

# PATENT SPECIFICATION (11)

1 341 413

## DRAWINGS ATTACHED

- (21) Application No. 1718/71 (22) Filed 13 Jan. 1971 (19)  
(61) Patent of Addition to No. 1 230 753 dated 20 Oct. 1967  
(31) Convention Application No. 2746 (32) Filed 14 Jan. 1970 in  
(33) United States of America (US)  
(44) Complete Specification published 19 Dec. 1973  
(51) International Classification C09J 7/02 B32B 11/00 25/00 13/04  
(52) Index at acceptance  
B2E 209 225 226 22Y 23Y 287 28Y 339 368 398 421 43Y  
461 531 53Y  
B6G 2D



## (54) WATERPROOFING SHEET-LIKE STRUCTURES

(71) We, W. R. GRACE & Co., a Corporation organised and existing under the laws of the State of Connecticut, United States of America, of 62 Whittemore Avenue, Cambridge, Massachusetts 02140, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to pre-formed sheet-like structures suitable for waterproofing surfaces, for example concrete surfaces, and to a method of forming a waterproof seal on a surface using the structures. The invention is an improvement in, or modification of, the invention of British Patent Specification No. 1,230,754, and is related to the inventions of British Patent Specifications Nos. 1,230,753, 1,230,755, 1,230,756, 1,265,952 and 1,265,953.

In the construction industry, waterproofing, dampproofing and/or vapour barriers are important items which, while only representing about 1% of construction costs, must be reliable since failure is intolerable. Of course the severity of the requirement and the penalty for failure depend on the circumstances. Nevertheless, the failure of waterproofing, dampproofing and vapour barriers has caused great loss and expense and is the subject of considerable concern in the industry. A number of compositions and methods have been suggested, although many of them derive one from the other or merely involve increasing the amount of a known composition.

Waterproofing and dampproofing basically differ only as a matter of degree while vapour barriers are by nature, somewhat different in kind; the two categories have therefore been treated somewhat differently in the industry. In this Specification, the invention is described chiefly with respect to waterproofing, but it should be under-

stood that the invention can be equally applied to dampproofing and vapour barriers since it is a feature of the present invention that it can be applied satisfactorily to both categories.

Waterproofing and dampproofing are commonplace problems in the construction industry which are demanding greater attention in all sections of the industry in response to changing construction techniques, architectural changes and increasing costs of material and labour. The requirement for waterproofing generally relates to protection against substantial accumulations of free or running water or water under pressure as illustrated below.

Above-ground installations within, or integral to, buildings, for example spandrel covers, through-wall installations over windows and doors, protection beneath shower, toilet and kitchen floors and protection for entrance canopies and stairwells.

Above or on-ground installations close to, or associated with, buildings, including terraces, precincts, alleys, planters, swimming pools, moats, sidewalks and above-ground parking areas.

Below ground installations, for example basement floors and walls, lower level parking garages, elevator pits, underground mechanical rooms, underground pipes and personnel or mechanical tunnels.

Further examples include reservoirs, traffic tunnels, bridges and parking structures.

Dampproofing installations are similar to a number of waterproofing installations, the basic difference being the amount of water anticipated. Dampproofing applications are those where some external moisture is expected but there is little likelihood of measurable water pressure or need to contain water passing from inside or above the structure. Principal dampproofing applications are in subfloor areas well above the water table or beneath slabs on the ground

in cases where flooding is not a problem.

Of prior art waterproofing materials and methods, probably the most common is the hot mopping of asphalt with alternate layers of roofing felt, glass cloth or open weave cotton. This is a relatively difficult application which is messy and unpleasant and involves dangerous fumes, heat and fire hazards. Increasing labour costs have made this method less attractive and some workers have objected or refused to do it. The hot mopping method is also disadvantageous because the hot bitumen frequently cools and stiffens before the felt or cloth can be applied. Where a length of material is applied improperly, it frequently cannot be corrected due to cooling of the bitumen. Experience indicates that only constant and rigorous supervision prevents improper installation and, even so, a good job is difficult to obtain. For example, it is important that the hot liquid asphalt be mopped on smoothly and in uniform thickness, because otherwise there may be formed channels or cavities where water can flow or collect, and further lack of uniformity creates weaknesses and stresses which frequently result in the splitting open of the membrane when it becomes brittle in cold weather.

Cold applied sheet rubber or plastics have also been used by adhering them just at the edges or across the entire area. However, such sheets are very heavy and expensive. They also require the application of a hot-mopped layer of asphalt with the same difficulties as mentioned above.

Vapour barrier characteristics are measured in terms of the moisture vapour transmission rate (MVTR).

The difficulty in the past in providing long lasting waterproofing, dampproofing and vapour barriers has not been simply in finding materials that will stop the passage of water etc. The problem is rather in providing materials in such a form and with such methods that they can be economically and uniformly applied over large areas so as to give satisfactory sealing both initially and over long periods without the need for excessive care or skill or for massive amounts of material.

The present invention provides a preformed sheet-like structure which is economically and uniformly preformed, easy to bring to the site, simple to install and is self sealing against accidental damage or failure on its surface or at its edges, joints or overlaps either during or after installation. It is preformed at a location remote from the construction site, brought to the site (preferably in the form of a roll) and laid on a surface in overlapping strips. It will provide waterproofing, dampproofing and vapour barrier characteristics equal to, or better than, most known materials. Most

importantly, as an integrated part of a construction, it is more likely to perform satisfactorily after installation; it is also resistant to damage during installation.

The structures of the invention comprise a preformed sheet-like structure comprising a sheet-like support and, adherent to one face of the support, a membrane of a waterproof and waterproofing pressure-sensitive adhesive, the membrane extending beyond at least one edge of the support, and being at least 0.025 cm thick, the adhesive being a bituminous-rubber adhesive and the structure being at least 15 cm wide.

The structure thus includes a flexible support sheet or film of natural rubber and/or synthetic organic polymer, e.g. polyethylene, which for most installations should be elongated, that is in the form of a wide strip. Adherent to, and coextensive with, one surface of the sheet is a waterproof and waterproofing membrane, which is a bituminous-rubber composition. The membrane is soft and flexible. It is substantially thicker than the support sheet and has the ability to reconsolidate or self seal and cold flow when placed under pressure where it is not confined by the support sheet.

The membrane can extend beyond either or both long (or short) sides of the support. A particularly effective seal is produced in the latter case.

Until the structure is applied, the surface of the membrane remote from the support is preferably covered by a protective coating or sheet (e.g. siliconised paper) which can be readily removed from the membrane without damage thereto. Where the structure is in the form of a roll, this protective sheet is especially advantageous because it enables the roll to be readily unrolled; in addition the direction of movement over the substrate to be covered can be easily controlled.

Figure 1 shows in cross-section the structure (1) in which a support sheet (2) has adherent thereto a membrane (3) carrying a releasable protective sheet (4). The membrane extends beyond one edge of the support sheet at (5). At (6) the membrane is recessed from the edge of the support sheet. The protective sheet (4) extends (at 7) slightly beyond one long edge of the membrane.

The structures can have a width of 61—122 cm, preferably about 92 cm, and should be as long as possible, having due consideration for shipping, handling and the size of the particular installation.

The support sheet should possess good vapour barrier and waterproofing characteristics and is preferably a polymeric film material. Polyethylene film, 0.013—0.051 cm, preferably 0.025 cm, thick, works very well since it combines the functional,

strength and flexibility characteristics necessary for the result desired.

The preferred bituminous-rubber composition is formed of natural or synthetic rubber, virgin or reclaimed, blended into bitumen to a smooth mixture. The ratio of bitumen to rubber is suitably at least 75:25.

The protective sheet is preferably a siliconised paper which will release easily from the membrane. The protective layer extends in width at least over the whole width of the membrane and preferably somewhat beyond.

Where the structure is in the form of a roll, the surface of the protective sheet which is remote from the membrane is provided with the release means along its lengthwise margin or margins corresponding to the portion of the membrane which extends beyond the support sheet as at (5) in Figure 1. By this means, the structure may be formed into a roll and then unrolled without damaging the membrane because the releasable margin contacts the portion of the membrane extending beyond the support sheet upon rolling.

The rubber-bituminous composition can contain additives (e.g. fillers); their use enables the membrane to remain flexible, soft and pliable, be cold-flowable under pressure, somewhat elastic and resilient to a greater or lesser extent, depending on the particular formulation; one of the advantages of the structures of the invention is that they are substantially insensitive to wide temperature variations so that construction can proceed at times where in the past it could not without great difficulty. This temperature insensitivity is also advantageous in maintaining waterproofing over long periods.

The structure will adhere to substrates, for example concrete substrates, and will form a continuous membrane which does not contain, and is not susceptible to the formation of, channels for the flow or collection of water and is highly resistant to damage during installation and failure thereafter. During such installation, the structure may be walked upon and will not displace due to wind or foot traffic. Any channels or spaces which do occur can be easily corrected by pressing on the structure; sometimes they will correct themselves.

In Figure 2, the structures are installed on a concrete construction member (6) in overlapping fashion. The first structure (7) is laid flat, its membrane (8) adhering to the rough dusty concrete surface. The second structure (9) overlaps the first structure by a substantial amount. At the point of overlap (10) a membrane-to-membrane contact is achieved due to the extension of the membrane of strip (9) beyond the support (11). Strip (9) is shown in the embodi-

ment of Figure 1 where only the edge to be underlapped has the extended portion of membrane, and the other edge has the membrane recessed, thus providing protection during installation. Strip (12) is a version wherein the membrane extends beyond both edges. An expansion joint in the concrete is shown at (13). It is preferred to press all overlaps between the structures to eliminate any bridging and to ensure good adhesion between the membranes.

The membrane suitably extends beyond the support by 0.16—2.54 cm, preferably 0.64—1.9 cm (especially about 1.27 cm) or 0.32—0.48 cm (especially about 0.32 cm). The thickness of the membrane is preferably 0.063—0.38 cm, especially 0.089—0.24 cm, particularly about 0.15 cm.

The structures are especially useful with certain increasingly common types of construction, for example the split-slab construction used in, for example precincts, alleys, and parking decks, which may be on or above ground and are frequently over an occupied area or in other cases where waterproofing from above is necessary. The split slab construction has a lower slab or base course (or deck), typically of concrete, which can be left in a rough finished condition, i.e. may be wood float finished but not steel trowelled. The lower slab is treated with a topping slab or wearing course, for example of concrete, asphalt, or a mortar setting bed in which brick, tile or stone may be set. The structure is applied between the slabs. The structures are especially useful in such constructions because the weight of the topping slab operates with the waterproofing structure to ensure its integrity. That is, it presses on the sheet and membrane assuring intimate contact of the membrane to the base and to the adjacent membrane of the overlapping structures. The pressure causes the reconsolidation and self healing as well as the closing of any cavities. Split-slab construction frequently requires, in addition to waterproofing, bond-breaking, that is the absence of a bond between the slabs so as to permit relative movement of the slabs. By the use of the present structures, the support sheet provides the bondbreaking action without disturbing the membrane while the membrane protects the sheet from puncture and wearing.

In another application, the structure is applied beneath slabs situated on the ground. In this case it is also advantageous to leave the protective layer on. As shown in Figure 3, the structure in the form of a roll is set at the starting end (14) of a desired path of application. The protective sheet (15) is stripped back a small amount and the exposed membrane is adhered to the substrate at the starting end (14). The

protective sheet (15) is then pulled as evenly as possible in the direction of application. The structure will unroll as the protective sheet is stripped off. About half the periphery of the roll consists of exposed, but free, membrane as at (16) which allows a degree of adjustment in the direction of the roll. Such adjustment can be made by moving or merely applying force on the sheet (15) as at (17), or by actually pushing one side of the roll.

The invention therefore also provides a method of forming a waterproof seal on a surface, the method comprising applying to the surface an exposed face of the membrane of a structure of the invention, the exposed face being remote from the support. Preferably the method is performed by stripping back a small portion of the protective coating to expose a small portion of the membrane, positioning the roll for unrolling in a desired path along the surface, adhering the small exposed portion of the membrane to the surface, pulling the protective coating in the direction of the desired path thus causing the protective coating to be stripped from the roll exposing the membrane and at the same time causing the structure to unroll along the desired path and adhering itself to the surface.

As indicated above a particularly effective seal is obtained when the membrane extends beyond both long sides of the support. This is because the adhesive will seal the overlapping edge of the support sheet along the long edges and will form a second seal at the undersides of the structures by providing an adhesive to adhesive point of seal.

The invention is illustrated by the following Examples.

#### EXAMPLE 1

A rough finished concrete tub about 92 cm square and 15.2 cm deep and having therein several holes of 1.27 cm diameter was lined with a structure comprising a polyethylene support sheet (0.025 cm thick) and a pressure-sensitive adhesive membrane (0.15 cm thick) which extends beyond the edges of the support by 0.32—0.64 cm. Three structures were used resulting in two overlaps 6.35 to 7.6 cm wide. The overlaps were positioned to overlay the holes in the tub. The overlapping areas were pressed with a wallpaper roller. After 24 hours with 15 cm of water in the tub, no leaks were detected under the tub.

#### EXAMPLE 2

Example 1 was repeated except that the overlapping width was 1.27—2.54 cm. Once again no leaks were detected.

#### EXAMPLE 3

The structures of Examples 1 and 2 were arranged in a bowl shape and filled with water. A roofing nail and a nail of about 0.32 cm diameter were pushed into the structure. There was no leak. Both nails were pulled out. Under the longer nail, a single drop of water only appeared at the time of extraction. No further leakage occurred at either hole.

#### EXAMPLE 4

In early spring and through the summer in San Antonio, Texas, U.S.A., 5600 m<sup>2</sup> of the structure of Example 1 were applied (using an overlap of 6.35—7.6 cm wide) in a split slab construction in which the substrate was a concrete structural slab and the topping course was a mortar settling bed in which stone was set. Underneath were offices and record storage. No leaks have been reported.

#### EXAMPLE 5

In Toronto, Canada, approximately 835 m<sup>2</sup> of the structure used in Example 4 were applied during December to March to a concrete substrate. Roughly 745 m<sup>2</sup> was applied horizontally and 93 m<sup>2</sup> was applied vertically. Concrete was laid on top, the constructions being a reservoir for an air conditioning system. No leaks have been detected.

#### WHAT WE CLAIM IS:—

1. A pre-formed sheet-like structure comprising a sheet-like support and, adherent to one face of the support, a membrane of a waterproof and waterproofing pressure-sensitive adhesive, the membrane extending beyond at least one edge of the support and being at least 0.025 cm thick, the adhesive being a bituminous-rubber adhesive and the structure being at least 15 cm wide.
2. A structure according to claim 1 wherein the membrane extends beyond both of the long sides of the support.
3. A structure according to claim 1 wherein the membrane extends beyond only one of the long sides of the support.
4. A structure according to any one of the preceding claims wherein the membrane extends 0.64 to 1.9 cm beyond the edge of the support.
5. A structure according to claim 4 wherein the membrane extends substantially 1.27 cm beyond the edge of the support.
6. A structure according to any one of the preceding claims wherein the membrane is thicker than the support.
7. A structure according to any one of the preceding claims comprising also a protective coating over the surface of the mem-

protective sheet (15) is then pulled as evenly as possible in the direction of application. The structure will unroll as the protective sheet is stripped off. About half the periphery of the roll consists of exposed, but free, membrane as at (16) which allows a degree of adjustment in the direction of the roll. Such adjustment can be made by moving or merely applying force on the sheet (15) as at (17), or by actually pushing one side of the roll.

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2. A structure according to claim 1 wherein the membrane extends beyond both of the long sides of the support.
3. A structure according to claim 1 wherein the membrane extends beyond only one of the long sides of the support.
4. A structure according to any one of the preceding claims wherein the membrane extends 0.64 to 1.9 cm beyond the edge of the support.
5. A structure according to claim 4 wherein the membrane extends substantially 1.27 cm beyond the edge of the support.
6. A structure according to any one of the preceding claims wherein the membrane is thicker than the support.
7. A structure according to any one of the preceding claims comprising also a protective coating over the surface of the mem-



\* C L M S \*

brane remote from the support and over optionally the exposed part of the membrane adjacent to the support, the protective coating being such that it can be removed from the membrane without substantially damaging the membrane.

8. A structure according to claim 7 in the form of a roll.

9. A structure according to claim 1 substantially as described in Example 1.

10. A method of forming a waterproof seal on a surface, the method comprising applying to the surface of an exposed face of the membrane of a structure according to any one of the preceding claims, the exposed face being remote from the support.

11. A method according to claim 10 wherein the surface is that of a concrete structure.

12. A method according to claim 11 wherein the concrete structure is part of a split-slab construction, and a topping slab is pressed on to the structure according to any one of claims 1 to 9.

13. A method according to any one of claims 10 to 12, wherein the structure is as defined in claim 8 and the method comprises stripping back a small portion of the protective coating to expose a small portion of the membrane, positioning the roll for unrolling in a desired path along the surface, adhering the small exposed portion of the membrane to the surface, pulling the protective coating in the direction of the desired path thus causing the protective coating to be stripped from the roll exposing the membrane and at the same time causing the structure to unroll along the desired path and adhering itself to the surface.

14. A method according to claim 10 substantially as described herein.

16. A surface treated by a method according to any one of claims 10 to 14.

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1973.  
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY  
from which copies may be obtained.



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