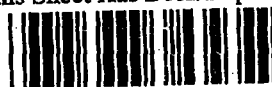
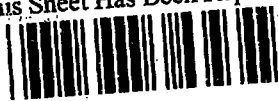


METHOD OF JOINING WATERSTOPS AND CONNECTORS
FOR USE THEREIN

This invention relates to a method of joining together a waterstop of non-water swellable material such as plasticised polyvinyl chloride and a waterstop of a water swellable material and to waterstop connectors for use therein.

Waterstops are used at joints in concrete structures to prevent the passage of water. Early waterstops were made from steel or copper strip, the latter often crimped to give greater flexibility. Composites of rubber with mild steel plates projecting from the rubber were also used. More recently strips of flexible water proof material, having two or more keying ribs extending along and projecting from the strip for keying the strip to the concrete at the two sides of the joint to be sealed, have been used. Such waterstops are commonly made of a rubber or plastics material and the most widely used material is at present plasticised polyvinyl chloride. Even more recently waterstops of a hydrophilic or water swellable material have come into commercial use. These waterstops rely on the swelling capacity of the material on contact with water to prevent the passage of water at joints or discontinuities in a concrete structure. Materials which are used for water swellable waterstops include water swellable polyurethane elastomers, a combination of butyl rubber and sodium bentonite and rubber containing particles of a water swellable resin.





Non-water swellable waterstops of rubber or plasticised polyvinyl chloride are of two types, one usually called an internal waterstop or centrally placed waterstop having ribs or projections on two opposite faces of the strip and the other usually called an external waterstop or a rear fixed waterstop having ribs or projections on one face only.

The present invention relates to connectors for external or rear fixed waterstops.

In certain applications it is desirable to be able to use both traditional rubber or plasticised polyvinyl chloride waterstops and water swellable waterstops. However, this can only be done if the two waterstop systems can be linked together in such a manner that the integrity of the combined systems is achieved to prevent the passage of water.

One such application is in deep basements in confined spaces in which a piled wall or trench is excavated and filled with concrete. Usually a recess or shelf is cast into the wall at the position of the base or floor slab. Since the wall consists of hardened concrete it is not readily possible to install a conventional polyvinyl chloride waterstop. The contractor attempts to achieve a junction and watertightness by encapsulating the polyvinyl chloride waterstop in a site placed waterproof mortar. However, this is seen as a poor solution since it is totally dependent upon the quality of workmanship in difficult conditions. It would therefore be advantageous to be able to use a hydrophilic or water swellable waterstop at the junction between the wall and the base slab, and



conventional external or rear fixed polyvinyl chloride waterstops in the base slab itself, because they are more appropriate and easier to use.

According to the present invention there is provided a method of joining together two waterstops, one of a non-water swellable material and the other of a water swellable material, the method comprising providing a strip of non-water swellable material having a plurality of spaced apart ribs on one face extending across the strip, adhesively bonding a ribbed edge of the strip to an elongate body of water swellable material and fixing the elongate body to the water swellable waterstop.

The strip of non-water swellable material may be the non-water swellable waterstop itself, or it may form part of a connector and be fixed to the non-water swellable waterstop. In the former case the method of the invention can be carried out wholly on site while in the latter case the strip may be conveniently adhesively bonded to the elongate body to provide a prefabricated connector which is subsequently fixed to the two waterstops.

According to a further feature of the invention there is provided a connector for joining together two waterstops, one of a non-water swellable material and the other of a water swellable material, the connector comprising a strip of non-water swellable material having a plurality of spaced apart ribs on one face extending across the strip and an elongate body of water swellable material adhesively bonded to a ribbed edge of the strip.



The elongate body of water swellable material may be for example a strip which is located alongside the strip of non-water swellable material and bonded to the edge of the strip and optionally to the lower part of the ends of the ribs.

The elongate body of water swellable material may also be a strip which is located perpendicularly to the strip of non-water swellable material and bonded to the ends of the ribs and to the edge of the strip of non-water swellable material.

In a preferred embodiment the ribs on the strip of non-water swellable material have top portions which project beyond one edge of the strip, the elongate body of water swellable material has an L - shaped portion comprising a vertical part and a horizontal part, the vertical part is bonded to the projecting ends of the ribs, and the horizontal part is bonded along its upper face to the underside of the rib projections and along its edge to the edge of the strip of non-water swellable material.

In the preferred embodiment the two different materials are bonded together at a large number of sites and the connector is therefore more robust than in the embodiments previously described.

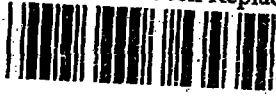
The non-water swellable material may be a flexible rubber such as natural rubber or a styrene-butadiene modified synthetic rubber or a flexible plastics such as plasticised polyvinyl chloride. Plasticised polyvinyl chloride is preferred.



The water swellable material may be for example a rubber or flexible plastics material containing dispersed particles of a water swellable resin but the preferred material is a polyurethane elastomer which is produced preferably from an aliphatic or alicyclic polyisocyanate as an isocyanate component and which is rendered water-swellable due to the presence of hydrophilic groups within its chemical structure. Such polyurethane elastomers show a stable swelling ratio in water containing metallic ions and as the ratio does not decrease in a long period of time, they show an excellent water stop effect. Such polyurethane elastomers are sold under the trade mark AQUAPRENE by Sanyo Chemical Industries and are produced having a range of degrees of swelling and rate of swelling when in contact with water. Among such polyurethane elastomers, one which has a swelling ratio of 1.2 - 2.5 times is preferable. These elastomers can readily be fixed to polyvinyl chloride by means of a solution of a cyanoacrylate, synthetic rubber, elastomer or polyurethane bonding agent.

The number and shape and configuration of the ribs on the strip of non-water swellable material can vary to suit the design of the rear fixed waterstop with which the connector is to be used.

Waterstop designs are based on two principles, the valve principle and the tortuous path principle, often used in combination. For the valve principle the waterstop has a number of relatively large projections or ribs, which may be for example bulb shaped, which allow ease of compaction of concrete around the waterstop and provide a positive water barrier. For the tortuous path principle a series of much smaller



ribs are located between the large ribs and these together with a centrally located large rib provide an enhanced tortuous path to the passage of water. The central rib may be a flat-topped rib to allow movement to be accommodated in expansion joints and to provide setting to support joint fillers, or a thin fin to assist setting out and shutter location.

The ribs on the strip of non-water swellable material extending across and projecting beyond one edge of the strip therefore correspond to the large ribs and the central rib of the waterstop, and the strip may also have a plurality of small ribs extending only across the strip to aid functioning by the tortuous path principle.

The connector of the invention can be readily butt jointed to waterstops of water swellable and non-water swellable material by techniques such as adhesive bonding in the case of water swellable waterstops and by hot-fusion welding in the case of non-water swellable waterstops.

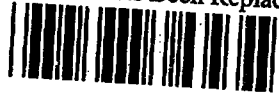
The connector provides a convenient solution to the problem of joining together the two types of waterstops in an application such as that described earlier.

The invention is illustrated with reference to the accompanying drawing which is a perspective view of a connector for joining together two waterstops one of plasticised polyvinyl chloride and the other of a water swellable material.



A connector 1 for joining together a waterstop of plasticised polyvinyl chloride and a waterstop of a water swellable polyurethane elastomer comprises a strip 2 of plasticised polyvinyl chloride having four ribs 3, 4, 5, and 6 on one face 7 having a bulb shaped top 8, a fin 9 located centrally of the same height as ribs 3, 4, 5, and 6 and flanges 10 at both lateral edges. The flanges 10 prevent tearing through of the connector 1 when it is fixed to concrete by means of nails hammered through the connector 1 just inside the flanges 10. The top portion of ribs 3, 4, 5, 6 and 9 extends across the strip 2 and projects beyond longitudinal edge 11. Between ribs 3 and 4 and between ribs 5 and 6 the upper face of the strip 2 has four small projecting ribs 12 which together with fin 9 provide an enhanced tortuous path to the passage of water. An elongate body 13 of water swellable polyurethane elastomer having an L-shaped section portion 14 comprising a vertical part 15 and a horizontal part 16 is fixed to the strip 2 by means of a polyurethane bonding agent such that the vertical part 15 is fixed to the projecting ends 17 of each of the ribs 3, 4, 5, and 6 and fin 9 and the horizontal part 16 is fixed along its upper face 18 to the underside 19 of the rib projections, and along its edge 20 to the edge 11 of the strip 2.

In use the strip 2 can be joined to the waterstop of polyvinyl chloride by means of, for example hot fusion welding, and the body 13 can be joined to the waterstop of water swellable polyurethane elastomer by means of, for example, a synthetic rubber or elastomer solution bonding agent.



CLAIMS



1. A method of joining together two waterstops, one of a non-water swellable material and the other of a water swellable material, characterised in that the method comprises providing a strip (2) of non-water swellable material having a plurality of spaced apart ribs (3, 4, 5, 6) on one face (7), extending across the strip (2), adhesively bonding a ribbed edge of the strip to an elongate body (13) of water swellable material and fixing the elongate body (13) to the water swellable waterstop.

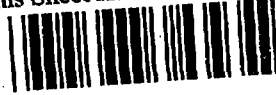
2. A method according to Claim 1, characterised in that the strip (2) of non-water swellable material is the non-water swellable waterstop.

3. A method according to Claim 1, characterised in that the strip (2) of non-water swellable material forms part of a connector (1) and is fixed to the non-water swellable waterstop.

4. A connector (1) for joining together two waterstops, one of a non-water swellable material and the other of a water-swellable material, characterised in that the connector comprises a strip (2) of non-water swellable material having a plurality of spaced apart ribs (3, 4, 5, 6) on one face (7) extending across the strip (2) and an elongate body (13) of water swellable material adhesively bonded to a ribbed edge of the strip (2).

5. A connector (1) according to Claim 4, characterised in that the elongate body (13) of water swellable material is a strip which is located

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alongside the strip (2) of non-water swellable material and bonded to the edge of the strip (2) and optionally to the lower part of the ends of the ribs (3, 4, 5, 6).

6. A connector (1) according to Claim 4, characterised in that the elongate body (13) of water swellable material is a strip which is located perpendicularly to the strip (2) of non-water swellable material and bonded to the ends of the ribs (3, 4, 5, 6) and to the edge of the strip (2) of non-water swellable material.

7. A connector (1) according to Claim 4, characterised in that the ribs (3, 4, 5, 6) on the strip (2) of non-water swellable material have top portions which project beyond one edge (11) of the strip (2), the elongate body (13) of water swellable material has an L-shaped portion (14) comprising a vertical part (15) and a horizontal part (16), the vertical part (15) is bonded to the projecting ends (17) of the ribs (3, 4, 5, 6) and the horizontal part (16) is bonded along its upper face (18) to the underside (19) of the rib projections and along its edge (20) to the edge (11) of the strip (2) of non-water swellable material.

8. A connector (1) according to any one of Claims 4 to 7, characterised in that the non-water swellable material is a flexible rubber or a flexible plastics.

9. A connector (1) according to Claim 8 characterised in that the flexible rubber is natural rubber or a styrene-butadiene modified synthetic rubber.



10. A connector (1) according to Claim 8, characterised in that the flexible plastics is plasticised polyvinyl chloride.

11. A connector (1) according to any one of Claims 4 to 10, characterised in that the water swellable material is a rubber or flexible plastics containing dispersed particles of a water swellable resin.

12. A connector (1) according to any one of Claims 4 to 10, characterised in that the water swellable material is a polyurethane elastomer which is rendered water-swallowable due to the presence of hydrophilic groups within its chemical structure.

13. A connector (1) according to Claim 12, characterised in that the polyurethane elastomer has a swelling ratio in water of 1.2 to 2.5 times.

14. A connector (1) according to Claim 12 or Claim 13, characterised in that the non-water swellable material is polyvinyl chloride and the elongate body (13) of water swellable material is bonded to the strip (2) of non-water swellable material by means of a solution of a cyanoacrylate, synthetic rubber, elastomer or polyurethane bonding agent.