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(54) **MODULAR BUILDING CONSTRUCTION EMPLOYING CONCRETE MOLD ASSEMBLY**

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(57) **ABSTRACT**

A modular building construction where each module consists of self-contained molds to allow concrete to form within the walls of each module as well as between the modules when two or more modules are placed together. The structural load capacities of the modules are transmitted directly into the concrete within the wall without bearing directly on the module below. The forming structure for the modules can be fabricated either using wood or metal construction. The exterior and interior wall finishes are the resulting structure of the molds. Since the molds are self-contained the walls can consist of, either drywall, rigid insulation, thin brick or siding just to name a few. The interior forming structure can extend into the concrete footing or above or to adjacent modules to structurally secure the modules together. The modules can be built with a flooring structure as well as ceiling. The interior walls as well as the floor and ceiling also function as wall supporting braces. The exterior walls have many different forming molds to accommodate many different construction situations. Some forming structures are formed with a thermal break between the exterior and interior forming structure. The thermal break allows the wall to also be used as a heating or cooling distribution system. Different types of connectors are described allowing for the connectors to be hidden. Several methods are shown how the electrical distribution can be provided within a concrete wall by using the forming structure within the mold. A ribbed concrete mold can be formed for a poured-in-place wall as well as for a floor and roof system. Temporary floor bracing can be used when pouring the flooring system, or only just the concrete beams can be poured and the floor can be poured later. The flooring system can be used as concrete wall or as a roof structure.

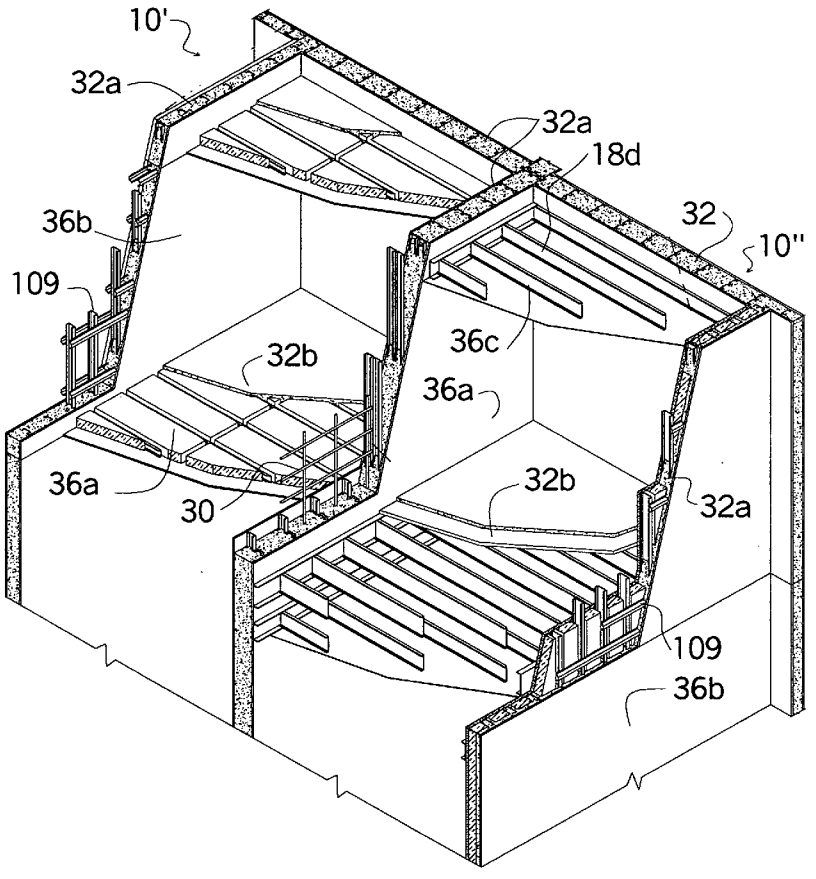


FIGURE 1

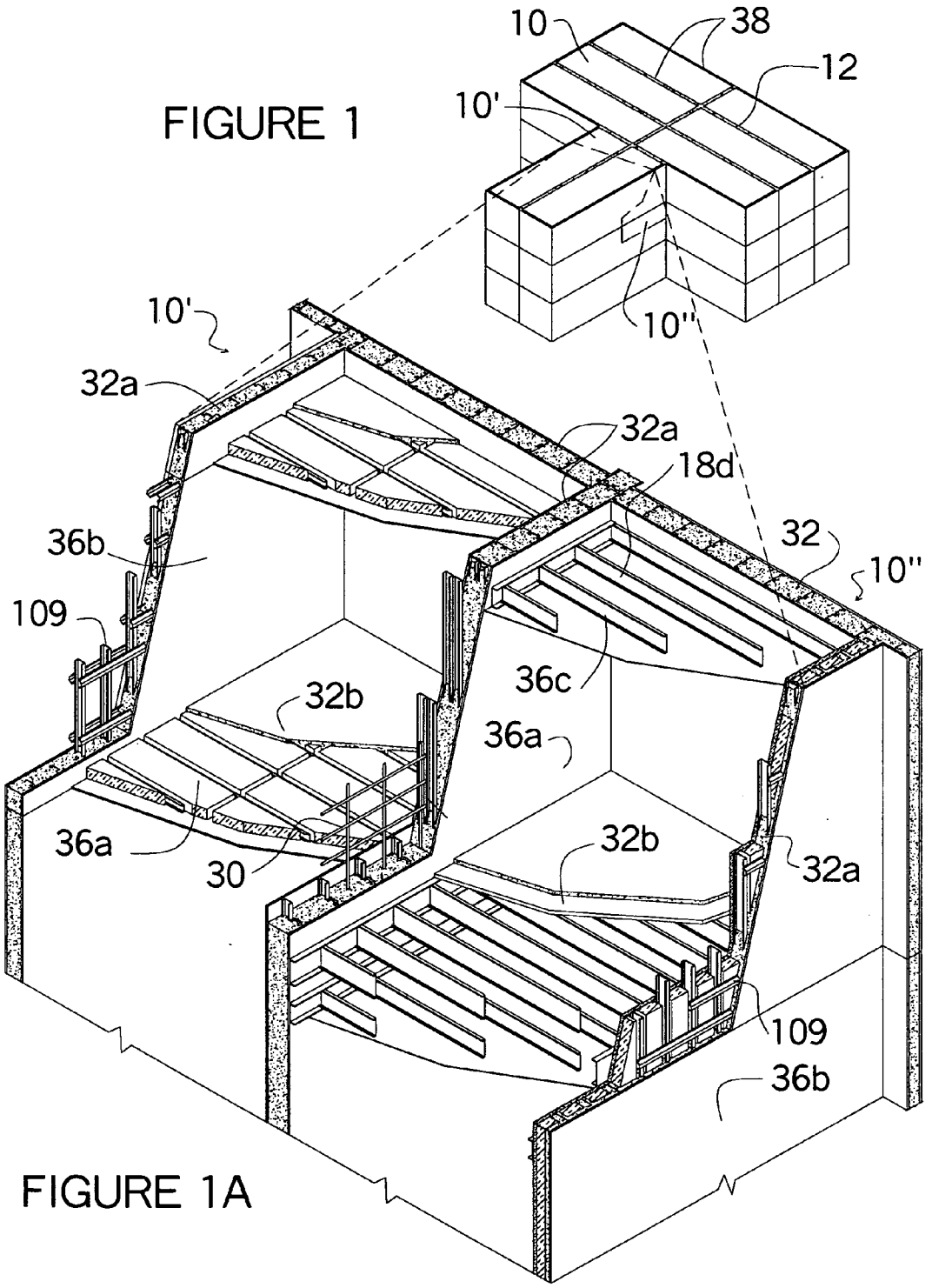
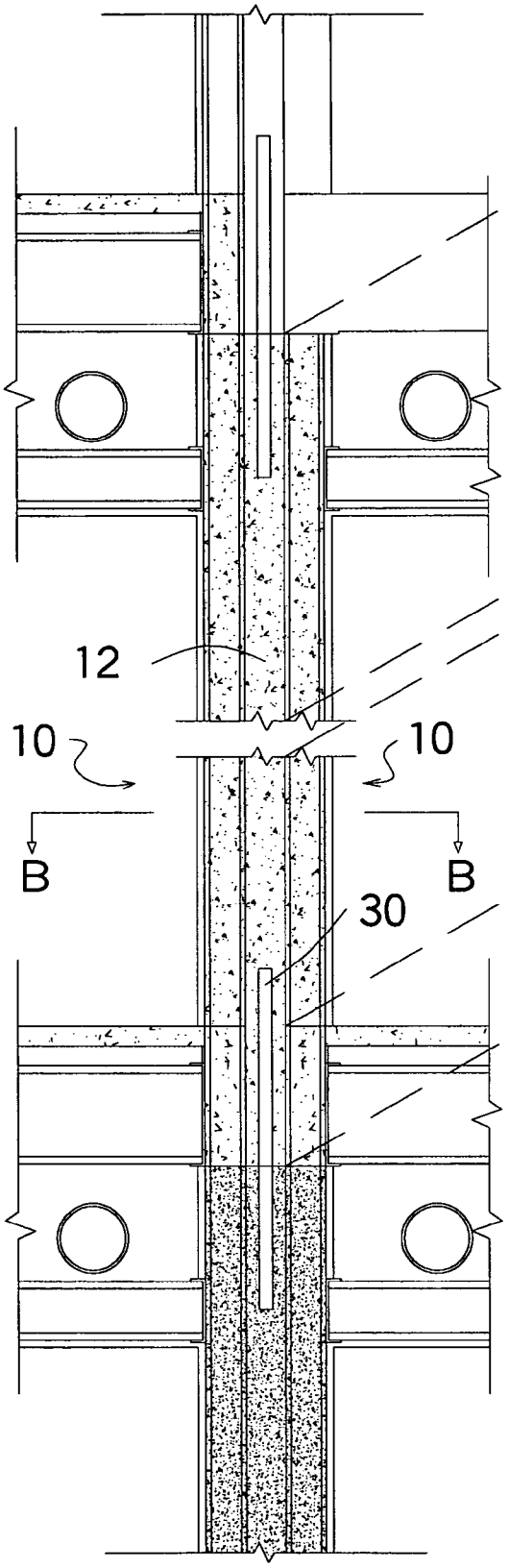


FIGURE 1A



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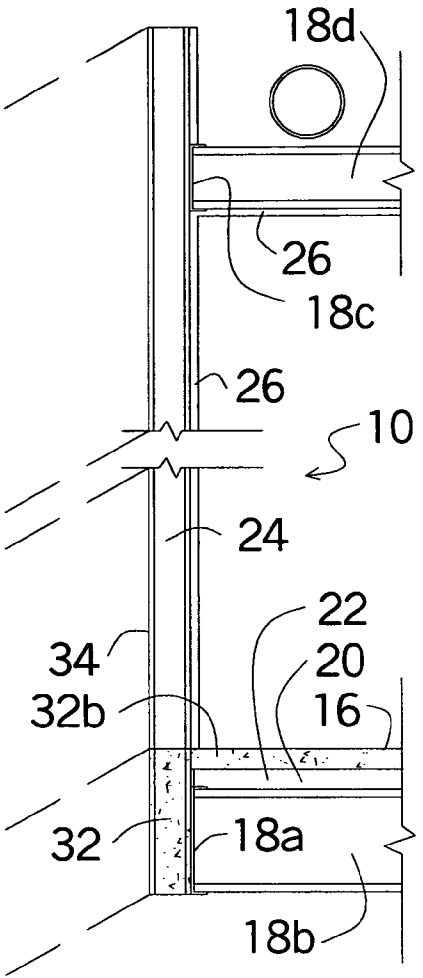

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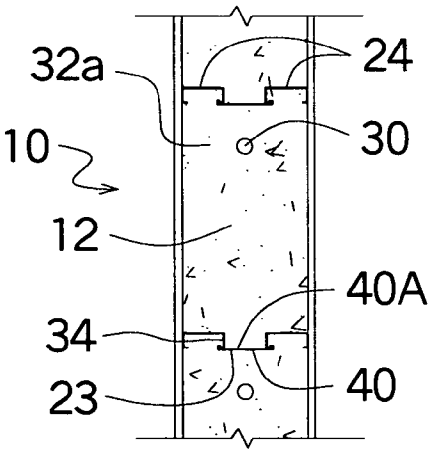

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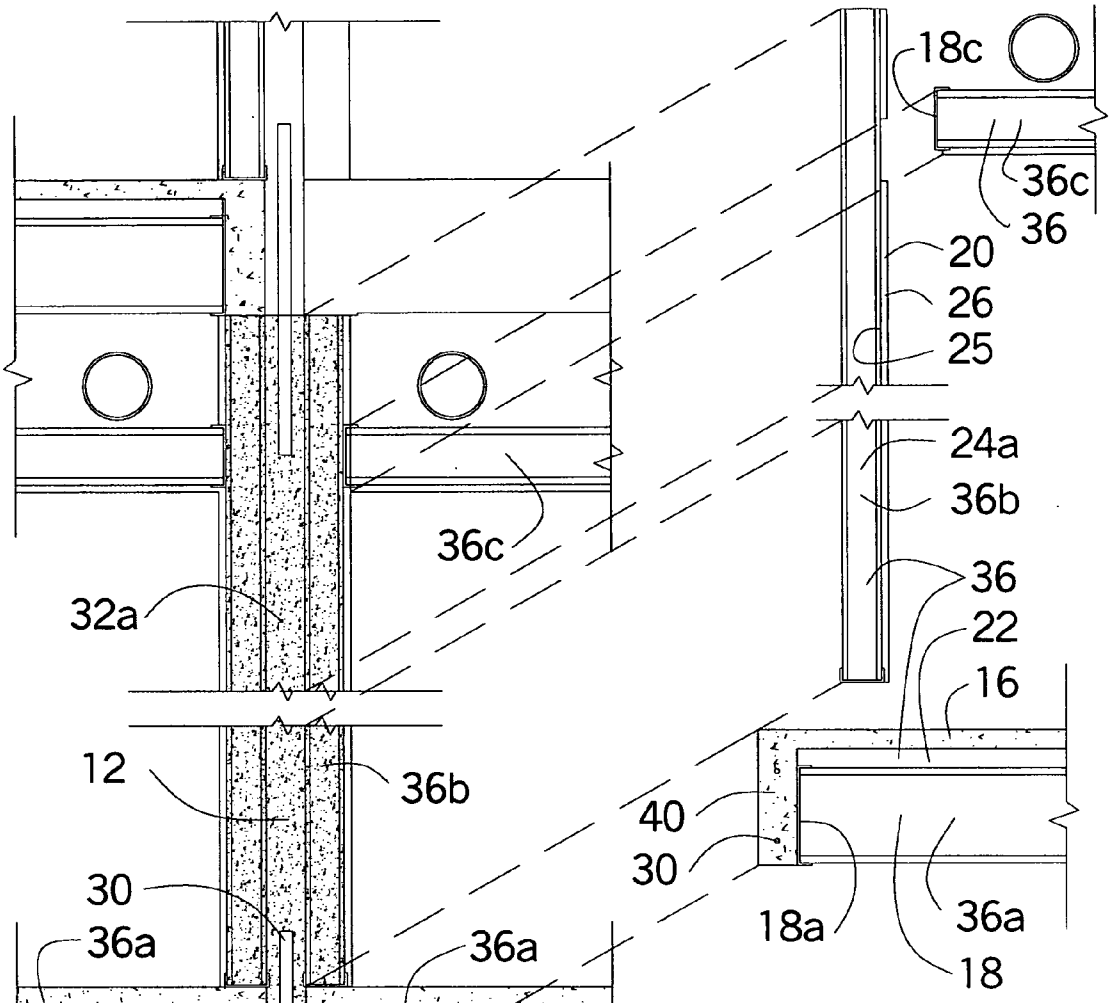
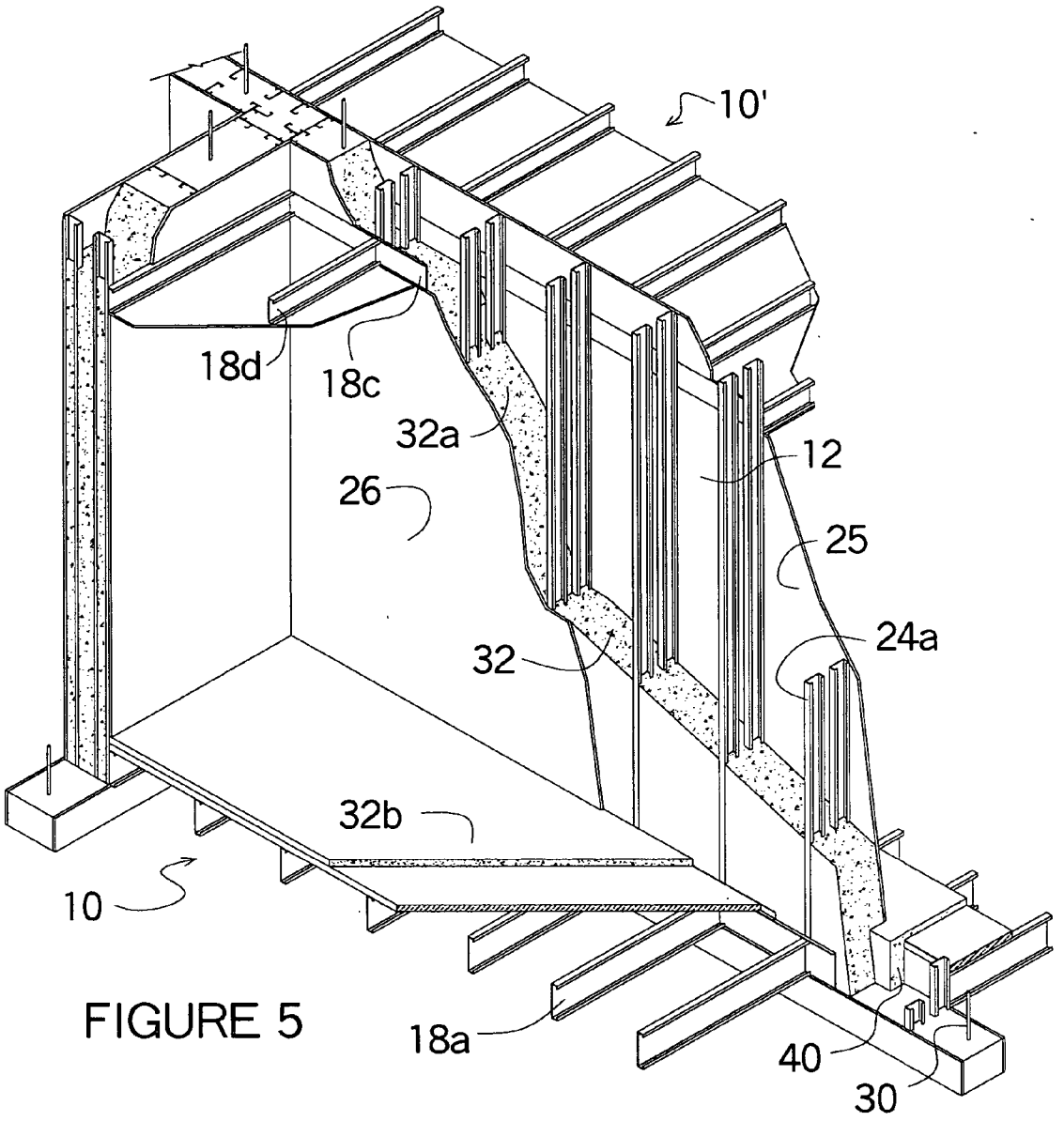


FIGURE 4A

FIGURE 4



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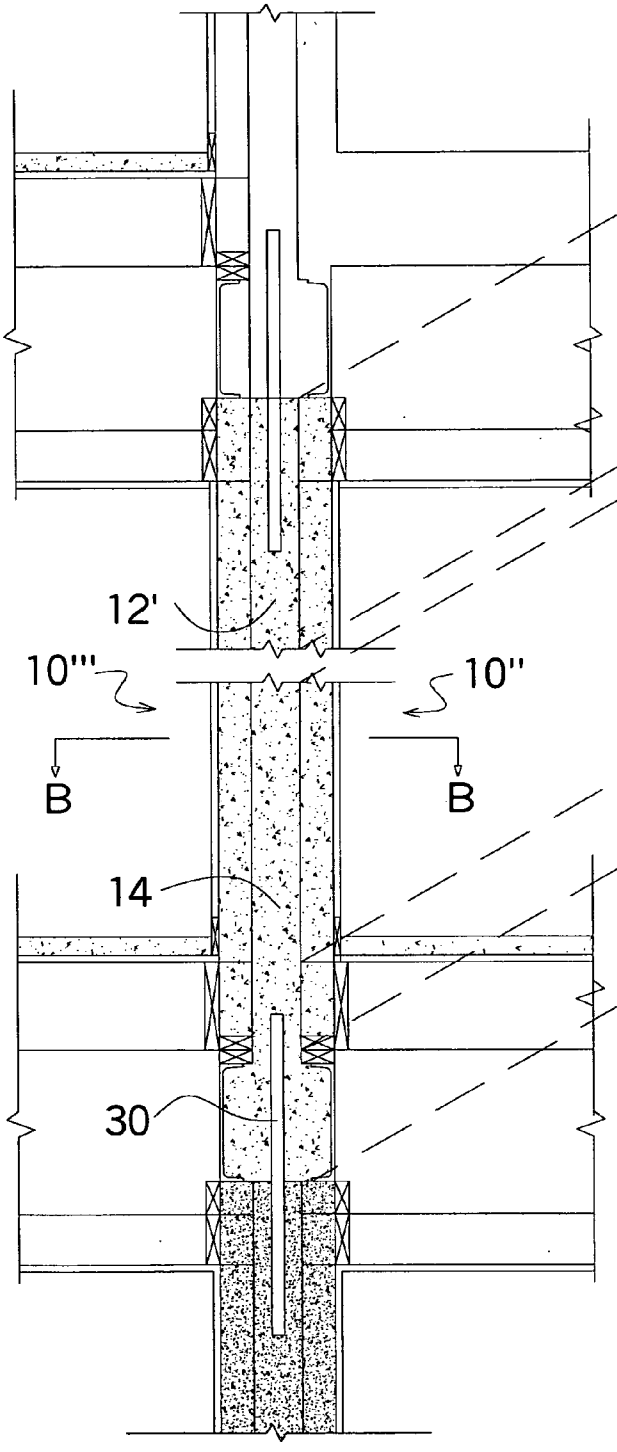

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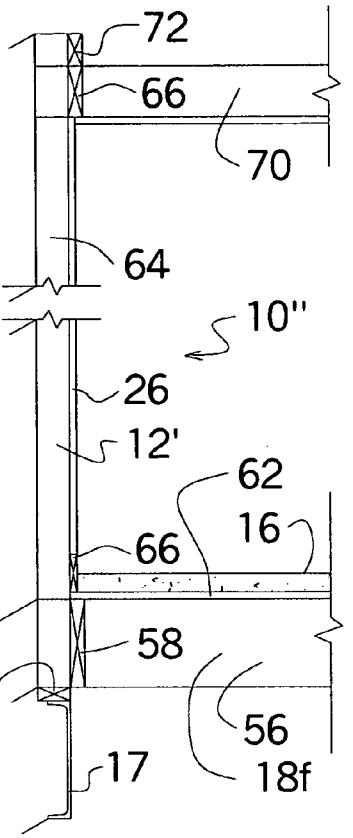

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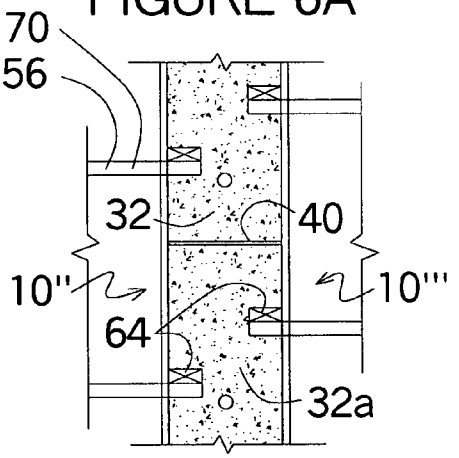

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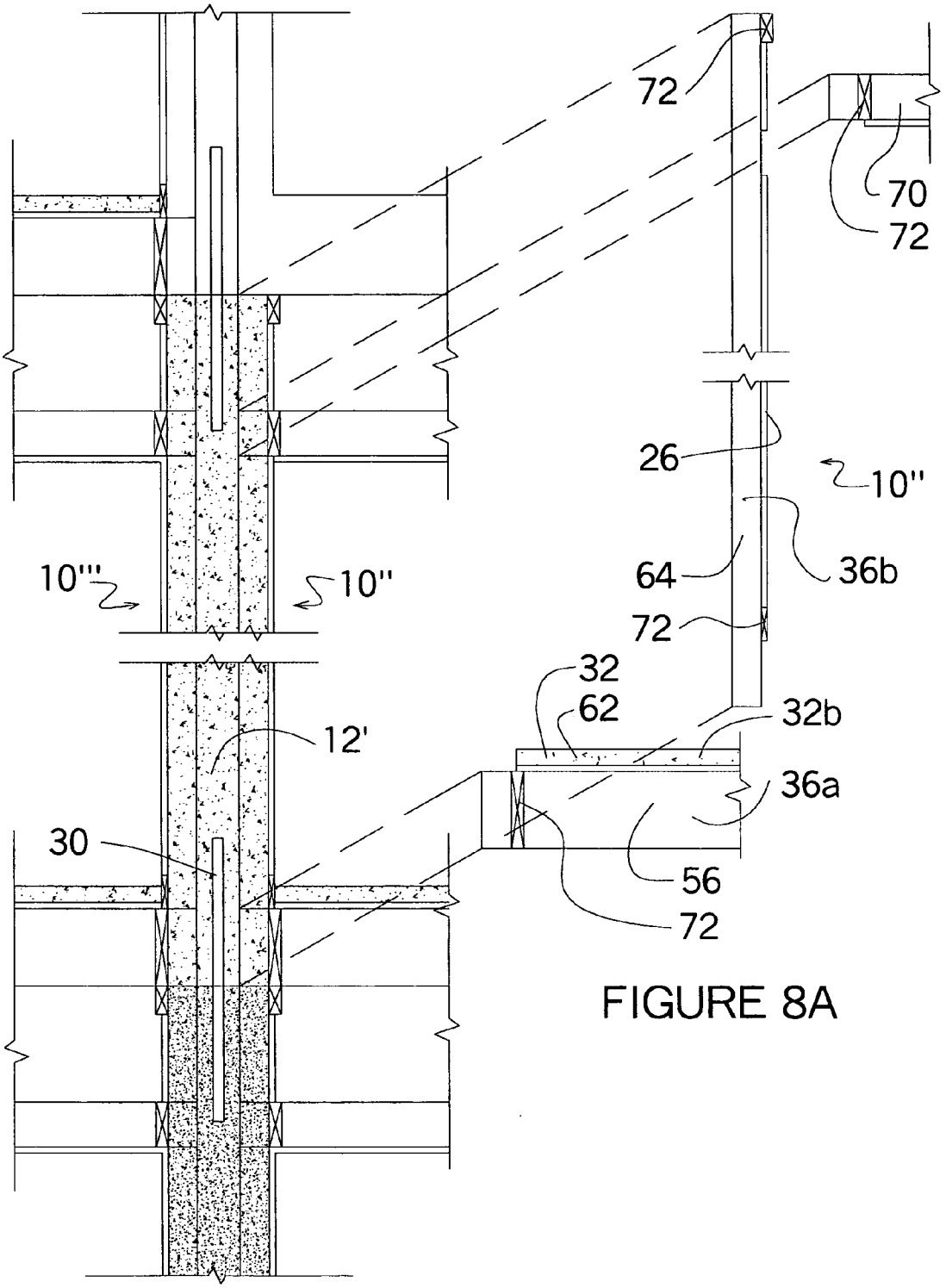
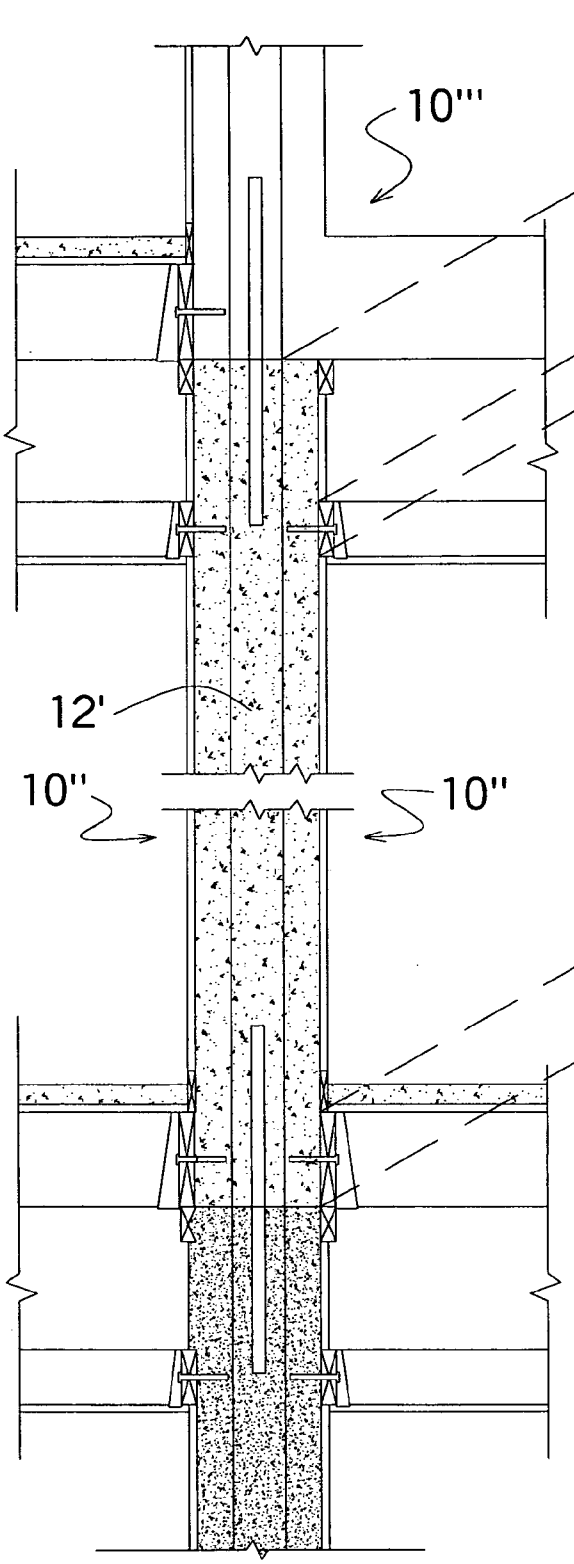


FIGURE 8A

FIGURE 8



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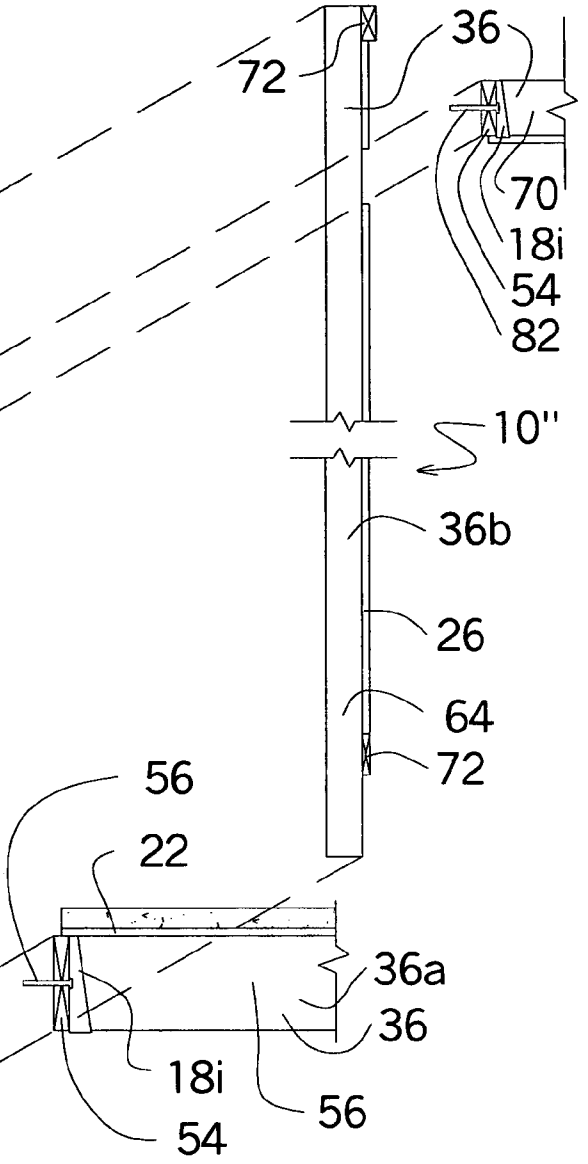

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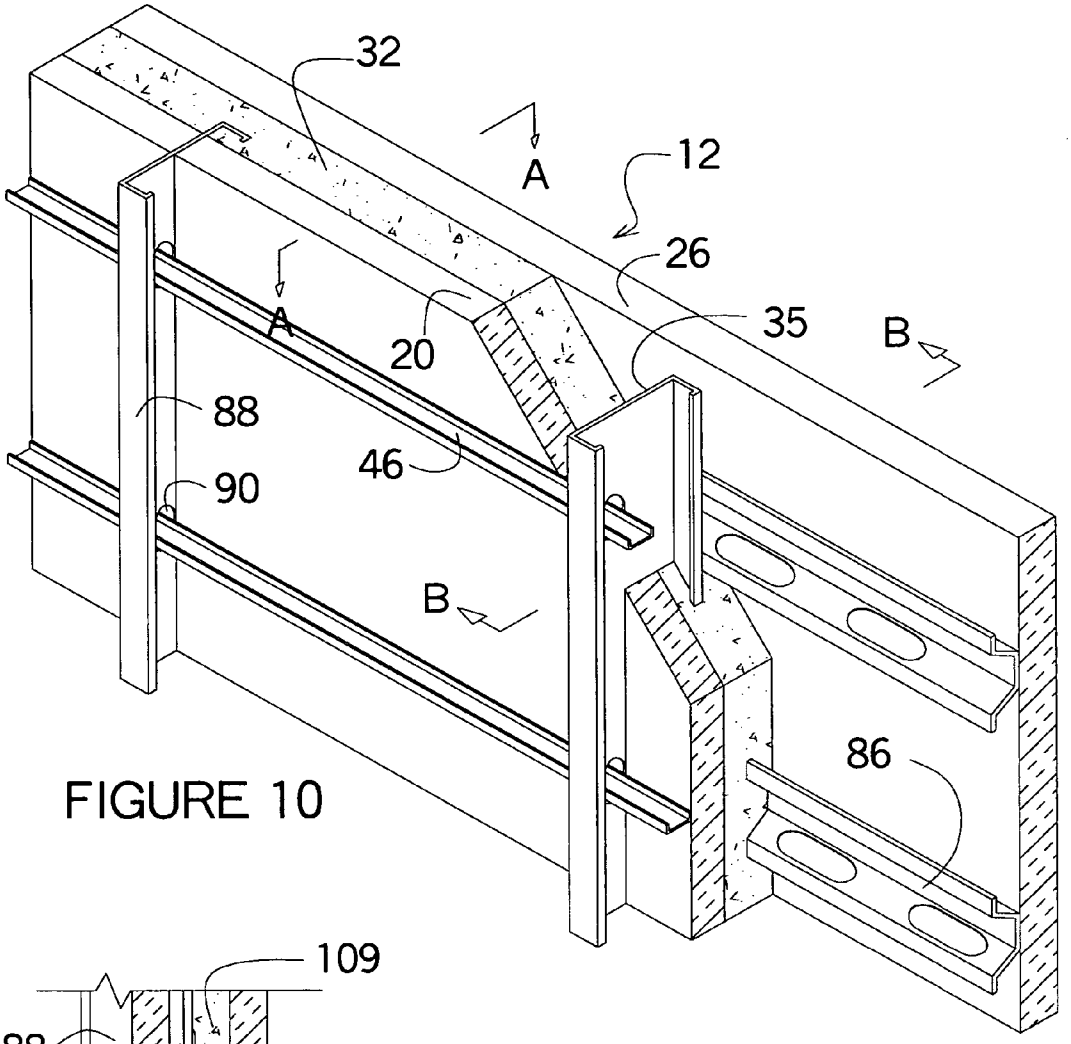

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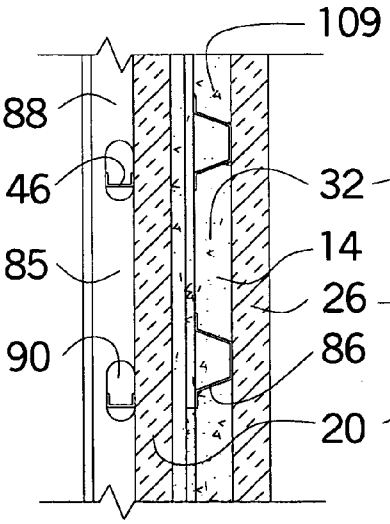

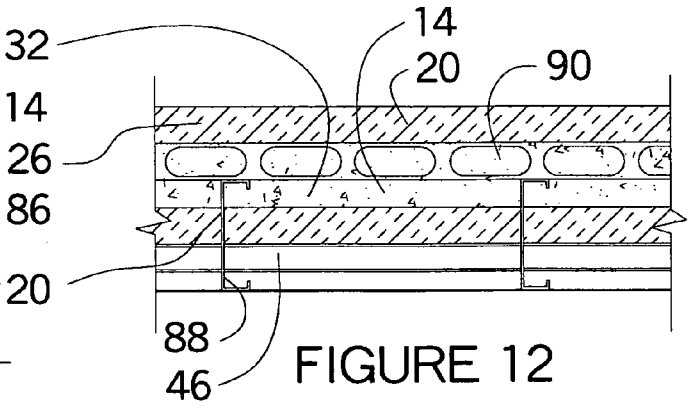

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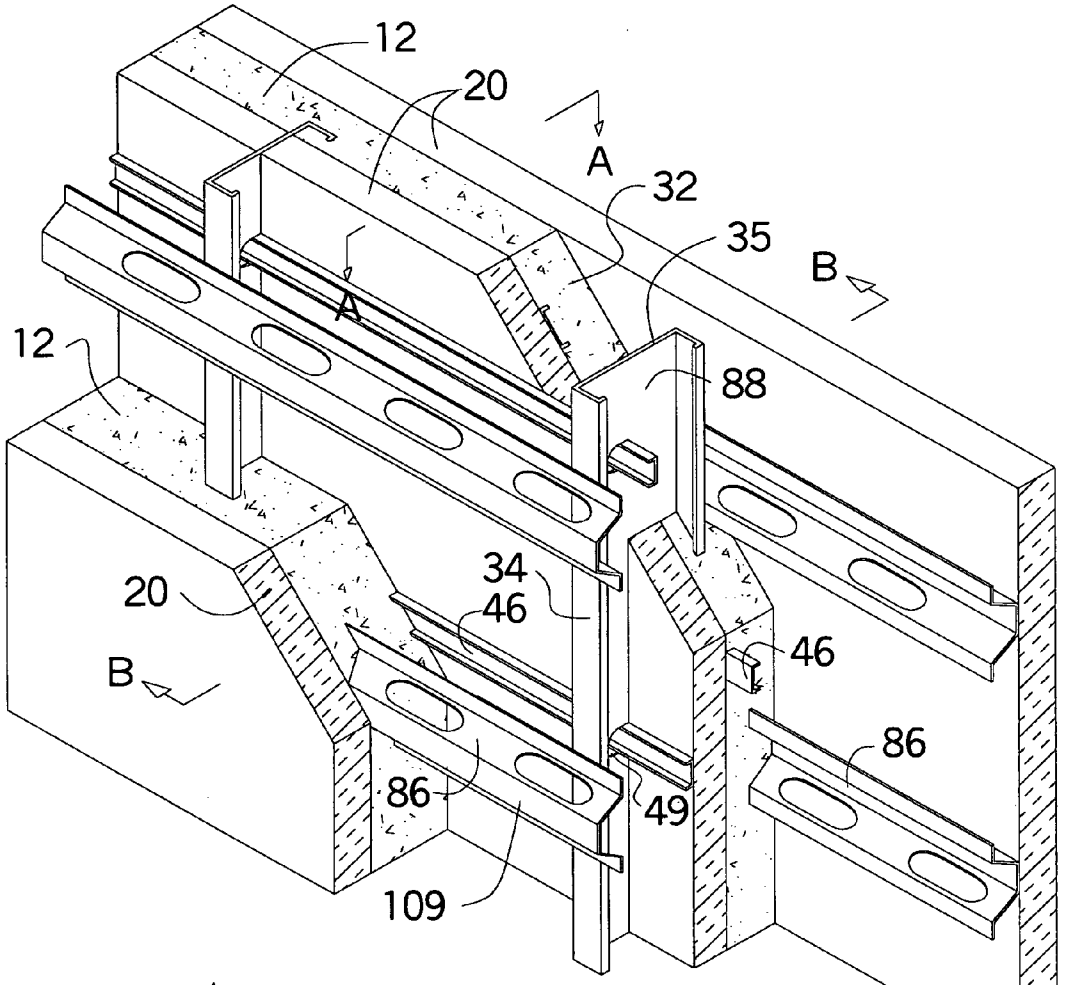

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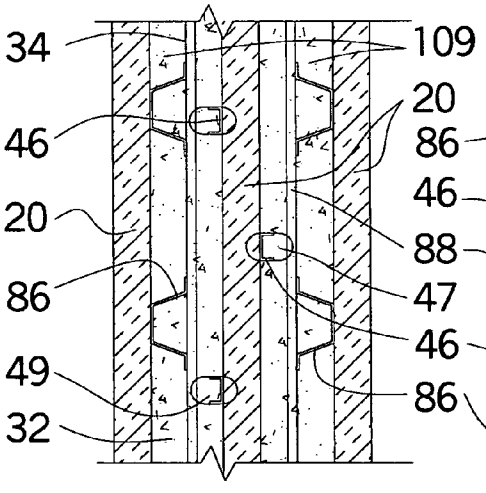

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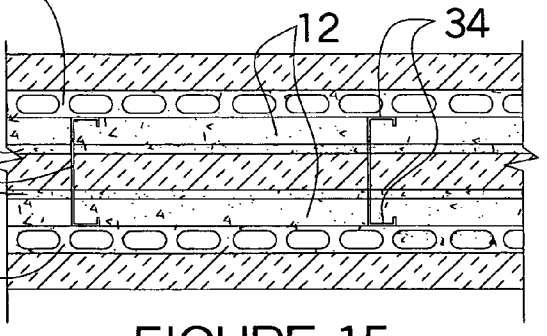

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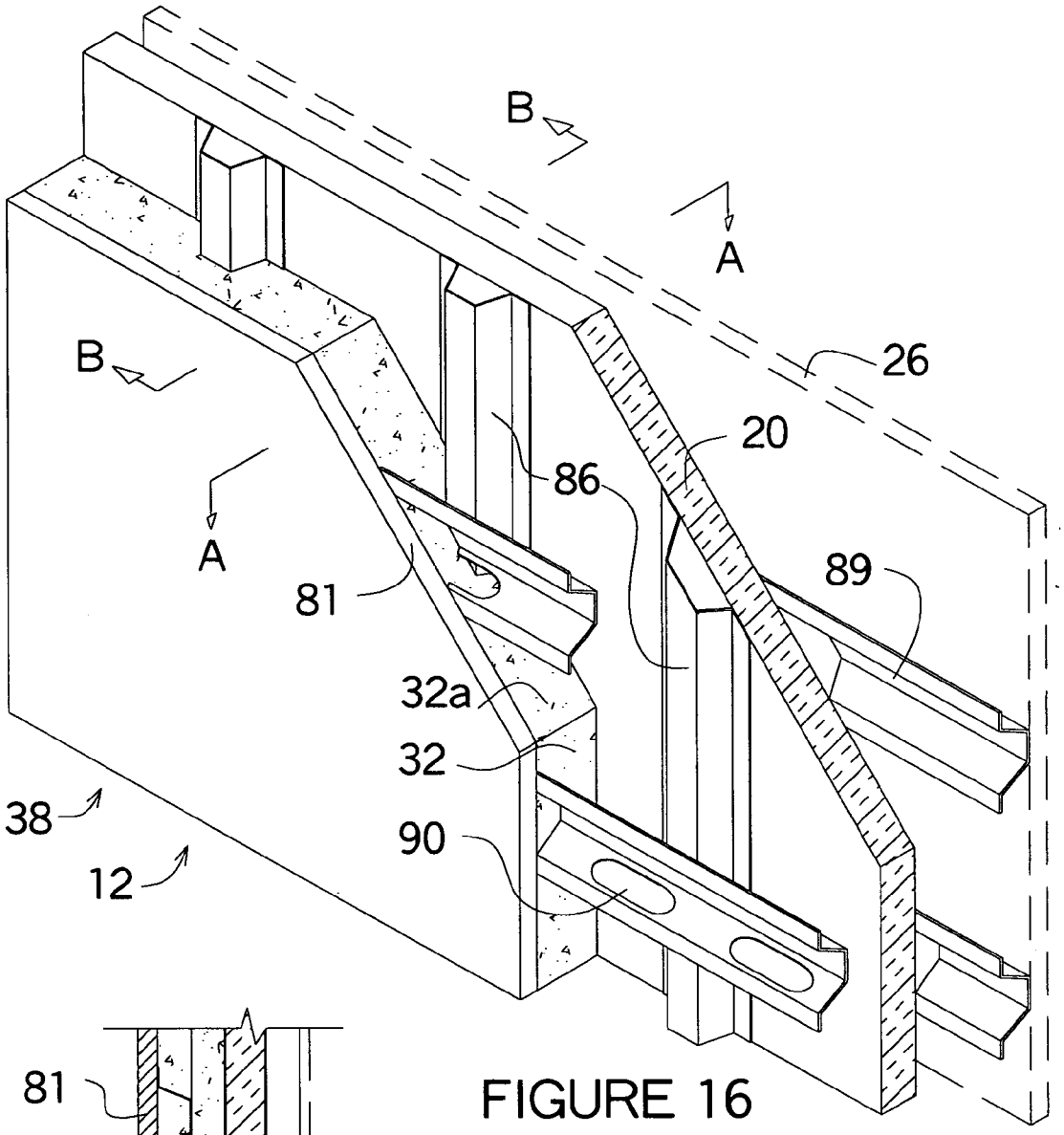

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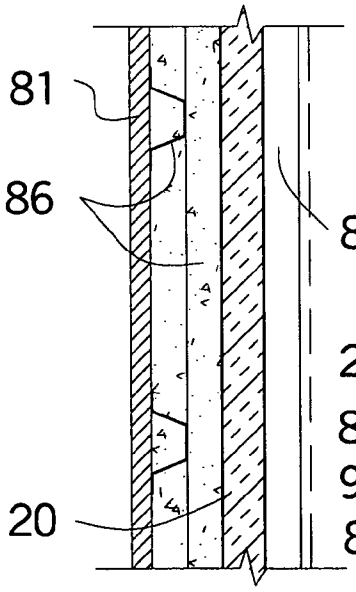

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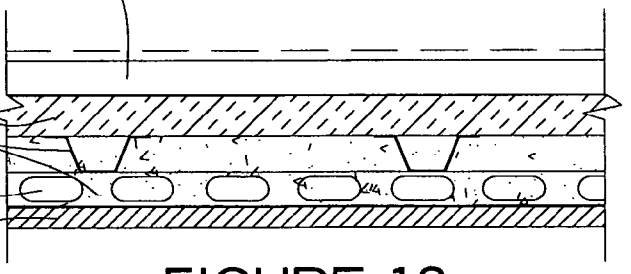

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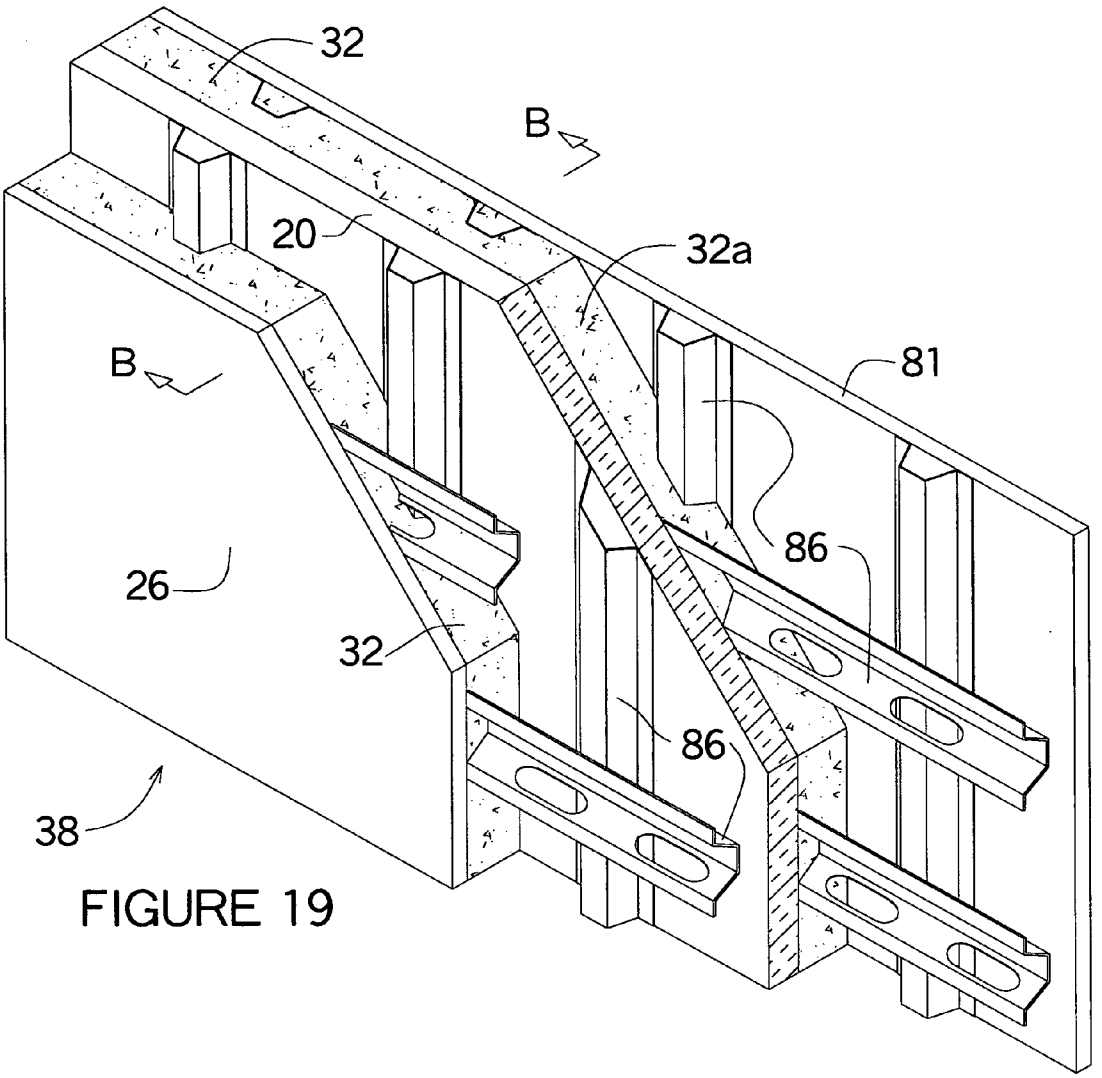

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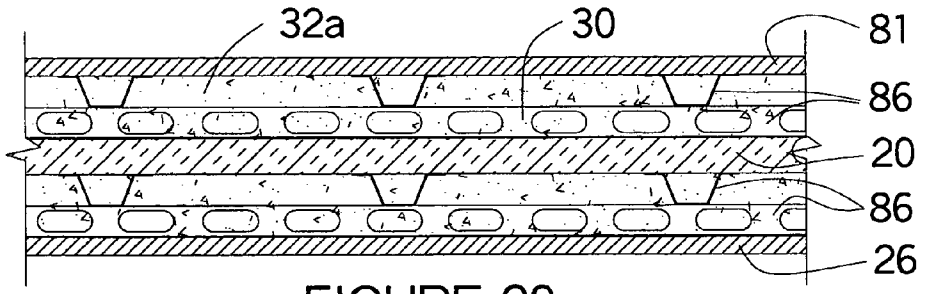

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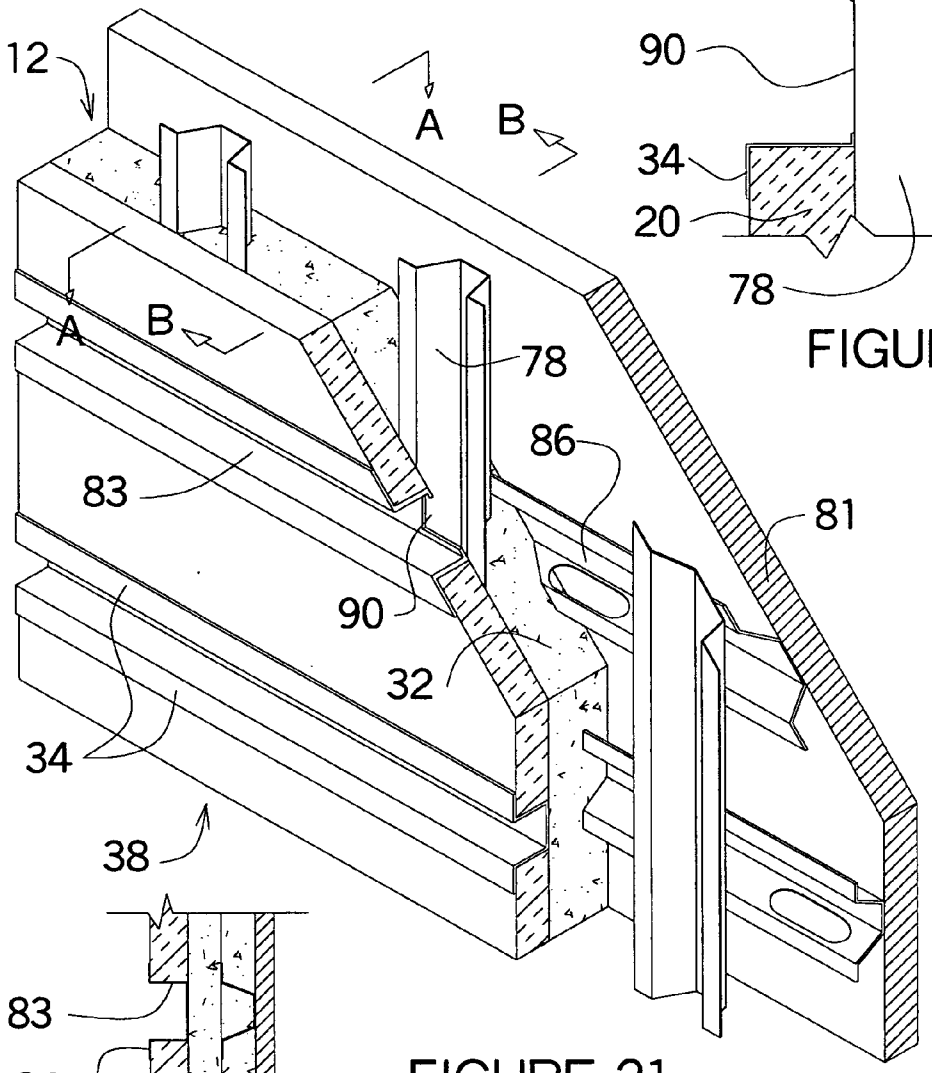

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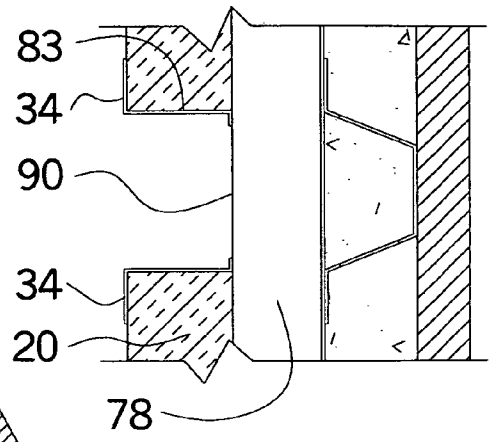

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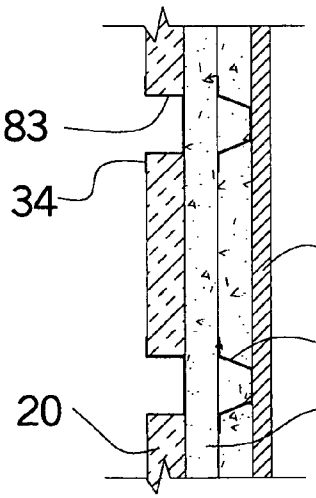

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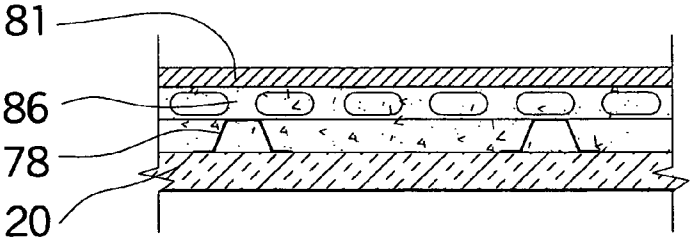

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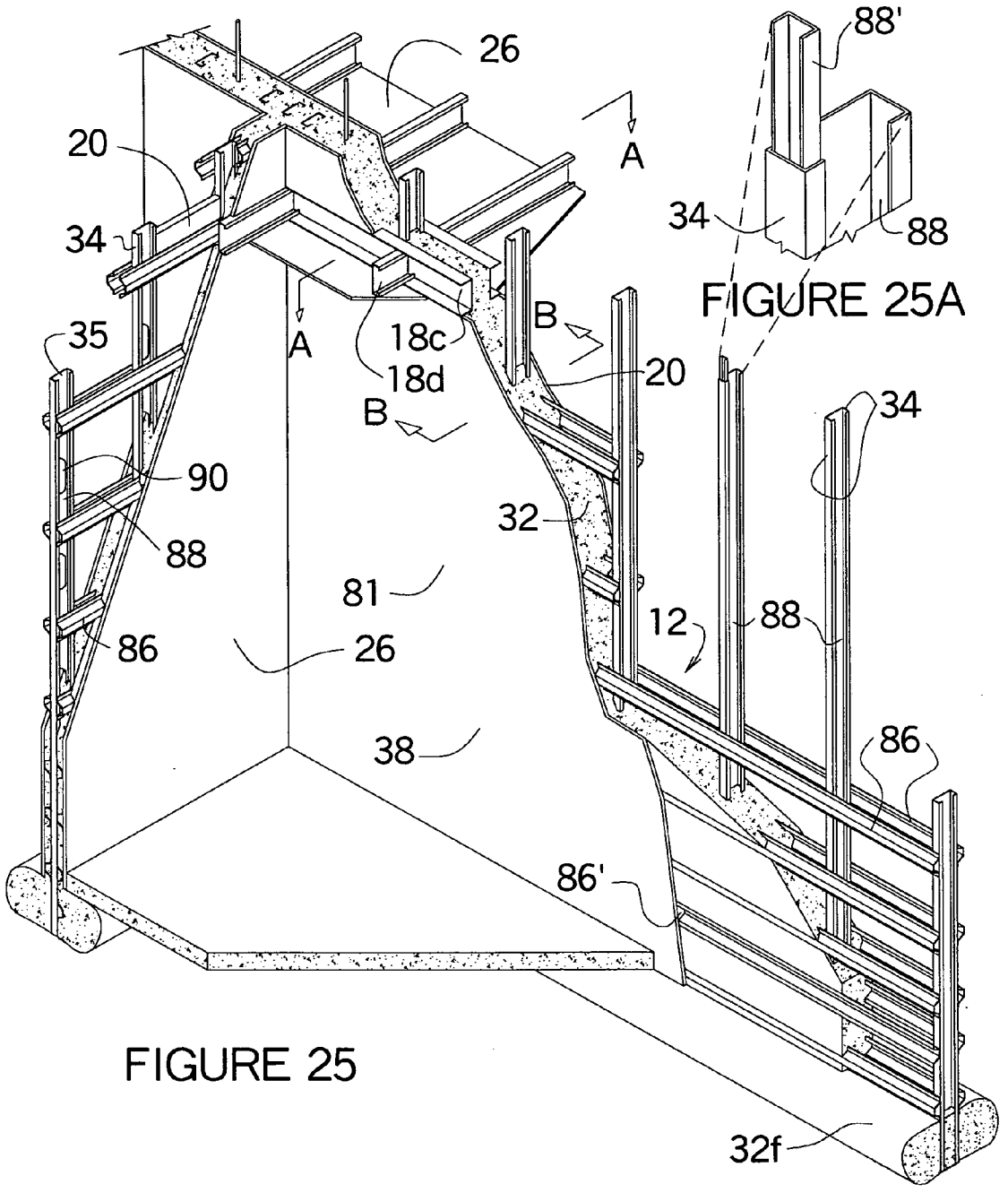
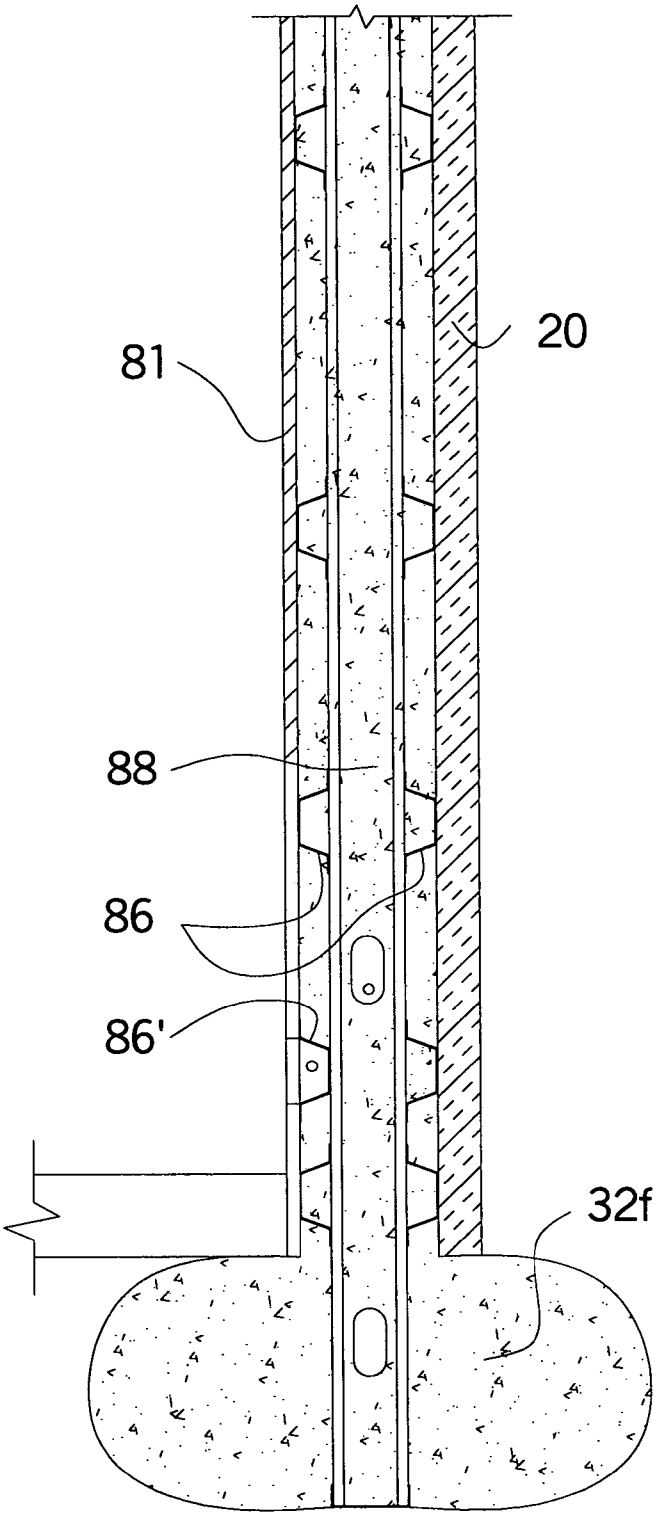


FIGURE 25A

FIGURE 25



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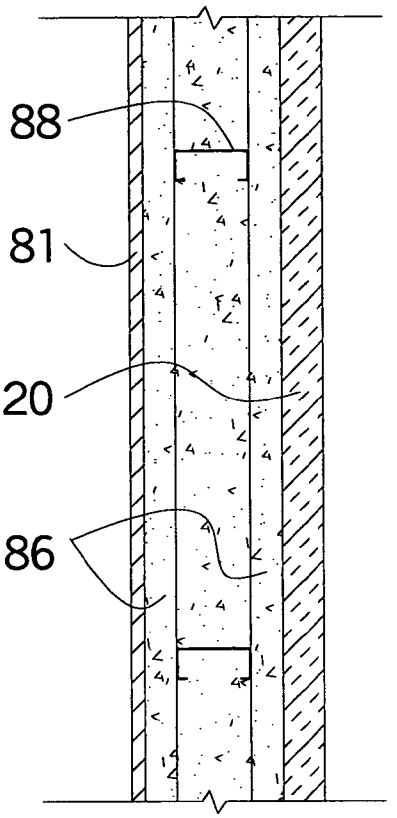

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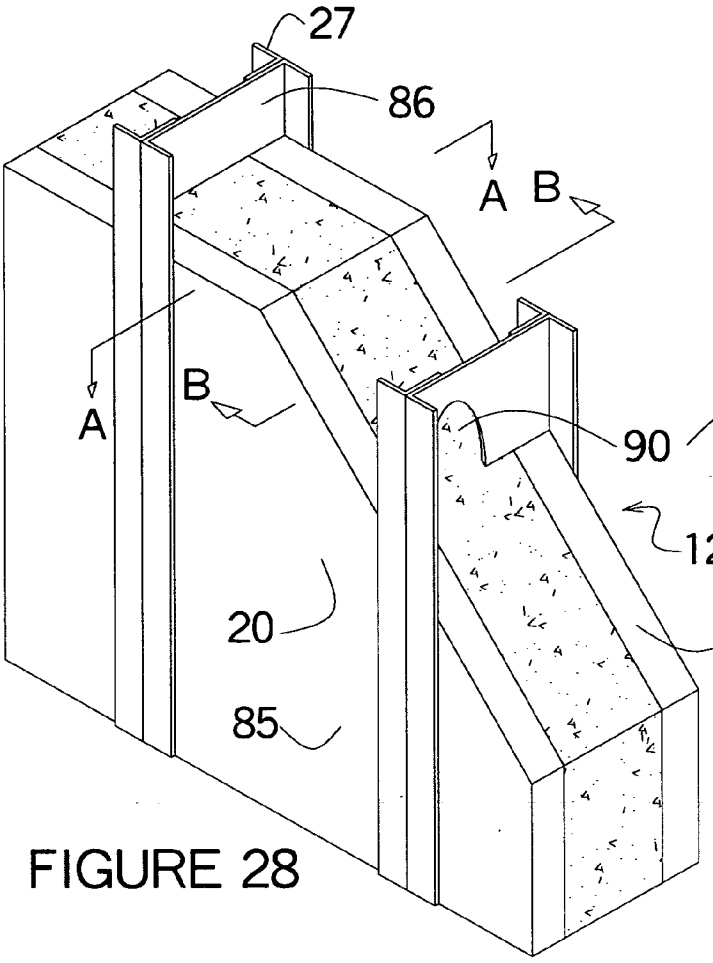

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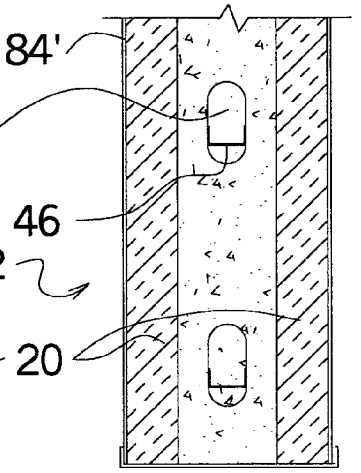

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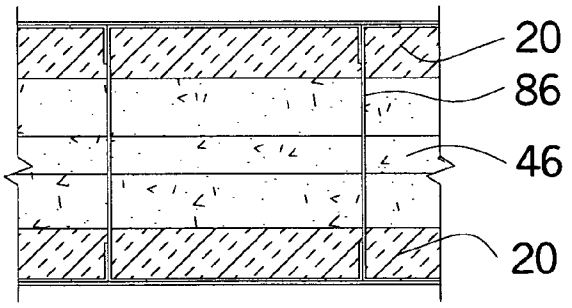

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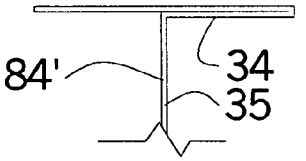

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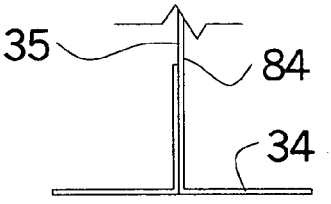

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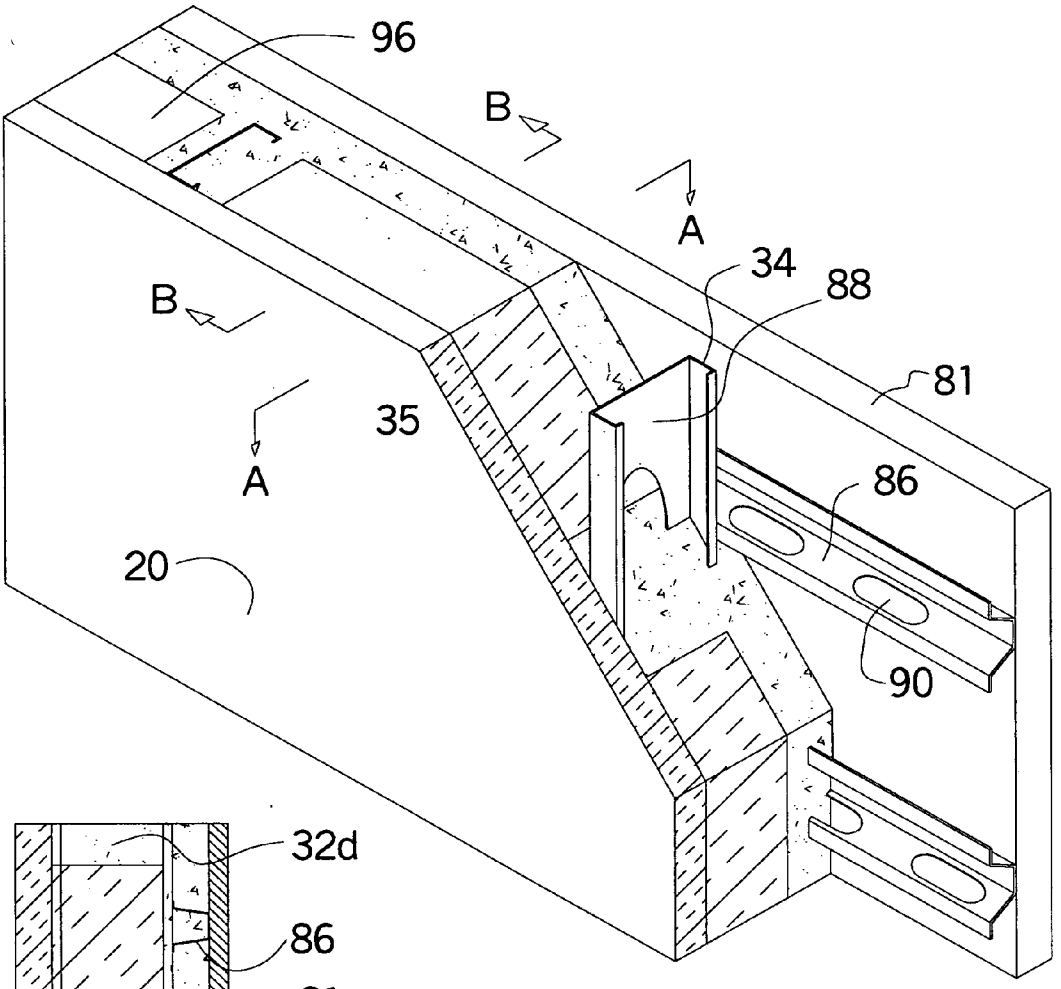

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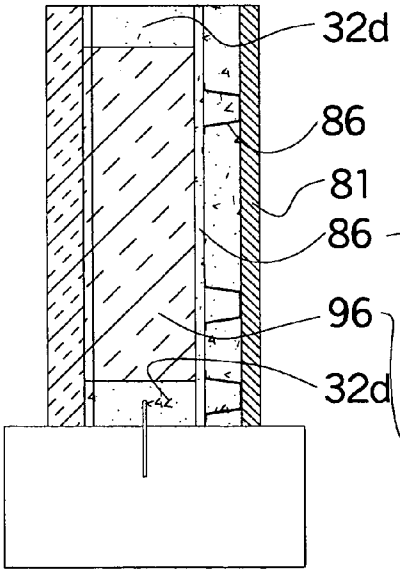

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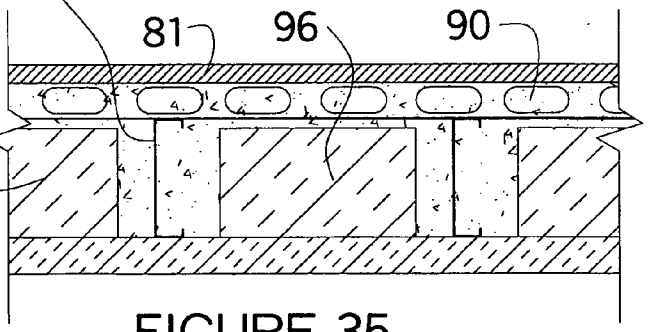

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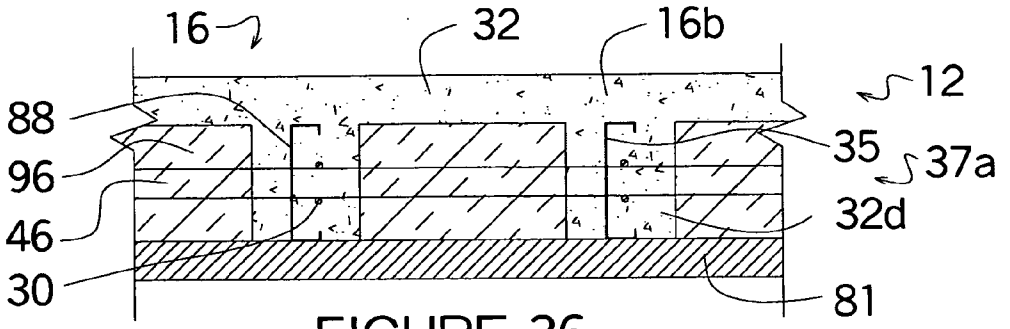

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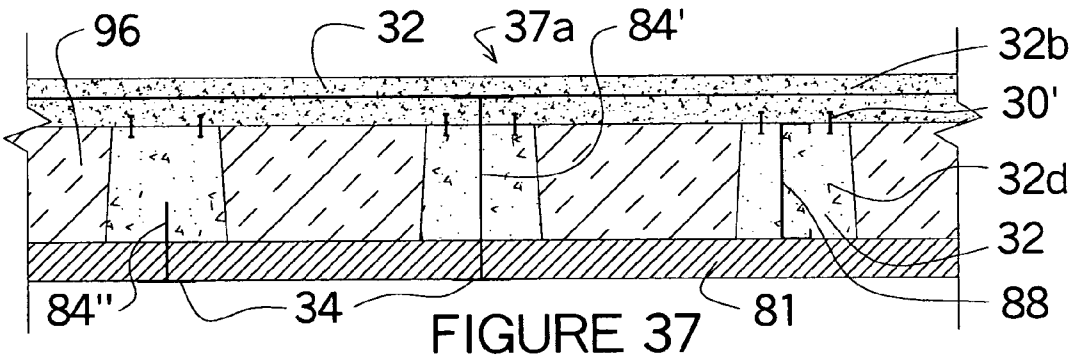

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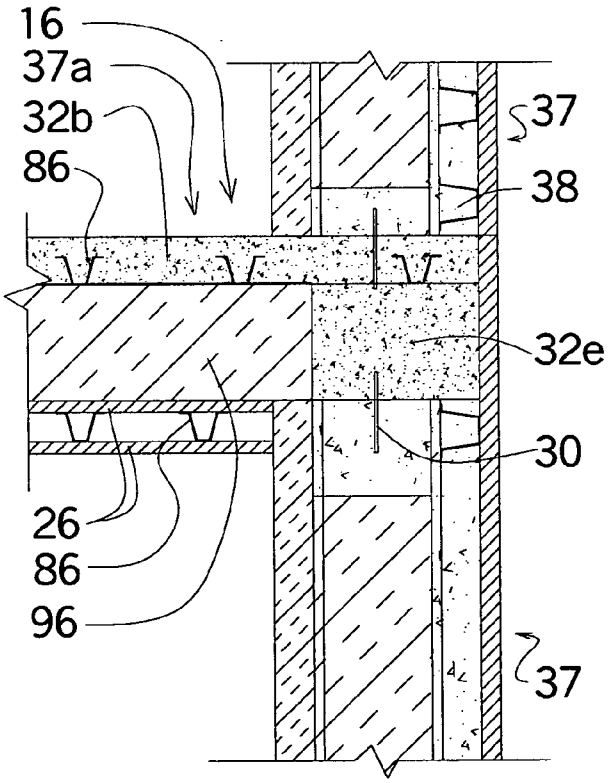

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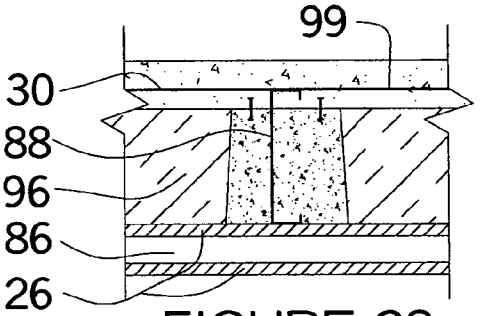

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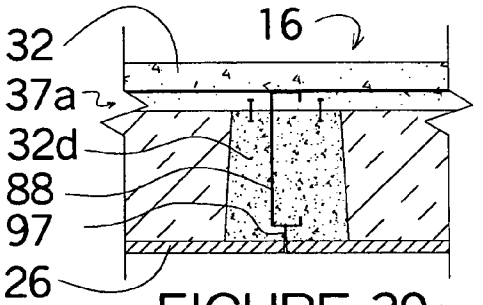

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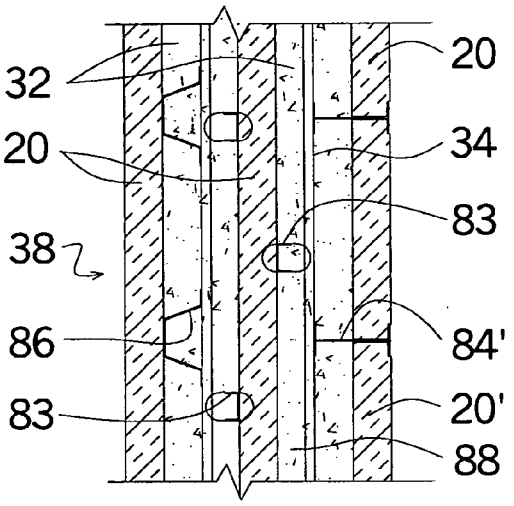

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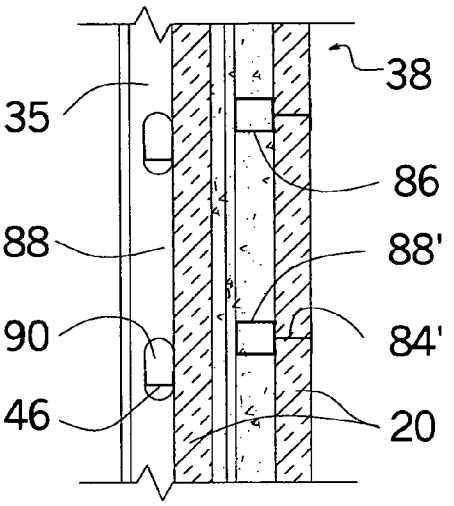

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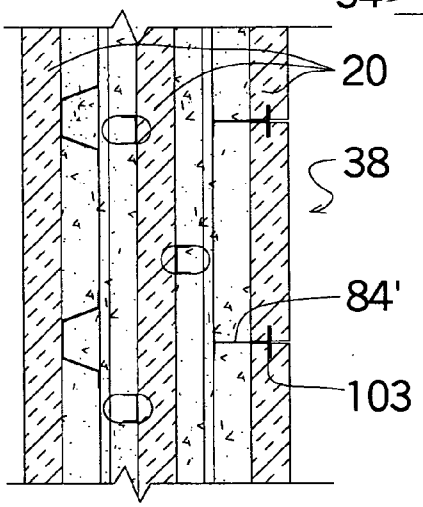

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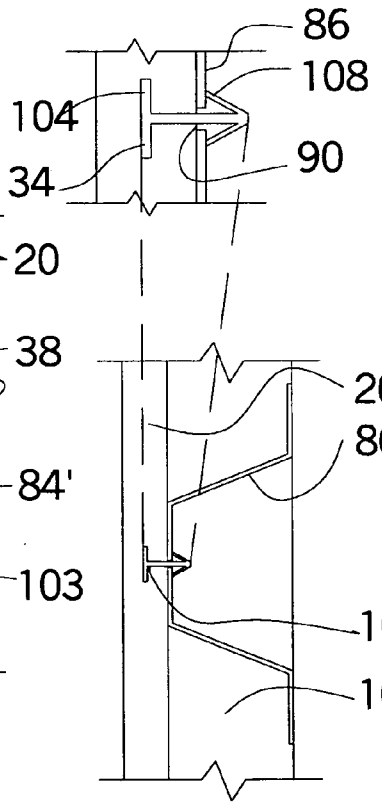

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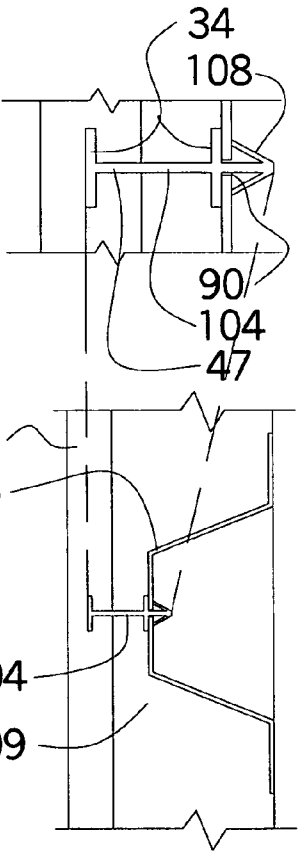

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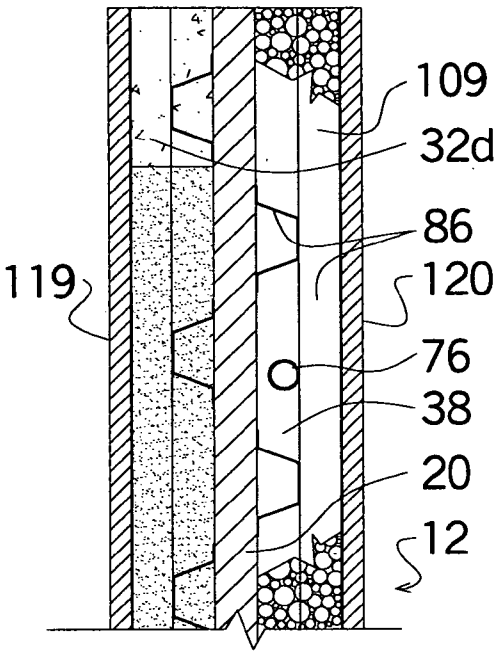

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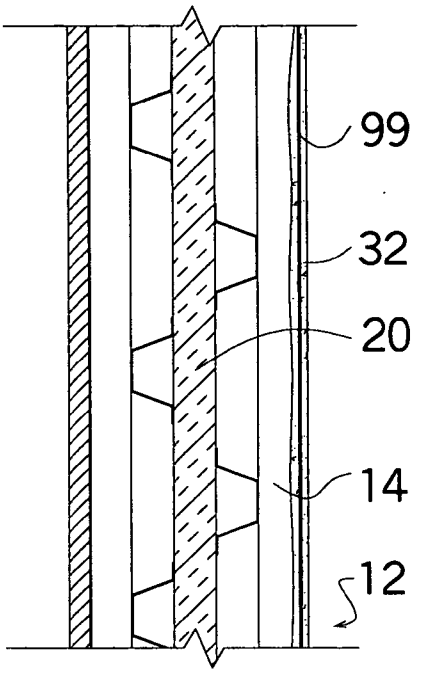

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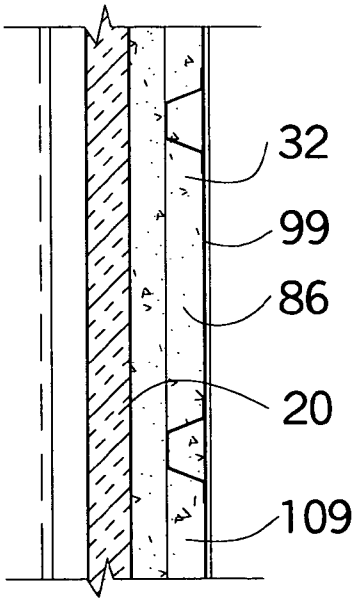

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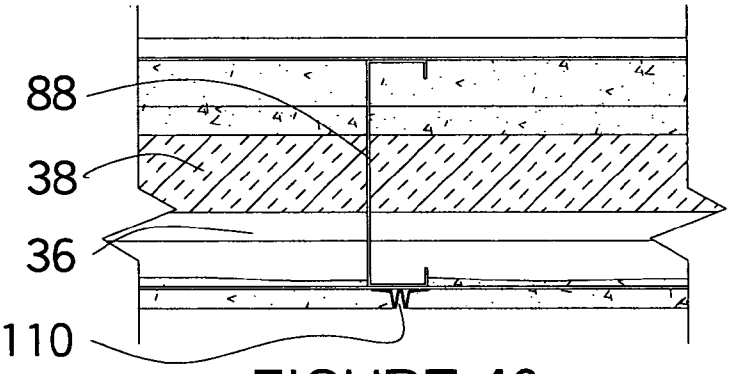

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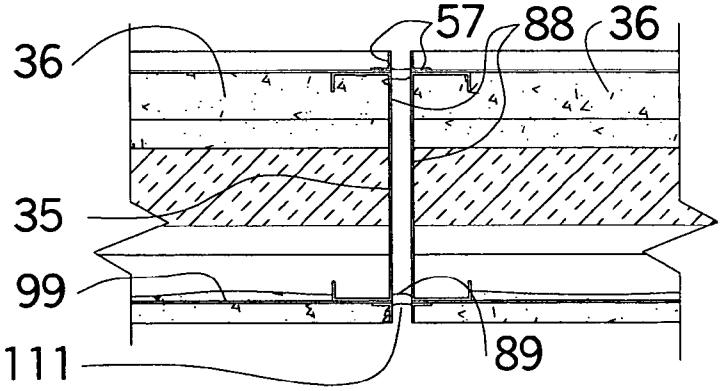

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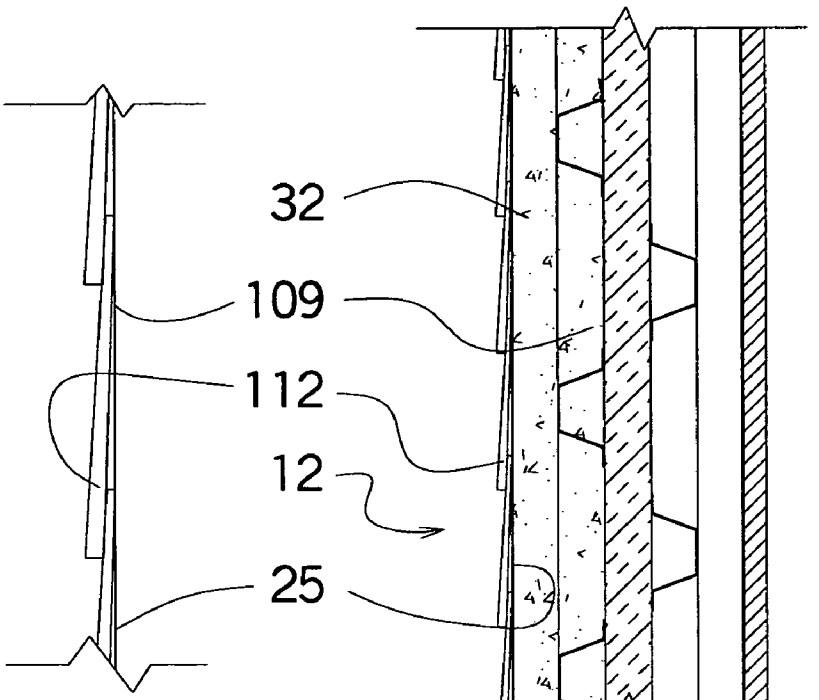

FIGURE 51

FIGURE 52

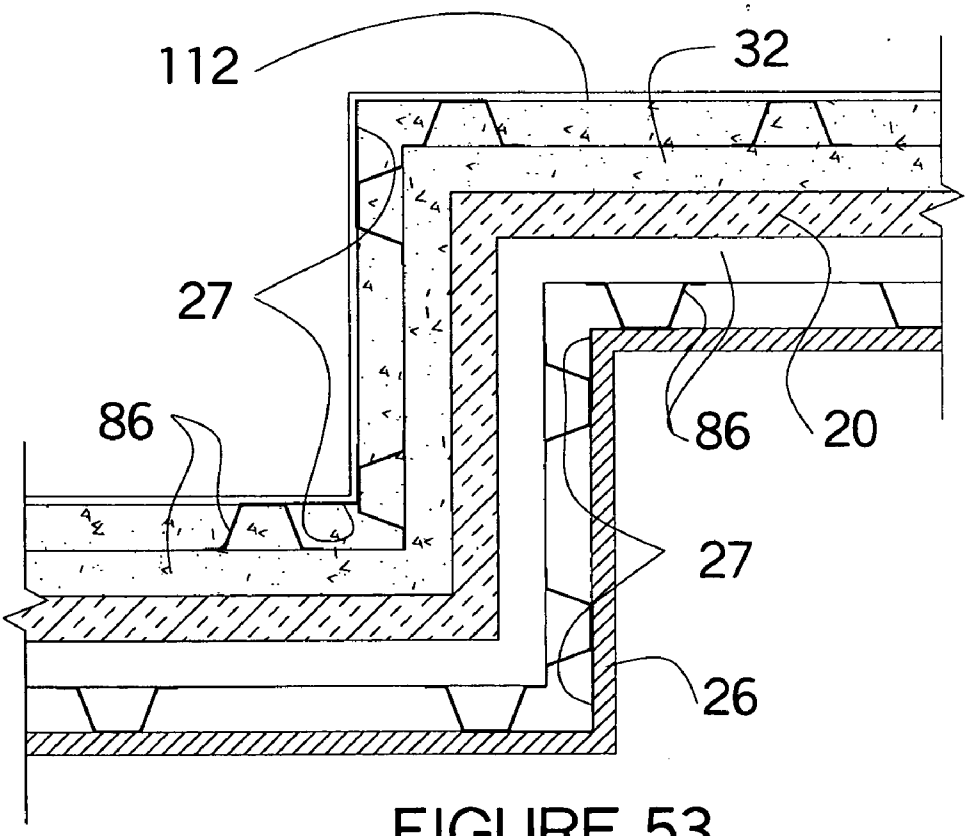

FIGURE 53

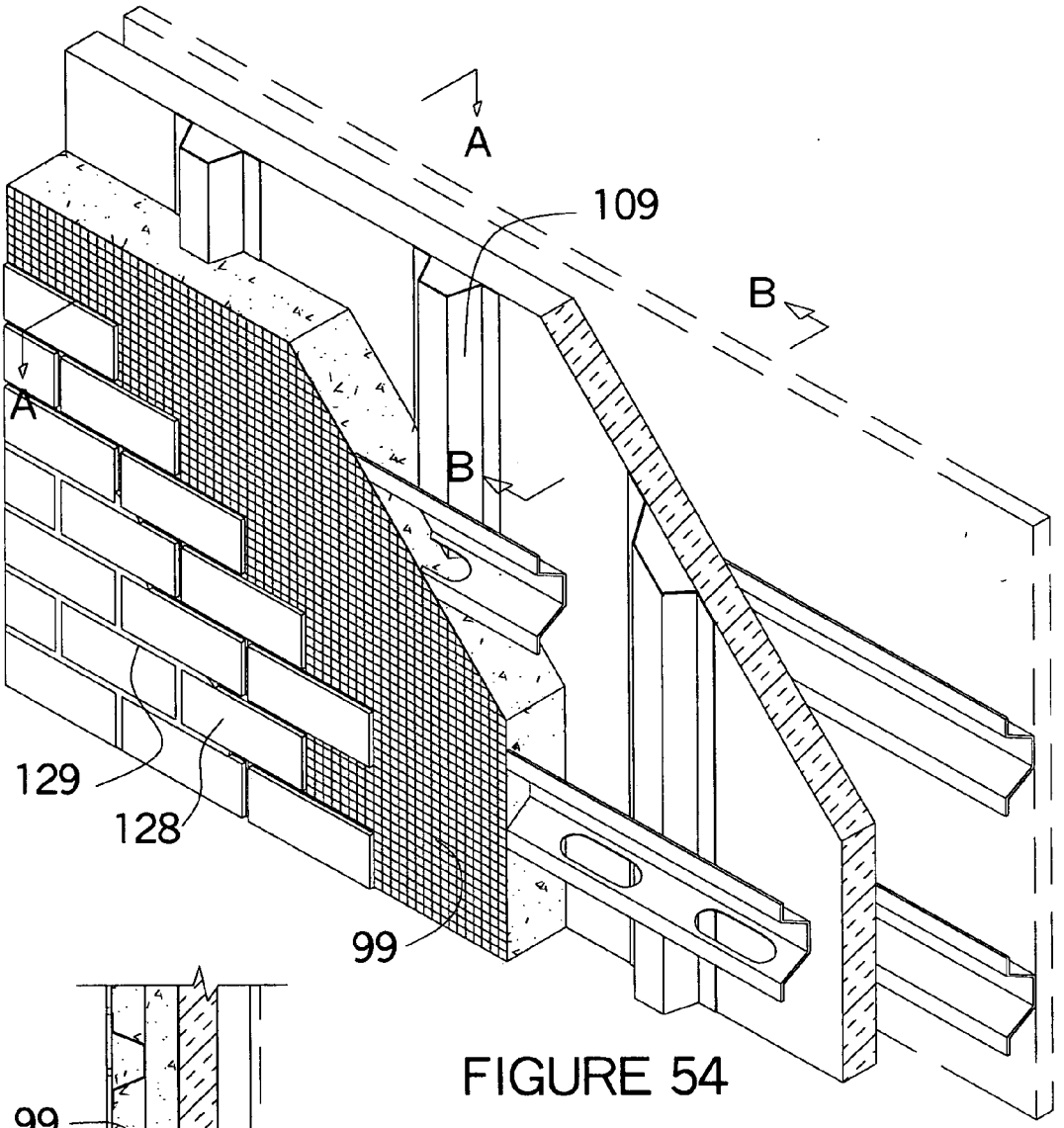

FIGURE 54

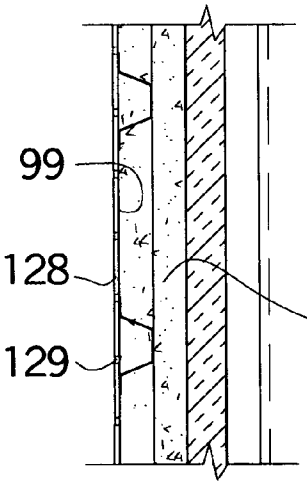

FIGURE 55

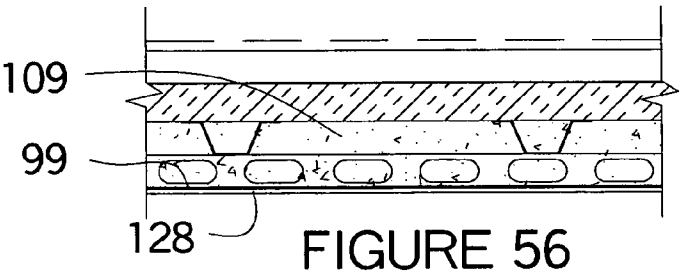

FIGURE 56

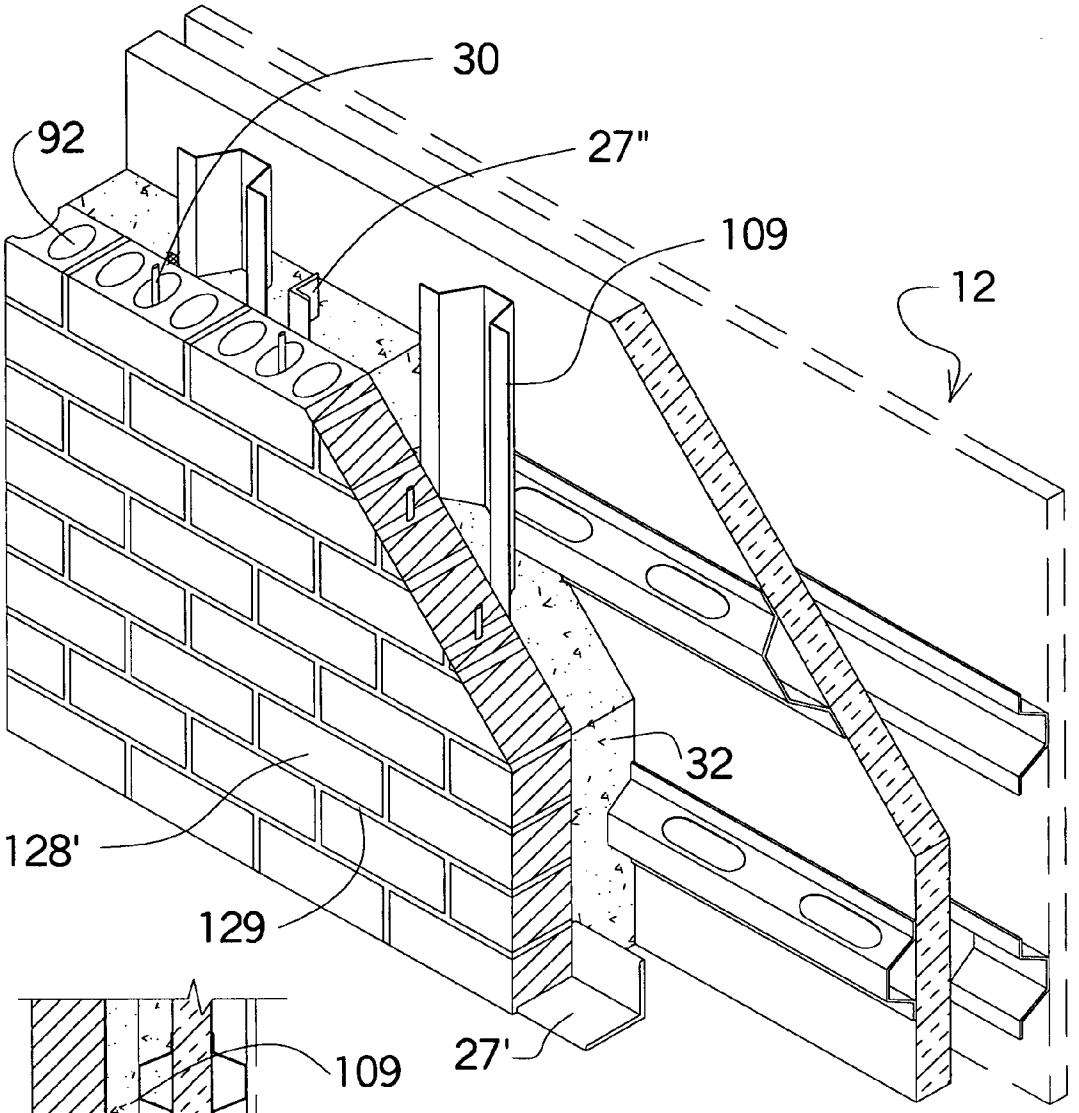

FIGURE 57

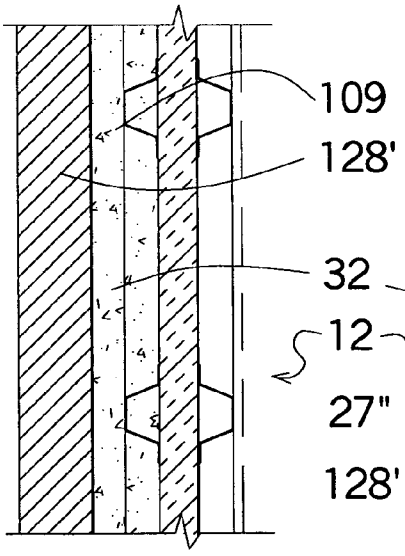

FIGURE 58

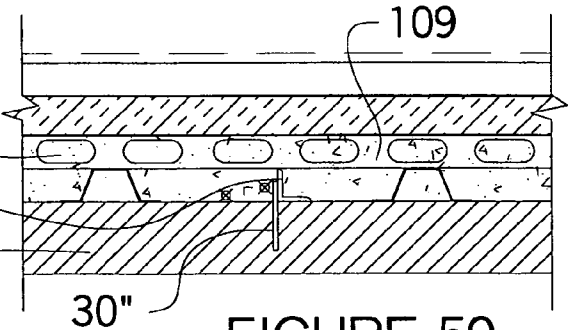

FIGURE 59

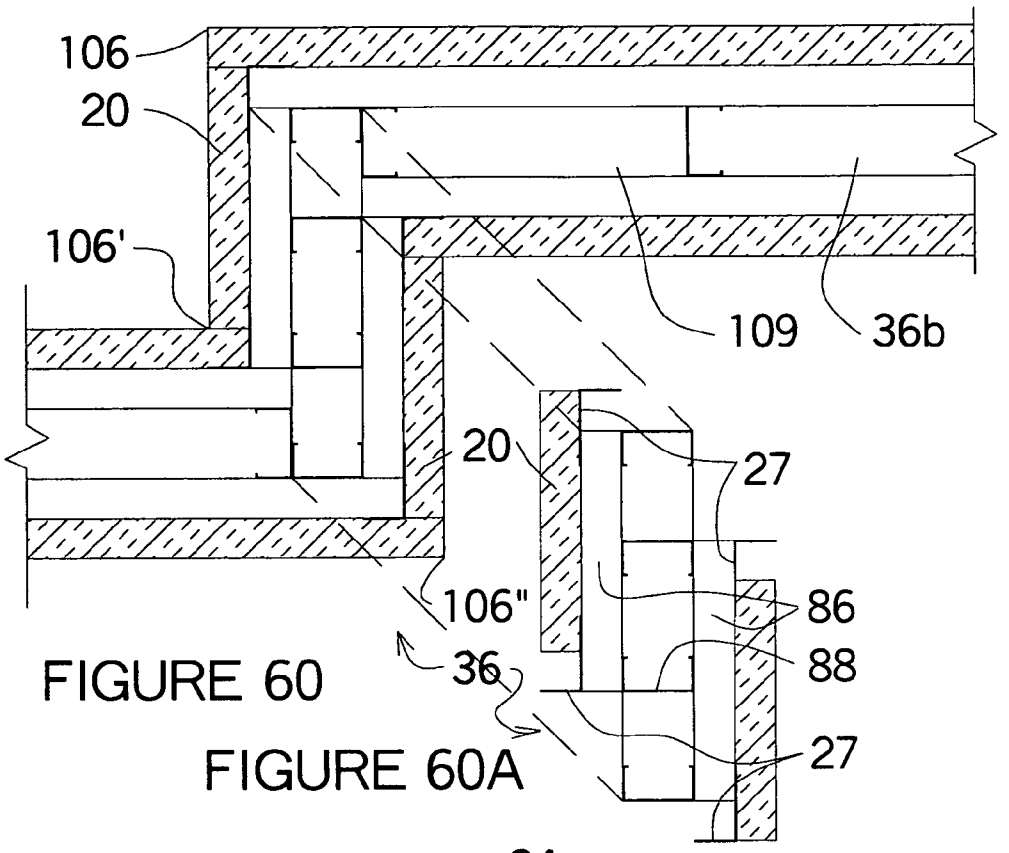

FIGURE 60

FIGURE 60A

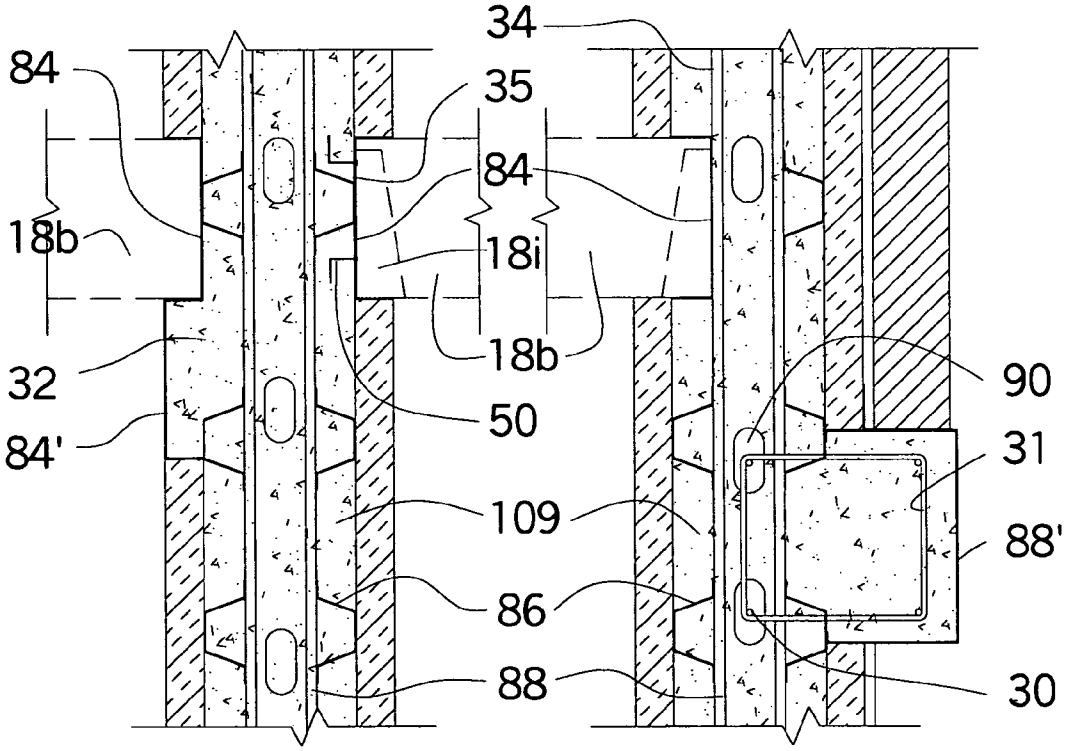

FIGURE 61

FIGURE 62

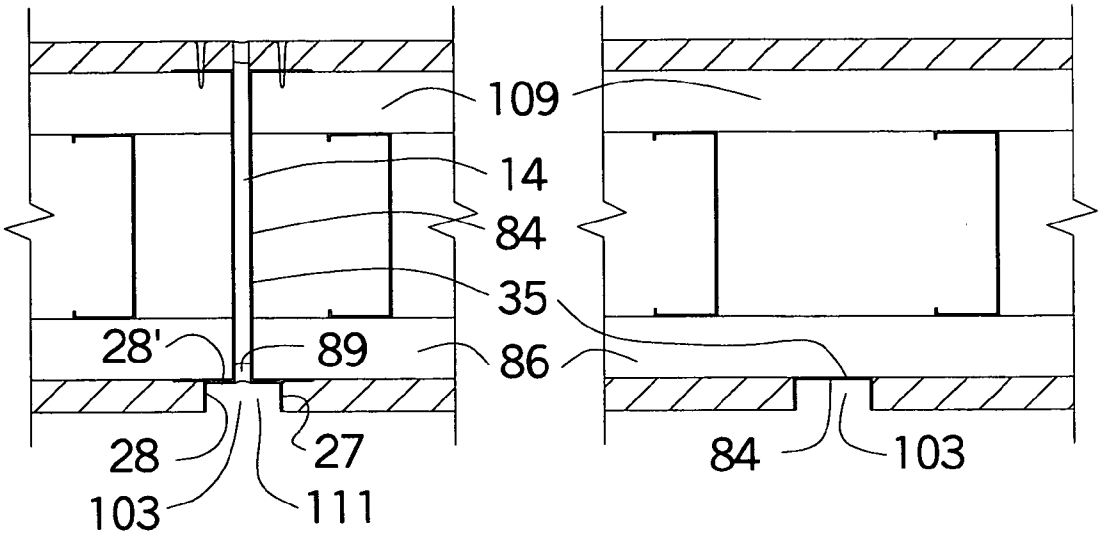

FIGURE 63

FIGURE 64

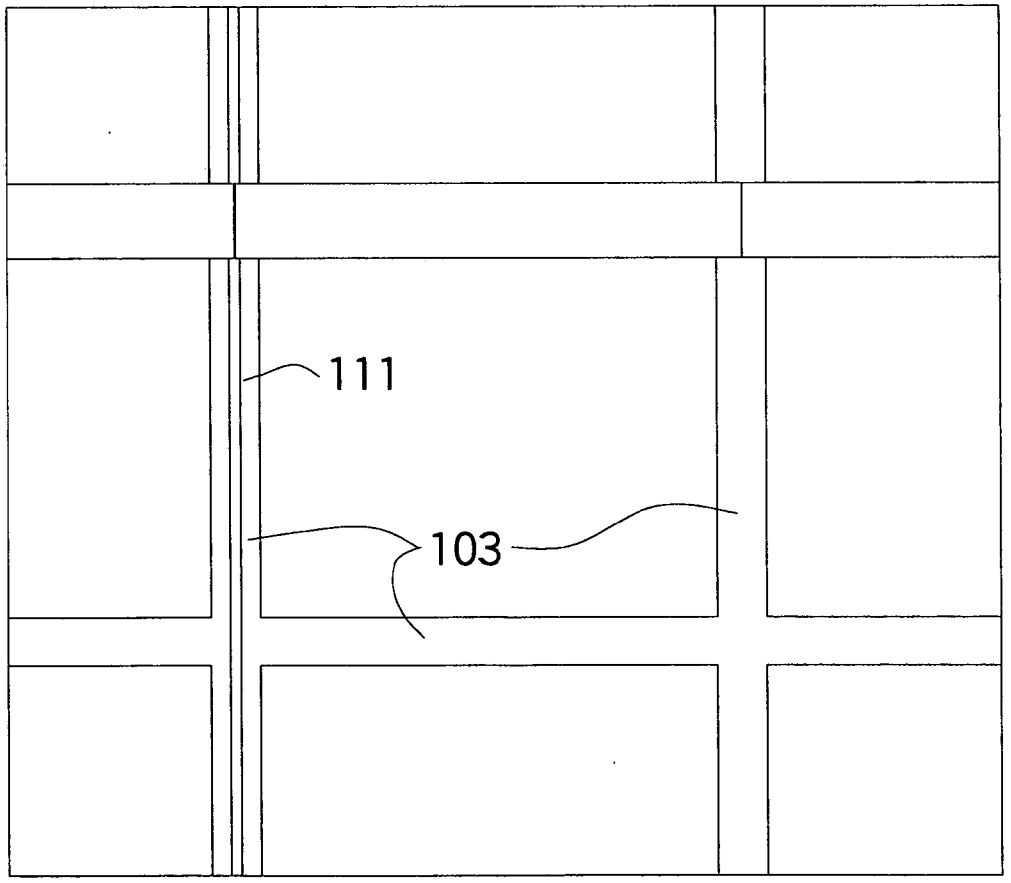

FIGURE 65

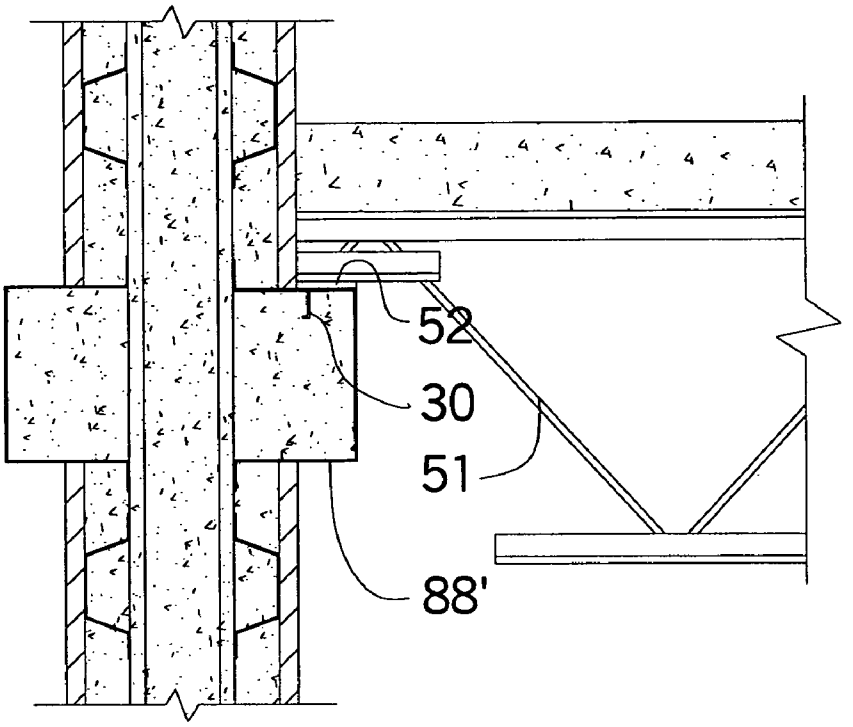

FIGURE 66

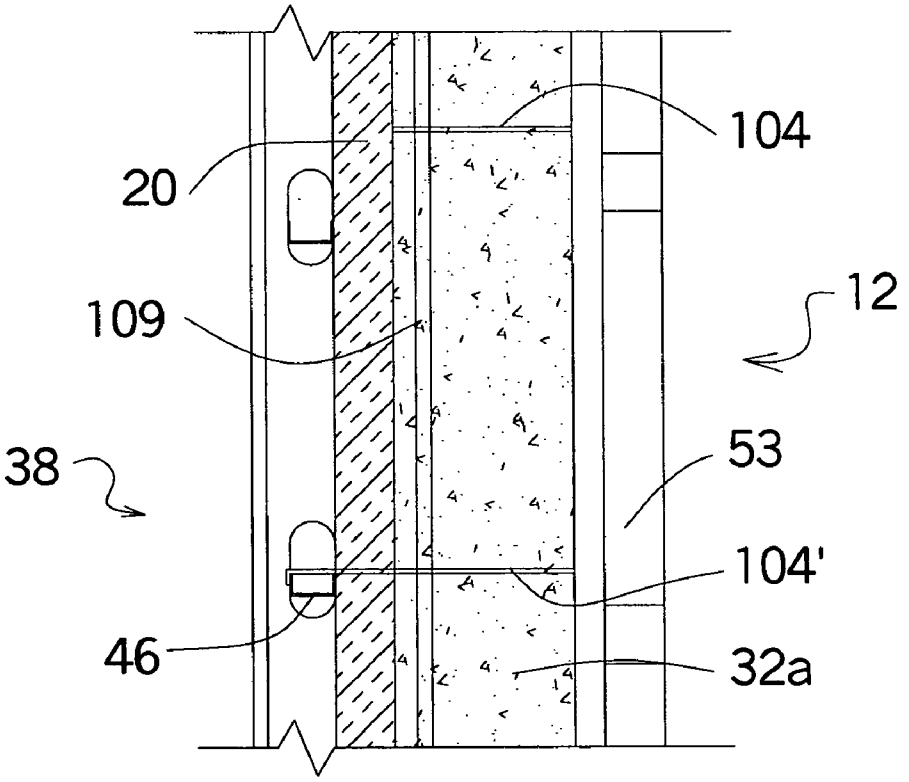

FIGURE 67

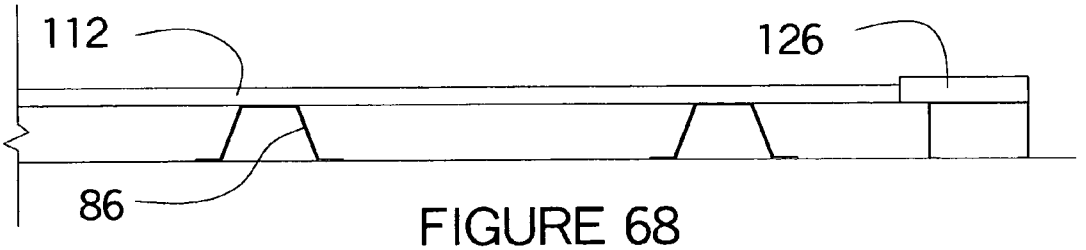

FIGURE 68

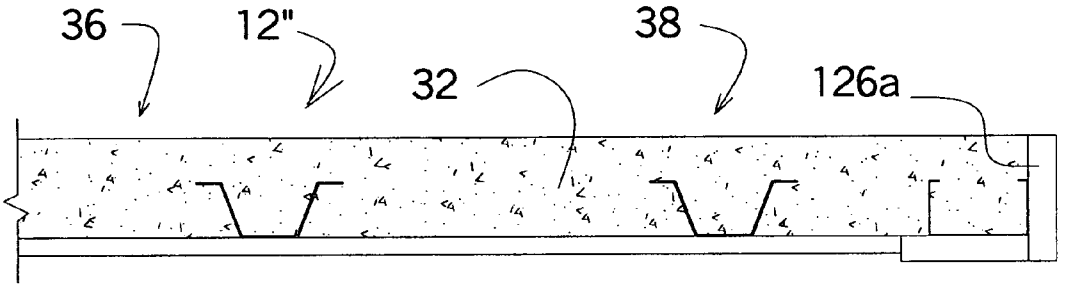

FIGURE 69

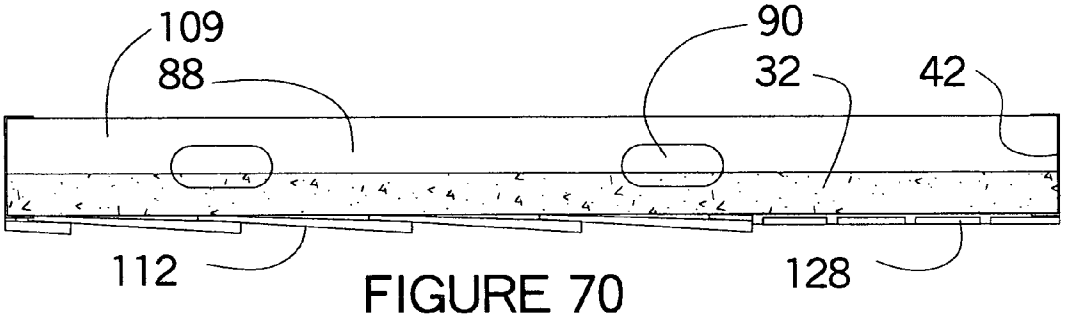

FIGURE 70

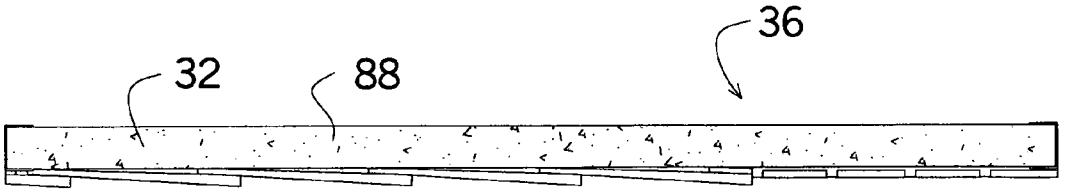

FIGURE 71

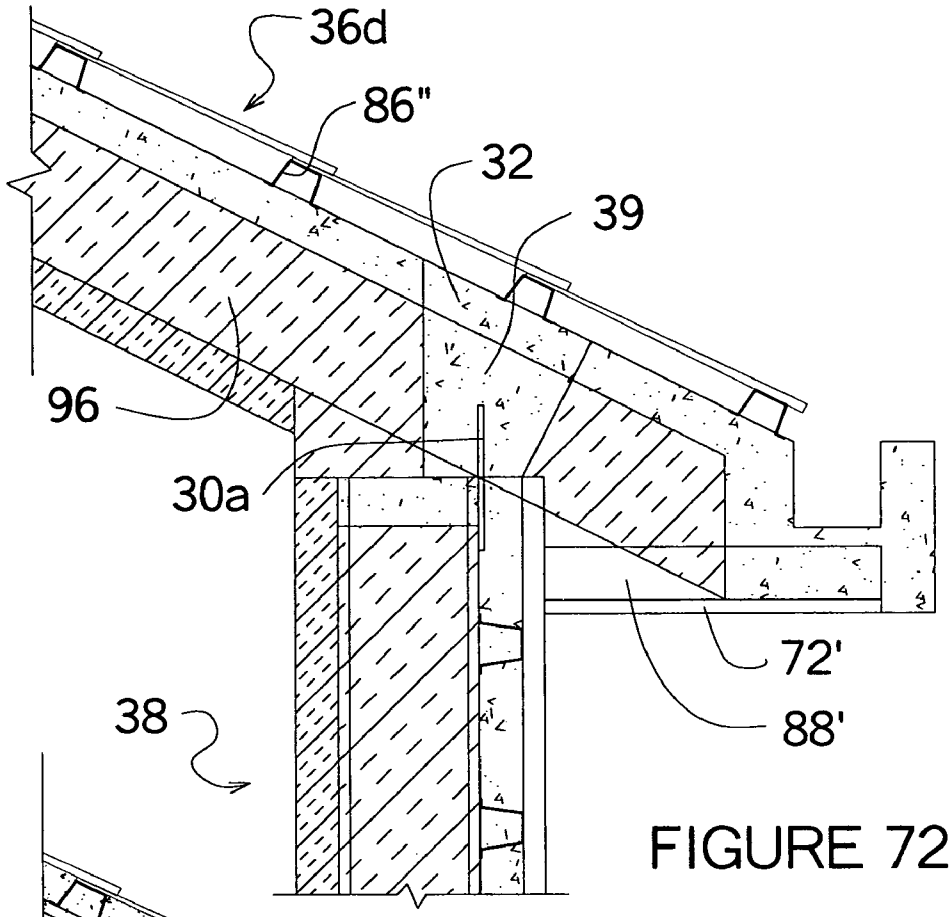

FIGURE 72

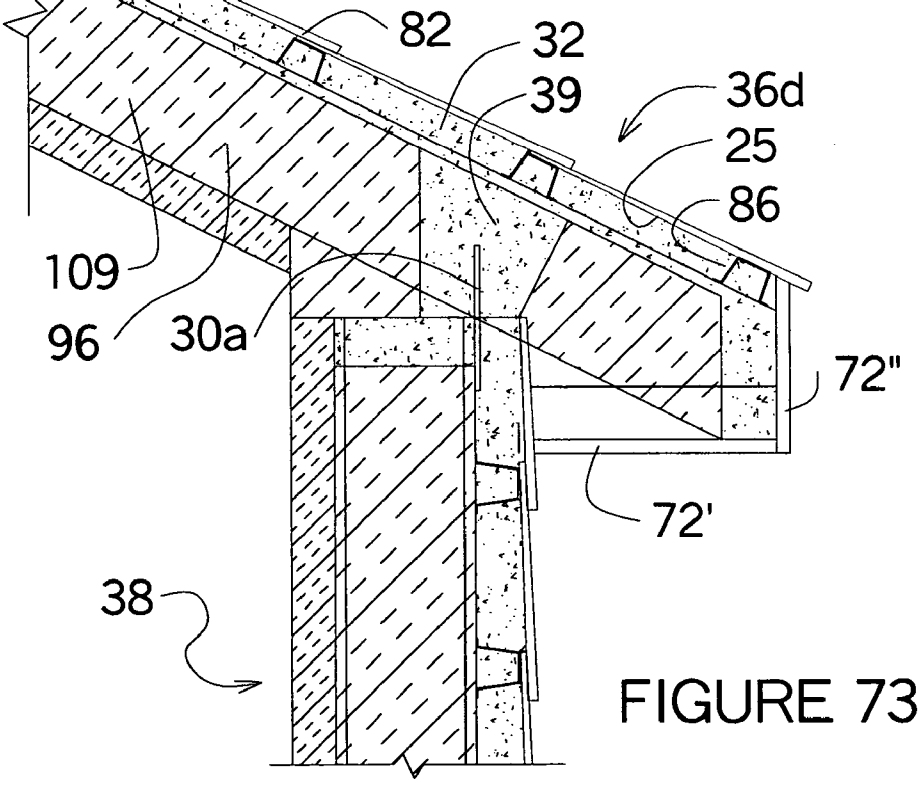

FIGURE 73

MODULAR BUILDING CONSTRUCTION EMPLOYING CONCRETE MOLD ASSEMBLY

FIELD OF THE INVENTION

[0001] The invention is directed to a modular building construction involving the assembly of panelized and modular building units manufactured off site and installed on site, said units employing on site molded concrete juncture means, said units consisting of walled one, or a combination of walls, floor and ceiling section modules assembled and unified on site.

DESCRIPTION OF THE PRIOR ART

[0002] The building has been constructed by the assembly of off site manufactured floor, wall and ceiling components brought to a building site and individually installed and unified at a construction site as a unified structure. The finished materials are exposed to the inside of the structure, for example, typically drywall is installed on the walls and ceiling. The floor of the unit is usually finished in carpet, ceramic or vinyl tile with the under layer of the floor being either concrete or wood sub floor finished. However, conventionally is brought to the construction site unfinished on the interior with an exterior sheathing, such as plywood or insulation, forming a structural system of wood joists or metal light gauge metal channels. After the floor, walls and ceilings are installed, lightweight concrete is poured over the plywood subfloor as sometimes required by National Building Codes.

[0003] In modular construction, the walls, floor and ceiling components are brought to the construction site as a single unit. The panelized technique has similar size restrictions, but constructing a modular component under the same limitations is more difficult. The width of all modular construction components are the width of what can be transported via a truck plus not exceeding the height limitations under bridges.

[0004] In panelized construction, the finished interior of the building is left exposed with the wood studs or galvanized metal channels. Sheathing is installed on the exterior side of the wall. For the interior panelized walls, the structural system is exposed and no sheathing or interior finish is shipped with the panel.

[0005] Modular construction involves the shipment of an entire three-dimensional structure, the interior being finished with dry wall or other material that is specified for that specific project. For the interior panelized walls, the structural system is exposed and no sheathing or interior finish is shipped with the panel since the visible shipped transported unit having the visible finish that is the exterior structure of wood studs or galvanized metal channels. It is noted that the construction industry ships bathroom modulars, portions or sections of housing units, kitchen modulars, hotel room modulars, and jail cell modulars just to name a few.

[0006] A building can contain many smaller modules, which will then become a part of a larger unit module. When these various modules are installed at a building site, such modules can be placed adjacent to each other or can have a void between the modules. This void functions as the mold into which concrete can be installed so as to create a greater structural system, stronger than any of its parts. The concrete wall also has a mass and mass reduces sound transmission, for example, between one apartment and another apartment. In addition, concrete is a fire rated material; the thicker the concrete, the greater the fire protection. For example, a 12-inch concrete wall is rated as a 4-hour wall and a six-inch wall will be rated only as a two-hour wall. The thicker the wall, the longer it takes for a fire to penetrate or spread to another area of the building. Concrete forms are installed on both sides of a concrete wall and tied together with a form tie. Reinforcing bars are added between the forms and the forms are sprayed with a release agent prior to pouring concrete between the forms. After the concrete is poured and the concrete has cured enough, the forms are removed. The exposed concrete is the remaining finish of the wall. After the forms are removed, the walls are furred out, that is additional wood or steel furring strips are added inside surface can be installed and dry wall can be added to create an interior finished wall surface.

[0007] Another method of building concrete walls is described as an "ICF", i.e. an "Insulated Concrete Form". This method involves rigid insulation being used to create the outside surface and ties are used to hold the insulation together creating the mold into which concrete can be poured. Reinforcing bars are added into the insulated concrete form and exterior temporary wall bracing is installed for lateral bracing. In this case, the insulation remains as the exterior finish of the wall. After the wall is poured, the insulation is hollowed out for the electrical wiring, the drywall is glued onto the wall or additional furring strips are added and then the drywall is added to create the interior finished wall surface.

[0008] The invention provides a self-contained mold formed by installation of two or more modules spaced apart to allow for concrete to form between the modules. The wall can be formed of metal or wood construction, preferably having an interior finish, which is to be the interior finish of the resulting structure. Reinforcing bars are added into the mold and floors, ceilings and interior walls are installed for wall bracing. In this case the insulation or wallboard, siding or brick remains as the exterior finish of the wall. The electrical distribution is distributed through the interior forming structure of the individual wall.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is an isometric representation of modular building components stacked on top of each other and joined together to form a larger unit or building component.

[0010] FIG. **1**A is an isometric enlargement of two adjacent modules;

[0011] FIG. **2** is a representation of a modular wall section showing two adjacent modules installed adjacent to each other, the modules being illustrated separated with an air space between them. One of the modules is shown separated from the wall mold prior to being installed on the job site.

[0012] FIG. **2**A is a diagrammatic representation showing the relationship of a single portion of one of the adjacent walls shown in FIG. **2**;

[0013] FIG. **3** is a plan section taken along line B-B of FIG. **2** showing the mold formed by placing two modules adjacent to one another, but yet separated apart to form the

mold for concrete to be installed; wall-forming ties being illustrated as installed between the one module and another module;

[0014] FIG. **4** illustrates a wall section of a panelized construction;

[0015] FIG. **4**A is a diagrammatic representation showing the relationship of a single portion of one of the adjacent walls shown in FIG. **4**;

[0016] FIG. **5** is an isometric representation of two modules placed adjacent to one another, one of the modules illustrating the various components that make-up the module being coupled to the adjacent module;

[0017] FIG. **6** illustrates a wall section showing a pair of modules installed near each other but separated by an air space, one of the modules being a modular wood construction;

[0018] FIG. **6**A is a diagrammatic representation of a module wall illustrated in FIG. **6**, showing the components of the module construction adjacent the wall section illustrated in FIG. **6**;

[0019] FIG. **7** is a plan view of a concrete mold formed by placing two modules adjacent to one another, but yet separated apart to constitute a mold for concrete to be installed, said view showing the wood studs and the floor and ceiling joists overlapping the wood studs.

[0020] FIG. **8** is a sectional view of a panelized wood construction illustrating two separate building module units that are installed near each other, but separated by an air space. One of the building units is illustrated as separated from the from the wall mold prior to being installed at the job site as well as separated by the wall, floor and ceiling building components;

[0021] FIG. **8**A is a diagrammatic illustration showing the relationship of elements of FIG. **8** of the wall section illustrated in FIG. **8** to the adjacent module;

[0022] FIG. **9** illustrates a modification of the panelized wood construction shown in FIG. **8**;

[0023] FIG. **9**A is a diagrammatic illustration showing the relationship of elements of FIG. **9** to the wall section illustrated in FIG. **9** to the adjacent module;

[0024] FIG. **10** is an isometric representation of a module having a thin wall of a module building using one of many types of poured-in-place wall construction where only a portion of the wall is filled with concrete and the remainder of the wall interior is left exposed for future electrical installations.

[0025] FIG. **11** is a section of the wall construction of FIG. **10** taken along line A-A of FIG. **10**;

[0026] FIG. **12** is a plan view of the wall construction of FIG. **10** taken along line B-B of FIG. **10**;

[0027] FIG. **13** is an isometric view of the wall construction of FIGS. **10-12** in which the wall is constructed as a double-sided construction;

[0028] FIG. **14** is a section of the wall construction of FIG. **13** taken along line A-A of FIG. **13**;

[0029] FIG. **15** is a plan view taken through line B-B of FIG. **13**;

[0030] FIG. **16** is an isometric representation of a wall construction using only hat channels as a supporting system.

[0031] FIG. **17** is a section of the wall of FIG. **16** taken along line A-A of FIG. **16**;

[0032] FIG. **18** is a plan section of the wall of FIG. **16** taken along the line B-B of FIG. **16**;

[0033] FIG. **19** is an isometric representation of a similar wall construction shown in FIGS. **16-18** except here is a double-sided, i.e. a thicker wall with an interior rigid insulation thermal break similar to a precast concrete wall with rigid insulation in the interior;

[0034] FIG. **20** is a plan section taken along the line B-B of FIG. **19**. The wall construction is built in the same manner, that is, where hat channels are placed on a table the length of the wall;

[0035] FIGS. **21-24** show a construction similar to the construction shown in FIGS. **19-20** where horizontal hat channels are spaced between rigid insulation and the open side of the hat channel facing the interior side of the wall;

[0036] FIG. **21** is an isometric representation of the construction using hat channels as a supporting system and an electrical distribution system;

[0037] FIG. **22** is a wall section taken through line A-A of FIG. **21**;

[0038] FIG. **23** is a plan section taken through line B-B of FIG. **21**;

[0039] FIG. **24** is a vertical wall section taken through hat channel **78** of FIG. **21**;

[0040] FIGS. **25-31** illustrate a wall structure having smaller vertical C channels and horizontal hat channels to create a wall structure;

[0041] FIG. **25** is an isometric drawing of the wall construction showing the vertical C-channels extending below the interior structure of the wall form into a concrete footing, which can be installed simultaneously with the concrete within the form:

[0042] FIG. **25**A is an enlarged isometric showing the vertical electrical distribution with the wall;

[0043] FIG. **26** is a wall section taken along taken along line A-A of FIG. **25**;

[0044] FIG. **27** is a plan section taken along lines B-B of FIG. **25**;

[0045] FIGS. **28-31** illustrate a wall structure where the interior structure of the mold extends to the outside surface of the wall board or rigid insulation;

[0046] FIG. **28** is an isometric representation of the wall construction of FIG. **28**;

[0047] FIG. **29** is a wall section shown along lines A-A of FIG. **28**

[0048] FIG. **30** is a plan section taken along lines B-B of FIG. **28**

[0049] FIG. **31** is an enlarged detail of the end of the U Channel and, instead of an angle added to the flange, the flange is bent **180** degrees and extends beyond the web of the U-Channel;

[0050] FIG. **32** is an enlarged detail of the end of the U Channel and shows an angle member attached to the web of the U Channel and being level to the flange of the U channel;

[0051] FIG. **33** is an isometric representation of the wall construction where the concrete structure within the wall is a vertical ribbed structure.

[0052] FIG. **34** is a wall section taken along lines A-A of FIG. **33** shows the interior rigid insulation not placed the full height of the wall, but shorter at both the top and bottom of the wall so concrete can form a beam at the top and bottom of the wall;

[0053] FIG. **35** is a plan section taken along section B-B of FIG. **33** shows holes in the hat channel allowing the concrete to flow more easily around and through the hat channels; additional hat channels being at the bottom of the wall due to increased pressure of the concrete at the bottom of the wall forming structure;

[0054] FIGS. **36** and **39** shows a wall construction similar to FIGS. **33** through **35** but instead of concrete being installed when the wall is erected in a vertical position, the concrete is installed in a horizontal position; the construction of the wall system being capable of being used either as a wall system, as a floor system or as a roof system;

[0055] FIG. **36** showing metal C channels spaced in an array and a flange of the C channels being attached to the rigid board and to metal C channels creating a rigid frame since they criss-cross each other;

[0056] FIG. **37** is similar to FIG. **36** and provides interior foam spacers tapered to be wider at the bottom of the beam;

[0057] FIG. **38** is similar to FIG. **37** but adds metal hat channels between two rigid boards below the metal C channels plus a larger C channel with wire mesh embedded in concrete floor;

[0058] FIG. **39** is similar to FIG. **38** except the depth of the concrete is deeper; a spacer being installed between the metal C channel and the rigid board below the beam for increased fireproofing;

[0059] FIG. **40** shows the flooring system attached to a vertical poured wall system plus a transverse beam criss-crossing the concrete floor beams;

[0060] FIGS. **41-45** show various types of connectors used to make the construction easier to build eliminating exposed screw connectors connecting the rigid wallboard to the interior structure of the wall;

[0061] FIG. **41** is similar to FIGS. **13** through **15**, except an H channel is used in lieu of the hat channel;

[0062] FIG. **42** is similar to FIGS. **10** through **12** except H channels are used in lieu of fasteners connecting the rigid insulation;

[0063] FIG. **43** substitutes a center groove in the rigid insulation instead of H channels encasing the rigid insulation;

[0064] FIGS. **44** and **45** both show connectors embedded within a wallboard and protrude out to become a fastening method to secure said wallboard to the inner structure of the mold;

[0065] FIG. **44** has a space between the wallboard and the hat channel. The stem of the connector has a flange added to hold the connector in place. Both connectors have a V carrot at the end of the stem thereof that passes through a hole of the hat channel **86**.

[0066] FIG. **45** is similar to the structure of FIG. **44** and has a space between the wallboard and the hat channel;

[0067] FIG. **46** is built using the same wall structure as shown in FIGS. **19** and **20**. rigid insulation is in the middle of the wall provides a thermal break between the interior wall and exterior wall but provides separate chambers to install two different materials on either side of the wall gravel, stones and sand being among the materials employed;

[0068] FIG. **47** is built using the same wall structure as FIGS. **19** and **20**;

[0069] FIG. **48** shows the same wall structure as FIGS. **19** and **47**; wire mesh is installed over the outer hat channel. The wall is erected vertically, concrete is introduced, and flows through the wire mesh and into the skeleton chamber, excesses being removed by a trowel (not shown);

[0070] FIGS. **49** and **50** are similar in the wall construction, show control and expansion joints as decorative elements of the wall design;

[0071] FIG. **49** shows a control joint;

[0072] FIG. **50** shows an expansion joint attached to a C channel. Two full depth channels are shown back to back to each other with a space between their webs;

[0073] FIGS. **51** and **53** are similar to FIGS. **13** and **15** except the exterior rigid insulation is a siding;

[0074] FIG. **51** is an enlarged detail showing the siding attached to the wall forming structure such as aluminum siding, vinyl siding, wood siding or an exterior finish surfacing material which can be applied to a building exterior;

[0075] FIG. **52** is a wall section similar to FIG. **19** showing siding attached to the wall forming structure;

[0076] FIG. **53** is similar to the plan view such as earlier shown and earlier described with reference to the plan view of FIG. **20**, showing exterior siding with vertical angles at the corners and the vertical and horizontal hat channels in the wall;

[0077] FIGS. **54** through **56** show an exterior finish material of thin brick attached to the wall forming structure and used as part of the mold;

[0078] FIG. **54** is an isometric view of the wall construction;

[0079] FIG. **55** is a wall section taken through section A-A of FIG. **54**;

[0080] FIG. **56** is a plan view taken through line B-B of FIG. **54**;

[0081] FIG. **57** through **59** are similar to the structures shown in FIGS. **54** through FIG. **56** except full width face bricks are used as part of the mold structure in lieu of the thin face bricks;

[0082] FIG. **57** is an isometric view of the wall construction;

[0083] FIG. **58** is a wall section taken along section line A-A of FIG. **57**;

[0084] FIG. **59** is a plan view taken along line B-B of FIG. **57**;

[0085] FIG. **60** shows how to make a corner using the wall structure shown in FIGS. **25** through **27**;

[0086] FIG. **60**A is a plan section of a corner wall panel;

[0087] FIG. **61** through FIG. **62** show a vertical wall sections similar to FIG. **26** with horizontal recessed grooves or horizontal projections for use as a structural support system or for architectural wall accents;

[0088] FIG. **61** illustrates a recessed U channel, normally called a ledger, to support the C channel floor joists;

[0089] FIG. **62** also has a horizontal U channel ledger, however this ledger is secured on the center C channel **88**, and also FIG. **62** shows a C channel protruding from the main body of the wall;

[0090] FIG. **63** and FIG. **64** show similar looking architectural recessed grooves both showing the FIGURES show the same wall structure as FIG. **53** except here the metal angles have both angle legs exposed;

[0091] FIG. **63** is a sectional detail of an architectural groove shown in the elevation of the finished wall at FIG. **65**;

[0092] FIG. **64** is a sectional detail of the architectural recessed groove shown in the finished wall at FIG. **65**;

[0093] FIG. **65** is an elevation of a finished wall showing some of the recesses shown in FIGS. **63** and **64**; the vertical recess on the left is shown in FIG. **63**, the vertical recess on the right in FIG. **64**; the recessed groove being shown in FIG. **64**;

[0094] FIG. **66** is similar to FIG. **62**, however the wall section shows how a steel bar joist is secured to the projection previously described in FIG. **62**;

[0095] FIG. **67** shows a wall similar to FIG. **11**, however the right side of the wall uses a conventional concrete form that is removed after the wall is poured;

[0096] FIG. **68** shows hat channels **132** as they would be laid out on a table (not shown) material is connected to the metal hat channels; wood or metal siding being shown and edge corner boards are installed at the edge of the panel;

[0097] FIG. **69** shows a building panel turned upside down with the exterior finish facing upside down. Metal C channels, where used, as wall studs and a metal base plate being installed at both ends of the C channel;

[0098] FIG. **70** illustrating a wall section shown in the opposite direction as FIGS. **68** and **69** with the exterior finish facing down. Metal C channels where used as wall studs and a metal base plate is installed at both ends of the Metal C channel;

[0099] FIG. **71** is similar to FIG. **70** except the concrete is poured to the full depth of the metal C channels. The thickness of the panel depending if the panel will be used as a structural element or just as a veneer to a greater structural system;

[0100] FIG. **72** illustrates a combination of a forming structure, showing a vertical wall similar to FIG. **34** and roof section detail similar to FIG. **36** showing how to connect a poured-in-place wall section with a precast roof panel;

[0101] FIG. **73** similar to FIG. **72** wherein a wall and roof structure is similar to FIG. **34** and where both the wall and roof structure are poured in place at the top of the wall and the ridge of the roof.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0102] The self-contained mold according to the invention is formed by installation of two or more wall panels or the wall of several modular components placed adjacent to one another, however spaced apart to allow for concrete to form between the panels or modules. The wall sections can be composed of metal construction or wood construction with the interior finish, preferably, to be the interior finish of the structure. The structural wood studs or steel studs, as well as the interior finish material, as a part of the structure and are not removed. Both galvanized steel, or wood fire rating capabilities, however, are nothing like the fire rating of concrete. The encasement of the steel studs or wood studs into concrete, increasing the structural capacity, as well as increasing the fire rating of the wall component. The prevention of air around the wall studs decreases the cause for a fire to start. Increasing the size of wood studs increases the strength and decreases the gauge size.

[0103] The wall mold also encases the ceiling joist and the floor joists into the concrete. The encasement of the wood joist or steel joist is where the maximum moment occurs, that is, the greatest shear occurs due to the live and dead load weight the joists can carry. The extension of the ends of the joists beyond the width of the wall studs results in the joists being encased in concrete. To create a joist-bearing pocket in a concrete wall using conventional methods, a void has to be created at the location of the joist pocket.

[0104] The joist pocket must be larger than the size of the joist or beam entering into the concrete pocket. The void material and then must be removed, then the joist must be installed, mortar added around the joist securely to install the joist within the wall. By installing the joist to bear on the concrete **32** the joist will not move. The wood studs below could shrink, but the joist may not move thus reducing the settlement within the building forming systems considered wall systems and are comprised of wall forming structures. When the floor or ceiling component is attached to a forming wall and part of its wall forming structure to the concrete prior to pouring of the concrete, the floor component and ceiling component also become a part of the flooring structure.

[0105] Referring to FIG. **1**, the isometric shows modular building components stacked on top of each other and jointed together; FIG. **1**A is an enlargement of two adjacent building modular units. The isometric in FIG. **1** shows various modular units **10** that are stacked on top of each

other and adjacent to one another, but are separated by a concrete wall **32**a or structural/shear wall **38**. It should be noted that the taller the building, the greater the wind loads are experienced. All buildings are required to withstand horizontal wind forces. The building structure must be designed for bending, requiring shear walls **38** to be added to the structure.

[**0106**] Another way to reduce bending is to install diagonal bracing between the columns in conventional construction, however by leaving a gap between modular units **10**, a concrete wall **32**a can be formed, creating a stronger wall and better than using diagonal braced walls. Wood framing **43** or light metal framing **45** have limited structural capabilities as well as fire limitations enforced by building codes. Therefore, either concrete or steel structural integrity must be used as subordinate building material have limited structural capabilities as well as fire limitations enforced by building codes. For example, to build a wood structure more than three stories high or five stories for a metal framing structure would not be permitted by building codes. Therefore, either a concrete or steel structural integrity must be used as subordinate building material.

[**0107**] A cut away section of two adjacent modules **10'** and **10"** is shown in FIG. **1**A. The modules **10** are three-dimensional structures consisting of a wall **38**, a floor **16** and a ceiling. The modules are built in a manufacturing plant, and finished on the interior, thereby leaving the structural system exposed on the exterior of the module where modules **10'** and **10"** abut one another. Other walls **38** of a modular are finished with an exterior finished material directly from the manufacturing plant. Modules are shipped by truck and hoisted by crane to its specified location within the building. As one module is installed, additional horizontal or vertical steel reinforcement **30** is added between one module **10'** and the other module **10"**. The additional steel reinforcing increases the strength of the concrete wall **32***a*. As module **10'** is installed adjacent to module **10"**, molds **12** are created between modules, into which concrete **32** is poured to form a concrete wall **32***a*. Some modules might have walls **38** that face the exterior, which can be finished with a variety of building materials and built using various wall forming structures **109**, which when poured with concrete **32** become part of the concrete wall **32***a*. The forming structures **109** can extend above, below or adjacent to another mold **12** to become part of and adjacent module. A concrete floor **32***b* and ceiling joist's **18***d* are also part of the components of this module **10** that is shipped together as one unit module and are used as wall braces to secure the wall prior to pouring concrete. A building module can also be shipped as molds **12** or panels **36** where the concrete is installed after each panel **36** is installed in place. A module consists of separate floor panels **36***a,* wall panels **36***b,* ceiling panels **36***c,* and even roof panels **36***d* (not shown), which when installed together will complete a mold **12** of the module and a building. Many different types of molds **12** can be manufactured using wood construction or metal construction to build various types of walls **38**. The molds can be finished with many different types of materials including drywall, fiber meshed drywall, concrete board, rigid insulation, decorative wallboard, however all the molds required a rigid board or more commonly known as a composite board. Module **10'** left outside concrete wall **32***a* is shown in FIG. **25** and Module **10"** right outside concrete wall **32***a* is shown in FIG. **33**. Module **10"** shows a concrete floor **32***b* and ceiling joists **18***d* shown in FIG. **2** or FIG. **4**. Module **10'** doesn't show a ceiling, but instead shows a concrete floor **32***b* shown in FIG. **37**.

[**0108**] In FIG. **2**, the modular wall section shows two adjacent modules **10** installed. The floor **16** is constructed using an array of metal floor joists **18***b* with a rim joist **18***a* extending the full length of the module and are secured to the end of the floor joists **18***b*. Rigid insulation **20** or floor decking **22**, then is attached to the floor joists **18***b* and are secured to the end of the floor joists **18***b*.

[**0109**] Metal wall studs **24** are attached to the rim joists **18***a*. Drywall **26** and a ceiling rim joist **18***c* are attached to the wall studs **24**, concrete then is poured over the floor decking **22** to the outer flange **34** of the metal stud **24***a* thereby encasing the metal stud **24***a* in concrete **32** to the level of the concrete floor **32***b*. The interior walls (not shown) are installed over the floor **16** and electrical, plumbing and heating are installed but not shown as a part of this FIG. **2**. An array of ceiling joists **18***d* are installed with or without drywall **26** attached and secured to the ceiling joists **18***d*.

[**0110**] The interior of the mold **12** therefore is left with drywall **26**, metal studs **24***a,* concrete **32** and ceiling rim joists **18***c*. Before installing the module **10**, additional reinforcing steel **30** can be added depending on the structural requirements of the concrete wall **32***a* for additional story modules. Half of mold **12** is complete when the module **10** has been installed. The two modules **10** are shown separated with an air space **14** there between which then completes mold **12** between modules.

[**0111**] FIG. **3** is a plan section along line B-B taken along FIG. **2** and illustrating a concrete mold **32***a* (wall forming mold) formed by placing two modules adjacent one to the other. After the modules **10** are secured to the modules **10** below, wall forming ties **40** are installed between the modules **10**. There are various forming ties **40** available for attaching the wall ties **40** for attaching the wall-forming ties to the modules for connecting one module to another without penetrating the formed wall. The metal wall tie **40***a* is a channel that is shaped to conform to the flange **34** and tip of the metal wall stud **24** or can be a channel having a web **23** and a pair of two bent ends. The web of either shaped channel covers the distance required for the thickness of the concrete wall **32***a*. The wall-forming tie **40** slides down between the outer flanges **34** of the metal wall stud **24** of one module **10** to the outer flanges of the adjacent module. Since the metal wall tie **40** has a continuous channel-like shape, the ties can be installed as one long channel or in shorter pieces versus a long channel.

[**0112**] FIG. **4** appears identical to FIG. **2**, however in this case, the individual floor, wall and ceiling panels are manufactured at a manufacturing plant, then are trucked to the building site and installed thereat. The flooring panels **36***a* are manufactured using light-gauge metal joists **18***b* and steel reinforcing **30** is installed parallel to the rim joist **18***a*. Concrete **32** then is poured over the floor decking **22** and into a temporary form **93** that becomes a concrete beam **32***a* in floor panel **36***a*. The wall panel **36***b* is manufactured using metal wall studs connected to a bottom base plate **27**. A vapor barrier **25** in the form of an ultra thin layer of plastic is placed between the flange **34** of the metal wall stud and the drywall interior surface of the completed wall panel **36***b*.

The ceiling wall panel **36***c* has ceiling joists **18***d* attached to a rim joist **18***c* and drywall **26** can be attached to the ceiling joists. The panels **36** are then loaded onto a truck and delivered to the job site.

[**0113**] The floor **16**, wall panels **36***b* and ceiling panels **36***c* then are hoisted into position to their designated location within the building structure forming half of mold **12**. The interior of the mold **12** is left with a vapor barrier **25**, in the form of a ultra thin layer of plastic (not shown), and drywall **26** or rigid insulation **20** is attached to the metal wall studs **24**, concrete **32** and the rim joists **18***c* from the ceiling panel **36***c*. Before the adjacent wall panel **36***b* is installed and additional reinforcing steel can be added depending upon the structural requirements of the concrete wall **32***a* for additional building height.

[**0114**] FIG. **5** shows two modules **10** and **10'** placed adjacent to one another. The two modules **10** and **10'** are built exactly the same, however one of the modules **10** is a clear depiction of two adjacent modular units. The concrete wall **32***a* including the concrete floor **32***b* is broken, thereby exposing the view of the adjacent module **10'**. The exposed module **10** shows the array of metal joists **18***a* of the floor. Attached to the metal studs **24***a* is the ceiling joists **18***d* and the rim joist **18***c* as well as the backside of the drywall **26**. In order to reduce the water penetration, a vapor barrier **25** is installed between the metal wall studs **24***a* and the drywall **26**. The floor assembly is exposed to the inside of the molds **12**, and drywall **26**. The exposed area in the concrete wall **32***a* is the concrete beam **40** that is part of the concrete floor **32***b* structure. The top of the wall structure below is at the base of the molds **10** and **10'** along with any exposed steel reinforcing bars **30** protruding from the wall below.

[**0115**] Referring to FIGS. **6** and **7**, the modular wall section shown in FIG. **6** also shows two modules **10"** and **10'"** installed near each other, but separated by an air space **14**. One of modules **10"** is shown closely separated from the wall mold **12'** prior to being installed at the job site and is shown in FIG. **6**A. The floor **16** is constructed using an array of wood floor joists **18***f*, which span the full width of the module and are connected with solid bridging **58** between each joist. The joist's **18***f* are set on top of a structural bridge frame **17** below the floor **16**, which also includes a sill plate **60** that is attached to the structural steel bridge frame **17**. Wood plywood decking **62** is attached to the array of floor joists **56**. The wall construction consists of an array of wood studs **64** with blocking **66** near the bottom and top of the wood studs **64**. A concrete floor **32***b* is added for fire resistance over the plywood subfloor, but is optional depending on local building requirements. Other interior walls (not shown) are installed over the floor **16** and the electrical plumbing and heating also are installed with or without the drywall attached and secured to the plywood **62**, wall studs **64** and ceiling joists **70**. In addition, the interior walls add additional bracing support to the exterior walls of the module. The exterior of the module wall therefore is left with drywall **26**, wood studs **64**, blocking **60**, **66**, **72**, floor joists **18***f* and ceiling joists **70**. Before installing the module **10"**, additional reinforcing steel can be added depending upon the structural requirements of the concrete wall **32***a* for additional story modules. Half of the forming mold **12'** is complete when the module **10"** is installed.

[**0116**] FIG. **7** is a plan view of a concrete mold formed by placing two modules adjacent to each other. The wood studs **64** and the floor and ceiling joists **56** and **70** overlap the wood studs **64**. The overlapping of the joists allows concrete **32** to flow under the joists **56** and **70** and therefore have a solid concrete base which permanently to rest upon after the modules **10"**and **10'"** are secured to the wall below and wall forming ties **40** installed between one module **10"** and another module **10'"**. There are various types of forming ties available to attach one module to another module.

[**0117**] FIG. **8** shows a panelized modular sections illustrating two separate buildings installed near each other, but are separated by an air space **14** between one of the building units **10"** and **10'"** as shown separated from the wall mold **12'**. The wall, floor and ceiling building components are shown in FIG. **8**A prior to being installed at the job site. Since panel construction does not require a structural beam for transport to the job site, the construction is different from the heretofore described building units. The floor panel **36***a* is constructed using an array of wood floor joists **56**, plywood decking **62**, concrete **32** and blocking **72** between the floor joists **56** and floor panel **36***a*. The wall panel **36***b* consists of an array of wood studs **64** with blocking **72** attached to the wood studs and drywall **26**. One half of mold **12'** is completed when the array of ceiling joists **70** are installed and secured to the wood studs **64** with blocking **72** between the ceiling joists **70** and connected to floor panels **36***a*. Before installing additional panels **36**, additional reinforcing steel can be added depending upon the structural requirements needed for the concrete wall **32***a* to accommodate additional building stories above. After the utilities have been installed, a concrete floor **32***b* need be added over the plywood subfloor **62**. An array of ceiling joists **18***h* are installed and secured to the wood studs **64** with blocking **72** between the ceiling joists **18***h* and floor joists **18***a*. Before installing the module, additional reinforcing steel **30** can be added depending upon the structural requirements of the wall **38** for additional story modules. Half of a forming mold **12'** is complete when the module has been installed. After the utilities have been installed, a concrete topping is added over the plywood sub floor, but is optional depending upon local building code requirements.

[**0118**] FIG. **9** is a very similar construction as the construction shown in FIG. **8**. However, joist hangers **18***i* are used to support the floor **56** and ceiling joists **70**. Another difference is that the floor and ceiling joists do not extend into the concrete wall **32***a*, but instead anchor bolt **56** extends into the concrete wall **32***a*. The floor panel **36***a* is constructed using an array of wood floor joists **56**, which span the full width of the building module. A joist hanger **18***i* is attached to the rim joist **54** of the floor panel **36***a*. Plywood decking **22** is attached to the array of floor joists **56**. The floor panel **36***a* is complete. The wall panel **36***b* consists of an array of wood studs **64** with blocking **72** near the bottom and top of the wood studs **64** with drywall **26**. Ceiling panel **36***c* consists of an array of ceiling joists **70** are attached to a rim joist **54**. Joist hangers **18***i* and bolt assemblies **82** are used to secure the joists **56** and **70**. The interior of the mold **12'** therefore is left with drywall **26**, wood studs **64**, and the blocking **72** between the ceiling joists **70** and floor joists **56**. Before installing the module **10"**, additional reinforcing steel can be added depending upon the structural requirements of the concrete wall **32***a* for additional story modules **10"** and **10'"**. Half of a forming mold **12'** is complete when the module **10"** has been installed. After the utilities have been

installed, a concrete floor **16***b* is added for fire resistance over the plywood decking **22**, but is optional depending on local building requirements.

[**0119**] A building can be built using many different types of poured-in-place wall constructions. Not all walls of a module abut one another as earlier disclosed, some are exterior walls which can be built using many different types of construction methods as shown in FIGS. **10** through **35**. These walls also remain as part of the module.

[**0120**] FIGS. **10** through **12** show a thin concrete wall **32***a* where only a portion of the concrete wall **32***a* is filled with concrete **32** and the remainder of the wall interior is left exposed for future electrical installations.

[**0121**] In FIG. **10** the metal C channels **88** are placed in an array on a table and then, a horizontal bracing channel **46** is installed through the holes **90** formed in the web of the C channels **88**. Rigid insulation **20** is placed between the web **35** of the C channels **88** and snug to the horizontal bracing channel **46**. A hat channel **86** then is attached to the flange **34** of the C channel **88** perpendicular to the C channels. The drywall **26** then is attached to the hat channels **86**. When tilting the wall structure **85** vertically into place, the space **14** created by the rigid insulation **20** between the C channels **88** and the outer drywall **26** or rigid insulation **20** is the area where concrete **32** is installed. Increasing the number of horizontal bracing channels **46** near the bottom of the wall structure **85** gives additional strength thereat where the greatest pressure will occur. Concrete **32** or other material is placed within the mold **12**. By using this method of construction there is no need to either turn over the wall structure **85** to secure the opposite side insulation or install the insulation after the wall structure **85** is erected. Even though the insulation is set in loose between the C channels **88**, when the wall structure **85** is placed vertically and concrete is installed through the top of the mold **12**, the concrete **32** will press against the horizontal bracing channel **46** securing the rigid insulation **20**. The hat channel **86**, attached to the flange **34** of the C channel **88**, provides for horizontal stability and ease of flow of concrete **32** within the mold **12**.

[**0122**] In addition, the horizontal bracing channel **46** holds the middle rigid insulation **20** from bending when any concrete or other material is installed from the top of the mold **12** into the wall forming structure **109**. The exposed portion of the C channels **88** act as furring strips normally required when a masonry or concrete wall **32***a* is finished on the interior as well as allowing electric or other items are installed prior to installation of the final drywall **26**.

[**0123**] In FIG. **11**, the wall is built placing the insulation **20** on a table (not shown) with the H channels **84** between the joints of one insulation sheet and another. The hat channels **86** are then installed to the H channels **84** and the flange **21** of the C channels **88**. Next, U channels **46** are installed through the holes **90** in the web **23** of the C channels **88**. Another C channel **88'** is installed on the other side of the interior insulation **20** through another set Of holes **90** in the web **23** of the C channels **88**. A hat channel **86** is installed at the other flange of the C channel **88** and then the outer sheathing is connected to the hat channel **86**. Again, after the wall **38** is installed vertically, concrete **32** then is installed on both sides other side of the interior insulation through another set of holes **90** in the web **23** of the C channel **88**. A hat channel **86** is installed at the other flange **21'** of the C channel **88** and then the outer sheathing is connected to the hat channel **86**. Again, after the wall **38** is installed vertically, concrete **32** then is installed on both sides of the interior insulation **20**, creating a concrete wall **32***a* with a finished surface on both sides of the wall **38**.

[**0124**] FIG. **12** is the plan section shown through B-B of FIG. **10**. The plan section clearly shows the holes **90** in the hat channel **86** allowing the concrete **32** to flow into the mold **12** and around the hat channel **86**.

[**0125**] FIGS. **13** through **15** are similar in construction to FIGS. **10-12** except here the wall forming structure **109** is constructed as a double-sided construction. Again the C channels **88** are placed in an array on a table and then horizontal bracing channels **46** are installed through rear holes **47** in the web **35** the C channel **88**, however another horizontal bracing channel **46** is installed through the front hole **49** of the C channel web **35**. The two horizontal bracing channels **46** secure both sides of the rigid insulation **20** in the middle of the C channel **88**. A hat channel **86** is installed on the flange **34** of the C channel **88** and rigid insulation **20** is attached to hat channel **86**. The wall forming structure **109** is then turned over and another set of hat channels **86** and rigid insulation **20** (wallboard **78**) is installed to the hat channel **86**. The completed wall forming structure **109** allows concrete **32** to be installed on both sides of the interior rigid insulation **20** creating two molds **12**.

[**0126**] FIGS. **16** through **18** show a simple self-contained wall system using only, hat channels **86** as its supporting system. Furring hat channels **89** typically have been used as a non-combustible spacer to fur out or make a masonry or concrete wall **32***a* level in order to install drywall **26** or other materials, but never as a supporting structure for a wall **38**. FIG. **16** is an isometric representation of a wall construction while FIG. **17** is a wall section taken along lines A-A of FIG. **16** and FIG. **18** is a plan section taken along lines B-B of FIG. **16**. The wall **38** is manufactured by placing furring hat channels **89** on a table, the length of the wall (not shown). Rigid insulation **20** is then placed over the furring hat channel **89** and a hat channel **86** is placed over the insulation **20** going in the opposite direction. The insulation **20** is secured by connecting the two hat channels **86** and **89** therefore locking the insulation **20** between the hat channels **86** and **89**. Another hat channel **86** going in the opposite direction is connected to the second hat channel **86** creating a criss-crossing structure. Finally an outer rigid board **81** or finish material can be installed over the third hat channel. The self-contained mold **12** is then erected and moved to the jobsite where concrete **32** or other interior material can be added between the interior structures of the form. The first hat channel **89** acts as a furring strip where electrical or other items can be installed prior to the drywall **26** (shown in phantom representation being installed). Also what is important here is the process for manufacturing this wall would not require the assembly to be flipped over to secure the rigid insulation **20** in the main self-contained wall **38**. In addition, the insulation creates a thermal break between the concrete **32** and the interior furring hat channels **89**. Criss-crossing the hat channels **86** allows for easy flow of the interior concrete **32**. Also, holes **90** can be added to the hat channels again for easy flow of the concrete as well as for creating a more solid wall **38**. Reinforced wire mesh **99** (not shown)

can be added between the criss-crossing hat channels **86** for a more structural load bearing capacity of the wall.

[**0127**] FIGS. **19** and **20** are similar in construction to FIGS. **16** to **18** except here the wall **38** is constructed as a double-sided construction or thicker concrete wall **38** with an interior rigid insulation **20** thermal break similar to a precast concrete wall with rigid insulation in the interior. FIG. **19** is an isometric drawing of the wall construction while FIG. **20** is a plan section taken along line B-B of FIG. **19**. The wall construction is built in the same manner, that is, hat channels **86** are placed on a table (not shown) the length of the wall **38**. Rigid insulation **20** is then placed over the hat channels **86** and another hat channel **86** is placed over the insulation **20** going in the opposite direction. The insulation **20** is secured by connecting the two hat channels **86** on either side of the rigid insulation **20** therefore locking the insulation **20** between the hat channels **86**. Another hat channel **86** going in the opposite direction is connected to the second hat channel **86** creating a criss-crossing structure and the outer rigid board **81** is installed. The wall **38** is turned over and a fourth hat channel **86** is installed in the opposite direction. Rigid insulation **20** or drywall **26** is then installed over the fourth hat channel **86** creating two chambers to install concrete **32** for thicker stronger concrete wall **32***a*.

[**0128**] FIGS. **21** through **24**, is similar to FIGS. **16-18**; FIG. **21** is an isometric representation of the wall construction; FIG. **22** is wall section taken along lines A-A of FIG. **21** and FIG. **23** is a plan section taken along lines B-B of FIG. **21** and FIG. **24** is a vertical section taken through vertical hat channel **78**. The FIGS. **21** through **24** differs from FIGS. **16-18** except here insulation bracing channels **83** are spaced between rigid insulation **20** and the open side of the insulation bracing channels **83** faces the interior side of the wall **38**. The flanges **34** of the insulation bracing channels **83** overlap the rigid insulation **20** and secure the rigid insulation **20** against the vertical hat channel **78**. Because of the insulation-bracing channel **83**, the wall is built differently. The insulation bracing channels are **83** placed horizontally and faced down so that the open interior side is facing the table. The rigid insulation **20** is spaced between the insulation bracing channels **83** so that the flanges **34** of the insulation bracing channels **83** overlaps the rigid insulation **20**. A vertical hat channel **78** is placed criss-cross over the insulation bracing channels **83** so that the interior side is facing the insulation bracing channels **83**. The vertical hat channel **78** is attached to the insulation-bracing channel **83** a hat channel **86** is attached to the vertical hat channel **78** thereby securing rigid insulation **20**. Hat channel **86** is installed parallel to the insulation-bracing channel **83** and rigid board **81** is then attached to hat channel **86**. Concrete **32** is then poured into the criss-crossed structure between the rigid insulation **20** and rigid board **81** after the wall **38** is erected vertically. The hat channel **86** and the outer rigid board **81** can be eliminated should the wall configuration be poured in a horizontal position and erected vertically after the concrete **32** has been cured like the precast wall to be shown in FIG. **37**. A hole **90** is shown connecting the insulation bracing channel **83** and the vertical hat channel **78** allowing electrical wiring to pass through the wall **38** in both a horizontal and vertical direction. In FIG. **24**, shows the insulation-bracing channel **83** securing the rigid insulation **20** and the vertical hat channel **78**. The hole **90** functions as a passage between the insulation bracing channel **83** and the vertical hat channel **78**.

[**0129**] FIG. **25** through **27** uses smaller vertical C channels **88** and horizontal hat channels **86** to create a wall forming structure. FIG. **25** is an isometric representation of the wall construction while FIG. **26** is a wall section taken along line A-A of FIG. **25** and FIG. **27** is a plan section taken along line B-B of FIG. **25**. FIG. **25**A is an enlarged detail showing a vertical small C channel **88'** for establishing electrical access. Horizontal hat channels **86** are placed on a table (not shown) the length of the wall **38**. Channels **88**, on the right wall of the isometric, are placed perpendicular to the hat channels **86** and attached to the flange **34** of the C channel and a rigid board **81** is attached to the hat channel **86**. The wall **38** is then turned over and a horizontal hat channel **86** is installed on the other flange **34** of the C channel **88** and rigid board **81** is attached to the hat channel **86**. Channels **88**, on the left wall of the isometric, are placed with the web **35** parallel to the hat channels **86**. The hat channel **86** are connected to the lip **34'** of the flange **34** of the C channel **88** and the opposite hat channel **86** is connect to the web **35** of the C channel. The left wall also shows rigid insulation **20** can be installed between the two hat channels **86**. The horizontal hat channels **86** increase the structural integrity of the wall **38** as well as allowing the concrete **32** to flow easily around the C channels **88**. By increasing the number of hat channels **86** at the bottom of the wall **38**, reduces the pressure exerted by the concrete against the rigid boards **81** or rigid insulation **20**. Also by reversing the hat channel **86'** so that the open cavity of the hat channel **86'** faces the rigid board **81** a space is created for electrical wiring to be installed within the wall structure **38**. The hat channel **86'** has the same function as the insulation bracing channel **83** as shown in FIG. **24**. The isometric drawing of FIG. **25** shows the web **35** of the ceiling rim joist **18***c* is attached to the flange **34** of the vertical C channel **88** for supporting the ceiling joists **18***d*, which is further described in FIG. **61**. FIG. **25** and FIG. **26** shows the vertical C channel **88** extending below the mold **12** so a concrete footing can be installed simultaneously with the concrete wall **32***a*. By pouring the concrete at the footing, the concrete in the footing secures the wall forming structure prior to additional concrete poured in the wall **38**. FIG. **25**A is an enlargement of vertical C channel **88** and a smaller vertical C channel **88'**. The smaller vertical C channel **88'** is located at the flange **34** of the vertical C channel **88** creating a hollow chamber for electrical wiring to be installed and connected to the horizontal hat channel **86'**.

[**0130**] FIGS. **28** through **32** show a wall structure where the interior structure of the mold extends to the outside surface of the rigid board **81** or rigid insulation **20**. FIG. **28** is an isometric representation of the wall construction of the wall structure while FIG. **29** is a wall section taken along line A-A of FIG. **28** and FIG. **30** is a plan section taken along line B-B of FIG. **28**. FIG. **31** and FIG. **32** are enlarged details of the end of the U channel **84**. FIG. **32** shows an angle **27** attached to the web **35** of the U channel **84**. FIG. **31** is similar to FIG. **32** in that instead of adding the angle **27**, the flange **34** is longer and is bent **180** degrees to extend beyond the web **35** of the U-channel **84**. In both FIGURES, the flange **34** or angle **27** extends beyond the web in both directions creating an H channel **84'**. The wall structure **85** is built by placing the H channels **84'**on a table (not shown) and installing rigid insulation **20** or drywall **26** between each

H channel **84'**. By adding the rigid insulation **20** between each H channel **84'** the flanges **34** are exposed to the outside of the wall **38**. The modified H channels **84'** have a hole **90** in the middle so that a horizontal bracing channel **46** can be installed there through. When the wall structure **85** is erected vertically, the concrete **32** is poured into the mold **12** interior and presses the rigid insulation **20** against the flanges **34** of the H channel **84'**. In addition, the horizontal bridging channel **46** locks the array of H channels **84'** into place and therefore, securing a rigid wall structure **85**.

[0131] FIGS. **33** through **35** show a concrete wall **38** having a vertical ribbed configuration. FIG. **33** is an isometric view of the wall construction while FIG. **34** is a wall section taken along line A-A of FIG. **33** while FIG. **35** is a plan section along line B-B of FIG. **33**. The wall **38** is built first by placing horizontal hat channels on a table of the length of the wall. C channels **88** are placed perpendicular to the hat channels **86** and attached at the flange **34**. Next, a rigid interior foam spacer **96** is then placed between an array of C channels **88** approximately the depth of the web **35** of the C channel **88** and less than the distance between the C channels **88**. The interior rigid insulation **20** is then attached to the flange **34** of the C channel **88** and the rigid interior foam spacer **96**, forming the vertical ribbed configuration of the wall **38**. The wall **38** is turned over and a rigid board **81** is installed on a hat channel **86**. The holes **90** in the hat channel allow the concrete to flow easier around and through the hat channels **86**. Additional hat channels **86** are located at the bottom of the wall **38** due to the increase in pressure of the concrete at the bottom of the wall forming the vertical ribbed configuration of the wall **38**. As shown in FIG. **34**, a rigid interior foam spacer **96** is not placed at the full height of the wall **38** and is shorter at both the top and bottom of the wall **38** so a concrete beam **32**d is formed at the top and bottom of the wall **38**.

[0132] FIGS. **36** through **39** show a similar wall construction as shown in the FIGS. **33** through **35**, however, here, instead of concrete being installed when the wall is erected in a vertical position, the concrete is installed in a horizontal position. The construction of the wall system **37** can be used either as a wall system **37** or as a floor system **37***a*. The strength of the concrete beam **32***d* and floor system **37***a* depends on the depth of the concrete beam **32***d* and the thickness of the concrete floor **16***b* plus the amount of steel reinforcing **30** that is added. The C channel **88** intent is to support the concrete beam **32***d* and/or the floor concrete **16***b* until the concrete cures plus adds structural strength to the beams **32***d*. Unlike typical scaffolding systems used to support the installation of concrete floor systems **37***a*, the scaffold is removed after the concrete **32** has cured. The size of the C channel **88** and thickness of the concrete floor **32***b* will vary depending on the span of the floor system.**37***a*. Any type of structural beam can be installed within the concrete beam **32***d* the concrete flooring system **37***a*.

[0133] In FIG. **36**, the C channels **88** are spaced in an array and the horizontal bracing channels **46** connect the webs **35** of the C channels **88** creating a rigid frame. A rigid board **81** is the attached to the C channel. Rigid interior foam spacers **96** are placed between the metal C channels **88** to the width of the desired beam and the thickness of interior foam spacers **96** is the height of the desired beam. The depth of the rigid interior foam spacers **96** and the space between the foam spacers **96** determines the structural capacity of the concrete beams **32***d* in the ribbed concrete structure. Additional steel reinforcing **30** can be added into the mold **12** for added strength. Concrete is then poured into the mold **12** that is around the C channel **88** creating beams and above the C channels **88** creating a structure. The self contained mold **12** can be poured in a factory and then shipped to the job site, or can be built in place ready to be poured at the job site. However, typically, the mold **12** would be delivered to a construction site, set in place and poured in place. When the concrete **32** is cured, the mold **12** can be used as a precast wall or precast floor. Mold **12** can also be used as a poured in place floor, however temporary braces would be required. Due to weight of the concrete, temporary braces (not shown) would be installed until the concrete has cured. The C channels **88** will vary in height and thickness depending on the structural integrity on the span and weight requirements of the floor **16** and the number of temporary braces used to erect the flooring system **37***a*.

[0134] FIG. **37** is similar in construction to FIG. **36**, except here the interior foam spacers **96** are tapered to be wider at the bottom of the concrete beam **32***d*. In this case, the concrete beams **32***d* are poured to the top of the interior foam spacers **96** and steel reinforcing **30'** is installed into the concrete beam **32***d* and left to cure. Horizontal hat channels **86** are installed over the C channels **88** (on the right side) and the interior foam spacers **96** for additional structural support. By pouring the concrete beam **32***d* first, it allows for the concrete **32** to harden and therefore eliminating any temporary shoring that might be required once the mold **12** is installed at the job site. Also, the foam spacer **96** is tapered creating additional friction and strength to support the weight of the concrete floor **32***b* above. The two-step concrete pour allows more flexibility in construction of the flooring system **37***a*. The concrete beam **32***d* in the middle shows an H channel **84'** instead of the C channel **88** shown on the right side. The flange **34** of the H channel **84'** supports the rigid board **81** and the weight of the concrete beam **32***d* until the concrete has set. A T channel **84"** is shown in the left concrete beam **32***d* instead of the H channel **84'** and the flanges **34** of the T channel **84"** also support the rigid board **81**. The electrical distribution systems described in FIGS. **21** through **26** (not shown in FIG. **37**) for the poured-in-place wall can also be applied for a poured-in-place floor as shown in FIG. **36** and **37**, or when the concrete has cured the panel would become a precast concrete wall. Many wall constructions however are thinner than a concrete floor **32***b* and therefore hat channels could be used similar to FIGS. **16-18** or FIGS. **21-23** but not shown this figure.

[0135] FIG. **38** is similar to FIG. **37**, except hat channels **86** are added between the two layers of drywall **26** below C channels **88**. The metal hat channel **86** adds strength either to support a person and the concrete **32** until it cures, the C channels **88** are deeper than the foam spacers **96** and additional reinforcing steel **30** or welded wire mesh **99** is installed and attached to the top flange **34** of the metal C channel **88**.

[0136] FIG. **39** is similar to FIG. **38**, except that the depth of the concrete beams **32***d* are deeper. A spacer **97** is installed between the metal C channel **88** and the drywall **26** below the beam **32***d*. The spacer **97** allows the concrete **32** to flow completely around the metal C channel **88** for imparting greater fire resistance to the flooring system **37***a*.

[0137] FIG. **40** shows the flooring system **37***a* attached to a vertical poured wall system **37**. The wall **38** (shown in FIG. **34**) and the floor **16** (combination of FIG. **37** and FIG. **38**) are similar, however hat channels **86** are installed above the foam spacers **96** and between the drywall **26** below the metal C channels **88**. The concrete floor beam **32***e* is shown perpendicular to the direction of the other concrete beam **32***d* shown in FIG. **37**. The concrete floor beam **32***e* can be poured simultaneous with the concrete beams **32***d* as shown here or poured after the concrete beams **32***d* (shown in FIG. **37**), the ones with the (channel installed) have cured. By pouring the wall beam **32***e* at the time of the concrete floor **32***b*, a more precise fit between the floor **16** and the wall system **37** can occur. In addition, horizontal concrete floor beams **32***e* can be installed anywhere a foam spacer **96** void occurs creating additional horizontal beams **32***e*, is installed between the concrete floor **32***b* and another wall **38** to assure a continuous structural system.

[0138] FIGS. **41** and **45** illustrate all various types of connectors **104** used to make the construction easier to build more and aesthetically pleasing by eliminating any exposed connectors that connects the drywall **26** to the interior structure of the mold. The connector **104** has a lip **108**, which can penetrate a hole **90** in the hat channel **86**. After the lip **108** penetrates the hole **90**, the lip **108** springs over the hole **90** and there secures the connector **104** to the hat channel **86**.

[0139] FIG. **41** is similar to FIGS. **13** through **15** except an H channel **84'** is used in lieu of the hat channel **86**. The wall **38** is built placing the insulation **20'** on a table (not shown) with the H channels **84'** between the ends of each rigid insulation **20'**. Even though the rigid insulation **20** is loose between the H channels **84'**, the flange **34** of the H channel **84'** secures the rigid insulation **20'** without using a fastener. Next, the C channels **88** are installed in the opposite direction of the H channels **84'** and are secured with connectors **104** (not shown) through the flange **34** of the C channel **88**. The remainder of the wall **38** using insulation bracing channels **83**, hat channels **86** and the rigid insulation **20** is built the same as FIGS. **13** through **15**. Even though the rigid insulation **20** is set in loose between the C channels **88**, when the wall **38** is placed vertically and concrete **32** is installed through the top of the concrete will press against the bracing channels **46** securing the rigid insulation **20**.

[0140] FIG. **42** is similar to FIGS. **10** through **12** except here, H channels **84'** are used in lieu of connectors connecting the rigid insulation **20**. The use of H channels **84'** encases the edges of the rigid insulation **20** therefore allowing the wall **38** to be constructed differently. The H channels **84'** are first laid on a table, then rigid insulation **20** is installed between the H channels **84'** securing the rigid insulation **20** and connected to smaller C channel **88'** or hat channel **86**. The hat channels **86** are then fastened to the C channels **88** at the flange **34** and rigid insulation **20** is installed between the C channels **88**. The horizontal bracing channels **46** are installed through the holes **90** at the web **35** of the C channel **88**. The bracing channels **46** hold the rigid insulation **20** in place.

[0141] FIG. **43** is similar to FIGS. **10** through **12** and FIG. **41**. Instead of the H channels **84'** encasing the rigid insulation **20** on the outer face of the rigid insulation **20**, the rigid insulation has a groove **103** to accept the H channel **84'**. By supporting the rigid insulation **20** in the middle, no fastener is visible from the outer surface of the rigid insulation **20** or drywall **26**. In addition, the rigid insulation **20** is secured because the groove **103** is holding the rigid insulation **20** from any movement. The remainder of the wall **38** is constructed the same as shown in FIGS. **10** through **12**.

[0142] FIG. **44** details connectors **104** that are embedded within a drywall **26** and protrude outward to become a fastening method to secure the drywall **26** to the wall forming structure **109** of the mold **12**. The connector **104** has a lip **108** which can penetrate a hole **90** in the hat channel **86**. After the lip **108** penetrates the hole **90**, the lip **108** springs over the hole **90** in the hat channel **86** and there secures the connector **104** to the hat channel **86**.

[0143] FIG. **45** shows connectors **104** embedded within a drywall **26** and protrude out to become a fastening method to secure the drywall **26** to the wall forming structure **109** of the mold **12**. The connector **104** has a lip **108** so that has a lip **108** penetrates the hole **90**. The stem of the connector **104** has a flange **34** added to hold the connector **104** in place. Both connectors have a V carrot at the end of the stem **47** thereof. The stem of the connector **104** has a flange **34** added to hold the connector in place. The connectors **104** at FIGS. **44** and **45** have a V carrot at the end of the stem thereof added to hold the connector in place. As the V carrot passes through the hole **90** in the hat channel, the end of the V carrot is secured by pressure exerting on the sidewalls of the mold **12**.

[0144] FIG. **46** is built using the same wall forming structure **109** as FIGS. **19** and **20**. The rigid insulation **20** in the middle of the wall **38** provides a thermal break between the interior wall **119** and the exterior wall **120** and provides two separate chambers **123** and **124** for installing two different materials on either side of the wall **38**. After the wall **38** is set in place in vertical position, the left side is shown filled with sand and the right side is shown filled with gravel. By installing sand in the wall forming structure **109**, the sand gives the wall **38** mass and the sand stabilizes as well as adds strength to the hat channels **86**. By installing gravel on the other side again gives the wall mass and also stabilizes the wall assembly, but the gravel allows air to flow within the wall **38**. Local materials can be used to give the wall **38** strength and rigidity without having to pour concrete **32** throughout the entire mold **12**. The gravel stones could be heated or cooled such as a hot water or cooling coil pipe **76** to create a radiant heating or cooling system within the wall **38** and also act as a storage system for any solar heating system. The gravel stones could be heated or cooled to create a heating or cooling system within the wall **38** and also act a storage system for any solar heating system. A concrete beam **32***d* also can be poured over the sand (or gravel) and steel reinforcing bars can be installed for additional strength.

[0145] FIG. **47** is built using the same wall structure as FIG. **19** and FIG. **20**. In lieu of placing a rigid insulation **20** on the right side of mold **12**, wire mesh **99** is installed over the hat channel **86**. A sprayed concrete finish is applied over the wire mesh **99** and allowed to protrude through the wire mesh **99**, thus securing the concrete **32** the wire mesh **99**. The concrete will not fill the entire area between the rigid insulation **20** and the reinforcing mesh **99** and therefore, an air space **14** will develop. The concrete is next troweled level and then smoothed to a desired textured finish.

[0146] FIG. **48** is built using the same wall structure as FIG. **17**. Again a wire mesh **99** is installed over the hat channel **86**. After the wall forming structure **109** is installed vertically, concrete **32** is placed between the wire mesh **99** and the middle interior rigid insulation **20**. Concrete **32** then is poured from the top of the wall and is allowed to flow through the reinforcing mesh **99** which can be troweled smooth prior to the concrete hardening. The concrete is then troweled and textured to the desired finish.

[0147] FIGS. **49** and **50** are similar to FIGS. **25** through **27** in the wall construction; however, the control joints **110** and expansion joints **111** are decorative architectural elements of a concrete wall design. In FIG. **49** a control joint **110** is shown attached to a C channel **88**. The control joint **110** is a joint where potentially a wall **38** would have a tendency to crack and the control joint **110** allows that joint to move. The control joint **110** is also used to level the excess concrete evenly over the entire panel **36** surface. The V shaped groove of the control joint **110** could also be an architectural accent strip for design purposes as discussed further in FIGS. **63** through **65**. In FIG. **50** two full depth C channels **88** are shown back to back to each other with a space between their webs **35**. Metal angles **57** are installed over the reinforcing mesh **99** and aligned with the web **23** of the C channels **88**. Caulk **89** then is placed between the C channels **88** to create an expansion joint **111** between panels **36**. The back-to-back full depth C channels **88** also could be the end sections between one panel **36** and another prefabricated panel **36**. An expansion joint **111** is different from a control joint **110** in that building materials expand and contract due to change of temperature, and an expansion joint **111** is where this is intended to occur.

[0148] FIG. **52** through FIG. **53** is similar to FIGS. **13** through **15** except the exterior rigid insulation is wood siding. FIG. **52** is a vertical wall section similar to FIG. **14** and FIG. **53** is similar to the plan view as shown in FIG. **15**. FIG. **51** is an enlarged detail showing the horizontal wood siding attached to the wall forming structure **109**. Other types or styles of siding materials like aluminum or vinyl siding or other exterior finish surfacing material can be applied to the self contained mold and then remain part of the finish wall construction. In conventional construction as well as other insulated concrete forms, a finish material like siding is installed after the wall is complete, not as part of the form construction. The wall construction can be built using any of the previous wall forming structures **109**, however the exterior component of the wall forming structure **109** must be a vertical component in order to attach the horizontal siding **112**. After the siding **112** is installed while in a horizontal position on a table (not shown), the wall is placed vertically and the wall is then ready to install concrete **32** into the mold **12**. If the siding were installed vertically, the interior support would then have to be a horizontal member. In addition, a vapor barrier **25** can be installed behind the siding **112** in order to prevent any concrete **32** from passing through the siding **112**. The wall forming structure **109** supporting the siding **112** can be configured in many ways as previously described. Other systems available today do not have a finish exterior wall surface as part of their construction system. Usually finish materials are applied over their construction in order to create a finish wall product.

[0149] The plan view FIG. **53** shows vertical angle **27** connecting the hat channels **86** from a continuous wall shown at a **90**-degree angle. By installing the angles **27** at the corners, the corners are reinforced so the concrete **32** does not escape where the insulation **20** or drywall **26** intersect each other.

[0150] The previous FIGURES discussed how siding could be used as an exterior forming material. These next several FIGURES show how face bricks are part of a poured in place concrete mold prior to the wall forming structure **109** being filled with concrete. There are several methods discussed. One method is first building the self-contained wall system, then attaching a mesh to the wall forming structure **109**. By attaching an adhesive to the mesh or cement type product and then placing the thin bricks onto the mortar, the face bricks become an integral part of the form and remain in place as part of the wall forming structure **109**. Another method is to first construct a brick veneer wall and then attach the forming structure to the backside of the face brick wall. In other concrete forming systems brick is not use as a form.

[0151] FIG. **54** through FIG. **56** shows an exterior finish material of face brick attached to the exterior of the wall forming structure **109**. FIG. **54** is an isometric view of the construction and FIG. **55** is a wall section of FIG. **54** taken through line A-A of FIG. **54** and FIG. **56** is a plan view taken through line B-B of FIG. **54**. FIGS. **16** through FIGS. **18** have a similar structure, however, in lieu of insulation **20** as part of the forming system, wire mesh **99** is installed over the exterior side of the wall forming structure **109**. An adhesive (not shown) can be installed behind each individual thin brick **128** or cement (not shown) can be installed over the wire mesh **99**. The individual thin bricks **128** then are placed into the cement and allowed to dry. After the thin bricks have been secured, the cement is allowed to harden to the back of the thin bricks **128**, the mortar **129** can be installed between the thin bricks **128**. The thin bricks can be installed after the wall forming structure **109** is installed at the project site (that is when the wall is in a vertical position). Other exterior wall materials such as ceramic tile or stone can be used in lieu of the thin brick **128**.

[0152] FIGS. **57** through FIG. **59** are similar to FIG. **54** through FIG. **56**, except here, full width face bricks **128'** are used as part of the wall forming structure **109**. FIG. **57** is an isometric view of the wall construction and FIG. **58** is a vertical section taken along line A-A of FIG. **57** and FIG. **59** is a wall section taken along line B-B of FIG. **57**. The wall structure is the same as shown in FIGS. **16** through FIG. **18**, except that here, full width face bricks replace the drywall **26**. Due to the weight of face brick, a horizontal steel angle **27'** is located at the bottom of the brick wall to support the brick **128'** when shipping the wall. In addition, vertical steel reinforcing **30** is added in the holes of the bricks for additional reinforcement. An additional vertical steel reinforcing is added in the holes **92** of the bricks for additional reinforcement. An additional vertical steel angle **27"** is placed at the rear of the face bricks **128'** and short steel reinforcing bars **30"** are placed between some of the mortar joints **129** for additional support. The steel reinforcing **30**, as well as the vertical steel angle **27"**, adds temporary support until the concrete **32** can be poured within the wall forming structure **109** of which the face brick **128'** acts as a mold **12** to withhold the concrete **32**.

[0153] Many different types of wall forming structures have previously described hereinabove, however, all walls are not continuous and require corners. FIG. **60** shows how to make a corner using the wall forming structures shown in FIGS. **25** through **27**. When the rigid insulation **20** or drywall **26** (not shown) is required to make a corner **106**, the rigid insulation must be secured to the wall forming structure **109**. At both the inside corner **106'** and outside corner **106"**, a metal angle **27** is installed parallel to the C channels **88** in the wall forming structure **109** and is attached at the horizontal hat channels **86**. In order for the wall panels **36***b* to make a corner, some of the horizontal hat channels **86** are required to extend beyond the individual wall panel **36**, so that the adjacent wall panel **36** perpendicular to it can be connected to the vertical C channels **88**. This procedure has to be completed when the wall panel **36***b* is erected vertically and then connected. The shorter wall section is shown in FIG. **60**A separated from the corner construction to show how various wall components are connected. When the various wall sections are fastened together, a portion of the rigid insulation **20** will have to be installed after the wall forming structure **109** is erected vertically in order to make the various connections or long screws (not shown) would be required should the rigid insulation **20** remain attached to the C channels **88**.

[0154] Conventional poured-in-place concrete walls have accent strips molds on the inside of their standard wall forms to create accents on the concrete wall when these standard wall forms have been removed. Precast concrete also provide accent strips or projections on their walls in the same manner as conventional construction.

[0155] FIGS. **61** and **62** show horizontal recessed grooves or horizontal projections in a poured-in-place wall. FIG. **61** and FIG. **62** show a vertical wall section similar to that shown in FIG. **26**. FIG. **61** illustrates a vertical wall section similar to that shown in FIG. **26**. FIG. **61** shows a U-channel **84** that typically fits over the ends of a floor joist **18***b*. The U-channel **84** is secured to the horizontal hat channels **86** that are part of the wall forming structure **109**. In order to provide proper support, a reverse C channel **84'** is installed directly below the floor joist shown on the left side of the wall section in FIG. **61**. When concrete is installed within the wall forming structure **109**, the reverse C channel **84'** is filled with concrete **32** giving the floor joist **18***b* ample structural support. The U channel **84** is shown on the right side of FIG. **61**, attached to the horizontal hat channels **86** at the interior of the wall forming structure **109**. In this case, however, there is no additional support below. Instead, anchor bolts **50** are installed in the web **35** of the C channel **84** and joist hangers **18***i* support the floor joists **18***b*.

[0156] FIG. **62** also has a horizontal U channel **84**, however, this U channel **84** is secured to the flange **34** at the C channel **88**. In this case, the U channel **84** is further back in the wall forming structure **109** and there is sufficient support to achieve a proper bearing for the floor joists **18***b*. Also, in FIG. **62**, a modified C channel **88'** protrudes from the main body of the wall **38**, that is the flanges **34** of the modified C channel **88'** is secured to the interior C channel **88**. Two steel reinforcing bars **30** are shown passing through the holes **90** in the center C channel **88** and a steel reinforcing stirrup **31** encases the two steel reinforcing **30** as well as two additional steel reinforcing **30** located in the protruding C channel **88'**. The protruding U channel **88'**, as well as the U channel **84**, are used as structural elements for additional building components. Both of these channels could also be used as decorative elements shown in FIG. **65** following.

[0157] FIG. **63** and FIG. **64** are similar appearing architectural recessed grooves. Both figures show the same wall forming structure **109** as FIG. **27**; however, the groove **103** recess is different. FIG. **63** is similar to FIG. **53** except the groove **103** recess is different. FIG. **63** is similar to FIG. **53** except here the metal angles **27** are turned so that the legs **28** of the angle **27** are exposed. The one leg **28** is flush with the drywall **26** and the other leg **28'** is attached to the horizontal metal hat channels **86** of the wall forming structure **109**. Two U channels **84** are used in the middle of the wall with an air space **14** between the webs **35** of the U channels **84**. The spacing of the U channels **84** allows the wall to move and, therefore, create an expansion joint **111**. Caulking **89** is installed between the U lo channels **84**. In FIG. **64**, a vertical recess is a U channel **84** connected to the web **35** of the hat channel **86** in the wall structure **109**.

[0158] FIG. **65** is an elevation of a finished wall showing some of the recess and projection details. The vertical grove **103** is the expansion joint **111** shown in FIG. **63** and the vertical grove **103** on the right is FIG. **64**. The horizontal projection on the top is similar to FIG. **62** while the lower grove **103** is similar to FIG. **61**.

[0159] FIG. **66** is similar to FIG. **62**, however the wall section shows how a steel bar joist is secured to the projection of the modified C channel **88'** as previously described in FIG. **62**. The bar joist is secured onto the ledge, a heavy steel plate **52** is required to be installed on top of the modified C channel **88'**and secured with steel reinforcing **30** welded to the steel plate **52** that the steel bar joist **51** rests on.

[0160] FIG. **67** illustrates the wall forming structure used in FIG. **11** except without the horizontal hat channel **86** and the rigid insulation **20** at the outside wall. In lieu of the rigid insulation, a conventional concrete wall form **53** is shown which can be removed after the concrete **32** is installed. A standard concrete wall tie connector **104** could be used to connect the one-half of the wall forming structure **109** of mold **12** of FIG. **11** and the conventional concrete form **53**. The incorporating of a removable conventional concrete form **53** on one side of the wall, allows for a concrete wall to be exposed for what-ever the reason might be. In lieu of the rigid insulation, a conventional concrete wall form **53** is shown except without the horizontal hat channel and the rigid insulation at the outside wall. A standard concrete wall tie connector **104** could be used to connect the half of the wall forming structure **109** with the conventional concrete form **53**. A standard wall tie connector is broken off from the concrete wall **32***a* after a conventional concrete form **53** is removed. A concrete wall tie **104'** is shown with its end bent around a horizontal bracing channel **46** thereby securing the wall forming structure **109** to the concrete wall tie **104'** without having to snap or brake off the connector **104'** at the exposed concrete side of the wall **38** where the conventional concrete form **53** was located.

[0161] The previous disclosures discussed herein poured-in-place concrete structures as well as different exterior finishes that can be applied to the wall structure. The exterior finishes like wood siding and brick were constructed using

the building wall as the structure and then concrete was poured into the wall forming structure **109** after the wall was installed vertically.

[**0162**] FIGS. **68-71** show configurations of exterior molds where the molds are placed horizontally upside down and concrete is filled into the mold. Various exterior molds are built using some of the techniques described earlier, however here the exterior faces of the molds are placed face down and concrete is poured into the molds.

[**0163**] In FIG. **68** metal hat channels **86** are laid out in an array where a final building material is connected to the metal hat channels **84**. Wood or metal siding **112** is shown and the edge corner boards **126** are installed at the edge of the panel. A metal channel **84** is used at the corner. Wood furring channels could be used in lieu the metal hat channels **84**.

[**0164**] In FIG. **69**, the exterior face of the building panel has been turned upside down. After the panel **36** is turned over so the finished exterior building surface now is facing down, another outside corner board **126***a* is added to complete a corner. The additional corner board **126***a* increases the thickness concrete, exterior finish facing down; concrete **32** is now poured inside the mold **12"**. Many different structures or materials can be added to this mold **12"** to create different configurations. However the result is still the same, that is, a finished building panel **36** where an exterior building material is the mold of the wall **38**.

[**0165**] FIG. **70** is a wall section shown in the opposite direction as FIGS. **68** and **69** and the exterior finish is facing down. In this case, metal C channels **88** where used as the wall forming structure **109** and metal base plate **42** has been installed at both ends of the C channel **88**. The wood siding **112** and thin face bricks **128** were added to the C channels **88**. After the siding and bricks were installed, concrete **32** is poured to flow between the holes **90** into the mold **12"** partially filling the mold and allowing the concrete **32** to flow between the holes **90** in the web **35** of the metal C channels **88**.

[**0166**] FIG. **71** is similar to FIG. **70** except the concrete **32** is poured to the full depth of the metal C channels **88**. The thickness of the panel **36** depends upon the use of the panel, that is, if the panel will be used as a structural element or just a veneer to a greater structural system.

[**0167**] FIG. **72** is illustrated as one of many wall forming structures, which can be integrated together. FIG. **72** is a detail of a vertical wall and roof section, which shows how to connect a poured-in-place wall **38** shown in FIG. **34** to a roof panel. The roof panel **36***d* is represented as a precast floor panel **36***b* such as shown in FIG. **36**, however the panel shown as a sloped roof panel **36***d*, horizontal beam **39** is installed as a sloped roof panel. As a roof panel **36***d*, the bottom of the beams of the roof section will be notched to conform to the desired angle of the wall **38**. When pouring the roof panel **36***d* the bottom of the beams of the roof section will be notched to conform to the desired angle of the roof, so the roof panel **36***d* will set flat onto the walls **38**. By not installing middle rigid insulation **96** between one beam and another beam (the rigid insulation **20** and concrete beams are shown in FIG. **36**) a horizontal beam **39** can be installed parallel to the wall is poured, a reinforcing steel bar **30***a* can be installed in the concrete **32** after the roof section is erected into place, the concrete beam **32***b* can be poured securing the panel **36***d*. The roof precast panel **36***d* is not just a roof panel. It is a roof panel **36***d* incorporates the roof, soffit, fascia and gutter all in one panel. The gutter and fascia are formed at the time the roof panel is poured. The soffit is shown as a smaller C channel **88'** connected the metal C channel **88** in FIG. **36**. Attached to the smaller C channels **88'** is a soffit board **72'** at the time the roof panel was precast. The soffit could be solid concrete, however, the smaller C channel **88'** reduces the weight of the roof panel. Horizontal hat channels **86"** set into the concrete **32** after the panel has been leveled and ready to begin to dry. A non-flexible roof shingle, like cedar shakes can be installed. The hat channels **86"** have holes **90** (not shown) so air can flow under the roof shingles allowing the concrete roof structure **36***d* to maintain a lower temperature. If wood furring strips (not shown) are embedded into the concrete **32** in lieu of metal channels **86"** the wood furring strips were installed flush with the top of the concrete, flexible asphalt shingles can be nailed into the wood furring strips. If no furring strips were installed on the roof, the roof surface can be finished with stencil or stamped concrete (not shown) to create a textured roof shingle pattern. Then no roof shingles would be required.

[**0168**] FIG. **73**, as shown, is similar in appearance to FIG. **72**. However, even though the roof looks similar, the wall forming structure **109** is the same as FIG. **34**, except therein the roof is at an angle. In lieu of the rigid board **81** as shown in FIG. **34** a rigid roofing shingle **82** is connected to the hat channel **86** and a vapor barrier **25** (not shown) is installed between the rigid roofing shingle **82** and the hat channel **86**. When pouring the roof panel **36***d* the bottom of the beams of the roof section will be notched to conform to the desired angle of the roof, so the roof panel **36***d* will set flat onto the walls **38**. By not installing middle rigid insulation **96** between one beam and another beam (shown in FIG. **36**) a horizontal beam **39** will be installed parallel to the wall **38** and secured by the reinforcing bar **30***a* at the top of the wall **38**. A soffit board **72'** and fascia board **72"** would have to be installed at the eave of the roof panel **36***d* prior to the mold **12** being filled with concrete **32**. The mold **12** can now be poured with concrete **32** from the top of the ridge of the roof filling both the beams shown in FIG. **36** and the horizontal beam **39**.

[**0169**] Many variations are contemplated in the structures of the modules and the associated panels, molds, concrete panels, methods, building constructions and modular arrangements

1. A building construction consisting of plural individual modules, each module is characterized by cavity walls comprising a self-contained mold for receiving concrete therein.

2. The construction according to claim 1 in which said walls are constructed of wood studs.

3. The construction according to claim 1 in which said walls are constructed of metal studs.

4. The construction according to claim 1 in which selected ones of said walls include an interior and an exterior finish.

5. The construction according to claim 1 in which selected ones of said walls extend downward whereby to enable formation of a continuous concrete footing when concrete is introduced into said one of said walls.

6. The construction according to claim 1 in which said structure includes a roof portion capable of receiving concrete introduced therein.

7. The construction according to claim 1 in which steel reinforcing means are introduced into said walls prior to introduction of concrete into said wall.

8. The construction according to claim 1 in which composite board forms the exterior finish of said walls.

9. The construction according to claim 1 in which a pair of modules are disposed separated by an air space, ceiling and floor joists span the full length of one of said modules and are connected by with solid bridging between each joist.

10. The construction according to claim 1 in which the exterior of the module wall is left with drywall, studs, ceiling joists, blocking, and floor joists.

11. The construction according to claim 1 in which the interior walls add additional bracing support to the exterior wall of the module.

12. The construction according to claim 9 in which floor and ceiling joists overlap the studs allowing concrete to flow under the joists whereby to form a solid concrete base so as to permanently rest upon the modules.

13. The construction according to claim 1 in which rigid insulation at the interior of the wall provides a thermal break between two separate chambers for installing concrete on either side of the thermal break.

14. The construction according to claim 13 in which the separate chambers are filled with two different materials on either side of the wall, one side having sand within one chamber and having gravel within the other chamber whereby the wall is provided with mass and gravel likewise provides mass, stabilizes said wall and rigidifies said wall.

15. The construction according to claim 14 which included a radiant heating system is provided with said wall capable of heating said gravel stones.

16. The construction according to claim 14 in which a cooling coil is provided within said wall capable of cooling said gravel stones.

17. The construction according to claim 14 in which said radiant heating system includes a source of hot water.

18. The construction according to claim 14 in which said gravel functions as a storage system for a solar heating system.

19. The construction according to claim 1 in which wire mesh is installed on one side of said mold and a textured concrete finish is applied to said wire mesh.

20. The construction according to claim 1 in which said walls are formed of hat channels.

21. The construction according to claim 1 in which said hat channels comprise a forming structure.

22. The construction according to claim 1 in which wire mesh is installed on one side of said mold and concrete is inserted into the mold, through the wire mesh and then formed to a desired finish.

23. The construction according to claim 1 in which said wall structure has smaller vertical C channels and horizontal hat channels.

24. The construction according to claim 23 in which the small vertical C channel is located at the flange of the vertical C channel creating a hollow chamber for electrical wiring.

25. The construction according to claim 1 in which a vertical open passage is connected to a horizontal open passage within the concrete wall created by the forming structure members within the all and conned by a hole between two open passages so as to accommodate utility distribution within the wall.

26. The construction according to claim 21 in which said electrical wiring is connected to the horizontal hat channel.

27. The construction according to claim 21 in which said electrical wiring is passed through the horizontal and vertical hat channels.

28. The construction according to claim 21 in which said forming structure criss-cross each other forming a rigid frame.

29. The construction according to claim 1 in which the floor and wall are connected to form a wall brace support to the walls of the module.

30. The construction according to claim 1 in which the ceiling and wall are connected to form a wall brace support to the walls of the module.

31. The construction according to claim 1 where the structural load capacity of the module floor and ceiling joists are transmitted directly onto the concrete within the wall without bearing directly on the module below.

32. The construction according to claim 20 in which the open cavity of the hat channel when placed against the composite board provides access for utility distribution within a concrete wall.

33. The construction according to claim 20 in which the flanges of the hat channels hold the composite board to the forming structure without using fasteners.

34. The construction according to claim 20 in which the C portion of the hat channels is an access for utility distribution.

35. The construction according to claim 20 in which the forming structures have holes.

36. The construction according to claim 1 in which the forming structure of said walls extend above, below or adjacent to a wall mold whereby to connect the forming structure to the wall to an adjacent module and are embedded with the concrete wall.

37. The construction according to claim 13 in which the wall is double sided, where the forming structure is a mirror image on both sides of the rigid insulation in the middle of the wall.

38. The construction according to claim 1 in which the horizontal bracing channel braces the rigid insulation in securing the wall.

39. The construction according to claim 3 in which the flanges of the H channels support the outer surface of the wall.

40. The construction according to claim 1 in which the foam spacers are added to the interior of the wall resulting in a ribbed concrete structure.

41. The construction according to claim 40 in which said interior foam spacer when installed less than full height will have concrete beams criss-crossing the ribbed concrete structure.

42. The construction according to claim 1 in which a connector secures the finished rigid boards.

43. The construction according to claim 42 in which an H connector wraps the edges of the composite board of the surface of the wall mold and the connector is secured to said forming structure of the mold.

44. The construction according to claim 42 in which one end of a connector is partially embedded in the composite

board of the wall mold and the other end of the connector has a lip that penetrates through the hole in the forming structure of the mold.

45. The construction according to claim 14 in which the wall mold plus the filled material within the wall forms a concrete beam.

46. The construction according to claim 1 in which control joints are secured to the forming structure of the mold.

47. The construction according to claim 1 in which an expansion joint is secured to the forming structure of the mold.

48. The construction according to claim 47 in which two C channels span the full width of the forming structure are separated by caulk.

49. The construction according to claim 4 in which the exterior finish includes siding.

50. The construction according to claim 49 in which a vapor barrier is behind the siding.

51. The construction according to claim 4 were brick is installed as part of the exterior finish.

52. The construction according to claim 1 in which the corners of the interior forming structure has metal angle corners.

53. The construction according to claim 1 in which a U channel support the floor and ceiling joists when attached to the interior forming structure.

54. The construction according to claim 1 in which a C channel provides load bearing support when attached to the interior forming structure.

55. The construction according to claim 53 in which the U channel is a decorative accent strip.

56. The construction according to claim 54 in which the C channel is a decorative accent strip.

57. The construction according to claim 1 in which a removable wall form is attached to the forming structure of the mold and removed upon the curing of the concrete.

58. The construction according to claim 57 in which wall ties connect to the interior structure of the wall mold through the removable form.

59. The construction according to claim 1 in which a ribbed shaped interior forming mold comprising a composite board, an array of metal framing members and interior foam spacers capable of receiving concrete therein.

60. The construction according to claim 59 in which metal framing is used to support the composite board and the interior foam spacers.

61. The construction according to claim 59 in which steel reinforcing is installed in the mold.

62. The construction according to claim 59 in which the interior foam spacers are tapered.

63. The construction according to claim 59 in which the concrete within the mold is be poured to only the height of the beams and cured.

64. The construction according to claim 63 in which additional steel reinforcing is added to the beam prior to curing.

65. The construction according to claim 63 in which additional concrete is installed over the beams after the concrete beams have cured.

66. The construction according to claim 63 in which additional utilities are installed above the interior foam spacers.

67. The construction according to claim 59 in which the interior foam spacers are less than full length of the beams allowing installation of crossing beams to be installed.

68. The construction according to claim 59 in which temporary scaffolding can be installed.

69. The construction according to claim 59 in which includes a roof portion.

70. The construction according to claim 59 in which includes a floor portion.

71. The construction according to claim 69 in which the soffit, fascia and gutter is installed as an integral part of the roof portion.

72. The construction according to claim 69 in which the horizontal beam connects the wall to the roof portion.

73. The construction according to claim 69 in which additional hat channels are embedded in the roof portion prior to the curing of said concrete creating an air space under the roof shingles.

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