EXTENDED LENGTH PANELS

FIELD

The present description relates to the building components and to methods of their manufacture.

In one form the present description relates to methods of installing building components when forming building structures from the building components.

In one form the building component is a building panel, typically for use as either an exterior building panel, such as, cladding or external covering on the outside of a building structure, such as for example, the external wall of a building, typically in the form of cladding or weatherproofing or similar, or for use internally as the internal wall of the building structure or part of the internal wall of the building structure, such as for example, as lining or covering or cladding for or of an internal stud wall or partition wall.

In one form the building component is a building panel of a size that is sufficiently long to extend from the base of the building structure to the top of the building structure as a single panel, such that the lower end of the panel is installed at the base of the building and the upper end of the panel is installed at the top of the building.

The building component of the present description finds particular application as one section of an external wall of a building structure, which component has a length which extends from the base or floor of the building structure, such as for example, from at or close to the foundations of the building at ground level, to the top or roof or ceiling of the building structure as a single component without the need to have a join part way along the height of the building structure.

Although specific examples of the building panel having an extended length when compared to the length of currently available building panels, and to methods of manufacturing such panels and to methods of installing such panels are described, it is to be noted that the scope of protection is not restricted to the described examples, but rather the scope of protection is more extensive so as to extend to include other forms, variations and arrangements of the building panel, their method of manufacture

and the methods of use of the panels, particularly methods of installing such panels.

BACKGROUND

Although the panels, their manufacture and their use in installation will be described with particular reference to the panels forming the external wall of a building structure by being attached to the exterior of the building structure, it is to be noted that the panels can be used as interior walls or as part of interior walls, both decoratively and/or structurally, typically by installing the panels in side by side abutting relationship with other similar panels.

Building panels made from autoclaved aerated concrete (AAC) are used to form walls in building structures because of the excellent properties of such panels. Such panels are available in a range of different thicknesses depending upon the requirements of the panel when installed within the building structure. In the interests of containing costs, panels having a thickness of 50 mm are often used as part of the external or internal wall structure of a building, particularly as such panels are of a significantly lighter weight as compared to some comparable products or panels. However, to date 50 mm thick AAC panels have only been available in a restricted range of lengths, up to a maximum length of about 2.2 meter or similar. This is due to the inherent weakness of such panels which can flex to such an extent that cracking of the panel occurs leading to fracture of the panels in some situations, rendering the panels unfit for use.

Despite the desirability of using 50 mm AAC panels due to their relatively light weight and relatively lower cost, the non-availability of such panels in lengths greater than 2.2 meter has restricted their widespread adoption for use in walls of building structures. When 50 mm panels of a length of up to 2.2 meter are used as the external cladding of building structures such as residential homes, it is necessary to join two panels in edge to edge abutting relationship to one another with one panel being a lower panel and the other panel being an upper panel located above the lower panel, which necessitates cutting one of the panels to size to form the upper panel which increases the time and cost of construction of the building structure. Therefore, there is a need to make longer panels which do not require cutting and joining to extend between the roof and the base or foundation of the building in which the panels are to be installed.

As 50 mm AAC panels are made in lengths greater than 2.2 meter, the panels become susceptible to damage through undue flexing, deflecting, bending or cracking owing to excessive movement of the panel because of the relative flexibility of the panel due to its increased length. Therefore there is a need to modify the panels to increase the strength and rigidity of the extended length 50 mm AAC panels.

Surprisingly, it has now been discovered that it is possible to extend the length of 50 mm AAC panels beyond the standard length of 2.2 meter whilst retaining the required strength and rigidity by modifying the reinforcement embedded within the panel in order to increase the strength and rigidity of the panel so that there is less chance of the panel being damaged by bending, flexing, wobbling or similar, leading to breaking, cracking or fragmenting of the panel or similar during transportation, installation, and use of the 50 mm panel. The increase in inherent strength and rigidity is due in part to using modified forms of reinforcement during manufacture of the reinforced panels.

SUMMARY

According to one form of the present invention there is provided a reinforced building panel made from autoclaved aerated concrete having a nominal thickness of about 50 mm, a nominal width of at least about 250 mm, and a nominal length of greater than about 2.2 meter, and a reinforcement having a multitude of longitudinally extending reinforcing elements and a multitude of transversely extending reinforcing rods arranged in an interconnected array, the panel being adapted for installation as part of a wall of a building structure in which the panel extends from, at or towards the base of the building structure to, at or towards the top of the building structure as a single panel. The reinforcement is substantially non-planar in which at least one of the transversely extending reinforcing rods has a first portion extending in a first plane and a second portion extending in a second plane such that the first portion is angularly inclined to the second portion, and wherein at least one of the multitude of longitudinally extending reinforcing elements is located at the change of orientation or direction of the first portion and the second portion of the at least one transversely extending reinforcing rod where the first plane and the second plane are angularly inclined to one another.

According to one form of the present invention there is provided a method of forming a reinforced building panel made from autoclaved aerated concrete having a

reinforcement embedded therein comprising the steps of forming the reinforcement, transporting the reinforcement to a moulding station, locating the reinforcement at a predetermined location within the moulding station, forming the building panel from an aerating mixture in the moulding station to wholly embed the reinforcement within the panel, the reinforced building panel having a nominal thickness of about 50 mm, a nominal width of at least about 250 mm, and a nominal length of greater than about 2.2 meter and the reinforcement having a multitude of longitudinally extending reinforcing elements and a multitude of transversely extending reinforcing rods arranged in an interconnected array, the panel being adapted for installation as part of a wall of a building structure in which the panel extends from, at or towards the base of the building structure to, at or towards the top of the building structure as a single panel, the reinforcement being substantially non-planar in which at least one of the transversely extending reinforcement rods has a first portion extending in a first plane and a second portion extending in a second plane such that the first portion is angularly inclined to the second portion, wherein at least one of the multitude of longitudinally extending reinforcing elements is located at the change of orientation of the first portion and the second portion where the first plane and the second plane are angularly inclined to one another.

According to one form of the present invention there is provided a method of forming a wall of a building structure using a reinforced building panel comprising the steps of locating the building panel with respect to a substrate of the building structure and fastening the panel to the substrate using fasteners to form part of the wall of the building structure in which the reinforced building panel is made from autoclaved aerated concrete having a nominal thickness of about 50 mm, a nominal width of at least about 250 mm, and a nominal length of greater than about 2.2 meter and a reinforcement having a multitude of longitudinally extending reinforcing elements and a multitude of transversely extending reinforcing rods arranged in an interconnected array, the panel being adapted for installation as part of the wall of the building structure in which the panel extends from, at or towards the base of the building structure to, at or towards the top of the building structure as a single panel, the reinforcement being substantially non-planar in which at least one of the transversely extending reinforcing rods has a first portion extending in a first plane and a second portion extending in a second plane such that the first portion is angularly inclined to the second portion, and wherein at least one of the multitude of longitudinally extending reinforcing elements is located at the change of orientation of the first

portion and the second portion where the first plane and the second plane are angularly inclined to one another.

BRIEF DESCRIPTION OF EMBODIMENTS

It is to be noted that all measurements of the panel and of the reinforcement, particularly the reinforcement array are nominal measurements and/or are taken from centreline to centreline of the reinforcing members or elements forming the reinforcement.

Manufacturing tolerances of forms of the reinforced building panel include the following:

length ± 5 mm
width ± 1.5 mm
thickness ± 1.5 mm
diagonals (max) 5 mm
edge straightness deviation (max) 1.5 mm

Forms of the panel have a length greater than 2.2 meter, typically a length of from about 2.2 meter to about 3.6 meter or greater, even more typically from about 2.4 meter to about 3.6 meter, preferably from about 2.7 meter to about 3.6 meter. Typical lengths of the panel are 2.7 meter, 3.0 meter, 3.3 meter, and 3.6 meter. It is to be noted that typically the length of the panel can be increased in 5mm increments from 2.2m upwards depending upon requirements of the end user of the panels.

Widths of the building panels include widths in the range of from about 250 mm to about 600 mm inclusively. Typical widths are about 270 mm, about 300 mm, about 350 mm, about 400 mm, about 500 mm, and about 600 mm. Other widths within this range are possible. Preferred widths are 600 mm ± about 3 mm, preferably 600 mm ± 1.5 mm.

The thickness of the reinforced building panel is nominally 50 mm. Typically, the thickness of the reinforced panel is 50 mm ± about 2 mm, typically 50mm ± 1.5 mm.

Forms of the reinforced panel have sides or edges which are substantially straight or arranged in substantially parallel pairs of sides so that two longitudinal sides are

substantially parallel to each other and two transverse sides are substantially parallel to each other. However, forms of the reinforced panel have diagonal manufacturing tolerances of up to about ± 10 mm, preferably up to about ± 5 mm. Forms of the reinforced panels have an edge straightness deviation of up to about 3 mm, more typically up to about 1.5 mm.

The reinforced panels can be mounted or installed to extend substantially vertically, substantially horizontally or obliquely so as to be angularly inclined to the base of the building structure in which the panels are being installed.

Without being bound by theory, it is believed that the main purpose for the deformed cross wires of the patterns and configuration of the different shapes is to push the longitudinal wires closer to the surfaces of the panel, i.e. to push the material with a greater tensile strength away from the neutral axis of the panel to increase the tensile strength close to the surfaces of the panel, thus increasing the bending capabilities of the panel.

The reinforcement embedded within the reinforced panel can have any suitable or convenient form, size, shape, profile, type, arrangement or similar.

It is to be noted that almost anything else that could be embedded in the concrete to increase the tensile strength of the panel towards the outer faces of the panel could be used in addition to the reinforcement in the reinforced panels. Examples are perforated steel mesh/expanded mesh, expanding trellis or the like typically made from extrusions, such as aluminium extrusions which can be formed into a corrugated form or other form to ensure the material is pushed as close as possible to the faces of the panel.

Other examples include perforated corrugated sheets or panels such as perforated corrugated sheets of galvanised steel, Colorbond®, or the like. Forms of the reinforcement include expandable mesh arrangements or adjustable perforated mesh and the like.

Forms of the reinforcement comprise long members or elements connected to or interconnected with short rods to form a regularly repeating pattern or array of openings, voids, gaps, spaces in the reinforcement between the array of long

members and short rods.

The reinforcement is typically in the form of a substantially rectilinear array or grid of substantially longitudinally extending reinforcement elements or members and substantially transversely extending reinforcement rods arranged substantially perpendicular to one another. However, in some embodiments, the longitudinal members or elements and transverse rods can be arranged at a non-perpendicular angle to each other, such as for example, in a diamond shaped array, a rhombic array, a scissors-like array or the like.

Forms of the reinforcement are fixed, in that the shape, size, profile, and dimensions of the openings between the interconnected reinforcing elements or members and rods are fixed whereas in other forms of the reinforcement the reinforcing members or elements forming the array are movable or adjustable with respect to one another, such as for example, in the form of an expanding/contracting array, typically in the form of a lattice, trellis, screen, such as for example in the form of an expanding screen. Typically, the size of the reinforcement is adjustable prior to installing the reinforcement at the predetermined location within the mould. Once embedded within the aerating mixture in the mould, the reinforcement is fixed in size and shape and cannot expand. The cross rods can be placed in unequal spacings throughout the length of the panel, or the long rods could be placed at unequal intervals across the panel.

Forms of the reinforcement have a regularly repeating pattern or arrangement in which the spacing between adjacent or adjoining long reinforcing elements or members is uniform or constant and the spacing between adjacent or adjoining short reinforcing rods is uniform or constant in which the two dimensions of the spacing is the same as one another in both directions or is different to one another in either direction.

Forms of the reinforcement have different spacing or different dimensions of the openings over the length or width of the reinforcement so that the reinforcement is substantially irregular or has irregular repeating patterns or arrays.

In forms of the reinforcement panel, the array of reinforcing elements or members and rods includes at least one inner pair of lengthwise extending reinforcing elements and

at least two outer lengthwise extending reinforcing elements wherein the spacing between the two individual reinforcing elements forming the inner pair of reinforcing elements is different to, typically less than, the spacing between one of the pair of inner reinforcing elements and one of the pair of outer lengthwise extending reinforcing elements, typically on the same side of the array or mesh.

In forms of the reinforcing panel, the reinforcement has four lengthwise extending reinforcing elements in the form of rods or bars or wires which are referred to as long rods, long bars or long wires and extend in spaced apart substantially parallel relationship to one another from, at, or towards one end of the reinforced panel to, at, or towards the opposite end of the reinforced panel.

In forms of the reinforced panel, the reinforcing elements are transversely extending rods or bars which are referred to as cross rods or cross bars which extend in spaced apart substantially parallel relationship to one another to extend substantially from one longitudinal side of the building panel to the opposite longitudinal side of the building panel. The cross rods or bars are substantially non-planar having at least one section or portion which is angularly inclined to another section or portion. In some forms the cross rods or bars have three or more angularly inclined sections or portions defining a compound or complex shape, including an angularly inclined shape or a generally arcuately inclined shape.

In one form the reinforcing members or reinforcing elements are cylindrical rods or bars having a diameter of about 4 mm. However, it is to be noted that other suitable or convenient sizes can be used, such as for example, the long rods and short rods can have a diameter in the range of from about 2.5 mm to about 8 mm, more typically in the range from about 3 mm to about 5 mm, more typically in the range from about 3.15 mm to 4 mm or similar. Forms of the rod include rods having the following diameters:

5 mm ± 0.05 mm
6 mm ± 0.06 mm
7 mm ± 0.16 mm
8 mm ± 0.06 mm
4 mm ± 0.08 mm, and

rods in the range from about 2.5mm to about 8mm, such as 3.15mm, 4mm, 5mm, 6mm, 7mm or 8mm but could be anything from 2.5mm to 8mm as stated above.

Although the rods or bars can have any suitable or convenient strength, forms of the rod typically have a tensile strength greater than about 500 MPa, typically in the range from about 500 MPa to about 800 MPa, more typically in the range from about 600 MPa to about 700 MPa, depending upon the diameter of the rods.

Forms of the rod undergo pre-treatment or are treated to be corrosion inhibiting, such as by undergoing a corrosion resistant treatment, typically having a corrosion resistant coating applied thereto. One form of the protective or corrosion inhibiting coating is FENTAK TC0380 or FENTAK TC0624.

It is to be noted that the angle of inclination between the first portion and a second portion and/or between the first plane and the second plane of the at least one longitudinally extending reinforcing element can be of any suitable or convenient size and/or value and/or be within any suitable or convenient range. The reinforcement can have an angle of inclination from about 10° to about 170°, typically in the range from about 20° to about 150°, even more typically in the range from about 60° to about 120°, preferably about 90°.

BRIEF DESCRIPTION OF DRAWINGS

Embodiments of the reinforced panel will now be described with reference to the accompanying drawings in which:

Figure 1 is a schematic perspective view of one form of reinforcement embedded within a reinforced panel shown in dotted outline.

Figure 2 is a schematic cross-section view of figure 1.

Figure 3 is a schematic cross section of another form of reinforcement embedded within a reinforced panel shown in dotted outline.

Figure 4 is a schematic cross-section of another form of reinforcement embedded

within a reinforced panel shown in dotted outline.

Figure 5 is a schematic cross-section view of another form of reinforcement embedded within a reinforced panel shown in dotted outline.

Figure 6 is a schematic cross-section view of another form of reinforcement embedded within a reinforced panel shown in dotted outline.

Figure 7 is a schematic cross-section view of another form of reinforcement embedded within a reinforced panel shown in dotted outline.

Figure 8 is a schematic elevation view of one form of a reinforced panel extending between the foundation and roof of a building as a single panel.

Figure 9 is a front view of one form of panel having one form of reinforcement.

Figure 10 is a cross section view through the panel of Figure 9.

DETAILED DESCRIPTION

One form of reinforced panel, generally denoted as 10, is illustrated in figure 1. Panel 10 is substantially in the shape of a rectangular prism or a parallelepiped having an obverse face, a reverse face, two opposed ends and two opposed sides which are shown in dotted outline in figure 1. Panel 10 has reinforcement in the form of a mesh, generally denoted as 12, embedded wholly within the panel so that no part of mesh 12 is exposed through any of the faces, sides or ends of panel 10. Mesh 12 is of a generally curved profile or shape when viewed from one end thereof, typically being of a generally sinusoidal shape. Mesh 12 has a multitude of straight reinforcing elements in the form of long straight rods, bars or wires 14 extending lengthwise along the longitudinal length of panel 10. Although five individual long straight rods 14 are shown in figure 1, it is to be noted that mesh 12 can have any suitable or convenient number of long straight rods 14 depending upon the dimensions, use and function of the panel. In the embodiment shown in figures 1 and 2, the five rods 14 are spaced apart from each other both in a vertical plane corresponding to the width of panel 10 and in a horizontal plane corresponding to the thickness of panel 10, so that rods 14 are arranged in staggered alternating relationship to one another over the width of

panel 10 in which one set of rods being the first, third and fifth rods are aligned with each other, and the other set of rods, being the second and fourth rods are aligned with each other but with the first set of rods being staggered with respect to the other set of rods so that the respective alignments of the two sets of rods are displaced from one another.

Mesh 12 also includes a multitude of sinusoidal transversely extending rods or bars 16 located at spaced apart locations from each other. Long straight rods 14 and short transverse sinusoidal rods 16 are interconnected to one another to form a grid array in which the respective sets of rods are welded to one another to form the rigid sinusoidal mesh 12 as shown in figures 1 and 2. Although the sinusoidal rods 16 are spaced apart from each other over the length of panel 10, all of the rods 16 are positioned within panel 10 so as to be in alignment with each other when viewed from either end of panel 10. It is to be noted that the curve or period or frequency of the sine wave produced by the sinusoidally curved rods 16 can have any suitable or convenient value or be of any suitable or convenient size or within any convenient or suitable range of values.

It is to be noted that the curvature of the sinusoidal transverse rods 16 is such so that mesh 12 is wholly embedded within panel 10 so that no part of mesh 12 is exposed beyond the faces, ends and sides of panel 10.

It is to be noted that the shape of curved mesh 12 contributes to the inherent strength and rigidity of panel 10, even though the panel is 50 mm thick. Without being bound by theory, it is believed that the main purpose for the deformed cross wires of the patterns and configuration of the different shapes of mesh is to push the longitudinal wires closer to the surfaces of the panel, i.e. to push the material with a greater tensile strength being the wire, away from the neutral axis of the panel to increase the tensile strength close to the surfaces of the panel, thus increasing the bending capabilities of the panel.

Further, it is to be noted that each of the inner long straight rods is located within curved mesh 12 such that the portions of the curved transverse rods on either side of the long straight rods changes orientation from extending in one direction to extending in another direction by being angularly inclined to one another such that the adjoining parts of curved rod 16 changes orientation at each location where inner long straight

rod is welded or otherwise interconnected to the curved rod.

Each curved transverse rod 16 has at least two portions or sections which are angularly inclined to one another. Curved transverse rod 16 has a first section 17 angularly inclined to a second section 18 on either side of bend 19. Longitudinal rod 14 is interconnected to bend 19 by any suitable means, such as for example by welding or similar.

In this form of mesh, the change of orientation of curved transverse rods 16 about the point of connection with each of the inner long straight rods so that the two portions are in effect oppositely inclined to one another, contributes to the strength and rigidity of mesh 12, and hence to the strength and rigidity of panel 10 so as to result in a panel of 50 mm thickness having increased resistance to cracking, breaking or fragmenting during manufacture, transportation and installation of the reinforced panel. Further, the main purpose for the deformed cross wires of the patterns and configuration of the different shapes of mesh is to push the longitudinal wires closer to the surfaces of the panel, i.e. to push the material with a greater tensile strength away from the neutral axis of the panel to increase the tensile strength close to the surfaces of the panel, thus increasing the bending capabilities of the panel.

A further embodiment of a reinforced panel having a different form of reinforcement than panel 10 is illustrated in figure 3. Panel 20 is also in the shape of a rectangular prism or parallelepiped having an obverse face, a reverse face, two sides and two ends arranged substantially orthogonally with respect to one another to form a rectangular cuboid shape. Panel 20 includes reinforcement in the form of mesh 22 totally embedded within the body of panel 20. Mesh 22 includes a multitude of longitudinally extending long rods, bars or wires 24, extending lengthwise panel 20 from at or towards one end to the other end in substantially parallel spaced apart relationship to one another along the length of panel 20. Rods 24 are similar to rods 14. Rods 24 are straight long rods.

Mesh 22 also includes a multitude of transversely extending short rods or bars 26 extending transversely of panel 20 from one side to the opposite side along the width of panel 20. Short rods 26 are substantially rectilinear being in the form of a “square wave form” in which one portion of the short rod is arranged to be substantially perpendicular to adjacent portions on one or both sides of the one portion to form the

substantially square wave form. Thus, each short rod 26 includes a first set of sections 28 which are arranged to be substantially parallel to one another in alignment with one another and a second set of sections 29 which are arranged to be substantially parallel to each other in alignment with one another in which each of the sections 28 of the first set of sections is substantially perpendicular to each of the second set of sections 29 to form the square wave form. It is to be noted that each of long rods 24 is located at and interconnected to short square rods 26 at locations which coincide with the junctions between the first set of sections and the second set of sections which change orientation to one another, in this case through about 90°. Thus, mesh 22 has a first set of rods which are located between first and second portions of the second set of rods which undergo a change of orientation by being angularly inclined to one another. In this case the angle of inclination between the first part of the short rods 26 and the second part of the short rods 26 is about 90°.

It is to be noted that the alternating staggered structure of the short rods of mesh 22 contribute to the inherent strength and rigidity of mesh 22 and, accordingly, to panel 20 so that panels having a thickness of 50 mm can be made in extended lengths, such as for example, lengths in the range from greater than about 2.4 meter to about 3.6 meter or longer.

A further embodiment of the reinforced panel having a different form of reinforcement is illustrated in figure 4. Panel 30 is also of a rectangular prism or parallelepiped shape in which mesh 32 is totally embedded. Mesh 32 has a different shape to either of mesh 12 or mesh 22. Mesh 32 includes a multitude of long rods 34 extending longitudinally in the lengthwise extending direction of panel 30 from towards one end to the opposite end. Mesh 32 also includes a multitude of transversely extending reinforcing rods in the form of more or less continuous loops 36 which interconnect each of the straight long rods 34 to form a mesh which can be described as a cage having, in effect, two layers or sides interconnected by ties in which the endless loop 36 comprises wide sides 38 and narrow sides 39 in which narrow sides 39 interconnect the two wide sides at either end of loop 36. Again, it is to be noted that long straight rods 34 are located at each of the junctions of the narrow sides 39 with wide sides 38 where the narrow sides and wide sides are arranged to extend substantially perpendicularly to each other so that the change in orientation of the angularly inclined parts of loop 36 are at about 90°.

Again, it is to be noted that the use of mesh 32 having a cage of endless loops 36 results in mesh 36 having increased strength and rigidity so that when this form of reinforcement is incorporated into the reinforced panel, the panel also has increased strength and rigidity due to the mesh having parts with sections which are angularly inclined to one another. The repositioning of the longitudinal wires closer to the surfaces of the panel improves the strength and rigidity of the panel while maintaining a form that is able to be manufactured.

A further embodiment of a reinforced panel is illustrated in figure 5. In this form panel 40 being in the shape of a rectangular prism or parallelepiped having an internal mesh 42 embedded therein. Mesh 42 includes a multitude of long straight rods 44 extending from one end to an opposite end and a multitude of transversely extending short rods 46 in which short rods 46 are of a complex or compound shape having a central straight portion 47, two straight end portions 48 located at either end of short rod 46 substantially extending in a direction which is perpendicular to the direction of extension of the central portion 47, and two inclined portions 49 in which one inclined portion extends between one end of central straight portion 47 and one end of end portion 48 and the other inclined portion 49 extends between the other end of central straight portion 47 and one end of the other end portion 48 located at the other side of panel 40. Again, it is to be noted that two of the long straight rods 44 are located at locations corresponding to the change in orientation of adjoining sections of short rods 46 so as to improve and enhance the structural strength and rigidity of the mesh and hence of the reinforced panel.

In forms of the reinforcement, the angle of inclination between different parts of the mesh can be in the range of 0° to 90°.

The further embodiments of the reinforced panel are illustrated in figures 6 and 7 which are modifications of panel 30 of figure 4, in which the transversely extending short rods corresponding to endless loop 36 are not continuous or endless but rather are discontinuous by being interrupted by the absence of a section joining the free ends. Panel 50 includes mesh 52 which is of a generally U-shape or C-shape or similar, having a multitude of straight long rods 54 and a multitude of substantially discontinuous loops 56 interconnecting the long rods. Again, it is to be noted that two of the long straight rods are located at locations corresponding to where different sections of the discontinuous loop 56 change orientation where the two sections are

angularly inclined at 90° to one another.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word “comprise” or variations such as “comprises” or “comprising” is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A reinforced building panel made from autoclaved aerated concrete having a nominal thickness of 50 mm, a nominal width of at least 250 mm, and a nominal length of greater than 2.2 meter, and a reinforcement having a multitude of spaced apart longitudinally extending reinforcing elements and a multitude of spaced apart transversely extending reinforcing rods arranged in an interconnected array, the panel being adapted for installation as part of a wall of a building structure in which the panel extends from, at or towards the base of the building structure to, at or towards the top of the building structure as a single panel, wherein the reinforcement is substantially non-planar in which at least one of the transversely extending reinforcing rods has a first portion extending in a first plane and a second portion extending in a second plane such that the first portion is angularly inclined to the second portion, and wherein at least one of the longitudinally extending reinforcing element is located at the change of orientation or direction of the first portion and the second portion of the at least one transversely extending reinforcing rod where the first plane and the second plane are angularly inclined to one another.

2. A method of forming a reinforced building panel made from autoclaved aerated concrete having a reinforcement embedded therein comprising the steps of forming the reinforcement, transporting the reinforcement to a moulding station, locating the reinforcement at a predetermined location within the moulding station, forming the building panel from an aerating mixture in the moulding station to wholly embed the reinforcement within the panel, the reinforced building panel having a nominal thickness of 50 mm, a nominal width of at least 250 mm, and a nominal length of greater than 2.2 meter and the reinforcement having a multitude of spaced apart longitudinally extending reinforcing elements and a multitude of spaced apart transversely extending reinforcing rods arranged in an interconnected array, the panel being adapted for installation as part of a wall of a building structure in which the panel extends from, at or towards the base of the building structure to, at or towards the top of the building structure as a single panel, the reinforcement being substantially non-planar in which at least one of the transversely extending reinforcement rods has

a first portion extending in a first plane and a second portion extending in a second plane such that the first portion is angularly inclined to the second portion, wherein at least one of the longitudinally extending reinforcing elements is located at the change of orientation of the first portion and the second portion where the first plane and the second plane are angularly inclined to one another.

3. A method of forming a wall of a building structure using a reinforced building panel comprising the steps of locating the building panel with respect to a substrate of the building structure and fastening the panel to the substrate using fasteners to form part of the wall of the building structure in which the reinforced building panel is made from autoclaved aerated concrete having a nominal thickness of 50 mm, a nominal width of at least 250 mm, and a nominal length of greater than 2.2 meter and a reinforcement having a multitude of spaced apart longitudinally extending reinforcing elements and a multitude of spaced apart transversely extending reinforcing rods arranged in an interconnected array, the panel being adapted for installation as part of the wall of the building structure in which the panel extends from, at or towards the base of the building structure to, at or towards the top of the building structure as a single panel, the reinforcement being substantially non-planar in which at least one of the transversely extending reinforcing rods has a first portion extending in a first plane and a second portion extending in a second plane such that the first portion is angularly inclined to the second portion, and wherein at least one of the longitudinally extending reinforcing elements is located at the change of orientation of the first portion and the second portion where the first plane and the second plane are angularly inclined to one another.

4. A reinforced building panel or method according to any preceding claim having manufacturing tolerances which include the following:

length ± 5 mm
width ± 1.5 mm
thickness ± 2 mm
diagonals up to ± 10 mm
edge straightness deviation up to 3 mm.

5. A reinforced building panel or method according to any preceding claim having a length of from 2.2 meter to 3.6 meter, even more typically from 2.4 meter to 3.6 meter, preferably from 2.7 meter to 3.6 meter, including lengths of 2.7 meter, 3.0 meter, 3.3 meter, and 3.6 meter.

6. A reinforced building panel or method according to any preceding claim having a width in the range of from 250 mm to 600 mm inclusively, including widths of 270 mm, 300 mm, 350 mm, 400 mm, 500 mm, and 600 mm.

7. A reinforced building panel or method according to any preceding claim having a thickness of 50mm ± 1.5 mm.

8. A reinforced building panel or method according to any preceding claim having a diagonal manufacturing tolerance of up to ± 5 mm and an edge straightness deviation of up to 1.5 mm.

9. A reinforced building panel or method according to any preceding claim in which the reinforcement comprises long members or elements connected to or interconnected with short rods to form a regularly repeating pattern or array of openings, voids, gaps, spaces in the reinforcement between the array of long members and short rods in the form of a substantially rectilinear array or grid of substantially longitudinally extending reinforcement elements or members and substantially transversely extending reinforcement rods arranged spaced apart and substantially perpendicular to one another or angularly inclined to one another.

10. A reinforced building panel or method according to any preceding claim in which the transversely extending reinforcement rods and the longitudinally extending reinforcement elements are arranged at a non-perpendicular angle to each other, such as for example, in a diamond shaped array, a rhombic array, a scissors-like array or the like.

11. A reinforced building panel or method according to any preceding claim in which the reinforcement is fixed, in that the shape, size, profile, and dimensions of openings between the interconnected reinforcing elements or members and rods are fixed whereas in other forms of the reinforcement

the transversely extending reinforcing rods and the longitudinally extending reinforcing elements forming the array are movable or adjustable with respect to one another, including being in the form of an expanding/contracting array.

12. A reinforced building panel or method according to any preceding claim in which the reinforcement has a regularly repeating pattern or arrangement in which the spacing between adjacent or adjoining long reinforcing elements or members is uniform or constant and the spacing between adjacent or adjoining short reinforcing rods is uniform or constant in which the two dimensions of the spacing is the same as one another in both directions or is different to one another in either direction.

13. A reinforced building panel or method according to any preceding claim in which the reinforcement has different spacing or different dimensions of openings over the length or width of the reinforcement so that the reinforcement is substantially irregular or has irregular repeating patterns or arrays.

14. A reinforced building panel or method according to any preceding claim in which the array of reinforcing elements or members and rods includes at least one inner pair of lengthwise extending reinforcing elements and at least two outer lengthwise extending reinforcing elements wherein the spacing between the two individual reinforcing elements forming the inner pair of reinforcing elements is different to, typically less than, the spacing between one of the pair of inner reinforcing elements and one of the pair of outer lengthwise extending reinforcing elements, typically on the same side of the array or mesh.

15. A reinforced building panel or method according to any preceding claim in which the reinforcement has four lengthwise extending reinforcing elements in the form of rods or bars or wires which are referred to as long rods, long bars or long wires and extend in spaced apart substantially parallel relationship to one another from, at, or towards one end of the reinforced panel to, at, or towards the opposite end of the reinforced panel, and transversely extending rods or bars in the form of cross rods or cross bars

which extend in spaced apart substantially parallel relationship to one another to extend substantially from one longitudinal side of the building panel to the opposite longitudinal side of the building panel.

16. A reinforced building panel or method according to claim 15 in which the cross rods are substantially non-planar having at least one section or portion which is angularly inclined to another section or portion, including having three or more angularly inclined sections or portions defining a compound or complex shape, including an angularly inclined shape or a generally arcuately inclined shape.

17. A reinforced building panel or method according to any preceding claim in which the reinforcing members or reinforcing elements are cylindrical rods or bars having a diameter in the range of from 2.5 mm to 8 mm, more typically in the range from 3 mm to 5 mm, more typically in the range from 3.15 mm to 4 mm or similar, including having the following diameters:

4 mm ± 0.08 mm
5 mm ± 0.05 mm
6 mm ± 0.06 mm
7 mm ± 0.16 mm
8 mm ± 0.06 mm.

18. A reinforced panel or method according to any one of claims 15 to 17 in which the rods or bars have a tensile strength greater than 500 MPa, typically in the range from 500 MPa to 800 MPa, more typically in the range from 600 MPa to 700 MPa, depending upon the diameter of the rods or bars.

19. A reinforced building panel or method according to any preceding claim in which the reinforcement has an angle of inclination from 10° to 170°, typically in the range from 20° to 150°, even more typically in the range from 60° to 120°, preferably 90°.

20. A reinforced building panel or method according to any preceding claim in which the reinforcement includes a multitude of sinusoidal transversely extending rods or bars located at spaced apart locations from each other in which long straight rods and short transverse sinusoidal rods are

interconnected to one another to form a grid array in which the respective sets of rods are welded to one another to form the rigid sinusoidal mesh.

21. A reinforced building panel or method according to claim 20 in which each of the inner long straight rods is located within a curved mesh such that the portions of the curved transverse rods on either side of the long straight rods changes orientation from extending in one direction to extending in another direction by being angularly inclined to one another such that the adjoining parts of the curved rod change orientation at each location where the inner long straight rod is welded or otherwise interconnected to the curved rod.

22. A reinforced building panel or method according to claim 21 in which each curved transverse rod has at least two portions or sections which are angularly inclined to one another, being a first section angularly inclined to a second section on either side of a bend.

23. A reinforced building panel or method according to claim 22 in which the change of orientation of the curved transverse rods about the point of connection with each of the inner long straight rods are oppositely inclined to one another, so as to contribute to the strength and rigidity of the mesh and to the strength and rigidity of the panel.

24. A reinforced building panel or method according to any one of claims 20 to 23 in which the short rods are substantially rectilinear being in the form of a “square wave form” in which one portion of the short rod is arranged to be substantially perpendicular to adjacent portions on one or both sides of the one portion to form a substantially square wave form in which the short rods include a first set of sections which are arranged to be substantially parallel to one another in alignment with one another and a second set of sections which are arranged to be substantially parallel to each other in alignment with one another wherein each of the sections of the first set of sections is substantially perpendicular to each of the second set of sections to form the square wave form.

25. A reinforced building panel or method according to any preceding claim in

which the longitudinally extending reinforcing element includes a multitude of long rods and the multitude of transversely extending reinforcing rods includes a multitude of short square rods in which each of the long rods is located at and interconnected to the short square rods at locations which coincide with the junctions between a first set of sections and a second set of sections which change orientation to one another through 90°.

26. A reinforced panel or method according to claim 25 in which the rods include a first set of rods and a second set of rods in which the first set of rods are located between the first and the second portions of the second set of rods at which locations the rods undergo a change of orientation by being angularly inclined to one another at 90°.

27. A reinforced building panel or method according to any preceding claim in which the reinforcement includes a multitude of transversely extending reinforcing rods in the form of more or less continuous loops which interconnect each of the straight long rods to form a cage having two layers or sides interconnected by ties in which the endless loop comprises wide sides and narrow sides, in which the narrow sides interconnect the two wide sides at either end of the loop, wherein the long straight rods are located at each of the junctions of the narrow sides with wide sides where the narrow sides and wide sides are arranged to extend substantially perpendicularly to each other so that the change in orientation of the angularly inclined parts of the loop is at 90°.

28. A reinforced building panel or method according to any preceding claim in which the reinforcement is in the form of a multitude of long straight rods extending from one end to an opposite end and a multitude of transversely extending short rods in which the short rods are of a complex or compound shape having a central straight portion, two straight end portions located at either end of the short rod substantially extending in a direction which is perpendicular to the direction of extension of the central portion, and two inclined portions in which one inclined portion extends between one end of the central straight portion and the one end of the end portion, and the other inclined portion extends between the other end of the central straight portion and the one end of the other end portion located at the other side of the panel.

29. A reinforced building panel or method according to claim 28 in which the transversely extending short rods are discontinuous by being interrupted by the absence of a section joining the free ends.

30. A reinforced building panel or method according to any preceding claim in which the reinforcement is a generally U-shape or C-shape or similar, comprising a multitude of straight long rods and a multitude of substantially discontinuous loops interconnecting the long rods.