A wall system is provided, comprising: a frame comprising at least one frame member; a cladding material disposed at an external side of the frame member; a drainage mat disposed between the frame member and the cladding material; and an insulation layer disposed at an internal side of the drainage mat.
WALL SYSTEM AND METHOD OF FORMING SAME

BACKGROUND

[0001] The external walls of a commercial or residential building are typically designed to provide the interior of the building with a barrier, for example, from weather conditions existing outside the building. Conventional wall systems often employ various types of materials to provide sufficient resistance to such weather conditions. For example, a conventional wall system used in commercial buildings typically employs an exterior sheathing present at an exterior side with respect to the building frame. Such exterior sheathing is typically employed to provide a temporary weather resistant barrier during construction of the building as well as a flat, rigid surface to facilitate further construction of the building. The installation of such exterior sheathing typically adds to the overall installation cost and time.

[0002] Thermal insulation material is typically added to spaces in the walls of a building in order to improve building maintenance efficiency. However, even with the use of such thermal insulation material, “thermal bridges” can still exist in which heat is conveyed into or out of the conditioned area inside the building through a relatively conductive path existing in the conventional wall system. This can especially be the case in buildings which employ a metal frame due to the conductive nature of metal.

SUMMARY

[0003] According to one aspect, a wall system is provided, comprising:
[0004] a frame comprising at least one frame member;
[0005] a cladding material disposed at an external side of the frame member;
[0006] a drainage mat disposed at an internal side of the cladding material; and
[0007] an insulation layer disposed at an internal side of the drainage mat.

[0008] According to another aspect, a method of forming the wall system is provided, the method comprising:
[0009] providing the frame comprising at least one frame member;
[0010] arranging the drainage mat at an external side of the frame member;
[0011] arranging the cladding material at an external side of the drainage mat; and
[0012] arranging the insulation layer at an internal side of the drainage mat.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Embodiments of the present invention will be described with reference to the drawings appended hereto, in which:
[0014] FIG. 1 schematically depicts a side cross-sectional view of an exemplary wall system;
[0015] FIG. 2 schematically depicts a side cross-sectional view of an exemplary wall system at a window head area;
[0016] FIG. 3 schematically depicts a side cross-sectional view of an exemplary wall system at a window jamb area;
[0017] FIG. 4 schematically depicts a side cross-sectional view of an exemplary wall system at a window sill area;
[0018] FIG. 5 schematically depicts a side cross-sectional view of an exemplary wall system at a foundation wall area;
[0019] FIG. 6 schematically depicts a side cross-sectional view of an exemplary wall system at a movement joint area;
[0020] FIG. 7 schematically depicts a side cross-sectional view of an exemplary wall system at a parapet area; and
[0021] FIG. 8 schematically depicts a fire blocking strip arranged between two adjacent frame members.

DETAILED DESCRIPTION

[0022] Referring to FIG. 1, a wall system 100 is provided that is suitable for use in a commercial or residential building. For example, the wall system 100 is suitable for use in building structures having a metal frame structure and a cladding material present at an external side of the metal frame structure.

[0023] As used herein, the term “external side” refers to a side of a component of the wall system 100 that faces the exterior of the building. Likewise, the term “internal side” refers to a side of a component of the wall system that faces the interior of the building. When a first component is said to be at an external side or internal side of a second component, the first and second components can be either in contact or partial contact with each other, or a space can exist between the components, or additional material(s) can be present between the components.

[0024] The wall system 100 includes a frame comprising at least one frame member 57. In an exemplary embodiment, the wall system 100 comprises a plurality of frame members 57. In FIG. 1, only one frame member 57 is shown for simplicity. The frame member 57 can be in the form of an elongated, vertically oriented support member such as a stud. Adjacent frame members 57 can be spaced a predetermined distance apart and the distance between frame members 57 can depend on, for example, applicable building codes and structural requirements. The frame member 57 can be formed from any suitable structural material, and is particularly suitable for use with metal frames such as iron frames. A frame cavity is defined between adjacent frame members 57.

[0025] The wall system 100 includes a cladding material 17 which can comprise the exterior of the wall system 100. The cladding material 17 can include, for example, brick, stone, metal, synthetic brick or stone, or combinations thereof. The cladding material 17 can be in any suitable form that facilitates construction such as block or panel form. The cladding material 17 can also include material for adhering the individual pieces of brick, stone, or other material together. The wall system 100 can constitute a continuous facade, or at least one opening can be formed in the cladding material 17 to accommodate a building feature such as a window or a door.

[0026] At least one cladding material support device 9 can be used to fasten the cladding material 17 to the frame member 57. In an exemplary embodiment, a plurality of cladding material support devices 9 can be employed. The cladding material support member 9 can provide structural support to the cladding material 17 and help maintain the cladding material 17 in place. The cladding material support device 9 can be formed from a substantially rigid and structurally resilient material such as metal, and can be attached to the frame member 57 and cladding material 17 by any suitable means.

[0027] For example, the support device 9 can include a first member having a screw end attached to the frame member 57, and a loop end which protrudes a predetermined distance from the frame member 57, for example, at least about one
A second member can have one end attached to the cladding material 17, and the opposite end having a hook engaged with the loop end.

The wall system 100 can also include a drainage mat 49 positioned at the external side of the cladding material 17. The drainage mat 49 is capable of draining water that penetrates through the cladding material 17 or otherwise collects on the interior surface of the cladding material 17, and/or decreasing the drying time of such moisture. In an exemplary embodiment, the drainage mat 49 is in contact with the cladding material 17. The drainage mat 49 can be positioned at an external side of the frame member 57. The drainage mat 49 can optionally be laminated on one side with a porous spun-bond non-woven material. In general, the thicker the drainage mat 49 is, the more ventilation will be provided to the internal side of the cladding material 17.

The drainage mat 49 can be made of a material that is sufficiently moisture and temperature resistant such that the drainage mat 49 can function throughout the life of the building structure. The material that is used to form the drainage mat 49 is not particularly limited, and can have any of the following characteristics, for example, minimal moisture adsorption, good resistance to mold and corrosion, good vertical water drainage, the ability to promote vertical air flow, good adhesion to spray foam insulation, and/or similar thermal expansion and contraction characteristics to spray foam and/or flexibility to mitigate or prevent delamination during expansion/contraction in the event spray foam is used. The thickness of the drainage mat 49 can vary depending on the anticipated weather conditions that the wall system 100 will be subjected to, in particular the amount of precipitation that will be expected. For example, the thickness of the drainage mat 49 can be from about 0.125 inch to about 1.25 inch.

Any drainage mat 49 that is suitable for use in the wall system 100 can be used. The drainage mat 49 can be formed from any suitable material, for example a dimpled sheet such as a DELTA-DRY mat available from Cosella-Dörken located in Beamsville, Ontario, or an ENKA DRAIN drainage product available from Colbond Inc. located in Enka, N.C. Other materials that can be used are described in U.S. Patent Application Publication Nos. 2001/0054263, 2003/0037499 and 2004/0003558, the contents of which are herein incorporated by reference.

The drainage mat 49 can be held in place by being attached to the at least one cladding material support device 9. For example, an end of the cladding material support device 9 can be pierced through the drainage mat 49, or alternatively, an aperture can be formed in the drainage mat 49 and an end of the cladding material support device 9 can be inserted into such aperture. The drainage mat 49 can be attached to or placed on the cladding material support device 9 prior to installation of the cladding material 17. A stop 51 can be provided on the cladding material support device 9 which is effective to maintain the drainage mat 49 at a predetermined distance from the cladding material 17 and/or framing member 57. For example, the stop 51 can be positioned such that the drainage mat 49 is in contact with the cladding material 17, or 0 to about ¾ inch from the cladding material 17. In an exemplary embodiment, the stop 51 can be designed such that the drainage mat 49 and cladding material 17 are in contact with one another, and that space exists between the interior side of the drainage mat 49 and the exterior side of the framing. Such space can be, for example, from about 1 to 5 inches wide, preferably about 2 inches. The drainage mat 49 can be fastened to the cladding material support device 9 by any suitable means, for example, by pressure fit of the mat around the support using a press-on cap or a tape seal.

Use of the drainage mat 49 in connection with the wall system 100 can allow for installation of the insulation layer 53 from the internal side of the wall system 100. Advantageously, this can allow the insulation layer 53 to be installed under a wide variety of weather conditions previously not possible in conventional wall systems. The ability to work in a wide variety of weather conditions including high wind and/or rain can be particularly beneficial when using spray polyurethane foam or a water absorbing fiber as insulation. In addition, employing the drainage mat 49 in connection with the wall system 100 in the manner described above can lessen or ameliorate the need for an exterior sheathing layer (such as of gypsum board), and can thereby result in a more cost-effective and time-efficient installation of the wall system. In an exemplary embodiment, the wall system 100 does not include an external sheathing layer that is positioned at an external side of the insulation layer 53 and/or in contact with the framing member 57.

In an exemplary embodiment, the drainage mat 49 can be of a sufficiently low weight such that the drainage mat 49 does not exert an undue burden on the cladding material support member 9. For example, the weight of the drainage mat 49 can be from about 50 to about 500 pounds per 1000 square feet of material.

An insulation layer 53 can be applied to the internal side of the drainage mat 49. The insulation layer 53 can be formed from any material suitable for providing thermal and/or acoustic insulation. In an exemplary embodiment, the insulation layer 53 can be a closed cell urethane spray foam. The density of such closed cell spray foam can depend on the particular application and can be, for example, about 2pcf. In applications where water absorption and exterior water drainage are substantially well controlled, and a semi-structural foam is not required, open cell urethane spray foam can be used. The density of such open cell spray foam can depend on the particular application and can be, for example, about 0.5 pcf. A blown-in fiberglass or cellulose insulation material can also be used such as that disclosed in U.S. Pat. Nos. 4,712,547 and 4,773,060, the contents of which are incorporated herein by reference.

The thickness of the insulation layer 53 can vary depending on the specific insulation and structural requirements of the wall system 100. For example, the thickness of the insulation layer 53, in the interior-to-exterior direction, can be from about 2 to about 4 inches. In an exemplary embodiment, the insulation layer 53 can be formed from a material which provides structural support to the wall system 100. The density of the insulation layer 53 can depend on whether the insulation layer 53 is to provide structural support to the wall system 100. For example, the density of the insulation layer 53 can be from about 0.4 to about 3.0 pcf, more preferably from about 1.8 to about 2.0 pcf.

The insulation layer 53 and the application method thereof can be selected such that it does not place any undue stress on the cladding material 17. In an exemplary embodiment, the materials and installation method of the drainage mat 49 and the foam insulation layer 53 can be selected such that the drainage mat 49 and the insulation layer 53 are capable of expanding and contracting with temperature, without undergoing substantial flexing due to seasonal and daily...
fluctuations in temperature and differences in air pressure on either side of the wall system 100.

In an exemplary embodiment, the ends of the cladding material support members 9 are not buried in insulation material such as spray foam which is applied from the external side of the building, as they can be in a conventional closed cell spray foam wall system. This can facilitate the installation process, as the cladding support devices can be readily found to facilitate attachment to the cladding material 17. The wall system 100 can further provide the option to install electrical wiring after the insulation layer 53 is installed.

The wall system 100 can also include an interior wall sheathing member 5, which can constitute the innermost layer of the wall system 100. When present, the interior wall sheathing member 5 is positioned at an internal side of the frame member 57. The interior wall sheathing member 5 can be formed from any suitable material such as, for example, gypsum board. A vapor barrier layer 3 can be provided at an external side of the interior wall sheathing member 5, and can be positioned in contact with the sheathing member 5. The sheathing member 5 can be installed in a predetermined distance away from the internal side of the insulation layer 53, to provide a space between the insulation layer 53 and the interior wall sheathing member 5 to accommodate features of the building such as, for example, wiring and/or plumbing. For example, the space can be from about 1 to about 4 inches wide.

The wall system 100 can include additional aspects to accommodate various structural features found in commercial and residential buildings. For example, FIG. 2 schematically depicts a wall system 100 at an area that is above an opening in the cladding material 17, for example, for a window or a door. A sealant 23 and a wall flashing 25 can be provided to the stud cavity 1. The window or door can be installed prior to applying the insulation layer. If a window is installed, the window can be covered and/or masked before applying the foam insulation. FIG. 3 schematically depicts a wall system 100 in an area of a window jamb, in which a sealant 23 can be provided to the stud cavity 1 and wall flashing 27 can be provided. FIG. 4 schematically depicts a wall system 100 at an area of a window sill. Sealant 29 can be provided along the cladding material 17. Referring to FIG. 5, at a foundation 39 of the building, a wall system 100 can be provided with a drip edge 15. A waterproof membrane 33 can be provided between the foundation 39 and the ground 41. A second waterproof membrane 35 can also be provided. A drainage sheet 37 may be provided between the waterproof membrane(s) and the ground 41. The drainage sheet 37 can be HYDRODUCT comprising, for example, a high impact studied polystyrene core. The core can be covered on one side with a non-woven, needle punched polypropylene filter fabric and on the other side with a high backing film. Continuous sealant beads 22 can be provided below the drip edge 15. FIG. 6 schematically depicts the wall system 100 at a movement joint, including a reinforced concrete column 43. FIG. 7 schematically depicts the wall system 100 at a parapet of the building. A vapor barrier 45 can be provided between the wall system and the roof of the building.

Referring to FIG. 8, the wall system 100 can also include at least one fire blocking strip 61 arranged between adjacent frame members 57. The fire blocking strip 61 can fit between the frame members 57 and be fastened to each of the frame members 57. In an exemplary embodiment, the fire blocking strip does not extend beyond the external side of the frame members 57 to permit the insulation layer 53 to fill the space behind the fire blocking strip 61.

Various modifications can be made to the exemplary wall system 100 shown in FIGS. 2-7. For example, referring to FIG. 4, the wall system 100 can be modified so that if the sealant 29 fails, water running off the window sill may be directed between the drainage mat and the cladding material. As another example, referring to FIG. 5, the drainage mat can be provided with a thermoformed L-shaped bottom to prevent the insulation layer from getting behind the drainage mat and blocking the ventilated joint in the space 61 where the cladding material rests on the shelf. The bottom of the drainage mat can be configured so as to generate a continuous weep hole along the entire bottom course of the cladding material. As an additional example, referring to FIG. 7, the parapet area 19 can be further insulated by applying a foam sheathing to provide a continuous thermal envelope area from the wall to the roof.

Although the present invention has been described with respect to the embodiments disclosed herein, it should be appreciated that various modifications may be apparent to those of ordinary skill in the art without departing from the scope and spirit of the claims appended hereto.

What is claimed is:

1. A wall system, comprising:
   a frame comprising at least one frame member;
   a cladding material disposed at an external side of the frame member;
   a drainage mat disposed between the frame member and the cladding material; and
   an insulation layer disposed at an internal side of the drainage mat.

2. The wall system according to claim 1, further comprising an interior sheathing layer arranged at an internal side of the frame member.

3. The wall system according to claim 2, wherein the interior sheathing layer and the insulation layer are arranged such that a space is present therebetween.

4. The wall system according to claim 1, wherein the insulation layer comprises foam, fiberglass, cellulose or combinations thereof.

5. The wall system according to claim 1, wherein the frame comprises a plurality of vertically arranged frame members.

6. The wall system according to claim 5, further comprising a fire blocking strip disposed between two adjacent frame members.

7. The wall system according to claim 1, wherein the drainage mat is in contact with the cladding material.

8. The wall system according to claim 1, wherein the drainage mat comprises a porous, spunbond, non-woven material.

9. The wall system according to claim 1, wherein the insulation layer comprises closed cell urethane foam.

10. The wall system according to claim 1, further comprising at least one cladding material support device attached to the at least one frame member and the cladding material.

11. The wall system according to claim 10, wherein the drainage mat is attached to the at least one cladding material support device, and wherein the at least one cladding material support device comprises a stop for maintaining the position of the drainage mat.

12. A method of forming the wall system of claim 1, comprising:
arranging the drainage mat at an external side of the frame member;
arranging the cladding material at an external side of the drainage mat; and
arranging the insulation layer at an internal side of the frame member.

13. The method according to claim 12, further comprising arranging an interior sheathing layer at an internal side of the frame member.

14. The method according to claim 13, wherein the interior sheathing layer is arranged such that a space exists between the interior wall sheathing layer and the insulation layer.

15. The method according to claim 12, wherein the insulation layer comprises foam, fiberglass, cellulose or combinations thereof.

16. The method according to claim 12, wherein the frame comprises a plurality of vertically arranged frame members.

17. The method according to claim 16, wherein the wall system further comprises a fire blocking strip disposed between two adjacent frame members.

18. The method according to claim 12, wherein the drainage mat is in contact with the cladding material.

19. The method according to claim 12, further comprising attaching at least one cladding material support device to the at least one frame member and the cladding material.

20. The method according to claim 19, wherein the drainage mat is attached to the at least one cladding material support device, and wherein the at least one cladding material support device comprises a stop for maintaining the position of the drainage mat.

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