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(54) **INTEGRATED, INSULATED, STRUCTURAL BUILDING PANELS**

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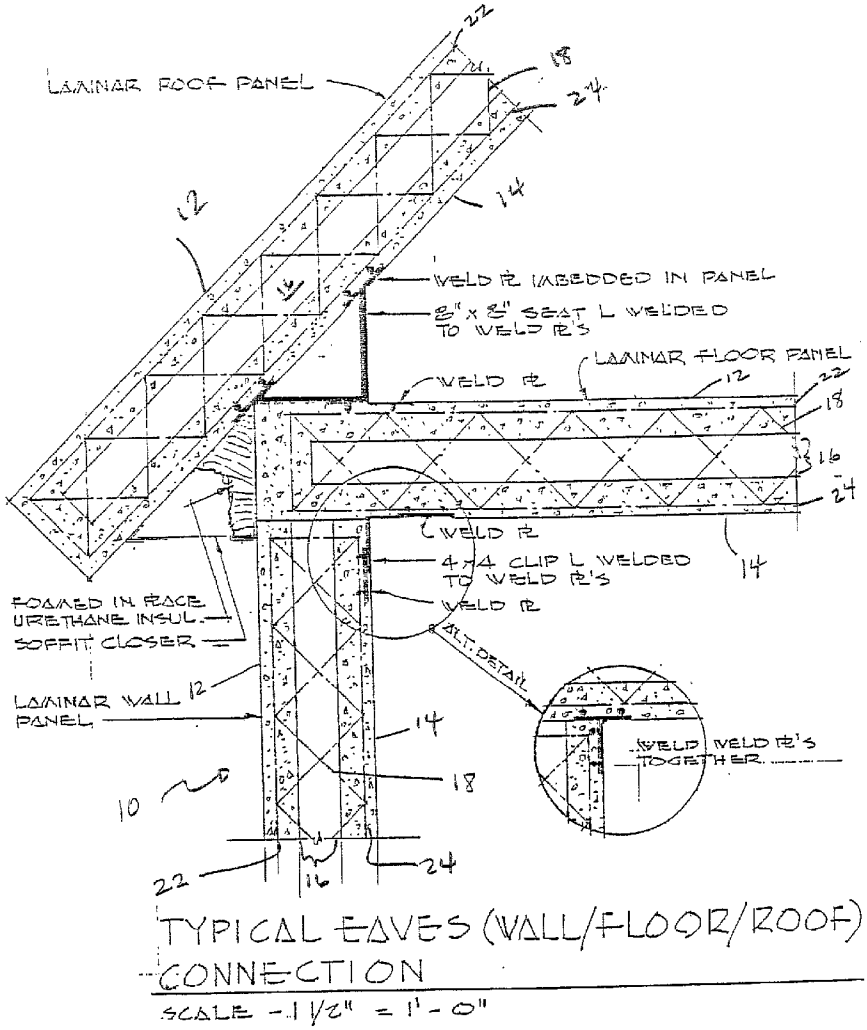
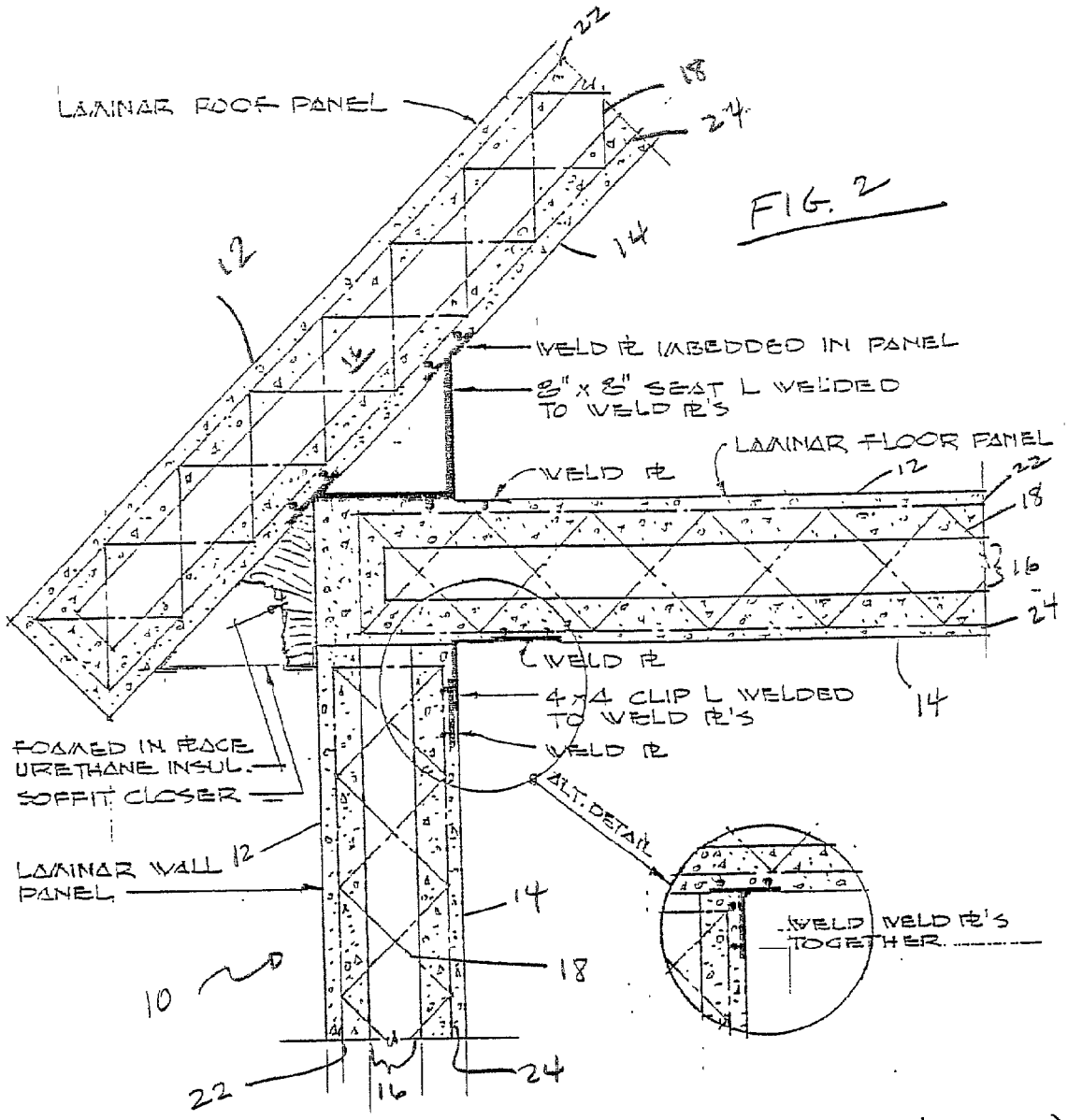
(57) **ABSTRACT**

The present invention provides an integrated, insulated panel for use in the construction industry. The integrated panel includes an integrity reinforcing truss disposed between upper and lower surface panels for enhancing the overall strength of the integrated panel. An adhesive insulating material is preferably disposed between the surface panels to assist in bonding the elements of the integrated panel into one piece. The strength and integrity of an integrated panel may be varied to satisfy the needs of a particular application through varying the dimensions and materials of the structural elements.



TYPICAL EAVES (WALL/FLOOR/ROOF) CONNECTION

SCALE - 1 1/2" = 1'-0"



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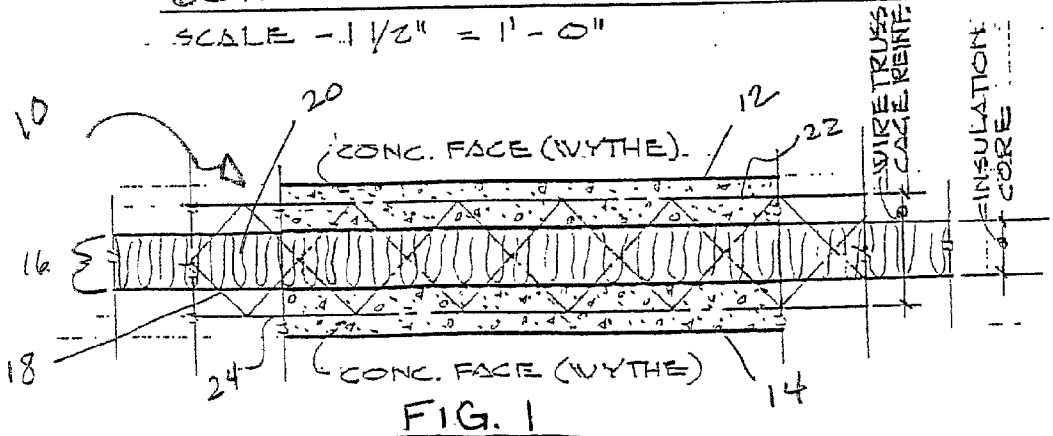


FIG. 1

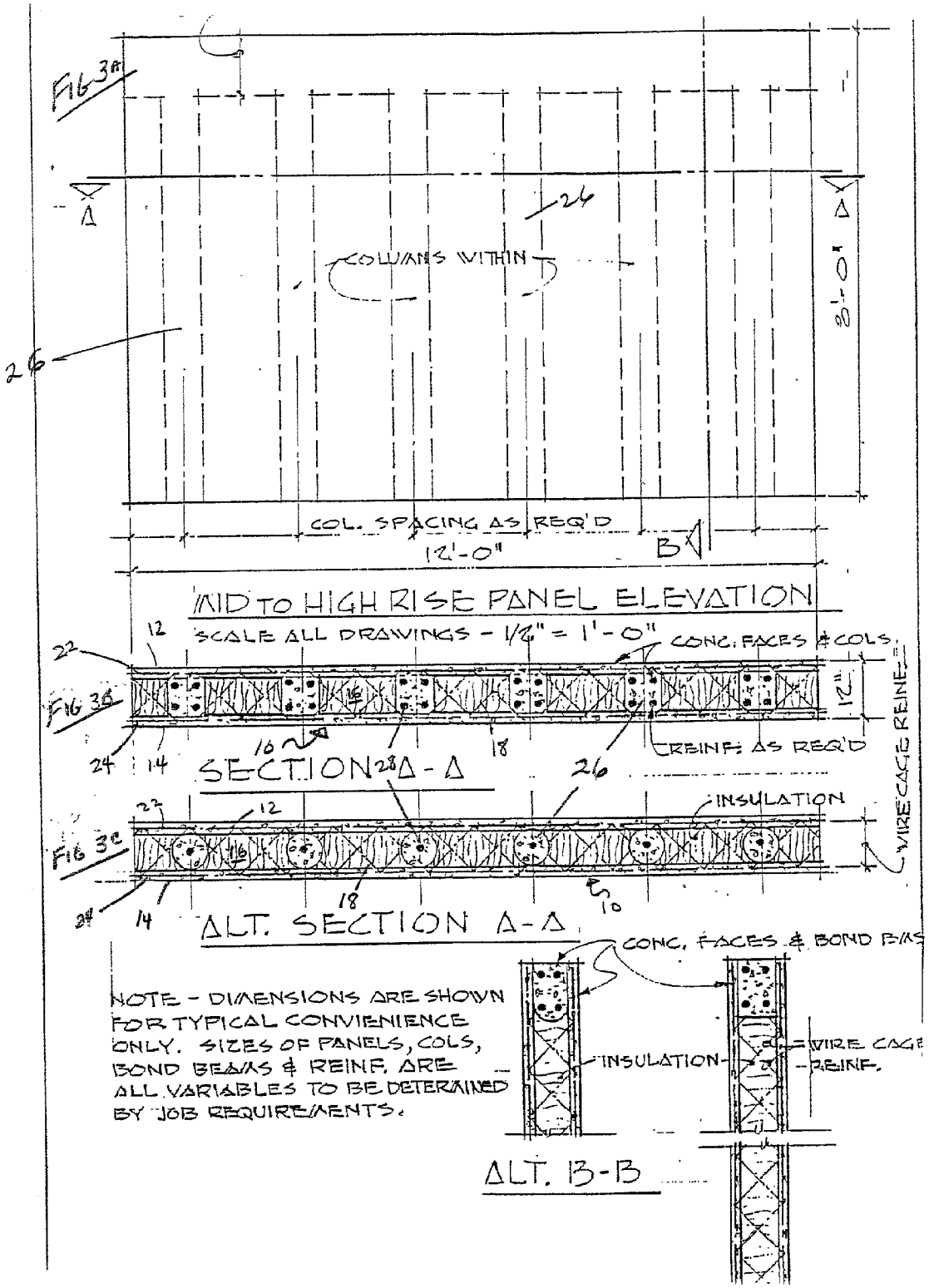
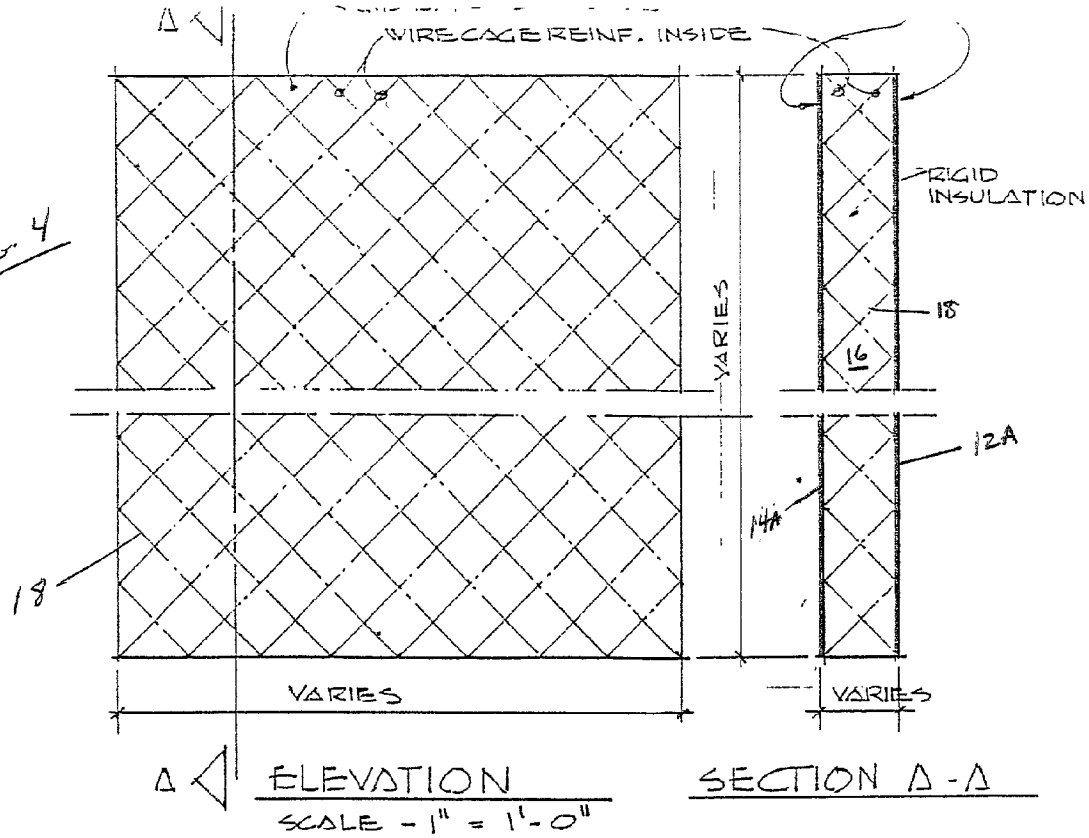


FIG 3A
COLUMNS WITHIN
26
20'-0"
COL. SPACING AS REQ'D
12'-0"
MID TO HIGH RISE PANEL ELEVATION
SCALE ALL DRAWINGS - 1/8" = 1'-0"
CONC. FACES & COLS.
12"
REINF. AS REQ'D
WIRE CAGE REINF.
FIG 3B
SECTION A-A
INSULATION
FIG 3C
ALT. SECTION A-A
CONC. FACES & BOND B/AS
INSULATION
WIRE CAGE REINF.
NOTE - DIMENSIONS ARE SHOWN FOR TYPICAL CONVIENIENCE ONLY. SIZES OF PANELS, COLS, BOND BEAMS & REINF. ARE ALL VARIABLES TO BE DETERAINED BY JOB REQUIREMENTS.
ALT. B-B

FIG. 4



LIGHTWEIGHT STRUCTURAL PANEL

NOTE - SIZES, EXTERIOR VENEERS, GAGE OF INTERIOR WIRE CAGE REINFORCING, ETC. ARE ALL VARIABLES TO BE DETERMINED BY JOB CONDITIONS.

INTEGRATED, INSULATED, STRUCTURAL BUILDING PANELS

RELATED APPLICATION

[0001] This application claims priority of U.S. Provisional Patent Application No. 60/279,971 filed Mar. 29, 2001, and is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to building panels for use in the construction industry, more particularly, to building panels having a reinforced core that includes elements which can be varied to meet desired structural needs.

[0004] 2. Background of the Invention

[0005] There are many types of pre-cast panels for use in the construction of buildings. These panels are sometimes manufactured with plastic, rigid insulation foam cores that are surfaced with various sheathing materials such as plywood, gypsum board, cementitious materials, steel, aluminum and others. These panels, however, rely on the structural capability of their veneers, the adhesion of the rigid foam cores to the backsides of the veneer faces and the thickness of the panels themselves for their structural integrity.

[0006] The present invention provides an improvement over the foregoing panel structure by adding a structural wire reinforcing cage introduced between the outer veneer faces whereby the overall structural integrity of the panels is increased.

SUMMARY OF THE INVENTION

[0007] The present invention relates to a method and apparatus for integrated, insulated structural building panels for use in the construction of low-rise, mid-to high-rise, mobile home and other similar markets in the building industry.

[0008] An integrated structural panel includes an upper panel and a lower panel wherein the lower panel is spaced a predetermined distance from the upper panel. Both the upper and lower panels are substantially equivalent in thickness, width and height for use in the particular application.

[0009] A truss is disposed in the space between the upper and lower panel to reinforce the structure rigidity of the panel. Preferably, the truss is made in the form of a wire cage having an upper chord embedded in the upper panel and a lower chord embedded in the lower panel.

[0010] An insulating material is disposed in the truss such that the upper panel, lower panel, truss and insulating material are integrally formed as one piece.

[0011] To add to the overall rigidity and strength of the panel, a reinforced concrete column may be disposed between the upper and lower panels along with the truss and insulating material.

[0012] The above-described panel may be engineered to withstand a multitude of dead and live load conditions as required for a particular construction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] A better understanding of the present invention will be had upon reference to the following detailed description when read in conjunction with the accompanying drawings wherein like-referenced characters refer to like parts in which:

[0014] **FIG. 1** is a view illustrating a cross-section of an integrated structural panel as according to the invention;

[0015] **FIG. 2** is a view illustrating integrated panels in combination to form the structural elements of a building;

[0016] **FIGS. 3*a*-3*c*** are views illustrating integrated panels including reinforcing concrete columns;

[0017] **FIG. 4** is a view illustrating integrated panels without the concrete veneers.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] The present invention provides an integrated structural panel **10** that can be constructed to satisfy the predetermined structural needs of a building.

[0019] As best illustrated in **FIG. 1**, an integrated panel includes an upper panel **12** and lower panel **14** spaced apart to a predetermined distance. The panels have a predetermined thickness, height and width substantially equivalent to one another such that they form the outer sheathing or veneers of the integrated panel **10**. The panels are made from concrete or cementitious material to ensure overall panel strength and rigidity.

[0020] A truss **18** is disposed in the space between the upper **12** and lower **14** panels for the purpose of reinforcing the overall strength and rigidity of the panel. Generally, the truss **18** is a wire cage that includes an upper **22** and a lower chord **24** that are embedded in the upper **12** and lower **14** panels, respectively, such that the wire cage **18** binds the upper **12** and lower **14** panels together. A high-strength steel wire is the material of choice used for construction of the truss, but other metals and/or plastics may be used as desired.

[0021] An insulating material **16** is disposed within the truss **18** and between the two panels whereby the panels, truss **18** and insulating materials are integrated to form one piece. Preferably, the insulating material **16** is foam plastic that expands and sets within the truss **18** and panels to securely bond all of the elements together. Polyurethane- and isocyanurate-type plastic insulations are preferable for their superlative insulation capabilities in addition to their excellent adhesive qualities. Additionally, while expanding the insulating material actually invades the surface pores of the surrounding materials producing an extremely strong, tenacious, mechanical as well as an adhesive bond. Most preferably, the truss **18** and insulating material **16** are pre-fabricated into a single unit prior to manufacturing the integrated panel **10** to effect a reduction in panel manufacturing time.

[0022] From the foregoing, an integrated structural panel is made for use as wall panels, ceiling and/or floor panels in housing, commercial buildings, mobile homes R.V.s, truck trailers, railroads and/or the like. As illustrated in **FIG. 2, a** plurality of panels are arranged to form various elements of

a construction. An appropriate fastening means is employed for connecting separate panels together and forming the construction.

[0023] Referring now to **FIGS. 3***a*-**3***c*, an alternative preferred embodiment is shown that includes a reinforcing concrete column **26** disposed between the upper **12** and lower **14** panels of the integrated panel **10** for the purpose of enhancing the overall strength and rigidity of the integrated panel. The columns **26** are arranged in space relation to one another in uniformity as illustrated in **FIGS. 3***b* and **3***c*, the concrete columns **26** may include rebar dowels **28** that further enhances the strength of the panel **10**. The shape of the columns **26** as shown in **FIGS. 3***b* and **3***c* are illustrative only and are not intended to limit the scope of the invention.

[0024] **FIG. 4** is a further alternative embodiment wherein the panel **10** includes upper **12***a* and lower **14***a* panels made using a non-concrete, lightweight veneer material which may be desired for certain building applications. These panels may be made of wood, gypsum board, aluminum or other types of materials known to those in the art that have a lighter weight than concrete. During manufacturing, **12***a* upper and lower **14***a* panels, having the truss **18** in between, are placed in a form. The panels are squeezed together causing the chords of the truss **18** to be pressed firmly against them. Insulating material **16** is introduced into the form between the panels such the entire void is filled. The insulating material **16** expands and invades the microscopic pores of all the materials before setting which results in an extremely strong mechanical as well as adhesively bonded integrated panel **10**. Other additives may be introduced into the fluid mixture of the insulating material **16** to impart various physical attributes to the product such as fire resistance.

[0025] **FIG. 1** illustrates an integrated, insulated panel **10** as according to the invention. The strength of an individual integrated panel **10** is extremely flexible and can be tailored to satisfy a multitude of desired conditions by varying the overall thickness of the panels **10**; the thickness of the concrete face slabs **12** and **14**, the strength of the concrete, the width of the space between the concrete faces, the strength of the wire used in the trusses or cages, the gauge of the wire used in the trusses or cages, and the spacing pattern of the wire truss components.

[0026] The anterior reinforcing columns **26** may also be made of steel, wood, hard plastic or other materials appropriate for such purpose.

[0027] Unlimited texture effects to simulate bricks, stone, wood paneling, siding, stucco and/or the like can be cast onto the outer surfaces of the upper **12** and lower **14** panel faces.

[0028] A method of fabricating an integrated structural panel **10** includes the steps of first, forming a lower panel **14** within a suitable form by pouring concrete material therein. If a textured surface is desired on the exterior surface of the concrete, a bond-breaking liner that incorporates the desired texture is first placed in the form before pouring the concrete therein. The next step requires embedding a truss **18** a predetermined depth in the concrete material of the lower panel **14** such that the lower chord **24** is submerged therein before it solidifies. The process continues with inserting insulation **16** within the truss **18** below an upper chord **22** limit of the truss **18** such that the chords may later be properly embedded into an upper panel **12**. It is appreciated that chemical additives may be added to the concrete material to reduce the hardening periods. Finally, the process is complete by forming an upper panel **12** within the form such that the upper chord **22** of the truss **18** are embedded in the upper panel **12** which is then left to solidify.

[0029] The form for the panels is placed on a foundation surface that is level to ensure proper settling and control over the panel forming process. The forms may be made of wood, plastic, steel or other similar materials designed to the desired shape and size of the panels and strong enough to contain the pressures of the fluid concrete to be placed inside.

[0030] A bond-breaking sheet, textured or otherwise, may be placed on the flat, level surface within the form as a means for preventing the concrete from adhering to the foundation surface during solidification.

[0031] The form including the concrete may be vibrated to ensure proper consolidation and embedment of the truss in the concrete panels. Alternatively, a portable vibrating device may be inserted into the fluid concrete and moved around until its purpose has been accomplished. This aids in establishing the spacing for the second concrete panel.

[0032] After inserting the insulation material into the truss and pouring the second concrete panel, a texture may be created on the upper surface of the panel by rolling or other suitable means on the still-fluid concrete.

[0033] If windows or doors are required to be located within a panel, a frame will be placed in the panel to accommodate the proper opening. As an alternative, these openings may be power sawed out of the panels after fabrication.

[0034] Additionally, during the assembly process, electrical rough-in boxes, conduit and/or plumbing chases and/or other devices may be placed within the panel during the molding process.

[0035] From the foregoing, it can be seen that the present invention provides a highly effective method and apparatus for an integrated structural panel for use in the construction industry that has an improved strength and rigidity beyond that of conventional pre-cast panels. Having described the invention, however, many modifications thereto will become apparent to those skilled in the art to which it pertains without deviation from the spirit of the invention as described by the scope of the appended claims.

We claim:

1. A method of fabricating an integrated structural panel, said method comprising the steps of:

forming a lower panel within the form;

embedding a truss a predetermined depth in the lower panel;

inserting insulation within the truss; and

forming an upper panel within the form.

2. A method as set forth in claim 1 including the step of positioning a form on a foundation surface.

3. A method as set forth in claim 1 including the step of positioning a bond-breaking sheet on a surface of a form.

4. A method as set forth in claim 1 including the step of positioning a textured bond-breaking sheet on a surface of a form.

5. A method as set forth in claim 1 including the step of vibrating the upper and lower panel to position the wire truss at a predetermined depth.

6. A method as set forth on claim 1 including the step of introducing a fire resistance additive into the insulating material.

7. A method as set forth in claim 1 including the step of finishing the lower panel.

8. A method as set forth in claim 1 including the step of locating a frame within the mold for an opening.

9. A method as set forth in claim 1 including the step of locating a device within the mold.

10. An integrated structural panel comprising:

an upper panel;

a lower panel, wherein said lower panel is spaced a predetermined distance from said upper panel;

a truss disposed in the space between said upper panel and said lower panel; and

an insulating material disposed within said truss, wherein said upper panel, lower panel, truss and insulating material are integral and formed as one piece.

11. An integrated structural panel as set forth in claim 8 wherein said truss is a wire cage.

12. An integrated structural panel as set forth in claim 8 wherein an upper chord of said truss is embedded in said upper panel and a lower chord of said truss is embedded in a lower panel.

13. An integrated structural panel as set forth in claim 8 including a reinforced concrete column disposed between said upper panel and said lower panel.

14. An integrated panel structure as set forth in claim 8 wherein the panels are made of a non-concrete material.

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