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THE THERMAL COEFFICIENT OF EXPANSION OF LUMNITE CEMENT MORTARS

THESIS FOR DEGREE OF B. S.

IN CIVIL ENGINEERING

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THESIS

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THE THERMAL COEFFICIENT

OF EXPANSION

OF LUMNITE CEMENT MORTARS

A Thesis Submitted to the Faculty of

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THESIS

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In reinforced concrete construction it is important that the thermal coefficient of expansion of the concrete is about the same as that of the reinforcing steel. Otherwise considerable stress may be caused in both the steel and concrete by a variation in temperature from the temperature at which the concrete set. The nescessity for expansion joints is also controlled by the coefficient of expansion.

Portland cement mortars and concretes have been tested, and the thermal coefficient of expansion has been found to agree closely with that of steel. However, a new cement, which is likely to become popular, because of its fast setting property, is now on the market. This is called Lumnite cement, and in America is made by the Atlas Lumnite cement Company. The purpose of this thesis is to explain the method used, and to give the results of, some tests made to determine the thermal coefficient of expansion of mortars of sand and Lumnite cement.

The apparatus used was the optical lever, telescope, and scale used for such work by the Physics Department of the Michigan State College, and a standard and steam jacket made for the purpose. With this apparatus, the coefficient could be determined within 0.0000001 inch, if care was taken.

The specimens were heated by steam, since this provided a sure method of uniformly heating them, and determining the temperature. The steam jacket was insulated with asbestos pipe covering, so that the posts of the standard would not be effected by the heat from the steam jacket.

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In order to avoid expansion thru moisture, the specimens were cured and stored in water. Two specimens were made of each mix tested, each being tested once, and the average coefficient was taken. All specimens were tested at 31 days.

The original intention was to cool the specimens in ice water, getting a wider range of temperature than by starting at room temperature. However, it was found to be difficult to maintain them at that low temperature while putting them in the steam jacket, and getting the first reading. The time needed to get full expansion was only from 20 minutes to 30 minutes, and the specimens would warm up appreciably in warm air in a few minutes.

The specimens were bars of mortar 38 inches long, and 1 inch in crossection. They were made as nearly of the same consistency as they could be, considering that they were made on different days and of different mixes. The normal consistency of Lumnite cement was taken from a bulletin by Mr. Rothgary, of the Civil Engineering Department of the Michigan State College. This value was 25.8% water. The percentage of water recommended by the American Society for Testing Materials for standard Ottawa sand mortar, 1:3 mix, to correspond to a normal consistency of 26%, is 10.8%. A sample of standard mortar, 1:3 mix, was made, using 10.8% water. This gave a standard for comparison in making the specimens. The sand used for the specimens was screened thru a 20 mesh sieve, from bank run gravel.

The results of the tests, as shown in the table, indicate that the cement is suitable for reinforced concrete work. The coefficient of expansion of neat Lumnite cement is , 0.0000071 as compared to 0.0000078 for Portland Cement. The coefficients for the mortars range about 0.0000060 while the coefficient of expansion of reinforcing steel is about 0.0000065.

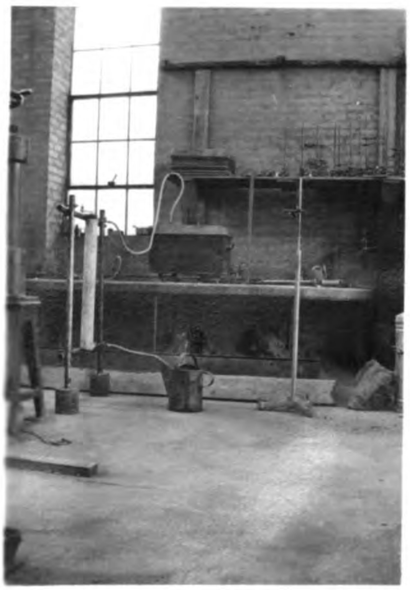
The expansion of the mortars decreases as the percentage of cement is decreased, until a minimum is reached with 1:3 mortar. From then on the expansion increases. There is no apparent reason for this, since, if the coefficient of expansion of sand is less than for the cement, the expansion of the mortars should decrease as the mixture is made weaker.

The only other explanations that seem to offer a solution, aside from an improbable variation in the nature of the sand, are variations in the consistancy of the mix, or variations in mixing or compacting of the specimens when molding them. A indication that one of these three is the proper explanation is the result obtained with a specimen of 1:3 mix, using 15% water, rather than 15.4%. The coefficient found for this specimen was 0.0000060 as compared to 0.0000064, which was found to be the coefficient for the specimens using 15.4% water.

Such results show that the coefficient of expansion cannot be predicted for any particular mix with accuracy, unless great care is taken to get exactly the same conditions in the mixing and handling, as were had in making the test specimens upon which the prediction is based. In other words, in practice the coefficient of expansion cannot be exactly predicted. However, these variations do not seem to amount to enough to seriously effect stressis in concrete or steel.

Table

mixture	% water	temperature change	scale reading	coeff.	av. coeff.
neat	10.8	135	37.0	.0000071	.0000071
1:1	16.4	148	37.0	.0000065	
1:1	16.4	148	35.0	.0000061	.0000063
1:2	16.5	138	30.0	.0000056	
1:2	16.5	139	30.5	.0000057	.00000565
1:3	15.4	145	36.0	.0000064	
1:3	15.4	143	35.0	.0000064	.0000064
1:4	16.0	145	38.0	.0000068	
1:4	16.0	145	38.0	.0000068	.0000068



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