A water swellable waterstop (2) for sealing between the faces of an expansion joint comprising an elongate body comprises (i) a first portion (4) for keying to the concrete of a first section, (ii) a second portion (6) to be located in the expansion joint and being sufficiently flexible to accommodate the movement of the opening and closing of the joint and (iii) a third portion (8) for keying to the concrete of a second section.
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WATERSTOPS AND A METHOD FOR THEIR INSTALLATION.

Field of the Invention

This invention relates to waterstops and a method for their installation.

Background of the Invention

Waterstops are used at joints in concrete to prevent the passage of water. Previously used waterstops have been in the form of strips of waterproof flexible 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. Such waterstops have been made of a rubber or plastics material such as plasticised polyvinyl chloride. More recently waterstops have been proposed which are made of a hydrophilic or waterswellable material. These waterstops use the swelling capacity of the material on contact with water to prevent the passage of water at joints in a concrete structure.

There have also been proposals to use waterswellable materials in combination with non water swellable materials. For example GB Patent No 2,208,881A discloses a waterstop which includes a waterswellable part. This patent discloses a waterstop having a body in the form of an elongate web with a keying formation at or near each edge of the web by which the waterstop may be secured to respective bodies of concrete and a number of transverse ribs which may be made of a water swellable material. The purpose of the transverse ribs is said to be to prevent water
running along the length of the waterstop between the keying formations.

Waterstops having a part of waterswellable material have also been described in GB Patent No 2,205,872A which describes a waterstop which comprises a web of rubber or polyvinyl chloride with a rib, referred to as a keying formation, near each end for securing the waterstop to a body of concrete. To improve the sealing performance in the event of water penetration a strip of water swellable material is attached to the ribs of the waterstop.

European Patent No 0575075A describes a connector for joining water swellable and non waterswellable waterstops together. The connector comprises an assembly of a strip of non water swellable material and an elongate body of water swellable material transversely bonded to the edge of the strip.

Materials which have been previously proposed for water swellable waterstops include certain polyurethane elastomers and a combination of sodium bentonite and rubber containing particles of a waterswellable resin. One of the benefits of these waterstops is that they are simpler to install in that they do not require the use of split stopends.

Problem to be solved by the Invention

Although waterswellable waterstops have been very satisfactory and their use has been growing, they have not yet been successfully applied to expansion joints which are designed to accommodate movement. The reason for this is that expansion joints incorporate a compressible
filler to allow the joint to close without the transmission of load, and as a consequence the hydrophilic material does not have a surface against which to apply pressure. This means that the advantages of simplified installation and elimination of split stopends can only be obtained with construction joints and cannot be obtained with expansion joints. The present invention provides a solution to this problem by a hydrophilic waterstop that can be used to seal between the faces of expansion joints.

Summary of the Invention.
According to the present invention there is provided a waterswellable waterstop suitable for use in an expansion joint between concrete sections comprising an elongate body having (i) a first portion for keying to the concrete of a first section,
(ii) a second portion to be located in the expansion joint and being sufficiently flexible to accommodate the movement of the opening and closing of the joint and
(iii) a third portion for keying to the concrete of a second section.

Advantageous Effect of the Invention
The waterswellable waterstops of the present invention can be used in expansion joints employing the simplified installation method mentioned above without the need for split stopends.
Brief Description of the Drawings

Figs 1 to 6 are cross sections of different embodiments of the water swellable waterstops of the invention.

Fig 7 is a cross sectional view showing the waterstop of Fig 3 installed at an expansion joint between two sections of concrete and Figs 8 to 10 are also cross sectional views of further embodiments and Figs 8A, 9A and 10A show these further embodiments installed at an expansion joint.

Detailed Description of the Invention

By accommodate the movement of the joint we mean that the waterstop will flex and compress under the compression forces when the joint closes and under the tension forces when the joint opens without being pulled out of its position. The first portion may be provided with a flared formation for keying into the concrete of the first pour.

The waterstop conveniently is provided with a laterally extending formation for contacting the surface of the concrete of the first section or pour and preferably also a laterally extending formation for contacting the surface of the concrete of the second concrete section or pour. By the use of an adhesive these laterally extending formations provide a keying action to their respective concrete section.

The second portion may have a cavity formed therein to provide the required compressibility and/or flexibility and may comprise a hollow structure formed for example by extrusion. The volume of the cavity in relation to the solid
material comprising the second portion of the
waterstop may for example be from 1:2 to 2:1.
The second portion may be defined as that portion
of the waterstop located in the gap in the
expansion joint filler as shown in Fig 10A for
example.
The keying formations of the first and third
portions may, for example, be in the form of a
block or mushroom shape or of bifurcated form.
The water swellable material employed to make the
waterstops of the present invention may be a
rubber or flexible plastics material containing
dispersed particles of a waterswellable resin.
The preferred material is a polyurethane
elastomer which is produced from an aliphatic or
alicyclic isocyanate and which is rendered water
swellable by the presence of hydrophilic groups
within its chemical structure. The waterstops of
the invention may be formed in one piece eg by
extrusion. The waterstops may be extruded in any
convenient length but this is usually from 1 to 5
metres.
According to another aspect of the present
invention a method for the installation of a
waterstop at an expansion joint in a concrete
structure comprises
(i) casting a first section of concrete,
(ii) positioning a waterstop of waterswellable
material against the first section where an
expansion joint is to be formed, the waterstop
being sufficiently flexible to accommodate the
movement of the opening and closing of the joint
and
(iii) casting a second section of concrete so that the waterstop is located in the expansion joint.

Referring to the accompanying drawings Fig 1 shows a waterstop indicated generally by numeral 2 which comprises a first portion 4 in the form of arms 5 to be adhered to a surface of a first concrete pour, a relatively compressible central portion 6 in the form of a tube which is intended to placed in the expansion gap between pours of concrete. The tube 6 has a cavity 7 of circular cross section and the tube 6 has six external flat faces 9. The waterstop 2 has a third portion 8 having arms 10 for contacting a surface of a second concrete pour and a mushroom shaped keying formation 12 for keying into a second concrete pour.

The arms 5 of the waterstop 2 provide a surface which is fixed to the concrete of the first pour using an adhesive such as Supercast SWX (trade name owned by Fosroc International Limited) hydrophilic adhesive. A 60 mm width is used to ensure sufficient area of adhesion is available. The hexagonal tube 6 is designed to compress and extend providing a low modulus system. The two sets of side arms 5 and 10 are intended to fit on each side of the expansion joint filler board pieces (not shown). The angle of the arms 10 is selected to provide some grip on the filler board and to work with 18mm filler board as well as the standard 25mm. The keying formation 12 is covered by the second concrete pour.

In Fig 2 the waterstop indicated generally by numeral 11 is identical with that in Fig 1 except that the first portion comprises a block 14
having a serrated face 16, the arms 13 have
serrations 15 on their faces and mushroom shaped
keying formation 18 is larger. The block 14 is
intended to fit into a slot cast in the first
concrete pour.

The purpose of the block 14 is that should water
reach it the block will swell inside the slot,
thereby creating a lateral pressure seal. The
serrations 16 on the lower face of the block 14
are to allow the adhesive eg Supercast SWX, which
bonds more strongly to concrete than to the
hydrophilic polymer, to exercise a mechanical key
supplementing the adhesive bond. The serrations
15 on the lower face of the arms provide
increased surface area to increase the bond
strength.

In Fig 3 the waterstop 22 is identical with that
of Fig 2 except that the tube 19 has a cavity 20
which is hexagonal in cross section, the arms 27
extend outward at a different angle and have
serrated upper faces 24 and the keying formation
26 comprises a forked projection.

In Fig 4 the waterstop 30 is identical with that
of Fig 3 except that the first portion indicated
by numeral 28 has no block.

In Fig 5 the waterstop 31 is identical with that
of Fig 3 except that the arms 32 are shorter and
have no serrations.

In Fig 6 the waterstop 35 is identical with that
of Fig 5 except that the arms 36 are shorter and
have no serrations.

Referring to Fig 7 a waterstop as illustrated in
Fig 3 is shown installed at an expansion joint in
a wall 39. Located between the first concrete
pour 40 and a second concrete pour 44 is an
expansion joint 46 which contains an expansion joint filler 48. The first concrete pour 40 has been cast with a slot 42 into which slot is fitted the block 14' of the waterstop. The serrated face 16' of the block is coated with an adhesive to improve keying with the concrete 40 of the first pour. The serrated faces 15' of arms 13' contact the face of the first concrete pour 40 and the serrated faces 29 of arms 27 contact the face of the second concrete pour 44. The above described waterstops, although being invented to overcome a problem involving the use of hydophilic waterstops at expansion joints, may also be used at construction joints.

Referring to Figs 8 and 8A a waterstop is indicated by numeral 50. Fig 8 shows the waterstop before use and Fig 8A shows it after it has been pushed into a channel 57 formed in section 56. The waterstop has flared keying formations 58 and 60 which key into the concrete sections 54 and 56 respectively. The waterstop has a cavity 59. In Fig 8A the waterstop is shown installed in a gap in expansion joint filler 52 between two sections of concrete 54 and 56. The first section of concrete 56 is cast with a channel 57 formed therein. The waterstop 50 is then pushed into the channel 57 and the expansion joint filler 52 applied to the required thickness. The second concrete section 54 is then poured.

Referring to Fig 9 and 9A a waterstop is indicated by numeral 70. Fig 9 shows the waterstop before use and Fig 9A shows it pushed
into channel 77 formed in concrete section 76. The waterstop has flared keying formations 78 and 80 which key into the concrete sections 74 and 76 respectively. The waterstop has a cavity 73. In Fig 9A the waterstop is shown installed in a gap in expansion joint filler 72 between two sections of concrete 74 and 76. The installation is as described with reference to Figs 8 and 8A.

Referring to Figs 10 and 10A a waterstop is indicated by numeral 82. In Fig 10A the waterstop is shown installed in a gap in the expansion joint filler 84 between two sections of concrete 86 and 88.

The waterstop has a cavity 93 and portion 92 which projects into channel 97 which has been formed in the concrete section 88. To provide a keying action the portions 90 and 92 and bonded to the concrete by means of Supercast SWX adhesive. The waterstop 82 has lugs or nipples 100, 102, 104 and 106 to assist in positioning the waterstop in the channel 97. The expansion joint filler 84 is built up to the required thickness (the distance between the two sets of lugs 100, 104 and 102, 106 being the thickness of the filler).

The waterstops of the present invention will usually be manufactured in lengths of typically 15 to 20 metres and transported to the construction site in the form of a roll. At the site they will be cut to the required length. When necessary lengths may be joined endwise by butt welding.
CLAIMS:

1. A waterswellable waterstop suitable for use in an expansion joint between concrete sections comprising an elongate body having
   (i) a first portion for keying to the concrete of a first section,
   (ii) a second portion to be located in the expansion joint and being sufficiently flexible to accommodate the movement of the opening and closing of the joint and
   (iii) a third portion for keying to the concrete of a second section.

2. A waterswellable waterstop as claimed in claim 1 wherein the keying is provided by a flared formation for keying to the concrete.

3. A waterswellable waterstop as claimed in claim 1 or 2 having a laterally extending formation for keying to the surface of the concrete of the first section at an expansion joint.

4. A waterswellable waterstop as claimed in any one of the preceding claims having a laterally extending formation for keying to the surface of the concrete of the second section at an expansion joint.

5. A waterswellable waterstop as claimed in any one of the preceding claims wherein the relatively compressible portion comprises a hollow structure.
6. A waterswellable waterstop as claimed in any one of the preceding claims wherein the keying formation on the third portion is flared.

7. A waterswellable waterstop as claimed in claim 2 wherein the keying formations of the first and third portions are in the form of a block or mushroom shape or bifurcated form.

8. A method for the installation of a waterstop at an expansion joint in a concrete structure comprising
   (i) casting a first section of concrete with a channel formed therein to receive a waterstop
   (ii) positioning a waterstop as claimed in any one of the preceding claims in the channel in the first section, and applying expansion joint filler to the required thickness and
   (iii) casting a second section of concrete so that the waterstop is located in the expansion joint.

9. A construction comprising two sections of concrete and an expansion joint between the two sections containing filler, there being a waterstop located in the expansion joint, the waterstop having a first portion which is bonded to the first concrete section, an intermediate portion located in a gap in the expansion joint filler and a third portion which is bonded to the second concrete section.

10. A construction as claimed in claim 9 wherein the first portion is located in a recess formed in the concrete of the first section.
### INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

| IPC 7 | E04B1/68 |

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

| IPC 7 | E04B |

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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- **X** Patent family members are listed in annex.
- Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance.
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**Date of the actual completion of the international search**

28 October 1999

**Date of mailing of the international search report**

05/11/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2 ND 2280 HV Rijswijk

Tel.: (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016

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