BUILDING MATERIAL AND METHOD OF MAKING AND INSTALLING THE SAME

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Appl. No.: 12/554,100
Filed: Sep. 4, 2009

Related U.S. Application Data
Division of application No. 10/849,279, filed on May 19, 2004, now Pat. No. 7,600,356.
 Provisional application No. 60/471,700, filed on May 19, 2003.

Publication Classification
Int. Cl.
E04C 2/38 (2006.01)
E04G 21/00 (2006.01)

U.S. Cl. ........................................... 52/474; 52/745.05

ABSTRACT
The building material, in one embodiment, has a jointing system that is uniquely configured to cover the frame of a structure. This building material, in one embodiment, is a building board with a conforming flange that is embossed onto the board and adapted to engage or mate with an end of an adjacent board. In another embodiment, the building material is an engineered panel joint comprised of a building board and a flexible or hinged article attached to the back surface of the building board. The article is preferably attached to the building board by an adhesive and extends beyond the edge and away from the building board for receiving a fastener to fix the building board to the structure. The fastener is preferably a nail. Components of the building material are preferably attached to the frame of the structure through the use of a single row of nails while maintaining or enhancing the shear strength performance of the building board system.
RECEIVING GREENSHEET FROM FORMING MACHINE

PUTTING PATTERN ON FRONT?

YES

PUTTING PATTERN ON GREENSHEET

CUTTING ANGLES ON BUILDING BOARD EDGES

NO

CURING MATERIAL

FINISHING MATERIAL (OPTIONAL)

APPLYING ADHESIVE AND THE JOINT

STACKING MATERIAL

FIG. 5
FIG. 6
FIG. 10A

FIG. 10B

FIG. 10C
BUILDING MATERIAL AND METHOD OF MAKING AND INSTALLING THE SAME

BACKGROUND OF THE INVENTION

[0001] This application claims priority to U.S. Provisional Patent Application No. 60/471,700, filed May 19, 2003, the entirety of which is incorporated by reference herein.

[0002] 1. Field of the Invention

[0003] This invention in one embodiment relates to a building material for covering the frame of a structure, wherein the building material is comprised of a building board having an extending flange adapted to engage an end of an adjacent board to provide a means by which to secure the building board within a system of building boards while improving the shear strength of the system in a cost effective manner.

[0004] 2. Description of the Related Art

[0005] The cladding market uses building boards for covering the frame a structure. The market includes building boards of different materials; in particular, wood, ceramic, metal, plastic or composites of two or more of these. These boards are generally in the form of discreet planks or panels that must be placed adjacent to each other on the frame of a structure in order to cover the structure and thereby provide a protective and decorative covering. In order for this covering to be contiguous, the joints between boards must be treated to appear aesthetically pleasing. This treatment, however, is time consuming and can be expensive. Accordingly, what is needed is an improved building material having a jointing system that reduces the cost and improves the ease of installing building boards. There is also a need in the market for building boards that are, among other things, better at preventing water seepage between the joints, improving the joint strength between building boards, and enhancing the shear strength of the building board system.

[0006] Construction industries, such as a residential construction, prefer using nailable building boards for attaching to various types of framing, including wood and metal framing. However, hard, dense or brittle materials, such as ceramic, concrete, stone or thick metal are not nailable and must therefore be attached to wood or steel frames by some other means, such as by providing pre-drilled holes for nails. Drilling holes is time consuming and expensive, so there is a need to reduce installation cost by finding a means of nailing a non-nailable substrate such as ceramic or dense cement composite without pre-drilled holes.

[0007] When installing building panels, the panels are butted against each other such that their edges simultaneously cover a framing member. Each panel edge is fastened to the framing member with a row of nails, such that there are two rows of nails at each panel joint. This process is necessary to achieve a minimum level of shear strength as established by building codes. As a way of reducing installation costs, it would be advantageous to minimize the number of nails applied to a panel joint while obtaining comparable or improved shear strength performance as the building board system having two rows of nails at each panel joint.

[0008] Nailable materials, such as plywood or OSB panels, that have shiplapped edges may reduce the number of nails needed to merely connect panels together; however, two rows of nails are still needed at each joint of those products in order to maintain the minimum level of shear strength needed to satisfy building codes. For instance, wood-based, shiplapped panels are nailed with two rows of nails; one through the shiplap of the under lapping board and one through the shiplap of the overlapping board to avoid buckling under shear forces. What is needed is a joint treatment using only one row of nails that is resistant to buckling under shear load.

[0009] Shiplapped building boards made of fibercrete are poor candidates for reducing the numbers of nails needed to connect boards together while maintaining the minimum level of shear strength. Fibercrete boards are generally brittle and thus, the shiplapped edges of such boards are prone to breakage during shipment and installation. In addition, it is expensive to machine shiplap joints into the edges of a fibercrete panel. What is needed is a means of treating the edges of a fibercrete panel to make the edge of the panel less prone to breaking.

[0010] Building boards are sometimes sold with a factory applied finish. Often, the finish on these boards is damaged when the boards are nailed to framing members. The building board must be repainted or recoated (or both) with a coating that matches the original finish. This is a time consuming process and adds cost. Thus, there is also a need for a means of nailing a building board to a framing member that minimizes the damage to the finished surface of the board.

SUMMARY OF THE INVENTION

[0011] A building material is provided for covering the frame of a structure. The building material, in one embodiment, is uniquely configured to cover a frame of a structure using a single row of fasteners at each joint or framing element. This building material is preferably a building board with a conforming flange that extends beyond an end of the building board. The conforming flange is preferably embossed onto the building board and adapted to engage or mate with an end of an adjacent building board. The building material may further have a water resistant material deposited between the adjacent building board along the shiplapped joint for managing water seepage.

[0012] In an alternative embodiment, the building material may be comprised of an article connected to a building board. The building board can be, but is not limited to, a panel, plank, trim, roofing state, shake, or tile. In addition, the building board can be made from any one of a number of materials, individually or in combination thereof, including, but not limited to, stone, brick, clay, metal, ceramic, glass, vinyl, fibercrete, cement, and PVC. More particularly, a fibercrete building board provides especially advantageous properties in a unique configuration. Likewise, the article may be made of any one of a number of materials, individually or in combination thereof, including, but not limited to, stone, brick, clay, metal, ceramic, glass, vinyl, fibercrete, cement, and PVC as well as fabrics and fiberglass.

[0013] The article preferably acts as a joint extending beyond one edge of the building board for receiving a fastener to fix the building board to the structure. In one embodiment, the article also preferably acts as a flange by which another building material of the same configuration can be easily aligned and secured to the structure. These two building materials work together as a building board system that can be attached to a framing element. This building board system has the capacity of achieving equal or greater shear strength than other building board systems. Preferably, the building board system achieves this level of shear strength by having each building board being nailed to framing members on only 5
edges, thus, reducing the cost and improving the ease of installing the system. The article may also be configured to provide a specific building board system with a specific aesthetic appearance, such as that of a board and batten construction.

[0014] The article may be comprised of more than one flange, wherein at least two of the flanges are connected by a hinge or a channel. The hinge is preferably made of a flexible material, such as polymer material, plasticized PVC, nylon mesh or an elastomer, and may be attached to the flanges by any suitable fastening means including, but not limited to, chemical bonding, mechanical bonding, thermal bonding, and adhesives such as a hot melt polyurethane glue. The hinge may also be co-formed with at least one of the flanges for example by co-extrusion, pultrusion or injection molding. The hinge preferably allows at least one of the flanges to rotate around the hinge and lie next to the flange attached to the building board or in a plane substantially parallel with the building board, which improves the strength of the joint. The hinge also provides flexibility to the joint, which helps to prevent damage resulting from packaging and shipping the building material.

[0015] The article may be attached to the building board by any suitable chemical, thermal or mechanical means. For instance, the article may be bonded to the building board using any suitable adhesive including structural adhesive, polyurethane glue, hot melt polyurethane adhesive, epoxy adhesive, acrylic foam, polyurethane foam, pressure sensitive adhesive, pressure sensitive foam adhesive (e.g., butyl rubber or acrylic foam), silicone caulk and polyurethane caulk. The adhesive may be applied as a layer between the article and the building board. In one embodiment, the adhesive may be incorporated into the body of the article and activated when the article is pressed against the building board. In another embodiment, the adhesive is also activated by heat. In another embodiment the article is a polymeric material and a solvent is used to swell and adhesively bond the polymer to the building article.

[0016] The channel may be made of a rigid material such as metal and may be attached to the flanges by any suitable fastening means including chemical bonding, mechanical bonding, thermal bonding, and adhesives. The channel preferably rests between the adjacent ends of the building boards to form a building system. The building board system is then secured to a framing element. To further improve the shear strength of the building board system, a jointer compound may be added between the edges of the building board system and/or in the channel connecting adjacent building boards.

[0017] The building boards may further have beveled edges and/or notches and tabs. The beveled edges and/or notches cause to interlock with adjacent boards to form a building board system with improved shear strength while improving the ease of installation of the boards.

[0018] The building material may be configured in other embodiments. For instance, the building material may be configured with angled edges building boards which help to reduce the conspicuousness of the seams between building boards. The building boards are preferably formed with angles along opposite edges, e.g., top and bottom edges or opposing side edges, so that the edges of adjacent building boards overlap when installed. This overlapping feature along the edges of the building board, in conjunction with the hinged article, helps to make the joint less conspicuous by allowing the edges of each board to slidingly engage with each other as the boards expand or contract from exposure to heat, cold or changing moisture content. The angled edges also help to reduce installation time by providing a means by which the building boards can be easily aligned and fixed to the framing members.

[0019] Likewise, in another embodiment, a building material is provided with a fiberembossment having a surface and opposing edges and an article connected to the surface of the board. The article extends beyond at least one of the opposing edges and is adapted to receive fasitener to fix the board to the structure. The article has at least one flange connected to the panel and a second flange extending beyond one of the opposing edges, the second flange being capable of moving relative to the first flange.

[0020] In a further embodiment, a building material is provided with at least two strips of material. Each strip of material has a surface, wherein the at least two strips are adjacent each other and connected together along an edge. The building material is further provided with a board having a substantially planar surface and opposing ends, wherein the surface of one of the at least two strips of material is connected to a surface of the board along one of the opposing ends of the board. One of the at least two strips of material is configured to extend beyond one of the opposing ends of the board, wherein the extending strip is capable of movement relative to the strip connected to the board.

[0021] In a further embodiment, a system of building materials is provided with at least two boards connected to a framing element, wherein one of the boards is a main board and a second of the at least two boards is an adjacent board. The at least two boards each have a surface, opposite ends, and opposite edges. The system is further provided with an article connected to the main board surface along one of the opposite ends of the main board, wherein the article has at least one flange parallel with the main board surface, the at least one flange extending beyond one of the opposite ends of the main board. The system is further provided with a row of fasteners extending at least through the article to the framing element, wherein the row of fasteners extending through the article secures the main board and the adjacent board relative to the framing element.

[0022] The various embodiments of the building material may be installed in numerous ways. In one embodiment, a method of installing a system of building materials is provided, which comprises selecting a first board having at least one flange extending from at least one of the opposing edges and away from the first board, positioning the first board on a framing element of the structure such that a surface of the article rests along an outward facing surface of the framing element, selecting a second board having a surface and opposing edges, aligning the second board on the framing element of the structure, wherein at least one of the opposing edges of the second board is adjacent one of the edges of the first board and fastening the article to the framing element causing to relatively secure the first board and second board to the framing element. In another embodiment, the method and system involves fastening the article to the framing member using only one row of nails at each board joint.

[0023] These and other objects and advantages will become more fully apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. 1A shows a cross sectional elevation view of one embodiment of a system of building materials with two shiplapped building boards in contact with each other at a framing element.
FIG. 1B shows a cross sectional elevation view of one embodiment of a system of building materials with two shiplapped building boards interlocked together at a framing element.

FIG. 1C shows a cross sectional elevation view of a system of building materials of FIG. 1B affixed to the framing element by means of at least one nail.

FIG. 2A shows a cross sectional elevation view of one embodiment of a building material with a hinged flange having a capillary break adhered to an edge of a building board.

FIG. 2B shows a cross sectional elevation view of a building material of FIG. 2A affixed to a framing element and a separate building board by means of a nail.

FIG. 3 shows a cross sectional elevation view of the building material of FIG. 2A wherein the flange is affixed to a framing element by means of a nail and is further affixed to a separate building board by means of an adhesive.

FIG. 4 shows an alternative embodiment of FIG. 3 wherein the building material is affixed to a framing element by means of a nail through the hinged connection of the flange.

FIG. 5 is a flow chart illustrating a preferred method of manufacturing the building material of FIG. 2A using a fiber cement building board.

FIG. 6 is a flow chart illustrating an alternative method of manufacturing the building material of FIG. 2A using building boards made from materials other than fiber cement.

FIG. 7A is a cross sectional elevation view of a system of panels connected to a structure based on how panels are typically installed wherein the joints between panels require two rows of nails at each framing element.

FIG. 7B is a cross sectional elevation view of one embodiment of a system of building materials wherein the panels are connected to a structure requiring only a single row of nails at each joint or framing element.

FIG. 8 is a cross sectional elevation view of one embodiment of the building material having a compound angle affixed to a separate building board.

FIG. 9A is a cross sectional elevation view of one embodiment of the joint with a substantially oval bead between the flanges, wherein the bead may serve as a hinge.

FIG. 9B is a cross sectional elevation view of one embodiment of the joint with a substantially semi-oval bead between the flanges, wherein the bead may serve as a hinge.

FIG. 10A is a cross sectional elevation view of one embodiment of the joint with a hinge between and substantially in the same plane as the flanges.

FIG. 10B is a cross sectional elevation view of one embodiment of the joint having two hinges between the flanges, wherein one of the flanges has a bead.

FIG. 10C is a cross sectional elevation view of one embodiment of the joint having two hinges between the flanges, wherein one of the flanges has a bead at the end of an extending member.

FIG. 11 is a cross sectional elevation view of one embodiment of a system of building materials wherein the building boards are connected by a jointer and a joining compound.

FIG. 12 is a perspective view of one embodiment of the joint, wherein the joint is a jointer having at least two flanges with perforated surfaces.

FIG. 13 is a cross sectional elevation view of one embodiment of a building material, wherein the joint is sandwiched between a strip of material and a surface of the building board such that the strip of material is flush with a surface of the building board.

FIG. 14 is a cross sectional elevation view of one embodiment of a building material, wherein the joint is sandwiched between a strip of material and a surface of the building board such that the strip of material rests along a surface of the building board.

FIG. 15 is a cross sectional elevation view of one embodiment of a building material, wherein the joint has an end with a channel adapted to receive a corresponding end of the building board.

FIG. 16 is a cross sectional elevation view of one embodiment of a building material, wherein the joint has an end with a j-style hook that is adapted to snap into a lip formed along a portion of the building board.

FIG. 17 is a cross sectional elevation view of one embodiment of a building material wherein the building board has apertures adapted to receive rivet portions of a joint.

FIG. 18 is a cross sectional elevation view of one embodiment of a system of building materials wherein an adhesive is positioned between the edges of adjacent building boards.

FIG. 19 is a top view of one embodiment of a system of building materials wherein two building boards are positioned side-by-side and an adhesive is applied at discrete locations along adjacent edges of the building boards.

FIG. 20 is a top view of one embodiment of a system of building materials wherein two building boards are positioned side-by-side and an adhesive is applied continuously along adjacent edges of the building boards.

FIG. 21 is a cross sectional elevation view of one embodiment of a system of building materials wherein an adhesive is positioned between the nailing region of the joint and a surface of an adjacent building board.

FIG. 22 is a top view of one embodiment of a system of building materials wherein two building boards have corresponding beveled edges adapted to mate together to form an interlock.

FIG. 23 is a top view of the building boards of FIG. 22 interlocked together.

FIG. 24 is a top view of one embodiment of a system of building materials wherein one board has a notch and the other board has a corresponding tab adapted to mate with the notch.

FIG. 25 is a top view of the building boards of FIG. 24 interlocked together.

FIG. 26 is a top view of one embodiment of a system of building materials wherein two building boards are connected together and biscuits are slotted along the adjacent edges of the building boards.

FIG. 27 is a cross-sectional elevation view of one embodiment of a building material, wherein a portion of the joint is extending from an edge of a flat plank trim.

FIG. 28 is perspective view of the building material of FIG. 27, wherein siding planks are connected to the trim.

FIG. 29 is cross-sectional elevation view of one embodiment of a building material, wherein a portion of the joint is extending from an edge of a corner trim.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In one embodiment, the building material 5 comprises at least one shiplapped building board. The building
material is preferably rabbeted so that the edge of one board 10 overlaps an adjacent board 20 to create a substantially flush joint 30 as shown in FIGS. 1A, 1B, and 1C. The building boards are preferably made of fiber cement but can be made of any suitable material including stone, brick, clay, metal, ceramic, glass, vinyl, cement, plastic or composites thereof. In addition, the shiplapped joint may be applied to panels, planks, roofing slates or shakes, tiles, and flooring boards.

The joint 30 preferably comprises a cut or groove 40 along a surface near at least end of the building board 10 adapted to receive the end 50 of an adjoining building board 20. Alternatively, the end 50 of the adjoining board 20 may be adapted to receive the unique configuration of the cut or groove 40. For instance, the end 50 of the board 20 shown in FIG. 1A has a recess 60 adapted to receive the cut or groove 40 of the building board 10. The recess 60 and the cut or groove 40 help to form the joint 30. The cut or groove 40 and the recess 60 of the building material 5 may be formed in any suitable manner. For instance, the recess 60 and cut or groove 40 may be embossed onto a fiber cement greensheet during the formation process.

Optionally, a portion of the recess 60 may be left uncovered by the cut or groove 40 of building board 10 as shown in FIGS. 1A, 1B, and 1C. When this is done, a batten 80 is preferably formed as a result of the exposed portion of the recess 60 and the end 70 of building board 10. The batten 80 is an ornamental feature of the system that can be further enhanced by molding, scoring, embossing, or extruding decorative elements such as the ribs 65 shown in FIGS. 1A, 1B, and 1C.

In addition to enhancing the look of the system, the building material may further provide for water management between adjacent building boards 10, 20. For instance, in FIG. 1B, a water resistant material 75 may be deposited between the surface of the groove 40 and the recess 60. The water resistant material 75 provides for a space for channeling water away that may seep into the system.

FIG. 1C is an alternative embodiment of the shiplapped building board. The recess 60 further comprises a channel 85 for receiving a protruding member 90 of building board 10. The channel 85 and protruding member 90 assist in interlocking the adjacent building boards 10, 20 and help to improve the shear strength of the system. The channel 85 also provides an indicator for fastening the building board 20 to the framing element 210. Although the fastener is preferably applied on the recess 60 of the building board 20 so that the groove 40 of the adjacent building board 10 covers the fastener and provides for blind fastening, the fastener may also be applied through the adjacent building boards 10, 20 to the framing element 210 at the joint 30.

To further improve the shear strength of the system, a bonding material may be applied between the surfaces of the groove 40 and the recess 60. The bonding material may be selected from any suitable material including structural adhesive, polyurethane glue, hot melt polyurethane adhesive, epoxy adhesive, acrylic foam, polyurethane foam, pressure sensitive adhesive, pressure sensitive foam adhesive (e.g., butyl rubber or acrylic foam), silicone caulk and polyurethane caulk. Adding bonding materials, such as a pressure sensitive adhesive, between the groove 40 and the recess 60 of the joint 30 will assist to restrict out of plane movement of the building boards and help prevent buckling at the joint between the building boards. In addition, the bonding material will assist in allowing building material 5 to attain higher shear load values, including instances where one row of fasteners is used to secure the building material 5 to framing member 210.

The shiplapped building boards provide a substantially rigid connection that allows for transfer of loads across joints enabling the system to act more like a single board. For instance, in a test of a system employing shiplapped boards attached to framing elements on a 6×12" nailing pattern (e.g., 6 inch intervals along the perimeter of the building board by 12 inch intervals within the field of the building board), the system deflected only ¼ of an inch upon application of a load over 250 lbs/ft. The minimum shear strength of a system employing shiplapped building boards is 270 lbs/ft.

In another embodiment, the building material comprises an engineered panel joint 100 as shown in FIG. 2A, which is pre-fabricated by a manufacturer and is sold ready to be installed by the builder. The engineered panel joint 100 is comprised of an article or joint 105 and a building board 110, such as, but not limited to, a panel, plank, trim, roofing slate, shake, or tile. The building board 110 can be made of a variety of materials, such as wood, metal or plastic. The building board 110 may also be made of a non-nailable material, including but not limited to, stone, ceramic or metal. Alternatively the building board 110 may also have either a factory applied finish or a finish applied in the field prior to installation. In one embodiment, the building board 110 is preferably made from fiber cement. Fiber cement advantageously has the preferred qualities of non-combustibility, strength, nailability and durability. Low-density fiber cement has additional advantages over higher density fiber cement because the material is more easily machined, and its decrease weight facilitates handling and installation.

The joint 105 is preferably affixed to the building board 110 by means of an adhesive 150, more preferably an adhesive capable of adhering a fiber cement board to the joint, such as, but not limited to, a hot melt moisture cured polyurethane, polyurethane glue, pressure sensitive foam, rubber tape, and elastomeric tape with fabric backing. However, the joint 105 could be the result of embossing or forming a flange along an end of a building board that provides an interlocking region integral with and conforming to the building board; the flange adapted to receive the end of an adjacent building board.

The joint 105 of FIG. 2A is preferably comprised of two flanges 120a and 120b connected by a hinge 130; however, the joint may be comprised of an integrated flange that can be directly adhered to the building board 110 and/or the framing element 210 without the intervening adhesive 150. The flange is preferably made of a flexible material, such as a mesh made of fabric and fiberglass, but could also be made from a rigid material such as metal. The individual components of the engineered panel joint 100, such as the unique characteristics of the adhesive and fiber cement, are further discussed and described in U.S. Pat. No. 6,572,697, U.S. Pat. No. 6,676,744, U.S. Pat. No. 6,689,451, U.S. Pat. No. 6,030,447, U.S. Patent Publication No. 2003-0056458, U.S. Patent Publication No. 2003-0046891, and U.S. Patent Publication No. 2003-0054123, which are hereby incorporated by reference in their entirety and considered a part of the detailed description disclosed herein.

In one embodiment, the joint 105 shown in FIG. 2A is affixed to only one edge of the pre-fabricated and pre-installed building board 110. It will be appreciated that in alternative embodiments, the joint 105 may be affixed to two opposing edges of a board, or even additional edges. The joint
The flanges 120a, 120b can be made of a variety of different materials such as metal, rubber or an elastomer, but are preferably made from PVC, and are preferably connected by a hinge 130 that is flexible. The flexible hinge 130 is preferably made from a plasticized PVC material but can be made from any material that is flexible such as plasticized polymers, natural or synthetic rubbers, metal, or elastomer materials. Although the flanges 120a, 120b of one preferred embodiment are made from the same material, the flanges 120a, 120b can be made from two separate materials. For instance, the flange 120a can be made from an elastomer while the flange 120b can be made from a plastic material such as PVC. In addition, even though the hinge 130 of the preferred embodiment is a different material from the flanges 120a, 120b, the hinge can be the same material as one or both of the flanges.

The hinge 130 is preferably positioned between the flanges 120a, 120b to allow the flange 120b to move or rotate about the hinge 130 and lie along a plane that is substantially parallel with the flange 120a and/or flush against the building board 110. However, the hinge 130 can take the place of one of the flanges. For instance, the flange 120a can be substituted for a longer and/or wider version of the hinge 130 such that the hinge may be directly adhered to the building board 110 as well as connect the building board with the flange 120b. The hinge 130 provides a means by which the engineered panel joint 100 may be easily packaged at the production site and shipped to the installation site while reducing the risk that the flanges 120a, 120b will snap off from the building board 110 or break in half. In addition, the hinge 130 also provides some give between the connected building boards 110, 220, as shown in FIG. 2B, so as to minimize the risk of cracking between the joint when the framing element 210, wherefrom the building boards are connected, moves with a settling structure.

An additional bead 135 may be added along the edge of building board 110 as shown in FIG. 2A to help protect the joint 105 and still allow movement between the flanges 120a, 120b. This bead 135 also helps to form a seal when the building board 110 is connected with another building board 220, as shown in FIG. 2B. The bead 135 is preferably resilient and/or deformable polymeric material such as silicone rubber so that it may conform to and fill the interstices between the building boards 110, 220 and to help protect against environmental elements, such as water, from seeping through the joint 105. The bead 135, however, could also be made from plasticized PVC or silicone. The bead 135 is preferably co-extruded with the joint 105 as shown in FIGS. 9A and 93, but may also be applied after the joint 105 is attached to the building board 110 either at manufacture or during installation. However, the presence of the bead 135 helps to minimize the need for caulking as a sealant and the additional step of applying caulking when installing the building boards to a structure.

FIGS. 9A and 9B show the joint 105 with the two flanges 120a, 120b co-extruded with the bead 135. In this embodiment, the bead 135 acts as a hinge as well as a retarding water ingress between the building boards 110, 220 and between the joint 105 and the framing element 210. Thus, the bead 135 could, in essence, replace the hinge 130 of the embodiment shown in FIG. 2A.

In FIG. 9A, the bead 135 is shown having a substantially oval shape between the flanges 120a, 120b. The oval shape of the bead 135 allows the bead to fill the interstices between the building boards 110, 220 as well as the interstices between the joint 105 and the framing element 210. In FIG. 9B, the bead 135 is shown having roughly a semi-oval shape with one surface of the bead 135 being substantially flush with the surfaces of the flanges 120a, 120b. The embodiment shown in FIG. 9B allows the joint 105 to potentially rest along a plane that is more flush with the framing element 210 than the embodiment shown in FIG. 9A.

In each of the embodiments, however, the bead 135 can be made from the same material as the flanges 120a, 120b or from a substantially different material than the flanges 120a, 120b. In one embodiment, the bead 135 is made from substantially the same material as the flanges 120a, 120b, but is generally more pliable and flexible than the flanges 120a, 120b. In this embodiment, the flanges 120a, 120b are preferably rigid or stiff. In an alternative embodiment, the bead 135 is made from substantially the same material and has substantially the same material properties as the flanges 120a, 120b. In this embodiment, the bead 135 and the flanges 120a, 120b are both preferably flexible and/or pliable. In a further embodiment, the bead 135 is made from a material that is substantially different from the flanges 120a, 120b, wherein the flanges are rigid and the bead is flexible and/or pliable.

In an alternative embodiment of the building material, the building boards are connected to joints that are substantially similar to the joints 105 shown in FIGS. 10A, 103, and 10C.

The joint 105 of FIG. 10A has a hinge 130 that is disposed between flanges 120a, 120b. The flanges 120a, 120b are normally substantially planar with the hinge 130; however, the hinge 130 is preferably made of a flexible material allowing flange 120b to move relative to flange 120a. A system of building materials employing the joint of FIG. 10A has improved shear strength capabilities. For instance, in a test of one embodiment of a system of building materials employing the joint of FIG. 10A, the system was able to deflect only an eighth of an inch under a load of 200 pounds per foot based on a 6" x 12" nailing pattern (e.g., approximately 6 inch intervals around the perimeter and roughly 12 inch intervals in the field).

The joint 105 of FIG. 10B has two hinges 130a, 130b spaced between three flanges 120a, 120b, 120c. Hinge 130a is disposed between flanges 120a and 120b while hinge 130b is disposed between flanges 120b and 120c. Hinges 130a, 130b are preferably made from a flexible material allowing flanges 120a and 120b to move relative to flange 120c. The joint 105 of FIG. 10B also preferably has a bead 135 on flange 120b to retard water ingress between the joint
A system of building materials having a joint with a dual hinge system assists in improving the shear strength characteristics of the building material. For example, a ASTM E72-02 Section 14 test of a system utilizing a joint substantially similar to the joint 105 of FIG. 103 exhibited increased shear strength. Based on that test using a 6"x12" nailing pattern, a system with boards having a thickness of 5/8 of an inch is able to withstand a load of approximately 150 pounds per foot or more. For instance, in a test of one embodiment of the system of building boards employing the joint of FIG. 10B, wherein a hot-melt polyurethane was used to adhere the joints to building boards having a 45 degree edge bevel, the system was able to withstand an ultimate load of greater than 200 pounds per foot and deflect only an eighth of an inch at approximately 154 pounds per foot. In a test of another embodiment of the system of building boards employing the joint of FIG. 10B, wherein a hot-melt polyurethane was used to adhere the joints to building boards having a 30 degree edge bevel, the system was able to withstand an ultimate load of greater than 200 pounds per foot and deflect only an eighth of an inch between approximately 150 and 170 pounds per foot. In a test of another embodiment of the system of building boards employing the joint of FIG. 10B, wherein a polyurethane glue was used to adhere the joints to building boards having a 30 degree bevel, the system was able to withstand an ultimate load of greater than 244 pounds per foot and deflect only an eighth of an inch at approximately 195 pounds per foot.

A system with boards having a thickness of 5/8 of an inch and attached to a structure according to a 6"x12" nailing pattern is able to withstand a load of approximately 250 pounds per foot or more. For instance, in a test of one embodiment of the system of building boards employing the joint of FIG. 10B, wherein a hot melt polyurethane was used to connect the joints with building boards having a 30 degree bevel, the system was able to withstand a load greater than 270 pounds per foot and deflect only an eighth of an inch at approximately 260 pounds per foot.

The joint 105 of FIG. 10C also has two hinges 130a, 130b spaced between three flanges 120a, 120b, 120c. Hinge 130a is disposed between flanges 120a and 120c while hinge 130b is disposed between flanges 120b and 120c. Hinges 130a, 130b are preferably made from a flexible material allowing flanges 120a and 120b to move relative to flask 120c. The joint of FIG. 10C also preferably has a bead 135 along an extending member of flange 120c. The surface of extending flange 120c is preferably parallel to the beveled edge of the building material (e.g., if the beveled edge of the building board is angled at approximately 30 degrees, the extending flange 120c is preferably angled at approximately 30 degrees). The extending member of flange 120c preferably acts as a means for managing water between adjacent boards. The bead 135 preferably acts as a sealant between the joint 105 and the framing element, and adjacent building boards. The bead 135 is preferably resilient and/or a deformable polymeric material such as silicone rubber.
The angles along the edges of the building board help to further provide adequate overlap between two adjoining or adjacent building boards such as the building boards 110 and 220 shown in FIG. 2B. The overlap is one means by which the building board system may compensate for movement between the building boards as a result of such external effects as weathering or settling. For instance, the overlap helps to minimize the risk of the framing element 210 from becoming exposed if the building boards 110, 220 are caused to move in a direction away from each other. In such a situation, the edge of building board 110 will shield the framing element.

The edges of the building board 10 are preferably designed with recessed portions to receive the flange 120a, but the edges could be manufactured without recess portions. If the edges of the building board 110 have recessed portions, the recessed portions are preferably no deeper or longer than necessary to adhere the flange 120a to the building board 110 and allow the top surface of the flange 120a to be flush with the top surface of the building board 110. While the illustrated embodiment has recessed portions along the edge of the building board 110 to avoid unevenness when the flange 120a is adhered to the building board, the building board could be manufactured having no recessed portions.

As shown in FIG. 2A, the edge of the building board 110 can be further embossed or machined to provide for a recess 235 along the surface opposite the side that is connected to the joint 105. Alternatively, the recess 235 can be molded or extruded when the building board 110 is a green-sheet. This recess 235 along the edge of the building board helps to form a batten 240 when the building board 110 is aligned with and connected to the building board 220 as shown in FIGS. 2B, 3, and 4. Although the batten 240 may be created by applying a recess along an edge of the building board 110, the batten is primarily ornamental and is not necessary for the functionality of the building board system.

The joint 105 is preferably co-extensive with the width of the building board 110; alternatively, the width of the joint 105 can be less than the width of the building board 110 so that multiple joints can be applied in discrete locations along the width of the building board. The flanges 120a, 120b of the joint 105 are preferably thinner than the building board 110, but may be equal or greater in thickness. The flange 120a is preferably wide enough to hold at least two beads of glue, but could be large enough to cover the entire back of the building board 110. The flange 120b is preferably wide enough to just cover the framing element width (nominal 2") and be able to hold a row of fixtures without breaking; however, the flange 120b could also be large enough to cover the entire back of an adjoining building board. Although the thickness of the flange 120a, 120b depends in part on the material of the flanges, the flanges are preferably thick enough to obtain the required shear values, but not so thick as to cause unevenness on the back of the building board. The texture of the flanges 120a, 120b may also vary; however, the flanges are preferably smooth. Ideally, the texture of the flanges 120a, 120b in the illustrated embodiment aids with the bonding process between the flanges and the building boards 110, 220.

The flanges 120a, 120b of the illustrated embodiment of FIG. 2A also have capillary breaks 140 to assist with water management when water enters the joint. The hinge 130, or flexible means, may be co-extruded with the flanges 120a, 120b and may be made from a softer material than the flanges that is pliable but still holds reasonable shear strength. The hinge 130 is also preferably sized to retard water ingress when compressed against the framing element. Alternatively, the hinge 130 can be replaced by an integrated flange comprised of two separate materials, wherein the flange 120a is made of a softer material than the flange 120b and the flange 120b is pliable but still holds reasonable shear strength. The adhesive 150 applied to flange 120a and the building board 110 during manufacture can be any adhesive that has comparable shear strength with that of the joint and, optimally, has quick drying characteristics for manufacturing purposes.

The hinge of the joint may be attached to the building board in numerous ways. Although the preferred embodiment illustrates bonding flange 120a to the building board 110 by means of the adhesive 150 between the flange and a surface of the building board as shown in FIG. 2A, the flange 120a could be attached to the building board 110 by using a strip of material 410 to sandwich a portion of the joint 420 with an end of the building board 110 as shown in FIGS. 13 and 14. The strip of material 410 can be made of any suitable material including fibercement, plastic, and metal. The bonding between the strip of material 410 and the building board 430 may occur by various means including adhesives, structural glue, chemical bonding, mechanical bonding, pressure sensitive adhesive, and tapes.

In an alternative embodiment, the joint 105 and building board 110 may be connected together by snapping the joint to an edge of the building board as shown in FIGS. 15 and 16 or by means of riveting the joint to the building board as shown in FIG. 17.

The joint 105 may be snapped into the building board 110 by various means. For instance, in one embodiment, the joint 805 can be machined or molded with a groove 810 along an edge of flange 820 that would be adapted to receive an edge of the building board 830 as shown in FIG. 15. Alternatively, in another embodiment, an end of the joint 845 can be formed with a hook 840 along the flange 850; the hook 840 being adapted to snap into an end of the building boards 860 as shown in FIG. 16.

The joint may be riveted with the building board. The joint 865 has at least one rivet portion 870 as shown in FIG. 17. The building board 880 can be molded or machined with at least one aperture 890 for receiving the rivet portion 870. The connection between the building board 880 and the joint 865 is formed by inserting the rivet portion 870 into the aperture 890 and hammering or otherwise bending the rivet portion for securing the rivet portion 870 with the building board surface.

The building material can be mounted to a wall or framing element in a number of ways. For instance, in one embodiment, the building material is an engineered panel joint 100 that can be mounted by aligning the joint 105 with the framing element 210, placing a building board 220 on the joint 105 to cover the flange 120b, and nailing the building board 220 and the flange 120b to the framing element 210 as shown in FIG. 2B. In this embodiment, the building boards 110 and 220 are affixed to the framing element 210 by a single row of nails. Although a second row of nails could be hammered through the batten 240 portion of building board 110 and the flange 120a to provide additional support to the building board system, a single row of nails 230 along the seam on the side opposite of the batten 240 is sufficient.

An adhesive 910 may be applied between the edges of the building boards 920a, 920b as shown in FIG. 18. The adhesive 910 may be selected of any suitable adhesive materi-
material preferably sufficient to adhere fiber cement together including, but not limited to, structural adhesive, polyurethane glue, hot melt polyurethane adhesive, epoxy adhesive, acrylic foam, polyurethane foam, pressure sensitive adhesive, pressure sensitive foam adhesive (e.g., butyl rubber or acrylic foam), silicone caulk and polyurethane caulk, rubber tape, and elastomeric tape with fabric backing. The adhesive 910 may be applied in one or more discrete, predetermined locations as shown in FIG. 19 or continuously along the edge of adjacent panels 920a, 920b as shown in FIG. 20. Although the system of building boards is preferably connected together to structural framing elements 210 by the joint 105, application of the adhesive 910 between the edges of adjacent building boards 920a, 920b will provide the system with sufficient shear strength without the joint 105. The adhesive 910 will not only assist in causing to connect adjacent building boards 920a, 920b together but increase the shear strength capacity of the assembly, restrict relative movement between building boards and out of plane movement, and increase load transfer between building boards.

[0099] The increased shear strength capacity of a system of building materials with an adhesive between the edges of adjacent building boards is exemplified by results of ASTM E72-02 Section 14 tests of such a system. For instance, where the adhesive is discontinuously applied between the edges of the boards, the system is able to withstand a load of more than 220 pounds per foot using a 6"x12" nailing pattern. Where the adhesive is continuously applied between the edges of the boards, the system is able to withstand a load of more than 260 pounds per foot using a 6"x12" nailing pattern.

[0100] Although the embodiment of FIG. 2B provides for an adhesive only between the flange 120b and the building board 110, the adhesive 150 may also be applied between the flange 120b and the building board 220 as shown in FIGS. 3 and 4. The adhesive 150 is preferably a hot melt polyurethane, such as Locite Hysol 3631 hot-melt polyurethane adhesive, however, the adhesive could be any suitable adhesive including, but not limited to, structural glue, such as a Bostik ISR 7003 polyurethane glue or in the form of a pressure sensitive adhesive tape, such as 3M VHB 4956 Pressure Sensitive Foam tape or PVT-3300 Butyl Rubber Tape (Calisle Coating & Waterproofing Inc). The adhesive 150 may be applied continuous or discretely along the length of the flange 120b. For instance, a pressure sensitive adhesive tape may be applied to the flange 120b at the factory, the tape having a peel away top material to protect the adhesive tape. The peel away top material can be removed in the field to expose the pressure sensitive adhesive prior to adhering the flange 120b to the building board 220. This method of installation has the added advantage of creating a “blind nail” in which the nail is hidden behind the building board 220 as opposed to the embodiment of FIG. 2B wherein the single row of nails 230 are in view.

[0101] The engineered panel joint 100 may, alternatively, be fixed to a framing element 210 by aligning the joint 105 to the framing element 210 and nailing the flange 120b to the framing element as shown in FIG. 21. In this alternative embodiment, the building board 110 is preferably secured to the framing element by a single row of nails 230 in a similar manner as described in connection with the embodiment of FIG. 2B. However, when the embodiment of FIG. 2B provides for an adhesive only between the flange 120a and the building board 110, the embodiment of FIG. 21 further provides for an adhesive, such as structural glue, or self adhesive tape, such as pressure sensitive adhesive tape, applied between the flange 120b and an end of the building board 220. The adhesive between the flange 120b and the building board 220 will help to restrict relative movement, out of plane movement and increase load transfer between panels. In addition, the adhesive 150 and/or pressure sensitive adhesive tape will help to increase the shear strength capacity of the building board system or assembly.

[0102] In yet another embodiment, the engineered panel joint 100 may be affixed to the framing element 210 by placing a single row of nails 230 through the hinge 130 of the joint 105 as shown in FIG. 4. In this embodiment, the building board 110 is installed by aligning the building board 110 on the flanging element 210 to place the hinge 130 near the center of the framing element 210, and then hammering or fastening a row of nails along and through the length of the hinge 130. The building board 220 is attached to the framing element 210 and the building board 110 by means of the adhesive 150, or a self adhesive tape, as shown in FIG. 4. The adhesive 150 is applied to either the flange 120b or the edge of the building board 220. As with the embodiment of FIG. 3, this method of installation has the advantage of creating a “blind nail” in which the nail is hidden behind the building board 220 as opposed to the embodiment of FIG. 2B wherein the single row of nails 230 are in view.

[0103] To enhance load transfers across the joint and allow the assembly or system of building boards to act in unison as one large building board, the edges of the boards may be beveled at a suitable angle to create an interlock 1005 between adjacent building boards 1010a, 1010b as shown in FIGS. 22-25. The angle of the bevel is preferably between 30 and 60 degrees as shown in FIG. 22. The interlock 1005 is preferably formed by a change in bevel angles along an edge of building boards 1010a, 1010b. Although FIGS. 22 and 23 show a change in the bevel angle near the approximate center of the building boards 1010a, 1010b, the change in angle could be fabricated at any point along the edge of the building board. In an alternative embodiment, the interlock 1005 is formed by creating at least one notch 1020 along the edge of the building board 1010a for receiving at least one tab 1030 adapted to fit within the notch 1020 as shown in FIGS. 24 and 25. The notch 1020 and corresponding tab 1030 are preferably located near the center of building boards 1010a, 1010b and has a length of approximately one foot, but the length can be any suitable measure capable of resisting shear loads. In alternative embodiments, the notch 1020 and corresponding tab 1030 may be positioned at multiple locations along an edge of the building boards 1010a, 1010b and spaced predetermined intervals along that edge.

[0104] The interlocks may be formed by using a water jet to cut the beveled angles or the notches and tabs along the ends of the building boards. The interlocks may also be formed when the building board is a greensheet or post autoclave on the finishing line. The resulting interlock will help to resist higher shear loads when adjacent building boards with the beveled angles and/or notches and tabs are connected together.

[0105] The increased shear strength capacity of a system of building materials having an interlock between adjacent building boards is exemplified by results of ASTM E72-02 tests on such a system. Based on such tests using a 6"x12" nailing pattern, the system of building materials having an interlocking feature is able to withstand a load of 200 pounds per foot or more. For instance, a test of one embodiment having a structure substantially similar to the system of FIG.
25, wherein the building board had a thickness of approximately 3/8 of an inch, the system was able to withstand a load of approximately 216 pounds per foot. In a test of another embodiment having a structure substantially similar to the system of FIG. 23, wherein the building board had a thickness of approximately 3/8, the system was able to withstand a load of over 250 pounds per foot.

[0106] As mentioned earlier, the building boards can be made from a number of different materials including, but not limited to, the grade and/or thickness of fibercement. However, regardless of the material or the dimensions of that material, a building board having the joint, discussed and provided for in the above description, is able to perform with sufficient shear strength, satisfying building codes, with a single row of nails along the joint connecting two building boards.

[0107] For instance, the industry standard uses two rows of nails on a panel without the joint 105. A system of panels, as shown in FIG. 7A, is attached to the exterior of a structure by aligning a panel 720 between two framing elements 210 so that two of the panel edges slightly cover each framing element. A row of nails 730 is then hammered or fastened through each panel edge to secure the panel 720 to the framing elements. Once this panel 720 is secured to both framing elements, another panel 710 is placed next to the secured panel and between another set of framing elements 210. This panel 710 is then secured to the framing elements 210 by hammering or fastening a row of nails 730 along each panel edge. This process is repeated until the exterior of the structure is covered with panels.

[0108] This typical process of securing panels requires the use of two rows of nails on each panel (e.g., one row of nails along opposite ends of each panel) and two rows of nails at a single framing element where the two panels meet. As one can quickly recognize, this process can be costly and inefficient. However, because of the available materials and products in the building industry, it is the industry standard to use two rows of nails at each joint or framing element to achieve the necessary joint and shear strength to meet building codes.

[0109] In a test conducted according to the ASTM E72-02 Section 14 standard using a 6"x12" nailing pattern, a system of engineered panel joints were nailed to framing elements using a single row of commercially available 8d nails, as shown in FIG. 7B, and then were subjected to a load. A similar test was conducted on a system of industry standard panels without the joint 105 but using two rows of commercially available 8d nails, as shown in FIG. 7A. The results of those tests, as summarized in Table 1, show that the engineered panel joints have better deflection values and a better ability to withstand an ultimate load of 200 pounds per foot than the industry standard.

**TABLE 1**

<table>
<thead>
<tr>
<th>Panel Grade</th>
<th>Row(s) of Nails</th>
<th>Thickness (inches)</th>
<th>1/4&quot; deflection</th>
<th>Ultimate Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineered</td>
<td>1</td>
<td>3/4</td>
<td>200</td>
<td>222</td>
</tr>
<tr>
<td>Modified</td>
<td>1</td>
<td>3/4</td>
<td>233</td>
<td>200</td>
</tr>
<tr>
<td>Fibercement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panel Joint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibercement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[0110] Systems of building materials employing embodiments of the invention, secured to a structure using a 6"x12" nailing pattern, will be able to withstand shear values between 130 lbs/ft and 270 lbs/ft in an ASTM E72-02 Section 14 test; however, such systems preferably have a minimum shear strength of 150 lbs/ft.

[0111] A system of building materials using embodiments of the invention that employ higher nailing patterns will be able to achieve even higher shear strengths. For example, a system of building materials using embodiments of the invention, secured to a structure using a 4"x6" nailing pattern, could have shear strengths greater than 300 lbs/ft. As exhibited in Table 2, the minimum shear strength values of the system of building materials employing embodiments of the invention will, in general, increase as the nailing pattern increases (e.g., as the nailing spacing perimeter decreases, the minimum shear strength values of the system increase).

**TABLE 2**

<table>
<thead>
<tr>
<th>Nail Spacing in Field (on framing)</th>
<th>Nail Spacing (inches)</th>
<th>1/4&quot; deflection</th>
<th>Ultimate load</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>12&quot;</td>
<td>150</td>
<td>208</td>
</tr>
<tr>
<td>6&quot;</td>
<td>8&quot;</td>
<td>162</td>
<td>212</td>
</tr>
<tr>
<td>4&quot;</td>
<td>6&quot;</td>
<td>175</td>
<td>308</td>
</tr>
<tr>
<td>3&quot;</td>
<td>6&quot;</td>
<td>191</td>
<td>397</td>
</tr>
<tr>
<td>2&quot;</td>
<td>6&quot;</td>
<td>178</td>
<td>488</td>
</tr>
</tbody>
</table>

[0112] To provide additional shear strength to the panel system, at least one biscuit 1105 may be inserted along the edge of the panel 1110a for receipt in a corresponding slot along the edge of an adjacent panel 1110b as shown in FIG. 26. Although FIG. 26 shows a panel system 1100 without the joint 105, the biscuits 1105 may be used in conjunction with the joint to increase the shear strength of a system of the engineered panel joints 100. The slots may be formed along the edge of the panels 1110a, 1110b by a joister router. Prior to connecting two adjacent panels 1110a, 1110b together, the biscuits 1105 may be inserted in the slots of at least one of the panels. The biscuits 1105 may be connected to the panels 1110a, 1110b by any suitable fastener including chemical bonding, mechanical bonding and adhesives. Although the biscuit 1105 shown in FIG. 26 is preferably made from
pressed wood particles, the biscuits can be made of any suitable material including metal, fibercement, and plastic.

[0113] The increased shear strength capacity of a system of building materials with biscuits between the ends of adjacent building boards is exemplified by results of ASTM E72-02 Section 14 tests on such a system. Based on such tests using a 6" x 12" nailing pattern, the system is able to withstand a load of at least 170 pounds per foot and deflect 1/4 inch under a load of approximately 230 pounds per foot or more. For instance, in a test of one embodiment having a structure substantially similar to the system shown in FIG. 26, wherein the building boards had a thickness of approximately 3/4 of an inch, the system had a shear strength greater than 150 pounds per foot.

[0114] In addition to attaching the joint 105 to a panel, as mentioned above, the engineered panel joint 100, with or without the biscuit 1105, can be formed from other building boards, including planks, roofing shakes, slates, and tiles. For instance, the joint 105 could be applied to a trim 1200 as shown in FIGS. 27-29.

[0115] The trim 1200 of FIGS. 27-29 is preferably made of a low density fibercement material; however, it could be made of a number of other materials including, but not limited to, wood, metal, and plastic. Trim 1200 may also be made of a non-nailable material, including but not limited to, stone, ceramic or metal. The trim 1200 may also have a factory applied finish or a finish applied in the field prior to installation.

[0116] The trim 1200 of FIG. 27 is shown as a flat plank; however, the trim assembly could be applied to corner pieces (as illustrated in FIG. 29) or planks adapted to be placed in any number of positions including around windows and doorways. Also, the corner trim 1200 can be assembled from separately formed flat pieces or extruded or molded to form, for example, the corner shape shown in FIG. 29. The trim 1200 may be extruded or molded into any type of arcuate or angled shape. Trim 1200 may also be assembled or formed from a combination of arcuate, angles or flat shapes to provide decorative trim articles suitable for use on or around windows, doors, entryways, gable vents, porticos, pilasters, shutters and the like.

[0117] The trim 1200 preferably has an edge 1205 with an extending flange 1210 along the front surface of the trim. The edge 1205 is preferably machined or extruded such that it can accommodate siding planks. The joint 105 is preferably attached to the back surface of the trim 1200 such that a portion of the joint 105 extends from the edge 1205 forming a channel 1220 with the edge 1205 and the flange 1210; the channel 1220 adapted to receive a siding plank. The joint 105 may be attached to the trim 1200 by any suitable means including chemical bonding, mechanical bonding, and adhesives.

[0118] As shown in FIG. 27, a portion of the joint 105 may serve as a nailing hem, wherein the trim 1200 is attached to a framing element by at least one fastener 230 through the joint 105 into a framing element 210. Using the joint 105 as a nailing hem offers the advantage of hidden nailing. As shown in FIG. 28, one or more siding panels 1230 may be inserted edgewise into channel 1220 such that the edge of siding panel 1230 is butted against trim edge 1205 and contained within channel 1220. In this assembly the joint 105 also acts as a flashing to prevent water ingress behind the siding panel 1230. Thus, the assembly does not require caulk and therefore reduces installation time and cost. Also, the surface of siding planks 1230 cause to cover the joint 105 and hide the row of nails when the siding planks are slotted into the channel 1220 between the flange 1210 and the joint.

[0119] The joint can be made of a number of different materials, including a variety of meshes, such as metal, fiber-glass, and fabric. Where the joint is formed of two flanges, such as the joint 105 of FIG. 2A, the joint preferably has a flexible hinge 130 and can function as flashing. The flexible hinge 130 can be made of a plastic material that assists with reducing water ingress. Alternatively, a plastic bead can be added between the joint 105 and the back surface of the trim 1200 to reduce water ingress.

[0120] A preferred method of manufacturing the engineered panel joint 100 from a fibercement building board involves the following steps as shown in FIG. 5. The method which is described and illustrated herein is not limited to the sequence of acts described, nor is it necessarily limited to the practice of all of the acts set forth. Other sequences or acts, or less than all of the acts, or simultaneous occurrence of the acts, may be utilized in practicing embodiments of the invention. Furthermore, as mentioned earlier, although the preferred material for building board is fibercement, the building board can be made from a variety of materials, such as wood or steel.

[0121] Step 510: Receiving greensheet from forming machine: In this step, a moldable fibercement “greensheet” is produced by a forming machine. This forming machine uses a slurry dewatering manufacturing process, such as, but not limited to, the Hatshok process. Once the moldable fibercement greensheet is formed, it is fixed through to the rest of the process.

[0122] Step 520: Putting pattern on front: In this step, a decision is made concerning whether to add a pattern or texture to the fibercement greensheet to provide for an ornamental feature on the building board. If it is determined that an ornamental feature is desired, the manufacturing process will proceed with step 530; if it is not desired, the manufacturing process will skip step 530 and proceed to step 540.

[0123] Step 530: Putting a pattern on the greensheet: In this step, a pattern is applied to the fibercement greensheet. This pattern is preferably applied to the greensheet by a means of embossing or pressing using a roller or a plate, but can be also be applied by a variety of other methods including, but not limited to, carving, beveling, or jet spraying. A texture or pattern is preferably applied to the front of the building board while on the back, a recessed channel is preferably created in which the joint will rest and become flush with the building board, adding no appreciable thickness to the engineered panel joint. Preferably, the battens are embossed or pressed into the greensheet after the texture is applied embossed or pressed.

[0124] Step 540: Cutting angles on building board edges: In this step, 30° angles are preferably cut from the top and bottom vertical edges of the building boards by a water jet. Angles other than 30° may be used within the range of 90° to 180°. Alternatively, the edges may have a combination of angles or compound angels as illustrated in FIG. 8. In addition, these angles can be cut by a means other than using a water jet, such as by using saws or by roll forming.

[0125] Step 550: Curing material: In this step, the fibercement greensheet is preferably pre-cured at an ambient temperature for a period of up to 24 hours. The greensheet is then preferably placed in an autoclave for a period of up to 12 hours at a temperature of approximately 180° C. and a pressure of approximately 125 psi. Alternatively, the fibercement
greensheet may be air cured or moisture cured under relatively humid conditions at an ambient or elevated temperature until a predetermined level of strength and/or a preselected material property is obtained. For example bending strength or tensile strength may be selected, but other material properties such as density, shear strength, moisture content or content of unreacted components may also be used as an index of degree of cure.

[0126] Step 560: Finishing material (Optional): In this step, a coating is optionally applied to at least one side of the building board preferably by a spray coating apparatus, but could be applied by other means including, but not limited to, roll coating, curtain coating, powder coating, vacuum coating, or other known means of coating. The coating is then cured in a manner appropriate to the coating formulation, for example by thermal curing, radiation curing, or a combination thereof.

[0127] Step 570: Applying adhesive and the joint: In this step, the adhesive and the joints are applied to the back side of the building board as the building board moves along rolling conveyors. The adhesive is preferably a hot melt polyurethane glue, but can be made from any composition that provides a good bond and adequate shear strength between polymers and cementitious surfaces. The joints may be made from a variety of materials, including fibercement, but is preferably made from a plastic material, such as PVC. The joints may be pre-cut as strips before they are applied to the building board or may be applied directly from a spool. Accordingly, there are alternate ways by which the adhesive and joints can be applied to the building board. For instance, the adhesive can be applied to the surface of the joint strips before the building board and joint strips are pressed together. Alternatively, the adhesive may be preformed on the joint strips in a liquid form or as a self-adhesive strip. The self-adhesive strip could be either attached to the building board during the manufacturing process or in the field during the installation process. In another embodiment, the building boards are flipped over after step 560 so that the backside of the building boards face up. The adhesive and joint strips are then applied to the backside of the building boards along the edge to form the engineered panel joint. The building boards are then flipped back over so that the front side faces up. In yet another embodiment, the joint strips are attached using various other fastener types such as, but not limited to, screws, staples, or other adhesive means. In a separate embodiment, the joints are installed onto greensheets after step 540. In another embodiment, the joint strips are sized to fit along the entire back surface of the building board. The joint strips are attached to cover most of the backside of the building board, but are offset from the building board such that the joint strip extends beyond the building board along one edge for joining the building boards.

[0128] Step 580: Stacking material: In this step, the finished engineered building material is stacked for packaging and/or shipping.

[0129] As mentioned above, one preferred embodiment of the engineered panel joint is manufactured from a fibercement building board. Other materials, however, may be substituted for the fibercement building board. If an alternative building board material is used, the following method of manufacturing the engineered panel joint, as shown in FIG. 6, is preferred. However, the method which is described and illustrated is not limited to the sequence of acts described nor is it necessarily limited to the practice of all of the acts set forth. Other sequences or acts, or less than all of the acts, or simultaneous occurrence of the acts may be utilized in practicing embodiments of the invention.

[0130] Step 610: Receiving finished material: In this step, any building board material, such as, but not limited to, wood, wood composites, and vinyl is obtained in a finished state or finished according to methods known to a person of ordinary skill in the art.

[0131] Step 620: Cutting angles on vertical edges: In this step, angles within the range of 30° and 60° are preferably cut from the top and bottom vertical edges of the building boards by a water jet. Other angles may be used including angles within the range of 90° to 180°. In addition, these angles can be cut by a means other than using a water jet. This step could be done earlier in the manufacturing process depending on the material being used and its corresponding finishing process.

[0132] Step 630: Creating recessed channel for the joint (Optional): In this step, a channel is optionally formed on the backside vertical edges by a process that includes, but is not limited to, routing or embossing depending on the building board material. The recessed channels along the backside vertical edges of the building board are preferably added to fit and place the joint.

[0133] Step 640: Applying adhesive and the joint: In this step, the adhesive and the joints are applied to the back side of the building board as the building board moves along rolling conveyors. The adhesive is preferably a hot melt polyurethane glue, but can be made from any composition that provides a good bond and adequate shear strength between polymers and cementitious surfaces. The joint may be made from a variety of materials, including fibercement, but is preferably made from a plastic material, such as PVC. The joints may be pre-cut as strips before they are applied to the building board or may be applied directly from a spool. Accordingly, there are alternate ways by which the adhesive and joints can be applied to the building board. For instance, the adhesive can be applied to the surface of the joint strips before the building board and joint strips are pressed together. Alternatively, the adhesive may be preformed on the joint strips in a liquid form or as a self-adhesive strip. The self-adhesive strip could be either attached to the building board during the manufacturing process or in the field during the installation process. In yet another embodiment, the joint strips are attached using various other fastener types such as, but not limited to, screws, staples, or other adhesive means. In another embodiment, the joint strips are sized to fit along the entire back surface of the building board. The joint strips are attached to cover most of the backside of the building board, but are offset from the building board such that the joint strip extends beyond the building board along one edge for joining the building boards.

[0134] Step 650: Stacking material: In this step, the finished engineered building material is stacked.

[0135] It will be appreciated from the embodiments described above that an improved joint can offer several advantages to a fibercement panel or other type of building board. These advantages are not limited to panels or even fibercement, but can be applied to a variety of building materials as described above.

[0136] The shiplapped board described above are preferably configured to provide a rigid connection allowing for load transfers across the joint. The rigid connection of the shiplapped board aids in enhancing the shear strength of the system and the individual boards that make up the system. Although the joint of the shiplapped board is preferably
embossed onto the board to conform with the board, the joint may be a separate article that is attached to a surface of the building board.

[0137] The articles or joints described above are desirably adhered to the board to provide a pre-fabricated board that simplifies installation of the board over a surface and provides excellent shear strength. For example, the article or joint can provide a nailing or fastening region, and in one embodiment, enables single row nailing of adjacent boards while achieving at least the same shear strength as a joint with two rows of nail at a framing element. In addition, the flexibility of one embodiment of the joint provides for a durable building material that can be easily manufactured, transported, and distributed, and a building material that can relieve stress between building boards caused by differential movement.

[0138] The articles or joints described above are also adapted to work with the edge of the building board to which it is adhered to create a locking region for connecting adjacent building boards and ensuring the building boards are properly aligned when nailed to the framing element. Additionally, the building material provides for a joint that does not require caulking to help prevent water seepage between the seams of the building board system.

[0139] Although the foregoing invention has been described in terms of certain preferred embodiments, other embodiments will become apparent to those of ordinary skill in the art, in view of the disclosure herein. Accordingly, the present invention is not intended to be limited by the recitation of preferred embodiments, but is instead intended to be defined solely by reference to the appended claims.

What is claimed is:

1-84. (canceled)

85. A building system for covering a structure, comprising at least two boards connected to a framing element, wherein one of the boards is a main board and a second of the at least two boards is an adjacent board, the at least two boards having a surface, opposite ends, and opposite edges;

an article connected to the main board surface along one of the opposite ends of the main board, wherein the article has at least one flange parallel with the main board surface, the at least one flange extending beyond one of the opposite ends of the main board; and

a row of fasteners extending at least through the article to the framing element, wherein the row of fasteners extending through the article secures the main board and the adjacent board relative to the framing element.

86. The building system of claim 85, wherein the fasteners are nails.

87. The building system of claim 85, wherein the article has a second flange, the second flange attached to the main board.

88. The building system of claim 87, wherein the row of fasteners extend through the second flange to the framing element.

89. The building system of claim 88, wherein the second flange is adhered to the adjacent board.

90. The building system of claim 87, wherein the second flange is attached to the main board by an adhesive.

91. The building system of claim 87, wherein the at least one flange extending beyond one of the opposite ends of the main board is connected to the adjacent board by the row of fasteners.

92. The building system of claim 91, wherein the row of fasteners extend through the adjacent board and the second flange to the framing element.

93. The building system of claim 81, wherein the second flange is connected to the at least one flange by a hinge.

94. The building system of claim 93, wherein the hinge is a bead, the bead filling at least one interstice between the main board and the adjacent board at the framing element.

95. The building system of claim 94, wherein the bead has a shape that retards water ingress between the article and the framing element.

96. The building system of claim 95, wherein the shape of the bead is substantially oval.

97. The building system of claim 85, wherein at least one of the opposite ends of the main board has a recessed portion, wherein the recessed portion forms a batten along a surface of the building system.

98. The building system of claim 85, wherein the main board is made of fibercement.

99. The building system of claim 98, wherein the main board is a panel.

100. The building system of claim 85, wherein the article is a jointer having a flange parallel with the at least one flange extending beyond one of the opposite ends of the main board and planar with a surface of the main board opposite the main board surface connected to the article.

101. The building system of claim 100, wherein the jointer is made of metal.

102. The building system of claim 87, wherein the second flange and the at least one flange are connected by a channel configured to receive the row of fasteners.

103. The building system of claim 102, wherein the surface of the main board and the surface of the adjacent board each have a recessed portion on at least one opposite end, wherein the ends of the main board and adjacent board having the recessed portion are directed toward each other.

104. The building system of claim 103, wherein the second flange of the article is connected to a surface of the recessed portion on the main board and the at least one flange of the article is connected to a surface of the recessed portion on the adjacent board.

105. The building system of claim 103, wherein the recessed portions of the main board and the adjacent board form a channel.

106. The building system of claim 105, wherein the channel formed by the recessed portions is filled with an epoxy jointing compound.

107. The building system of claim 106, wherein a surface of the epoxy jointing compound is substantially flush with the surface of the main board and the surface of the adjacent board.

108. The building system of claim 85, wherein at least a portion of one of the edges of the main board is angled relative to the surface of the main board to correspond with a portion of one of the edges of the adjacent board.

109. The building system of claim 108, wherein the angled edge of the main board is substantially 30 degrees.

110. The building system of claim 85, further comprising an adhesive layer between the main board and the adjacent board at the framing element.

111. The building system of claim 110, wherein the adhesive layer is composed of a pressure sensitive adhesive.

112. The building system of claim 110, wherein the adhesive layer is composed of a hot melt adhesive.
113. The building system of claim 85, further comprising a load directed against the main board, wherein the main board has a thickness of approximately 3/4 of an inch or less.

114. The building system of claim 113, wherein the system is able to withstand the load against the main board, wherein the load is approximately 150 pounds per foot or more.

115. The building system of claim 114, wherein the load is approximately 250 pounds per foot or more along the surface of the main board, wherein the main board has a thickness of approximately 1/2 of an inch or less.

116. The building system of claim 85, wherein the main board and the adjacent board have adjacent edges that are in contact at the framing element, wherein the adjacent edges are beveled interlocking the main board and adjacent board together.

117. The building system of claim 116, wherein the system is able to withstand a racking load approximately 200 pounds per foot or more along the surface of the main board.

118. The building system of claim 110, wherein the system has a shear strength of more than 220 pounds per foot.

119. The building system of claim 85, wherein said article further comprises at least two hinges spaced between at least three flanges, wherein at least one flange has an extending member having a bead.

120. A method of installing a system of building materials for covering a frame of a structure, comprising: selecting a first board having a substantially planar surface, opposing edges, and an article, the article having at least one flange extending from at least one of the opposing edges and away from the first board; positioning the first board on a framing element of the structure such that a surface of the article rests along an outward-facing surface of the framing element; selecting a second board having a surface and opposing edges; aligning the second board on the framing element of the structure, wherein at least one of the opposing edges of the second board is adjacent one of the edges of the first board; and fastening the article to the framing element causing to relatively secure the first board and second board to the framing element.

121. The method of claim 120, wherein the article to the framing element involves nailing the article to the framing element.

122. The method of claim 120, wherein fastening the article to the framing element involves nailing the second board to the framing element such that the article is sandwiched between the framing element and the surface of the second board.

123. The method of claim 122, wherein nailing the second board to the framing element results in connecting the first board to the framing element.

124. The method of claim 120, wherein the first board is made of fibercement.

125. The method of claim 124, wherein the second board is made of fibercement.