MATERIALS DIVISION

Virginia Department of Transportation

MEMORANDUM

GENERAL SUBJECT: **Revisions to Materials Division Manual of Instructions**	**NUMBER:** **MD 318-09**
SPECIFIC SUBJECT: **Revisions to Section 405.07 Remediation of Alkali Silica Reaction**	**DATE:** **June 1, 2009**
DIRECTED TO: **District Administrators**	**SIGNATURE:** **Charles A. Babish, P.E.** **State Materials Engineer** *Signature on original copy of memorandum*

This memorandum is being issued to revise the Materials Division Manual of Instructions Section 405.07 on the remediation of ASR in concrete. These changes were made to incorporate the Virginia Transportation Research Council/Concrete Research Advisory Committee's recommendations requiring minimum pozzolan replacements for all concrete to improve overall performance. Also, these changes will harmonize the MOI with the latest changes to the VDOT Road and Bridge Specifications, Section 217.02(a) and allow contractors or producers innovation with their mix design developments using blended pozzolans.

Modify Section 405.07 as follows:

Sec. 405.07 Remediation of Alkali Silica Reaction

Alkali Silica Reaction *(ASR)* is a reaction between the alkalies in concrete and reactive *silica in* aggregates causing expansion and usually ~~showing up as~~ *indicated by* cracks in concrete. Cement is the principal source of the alkalies in concrete. There are several ways of controlling ASR: use low alkali cement, use non-reactive aggregates, keep ~~moisture away~~ *the hardened concrete dry*~~,~~ and*/or* mitigate the reaction with mineral admixtures. ~~The first three options are not plausible in Virginia, so m~~ Mitigation of the reaction *using mineral admixtures* is the most practical approach for control *given the materials available for use in Virginia.*

The method of measurement of potential expansion of the cementitious materials is by ASTM C-~~441~~ *227*, which uses ~~crushed pyrex~~ *borosilicate* glass as the reactive aggregate. The 56 day results are used, since the results of the test are inconclusive at 14 and 28 days. *The VTRC* ~~It~~ has ~~been~~ determined that the expansion of the samples should be limited to a maximum of ~~0.10~~ *0.15%*.

Certain combinations of cement/mineral admixtures have been found to be effective based on the alkali content of the cement. These minimum quantities are tabulated *in the VDOT Road and Bridge Specifications, Section 217.02(a)* ~~below~~. Approval of *other* ~~lower total~~ mineral admixture *blends* ~~contents~~ or ~~a~~ new mineral admixture*s not listed in this table* may be obtained ~~by test results furnished to~~ *from* the Department ~~for assessment~~ by furnishing test results that demonstrate effectiveness. The ~~assessment~~ *effectiveness testing* should be ~~based on testing~~ performed ~~at~~ *with* a minimum of three *control cements having* alkali ~~levels~~ *contents* ~~,each level will include control cement, and a cement with~~ *spread across the range from 0.5 to 1.0%, and test mixtures containing* the proportion of mineral admixture requested. These test values should be normalized in accordance with ~~e~~ Equation 5 in VTRC 95-R21 - Use of Fly Ash, Slag, or Silica Fume to Inhibit Alkali-Silica Reactivity by D. Stephen Lane and H. Celik Ozyildirim.

~~Combination of Cementitious Materials~~	~~Maximum Cement Alkali~~
~~Cement Only~~	~~0.45%~~
~~Cement with Minimum 15% Class F Fly Ash~~	~~0.60%~~
~~Cement with Minimum 20% Class F Fly Ash~~	~~0.68%~~
~~Cement with Minimum 25% Class F Fly Ash~~	~~0.75%~~
~~Cement with Minimum 30% Class F Fly Ash~~	~~0.83%~~
~~Cement with Minimum 25% Slag~~	~~0.60%~~
~~Cement with Minimum 35% Slag~~	~~0.90%~~
~~Cement with Minimum 50% Slag~~	~~1.00%~~
~~Cement with Minimum 3% Silica Fume~~	~~0.60%~~
~~Cement with Minimum 7% Silica Fume~~	~~0.90%~~
~~Cement with Minimum 10% Silica Fume~~	~~1.00%~~

The maximum amount of mineral admixture is controlled by *VDOT's Road and Bridge S*specifications. The minimum amount of mineral admixture is controlled by the alkali content of the cement. The proportions used may be any amount within thes*e* limits ~~of maximum to minimum~~ *unless otherwise approved by the Engineer. Note that if there are specification requirements for concrete permeability, the minimum amount of mineral admixture used may be governed by either the permeability specification or the minimum amount of mineral admixture required to mitigate the ASR.*

A precautionary note: the strength of the concrete at early ages is retarded by the use of mineral admixtures. Mineral admixtures replace cement and rely on the by-products of *cementitious* hydration for reaction. To improve the strength gain in colder weather, additional amounts of cementitious materials may be added, or the concrete mixing and curing temperatures may be increased.

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