Engineering Brief # 25

Date: April 18, 1981
In Reply Refer To: AAS-200

SUBJECT: INFORMATION: Engineering Brief No. 25 - Shrinkage - Compensating Cement for Airport Pavements

From: Chief, Engineering and Specifications Division, AAS-200
To: All Regions

ATTN: Airports Division Chiefs

Enclosed are copies of Engineering Brief No. 25, Shrinkage-Compensating Cement for Airport Pavements. This brief provides information and guidance on the use of shrinkage- compensating cement for concrete airport pavements. Any comments you may wish to offer would be appreciated.

ORIGINAL SIGNED BY:
RAYMOND T. UHL
for
EDWARD AIKMAN

Enclosure

ENGINEERING BRIEF NO. 25

Shrinkage - Compensating Cement for Airport Pavements

The purpose of this Engineering Brief is to discuss the use of shrinkage - compensating cement on airport pavements. Systems Research and Development Service recently published research report number FAA-RD-79-11, "Shrinkage - Compensating Cement for Airport Pavement, Phase 3 - Fibrous Concrete." Publication of this report completes our request for research on shrinkage - compensating cements. Two reports were published previously under this effort; FAA-RD-75-89, "Shrinkage -Compensating Cement for Airport Pavements," dated June 1975 and FAA-RD-79-11, "Shrinkage - Compensating Cement for Airport Pavements," Phase 2, dated September 1979.

Shrinkage compensating cement is designated as Type E-l(K) in ASTM Specification C-845. Concrete produced with shrinkage-compensating cement expands after mixing and during the moist cure period. As the concrete is allowed to air-dry it shrinks. In an ideal situation, the initial expansion would exactly equal the air dry shrinkage and the volume of the concrete would be the same after curing as during placing. In this instance the need for contraction"" joints would be eliminated.

Concrete produced using shrinkage - compensating cement was used on two projects on Love Field in Dallas, Texas, in 1969 and 1971-72. Slab lengths of 125 feet and 75 feet were used on the '69 and '71-'72 projects respectively. The reason for reducing the joint spacing in the latter project was because the joint sealant was unable to accommodate the temperature induced movements experienced with the 125 foot joint spacing.

Should a sponsor wish to construct a rigid pavement using shrinkage - compensating cement as a pilot project, headquarters would be receptive to such a project. Since joints in rigid pavements are often a source of maintenance problems, we feel materials which have the potential for reducing the number joints merit further work. Some unique factors must be considered@ in planning a pilot project using shrinkage - compensating cement. The factors which we feel are important are discussed below:

1. Jointing. - The number of contraction joints can be reduced significantly when shrinkage - compensating cement is used in the concrete, however, slab movements brought on by thermal changes and gradients must still be accommodated. The longer joint spacing will result in larger movements at the joints thus placing greater demands on joint sealant materials and load transfer devices. Reliance on aggregate interlock for load transfer is not recommended.

2. Costs. - The use of shrinkage - compensating cement in concrete will add about $10 to $12 to the cost of a cubic yard of concrete, depending on the cement factor. The slabs must also contain steel reinforcement which adds to the cost of the pavement. The minimum amount of reinforcement recommended in American Concrete Institute (ACI) 223-77 "Recommended Practice for the Use of Shrinkage Compensating Concrete" for slabs on grade is 0.15 percent in each direction. In computing the cost benefit associated with the use of shrinkage - compensating cement the added cost of the cement and steel must be weighed against the advantages of greater joint spacings and attendant reduction in pavement maintenance costs. '

3. Water Cement Ratio. - Concrete made with shrinkage - compensating cement will require a higher water cement ratio because of its increased water demand for hydration. The resulting higher than normal slump affords much easier workability without loss of strength or formation of bleed water. On site inspectors need to be advised that higher than normal slumps should be expected. Slip form paving ma@ be very difficult if not impractical due to the high slump particularly if thick pavements are involved.

4. Slab Size. - While the above referenced research studies indicate slab lengths of up to 200 feet are possible, this office feels slab lengths should be limited to 125 feet until more experience is gained. Slab widths should be kept to a maximum of 25 feet. The reason for recommending these values is based on the need to accommodate temperature induced slab movements. We feel joint sealants and load transfer devices could not perform their intended functions in slabs 200 feet long without very elaborate and costly jointing s@stems. In limiting slab widths to 25 feet our rationale is to keep warping stresses within reasonable bounds.

5. Setting Time. Shrinkage-compensating concrete is slightly

more sensitive to temperature extremes than conventional concrete, i.e. , it tends to set somewhat faster in hot weather and somewhat slower in cold weather. However, under normal conditions, its handling characteristics are very similar to a comparable Type I portland cement concrete.

6. Durability. Concrete produced with shrinkage-compensating cement is as resistant to freeze-thaw effects and has sulfate resistance equal to or better than conventional portland cement concrete. Shrinkage- compensating cement is more resistant to abrasion and less permeable than conventional portland cement concrete.

7. Placement. - Guidelines contained in ACI 223-77 offer useful- information on placement techniques.

The above list of factors which we feel affords special attention in any project involving shrinkage-compensating cement for airport pavements is probably not all inclusive. The list represents what we envision as important considerations based on limited experience and research.

Attached is a copy of ACI 223-77 which contains the most comprehensive discussion of the use of shrinkage-compensating cements currently available. Reproduction of ACI-223-77 was allowed by special permission from the American Concrete Institute.

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