South Dakota Department of Transportation
PCCP Sustainability Practices

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INTRODUCTION

The South Dakota Department of Transportation recognizes the importance of designing longer lasting pavements, conserving natural resources, and minimizing the waste of products with road construction value. Concrete pavements are being designed to provide the public with a safe and reliable service life of 40 to 50 years with minimal amounts of maintenance and treatment. As part of its sustainability effort, SDDOT specifies the option to recycle existing concrete pavement for use as gravel cushion or base course material.

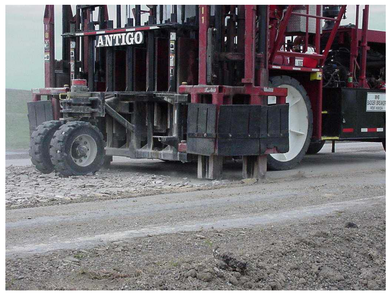

Figure 1. Rubblization of Concrete Surface

The SDDOT requires the use of a modified Class “F” fly ash for paving and bridge superstructure mix designs; specifications also allow for its use in most other structural and miscellaneous concrete mix designs.

Figure 2. Fly ash, a by-product of coal, is an admixture used in the concrete mix design which possesses pozzolanic properties to increase the strength, workability, and durability of the concrete.

RECYCLED PORTLAND CEMENT CONCRETE PAVEMENTS FOR BASE COURSE AND GRAVEL CUSHION MATERIAL

The SDDOT Research Office and Burns Cooley Dennis, Inc. provided the Study SD2005-07 “Evaluation of Recycled Portland Cement Concrete Pavements for Base Course and Gravel Cushion Material”. This study is located at the website location www.state.sd.us/applications/hr19researchprojects/projects.asp Information from the study is detailed in the following paragraphs.

Recycled materials from construction and demolition operations were once disposed of in landfill sites. Concrete is estimated to account for up to 67 percent, by weight, of construction and demolition waste in the U.S. There is a need to use recycled aggregate as a supplement to natural aggregates in order to conserve natural resources and keep landfills free of concrete. Using recycled PCC pavements in construction activities can also greatly reduce the hauling distance for materials that would otherwise not be locally available.

Research has shown that recycled concrete aggregates (RCA) are a viable option in the construction of pavement structures. RCA materials have been used within PCC and hot mix asphalt, as well as fill material in highway embankments. However, the largest use of RCA in pavement construction has been in the placement of unbound layers under both rigid and flexible pavements.

Figure 3. Recycled Crushed Concrete Stockpile

Some conclusions drawn from the study include:

•Because the SDDOT specifies and constructs gravel cushion and aggregate base course layers to be relatively impermeable, leachates or precipitates should pose no problems.

• Alkali-Silica reactivity is not considered a potential problem in gravel cushion or aggregate base course layers; however, it is unclear if some new deicing materials could affect the potential for alkali-silica reactivity problems in the future.

• There is a concern about sulfate attack in thick layers of gravel cushion or aggregate base course. The critical thickness is not known.

•Strong and stable gravel cushion and aggregate base course layers can be attributed to the gradation, angularity and cleanliness of the RCA materials. Current gradation requirements contained within SDDOT specifications for gravel cushion and aggregate base course are applicable.

•Recycled portland cement concrete pavements have a relatively high level of water absorption. This could potentially make the proper compaction of gravel cushion and aggregate base course layers variable.

As a result of the findings of this study, SDDOT has implemented the following plan note to allow for the use of RCA:

“PCC Pavement removed from this project may be crushed and reused as Gravel Cushion provided the material meets the Standard Specifications for Gravel Cushion. If the material is utilized as Gravel Cushion, payment for the material will be at the contract unit price per ton for GRAVEL CUSHION. There is an estimated 68,336.5 tons of PCC Pavement on this project that can be crushed and reused. The 68,336.5 tons is based on a unit weight of 118 lbs. per cubic foot.”

FLY ASH USE IN SOUTH DAKOTA

SDDOT has specified a modified class “F” fly ash for the purpose of maximizing alkali silica reactivity (ASR) mitigation. Modified class “F” fly ash as classified in the 2004 SDDOT specification book conforms to AASHTO M295 including optional requirements except as modified by the following:

•Loss on ignition, 2.0% Max.
•Moisture content, 2.0% Max.
•Available alkalies as Na_2O, 1.5% Max. (2.0% Max. with 14-day mortar expansion results < or = control sample)
•Total SiO_2 plus Al_2O_3 plus Fe_2O_3 shall be at least 66.0% by dry weight of the total fly ash composition.
•SiO_2 shall be at least 40.0% by dry weight of the total fly ash composition.

Specifications require the use of modified Class “F” fly ash at a rate of 20% of cementitious material in all concrete paving and bridge superstructure mix designs. For most other bridge substructure, box culvert, and other structural concrete, specifications provide for the optional use of modified Class “F” fly ash at a rate of 15-20% of cementitious material.

Fly ash is required in controlled density fill, pavement jacking, and undersealing mixes in South Dakota. These grout designs require a rate of 75% of cementitious material and allow for the use of Class “C” fly ash.

Including fly ash in mix designs can significantly reduce the overall cost of concrete while increasing the concrete’s strength and durability. The properties of the fly ash particles reduce permeability and increase the workability of the concrete without increasing the water content.