DATE: April 29, 1991

TO: Unit Leaders

FROM: A. J. Siccardi

SUBJECT: Technical Memorandum #8
Observations of a Texas study concerning abutment backwall damage. (Study by Texas Transportation Institute (TTI))

The following figure depicts a longitudinal section through a typical bridge approach as used by the Texas State Department of Highways and Public Transportation (Texas SDHPT). The section is not significantly different from the practice in Colorado; i.e., we have pretty much settled on stub type abutments more often than not, supported on piling rather than on drilled shafts, but in most cases one of these two systems, approach slabs, and sleeper slabs.

FIGURE

The Texas Study observed abutment backwall damage on a random sampling of some 83 bridges. Of the sampling, 77 bridges were adjacent to asphalt concrete pavement (ACP); 6 bridges were adjacent to portland cement concrete pavements (PCCP). It is

interesting that no damage to abutment backwalls was noted in those bridges adjacent to ACP's while damage was observed in 3 of those bridges adjacent PCCP's. It is reasonable to assume, based on these observations, that similar mechanisms are likely to be encountered in similar circumstances, i.e., if abutment damage is to be observed, it is likely to occur at bridge abutments adjacent to PCCP.

Two mechanisms were identified by TTI as potential causes of the longitudinal motion or growth of the PCCP resulting in backwall damage.

1. Thermal Ratcheting Mechanism - This mechanism consists of a thermal expansion of the PDDP during a summer season, followed during cooler months by a thermal contraction which is restrained by ground friction on the lower surface of the PCCP sufficiently to open transverse cracks. These tracks are partially blocked with fne soil particles carried from the roadway into the cracks by water. Subsequent seasonal expansion and contractions result in a "ratcheting increment of growth. This mechanism is hypothetically unbonded and could cause enough longitudinal growth to close the joints between the pavement and the approach slab, and between the approach slab and the bridge deck.

2. Chemical Reactions Resulting in Dilatational (Growth) Strains - A second mechanism is a chemical reaction involving the alkali in the cement and aggregate. In general, such reactions may be occurring in Colorado; however, there is no evidence to suggest this is a general cause of distress to backwalls. Nevertheless, this mechanism cannot be categorically ruled out.

Summary and Conclusions

1. Isolation of the PCP from the approach slab is likely the most certain method of mitigating damage to abutment backwalls. Colorado uses this approach. The recent detail which includes a sleeper slab is an appropriate response to the potential problem of PCCP growth. The detail of a 0-4" expansion joint between sleeper slab and the PCCP should be observed and reported upon (if distress is apparent) during field visits of staff personnel to structure sites.

2. If the joint exhibits inadequate room for pavement growth, we may wish to explore the use of a relatively large gap (36 inches) filled with ACP between the edge of the pavement and the sleeper slab.

3. Strengthening the backwall sufficiently to resist thermal expansion is not practical; however, careful attention should be given to the design of reinforcement details in the abutment backwall.

AJS/mmk

cc: R. R. Akin
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