TECHNICAL INFORMATION ON BUILDING MATERIALS

TIBM-56

FOR USE IN THE DESIGN OF LOW-COST HOUSING

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PLASTIC CAULKING AND POINTING MATERIALS

Part II

Investigations

A discussion of the composition, uses, and service requirements of plastic caulking and pointing materials appears in TIBM-24, as issued in August, 1936. Since that time additional studies have been made under the direction of D. W. Kessler on the performance of various proprietary materials in actual service, in exposure tests, and by laboratory tests. In this work particular attention was given to determining the reliability of laboratory tests as an indication of service value. The laboratory methods used in testing samples for numerous government buildings have been described in a paper entitled, "A Test Procedure for Plastic Caulking Materials", published in the Proceedings of the American Society for Testing Materials, Vol. 35, Part II, page 581, 1935. A brief summary of the results of such tests on 15 brands of the more widely used caulking materials is given in the following table:

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SUMMARY OF TEST RESULTS FOR
FIVE SUCCESSIVE YEARS*

BRAND	1932		1933		1934		1935		1936		PASSING AVERAGE (PERCENT)
	NO. TESTED	PERCENT PASSING	NO. TESTED	PERCENT PASSING	NO. TESTED	PERCENT PASSING	NO. TESTED	PERCENT PASSING	NO. TESTED	PERCENT PASSING	
A	3	100	2	100	1	100	8	87	9	67	91
B	0	0	9	78	3	67	2	50	1	100	74
C	9	67	12	67	6	83	10	60	20	45	64
D	10	60	13	23	10	60	20	55	18	67	53
E	42	81	44	75	31	29	32	44	18	28	51
F	6	17	19	32	5	80	40	52	41	68	50
G	32	12	30	87	18	61	27	41	43	35	47
H	17	71	12	25	3	67	19	16	28	36	43
I	19	32	13	54	4	25	8	63	7	30	41
J	8	63	10	70	8	25	3	33	4	4	38
K	3	0	13	31	7	71	3	67	6	17	37
L	2	0	8	25	4	50	7	0	12	50	25
M	4	50	6	33	4	0	21	19	13	15	23
N	5	80	3	0	4	0	3	0	1	0	16
O	19	10	13	15	6	0	16	13	20	10	10

*IN THIS RATING, SAMPLES SHOWING ONLY A SLIGHT STAIN ON MARBLE OR SLIGHT SLUMPING IN A LIMESTONE GROOVE WERE CONSIDERED AS PASSING THESE TESTS.

The large number of failures shown for most brands indicate that factory processes are not usually controlled sufficiently to insure uniform performance. Hence, it is not logical to specify such materials by brand alone. Unsystematic fluctuations in most brands suggest that different consignments of raw materials may vary sufficiently to account for the lack of uniformity in the finished products. Certain phases of the investigation have progressed sufficiently to give results of interest. These are described as follows:

EXPOSURE TESTS

Limestone Staining Test Specimens: These studies were made primarily for the purpose of determining whether test methods give accurate indications of service values, and whether simpler tests can be employed. Specimens used for slump and staining tests on all samples tested during the past six years have been exposed to the weather for observations. About 2000 of these are now being studied. Specimens showing shrinkage or cracking sufficient to indicate that the joint is no longer watertight, are rated as failing, and the exposure period noted. This method of rating has its shortcomings: first, because one cannot always be sure of the watertightness of a joint from external appearances; and second, a joint free from stresses or movements gives too little information on what the materials might do if subjected to strain, as in actual service.

Several of these specimens were tested with water to determine the dependability of the visual rating, and the indications were that about 75% of these ratings were correct. It was found that joints sometimes appeared to be faulty on account of separation of the caulking from the stone near the exposed face when they were still in good condition at a greater depth. After testing these joints with water at room temperatures, they were put in storage for a few hours at 32° F, tested, then chilled overnight at 10° F,. and again tested. The results showed only one of twenty-three specimens with an increased leakage at the lower temperatures.

Visual ratings on 838 specimens, compared with results of the usual tests, seem to show that the strain test and staining test on limestone give indications of service values. A summary of these studies is given as follows:

(1) Samples passing the strain test and showing a durability of more than three years = 47%.

(2) Samples failing on the strain test but showing a durability of more than three years = 20%.

(3) Samples failing on strain test and staining limestone, but showing a durability of more than three years = 8%.

In computing the results under (3) both primed and unprimed joints of each sample were considered, i.e., if either the primed or unprimed joints indicated a durability of three years, the sample was counted as one giving

better service than the usual tests would predict.

Since a large percentage of the specimens are apparently still in good condition, it is not possible to reach definite conclusions concerning the relation between the usual laboratory tests and durability. From the analysis of 838 exposure specimens, it appears that 8% of the materials rejected by the strain test and staining test on limestone would give reasonably good service in joints where the caulking material is not subjected to strain.

The strain test is a measure of adhesiveness as well as extensibility. The staining test determines the resistance of the caulking to loss of oil by capillary suction of the masonry. In general, it may be said that loss of oil reduces the plasticity of the caulking material in proportion to the amount of oil lost. Adhesiveness and cohesiveness may likewise be affected; hence, the two tests are related. The staining test on marble often causes rejections of samples which pass all other tests. However, a sample may cause a large amount of staining on marble without causing much change in plasticity. This result is attributable to the low pore space in marble, since a small amount of oil will fill the pores of a considerable volume of marble.

Twelve percent of the samples failed to pass a copper corrosion test, but of this number 91% would have been rejected by failing to pass one or more of the other tests. Of the number rejected by the copper test alone (less than 2% of the total) nearly 60% showed satisfactory durability values.

From the foregoing, it would seem that both the staining test on marble and the copper corrosion test could be dispensed with so far as quality tests are concerned. Where caulking is to be used on marble the staining test should be made, since oil stains on marble are unsightly and difficult to remove.

The copper corrosion test might be of value in cases where facilities are not available for making the strain test, because samples that fail on copper usually fail on the strain test. Since many samples pass the copper test, and still do not have proper bonding properties, plasticity, or cohesiveness, it is not logical to replace the strain test by the copper corrosion test.

Strain Test Specimens: As the above described exposure tests gave no information on how well the caulking materials adjust themselves to structural movements, tests were initiated about two years ago in which strain test specimens are being exposed to the weather. These tests include limestone, marble, slate, and five grades of brick. Groove joints are included in these exposures with the caulking in contact with concrete, steel, and wood.

In this part of the research, strain tests are made on specimens after standing thirty days in the laboratory, and after weather exposure of thirty

days, and one year, respectively. The insufficient number of these tests completed does not justify conclusions, but certain statements in regard to apparent trends may be of interest.

Tests on limestone generally showed no differences between results for specimens stored thirty days in the laboratory, and those exposed to the weather for the same length of time. But, for specimens exposed one year, the performance was, in most cases, less satisfactory. Theories have been advanced that caulking materials perform more satisfactorily and are more durable on dense masonry materials than on the more porous varieties. These tests do not confirm that belief throughout, although the results on marble and slate are, in most cases, better than those on limestone. The tests on brick, however, seem to indicate that porosity may not be very important because several excellent results on joints between bricks were obtained where the absorption of the brick was two or even three times that of the limestone. Since no appreciable oil penetration into the bricks was noticeable, it is assumed that lower capillary suction in brick may account for the differences in performance.

Oil and Volatile Matter Losses: Shrinkage of the caulking materials in contact with masonry materials usually occurs and is believed to be mainly the result of oil loss. Since most of the materials contain some volatile oils, this loss also contributes to shrinkage. Such shrinkage causes reduction of plasticity and hence, reduces the effectiveness of the mass.

Measurements of oil and volatile matter losses have been made on various samples of caulking materials to determine their quality. Such determinations are being made in conjunction with exposure tests. If a sufficient degree of correlation is found, it may be possible to simplify test methods and reduce the time of testing.

Inspections: Several buildings were inspected during 1936-1937, for the purpose of determining the performance of plastic caulking materials in actual service. Examinations were usually made from the exterior, and in some cases it was not possible to view the materials at close range. Statements in regard to the condition of materials may not always do them justice, or faults may be overlooked at a distance of several feet. Except for the fact that caulking materials are shown under actual service conditions, and in contact with a greater variety of other materials, it is believed that the information obtained by inspection was not as satisfactory as that obtained by examining test specimens after exposure.

Where caulking materials are used around wood frames, they are nearly always covered by the staff bead and hence, not visible.

Summary: The physical tests now in use have been described and a resume of tests on samples from several of the larger producers is listed. Considering the variations of samples of any one producer which pass the test for successive years, one may conclude that none of these products should be accepted without testing, as less than half of the samples of most brands actually pass the tests.

A study of groove joints in limestone exposed to the weather for periods of from three to six years has been made for the purpose of gaining some information on how well the laboratory tests predict actual service values. Although the means of judging the exposure results is by external appearance, which is not entirely satisfactory, and the joints are not subject to appreciable deformations, as in service, it is believed that some information of value was obtained. These studies have indicated that the tests now being used, do give valuable information on durability. It seems that certain tests are unduly severe in that they reject some materials which would give good service. However, before any change is made it is desirable to gain more information on the behavior of weathered joints under strain.