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A STUDY OF FIBERGLASS FABRICS FOR MEMBRANE AND JOINT WATERPROOFING

by

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A STUDY OF FIBERGLASS FABRIC FOR MEMBRANE AND JOINT WATERPROOFING

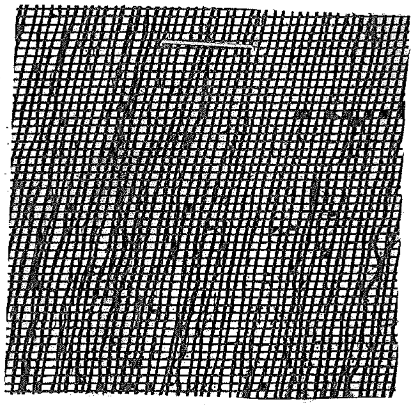
This investigation was begun at the request of the Construction Division in order to determine the feasibility of using fiberglass fabrics as a substitute or alternate for cotton fabric in connection with damp-proofing, membrane waterproofing and joint waterproofing operations on concrete structures. In addition to the fiberglass and conventional bituminized cotton fabrics, a material utilizing war surplus shrimp netting was also included in the study.

Samples of the four types of material, consisting of fiberglass with and without asphalt coating, bituminized cotton fabric, and bituminized shrimp netting respectively, are shown and described in Figure 1.

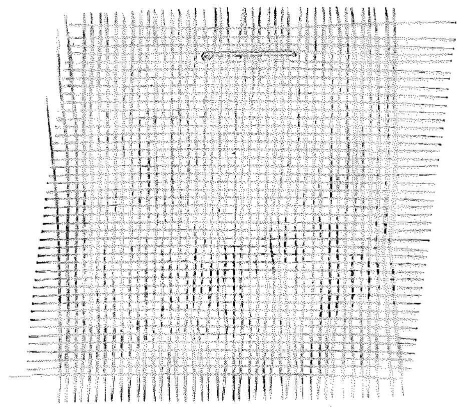
Two series of tests were made of both cotton and fiberglass fabrics. In the first series the materials were tested in accordance with the standard ASTM methods required by current Department specifications. In the second, a low-temperature tensile test of the material when applied over a concrete joint was used.

Standard Tests

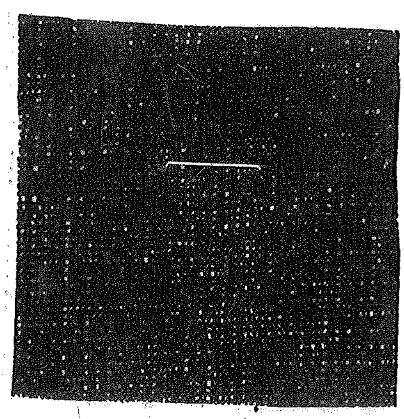
Present Department requirements for bituminized cotton fabric are covered by ASTM specification D 173, except that moisture content is limited to a maximum of 2 per cent instead of 4 per cent. Tests for breaking strength, pliability, moisture content and amount of saturant were carried out in accordance with ASTM method D 146-47 for bituminous saturated fabrics, except that the Material B was obtained by removing the asphalt from the glass fabric in order to determine whether or not its presence materially affected the



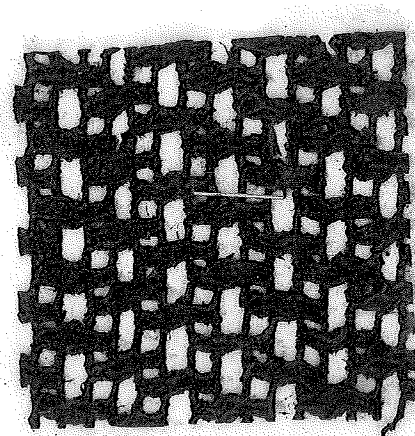
Material "A"
An asphalt-impregnated glass fabric submitted by the Owens-Corning Fiberglass Corporation of Detroit, Michigan.



Material "B"
The same glass fabric with the asphalt removed by means of a suitable solvent.



Material "C"
An asphalt-impregnated cotton fabric with a fine weave. Philip Carey Company, Detroit, Michigan.



Material "D"
An asphalt-impregnated shrimp netting. Servicized Products Company.

Figure 1. Types of fabrics included for study.

physical characteristics of the fabric. Removal was accomplished by repeatedly washing the fabric in trichloroethylene until the solvent and cloth were no longer discolored.

Table 1 gives a comparison of the test results for the various materials with Michigan State Highway Department Specifications. Moisture content and saturant tests were not run on Material B because the specifications would not be applicable in this case, nor on Material D due to lack of samples. It is to be noted that the quantity of saturant is low for Material A. This is to be expected since the glass fibers are nonporous, and the absorption correspondingly low. For that reason this specification should not apply to Material A. Moreover, in view of the fact that the glass is not subject to rotting, there seems to be no valid reason for pretreating this type of fabric with asphalt.

The tensile tests showed that the strengths of Materials A, B and C are well over the present specification requirement of 50 lb. per in. for cotton fabrics, and that the glass fabrics were stronger than the cotton. Material D falls far short of minimum strength requirements in both the wet and dry state.

In handling the glass fabrics, it was noticed that the glass fibers were quite brittle. This was evidenced by the fact that the fabric broke upon sharply creasing the cloth a few times in the same spot with the fingers, although the material passed the ASTM mandrel test.

Low-Temperature Tensile Test

The low-temperature tensile test was carried out in order to study the behavior of the fabrics under conditions similar to those encountered in the field. Concrete blocks 3 in. thick, 6 in. long and 8 in. wide were cast and

TABLE 1

SUMMARY OF DATA FROM STANDARD TESTS

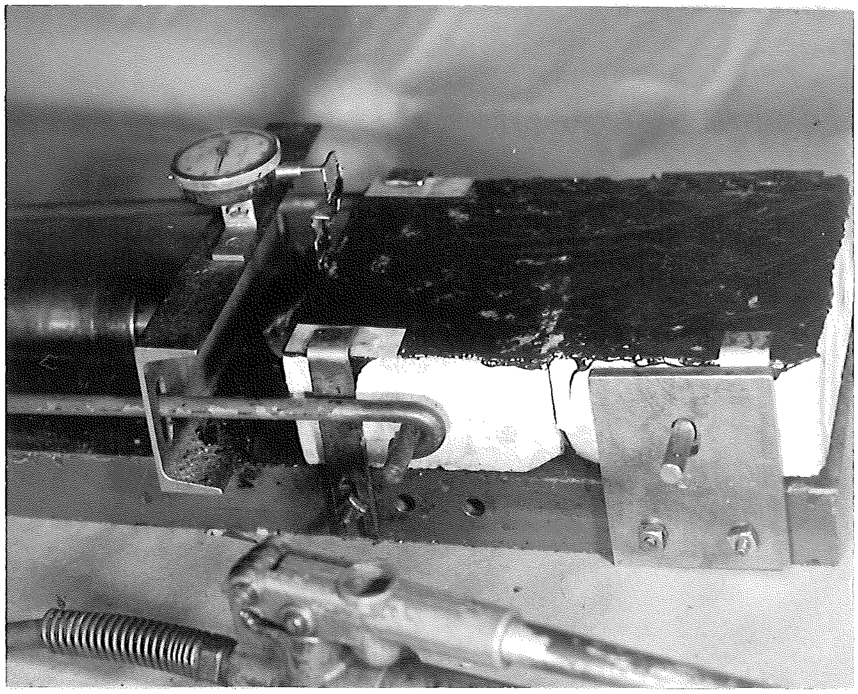
Test	M.S.H.D. Requirements	Material A	B	C	D
Average Strength, Dry					
Warp	50 lb. minimum	81.8	86.0	69.8	19.4
Filling	50 lb. minimum	88.2	75.2	55.6	0.6
Average Strength, Wet					
Warp	50 lb. minimum	—	—	68.4	20.8
Filling	50 lb. minimum	—	—	60.0	1.0
Pliability at 32° F	No cracking when bent over a 1/16-in. mandrel 180° in one direction and then 360° in the other direction.	OK	OK	OK	OK
Moisture Content	2 per cent maximum	0.1	not tested	2.0	not tested
Saturant in Fabricated Material	1.6 times the wt. of moisture-free fabric in the same area.	0.79	not tested	1.65	not tested

cured. The blocks were surface-ground in order to remove the laitance, air-dried, and blown free of dust. The fabric was then applied across a joint formed by placing two of these blocks together, 6-inch edges in contact. Application was according to Michigan State Highway Department Standard Specifications, except that SOA was substituted for MOA. This method made a specimen with two layers of fabric sandwiched between three layers of SOA, having a test width of 6 inches at the joint. The fabric area bonded to the surface of each block was 6- by 6-in. The specimens were cooled to 0° F and then placed in a tensile tester (Figure 2, illustrations A and B) with a cabinet over the specimens. By keeping dry ice inside the cabinet, an equilibrium temperature near 0° F was maintained throughout the test. Applied load and elongation of the fabric at the joint were observed and recorded. The type of failure was also noted.

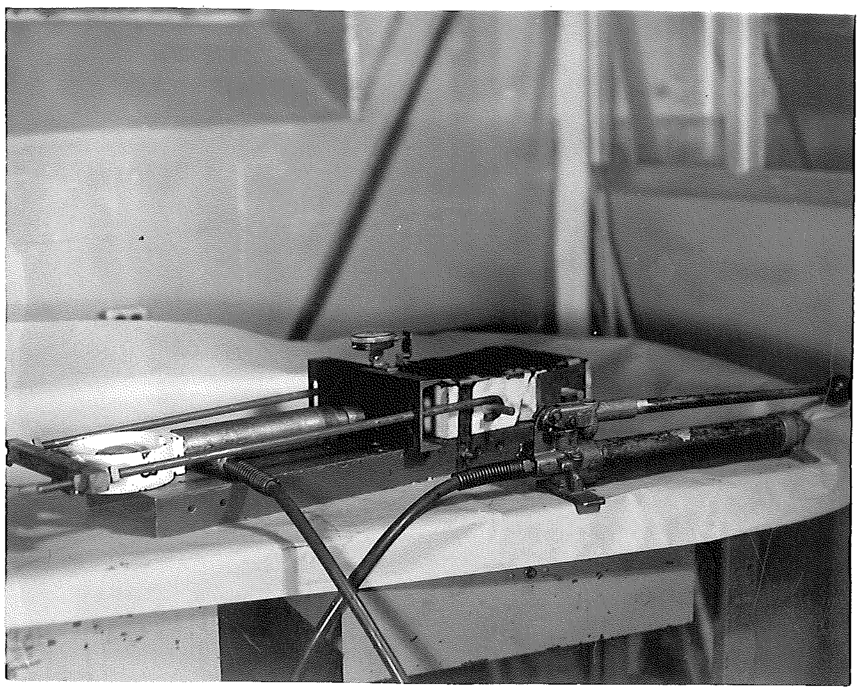
The low-temperature test showed three distinct types of failure:

1. Failure in bond between asphalt and concrete - Figure 3.
2. Failure in bond between asphalt and fabric - Figure 4.
3. Failure of fabric - Figure 5.

Fabrics A, B and C exhibited both of the first two types of failure, while fabric D exhibited the last type. The data on cold tensile strength test given in Table 2 indicate that the glass fabrics, both impregnated and untreated, were considerably stronger in the low-temperature test than either of the cotton fabrics. This seemed to be due to better bonding between the asphalt and the glass fabrics than between the asphalt and cotton fabrics. The data in Table 2 are also presented graphically in Figure 6 and show that there was little difference in the elongation of the four membranes at failure. It should be kept in mind, however, that all of the membranes did not



A



B

Figure 2. Two views showing apparatus used in low-temperature tensile test of waterproofing fabrics.

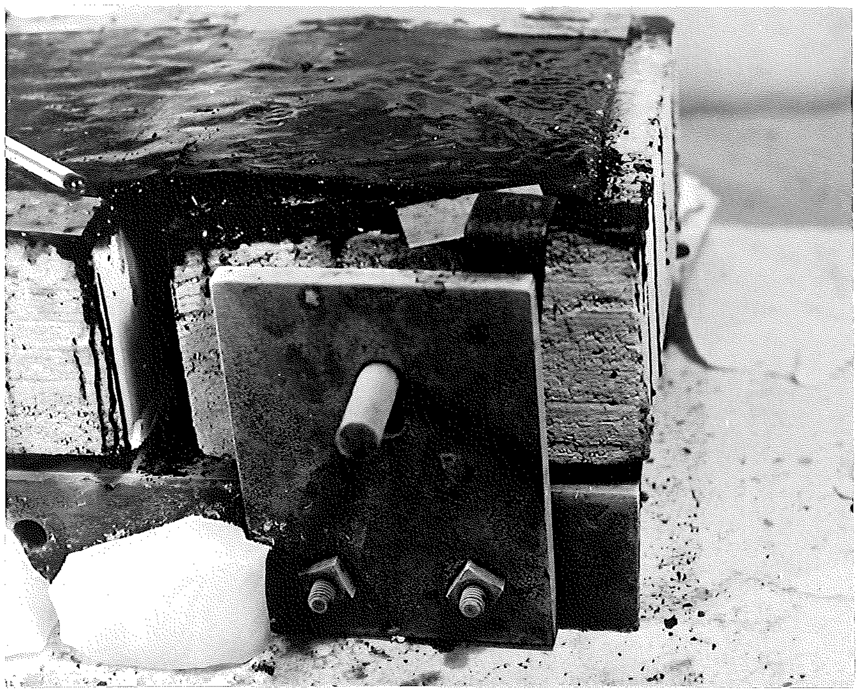


Figure 3. Note how cloth has slid over surface of the block.

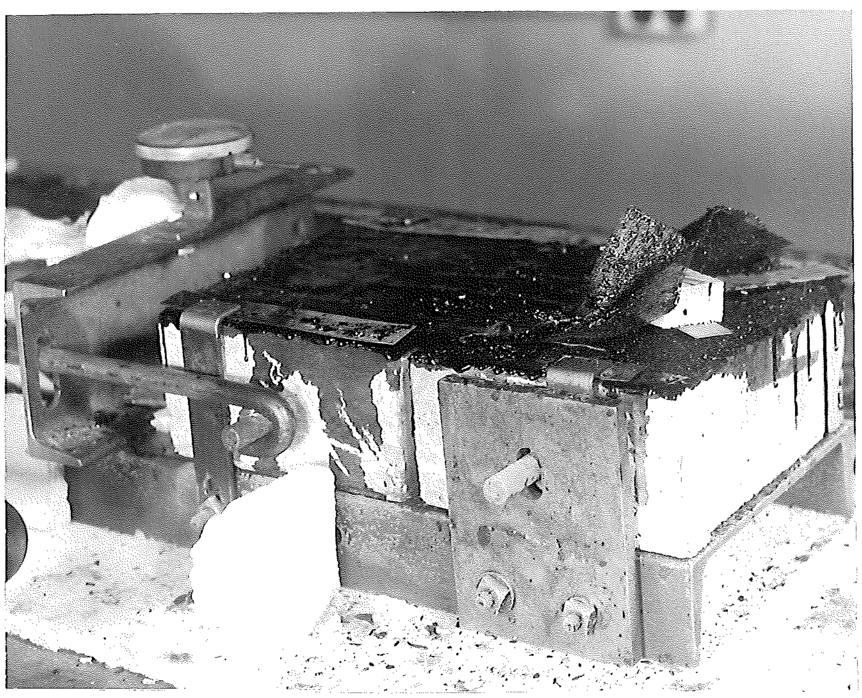


Figure 4. Note how fabric layers have separated.

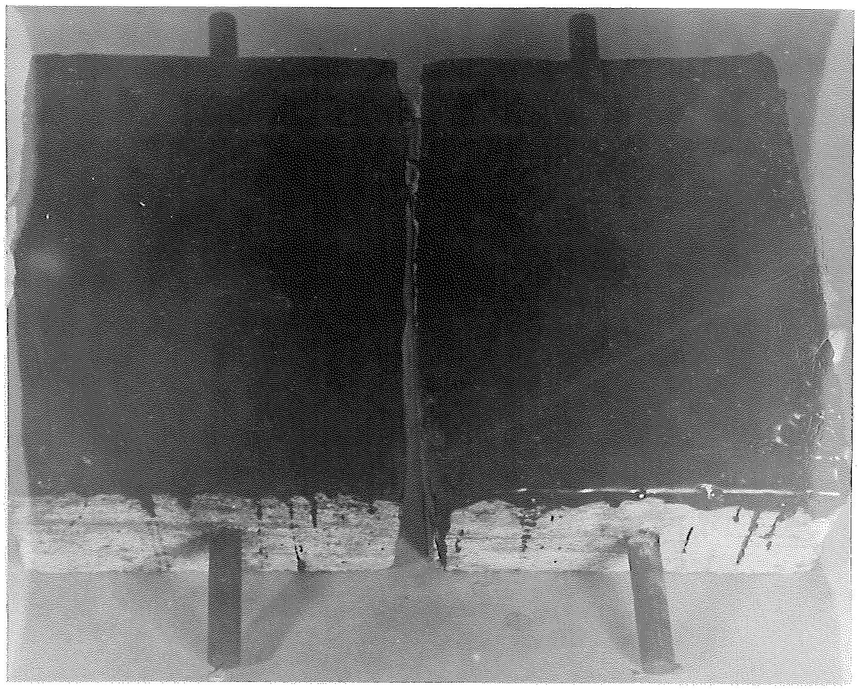
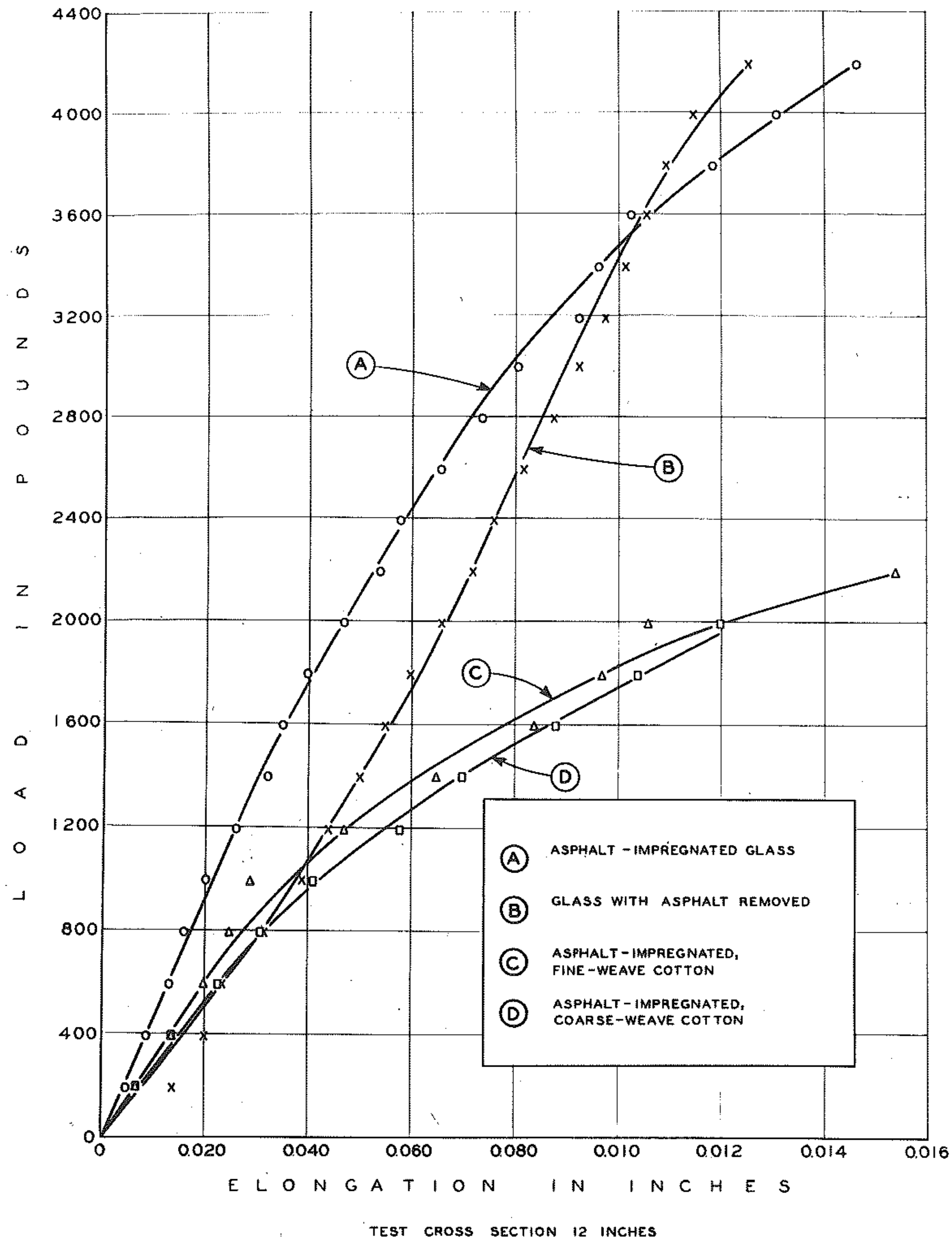


Figure 5. Note clean break of fabric at the joint.



LOAD-ELONGATION CURVES *for* COLD TENSILE TESTS *of* WATERPROOFING FABRICS

Figure 6

TABLE 2

DATA SUMMARY FOR COLD TENSILE TEST OF
WATERPROOFING FABRICS

Load, lb.	Stress, lb./in.	Average Elongation, inches A	B	C	D
200	16.7	0.014	0.005	0.007	0.007
400	33.3	0.020	0.009	0.014	0.014
600	50.0	0.020	0.013	0.020	0.023
800	66.7	0.032	0.016	0.025	0.031
1000	83.4	0.039	0.020	0.029	0.041
1200	100.0	0.044	0.028	0.047	0.058
1400	116.7	0.050	0.032	0.065	0.070
1600	133.4	0.056	0.035	0.084	0.086
1800	150.0	0.060	0.040	0.097	0.104
2000	166.6	0.066	0.047	0.106	0.120
2200	183.4	0.072	0.054	0.154	——
2400	200.0	0.076	0.058	——	——
2600	216.7	0.082	0.066	——	——
2800	233.3	0.088	0.074	——	——
3000	250.0	0.093	0.081	——	——
3200	266.7	0.098	0.093	——	——
3400	283.3	0.102	0.097	——	——
3600	300.0	0.106	0.103	——	——
3800	316.0	0.110	0.119	——	——
4000	333.3	0.115	0.131	——	——
4200	350.0	0.126	0.147	——	——

Note: Last figure in elongation column indicates elongation immediately prior to complete failure.

fail in the same manner, the membrane containing Material D being the only one in which the fabric was broken at failure.

Summary

From these tests and observations the following conclusions can be drawn:

1. Glass fabric of the type included in the investigation is suitable as a substitute or alternate for bituminized cotton fabrics manufactured for membrane waterproofing purposes.
2. Apparently the asphalt coating of the fiberglass fabric serves no useful purpose, except possibly to promote ease of handling, and a reduction in cost might be effected by eliminating this operation from the manufacturing process.
3. The bituminized shrimp netting submitted for these tests is not satisfactory for waterproofing because of its very low tensile strength.