A structural insulated panel (SIP), such as 8 feet x 24 foot, is made with a foam plastic core, oriented strand board on each face, and structural paper on either side of that, all bonded together. The oriented strand board capped with structural paper provides a particularly strong wall structure. Also, the structural paper provides a finished surface as manufactured. SIP-to-SIP joints are created using an insert sandwiched between end portions of in-line-joined SIP panels.
STRUCTURAL INSULATED PANEL FOR BUILDING CONSTRUCTION

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims benefit under 35 U.S.C. §119(e) of provisional application Ser. No. 61/056,217, filed May 27, 2008, entitled STRUCTURAL INSULATED PANEL FOR BUILDING CONSTRUCTION, the entire contents of which are incorporated herein in its entirety.

BACKGROUND

[0002] The present invention relates to structural insulated panels such as for building exterior walls, and building structures using same.

[0003] Structural insulated panels (SIPs) have been around for a number of years. In the 1950’s until about 1980, panels were made 4 feet wide and up to 12 feet long with commodity plywood and other materials. Some of these panels have finishes that were acceptable as exterior wall surfaces. The most common was a plywood pattern called reverse board and batten or sometimes T 1-11 ply. The inside of that was a material such as drywall or plywood. The center of these panels was plastic foam to complete a SIP panel.

[0004] The SIP panels discussed above were largely superseded when oriented strand board (OSB) became available in 8 foot by 24 foot sheets. The 4 foot wide panels were too costly and inefficient to install when one big panel could replace six small 4-foot-wide panels. However, a problem with this big 8 foot by 24 foot panel was that it did not have a finished surface on the inside nor outside, since OSB does not provide it. Thus, the big panels were usually covered with drywall on the inside and covered with exterior siding on the outside. Unfortunately, this process of covering inside and outside surfaces after building/wall construction is very expensive and made construction with SIPs more expensive than conventional “stick” construction. Even though SIP construction could save 30% to 50% of the heat loss, there has been continued resistance to use the SIP systems because of costs of material versus “stick” construction.

SUMMARY OF THE PRESENT INVENTION

[0005] One aspect of the present invention is a structural insulated panel made with a foam plastic core and oriented strand board attached on either side to form board faces. The oriented strand board faces are capped with a structural paper that provides a finished surface. The core, OSB and structural paper are all securely bonded together.

[0006] Another aspect of the present invention is a “frameless” building where exterior walls are constructed primarily using structural insulated panels.

[0007] In another aspect of the present invention, a building wall includes two structural insulated panels positioned in-plane and with end edges adjacent. Each panel includes a foam core, an OSB facer on each side, and structural paper on each side. Each panel also includes an end portion with OSB facer extending beyond an outer surface of the foam core to define a cavity and an insert positioned between the end portions and extending into the cavity. The insert includes a foam core and OSB facer on each side, the OSB facer on the insert fitting inside the OSB facer on the panels, and listeners fastening each panel to the insert.

[0008] These and other aspects, objects, and features of the present invention will be understood and appreciated by those skilled in the art upon studying the following specification, claims, and appended drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. 1 is a perspective view of a structural insulated panel (SIP) embodying the present invention.

[0010] FIGS. 2-4 are perspective, side, and front views of a partially constructed building.

[0011] FIG. 5 is a cross section taken along line V-V in FIG. 4.

[0012] FIGS. 6-9 are cross-sectional views showing various joints in an exterior wall of the building, including FIG. 6 showing an exterior-wall-to-roof-beam joint, FIG. 7 showing an exterior-wall-to-floor joint, FIG. 8 showing a SIP-to-SIP joint, and FIG. 9 being an exploded view of FIG. 8.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0013] The illustrated structural insulated panel (SIP panel) is large in size, such as 8 foot by 24 foot, and further incorporates outer layers forming high grade exterior and interior finishes as manufactured. The large size reduces on-site construction costs, and the exterior and interior finishes reduce on-site finishing costs. As a result, the present SIP panels reduce the overall cost of total building construction, so that the completed cost is less expensive than “stick” construction (e.g., wood stud framing for “framed” buildings having an on-site added outside such as vinyl siding and an on-site added inside such as drywall). The present SIP panels also save up to 50% of the heating and cooling costs, as well as meet fire code regulations.

[0014] This invention applies a finish in the factory to these large SIP panels. A combination of changed factors and upgrades of materials with the oriented strand board (OSB) and structural insulated paper makes for a panel finished inside and out.

[0015] 1. The OSB supplied is a higher grade that has minimum edge swell so that it is more suitable for exteriors, and its thickness is selected for functional requirements of the application of use. For example, the OSB thickness can be ¼” to ½”, or more typically about ⅝” to ¾”.

[0016] 2. The OSB is treated and has a high degree of fire resistance for the inside to help meet building fire codes.

[0017] 3. A structural paper (Kraft) with a polyurethane impregnation is used to face the OSB. Urethane impregnation of the Kraft paper is usually from 20% to 35%.

[0018] 4. A waterproof adhesive is used to apply the structural paper to the OSB. The adhesive is of a fire-resistant type to help meet building codes. The adhesive penetrates well into the OSB to prevent delaminations.

[0019] 5. A prime coat of white paint is applied to the structural paper to make panel more weather-resistant on the outside and ready for a finish coat on the inside by the owner in the field.

[0020] 6. The outer and inner faces of prime paint, structural paper and OSB are laminated to both sides of the plastic foam. (Alternatively, one or both of the prime paint and the structural paper can be left off one side.)

[0021] 7. The foam is usually an Expanded Polystyrene, Extruded Polystyrene or Urethane foam plastic. The
foam acts as an insulator and as part of the structure. It can have whatever foam weight and additives that are appropriate for a particular application. It is contemplated that expanded foam having a weight of about 0.8 to 2 pounds per cubic foot, or more preferably about 1 pound per cubic foot will work well in many applications.

[0022] 8. The application of the paper to the OSB must be done with heat and pressure for good bonding. The system can be either accomplished with a flat bed press or a roller press where the heat is transferred through the paper very rapidly since it is very thin. Thickness of the paper is typically 0.011 inches to 0.022 inches.

[0023] 9. The SIP panels can be cut on-site or pre-cut at the factory.

[0024] By way of example, structural paper is commercially available and can be used in the present SIP. Some grades of structural paper have a tensile strength in a machine direction (parallel a longitudinal plane of the paper) of over 15,000 psi, which is up to about half a tensile strength of mild steel. When adhered to outside and inside surfaces of an SIP arrangement, a strength of the structural paper adds significant beam strength to the SIP.

[0025] FIGS. 2-5 illustrate a “frameless” building construction made using the present SIPs in exterior walls. Note FIGS. 6-9 which disclose various joint arrangement optimized for the particular SIPs. It is contemplated that door and window openings as well as other features (e.g., openings for electrical boxes, outlets, switches, utility runs, and the like) can be pre-cut into the SIPs to reduce on-site construction labor and for a more efficient on-site construction. (FIGS. 2-3, 5 show a circular window, but it is contemplated that different window shapes, sizes, and types can be accommodated.) Also, components can be added to the prefabricated SIPs, if desired and appropriate, such as final outer colors, windows, hardware, utilities, inter-connectable utility modules adapted to interconnect between SIP panels, etc.

[0026] The illustrated SIP panel (FIG. 1) includes prime paint 1 (such as white acrylic), structural paper 2 (such as Kraft paper with urethane impreg), adhesive 3 (such as resorsinal or phenolic), oriented strand board (OSB) 4, adhesive 5 (such as urethane), and foam core 6 (such as expanded polystyrene). The OSB 4 is a facer for the foam core 6. A plurality of the SIP panel of FIG. 1 are used to construct the frameless building construction of FIGS. 2-5. The illustrated building of FIG. 2 includes four SIP panels for each half of the roof, three for each of the building sides, and three for the floor. However, it is contemplated that each roof portion, building side, and floor can be made of one, two, or more SIP panels.

[0027] The building (FIG. 3) includes a supporting frame including stilts 10 with diagonal cross braces 11, floor joists 12, a window 13 in one end, and roof truss members 15 (see FIG. 5). Pre-manufactured and pre-cut SIP panels are used to form the floor, walls, and roof. The building can be designed with dimensions selected as desired. The illustrated building (FIG. 3) includes exemplary dimensions: D1 of 24”, D2 of 20-6”6”, D3 of 16”, D4 roof pitch of 12” run to 6” rise, D5 floor height of 9-8”8”, D6 under-floor joist height of 8”, D7 SIP width of 8”, D8 floor-to-ceiling height of about 10-9”4”, D9 peak ceiling height of 16-9”4”, and D10 window diameter of 5”. Notably, in addition to the window 13, additional openings can be made, such as for doors, rectangular windows, channels for utility routing, and the like.

[0028] FIGS. 6-9 are cross-sectional views showing various joints in a building 20 including an outer wall SIP panel 21 and roof SIP panel 22. Specifically, FIG. 6 shows an exterior-wall-to-roof-beam joint 23. A roof SIP panel 22 is secured to an outer wall SIP panel 21 as follows. The outer wall SIP panel 21 includes a wood 2x4 topper 24 secured to the foam core 6 of the outer wall SIP panel 21 with a foam sealant 25, and further secured by 8d nails 26 (or #14 1½” staples) that extend through OSB 4 into sides of the topper 24. Beams of foam sealant 27 provide a continuous bond to make a wood-to-wood (i.e., OSB to topper) connection. A beveled (triangular) 2x seat component 28 that provides a minimum bearing of 3 inches for the roof SIP panel 22 on the topper 24 and outer wall SIP panel 21. A screw 29 (such as #14 panel screw 1½”) longer than the roof SIP panel 21 is extended through the roof SIP panel 21 into the topper 24. The roof SIP panel 22 includes EPS foam core 6 and OSB 4 on both sides, but structural paper 2 only on the inside/outer surface facing the wall SIP panel 21.

[0029] FIG. 7 shows an exterior-wall-to-floor joint 30 between an outside wall SIP panel 21 and a floor SIP panel 31. The outside wall SIP panel 21 includes EPS foam core 6 and OSB 4 on both sides as well as structural paper 2 on both sides of the wall SIP panel 22. A ledger board 32 (e.g., 2x8 wood board) is attached to the outer wall SIP panel 21 by using screws 29 (such as #14 panel screw 1½”) longer than the outer wall SIP panel 21 extended through the outer wall SIP panel 21 into the ledger board 32. A second board 33 fits against an end of the floor SIP panel 30, and in particular fits between the OSB boards 4 and against the foam core 6. Several 8d nails 34 (or #14 1½” staples at 6” O.C. typical) extend through the OSB boards 4 into the second board 33. Additional screws 29 (such as #14 panel screw 1½”) longer than the outer wall SIP panel 22 are extended through the outer wall SIP panel 22 into the second board 33. Adhesive and/or sealant can be used as desired.

[0030] FIG. 8 shows a SIP-to-SIP joint 40, and FIG. 9 is an exploded view of FIG. 8. The joint 40 includes opposing end portions 41 of SIP panel 21 (or of SIP panels 22 or 31) and an insert 42. The insert 42 includes a foam core 43 (similar to core 6) and OSB 44 (similar to OSB 4) adhered together. A thickness of the insert 42 fits between and inside the OSB 4 of the end portions 41 of each SIP panel 21. Beads 45-47 are placed along an inside of the end portions 41 on the OSB 4 and the foam core 6 of each SIP panel 21. The end portions 41 are brought against the insert 42, and 8d nails 48 (or #14 1½” staples) are extended through OSB 4 into sides of the insert 42. The OSB 4 on each side of the SIP panels 21 abut (or are closely adjacent) in inline positions. The illustrated insert 42 is about 3¼” long, such that about 1¼” of each end of the insert 42 fits into the mating cavity in the end portions 41 of the SIP panel 21.

[0031] It is to be understood that variations and modifications can be made on the aforementioned structure without departing from the concepts of the present invention, and further it is to be understood that such concepts are intended to be covered by the following claims unless these claims by their language expressly state otherwise.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A structural insulated panel comprising:
   a. A foam plastic core and oriented strand board (OSB) attached on either side of the core to form board faces, the board faces being capped with a structural paper that
provides a finished surface; the core, OSB and structural paper all being securely bonded together.

2. The structural insulated panel defined in claim 1, wherein a prime paint is applied to the outer face of the structural paper.

3. The structural insulated panel defined in claim 1, wherein the adhesive used to bond the paper to the OSB is waterproof and adds to the fire resistance.

4. The structural insulated panel defined in claim 1, wherein the plastic foam core is one of Expanded Polystyrene, Extruded Polystyrene, or Urethane.

5. The structural insulated panel defined in claim 1, wherein the OSB has added chemicals to reduce the edge swell and increase the fire resistance.

6. The structural insulated panel defined in claim 5, wherein the OSB is at least about 2½ inch thick to provide good fire resistance.

7. The structural insulated panel defined in claim 1, where the panel size is very large, such as 8 foot by 24 foot, to eliminate the need for many small panels with numerous junctures.

8. A building comprising a plurality of the structural insulated panels defined in claim 7, the plurality of panels being attached together to form walls without wood framing, whereby the interconnected arrangement of large panels speeds erection of the building, improves building structure, and reduces energy loss through the building walls once constructed.

9. The structural insulated panel defined in claim 1, where a panel substantially forms a structural wall or roof of a building.

10. A building wall comprising:
    two structural insulated panels positioned in-plane and end edges adjacent; each panel including a foam core, an OSB facer on each side, and structural paper on each side; each panel including an end portion with the OSB facer extending beyond an outer surface of the foam core to define a cavity; and
    an insert positioned between the end portions and extending into the cavity; the insert including a foam core and OSB facer on each side, the OSB facer on the insert fitting inside the OSB facer on the panels; and
    fasteners fastening each panel to the insert.

11. The building wall defined in claim 10, wherein the fasteners include shafts that extend through at least one of the OSB facers on the insert and through an adjacent one of the OSB facers on the panels.

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