INSULATED MASONRY BUILDING WALL CONSTRUCTION

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ABSTRACT

Highly heat insulated masonry building walls are made economically with required strength yet with less thickness and much lesser weight than a typical cavity wall by building up a masonry structure of limited thickness having the compressive strength but not all the lateral strength required; erecting metal reinforcing rods at intervals next to a side of the masonry structure; then attaching over it, as by strips of adhesive, preformed stiff panel sections made of a durable lightweight heat insulating material, e.g., of polystyrene foam, which form with the masonry structure separate vertical pockets enclosing the rod locations and shallow anticondensation cavities between them; and finally filling the pockets with a masonry binder such as grout and hardening the cast masses of binder about the rods to form in the pockets reinforcing ribs bound monolithically to the masonry structure. A new form of molded, mating insulating panel sections is provided for constructing the walls.

10 Claims, 4 Drawing Figures
This invention relates to new and improved insulated masonry walls for buildings and to a method and insulating paneling for constructing such walls.

Masonry building walls are commonly constructed as cavity walls to give them both the required strength and better heat insulating properties than a solid masonry wall. A typical cavity wall has two upright structures, such as an inner one of blocks about 4-inches thick and an outer brick structure about 4-inches thick, which are spaced apart by about 2 inches to provide an air limiting cavity in between. The cavity must be provided with suitable vent holes in order to avoid condensation and freezing of moisture inside the wall.

The construction of such a wall is quite costly in both labor and materials, and even though a heavy wall of about 10 inches or more in thickness is formed the insulating properties obtained are not satisfactory. Large amounts of heat are conducted through the wall under inclement weather conditions, unless it is provided with an effective additional layer of heat insulating material, which ordinarily would add endlessly to the costs of its construction.

An object of the present invention is to provide a building wall composed principally of masonry that can be made with required strength yet with less thickness and weight and more economically than conventional masonry building walls.

Another object of the invention is to provide an insulated masonry wall construction which, though made with less thickness and much less weight, will have as much or more strength and far greater heat insulating value than the usual cavity wall.

Another object is to provide a method and a new form of paneling for the economical construction of relatively light yet strong and highly insulated masonry building walls.

A further object is to provide an insulated masonry wall construction which is so economical that it can be widely employed in building construction and which has such high heat insulating properties that it will enable extensive economical uses of electrical energy instead of air polluting fossil fuels for heating and air conditioning buildings made with this wall construction.

The stated objects are achieved by the invention through the application of several interrelated concepts and findings which may be described generally as follows:

1. An upright masonry wall structure can be made with a limited thickness, as by building it up from masonry elements such as bricks, blocks or stones laid to a thickness of, for example, about 4 inches, so as to have the compressive strength but not all the lateral strength required for an outside building wall.

2. Such a masonry structure can than be brought to all or more than the required strength by providing vertical reinforcing ribs, or studs, in monolithic attachment to it at locations suitably spaced apart along one of its sides.

3. A masonry wall structure so formed and reinforced can be insulated with great effectiveness, while still keeping the total wall thickness as little as or less than that of a typical cavity wall, by covering it with suitably preformed stiff paneling of a durable lightweight heat insulating material such as a polystyrene foam or a similar insulating material.

4. The insulating paneling can be made to constitute pockets for forming and enclosing the reinforcing studs, and also to provide beneficial cavitation inside the finished wall, by forming the inner side of the paneling with vertically extending bearing portions, or ribs extending longitudinally thereof so as to bear and extend vertically against the said masonry structure, and having suitably recessed formed between them so that the bearing portions, or ribs, will serve for attachment of the paneling to the masonry structure, as by means of strips of adhesive applied to their faces, and so that some of the recesses will define with the masonry structure individual vertically open pockets in which vertical studs of a masonry binding composition such as grout or a fine aggregate concrete may be cast and hardened in monolithic attachment to the masonry structure at locations where it is deficient in lateral strength.

5. By attaching insulating paneling so made to the erected masonry structure, a highly insulated cavitated structure having the final wall thickness, except for the thickness of any desired wall finish to be applied to the insulation, is obtained before the reinforcing studs are formed, and these ribs then may be formed simply by casting and hardening masses of the binding composition in the pockets formed by the paneling at suitably spaced locations inside this structure. The preapplied insulating paneling eliminates all need for the erection and removal of forms of the kind ordinarily required for the construction of cast reinforcing studs. It can be made sufficiently thick and heat-insulating, even at the locations where it forms the pockets for reinforcing studs, so that the reinforcing ribs formed in the wall will not cause thermal air currents to develop along the outer or exposed side of the insulation.

6. The reinforcing studs themselves may be reinforced and the masonry structure further strengthened by erecting metal reinforcing elements such as steel bars vertically next to the masonry structure before the paneling is applied, in the locations were the ribs are to be formed. The metal elements will then be enclosed in the pockets formed by the applied paneling and will be embedded in, and bound to the masonry structure by, the masses of binding composition cast and hardened in the pockets.

According to the invention it embodies all of those concepts, a very strong, highly insulated masonry building wall is constructed quite economically, yet with less thickness and much less weight than a typical cavity wall of like strength, by first erecting masonry elements with a suitable binder into the upright masonry structure of limited thickness; then erecting metal reinforcing elements vertically next to the masonry structure in the horizontally spaced locations where lateral reinforcement of the masonry is required, as by typing steel reinforcing bars, or rods, to mortar layers of the masonry structure, or one to another, in such locations; then attaching the preformed insulating paneling to and over the same side of the masonry structure so that the vertical pockets formed by certain recesses in the paneling will enclose spaces occupied by the preinserted reinforcing elements; and finally filling the pockets with a suitable binder poured into them about the reinforcing elements and letting the cast masses of binder harden in the pockets to form reinforcing studs bound monolithically to the masonry structure.

The insulating paneling to be employed is advantageously provided in the form of a plurality of similar elongate planform bodies, or sections of the insulating material molded to the required thickness and configuration and having a size enabling them to be easily lifted and applied by hand one next to another so as to form a substantially continuous insulating panel covering a side of the masonry structure. The panel sections are made with matable formations along their longitudinal edges so that they may be fitted together edgewise into a closed panel. Their outer sides may be made even so that the panel formed by any number of them will present a substantially even wall surface that can be easily finished by adhering to it a layer of a conventional decorative or finishing material made of paper, fabric, plastic sheeting, wood veneer, or the like, or a layer of plaster.

The individual panel sections are conveniently made with a length corresponding to the height of the masonry wall structure, an over all thickness of about 3 1/2 to 4 inches, and a width corresponding to the spacing of the locations in which reinforcing studs are to be formed in attachment to the masonry structure. Thus, the inner side of each panel section may be formed with at least one recess that is sufficiently deep and wide to provide a vertical pocket in which a reinforcing stud
may be formed. In the case of a masonry structure made of common brick, the lateral reinforcement required will ordinarily be obtained by forming reinforcing studs bound to the brick structure at center distances of about 2 feet, and the insulating paneling for such a structure can conveniently be made in sections each having an effective width of about 2 feet and having one pocket forming recess formed in its inner side. The inner side of each panel section may be formed with three or more of the above-mentioned bearing portions extending longitudinally thereof and spaced apart transversely thereof, with individual recesses extending longitudinally thereof between respective pairs of the bearing portions. At least one of these recesses is provided on a stud forming pocket, while each other recess is made relatively wide and shallow to form between the panel section and the masonry structure an individual shallow cavity which will prevent moisture from condensing inside the insulated wall. The shallow cavities are self-ventilating along edges of the paneling. They not only have a beneficial insulating function but also provide concealed spaces through which conduits or other devices may be passed easily without any damage to the finished wall.

The longitudinal bearing portions, or ribs, of the panel sections are adapted to bear against vertically extending areas of the masonry structure and to be adhered thereto by suitable adhesive. They preferably have shallow grooves formed longitudinally in their faces to receive the adhesive. These strips may be applied by laying extrusions, or beads, of a plastic adhesive composition into the grooves, wherein the panel sections may be attached to the masonry structure by simply pressing them against it, one after another, with their mating longitudinal edges fitted together. The long strips or extrusions of adhesive then fasten each panel section securely to the masonry, and, in addition, form seams along opposite sides of each rib forming pocket so that there will be no objectionable leakage of grout subsequently cast into the pocket.

If the masonry wall structure to be reinforced should happen to be especially thin and weak at any particular location, the weakness can be overcome according to the invention by forming an especially large reinforcing rib, or stud, in attachment to the masonry at that location. An enlarged pocket for the formation of such a stud can be provided between the insulating panel and the masonry structure by inserting an especially formed slab of the insulating material between longitudinal edges of two of the described panel sections.

In some cases it may be desirable to construct a wall in the manner described with reinforcing studs spaced along, and insulating paneling covering, each side of the masonry wall structure of limited thickness. It will be evident that a masonry wall thus doubly reinforced and insulated can be provided readily according to the invention.

The above mentioned and other objects, features and advantages of the invention will be apparent from the following detailed description and the accompanying drawing of illustrative embodiments of the invention. In the drawing:

FIG. 1 is a schematic perspective view of an insulated masonry wall in the course of being made according to the invention, showing several stages of the construction;

FIG. 2 is a horizontal cross section through a representative portion of the wall, as viewed approximately along line 2—2 of FIG. 1;

FIG. 3 is a horizontal cross section through another insulated masonry wall constructed according to the invention; and

FIG. 4 is a perspective view of a preformed insulating panel section used in the wall construction.

In FIG. 1 and FIG. 2 of the drawing, 10 represents an upright masonry wall structure made as an outside building wall by laying masonry elements 12 such as bricks, stones, or concrete or cinder blocks, one upon and next to another to a single width of these elements and binding the elements together by intervening layers of a masonry binding composition such as mortar, so that the structure 10 will have a limited thickness and weight rendering it sufficiently strong in compression but deficient in lateral strength for the purposes of the permanent wall required.

When common bricks are used as illustrated the structure 10 will have a thickness corresponding to their width, i.e., of about 4 inches. At some locations, however, its thickness and lateral strength may be less than that given by masonry element laid to their full width. For example, as indicated at location A in the figures, a white brick 12a and a brick piece 12b may be laid edgewise in confronting relation so that a gap is left open in the inner side of the structure.

If desired, the masonry structure may be provided with internal reinforcing if made from a masonry of conventional nature, such as metal strips or rods of the kind known as "Dur-O-Wall" units, disposed horizontally in mortar layers between superimposed courses of the masonry elements.

When the masonry structure 10 has been erected, strong elongate metal reinforcing elements such as steel bars or rods 20 are installed vertically next to the inner side of the masonry structure at suitable locations spaced apart horizontally therealong. Typical locations for these elements are indicated at A, B and C in FIG. 1. For a structure 10 made of conventional masonry elements, the locations of the reinforcing elements 20, which correspond to the locations of reinforcing studs to be formed in the wall, will ordinarily be spaced apart by a center-to-center distance of about 2 feet. It has been found that reinforcing studs formed at this spacing with steel reinforcing bars of standard No. 3 or No. 4 size will ordinarily carry all the positive and negative moments generated by lateral forces, in conformance with the usual requirements of building codes in respect of non-load-bearing masonry walls. In cases of masonry walls required to fulfill special lateral force requirements, the elements of conventional nature, size and/or number of the reinforcing bars provided in them can be determined by conventional structural calculations.

The reinforcing elements 20 are held vertically in the required locations by conventional wire ties 22 embedded in mortar layers of the masonry structure. Ordinarily a single rod 20 in each rib location will suffice, as shown at locations B and C. Where an especially large and stronger reinforcing stud may be needed, as at location A where the masonry structure is weaker than at locations B and C, two or more of the rods may be provided and may be held vertically in place by wire ties 23 extending from one rod to another. The metal reinforcing elements 20 having been erected next to the inner side of the masonry structure 10, the studs are ready to be covered by the insulating paneling. This is applied to form a substantially continuous, highly heat insulating layer or panel 30 over the inner side of the masonry structure, which panel in the form shown has an overall thickness of about 3/4 inches and is formed integrally over its own inner side with a number of vertically extending bearing portions or ribs 32 held against the masonry structure and with individual recesses 33, 34 and 35 extending vertically between many of these bearing portions.

The recesses 33 are relatively deep and are provided at the locations A, B and C where reinforcing studs are to be formed, being sufficiently deep and wide to form with the masonry structure 10 at these locations vertically open pockets enclosing the rods 20 previously erected there. The recesses 34 and 35 are relatively wide and shallow, and serve to provide shallow cavities between the masonry structure 10 and the insulating panel 30 over major proportion of the area of the finished wall.

The insulating panel 30 of FIG. 1 and FIG. 2 is constructed by attaching a suitable number of preformed panel sections like and section 40 shown in FIG. 4, one after and in edgewise mating relation to another, to the face of the masonry structure. Each panel section 40 is a stiff elongate planiform body molded from polystyrene foam or a similarly durable firm lightweight insulating material. Its length may be, for example, about 8 feet and its effective width about 2 feet. The outer side 42 of the body shown is substantially even and flat.
Insulating materials which may be formed into paneling suitable for the invention include not only polystyrene foam but also other foamed synthetic resins, e.g., a rigid polyurethane foam, foam glass, cork, wood fiber board compositions, and compressed wood fiber materials. Panel section 40 has one longitudinal edge 43 recessed at the inner side and the other longitudinal edge 44 recessed at the outer side, so that any number of like sections will fit together edgewise to form a substantially continuous panel 30 having an even outer surface as shown. The inner side of the body is formed with four longitudinal bearing portions 35, two of which are at its edges and the other two of which border relatively deep recesses 33 in which a reinforcing stud is to be formed. The intervening wider areas of the inner side are formed with relatively wide shallow recesses 34 and 35 which, for example, may have a depth of about one-half inch. The bearing portions have shallow grooves 45 formed longitudinally in their faces to receive long strips, or extrusions, of an adhesive suitable for attaching them to the masonry structure.

The several panel sections 40 required for forming the insulating panel 30 can be attached in place by simply pressing them one after another against the masonry structure after laying strips of adhesive 46 in the grooves 45 along the faces of their respective bearings portions 32. The adhesive strips 46 adhere them firmly to the masonry structure and seal off sides of the pockets formed by the recesses 33 at the locations A, B, and C. Then these pockets are filled with a suitable masonry binder such as grout or a concrete made with fine aggregate, which is easily poured into the pockets from the top of the wall structure. Upon hardening of the masses of binder cast into the pockets, strong reinforcing studs 50, 52 and the like having the reinforcing rods 20 embedded in them are obtained in secure monolithic attachment to the masonry structure 10 at locations A, B, C, and the like.

The wall construction shown in Fig. 3 is similar to that of Fig. 1 and Fig. 2, being made in similar manner with a masonry structure 10A of limited thickness, with an insulating panel 30A formed from several panel sections 40 attached to the masonry structure by adhesive strips extending along the faces of their bearing portions, and with reinforcing studs 50 and 52 cast about rods 20 in vertical pockets formed by panel recesses 33 and adjacent parts of the inner side of the masonry structure. Fig. 3, however, illustrates a modification of the invention wherein an abnormally large and strong reinforcing stud 54 is formed at a location where the masonry structure requires special reinforcement.

As shown in Fig. 3, the masonry structure 10A has a relatively weak area at location D, where its thickness is represented by that of a single half brick 12a. A group of four steel reinforcing rods 20 tied by wires 24 is erected next to the masonry structure at this location, and preformed sections 40 of the insulating panel 30A are applied near to this location so that there will be a considerable gap between them where the rods have been erected. This gap is then filled by an especially formed slab 56 of the heat insulating material, which may be cut to fit into the notch along edge 44 of one panel section and be glued to the edge 43 of the next panel section. Thus an enlarged vertically open pocket is formed to enclose the several metal reinforcing elements at location D, and when it is filled with grout or a like binder and the binder is hardened an abnormally large and strong reinforcing stud 54 is obtained in monolithic attachment to the masonry elements at that location.

The thin layer seen at 60 in Fig. 1 and Fig. 2 represents a finishing layer of plaster or a suitable sheet material applied over the outer or exposed side of the insulating panel of the completed wall.

It will be evident that the new features of the invention herein set forth may be utilized in various ways other than those particularly described and illustrated in the drawing. The invention is not intended to be restricted to particularity of the description or of the illustrated embodiments except as may be required by fair construction of the appended claims.

1. An insulated masonry building wall comprising an upright wall structure made up of masonry elements with a thickness rendering said structure self-sustaining with the compressive strength but not all the lateral strength required for said wall, a panel of durable firm lightweight nonmasonry heat insulating material attached to and covering a side of the structure, the inner side of said panel having formed integrally therewith bearing ribs spaced apart horizontally and extending vertically against said structure, and having vertically extending recesses defined therein between said bearing ribs, some of said recesses formed between said panel and said structure individually vertically extending pockets having enclosed therewithin reinforcing studs formed vertically upon said side of said structure at locations spaced apart horizontally therealong where said structure if standing without said studs would be deficient in lateral strength, each of said studs comprising a vertically elongate mass of a masonry binding composition cast and set against said structure and thus monolithically bound thereto over substantially the entire extent thereof at one of said locations, said masonry structure and said studs thereon providing substantially all the compressive and lateral strength of the complete wall.

2. A wall according to claim 1, said studs comprising elongate masses of said composition cast and hardened in situ in said pockets.

3. A wall according to claim 1 each of said studs also comprising at least one metal reinforcing element erected vertically next to said structure and embedded in said mass of said binding composition.

4. A wall according to claim 1, said panel comprising a plurality of elongate molded planiform sections of said material having mating formations along their longitudinal edges for interfitting them edgewise one with another, each of said sections being formed along one side thereof with a plurality of said bearing ribs and at least one of said pocket-forming recesses.

5. A wall according to claim 1, said panel comprising a plurality of elongate molded planiform sections of a polystyrene foam having mating formations along their longitudinal edges for interfitting them edgewise one with another, each of said sections being formed along one side thereof with a plurality of said bearing ribs and at least one of said pocket-forming recesses.

6. A wall according to claim 1, the others of said recesses being relatively wide and shallow and forming individual shallow cavities extending vertically between said masonry structure and said panel to prevent condensation therebetween.

7. A wall according to claim 1, said panel comprising a plurality of elongate planiform sections of a molded foamed synthetic resin material, said sections fitting one against another along their longitudinal edges, each of said sections being formed along one side thereof with a plurality of said bearing ribs and at least one of said pocket-forming recesses.

8. A wall according to claim 1, said panel being attached to said structure by strips of adhesive applied to and along the faces of said bearing ribs and adhered to said structure.

9. A wall according to claim 8, said faces having shallow grooves formed longitudinally therein, strips being extrusions of a plastic adhesive composition laid in said grooves.

10. An insulated masonry building wall comprising an upright masonry structure made up of masonry elements and intervening layers of a masonry binding composition with a limited thickness rendering said structure self-sustaining with the compressive strength but not all the lateral strength required for said wall, an insulated masonry panel attached to and covering a side of said structure, said panel comprising a plurality of vertically elongate planiform sections of a molded foamed synthetic resin material, each of said sections having formed integrally therewith along its side facing said structure a plurality of longitudinal ribs spaced apart horizontally and extending and bearing vertically against said structure, and having vertically extending recesses defined therein between said ribs, at least one of said recesses of each said section.
forming between said section and said structure a vertically extending pocket and others of said recesses being wider and shallower than said pocket so as to form individual shallow cavities extending vertically between said section and said structure to prevent condensation therebetween, each said pocket having enclosed therewithin a reinforcing stud comprising at least one metal reinforcing element erected vertically next to said structure and a vertically elongate mass of a masonry binding composition cast and set in said pocket about said reinforcing element and against said structure and thus monolithically bound to said structure over substantially the vertical extent thereof at a location where said structure if standing without said stud would be deficient in lateral strength, and strips of adhesive applied to faces of said ribs of each said section and adhering them to said structure, said masonry structure and said studs thereon providing substantially all the compressive and lateral strength of the complete wall.