FY-XXIX-82
RIVERDALE HAULROAD GRADE SEPARATION - LIGNITE ASH DEMONSTRATION PROJECT

CONTRACTOR: The Falkirk Mining Company

PRINCIPAL INVESTIGATOR: Lynn A. Bergman
701-442-5751 (O)
Dave Kaufman (Contact Person)
701-250-2491 (O)
dave.kaufman@falkirk.com

PARTICIPANTS

Sponsor	Cost Share
The Falkirk Mining Company	$891,230
ND Industrial Commission	$298,000
Total Project Costs	$1,189,230

Project Schedule 10 - Months

Contract Date - 5/13/98
Start Date – 5/13/98
Completion Date – 4/1/99

Project Deliverables

Status Report – 6/30/1998✓
Status Report – 9/30/1998✓
Status Report – 12/30/1998✓
Final Report – 4/1/1999✓

OBJECTIVE / STATEMENT OF WORK

The objective of this project is to demonstrate high-volume use of coal combustion byproducts (CCB) in bridge and roadway construction. Current acceptable practice is replacement of Portland Cement with 15% to 20% CCB fly ash. A goal of this project is to demonstrate replacement of Portland Cement with 30% to 70% CCB fly ash. The project includes preparation and testing of design mixes, construction of the bridge and roadway, and long-term monitoring of the structure. An additional goal of this project was to allow county road traffic to cross over the Riverdale Haulroad, thereby eliminating an at-grade crossing near an intersection.

STATUS

The concrete component of the grade separation includes: 1) Prestressed, precast concrete, 2) Precast concrete, and 3) Cast-in-Place concrete. Replacement of Portland Cement with fly ash for the various bridge elements is reported for:

Reinforced Concrete Pipe	20, 30, 40, 50 & 60% (by weight)
Concrete Retaining Walls (T-walls)	20, 30, 40, 50 & 60% (by weight)

Prestressed Concrete Bridge Pilings	35% (by weight)
Prestressed Concrete Bridge Box Girders	25% (by weight)
Cast-in-Place Bridge Abutments	40% (by weight)
Cast-in-Place Bridge Deck	30% (by weight)

Various components of the grade separation will be monitored for five years. Testing for various components is completed and summarized:

- **Prestressed, Precast Concrete**
  Compressive strength tests on the bridge box girders and pilings gave excellent results. The 28-day design strengths were met or exceeded after 1 day.

- **Precast Concrete**
  Testing of reinforced concrete pipe indicates optimum replacement of Portland cement with 40% fly ash (by weight) to maximize water absorption, thereby enhancing long-term durability.

  Results of testing performed on the concrete retaining wall (T-wall) indicate good strength gain over time. Optimum replacement percentage could not be observed, although it is likely that 30% to 40% replacement of Portland Cement with fly ash (by weight) is optimum for this "wet cast" product.

- **Cast-in-Place**
  Results of testing performed on the bridge deck and abutments indicate that replacement of Portland Cement with fly ash on a volume basis, while beneficial (for ease of finishing), produced slightly less initial compressive strength gain than expected. Compressive strength gain continued, however, and at 90 days exceeded the 28-day design strength by 1,1150 psi.

Other Observations

- Concrete absorption, volume of permeable pore spaces and air voids were all lowest at 40% replacement (by weight) of Portland cement with fly ash.

- While "creep" in concrete is influenced by concrete age, type of cement and type of aggregate, creep for 35% replacement of Portland cement with fly ash is about two-thirds that of Portland cement with no fly ash when the other factors are equal.

- Rapid chloride permeability at 35% replacement of Portland cement with fly ash was about one-half the permeability of Portland cement with no fly ash.