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(54) **CAVITY WALL SYSTEM**

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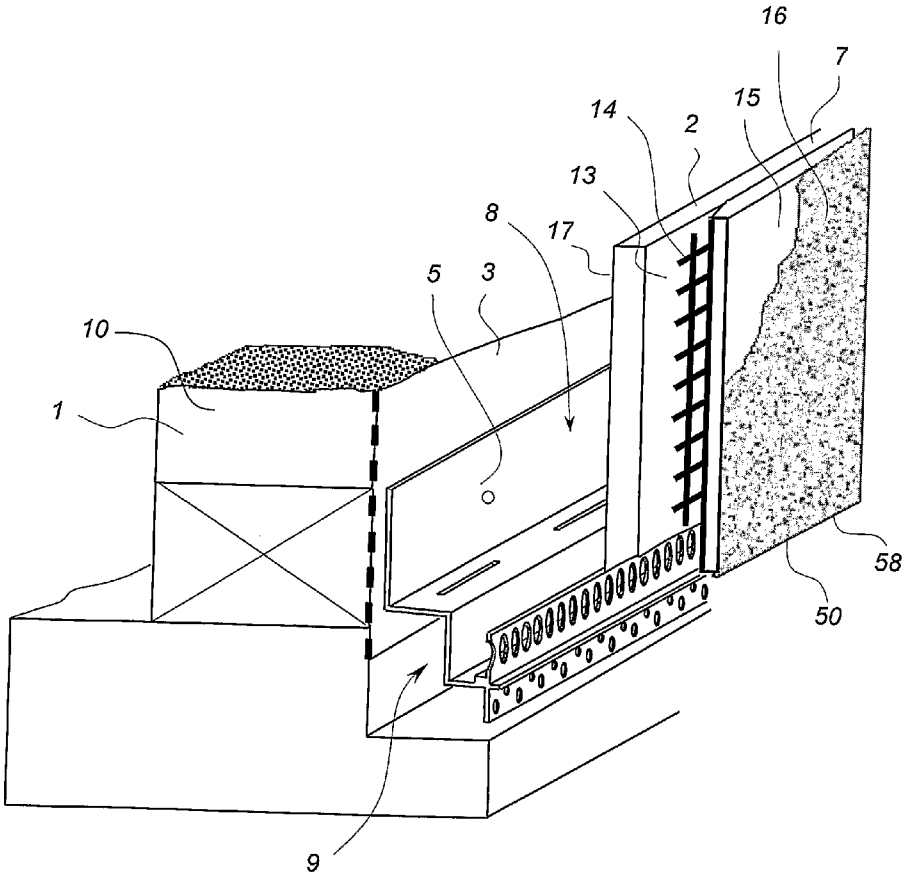
(57) **ABSTRACT**

A cavity wall system and a method of forming a cavity wall including: a wall structure (**1**); a plurality of outer wall cladding panels (**2**); and a plurality of discrete mounting elements (**4**, **5**, **6**) for mounting the cladding panels a predetermined distance away from the wall structure (**1**) so as to form a substantially flat exterior wall surface (**7**) and a substantially uninterrupted internal wall cavity (**8**) between the cladding panels (**2**) and the wall structure (**1**); the mounting elements (**4**, **5**, **6**) being sized and arranged so as to allow substantially uninterrupted fluid flow throughout the cavity (**8**); and the system further including moisture control means defining a moisture control plane to minimise migration of liquid moisture from the cavity (**8**) into the wall structure (**1**). The invention also provides a mounting member (**4**) and a termination member (**5**) for use as mounting elements in the cavity wall system and method.



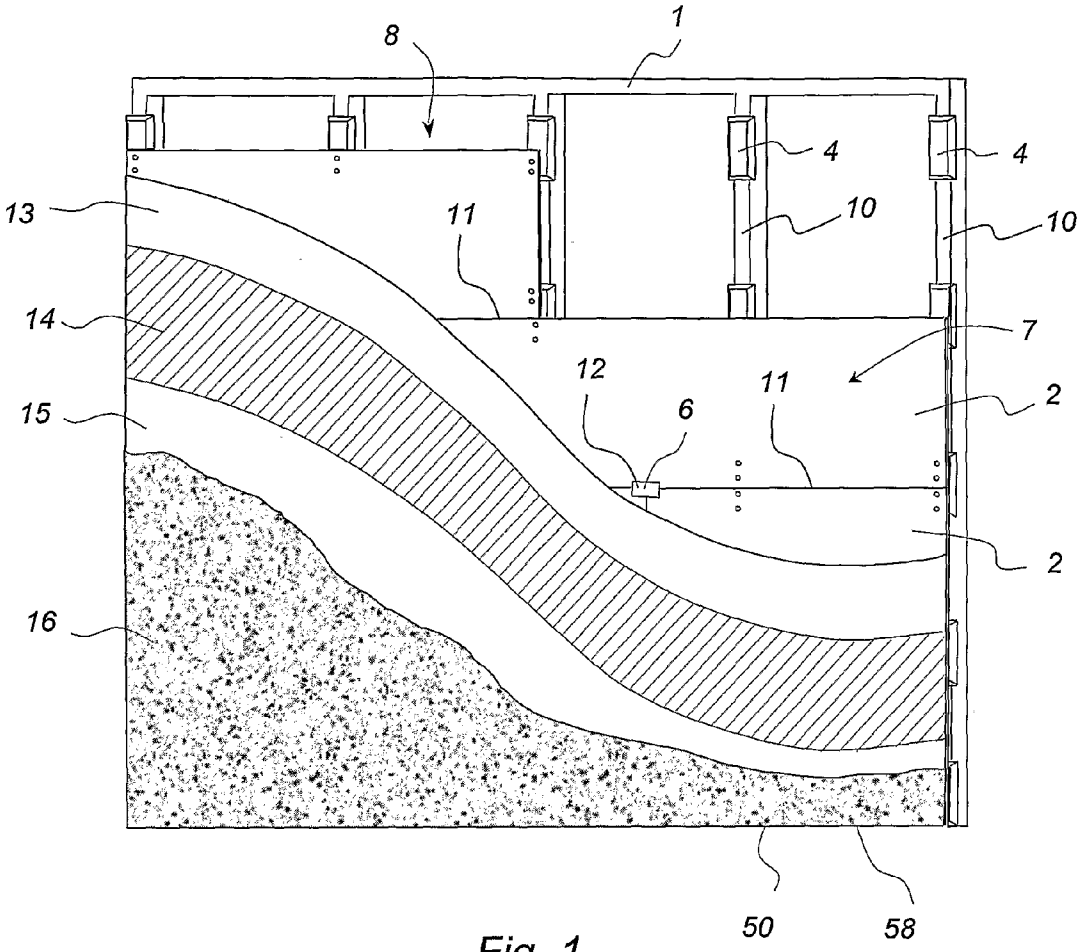


Fig. 1

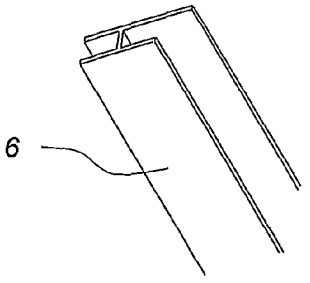


Fig. 2

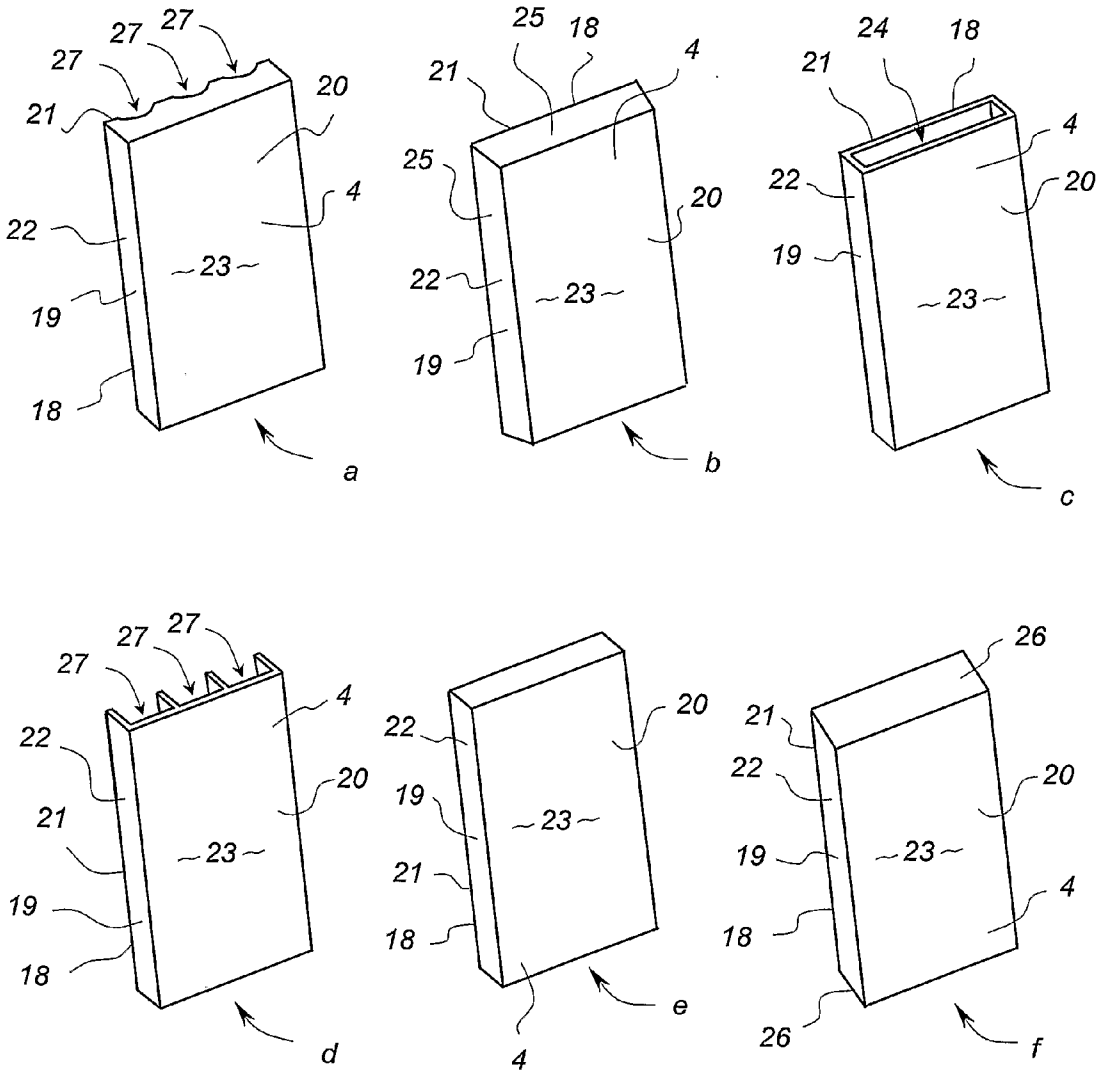

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Fig.3

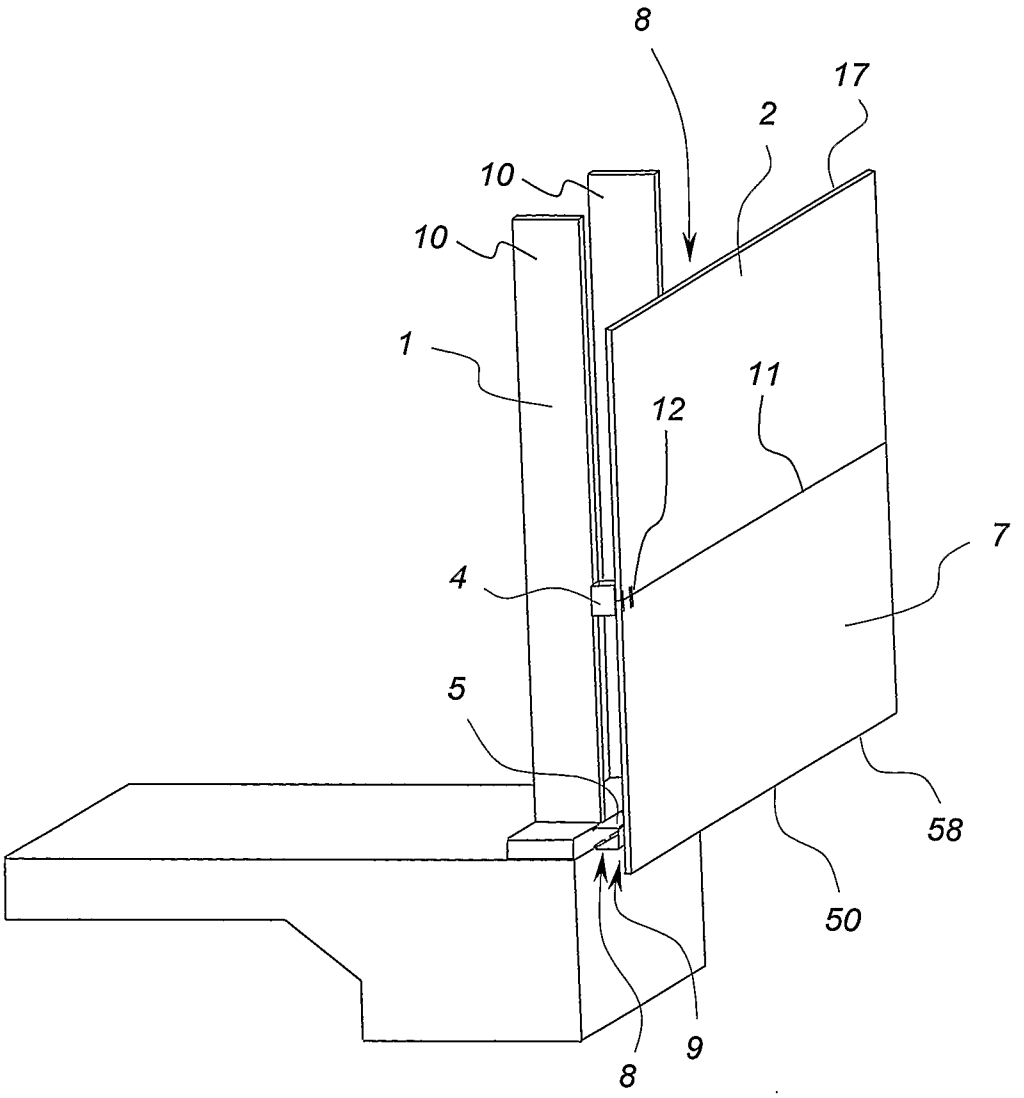

Fig. 4

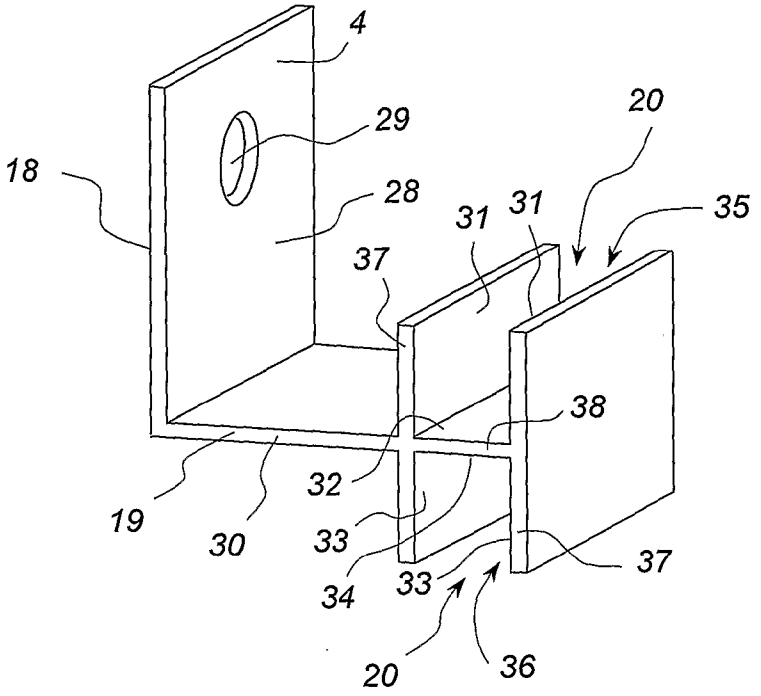
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Fig. 5

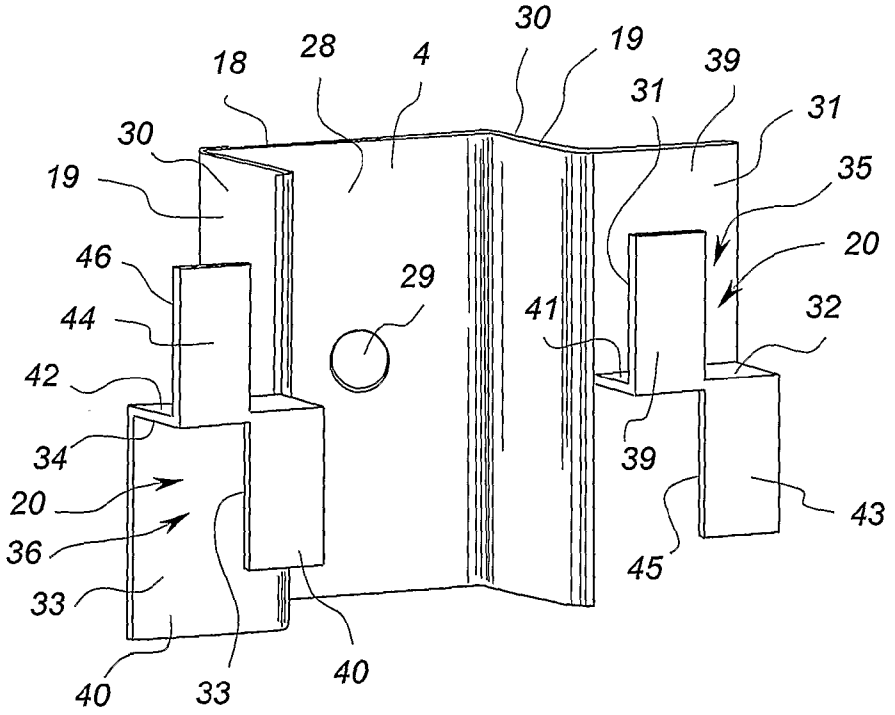
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Fig. 6

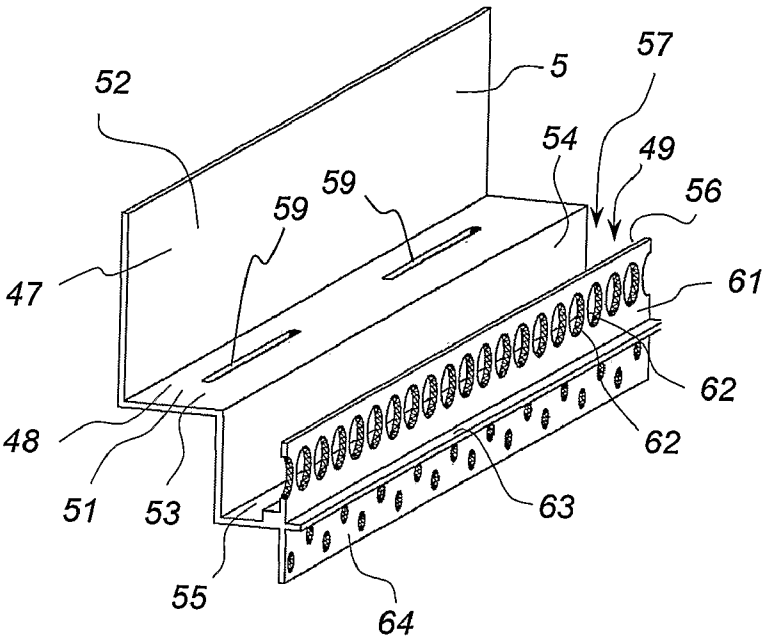
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Fig. 7

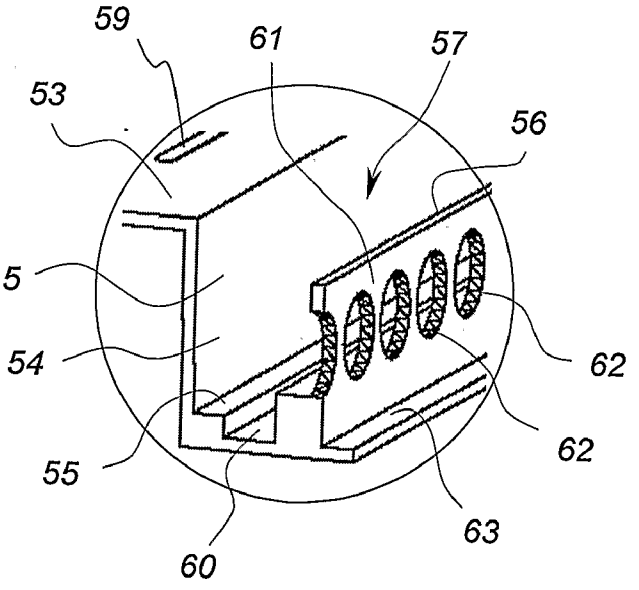
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Fig. 8

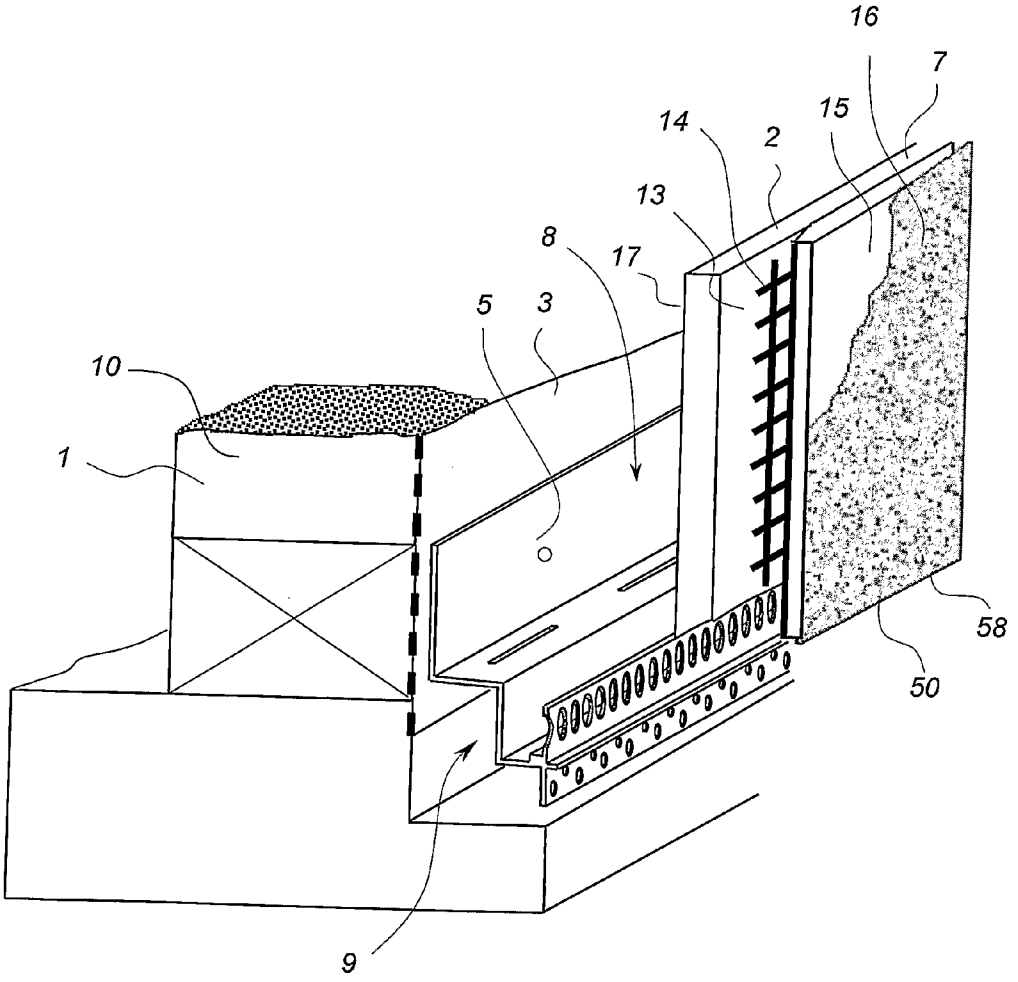

Fig. 9

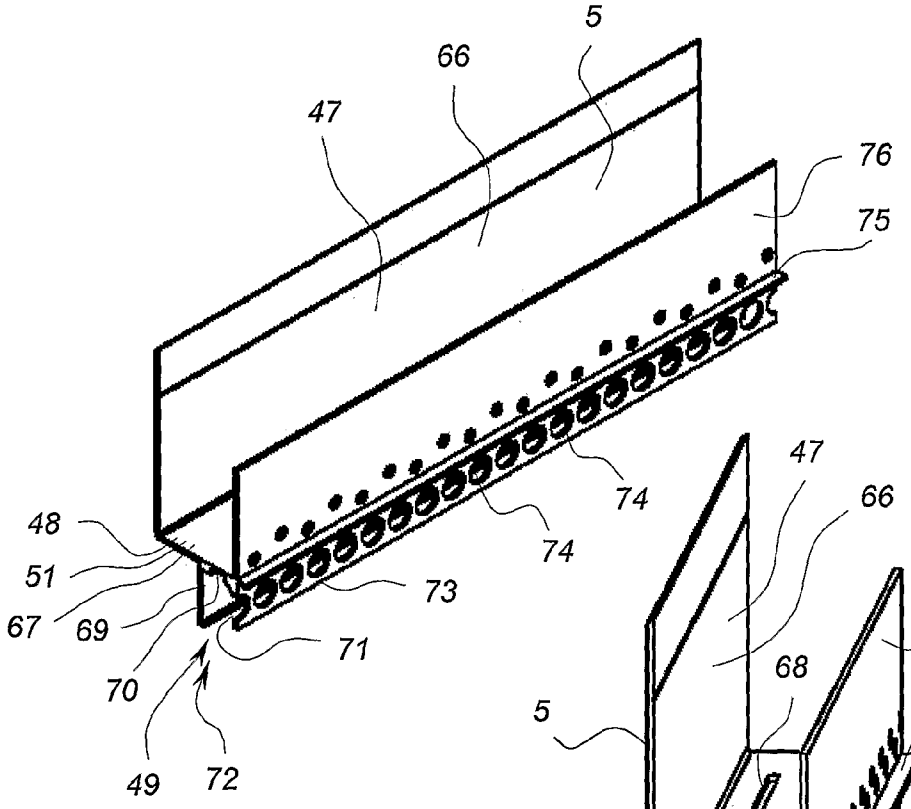

Fig. 10(a)

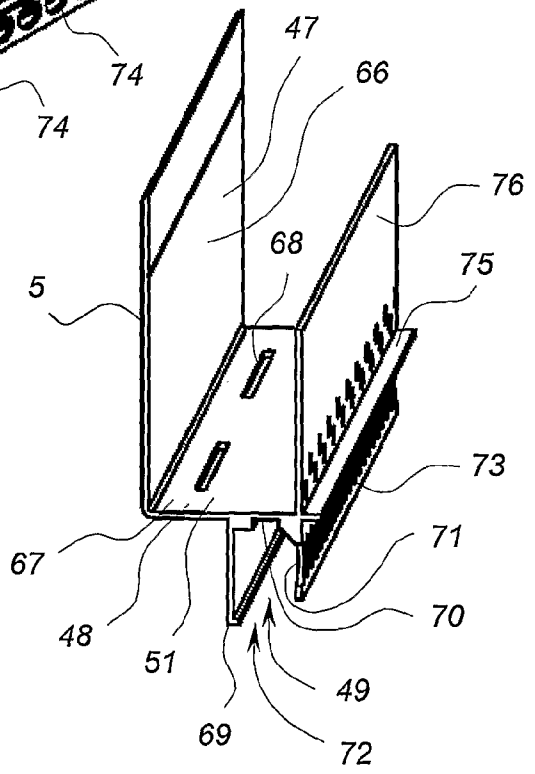

Fig. 10(b)

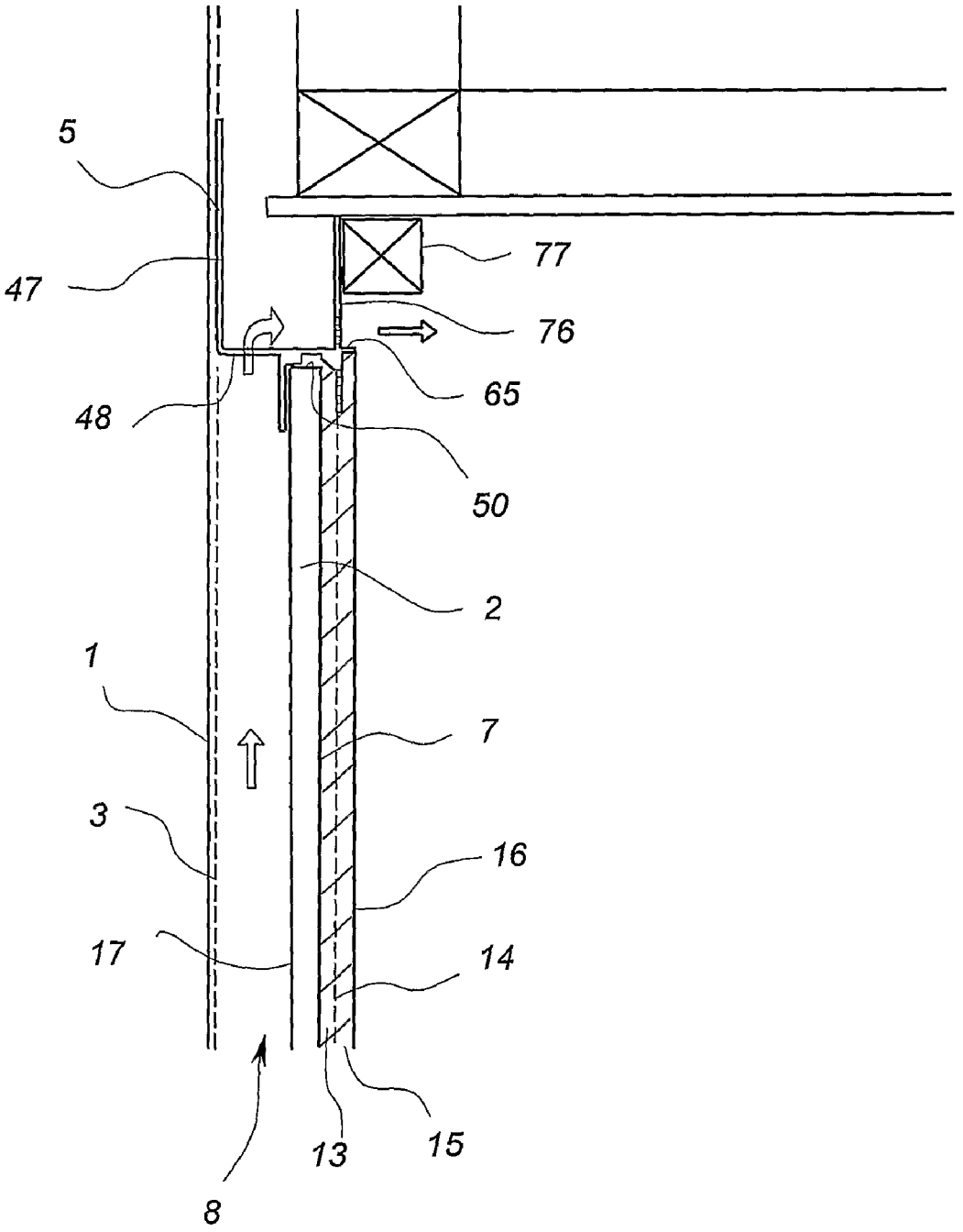

Fig. 11

CAVITY WALL SYSTEM

FIELD OF THE INVENTION

[0001] The present invention relates to a building system and method of construction of the type providing a wall cavity and a monolithic surface finish.

[0002] The invention has been developed primarily for use in the construction of domestic dwellings. However, it will be appreciated the that the invention is not limited to this particular field of use, being readily adaptable to commercial, industrial and other forms of building construction.

BACKGROUND TO THE INVENTION

[0003] The following discussion of the prior art is intended to place the invention in an appropriate technical context and enable the advantages of it to be fully understood. However, these references should not be construed as an admission that any such art is well known or forms part of common general knowledge in the field.

[0004] Modern residential housing construction is typically in the form of full masonry, timber framing with attached cladding, or a combination of masonry and timber framing such as brick veneer. Masonry construction in exterior walls may take the form of solid single skin masonry such as concrete, stone or brickwork, or multi-skin masonry such as double brick or cavity brick construction. Multi-skin masonry has the advantage of providing a gap to separate the capillary moisture transfer from one skin to the other. It also allows for water drainage through the provision of weepholes and flashing at horizontal junctions, at openings and at the base of the wall to divert the water to the outside of the building. Multi-skin masonry also provides superior thermal installation characteristics.

[0005] Timber frame construction with attached cladding has been used extensively, particularly in areas of extensive natural and plantation timber. In such situations, wood products are often also used for cladding, in the form of weatherboards or timber siding. More recently, alternative materials to wood have been used for cladding such as profiled metal, plastic and fibre cement. Foamed plastics such as EPS (expanded polystyrene) have been used as cladding substrates over which texture coatings and reinforcing mesh are incorporated to produce the desired monolithic finish. Cladding systems incorporating EPS as a texture substrate are commonly known as EIFS (exterior insulated finish system). More recently EIFS systems have incorporated improved methods for managing moisture that may penetrate the exterior finish, for example around window openings and wall connections. One such method involved the inclusion of a drainage plane material such as building wrap between the frame or sheathing and the EPS substrate panel, which provides an improvement on bonding the EPS directly to the sheathing. A further improvement was to profile the back of the foam substrate panel or install battens prior to panel installation, so as to provide a space for water drainage and potentially ventilation.

[0006] The increasing trend in developed countries around the world is to provide greater control over the interior environments of buildings to enhance comfort levels for human habitation. Further to this trend, the global impetus to control greenhouse gas emissions has led to increasing levels of energy efficiency being adopted or mandated by building and town planning regulators. Increased energy efficiency generally involves increased levels of insulation and seating of walls, so as to isolate more effectively the interior dwelling space of buildings from the external environment.

[0007] This trend toward improved insulation has tended to dictate more extensive use of construction techniques involving wall cavities, in conjunction with improved insulation materials such as flexible cavity lining membranes or building wraps. While providing greater energy efficiency, however, these techniques have given rise to new difficulties, particularly in terms of water management, moisture control and drainage in wall cavities because historically, the complicating factors associated with insulation membranes and building wraps did not arise. More particularly, it will be appreciated that if moisture is able to penetrate the external envelope of the building and then permeate the internal timber framing, either as a result of inadequate design or faulty construction, and the framing is unable to dry relatively quickly, it can require costly corrective maintenance. If left unchecked, this can lead to wood rot and accelerated structural deterioration. This problem is particularly significant in areas of high rainfall or high humidity, especially if in conjunction with strong winds.

[0008] In parallel with the tendency toward improved energy efficiency, and the concomitant need for more effective water management in new construction techniques, there has been an architectural trend toward a monolithic masonry style of external appearance in domestic dwellings, while retaining the design flexibility and cost effectiveness of timber frame and cladding construction.

[0009] To this end, one known construction technique involves attaching a cement or fibre cement sheet material to a timber frame, over a pliable building membrane or building wrap. Intermediate layers of sarking or building paper, as well as bracing panels, insulating panels, fire rating panels, and the like may additionally or alternatively be included. A textured or rendered finish is then applied to the fibre cement sheet substrate, so as to create an effectively continuous monolithic appearance similar to that of rendered brickwork. The render may optionally be paint finished to a desired colour or surface texture. Such techniques have been relatively successful in providing the desired aesthetics and architectural flexibility in a cost-effective manner. Hitherto, however, they have either not provided a significant wall cavity and have therefore afforded sub-optimal insulation characteristics, or have not provided significant water management functionality within the wall cavities. These techniques have therefore been compromised either in terms of energy efficiency, durability under adverse environmental conditions, or both, particularly in the event of substandard workmanship which is widely prevalent in the building industry. In many cases, previously known techniques are also compromised aesthetically because the joints between cladding panels are highly visible and are therefore unable to convey a convincing visual impression of monolithic masonry construction.

[0010] It is an object of the present invention to provide a building system and method of construction that overcomes one or more of the disadvantages of the prior art, or at least provides a useful alternative.

DISCLOSURE OF THE INVENTION

[0011] Accordingly, in a first aspect, the invention provides a cavity wall system including:

[0012] a wall structure;

[0013] a plurality of outer wall cladding panels; and

[0014] a plurality of discrete mounting elements for mounting the cladding panels a predetermined distance away from the wall structure so as to form a substantially flat exterior wall surface and a substantially uninterrupted internal wall cavity between the cladding panels and the wall structure;

[0015] the mounting elements being sized and arranged so as to allow substantially uninterrupted fluid flow throughout the cavity; and

[0016] the system further including moisture control means defining a moisture control plane to minimise migration of liquid moisture from the cavity into the wall structure.

[0017] According to a second aspect, the invention provides a method of forming a cavity wall, said method including the steps of:

[0018] forming a wall structure;

[0019] providing a plurality of outer wall cladding panels; and

[0020] mounting the cladding panels a predetermined distance away from the wall structure with a plurality of discrete mounting elements to form a substantially flat exterior wall surface and a substantially uninterrupted internal wall cavity between the cladding panels and the wall structure;

[0021] sizing and arranging the mounting elements so as to allow substantially uninterrupted fluid flow throughout the cavity; and

[0022] providing moisture control means to define a moisture control plane adapted to minimise migration of liquid moisture from the cavity into the wall structure.

[0023] According to third aspect, the invention provides a cavity wall formed in accordance with the method of the second aspect of the invention as described above.

[0024] In one preferred embodiment of the invention, the wall structure is formed from concrete or masonry, and the moisture control plane is formed by a coating of sealant or moisture resistant paint on the cavity side of the structure. In a variation of this embodiment, a relatively dense or moisture-impervious concrete or other formulation is used for the wall structure itself, such that an additional coating of sealant or paint is not required. In a further preferred variation, a pliable building membrane is used to cover and seal the wall structure, and in this case, the membrane itself forms the moisture control plane.

[0025] In an alternative and particularly preferred embodiment, the wall structure is formed from a timber frame, and the moisture control plane is formed by a substantially waterproof pliable building membrane that is preferably permeable to moisture vapour, or a plurality of overlapping membranes, covering the outer or cavity side of the frame. The membrane or membranes are preferably breathable or permeable to water vapour, to enable the underlying frame to dry in the event that it does become damp or wet as a result of water or moisture ingress.

[0026] It will be appreciated that in each of these embodiments, the moisture control means defining the moisture control plane may take the form of a separate coating, covering, layering or membrane, whether individual or composite in nature, or may be inherent in the composition of the wall structure itself. In any case, the moisture control plane serves to redirect liquid water within the cavity downwardly for easy escape to the outside of the structure individually or in combination with flashings, while permitting migration of water in vapour form through the moisture control plane so as to facilitate drying of the underlying wall structure.

[0027] Preferably also, the membrane includes an outer reflective surface, or a supplementary sarking membrane having a reflective outer surface is provided, to enhance the thermal insulation characteristics of the wall. In situations where maximum thermal insulation is required, outwardly directed reflective surfaces are applied to both the cavity side of the cladding panels and the cavity side of the wall structure, using suitable paints, coatings, sarkings and/or membrane materials.

[0028] Preferably, supplementary spacers are included to maintain the internal wall cavity between the pliable building membrane and the cladding panels, and to reduce wind-induced movement of the membrane, particularly between the framing members. Advantageously, these supplementary spacers minimise any "flapping" of the membrane under high or variable wind conditions.

[0029] Preferably, a lower periphery of the cavity includes an opening to permit drainage of liquid from the cavity and venting of the cavity. Preferably, an upper periphery of the cavity includes a vent that permits venting of the cavity.

[0030] Preferably, the exterior wall surface defined by the cladding panels constitutes a substrate supporting at least one outer finishing layer. Preferably, the outer finishing layer conceals the edges between adjacent cladding panels and any exposed portions of the mounting elements to provide a monolithic finish over the exterior wall surface. More preferably, the outer finishing layer is applied by rendering or textured coating, and is optionally sealed, primed, painted or a combination thereof to produce an outer surface finish resembling that of monolithic masonry construction.

[0031] In the preferred embodiment, the cladding panels are formed substantially from fibre cement sheet. In this embodiment, the exterior surface of each cladding panel is preferably coated with an outer finishing layer such as render or paint, and the interior surface of each cladding panel is preferably covered with a carbonation reducing coating, so as to reduce differential carbonation within the fibre cement panel. Alternatively, the substrate panels can be formed from other materials such as EPS, of sufficient strength and thickness to span between the respective mounting elements.

[0032] Preferably, the exterior wall surface is coated with a sub-layer of render, a reinforcing mesh layer over the sub-layer, and an external finishing layer over the reinforcing layer.

[0033] Preferably, the mounting elements include both mounting members and termination members. These members can be formed from materials of sufficient strength to support the intended dead and imposed live loads, including shaped metals, extruded or processed plastics, and the like.

[0034] In a fourth aspect, the invention provides a mounting member for use in the cavity wall system and method as described above, the mounting member including:

[0035] a mounting portion adapted for attachment to a wall structure;

[0036] a spacing portion adapted to space at least one associated cladding panel outwardly from the mounting portion by a predetermined distance corresponding to the intended depth of an internal wall cavity;

[0037] and at least one positioning portion adapted for connection to the associated cladding panel;

[0038] the mounting member being adapted, in conjunction with a plurality of like members, to support and position a plurality of cladding panels in substantially contiguous each to edge relationship at the predetermined distance away from

the wall structure, thereby to form a substantially flat exterior wall surface and a substantially uninterrupted internal wall cavity between the cladding panels and the wall structure.

[0039] Preferably, the mounting portion is adapted for attachment to the wall structure over the moisture control plane.

[0040] In one preferred embodiment, the mounting member takes the form of a mounting block wherein the mounting portion is defined by an inner face of the block, the spacing portion is defined by a main body of the block, and the positioning portion is defined by an outer face of the block. Preferably, a plurality of these mounting blocks in spaced apart relationship support and position the plurality of cladding panels by fasteners driven into the cladding panels, through the respective blocks, and into the underlying wall structure. It is also preferred that the mounting members are profiled to allow substantially uninterrupted fluid flow around or through the respective bodies.

[0041] In another preferred embodiment, the mounting member takes the form of a mounting bracket, wherein the mounting portion includes a mounting plate, the spacing portion includes a spacing web, and the bracket further includes:

[0042] a first pair of spaced apart substantially parallel positioning surfaces interconnected by an orthogonal web, both first positioning surfaces being substantially parallel to the mounting plate and located at one end of the spacing web opposite the mounting plate; and

[0043] a second pair of spaced apart substantially parallel positioning surfaces interconnected by an orthogonal web, both second positioning surfaces being substantially parallel to the mounting plate and located at the end of the spacing web opposite the mounting plate;

[0044] the first pair of positioning surfaces and the second pair of positioning surfaces and their respective interconnecting webs forming oppositely directed substantially U-shaped positioning channels, the positioning channels being adapted to receive and locate adjacent edges of adjoining cladding panels, to retain the panels in substantially contiguous each to edge relationship, outwardly of the wall structure.

[0045] Preferably, the mounting portion includes a perforation for a fastener.

[0046] Preferably, the spacing web includes a spacing plate extending substantially normally to the mounting plate by a predetermined distance corresponding to the intended depth of the wall cavity. Preferably also, the positioning surfaces are located on respective positioning plate flanges.

[0047] According to a fifth aspect, the invention provides a termination member for use in the cavity wall system and method as defined, the termination member including:

[0048] a mounting portion adapted for attachment to a wall structure;

[0049] a spacing portion extending outwardly from the mounting portion by a predetermined distance corresponding to the intended thickness of the internal wall cavity;

[0050] a positioning portion connected to the end of the spacing portion opposite the mounting portion, the positioning portion being adapted for connection to at least one associated cladding panel;

[0051] the termination member being adapted to support and position the associated cladding panel at the predetermined distance away from the wall structure, and to define an edge of the exterior wall surface;

[0052] the termination member further including a drainage portion adapted to permit drainage of liquid from the wall cavity.

[0053] Preferably, the mounting portion is adapted for attachment to the wall structure over the moisture control plane.

[0054] In one preferred embodiment, the termination member takes the form of a starter strip wherein the mounting portion includes a mounting plate, the drainage portion includes a drainage surface extending outwardly from the mounting plate, and the positioning portion includes:

[0055] an inner positioning surface extending in one direction from the drainage surface parallel to the mounting plate;

[0056] a support surface extending outwardly from the inner positioning surface; and

[0057] an outer positioning surface extending from the support surface parallel to the mounting plate;

[0058] whereby the inner positioning surface, support surface and outer positioning surface together form a substantially U-shaped channel adapted to receive and locate a peripheral edge of the associated cladding panel.

[0059] Preferably, the drainage surface is configured to drain away from the mounting plate. In another preferred embodiment, the drainage surface drains towards the support surface. In yet another preferred embodiment, the drainage surface includes perforations for drainage or ventilation.

[0060] Preferably, the support surface includes a drainage groove to permit drainage of liquid from the interior surface of cladding panels and away from the wall cavity.

[0061] The outer positioning surface is preferably located on an outer positioning flange having perforations for keying with an over-coating render.

[0062] Further, the termination member preferably includes an alignment flange extending generally outwardly from the outer positioning flange for supporting and aligning an applied exterior wall surface coating. The termination member also preferably includes a perforated flange extending away from the U-shaped channel generally orthogonally from the support surface for providing ventilation or drainage along an edge of the exterior wall surface.

[0063] In another preferred embodiment, the termination member takes the form of a top strip wherein the mounting portion comprises a mounting plate, the spacing and ventilation portion comprises a perforated spacing surface extending outwardly from the mounting plate, and the positioning portion comprises:

[0064] an inner positioning surface extending in one direction from the perforated spacing surface parallel to the mounting plate;

[0065] a support surface extending outwardly from the inner positioning surface; and

[0066] an outer positioning surface extending from the support surface parallel to the mounting plate;

[0067] whereby the inner positioning surface, support surface and outer positioning surface together form a substantially U-shaped channel adapted to receive and locate a peripheral edge of the associated cladding panel.

[0068] The outer positioning surface is preferably located on an outer positioning flange having perforations for keying with an over-coating render.

[0069] Further, the termination member preferably includes an alignment flange extending generally outwardly from the outer positioning flange for supporting and aligning an applied exterior wall surface coating. The top strip prefer-

ably also includes a perforated flange extending upwardly away from the U-shaped channel generally orthogonally from the support surface to provide ventilation along an edge of the exterior wall surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0070] Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

[0071] FIG. **1** is a perspective view of a cavity wall system according to the invention;

[0072] FIG. **2** is an enlarged fragmentary view of an off-stud joiner of the cavity wall system;

[0073] FIGS. **3***a*-**3***f* are perspective views of various embodiments of a mounting member of the cavity wall system;

[0074] FIG. **4** is a fragmentary view of another embodiment of a cavity wall system according to the invention;

[0075] FIG. **5** is a perspective view of a mounting member for a cavity wall system according to the invention;

[0076] FIG. **6** is a perspective view of another embodiment of a mounting member for a cavity wall system according to the invention;

[0077] FIG. **7** is a perspective view of a termination member for a cavity wall system according to the invention;

[0078] FIG. **8** is a fragmentary perspective view of another embodiment of a termination member for a cavity wall system according to the invention, and showing an embodiment of a drainage groove in the support surface;

[0079] FIG. **9** is a fragmentary partially cut-away view of an embodiment of a cavity wall system including the termination member shown in FIG. **7**;

[0080] FIG. **10** is perspective view of a termination member in the form of a vented top strip according to the invention; and

[0081] FIG. **11** is sectional view of a wall assembly incorporating upper ventilation of the cavity through the vented top strip of FIG. **10**.

PREFERRED EMBODIMENTS OF THE INVENTION

[0082] Referring to the drawings, the invention provides a cavity wall system including a wall structure **1** and a plurality of outer wall cladding panels **2**. In the preferred embodiment, the wall structure is a building frame with its outer side substantially covered by moisture control means in the form of a pliable building membrane **3** defining a moisture control plane. Also preferably, the cladding panels **2** are formed substantially from fibre cement sheets, or other materials such as EPS, of sufficient strength and thickness. The system further includes a plurality of discrete mounting elements including mounting members **4**, termination members or starter strips **5** and off-stud joiners **6**. These are attached over the building membrane to mount the fibre cement cladding panels a predetermined distance away from the building membrane, forming a substantially flat exterior wall surface **7** and a substantially uninterrupted internal wall cavity **8** between the cladding panels and the building membrane. The mounting elements are sized and arranged so as to allow substantially uninterrupted airflow and water drainage throughout the cavity. As best shown in FIG. **9**, a lower periphery of the cavity includes openings **9** to permit drainage of liquid from the cavity.

[0083] In other embodiments, the wall structure may be a masonry wall or a concrete wall. In these other embodiments, the moisture control means may be a coating of sealant or paint. In further alternative embodiments, the moisture control means may be a reflective membrane or a form of sarking attached to the wall structure in a continuous configuration or an overlapping configuration. Reflective membranes further enhance the already increased insulation performance of the cavity wall system over known systems such as direct fix cladding. In embodiments where a pliable building membrane is used, supplementary spacers (not shown) are preferably included to maintain the internal wall cavity **8** between the pliable building membrane **3** and the cladding panels **2** and to reduce wind-induced movement of the pliable building membrane. These spacers are particularly useful where the pliable building membrane spans between the studs **10** of a frame wall structure **1** or between the mounting elements of the cavity wall system. The spacers can be discrete units or continuous, profiled or solid, and preferably formed from a material with high thermal insulation properties such as expanded polymeric foam material. The spacers may be adhered with tapes, adhesives or fasteners, as appropriate.

[0084] The wall surface **7** constitutes a substrate, which is adapted to support at least one outer finishing layer. The outer finishing layer conceals the edges **11** between adjacent cladding panels and the exposed portions **12** of the mounting elements to provide a monolithic finish over the wall surface. In the embodiments shown in FIGS. **1**, **9** and **11**, the external wall surface is coated with a sub-layer of render **13**, a reinforcing mesh layer **14** over the sub-layer, and an outer rendered layer **15** over the reinforcing layer. The outer rendered layer is ideally painted to produce an outer surface finish **16** resembling that of monolithic masonry construction. Concealing the cladding panels allows the panels to be of different sizes and shapes, which allows for greater flexibility in the positioning of the edges of the panels. Additionally, the interior surface **17** of each cladding panel is preferably covered with a carbonation reducing coating, so as to reduce differential carbonation within the fibre cement panel.

[0085] Each mounting member **4** includes a mounting portion **18** adapted for attachment to the frame over the building membrane **3**, a spacing portion **19**, and at least one positioning portion **20** adapted for connection to an associated cladding panel **2**. The spacing portion **19** is sized to space the associated cladding panel outwardly from the frame by a predetermined distance corresponding to the intended depth of the wall cavity **8**. In this way, the mounting members are adapted in combination to position and support a plurality of the fibre cement cladding panels in substantially contiguous edge-to-edge relationship at the same predetermined distance away from the frame, so as to form the effectively continuous exterior wall surface **7** and the substantially uninterrupted internal wall cavity **8**.

[0086] FIGS. **3***a* to **3***f* show several preferred embodiments of the mounting member **4**. In these embodiments, the mounting member takes the form of a mounting block wherein the mounting portion **18** is defined by an inner face **21** of the block, the spacing portion **19** is defined by the body thickness **22** of the block, and the positioning portion **20** is defined by an outer face **23** of the block. The simplest embodiment is a substantially right rectangular prism, as shown in FIG. **3***e*. However, the other embodiments are profiled to allow improved fluid flow around or through the body. FIG. **3***c* shows a hollow right rectangular prism with openings **24** at

the top and bottom in the installed configuration. The hollow configuration thereby allows fluid to flow downwardly through the body of the mounting member. FIG. **3***b* shows a block with sides **25** that taper inwardly from the inner face **21** towards the outer face **23**. FIG. **3***f* shows a block wherein both the top and bottom sides **26** taper downwardly in the installed configuration. The tapered sides featured in these embodiments allow fluid to flow more readily around the body. FIGS. **3***a* and **3***d* each show a right rectangular prism with three parallel channels **27** recessed into the inner face **21** to allow fluid to flow vertically through the body in the installed orientation. FIG. **3***a* shows arcuate channels, while FIG. **3***d* shows rectangular channels. It will be appreciated that many configurations of three-dimensional shaped or profiled spacers may be used.

[0087] Whatever the precise shape and configuration, a plurality of these mounting blocks are used in appropriately spaced apart relationship to support and position the fibre cement cladding panels by fasteners driven into the cladding panels, through the respective block bodies and into the underlying frame. These fasteners may take the form of nails, screws, staples, tacks or similar forms of fastener. Alternative forms of fastening such as gluing may also be used.

[0088] FIGS. **5** and **6** show alternative types of mounting members, in the form of mounting brackets. In these embodiments, the mounting portion **18** comprises a mounting plate **28** with a pre-formed perforation **29** adapted to receive a fastening element such as a nail or self-tapping screw. The spacing portion **19** comprises at least one spacing web **30** in the form of a plate extending substantially normally to the mounting plate by a predetermined distance corresponding to the intended depth of the wall cavity. The spacing web supports a first pair of spaced apart substantially parallel positioning surfaces **31** interconnected by an orthogonal web **32**, and a second pair of spaced apart substantially parallel positioning surfaces **33** interconnected by an orthogonal web **34**. The first and second positioning surfaces are substantially parallel to the mounting plate and in conjunction with their respective interconnecting webs form oppositely directed substantially U-shaped positioning channels **35** and **36**. These channels are adapted to receive and locate adjacent edges of adjoining cladding panels **2**, to retain the panels in substantially contiguous edge-to-edge relationship, outwardly of the frame **1**.

[0089] In the embodiment shown in FIG. **5**, the mounting plate **28** and one spacing web **30** form an L-shape with the spacing web projecting orthogonally from the bottom of the mounting plate in its installed configuration. The end of the spacing web terminates at a pair of identical spaced parallel positioning flanges **37** interconnected midway between their respective ends by an orthogonal web **38**. The orthogonal web extends linearly from the spacing web **30**. The first positioning surfaces **31** are located respectively on the mutually opposed inwardly facing surfaces of the upwardly projecting portions of the positioning flanges **37**. The second positioning surfaces **33** are located respectively on the mutually opposed inwardly facing surfaces of the downwardly projecting portions of the positioning flanges **37**. Further reinforcing webs can be added to strengthen the mounting member if necessary. The mounting member of this embodiment is well suited to being formed from extruded aluminium or suitable plastics materials such as vinyl.

[0090] In the embodiment of FIG. **6**, the mounting plate **28** and two spacing webs **30** form a U-shaped channel, with the plane of each spacing web in a vertical orientation when installed. Connected to each spacing web is a corresponding pair of spaced parallel positioning flanges **39** and **40** interconnected by respective orthogonal webs **41** and **42**. Both pairs of positioning flanges are parallel to the mounting plate **28** and are connected to a respective spacing web along the side of the respective inner positioning flange. However, one pair of positioning flanges **39** is upwardly directed and the other pair **40** is downwardly directed. Additionally, each outer positioning flange is split vertically in half with one half of the outer positioning flange reversed into the opposing direction. This results in an additional positioning flange **43** directed downwardly from upwardly directed positioning flanges **39** and an additional positioning flange **44** directed upwardly from downwardly directed positioning flanges **40**.

[0091] The first positioning surfaces **31** are located respectively on the inwardly facing surfaces of the upwardly directed positioning flanges **39**. An additional first positioning surface **46** is located on the inwardly facing surface of the upwardly directed additional positioning flange **44**. The second positioning surfaces **33** are located respectively on the inwardly facing surfaces of the downwardly directed positioning flanges **40**. An additional second positioning surface **45** is located on the inwardly facing surface of downwardly directed additional positioning flange **43**. The mounting member of this embodiment is well suited for cold forming from metals such as galvanised steel, Zincalume or stainless steel, but again may alternatively be formed from suitable plastics materials such as vinyl.

[0092] The termination member **5** includes a mounting portion **47** adapted for connection to the building frame, a spacing portion **48** extending outwardly from the mounting portion by a predetermined distance corresponding to the intended thickness of the wall cavity, and a positioning portion **49** adapted for connection to at least one of the outer wall cladding panels **2**. The termination member is adapted to support and position the associated cladding panels at the predetermined distance away from the frame, and to define a peripheral edge **50** of the exterior wall surface **7**. The termination member further includes a drainage portion **51** adapted to permit drainage of liquid from the cavity and air to vent the cavity.

[0093] In one preferred embodiment, the termination member takes the form of a starter strip, as best shown in FIGS. **7**, **8** and **9**. In this embodiment the mounting portion **47** comprises a mounting plate **52**, and the drainage portion **51** comprises a drainage surface **53** extending outwardly from the mounting plate. The drainage surface **53** also forms the spacing portion **48** in this embodiment. The positioning portion **49** comprises an inner positioning surface **54** extending in one direction from the drainage surface parallel to the mounting plate, a support surface **55** extending outwardly from the inner positioning surface, and an outer positioning surface **56** extending from the support surface parallel to the mounting plate. The inner positioning surface, support surface and outer positioning surface together form a substantially U-shaped channel **57** adapted to receive and locate the outer peripheral edge **50** of an associated cladding panel **2**.

[0094] The starter strip is normally located at the bottom peripheral edge **58** of the external wall surface **7**. The drainage surface **53** is configured to drain away from the mounting plate **52** towards the support surface **55**. The drainage surface preferably also includes perforations **59** for drainage or ventilation of the internal wall cavity **8**. The support surface **55**

includes a drainage groove **60** to permit drainage of liquid from the interior surface of the cladding panels **2** and away from the cavity **8**.

[0095] The outer positioning surface **56** is located on an outer positioning flange **61** having perforations **62** for keying with an over-coating render. The starter strip also includes an alignment flange **63** extending generally outwardly from the outer positioning flange **61** for supporting and aligning an applied exterior wall surface coating. The starter strip further includes a perforated flange **64** extending away from the U-shaped channel **57** generally orthogonally from the support surface for providing ventilation or drainage along a peripheral edge **50** of the exterior wall surface.

[0096] The top of the wall or wall section **65** can be terminated by a top strip, an alternative form of the termination member, as best shown in FIGS. **10** and **11**. The top strip extends the full length of the wall termination. The mounting portion **47** comprises a mounting plate **66**, and the drainage portion **51** comprises a ventilation surface **67** extending outwardly from the mounting plate. The ventilation surface **67** also forms the spacing portion **48** in this embodiment and includes perforations **68** to vent the wall cavity **8**. The positioning portion **49** comprises an inner positioning surface **69** extending in one direction from the ventilation surface parallel to the mounting plate, a support surface **70** extending outwardly from the inner positioning surface, and an outer positioning surface **71** extending from the support surface parallel to the mounting plate. The inner positioning surface, support surface and outer positioning surface together form a substantially U-shaped channel **72** adapted to receive and locate the outer peripheral edge **50** of an associated cladding panel **2**.

[0097] The outer positioning surface **71** is located on an outer positioning flange **73** having perforations **74** for keying with an over-coating render. The top strip also includes an alignment flange **75** extending generally outwardly from the outer positioning flange **73** for supporting and aligning an applied exterior wall surface coating. The top strip further includes a perforated flange **76** extending upwardly away from the U-shaped channel **72** generally orthogonally from the support surface. The perforated flange **76** extends sufficiently upwardly to provide for trim cover mouldings **77** and also provides for a perforated area for ventilation to the termination. The upper periphery of the termination, as shown in FIG. **11**, provides a practical and aesthetically acceptable finish.

[0098] The termination member can also be located at other peripheral edges of the external wall surface and at horizontal junctions such as window openings, door openings, mid-storey junctions, flashings and control joints.

[0099] It will be appreciated that the termination member is well suited for setting out an external wall surface, supporting cladding panels, forming a wall cavity, permitting drainage from a wall cavity, providing ventilation to a wall cavity, and providing a screed and levelling guide for applying outer finishing layers to the external wall surface.

[0100] The mounting elements also include off-stud joiners **6**. As shown in FIG. **2**, one preferred embodiment of this element takes the form of an H-sectioned joiner. The joiner receives and aligns the longitudinal edges of adjacent cladding panels in substantially contiguous relationship, and retains the adjoining panels in coplanar alignment even when the joins do not directly overlie the frame members.

[0101] The material strength, gauge, profile and spacing of the mounting elements are such that when the mounting elements are installed with strong durable fasteners they are well suited to withstand very high wind loads. The cavity wall system also allows the fixing of bracing elements (not shown) to the frame **1** to resist shear or racking loads on the wall from wind, seismic or similar loads on a building. In one preferred form, fibre cement bracing panels are fastened directly to the frame **1**. In this embodiment, the mounting elements are provided in various sizes to allow for the space taken up by the bracing panels and to maintain the substantially flat exterior wall surface **7**.

[0102] Fire rating performance can also be incorporated into the cavity wall system. In one preferred form, water-resistant fire-resistant gypsum boards (not shown) are installed onto the frame under the building membrane **3**.

[0103] The cavity wall system provides a vented cavity that is well suited to reduce the tendency to generate cyclic wind pressures in the wall cavity **8**. This also reduces the flapping of the building membrane **3** that results from these cyclic wind pressures.

[0104] Turning now to describe briefly the preferred method of construction of a cavity wall in accordance with the invention, a wall structure is initially constructed. In the preferred embodiment, the wall structure is in the form of a building frame and the outer surface of the frame is covered with a flexible, substantially waterproof building membrane using conventional materials and techniques. The membrane is ideally breathable or permeable to water vapour, to facilitate drying of the underlying frame or wall structure in the event of water or moisture ingress. A series of starter strips are then installed along a lower edge of the frame, at a level corresponding to the lower edge of the wall. A first run of fibre cement cladding panels is then positioned along the bottom edge of the frame, with the bottom edges of the cladding panels being located and captively retained by the respective starter strips. As each panel is vast positioned, the upper edge is engaged with a first series of mounting members, which are successively fastened to the respective underlying framing members. In this way, the bottom edge of each cladding panel in the first run is secured by one or more of the starter strips, and the top edge is secured by one or more of the first row of mounting members. The panels are joined to each other where necessary with respective off-stud joiners.

[0105] With the first run thus in place, a second run of cladding panels is installed in a similar manner, with the bottom edge of each panel in the second row being located by the respective positioning surfaces on the first row of mounting members, and the upper edge of each panel in the second row being located by the respective positioning surfaces of a second row of mounting members. This process is repeated for as many rows as are required in order to cover the frame with cladding panels to the required height, with the upper edges of the top row being finished with suitable termination members. In this way, the panels collectively form a substantially flat, effectively continuous external cladding surface and the mounting members provide a substantially uninterrupted internal wall cavity between the cladding panels and the building membrane.

[0106] The external cladding surface forms a substrate, to which is preferably added a base layer of render, a layer of reinforcing mesh over the base layer, an outer layer of render over the reinforcing mesh, and a top coat of paint or textured finish, to provide the desired aesthetic such as that reminis-

cent of monolithic masonry construction. Preferably, the render applied directly to the external cladding surface is forced into the small spaces between the edges of adjacent cladding panels and between the cladding panels and mounting elements. This conceals the edges and any exposed portions of the mounting elements to give a generally continuous and flat monolithic external finish. This also reduces the tendency for the cladding panels to deform, drum or rattle in response to wind, seismic or other loads on the wall. Concealing the cladding panels allows the panels to be of different sizes and shapes, so cladding panels can be cut to fit the particular dimensions and features of the underlying wall structure. This enhances design flexibility, reduces labour and material costs, and minimises wastage of off-cuts.

[0107] The construction technique of the present invention allows fast and efficient drainage of water downwardly through the cavity and out through the apertures in the starter strips. At the same time, moist air is able to circulate freely in substantially any direction within the cavity around the mounting members, and out through the top or bottom apertures. These apertures also prevent the accumulation of pressure within the cavity, either as a result of thermal expansion or wind forces, which otherwise have the potential to force entrapped water through openings in the membrane and into the framing members. The moisture control plane ensures that any liquid moisture within the wall cavity is prevented from migrating into the underlying wall structure.

[0108] This method of construction also allows for the installation of the mounting elements and the associated cladding panels in one pass. In the preferred form, the installation of the mounting elements and the associated cladding panels effectively occurs simultaneously. This provides an advantage over prior art methods where mounting elements such as battens are fastened to the building frame in a first pass and the cladding panels installed in a subsequent second pass. This improvement can result in significant reductions in installation time and cost. The use of discrete mounting elements can also result in significant material savings when compared with prior art mounting elements such as elongate timber battens or steel profiled sections.

[0109] It will be appreciated that the invention thus provides a cavity wall system, which is efficient and cost-effective to construct, allows great design flexibility, provides highly desirable aesthetics reminiscent of more costly construction techniques, provides superior thermal insulation characteristics, provides substantially improved drainage and water management and is significantly more durable in adverse weather conditions relative to comparable known methods of building construction. In all these respects, the invention represents a practical and commercially significant improvement over the prior art.

[0110] Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

1. A cavity wall system including:
a wall structure;
a plurality of outer wall cladding panels; and
a plurality of discrete mounting elements for mounting the cladding panels a predetermined distance away from the wall structure so as to form a substantially flat exterior wall surface and a substantially uninterrupted internal wall cavity between the cladding panels and the wall structure;
the mounting elements being sized and arranged so as to allow substantially uninterrupted fluid flow throughout the cavity; and
the system further including moisture control means defining a moisture control plane to minimize migration of liquid moisture from the cavity into the wall structure.

2. A cavity wall system according to claim **1** wherein a lower periphery of the cavity includes an opening to permit drainage of liquid from the cavity and venting of the cavity.

3. A cavity wall system according to claim **1** wherein an upper periphery of the cavity includes a vent to permit venting of the cavity.

4. A cavity wall system according to claim **1** wherein the mounting elements include at least one mounting member and at least one termination member.

5. A cavity wall system according to claim **4** wherein the mounting member is a mounting member as defined in claim **52**.

6. A cavity wall system according to claim **4** wherein the termination member is a termination member as defined in claim **62**.

7. A cavity wall system according to claim **1** wherein the cladding panels define an exterior wall surface a substrate supporting at least one outer finishing layer.

8. A cavity wall system according to claim **7** wherein the outer finishing layer conceals edges between adjacent cladding panels and any exposed portions of the mounting elements to provide a monolithic finish over the exterior wall surface.

9. A cavity wall system according to claim **7** wherein the outer finishing layer is applied by rendering or textured coating.

10. A cavity wall system according to claim **7** wherein the outer finishing layer is sealed, primed or painted to produce an outer surface finish resembling that of monolithic masonry construction.

11. A cavity wall system according to claim **7** wherein the outer finishing layer includes a sub-layer of render, a reinforcing mesh layer over the sub-layer, and an external finishing layer over the reinforcing layer.

12. A cavity wall system according to claim **1** wherein the cladding panels are formed substantially from fibre cement sheet.

13. A cavity wall system according to claim **12** wherein an exterior surface of each cladding panel is coated with an outer finishing layer, and an interior surface of each cladding panel is covered with a carbonation reducing coating, so as to reduce differential carbonation within the fibre cement panel.

14. A cavity wall system according to claim **1** wherein the cladding panels are formed substantially from EPS.

15. A cavity wall system according to claim **1** wherein the wall structure is formed from concrete or masonry, and the moisture control plane is formed by a coating of sealant or moisture resistant paint on the cavity side of the structure.

16. A cavity wall system according to claim **1** wherein the wall structure is formed from a relatively dense or moisture-impervious concrete such that an additional coating of sealant or paint is not required to form the moisture control plane.

17. A cavity wall system according to claim **1** wherein a substantially waterproof pliable building membrane is used to cover and seal the wall structure, the membrane forming the moisture control plane.

18. A cavity wall system according to claim **1** wherein the wall structure is formed from a timber frame, and the mois-

ture control plane is formed by a substantially waterproof pliable building membrane covering the outer or cavity side of the frame.

19. A cavity wall system according to claim **18** wherein the building membrane is formed from a plurality of overlapping membranes.

20. A cavity wall system according to claim **17** wherein the building membrane is permeable to moisture vapour.

21. A cavity wall system according to claim **17** wherein the building membrane includes an outer reflective surface to enhance the thermal insulation characteristics of the wall system.

22. A cavity wall system according to claim **1** further comprising a supplementary sarking membrane having a reflective outer surface to enhance the thermal insulation characteristics of the wall system.

23. A cavity wall system according to claim **1** wherein outwardly directed reflective surfaces are applied to both the cavity side of the cladding panels and the cavity side of the wall structure to enhance the thermal insulation characteristics of the wall system.

24. A cavity wall system according to claim **23** wherein the reflective surfaces are provided by paints, coatings, sarkings, membrane materials, or any combination thereof.

25. A cavity wall system according to claim **17** further comprising supplementary spacers to maintain the internal wall cavity between any one of the membranes and the cladding panels such that wind-induced movement of the membranes is minimized.

26. A method of forming a cavity wall including the steps of:

forming a wall structure;

providing a plurality of outer wall cladding panels; and

mounting the cladding panels a predetermined distance away from the wall structure with a plurality of discrete mounting elements to form a substantially flat exterior wall surface and a substantially uninterrupted internal wall cavity between the cladding panels and the wall structure;

sizing and arranging the mounting elements so as to allow substantially uninterrupted fluid flow throughout the cavity; and

providing moisture control means to define a moisture control plane adapted to minimize migration of liquid moisture from the cavity into the wall structure.

27. A method according to claim **26** further comprising the step of providing an opening at a lower periphery of the cavity to permit drainage of liquid from the cavity and venting of the cavity.

28. A method according to claim **26** further comprising the step of providing a vent at an upper periphery of the cavity to permit venting of the cavity.

29. A method according to claim **26** wherein the mounting elements include at least one mounting member and at least one termination member.

30. A method according to claim **29** wherein the mounting member is a mounting member as defined in claim **52**.

31. A method according to claim **29** wherein the termination member is a termination member as defined in claim **62**.

32. A method according to claim **26** further comprising the step of applying at least one outer finishing layer to the exterior wall surface defined by the cladding panels.

33. A method according to claim **32** wherein the at least one outer finishing layer conceals joins between adjacent cladding panels and any exposed portions of the mounting elements to provide a monolithic finish over the exterior wall surface.

34. A method according to claim **32** wherein the at least one outer finishing layer is applied by rendering or textured coating.

35. A method according to claim **32** including the step of sealing the outer finishing layer, priming the outer finishing layer or painting the outer finishing layer to produce an outer surface finish resembling that of monolithic masonry construction.

36. A method according to claim **32** wherein the step of applying the outer finishing layer includes the steps of applying a sub-layer of render, applying a reinforcing mesh layer over the sub-layer, and applying an external finishing layer over the reinforcing layer.

37. A method according to claim **26** wherein the cladding panels are formed substantially from fibre cement sheet.

38. A method according to claim **37** including the step of coating an exterior surface of each cladding panel with an outer finishing layer, and covering an interior surface of each cladding panel with a carbonation reducing coating, so as to reduce differential carbonation within the fibre cement panel.

39. A method according to claim **26** wherein the cladding panels are formed substantially from EPS.

40. A method according to claim **26** wherein the wall structure is formed from concrete or masonry, and the moisture control plane is formed by applying a coating of sealant or moisture resistant paint on the cavity side of the structure.

41. A method according to claim **26** wherein the wall structure is formed from a relatively dense or moisture-impervious concrete such that applying an additional coating of sealant or paint is not required to form the moisture control plane.

42. A method according to claim **26** including the steps of covering and sealing the wall structure with a substantially waterproof pliable building membrane, the membrane thereby forming the moisture control plane.

43. A method according to claim **26** wherein the wall structure is formed from a timber frame, and the moisture control plane is formed by covering the outer or cavity side of the frame with a substantially waterproof pliable building membrane.

44. A method according to claim **43** wherein the building membrane is formed from a plurality of overlapping membranes.

45. A method according to claim **42** wherein the building membrane is permeable to moisture vapour.

46. A method according to claim **42** wherein the building membrane includes an outer reflective surface to enhance the thermal insulation characteristics of the cavity wall.

47. A method according to claim **26** including the step of providing a supplementary sarking membrane having a reflective outer surface to enhance the thermal insulation characteristics of the cavity wall.

48. A method according to claim **26** including the step of applying outwardly directed reflective surfaces to both the cavity side of the cladding panels and the cavity side of the wall structure to enhance the thermal insulation characteristics of the cavity wall.

49. A method according to claim **48** wherein the reflective surfaces are provided by paints, coatings, sarkings, membrane materials, or any combination thereof.

50. A method according to claim **42** including the step of providing supplementary spacers to maintain the internal wall cavity between any one of the membranes and the cladding panels such that wind-induced movement of the membranes is minimized.

51. A cavity wall formed by the method as defined in claim **26**.

52. A mounting member for use in the cavity wall system as defined in claim **4** or in the method of forming a cavity wall as defined in claim **29**, the mounting member including:

a mounting portion adapted for attachment to a wall structure;

a spacing portion adapted to space at least one associated cladding panel outwardly from the mounting portion by a predetermined distance corresponding to an intended depth of the internal wall cavity;

and at least one positioning portion adapted for connection to the associated cladding panel;

the mounting member being adapted, in conjunction with a plurality of like members, to support and position a plurality of cladding panels in substantially contiguous each to edge relationship at the predetermined distance away from the wall structure, thereby to form a substantially flat exterior wall surface and a substantially uninterrupted internal wall cavity between the cladding panels and the wall structure.

53. A mounting member according to claim **52** wherein the mounting portion is adapted for attachment to the wall structure over the moisture control plane.

54. A mounting member according to claim **52** in the form of a mounting block wherein the mounting portion is defined by an inner face of the block, the spacing portion is defined by a main body of the block, and the positioning portion is defined by an outer face of the block.

55. A mounting member according to claim **54** adapted for positioning in spaced apart relationship with a plurality of like blocks to support and position a plurality of the cladding panels by means of fasteners driven into the cladding panels, through the respective blocks, and into the wall structure.

56. A mounting member according to claim **52** in the form of a mounting bracket, wherein the mounting portion includes a mounting plate, the spacing portion includes a spacing web, and the bracket further includes:

a first pair of spaced apart substantially parallel positioning surfaces interconnected by an orthogonal web, both first positioning surfaces being substantially parallel to the mounting plate and located at one end of the spacing web opposite the mounting plate; and

a second pair of spaced apart substantially parallel positioning surfaces interconnected by an orthogonal web, both second positioning surfaces being substantially parallel to the mounting plate and located at the end of the spacing web opposite the mounting plate;

the first pair of positioning surfaces and the second pair of positioning surfaces and their respective interconnecting webs forming oppositely directed substantially U-shaped positioning channels, the positioning channels being adapted to receive and locate adjacent edges of adjoining cladding panels, to retain the panels in substantially contiguous each to edge relationship, outwardly of the wall structure.

57. A mounting member according to claim **56** wherein the mounting portion includes a perforation for a fastener.

58. A mounting member according to claim **56** wherein the spacing web includes a spacing plate extending substantially normally to the mounting plate by a predetermined distance corresponding to the intended depth of the wall cavity.

59. A mounting member according to claim **56** wherein the positioning surfaces are located on respective positioning plate flanges.

60. A mounting member according to claim **52** being profiled to allow substantially uninterrupted fluid flow around or through the member.

61. A mounting member according to claim **52** formed from a material or materials of sufficient strength to support the intended dead and imposed live loads, being selected from a group comprising metal, plastics, fibre cement, timber and composite materials.

62. A termination member for use in the cavity wall system as defined in claim **4** or in the method of forming a cavity wall as defined in claim **29**, the termination member including:

a mounting portion adapted for attachment to a wall structure;

a spacing portion extending outwardly from the mounting portion by a predetermined distance corresponding to an intended thickness of the internal wall cavity;

a positioning portion connected to the end of the spacing portion opposite the mounting portion, the positioning portion being adapted for connection to at least one associated cladding panel;

the termination member being adapted to support and position the associated cladding panel at the predetermined distance away from the wall structure, and to define an edge of the exterior wall surface;

the termination member further including a drainage portion adapted to permit drainage of liquid from the wall cavity.

63. A termination member according to claim **62** wherein the mounting portion is adapted for attachment to the wall structure over the moisture control plane.

64. A termination member according to claim **62** in the form of a starter strip wherein the mounting portion includes a mounting plate, the drainage portion includes a drainage surface extending outwardly from the mounting plate, and the positioning portion includes:

an inner positioning surface extending in one direction from the drainage surface parallel to the mounting plate;

a support surface extending outwardly from the inner positioning surface; and

an outer positioning surface extending from the support surface parallel to the mounting plate;

whereby the inner positioning surface, support surface and outer positioning surface together form a substantially U-shaped channel adapted to receive and locate a peripheral edge of the associated cladding panel.

65. A termination member according to claim **64** wherein the drainage surface is configured to drain away from the mounting plate.

66. A termination member according to claim **64** wherein the drainage surface drains towards the support surface.

67. A termination member according to claim **64** wherein the drainage surface includes perforations for drainage or ventilation.

68. A termination member according to claim **64** wherein the support surface includes a drainage groove to permit drainage of liquid from the interior surface of cladding panels and away from the wall cavity.

69. A termination member according to claim **64** wherein the outer positioning surface is located on an outer positioning flange having perforations for keying with an over-coating render.

70. A termination member according to claim **64** including an alignment flange extending generally outwardly from the outer positioning flange for supporting and aligning an applied exterior wall surface coating.

71. A termination member according to claim **64** including a perforated flange extending away from the U-shaped channel generally orthogonally from the support surface for providing ventilation or drainage along an edge of the exterior wall surface.

72. A termination member according to claim **62** in the form of a top strip wherein the mounting portion includes a mounting plate, the spacing and ventilation portion includes a perforated spacing surface extending outwardly from the mounting plate, and the positioning portion includes:

an inner positioning surface extending in one direction from the perforated spacing surface parallel to the mounting plate;

a support surface extending outwardly from the inner positioning surface; and

an outer positioning surface extending from the support surface parallel to the mounting plate;

whereby the inner positioning surface, support surface and outer positioning surface together form a substantially U-shaped channel adapted to receive and locate a peripheral edge of the associated cladding panel.

73. A termination member according to claim **72** wherein the outer positioning surface is located on an outer positioning flange having perforations for keying with an over-coating render.

74. A termination member according to claim **72** including an alignment flange extending generally outwardly from the outer positioning flange for supporting and aligning an applied exterior wall surface coating.

75. A termination member according to claim **72** including a perforated flange extending upwardly away from the U-shaped channel generally orthogonally from the support surface to provide ventilation along an edge of the exterior wall surface.

76. A termination member according to formed from a material or material of sufficient strength to support the intended dead and imposed live loads, being selected from a group comprising metal, plastics, fibre cement, timber and composite materials

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