NOTES ON POSSIBLE MECHANISMS OF EARLY AGE CRACKING OF CONCRETE PAVEMENTS OVER LEAN CONCRETE BASES

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These condensed preliminary notes are limited to the possible interactions of rigid bases (lean concrete bases) with concrete pavements, causing early age cracking of the pavements. The detrimental interactions known to us and investigated in the field can be grouped, according to their physical nature, as follows:

- Interactions caused by bonding of rigid base to concrete pavement, and
- Interactions caused by absorption of moisture by lean concrete base.

Bonding of concrete pavement to lean concrete base results in:

- Restraining volume changes of pavement,
- An increase of the total thickness of the pavement section (which typically is not compensated accordingly by deeper saw cutting, because the contractor is unaware of such bonding), and
- Telegraphing cracks formed in lean concrete base after concrete placement into the pavement layer.

All three conditions result in promoting early age cracking of concrete pavements and make saw cutting less efficient and predictable in preventing formation of random cracks.

Caltrans specifications and special provisions of projects do not limit maximum compressive strength of lean concrete base. FAA documents set both minimum and maximum strength requirements for econocrete. For example, if strength of econocrete as established in the course of the mix design studies exceeds 500 psi in 3 days, econocrete is required to be saw cut at the locations of the future saw cuts in concrete pavement. Comparison of Caltrans and FAA requirements may be of interest.

Absorption of water from pavement by lean concrete base results in:

- Redirecting moisture movement from “bottom to top” to “top to bottom,” and
- Causing “bubbling” on the surface of fresh concrete.

Lean concrete bases are often produced using recycled aggregates. Absorption of recycled aggregates, especially of their fine sizes, is moderately to significantly higher than that of the natural aggregates. Therefore the impact of moisture absorption on the cracking of pavement would be expected to be more pronounced in rigid base containing recycled aggregates than in that containing natural aggregates. Redirection of moisture movement increases risk of direct moisture evaporation from concrete due to ambient conditions and promotes plastic shrinkage cracking. In this case analysis using the Menzel equation only, as provided by ACI 305, may underestimate plastic shrinkage potential.

The absorption of water by lean concrete base causes a delayed release of additional quantities of air into unhardened concrete after completion of vibration and is one of the mechanisms contributing to bubbling.

The two simplest measures to prevent cracking of pavements due to their interactions with lean concrete bases are:

- Proper debonding of lean concrete from the pavement course, and
- Saturating lean concrete base with water prior to placing portland cement concrete pavement.

An additional measure to prevent direct moisture evaporation from concrete and to reduce the risk of plastic shrinkage cracking due to redirecting moisture movement is fogging prior to application of curing compound. This measure is, however, associated with an additional cost.