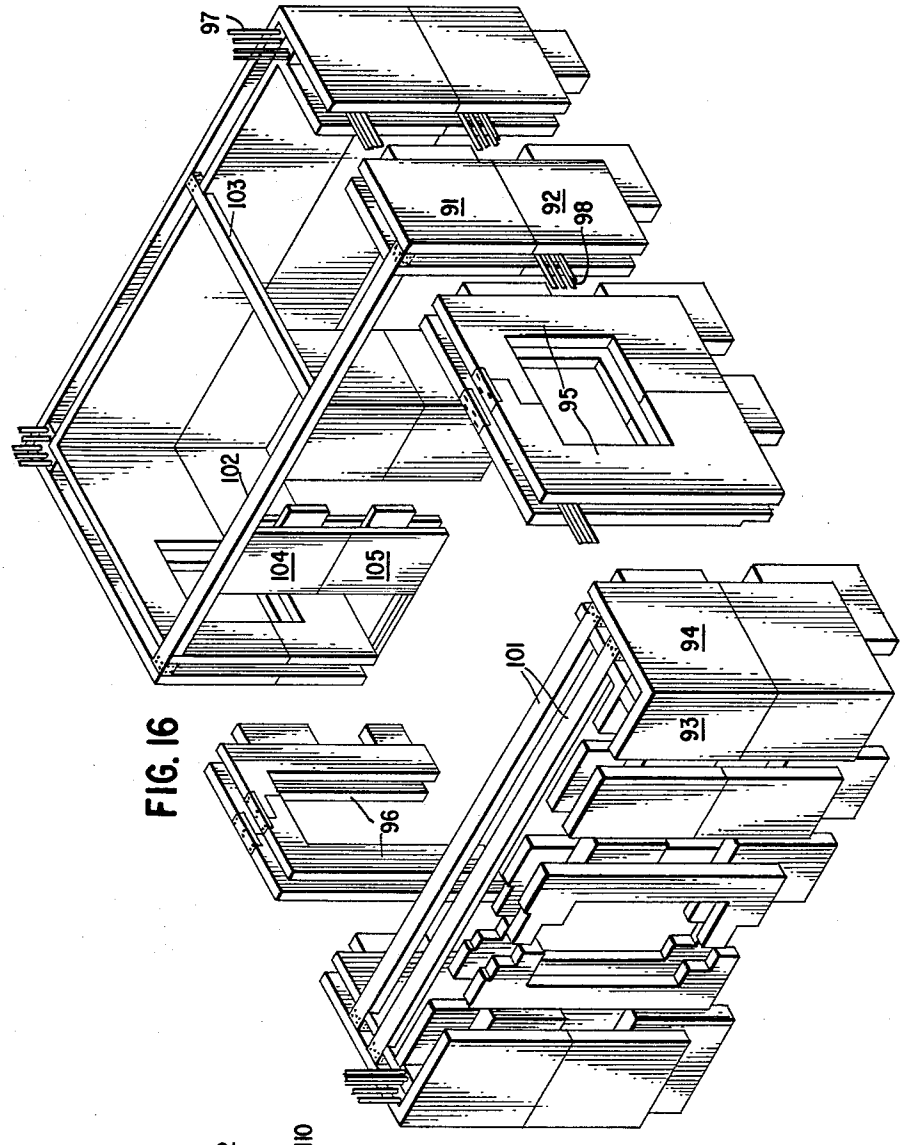

FIG. 16

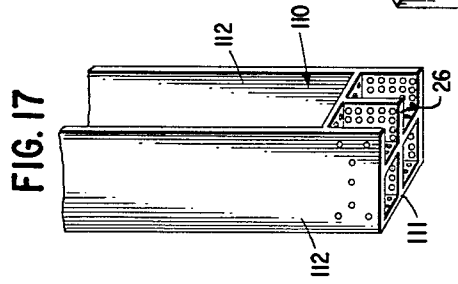

FIG. 17

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United States Patent Office 3,149,437 Patented Sept. 22, 1964

3,149,437

BUILDING CONSTRUCTION

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(46 Chester St., Northport, N.Y.)

Filed Sept. 16, 1958, Ser. No. 761,412
6 Claims. (Cl. 50—373)

The present invention relates to building construction, this application being a continuation-in-part of my application, Serial No. 113,725 filed September 2, 1949, now Patent No. 2,851,873. The invention is directed particularly to putting well-built and long-lasting housing within the means of lower and medium income families, but is also applicable to industrial, agricultural and other structures.

During the past ten years the cost of building homes has more than doubled and has reached the point where families in the lower and middle income brackets cannot afford to build and own a house. The New York State Housing Commissioner has reported that in New York State alone more than 2 million people are living in unsafe or substandard housing that should be torn down or rehabilitated. Mass produced houses including prefabricated structures have failed to meet this need despite certain economies effected by them. In some areas public housing has been provided for low income families but middle income families have been left in a bad squeeze since they are not eligible for public housing and cannot afford new private rental housing or home ownership.

The high cost of housing stems largely from the fact that the building industry continues to use obsolete methods and materials and has failed to make any appreciable use of the mass production methods of other industries. The construction of a house consists of the most part of the cutting and assembly by skilled craftsmen of small pieces or components on the building site. The building industry is the last stronghold of pre-industrial craft production.

Because of the extremely high cost of well constructed houses there has been a trend toward using cheaper materials. A recent survey has shown that one family frame houses outnumber solid masonry houses 5 to 1. In many instances the houses are of such flimsy and shoddy construction that they have an extremely short life and require continual maintenance and repair. Poor thermal insulation results in the houses being uncomfortable in hot weather and expensive to heat in cold. Frame houses often constitute a serious fire hazard and are also subject to attack by termites and by wet and dry wood rot.

An effort has been made to reduce the cost of homes by the use of prefabricated housing construction. While prefabrication of housing as practiced today results in some savings, the usual prefabricated house still requires masonry, considerable carpentry in cutting, assembling wood components and skilled labor in plastering, painting and other finishing operations. The extensive use of wood in such houses, particularly for joists and floors, presents a serious fire hazard. Moreover, the construction leaves the house nonresistant to soil subsidence, earthquake tremors, cyclone and hurricane damage and vermin attacks.

Both frame and masonry housing is monolithic in the sense that it depends on the walls to carry the weight of the floors and roof as in prehistoric structures of ancient Egypt. This monolithic structure is inherently expensive and is also a factor in limiting the use of new materials. While plastics and other new materials have come into use for trim and for interior wall and floor coverings they have made little contribution to exterior use despite the valuable qualities that many of them have. The limited use of such new materials is attributable in part to building conservatism and in part to the fact that many

of the materials that are otherwise desirable lack the weight-bearing capability necessary in a monolithic structure.

Non-monolithic construction has come into wide use for skyscrapers and other industrial and commercial buildings. Such buildings have a skelton or framework of structural steel which carries the weight of walls, floors, ceilings and roofs. However, this type of construction has not been found applicatble to the building of homes because the high cost of structural steel and the high wages paid to steel workers makes this type of construction too expensive.

It is an object of the present invention to provide an improved building construction that materially reduces building costs while at the same time utilizing new materials in an efficacious manner to achieve low maintenance, long life, good thermal insulation and high resistance to fire, vermin and weather. The construction in accordance with the present invention represents a radical departure from conventional home construction in that it utilizes the non-monolithic principles of skyscraper construction while avoiding the high costs of such construction. In accordance with the invention a house, multiple dwelling or other building is constructed of modules which fit together with adjacent modules to form channels or ducts which provide molds or forms in which to cast concrete, columns and beams constituting the skeleton or framework of the completed building. The concrete is preferably reinforced with wires, rods or cables to provide a still stronger construction. The channels or ducts formed by the modules also provide convenient passageways for installing heating, plumbing and wiring for the building. The modules are of such size and weight that they can be readily handled and installed by one or two men without the use of hoists, cranes or other heavy equipment.

One drawback of prefabricated housing has been that the designs available in such housing have been quite limited. Each manufacturer ordinarily stocks or supplys a relatively small number of styles or types of homes. The prospective home owner must choose between the designs currently available and can exercise no individuality in making alterations to provide changes in floor plan or particular features that he desires.. The module construction in accordance with the invention, on the contrary, provides infinite varitey. A relatively small number of standard modules can be put together in different ways to achieve almost any size, shape and design of house desired. Moreover, the construction in accordance with the present invention lends itself to making alterations after a house has been constructed. Partition walls can be readily inserted, taken out or moved to provide additional rooms, larger rooms or a different room layout. Moreover, provision is made for readily enlarging a house by adding one or more additional rooms to it.

The modules for building a house in accordance with the present invention are manufactured efficiently and economically in factories by mass production methods. The modules are of extremely simple construction. No intricate molds, expensive dies or complicated machinery is required. The modules are for the most part constructed of flat sheet or slab material. The construction in accordance with the invention particularly lends itself to utilizing to full advantage a wide variety of materials presently available and other materials that may be developed from time to time.

The "do-it-yourself" trend that has become prevalent in recent years has made but little inroad in the field of home building since there are relatively few persons who have sufficient experience or skill to build a home by present methods. Some prefabricated homes have been avail-

able for erection by the home owner but these have been limited to houses that are relatively small and of simple construction with little choice of design. The erection of prefabricated homes of even such modest character has been beyond the ability of most prospective home owners. Moreover, most prefabricated construction has heretofore involved the erection annd assembly of relatively large sections which could not be handled by one person but required a sizable crew or cranes or hoisting equipment. The construction in accordance with the present invention overcomes these difficulties and makes it possible for a prospective home owner to build his own home. The modules are of such size and shape that they can be handled by a single person without any special equipment. Moreover, they can be assembled without special tools and with no more skill than that of a child building a house of blocks.

Not only does the present invention enable a home owner to build his own house quickly and economically but it also makes it possible for him to incorporate such special features as a fireplace. Heretofore a fireplace has been an expensive luxury in building a home because of the high labor and material costs it involves. With the construction principles of the present invention, a fireplace can be built into a house at low cost and without the need of skilled labor.

The objects, characteristics and advantages will appear more fully from the following description and claims and from the accompanying drawings in which:

FIG. 1 is a perspective view of a basic module used in constructing a building in accordance with the invention and portions of adjacent modules showing how the modules fit together.

FIG. 2 is a perspective view of another form of module.

FIG. 3 is a perspective view showing a third form of basic module made up of seven superposed elements.

FIG. 4 is a perspective skeletonized view of a basic module having an internal frame.

FIG. 5 is a perspective view showing a corner construction.

FIG. 6 is a perspective view of elements for positioning reinforcing steel in columns and beams and for joining adjacent building sections.

FIG. 7 is a perspective exploded view showing a basic module and a module used in gable construction.

FIG. 8 is a perspective exploded view showing modules framing a door aperture.

FIG. 9 is a perspective exploded view showing modules framing a window aperture.

FIG. 10 is a perspective view of a light truss for supporting the roof of a building.

FIG. 11 is a perspective view showing basic modules provided with means for joining a subsequent addition to a building.

FIGS. 12, 13, 14 and 15 are perspective views illustrating superposed portions of a fireplace and chimney construction.

FIG. 16 is a perspective partially exploded view showing typical modules in accordance with the invention partially assembled for one floor of a house.

FIG. 17 is a fragmentary perspective view showing a form or mold for casting a reinforced concrete beam in permanent position.

In FIG. 1 there is shown a basic module for constructing a building wall in accordance with the invention. The module comprises an outer panel **1**, an intermediate panel **2** and an interior panel **3** assembled in sandwich construction. The respective edges of the outer panel **1** and interior panel **3** are substantially in registry with one another while the intermediate panel **2** is offset laterally and downwardly and is of smaller overall size than the outer and interior panels. When the modules are assembled as illustrated in FIG. 1 a substantial portion of the intermediate panel of each module fits in between the outer and interior panels of a horizontally adjacent module

while other portions fit in between the outer and interior panels of the vertically adjacent module and a diagonally adjacent module. The portion of the intermediate panel of a module that projects into the horizontally adjacent module is at least approximately as great as the portion interposed between the outer and interior panels of the module of which the intermediate panel is a part. Hence the joints between the outer and interior panels of horizontally adjacent modules are located at approximately the center of the intermediate panel in a horizontal direction. Likewise substantial portions of the intermediate panel of each module extend between the outer and interior panels of the vertically adjacent section and a diagonally adjacent section to provide a strong interlock and substantially integral construction as distinguished from a shallow tongue and groove type joint.

For home construction the basic modules preferably are approximately square and half ceiling height so that a one story wall is composed of two tiers of modules. Thus for a house with 8 foot ceilings the modules are preferably 4 feet square. This makes a unit small enough to be handled conveniently by one or two persons without special equipment while at the same time avoiding the extra skill and labor that would be required to assemble and install a large number of small elements or units. When the modules are assembled as illustrated in FIG. 1 a vertically extending space or channel **4** is provided between the vertical edges of the intermediate panels of adjacent modules and between the outer and interior panels of a module. This channel provides a mold or form in which concrete or other casting material is poured to constitute a skeleton or frame of the building. It will be seen that the concrete or other column thus provided is located at approximately the center of a module rather than at its lateral edges. This provides a strong construction and eliminates leakage of concrete that might occur during the pouring operation if the channels were located at the joints between lateral edges of successive modules. The assembled modules also provide a space or channel **5** defined by the outer and interior panels **1** and **3** and the upper edges of the intermediate panels **2**. The channel **5** provides a form or mold for casting a horizontal beam or girder for supporting the roof or an upper floor. The horizontal beam which is cast in the space **5** is preferably poured at the same time as and is hence integral with the vertical columns in the spaces **4** so as to provide a strong integral framework for the building. The upper edge portions of the interior panels **3** are preferably notched as indicated at **6** to receive beams, girders, joists or rafters which rest directly on and are supported by the horizontal beam cast in the space **5**. The size and spacing of the notches **6** are suited to the particular structure they are intended to receive. When concrete beams are to be used to support a ceiling, roof or upper floor structure, they are preferably cast in place as described below so as to be integral with the beam cast in the space **5**. The modules forming the lower portion of a wall are similarly notched as desired to receive the joists or beams of the floor.

To provide a still stronger construction the upper edges of the intermediate panels of the modules in a lower tier of a wall are spaced from the lower edges of the intermediate panels of the upper modules so as to provide a horizontally extending space or channel **7** which may be used as a form for casting in place a further beam or frame member. In the erection of a wall the lower tier of modules is preferably assembled first and concrete is poured in the vertically extending space **4** and in the horizontally extended space **7** to form the lower portions of vertical columns and an integral horizontal beam connecting the columns. The upper tier of modules is then assembled on the lower tier and additional concrete is poured to form the upper portions of the vertical columns an integral horizontal beam in the space **5**. Particularly when the wall is to be continued on up for an upper

story, concrete is preferably poured only in the lower portions of the space 5 up to the bottom of the notch 6, the upper portion being left empty to receive downwardly projecting portions of intermediate panels of modules forming the next tier of the wall. The concrete columns and beams formed in the spaces 4, 5 and 7 are preferably reinforced with steel, wire, rods or cables as described below. Moreover, the spaces 4, 5 and 7 are conveniently utilized for installing wiring, plumbing and heating conduits or pipes in the wall.

As the basic module is formed merely of 3 flat rectangular panels with square edges it can be rapidly and economically manufactured from sheet stock. Moreover, the construction lends itself to utilizing in the most economical and efficacious manner the various construction materials that are available. Since the three panels making up a basic module are produced independently and then assembled, each can be made of a different material selected to provide the desired characteristics. Thus for example the outer panel 1 is made of material selected to provide a good exterior appearance, moisture-proofing and weather resistance. The outer surface may simulate conventional building materials such as brick, stone, stucco, clapboards or shingles or may be modern in appearance. The intermediate panel 2 is formed of material providing good heat insulation and having sufficient strength to provide a strong joint between successive modules by the interleafing construction described and shown. The inner panel 3 is selected to provide an attractive interior finish, moisture-proofing, easy cleaning characteristics and such other properties as may be desired, for example selected acoustic characteristics. The thickness of each of the panels is selected in accordance with the characteristics of the panel and the requirements of the building being constructed. For example if the inner and outer panels are formed of relatively high cost plastic or other material they may be made relatively thin for purposes of economy. The intermediate layer 2 on the contrary may be formed of foamed plastic or other lightweight inexpensive material and may be made correspondingly thicker to provide good heat insulation and also increase the thickness of the concrete framework poured in the spaces 4, 5 and 7 to provide a stronger yet inexpensive construction. The intermediate panel may be several times as thick as the inner and outer panels. For example for residence construction the inner and outer panels may be one-eighth inch to one inch thick and the intermediate panel may be one inch to six inches thick. Moreover, any or each of the panels constituting the module may be formed of laminated construction. For example the outer panel may have a relatively thin outer layer of material providing an attractive appearance and good weather resistance and one or more inner layers of less expensive material. Likewise the interior panel 3 may have a surface of plastic or other material providing an attractive, durable and easily cleaned surface and supporting layers of other material.

The panels composing a module are secured together in any desired manner. For many types of construction it is desirable to bond the panels together with suitable adhesives to provide strong integral constructions without interruption of the inner and outer surfaces of the modules. However, bolts, rivets, nails or other fastening means may be used if desired.

In FIG. 2 there is shown another form of basic module comprising an outer panel 8, intermediate block or panel 9 and an inner panel 10. The intermediate panel 9 is of hollow construction comprising spaced walls 9*a* and 9*b*. The space inside the hollow panel 9 may, if desired, be left empty or may be filled with insulating or other material. The modules shown in FIG. 2 are particularly suitable for making cellar or garage walls by assembling a plurality of such modules and filling the space between the inner and outer panels with concrete, plastic or other casting materials. The space inside the hollow intermediate panel 9 may be filled with the same material or with a different material. All or selected ones of the panels comprising the module may economically be made of sheets or slabs formed of wood waste in chop, shaving or sawdust form bonded with Portland cement to form a strong, lightweight and inexpensive material. Holes are shown at 11 for bolting or riveting the panels together.

In FIG. 3 there is shown another form of basic module comprising an outer panel 12, an intermediate panel 13 and an inner panel 14. The outer panel 12 is composed of three sheets or layers comprising an outer layer 12*a*, an intermediate layer 12*b*, and an inner layer 12*c*. The intermediate layer 12*b* is offset horizontally and vertically with respect to the inner and outer layers 12*a* and 12*c* so as to project on two edges of the module and be recessed on the other two edges. Similarly, the inner panel 14 comprises three sheets or layers 14*a*, 14*b* and 14*c* with the intermediate layer 14*b* offset horizontally and vertically. The intermediate panel 13 is preferably also of laminated construction but with all of its layers in registry with one another. When modules of the kind shown in FIG. 3 are assembled the projecting portions of the intermediate panel 13 fit in between the inner and outer panels of adjacent modules. The projecting portions of the layers 12*b* and 14*b* of the inner and outer panels similarly project into corresponding recesses in adjacent modules to provide a multiple interlock.

In FIG. 4 there is shown a basic module construction in which an outer panel 15 and an inner panel 17 are formed of an extruded aluminum grid or frame on which plastic material such as polyesters are bonded. Sheet plastic material may cover the entire frame or may be set into the openings of the frame like glass in a window. Alternatively, the spaces within the frame structure are filled with foamed plastic material which may be cut from sheets or slabs and fitted into the spaces or may be foamed in place by laying the frame horizontally on a flat surface and pouring the plastic in until the frame is filled to the desired level. As the plastic cures or hardens, it forms an integral skin covering both exposed surfaces while the interior is of cellular structure. The metal frame provides strength with lightweight and offsets the tendency of certain plastics to creep. An intermediate panel 16 of the module—which is offset horizontally and vertically as described above in connection with FIG. 1 may likewise be of frame construction or may be made of foamed plastic or other material having the desired characteristics.

In FIG. 5 there is shown a corner construction in which modules 20 and 21 cooperate to form the corner of a building. The inner and outer panels of the two modules cooperate with vertical edges of intermediate panels 22 and 23 of the module 21 and a module 24 adjacent the module 20 to define a vertical channel of L-shaped cross section in which is cast a corner column which is illustrated as being reinforced by a plurality of rods or wires 25 held in place by perforated L-shaped plates 26. The plates 26 further serve to hold the modules in assembled relation. The reinforcing rods are shown as extending vertically so as to extend continuously through an upper portion of the column as the wall is built upwardly. The inner and outer panels of the modules in cooperation with the upper edges of the intermediate panels 22 and 23 also define horizontally extending channels which constitute forms for casting concrete beams which are illustrated as being reinforced by rods or wires 27.

FIG. 6 shows detailed views of apertured plates 28 which are used for supporting and positioning reinforcing rods while concrete is being poured to form columns or beams as well as various other purposes as will hereinafter appear. Each of the plates 28 is approximately square and is slotted as indicated at 29 so that two of the plates fit together at right angles to one another as illustrated in the lower portion of FIG. 6.

In FIG. 7 there is shown a wall module **30** and a module **31** of triangular shape used for forming a gable. The triangular module **31** comprises an outer panel **31***a*, an intermediate panel **31***b* and an inner panel **31***c*. It will be seen that the upper edge and the vertical side edge of the intermediate panel **31***b* is recessed with respect to the inner and outer panels while the lower edge portion projects downwardly below the inner and outer panels so as to fit in between the inner and outer panels of the wall module **30** and thereby join the gable module with the wall module. Moreover, the recessed upper edge of the intermediate panel **31***b* provides a channel in which reinforced concrete or other material may be cast to form a structural member supporting the roof.

In FIG. 8 there is shown a door frame construction composed of two modules **33** and **34**. The modules have sill portions **33***a* and **34***a* and lintel portions **33***b* have **34***b* joined by scarf joints. Moreover, the lintel portions are recessed as indicated at **35** to receive fish plates which further reinforce the joint between the two modules. It will be seen that the left hand door frame module **33** is provided with a space between inner and outer panels to receive intermediate panels **36** of adjacent wall modules while the right hand door frame module **34** is provided with projecting intermediate panels **37** which fit between outer and inner panels of adjacent wall modules. Each of the door frame modules **33** and **34** may, if desired, be divided into upper and lower sections having an intermediate panel of one section fitting in between inner and outer panels of the adjacent section to join the two sections together as described above in conjunction with the basic module shown in FIG. 1.

In FIG. 9 there is shown a window frame composed of cooperating modules **40** and **41** having lintel portions **40***a* and **41***a* joined by a scarf joint and fish plates as described above in conjunction with FIG. 8. The lower portions **40***b* and **41***b* of the window frame modules comprise inner and outer panels fitting over an intermediate panel **42** of a module forming the portion of the wall below the window. The vertically extending portions of the modules **40** and **41** likewise interlock with adjacent wall modules in accordance with the basic principles of the invention, an intermediate panel of an adjacent wall module being indicated schematically at **43** interfitting between the inner and outer panels of the window frame module **40**. The door frame assembly shown in FIG. 8 and the window assembly shown in FIG. 9 preferably have overall dimensions corresponding to the basic modules forming the wall so as to fit into the wall structure without cutting or fitting operation.

FIG. 10 illustrates a light truss **45** preferably made of aluminum alloy of the requisite tensile strength. The truss is made in two sections for ease in handling, the sections being joined with bolts as indicated at **46**. The lower part **47** of the truss is of inverted channel section designed to fit over a beam **48** and be bolted thereto. The beam **48** may be cast of fireproof material as illustrated in FIG. 17 or may be a channel-shaped beam of aluminum alloy.

In FIG. 11 there is illustrated means for joining the wall of an additional room on an existing house. To provide for possible later expansion, a wall portion comprising modules **49**, **50**, **51** and **52** is provided with fittings comprising cross perforated plates **28** of the kind illustrated in FIG. 6. These projecting plates can be temporarily enclosed by a suitable plastic or other box-shaped member which will look like a projecting end of a beam. When at a later date it is desired to join a further wall to an existing wall, the enclosures are removed and reinforcing rods for the horizontal structural members of the new wall portion are hooked into the holes of the plates **28** and thereby anchored to the existing wall structure.

FIGS. 12, 13, 14 and 15 illustrate a complete fireplace and chimney construction designed to eliminate expensive brick or stone masonry work by using basic modules in accordance with the invention as molds or forms for casting structural components which unite the modules into an integral construction. The structure comprises a foundation section **55**, a fireplace section **56**, one or more intermediate chimney sections **57** and an upper chimney section **58**. The foundation section **55** is made up of a front module **60**, two side modules **61** and a rear module **62**. As in the basic module construction described above, each module consists of inner and outer panels with an intermediate panel or block sandwiched between them. Thus the front module **60** comprises an outer panel **60***a*, an intermediate panel **60***b* and an inner panel **60***c*. The other modules are of similar construction. The four modules fit together at their side edges to form corners of the foundation structure in substantially the same way as the modules of the corner construction illustrated in FIG. 5. The side edges of the intermediate panels of the modules are set back from the edges of the outer panels so as to provide vertically extending spaces or channels **64** in which concrete is poured to form vertical columns. Reinforcing rods or wires **65** are preferably positioned in these channels before the concrete is poured in. The upper edges of the intermediate panels of the modules other than the front module **60** are also recessed to receive downwardly extending portions of the intermediate panels of modules forming the fireplace section **56** so as to lock the two sections together. A beam **66**, which may be of the construction shown in FIG. 17 and described below, extends across between the two side modules **61** just rearwardly of the front module **60** and is supported by concrete poured in the space between the inner and outer panels of the modules. The beam **66** and the upper edge portion of the front module support the hearth of the fireplace. If desired, the upper portion of the intermediate panel of the front module may also be recessed to receive concrete. The modules forming the foundation section of the fireplace are formed of panels or blocks of suitable materials. For example the inner and outer panels may be formed of wood waste material bonded with Portland cement while the inner panels or blocks may be formed of foamed concrete or other inexpensive moisture proof material.

The fireplace section **56** comprises a preformed fireplace shell **70** which may be of metal or ceramic construction. The fireplace shell is set in a structure comprising a front module **71**, side modules **72** and a rear module **73**, the front module being cut out to fit over the fireplace shell. The modules are made up of inner, outer and intermediate panels as described above, the side edges of the intermediate panels being recessed to provide spaces **74** forming vertical extensions of the spaces **64** of the foundation section **55**. At least the inner panels of the modules are formed of heat resistant material, for example asbestos cement. The fireplace section is preferably covered with a decorative cladding **75** which may consist of stone or brick facing, metal, fireproof wall board or other suitable material. Any space between the cladding and the modules enclosing the fireplace shell is left empty or filled with insulating material.

Each of the intermediate chimney sections comprises a front module **76**, two side modules **77** and a rear module **78** fitting together to define a flue channel **79**. The front module is made up of an outer panel **76***a*, an intermediate panel **76***b* and an inner panel **76***c*. The other modules are of like construction. The side edges of the intermediate panels are recessed to provide continuations of the vertically extending spaces **64** for the corner columns. The lower edge of each intermediate panel extends downwardly between the inner and outer panels of the subjacent modules while the upper edges are recessed to receive the lower edge portions of the intermediate panels of superposed modules, thus locking the modules together. One or more of the intermediate chimney sections are used to provide a chimney of the desired height.

The upper chimney section 58 is essentially the same as the intermediate section 57. The poured concrete columns formed in the vertically extending channels 64 and the reinforcing elements for the columns extend integrally through all of the sections. A flue 80 for the fireplace and a smaller flue 81 for a furnace or water heater extend up through the vertical flue space 79 and preferably project above the upper chimney section 58, the upwardly projecting portion of the flues being enclosed in a cladding 82 formed of real or artificial brick or other suitable material. The modules forming the intermediate and upper chimney sections are formed of fireproof material, at least the intermediate panels of the modules being formed of heat insulating material, for example foamed concrete.

From the foregoing description it will be seen that the fireplace and chimney unit is easily assembled, even by unskilled persons, by merely fitting the modules of successive sections together and pouring in concrete to form the vertical columns.

FIG. 16 is a partially exploded perspective view illustrating schematically how several forms of basic modules fit together to form an integrated structure. Thus there are shown upper and lower wall modules 91 and 92, corner modules 93 and 94, window modules 95 and door modules 96. When the modules are fitted together they provide vertical and horizontal channels, as described above, into which concerete or other suitable material is poured to form a skeleton or framework which carries the roof and floor loads of the building. Hence the panels are not load-carrying members, the building being of non-monolithic construction. The skeleton is preferably reinforced by wires or rods as illustrated at 97 and 98. The channels also provide convenient space in which to install service pipes, conduits wires, etc. Beams 101 carried by the framework of the building support the ceiling and the upper floor, if any. Beams 102 and 103 are also shown as positioning partitions formed of modules 104 and 105 which are like the basic wall modules except they are preferably of lighter construction. The upper edges of the intermediate panels of the upper modules and the lower edges of the intermediate panels of the lower modules are recessed so that the modules fit over beams or stringers extending along the ceiling and floor to position the partitions. Since the partitions carry no load the modules are preferably merely fitted together without any concrete framework. They can hence easily be installed, removed or moved to new locations to change the arrangement of the rooms.

If the building is to have a further story the walls are carried on up by the addition of further tiers of modules. The modules for the upper story may be the same as those for the lower floor or they may be of different materials. Moreover, the intermediate panels of the upper story modules may be somewhat longer than those of the lower story so that the concrete frame work members are of correspondingly smaller cross section since the loads are less.

As wooden beams constitute a fire hazard, it is desirable for the beams 101, 102, 103 etc. to be of fireproof construction. Strong, fireproof beams are easily formed in place by use of the mold or form 110 shown in FIG. 17. The form consists of a bottom panel 111 and side panels 112 joined to form a trough open at the top. The panels are formed of suitable material which is preferably laminated with an outer layer of plastic or other material providing a permanent decorative finish. The form is positioned where the beam is desired and then filled wtih concrete, the form being left in place and constituting a permanent part of the beam. When greater strength is required, the beam is reinforced with steel wires or rods which are preferably positioned by a suitable assembly of the perforated plates 26 illustrated in FIG. 6 and described above.

The flooring material for the first floor is laid directly on level cement, or if there is a basement, on slabs formed of wood waste bonded with cement and supported by beams as described. Vinyl plastics in sheet or tile form make excellent flooring material.

A variety of plastics is available for the walls of the building. Polyesters reinforced with glass fibers can function as the exposed surfaces of wall modules for both interior and exterior use. Acrylic plastics, styrene plastics and melamines are also useful for exposed surfaces of modules. The intermediate panels of the modules are formed of inexpensive, light weight materials such as foamed phenolics, styrene, urethene and other plastics. Polyethylene used as a layer in the laminated module construction makes an excellent vapor barrier. Numerous other plastics can also be used as desired. The laminated construction of the modules in accordance wtih the invention makes it possible to utilize available materials to fullest advantage.

It will be understood the principles of construction in accordance with the invention are applicable to a variety of shapes and sizes of modules and that the features of the several units herein.

What I claim and desire to secure by Letters Patent is:

1. A building structure comprising a plurality of similar wall sections arranged vertically and horizontally to form a wall, each of said sections comprising opposing and symmetrically arranged inner and outer panels and a smaller and thicker intermediate panel between said inner and outer panels, said panels being united to form said wall section, said intermediate panel projecting laterally and vertically beyond two adjacent edges of said inner and outer panels, and the projecting portions of said intermediate panel being received between the inner and outer panels of adjacent wall sections, the width of said intermediate panel being substantially less than the width of the inner and outer panels to provide vertical channels defined by the edges of said intermediate panels and inner faces of said inner and outer panels, fluent concrete being cast in situ in said channels to form vertical columns comprising a load-carrying frame of said structure, the portions of each intermediate panel projecting laterally beyond the edges of said inner and outer panels being approximately equal in width to the portion of each intermediate panel disposed between said inner and outer panels so that said vertical columns are disposed approximately centrally of said inner and outer panels.

2. A building structure according to claim 1 in which said intermediate panel is formed of cellular material and said inner and outer panels are of denser material.

3. A building structure according to claim 1, in which inner and outer panels are solid and said intermediate panel is hollow.

4. A building structure according to claim 1, in which at least one of said inner and outer panels is formed of a metal frame and sheet plastic material bonded on said frame.

5. A building structure according to claim 1, in which each of said wall sections is approximately half ceiling height and approximately square.

6. A building structure comprising a plurality of similar wall sections arranged vertically and horizontally to form a wall, each of said sections comprising opposing and symmetrically arranged inner and outer panels and a smaller and thicker intermediate panel between said inner and outer panels, said panels being united to form said wall section, said intermediate panel projecting laterally and vertically beyond two adjacent edges of said inner and outer panels, and the projecting portions of said intermediate panel being received between the inner and outer panels of adjacent wall sections, the width and height of said intermediate panel being substantially less the width and height of the inner and outer panels to provide vertical channels and horizontal channels defined by the edges of said intermediate panels and inner faces of said inner and outer panels, fluent concrete being cast

in situ in said channels to form vertical columns and integral horizontal beams comprising a load-carrying frame of said structure the portions of each intermediate panel projecting laterally beyond the edges of said inner and outer panels being approximately equal in width to the portion of said intermediate panel disposed between said inner and outer panels so that said vertical columns are disposed approximately centrally of said inner and outer panels.

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