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LABORATORY STUDY OF EFFECTS OF ENVIRONMENT AND CONSTRUCTION PROCEDURES ON CONCRETE PAVEMENT SURFACES

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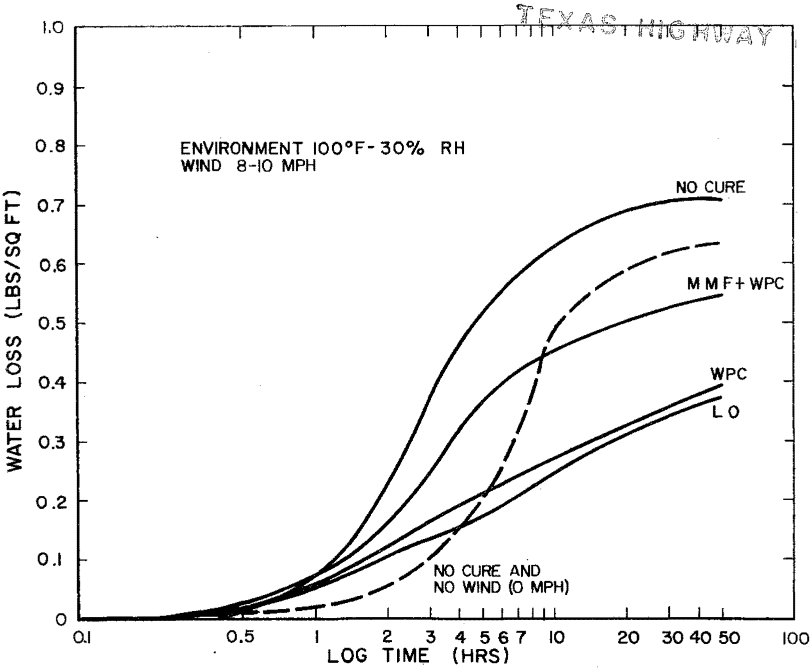

Effect of Curing Method on the Evaporation of Water from the Surface of the Concrete Slabs at a Curing Temperature of 100°F and Wind Velocity of 8-10 mph.

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Laboratory Study of Effects of Environment and Construction Procedures on Concrete Pavement Surfaces

by

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General

The construction procedures for Continuously Reinforced Concrete Pavements (CRCP) have continued to change during the past ten years of extensive use. These changes have come about through field experience and research and have resulted in better pavements. However, costly failures still occasionally occur, even though the state-of-the-art has continued to be improved. A concrete pavement must provide a smooth ride for the traveling public, be durable when subjected to natural weathering and to chemicals used for snow and ice control, and be capable of sustaining the traffic it was intended to carry.

Proper consolidation, proper finishing, and proper curing are of particular importance in the production of this high quality concrete. Today, considerable research efforts are being applied to the problems of improper consolidation, finishing, and curing of CRCP. This research study has been devoted to determining the effects of variations in surface finishing, curing method and environment, materials, and vibration of CRCP. This report summarizes the results of the laboratory examination of construction practices related to this research study.

Purpose of the Investigation

This study was initiated to develop methods whereby the handling practices of portland cement concrete pavements during construction could be improved through a laboratory examination of construction practices related to the consolidation, finishing, and curing.

Scope

The scope of this laboratory investigation included:

1. A determination of the effects of vibration on concrete properties by varying the method of vibration, coarse aggregate type, and subbase type.

2. A determination of the effects of surface finish on the surface properties of concrete by varying the type of surface finish.

3. A determination of the combined effects of wind velocity, air temperature and relative humidity, concrete temperature and type of curing compound on surface properties of concrete.

Conclusions

The following conclusions were reached after laboratory evaluations were made on high quality, low slump concrete.

1. All of the methods of consolidation investigated produced adequate strength.

2. Mechanical vibration of concrete slabs, whether internal or surface, improved the surface properties of the concrete.

3. Concrete slabs made with a mixture of rounded siliceous gravel and crushed limestone resulted in higher strengths than concrete made with either rounded or crushed coarse aggregate and a single fine aggregate.

4. Neither the type nor the texture of the subbases investigated adversely affected the strength of the concrete slabs.

5. Placing fresh concrete on a dry subbase (even at 140°F) did not adversely affect the strength of the concrete slabs. However, there may be other benefits from wetting the subbase.

6. In all cases (73°, 100°, and 140°F curing temperatures) adequate strengths were obtained. But, curing temperatures in excess of 100°F resulted in a significant reduction in the strength of the top portion of all concrete slabs, even though adequate curing methods were used. With the simulated wind conditions of 8-10 mph and 18-20 mph, this reduction in strength was even more pronounced. Conversely, high curing temperatures and the wind conditions did not significantly affect the strength of the bottom portion of the concrete slabs.

7. At temperatures in excess of 100°F, the surfaces cured with the combination monomolecular film (one application before final finish) followed by white pigmented compound (MMF + WPC) showed a high abrasion loss as compared to the surfaces cured with either water soluble linseed oil (LO) or white pigmented compound (WPC) by itself. Thus, there appeared to be no surface strength benefits from the one application of the MMF before finishing.

8. Evaporation of water from the surface of the slabs was significantly retarded with the use of any of the curing compounds (MMF + WPC, LO, and WPC). LO and WPC tended to retard the evaporation more than MMF + WPC. Thus, the laboratory results do not show any advantage to the particular way in which MMF was used as an evaporation retarder. Conversely, the use of an adequate curing compound was shown to be advantageous (see Figure).

9. Evaporation rates measured experimentally in this study did not agree with the values predicted by the PCA chart, especially those where wind was present.

Recommendations

Based on the results of the laboratory phase of this study, the following recommendations are made:

1. Extend the scope of the laboratory study by initiating full scale field tests to verify the conclusions reached in this laboratory study.

2. Conduct a laboratory investigation under low temperatures (50°F) and compare these results with the results obtained from this research.

3. The water soluble linseed oil curing compound should be checked against current Highway Department specifications and utilized in a full scale field test to verify its value.

Implementation Statement

As a result of this study, the present Texas Highway Department specifications and/or the Construction Manual include requirements for (1) minimum vibration frequency, (2) maximum internal vibrator spacing, and (3) the use of evaporation retarders to prevent the pavement from drying too rapidly during equipment breakdown or other emergencies.

Additional implementation is not recommended until these laboratory results are verified under field conditions.

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