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(54) IMPROVEMENTS IN OR RELATING TO BUILDING PANELS

(71) I NICOLAAS WINSTOK, a Subject of the Queen of the Netherlands, of 43 Clarendon Road, Auckland, New Zealand, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to building panels.

In building it is frequently found to be desirable that a brick or other tile finish be provided as an architectural feature in a structure, whether domestic dwelling or other building. However, conventional bricklaying methods are time consuming and suffer from other disadvantages particularly where a complex design is required.

To overcome some of these difficulties, it is desirable to provide a precast panel faced with bricks or tiles, for example, ceramic tiles to provide a brick finish. However with present methods of forming the panels, it is likely that the tiles will suffer from some cement staining on the exposed surface which has a deleterious effect on the appearance of the finished panel. Also the finishing of corners and the simulation of a free standing brick wall panel are not easy with panels according to present proposals.

Furthermore with present methods pointing is frequently required after the panel has been made and also bricks or tiles of close dimensional tolerances are required.

In this specification a forming means for defining the shape of an element under construction is hereinafter called a form.

According to the invention there is provided a method of forming building panels comprising the steps of arranging bricks or tiles on a table surface with the faces of the bricks or tiles to be exposed in use facing downwardly, placing resilient spacing means between adjacent bricks or tiles, positioning further bricks or tiles to a desired panel size

and pattern, arranging the resilient spacing means and the bricks or tiles so that the spacing means are compressed when the desired panel size has been reached so that said resilient spacing means form a seal around each brick or tile in the panel, placing a cementitious backing on said bricks or tiles and allowing some of the backing to penetrate between the tiles until prevented from further penetration by the spacing means, the remainder of the backing covering the bricks or tiles, to form a monolithic panel.

According to the invention there is further provided a method of forming building panels comprising the steps of arranging a row of bricks or tiles on a flat surface with the faces of the bricks or tiles to be exposed in use facing downwardly, placing individual resilient spacing means between the row of bricks or tiles and a next row of bricks or tiles and placing further individual resilient spacing means between bricks or tiles in the rows, repeating the rows and spacing means until the desired panel size has been completed, arranging the resilient spacing means so that they are compressed when the panel has been made up, so that said resilient spacing means form a seal around each brick or tile in the panel, placing a cementitious backing on said bricks or tiles and allowing the backing to penetrate between the bricks or tiles and to cover the backs of the bricks or tiles to form a monolithic panel.

According to the invention there is still further provided a building panel constructed according to the aforesaid methods.

According to the invention there is yet further provided apparatus for use in a method for making building panels comprising a table surface adapted to receive bricks or tiles with the surface of the bricks or tiles adapted to be exposed in use on the surface of the table, a form adapted to define the perimeter of a building panel, resiliently flexible spacing means, one such spacing means

being placed in the space between adjacent rows of bricks or tiles as a substantially continuous length and further spacing means adapted to be placed in the space between contiguous bricks or tiles in each row, the construction and arrangement being such that said spacing means are compressed by the bricks or tiles and the form when the apparatus is loaded with bricks or tiles ready to receive a cementitious backing material adapted to form the tiles into a building panel.

Preferred embodiments of the invention will now be described in greater detail, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a perspective view of a table on which panels according to the invention are formed,

Figure 2 is a part-plan view of a form for a panel, part of a panel being shown therein, Figure 3 is an end-view of Figure 2,

Figure 4 is a part cross-section of a panel having a tongue thereon, and includes a form to make such a tongue,

Figure 5 is a part cross-section of the opposite side of the panel shown in Figure 4,

Figure 6 is a part-perspective view of two panels joined together,

Figure 7 is a perspective view of a mould for use in forming corner posts,

Figure 8 is an end-view of an alternative embodiment of the panel,

Figure 9 is a part end view of a panel having tiles on both sides thereof,

Figure 10 is a diagrammatic end view of a pair of tablets adapted to form a wall having tiles on both sides, and,

Figure 11 is as Figure 10 but with the tables shown holding panels in a vertical disposition.

Referring to the drawings, a building panel is constructed having a decorative surface provided by a plurality of tiles embedded in a bed of cementitious materials. The tile may be of any convenient type, but it is particularly envisaged that the present invention will be suitable for using ceramic tiles to simulate brick work. The cementitious material is preferably concrete which is reinforced with suitable reinforcing, such as nylon or fabricated fibre such as polypropylene, or H.R.C. Mesh or netting or a combination of these. If desired, the panels could be pre-stressed either by post-tensioning or by any other pre-stressing method. The concrete used is preferably a light weight concrete, but the density may be varied according to the end use of the panel, thus for exterior use a heavier density would be used than for an interior panel.

The panel sizes may of course be varied, but it has been found that a panel size of eight feet long by eight bricks wide, i.e. about 25 inches, or 10 feet long, 4 courses high is convenient for most building purposes and

is relatively easily handled by two men who may carry and erect a light weight concrete panel for use. Obviously larger panels for handling by mechanical equipment may be made and some of these may be load bearing in use.

In order to form a panel, a table 1 or other suitable flat surface is provided. Such a table may be provided with quadrantal members 2 connected to feet 3 so that the table may be rolled from the horizontal disposition to the vertical disposition to assist in unloading panels from the table. Furthermore, although it has been stated that the surface is flat, it has been found that there is some tendency for the panel to warp due to shrinkage of the concrete, particularly where a low density concrete is used. To allow for this, the table may be provided with a slight adjustable reverse bend which will result in a panel which, when it has warped after drying will warp to a substantially plane surface, and the table is usually arranged so that the centre is higher than the edges.

The top of the table is preferably surfaced with rubber, for example, a $\frac{1}{4}$ " thick layer of rubber. A row of tiles are then laid out on the table top, the face to be exposed in use resting on the table top 4, the first row 5 is placed against a bar member 6, so that the row is straight. Along the free edge of the row parallel to the bar member, a length of a resilient spacing means 7 (Figure 2) is provided which may comprise, for example, sponge or solid rubber, but which preferably has a rectangular cross-section, for example, a length of neoprene having a $\frac{3}{8}$ " by $\frac{1}{4}$ " cross-section, or that shape required to give the required joint shape. This material has been found to be particularly effective since it withstands attack by the cement in the mortar and also provides adequate resiliency. To position the spacing means, bars 8 are positioned at the sides of the panels which have notches 9 on the lower surfaces thereof and the Neoprene strips 7 pass through these notches. The strips 7 are stretched and a knot 10 simply tied in the stretched strip to hold it in the stretched condition. In addition, as each tile is laid in place, a short strip of Neoprene 11 is placed against the short edge of the tile and the next tile is placed in position and pushed towards the first tile to compress the neoprene between the tiles. The placing of strips 11 and tiles 12 is continued and the bars 6, 8, 13, 14 surrounding the panel are of a size such that the last tile can only be inserted between the bars 8 and 14 by the use of some force, so that the short lengths of Neoprene are maintained in a compressed condition. Further rows of ties 15, 16, 17, 18 and 19 are built on the table with the desired surface, that is, the surface to be exposed on the face of the panel in use on the face of the table, until the panel is com-

plete. Spacing means are placed so that such spacing means surround all the tiles. The bars 6, 8, 13 and 14 or opposite pairs of them within which the panel is formed have inner faces shaped to provide an interlocking formation, for example, a tongue on one edge of a panel and a groove on the other, the shape of the tongue 20 (Figure 4) preferably being such as to have a broader base than the outer end thereof. In a similar way the groove 21 (Figure 5) has a narrow base with a wide mouth. These are arranged so that when erected adjacent panels can have the tongue of one engaging the groove of the other in a manner such that the panels are located relative to each other and in addition this provides some waterproofing effect and also gives a continuous brickwork appearance.

Where a stretcher bond or other brick bond is used which results in the ends of bricks in adjacent rows being displaced from each other by a distance, which is usually half the length of a brick, wooden or rubber blocks 22 are placed in position rather than tiles, these blocks being the same thickness as a tile. When the tiles have all been laid in position and the panel surround is in position, the stretched spacing means are released and upon release the rubber spacing means tends to expand and as a result the tiles tend to keep the strips 7 in compression. It will be understood that such compression could also be gained by pressing each tile firmly in place against the resilient spacing means but it has been found that by stretching the spacing means between adjacent rows advantages are gained in that the tiles are kept substantially in line with each other. This could be assisted by having a movable straight edge against which each row of tiles is aligned in turn.

A cementitious material 23 is now placed on the backs of the tiles in the finished panel and this may comprise a mortar 24 which is then followed with a coating of concrete which is preferably a light weight concrete. However, for heavier density light weight concrete, it has been found that this alone may be used without using a separate mortar. During concreting a reinforcing is provided which may comprise, for example, nylon or a fabricated fibre such as polypropylene or H.R.C. mesh 25 or other mesh reinforcing placed just above the tiles or may comprise rods or netting placed suitably or a combination may be provided. If desired, the reinforcing may be pre-stressed, the tendons being post-tensioned or otherwise as desired. The backing material 23 will pass between adjacent tiles 12 until a strip 7 or 11 is met. Because of the compression of these strips an effective seal is provided to prevent the cementitious material from contacting the faces of the tiles 12 which are in contact with the table 4, i.e. the exposed

face of the panel in use. The strips 7 and 11 also have the result that without further hand work the effect of pointed brick work is given which could be assisted by sloping the surfaces 26 of the strips 7 and 11 to, for example, a concave shape.

To fix the panels in position, wire loops (not shown) may be provided at suitable intervals, for example, top and bottom of a panel which will be arranged vertically in use or at either end of the panels, but the invention does envisage the fixing of the panels in place simply by nailing corrosion resistant nails through the joints between tiles and through the light weight concrete into studs and although predrilling is desirable, it is not essential.

The assembly of a wall using panels which simulate bonded tiles or brick work is as follows:

The places where the wooden or rubber blocks 22 were positioned will leave a blank space 27 (Figure 6) with the concrete backing showing in two adjacent panels 28 and 29. These are positioned adjacent each other and a tile 30 fixed in position with mortar or preferably an adhesive; thus the bond is continued across the panels. An advantage of this construction is that the panels are rectangular and have no projections to be damaged.

Corner posts can also be manufactured by a method according to this invention by providing a trough-shaped support 31 with the sides at an angle of 45° to the vertical and either tiles such as those used for the surface of the panel are placed alternately one on either side in the trough using resilient spacers according to the invention, or preferably the tiles comprise L shaped tiles 32 with one long arm 33 and one short arm 34. These are placed with the long and short arms alternating down each side of the post. Where the short arms are positioned rubber blocks 35 are provided which extend the short arm to the edge of the outer end of the long arm. These rubber or wooden blocks are of the same dimensions as a half-tile and in particular the same thickness. Again a cementitious backing is applied (not shown), at least some of which may be of light weight concrete.

The invention also envisages a panel which may be cut on the job to fit in a particular place which may be too narrow to enable an ordinary or standard panel to be used. In such a panel the tiles shown in Figure 8 are laid out as before and are covered with a mortar but a form is provided which reaches some distance in from the longitudinal edges and the cementitious backing material is continued over this form, so that after the panel has been completed and has been cured, the form may be withdrawn leaving an opening or slot 36 between a front tile portion 37 of

the panel and a back portion 38. In use the front tile portion 37 of the panel is cut for example, with a circular saw using a masonry abrasive disc, but the back portion 38 is left in position and the back portion 38 is preferably grooved as at 39 so that water passing through for example, a joint between the panel and for example, joinery will simply run down the grooves for discharges through weep holes in the foundation.

To form a panel 40 with tiles on each side (Figure 9), a panel is formed as above described and further tiles 41 laid on the surface before the cementitious material has set and lightly vibrated in. However, it is preferred to place two tables 42 and 43 (Figures 10 & 11) with quadrantal legs 44 spaced apart from each other having teeth or pegs 45 and running, for example, in racks 46 so that the tables may take up vertical positions, at a fixed distance from each other, suitable braces (not shown) being provided to hold the tables in position. Panels 47 are made on each table, preferably with the tiles mortared in only and the mortar is allowed to set. The panels are then placed vertically as in Figure 11 and reinforcing 48 and concrete 49 placed between the panels. L shaped tiles may be used on the ends of the walls. Also cured panels may be used as *in situ* boxing on the job to provide either a single or a double faced concrete wall.

An advantage of this invention is that the panels may be readily erected on the site. The apparatus for forming the panels is relatively simple and involves only a small capital expenditure. A number of tables arranged substantially as aforesaid could be provided on a site and the panels could be cast thereon as above described. The tables are preferably suitable for using some suitable mechanical means for tilting. Thus the tables may be operated by a screwed drive rotated by an electric motor or manually or by hydraulic rams or may use quadrantal legs as above described. The actual method of tilting the table will of course vary but the object is to make the table so that once the panel has been cast thereon and is set the table may be moved so that the panel can be tilted to a substantially vertical position. If the table is correctly positioned relative to the site where the panel is to be erected the panel may be moved from the table substantially directly into the final position. The table will assist in holding the panel until the operator has made the initial fixing to secure the panel in use. In this way an extremely quick method of cladding a building is possible. Also the panels have substantial versatility because the backing of concrete can be varied to suit the individual requirements. For example, a five inch or even thicker panel of brick and concrete can be used and with suitable reinforcing will provide a load-bearing wall.

Alternatively thinner panels can be used and can be fixed to a structural framework in a housing where the cladding is used for a veneer only.

An alternative method for joining the panels may be provided by forming panels with edges substantially at right angles to the front face. A longitudinal groove is formed centrally in each edge and a weather-resistant strip may be positioned in the recess provided by the two grooves when the panels are abutted. A neoprene strip provides a suitable seal.

An alternative to the structural load-bearing walls previously described using the panels having a thicker precast slab of concrete could be provided using two thin panels according to the present invention on either side of reinforcing steel projecting from the foundation or a small nib wall. The panels may be connected and used as formwork for the wall which can then be poured in the cavity between two panels, i.e. in a similar manner to that shown in Figures 10 and 11. Reinforcing starters would be left projecting from the back face of the panels to provide a suitable bond with the cast-in concrete. The thickness of the wall could be adjusted depending upon the load bearing characteristics required.

The corner panels are formed on a special mould so that an L-shaped start for each adjoining wall is provided.

The material to be stretched in the grooves between the panels may have a cross-sectional shape similar to the type of finished joint required, that is, a section in accordance with any of the conventional pointings used between brick work.

While the invention has particular application for use in providing the panels having the cementitious connecting layer at the back of the ceramic tiles or bricks the method of erection or machine or table used therefor could equally well be used for the fabrication and erection of conventional brick panels held together by a mortar. Once again the bricks would be separated using the spacers but would be bonded together by the mortar between the joints.

With either type of panel, and particularly with the first type above described, the panels could be provided with cast-in brackets, ties or any other suitable fixing device.

One of the advantages of using a method according to this invention is that variations in brick sizes as commonly experienced are not important, and all types of bonding or pattern work can be easily and quickly achieved.

It has been found that a particular advantage accrues when light-weight concrete is used as is no evidence of efflorescence occurring. This may be due particularly to the use of light weight concrete in that it may well be that the salt enters the air cells and can-

not migrate therefrom, or it may be due to the fact that a construction according to the invention involves only relatively small volumes of material, but the difference compared with conventional brick walls is marked.

WHAT WE CLAIM IS:—

1. A method of forming building panels comprising the steps of arranging bricks or tiles on a table surface with the faces of the bricks or tiles to be exposed in use facing downwardly, placing resilient spacing means between adjacent bricks or tiles, positioning further bricks or tiles to a desired panel size and pattern, arranging the resilient spacing means and the bricks or tiles so that the spacing means are compressed when the desired panel size has been reached so that said resilient spacing means form a seal around each brick or tile in the panel, placing a cementitious backing on said bricks or tiles and allowing some of the backing to penetrate between the tiles until prevented from further penetration by the spacing means, the remainder of the backing covering the bricks or tiles, to form a monolithic panel.

2. A method of forming building panels comprising the steps of arranging a row of bricks or tiles on a flat surface with the faces of the bricks or tiles to be exposed in use facing downwardly, placing individual resilient spacing means between the row of bricks or tiles and a next row of bricks or tiles and placing further individual resilient spacing means between bricks or tiles in the rows, repeating the rows and spacing means until the desired panel size has been completed, arranging the resilient spacing means so that they are compressed when the panel has been made up, so that said resilient spacing means form a seal around each brick or tile in the panel, placing a cementitious backing on said bricks or tiles and allowing the backing to penetrate between the bricks or tiles and to cover the backs of the bricks or tiles to form a monolithic panel.

3. A method as claimed in claim 2 wherein said resilient spacing means between rows comprise lengths of synthetic rubber which are held in a stretched condition during placing of the bricks or tiles in position and released before the cementitious backing is placed in position.

4. A method as claimed in any one of the preceding claims wherein said cementitious backing comprises concrete.

5. A method as claimed in claim 4 wherein said concrete is reinforced.

6. A method as claimed in claim 4 or claim 5 wherein said concrete comprises a light-weight concrete.

7. A method as claimed in any one of the preceding claims wherein a wall having bricks or tiles on both surfaces is made by forming panels on two adjacent tables, turning the

tables towards each other so that the two panels are placed side by side vertically with a space, therebetween and filling the space with concrete with or without reinforcing.

8. A method of making building panels or walls substantially as described with reference to the accompanying drawings.

9. A building panel constructed by a method according to any one of the preceding claims.

10. A building panel as claimed in claim 9 wherein said panel is rectangular and on at least the longer edges thereof a tongue formation on one edge and a groove formation on the other edge or other interlocking formation is provided.

11. A building panel as claimed in claim 9 or claim 10 wherein the panels are intended to simulate bonded brick work with staggered joints, and wherein spaces are left in panels, which spaces correspond to the part-lengths of brick or tile so that when two panels are erected contiguous to each other loose bricks or tiles may be fixed to the concrete backing in the spaces provided so that a continuous representation of bondwork is provided over a series of panels.

12. A building panel as claimed in any one of claims 9 to 11 wherein the panel has a facing and a backing and adjacent the edges of the panel the facing is independent of the backing there being a groove or slot between the two.

13. A building panel as claimed in Claim 12 wherein said backing is provided with water grooves on a surface of said slot or groove.

14. A building panel as claimed in any one of Claims 9 to 13 wherein the panel is in the form of a corner post or column, said corner post comprising a series of corner tiles arranged each with its outer surface at the angle desired.

15. A building panel as claimed in Claim 14 wherein spaces are left on the backing of the corner post to enable separate bricks or tiles to be fixed across the joint between the corner post and panels.

16. A building panel constructed by the method of claim 1 substantially as hereinbefore described with reference to the accompanying drawings.

17. Apparatus for use in a method according to any one of Claims 1 to 8 or for use in making building panels according to any one of Claims 9 to 16 said apparatus comprising a table surface adapted to receive bricks or tiles with the surface of the bricks or tiles adapted to be exposed in use on the surface of the table, a form adapted to define the perimeter of a building panel, resiliently flexible spacing means, one such spacing means being placed in the space between adjacent rows of bricks or tiles as a substantially continuous length and further spacing means adapted to be placed in the space be-



(18)

not migrate therefrom, or it may be due to the fact that a construction according to the invention involves only relatively small volumes of material, but the difference compared with conventional brick walls is marked.

WHAT WE CLAIM IS:—

1. A method of forming building panels comprising the steps of arranging bricks or tiles on a table surface with the faces of the bricks or tiles to be exposed in use facing downwardly, placing resilient spacing means between adjacent bricks or tiles, positioning further bricks or tiles to a desired panel size and pattern, arranging the resilient spacing means and the bricks or tiles so that the spacing means are compressed when the desired panel size has been reached so that said resilient spacing means form a seal around each brick or tile in the panel, placing a cementitious backing on said bricks or tiles and allowing some of the backing to penetrate between the tiles until prevented from further penetration by the spacing means, the remainder of the backing covering the bricks or tiles, to form a monolithic panel.

2. A method of forming building panels comprising the steps of arranging a row of bricks or tiles on a flat surface with the faces of the bricks or tiles to be exposed in use facing downwardly, placing individual resilient spacing means between the row of bricks or tiles and a next row of bricks or tiles and placing further individual resilient spacing means between bricks or tiles in the rows, repeating the rows and spacing means until the desired panel size has been completed, arranging the resilient spacing means so that they are compressed when the panel has been made up, so that said resilient spacing means form a seal around each brick or tile in the panel, placing a cementitious backing on said bricks or tiles and allowing the backing to penetrate between the bricks or tiles and to cover the backs of the bricks or tiles to form a monolithic panel.

3. A method as claimed in claim 2 wherein said resilient spacing means between rows comprise lengths of synthetic rubber which are held in a stretched condition during placing of the bricks or tiles in position and released before the cementitious backing is placed in position.

4. A method as claimed in any one of the preceding claims wherein said cementitious backing comprises concrete.

5. A method as claimed in claim 4 wherein said concrete is reinforced.

6. A method as claimed in claim 4 or claim 5 wherein said concrete comprises a light-weight concrete.

7. A method as claimed in any one of the preceding claims wherein a wall having bricks or tiles on both surfaces is made by forming panels on two adjacent tables, turning the

tables towards each other so that the two panels are placed side by side vertically with a space, therebetween and filling the space with concrete with or without reinforcing.

8. A method of making building panels or walls substantially as described with reference to the accompanying drawings.

9. A building panel constructed by a method according to any one of the preceding claims.

10. A building panel as claimed in claim 9 wherein said panel is rectangular and on at least the longer edges thereof a tongue formation on one edge and a groove formation on the other edge or other interlocking formation is provided.

11. A building panel as claimed in claim 9 or claim 10 wherein the panels are intended to simulate bonded brick work with staggered joints, and wherein spaces are left in panels, which spaces correspond to the part-lengths of brick or tile so that when two panels are erected contiguous to each other loose bricks or tiles may be fixed to the concrete backing in the spaces provided so that a continuous representation of bondwork is provided over a series of panels.

12. A building panel as claimed in any one of claims 9 to 11 wherein the panel has a facing and a backing and adjacent the edges of the panel the facing is independent of the backing there being a groove or slot between the two.

13. A building panel as claimed in Claim 12 wherein said backing is provided with water grooves on a surface of said slot or groove.

14. A building panel as claimed in any one of Claims 9 to 13 wherein the panel is in the form of a corner post or column, said corner post comprising a series of corner tiles arranged each with its outer surface at the angle desired.

15. A building panel as claimed in Claim 14 wherein spaces are left on the backing of the corner post to enable separate bricks or tiles to be fixed across the joint between the corner post and panels.

16. A building panel constructed by the method of claim 1 substantially as hereinbefore described with reference to the accompanying drawings.

17. Apparatus for use in a method according to any one of Claims 1 to 8 or for use in making building panels according to any one of Claims 9 to 16 said apparatus comprising a table surface adapted to receive bricks or tiles with the surface of the bricks or tiles adapted to be exposed in use on the surface of the table, a form adapted to define the perimeter of a building panel, resiliently flexible spacing means, one such spacing means being placed in the space between adjacent rows of bricks or tiles as a substantially continuous length and further spacing means adapted to be placed in the space be-

5 between contiguous bricks or tiles in each row, the construction and arrangement being such that said spacing means are compressed by the bricks or tiles and the form when the apparatus is loaded with bricks or tiles ready to receive a cementitious backing material adapted to form the tiles into a building panel.

10 18. Apparatus as claimed in Claim 17 wherein said table is adapted to be tilted from having its surface in the horizontal position to a position having its surface substantially vertical.

15 19. Apparatus as claimed in Claim 18 wherein said table has quadrantal legs on which the table may be rolled to change its position.

20 20. Apparatus as claimed in Claim 18 or 19 wherein two tables are provided, the surfaces of which are adapted to move towards each other when being changed from the hori-

zontal to the vertical disposition, positioning means being provided so that when the tables are in the vertical position a space is left between the building panels on the tables adapted to receive concrete therein.

25 21. Apparatus as claimed in Claim 20 wherein said positioning means comprise pegs or teeth on said quadrantal legs and corresponding engaging means on guide means on which said quadrantal legs run.

30 22. Apparatus as in claim 17 for use in making building panels substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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