

# Durability of Concrete Produced with Alternative Supplementary Cementitious Material

## *Testing viability of New Mexico pozzolan as opposed to class F fly ash as a SCM*

**Project Number:**

20CNMSU40

**Start Date:**

08/01/2020

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**Funding Source(s):**

Tran-SET

New Mexico State University

**Total Project Cost:**

\$120,000

New Mexico contains several aggregate sources that are very susceptible to alkali-silica reaction (ASR). To moderate ASR, the New Mexico Department of Transportation (NMDOT) requires at least 20% class F fly ash (by cement mass) in almost all concrete produced in their projects. However, Class F fly ash has become difficult for concrete producers to procure, and future availability is uncertain. Therefore, NMDOT is considering using alternative supplementary cementitious materials (SCMs) that could be used instead of Class F fly ash. These potential SCMs are to be studied and chemically tested for increased strength and durability. The purpose of this research project is to assess an alternative SCMs being considered for potential acceptance by NMDOT. The SCM under consideration is a natural pozzolan mined from a pumicite deposit near Espanola, NM. Natural pozzolans are a class of siliceous or siliceous and aluminous materials that possess virtually no cementitious value on their own, but react chemically with calcium hydroxide and water at ordinary temperatures to form compounds possessing cementitious properties that can improve concrete strength and durability. NMDOT has scarce information on mixture proportions and durability properties of concrete produced with this material, so they are not able to fully accept the material for use in concrete produced for NMDOT projects, even if class F fly ash is not available.

## Problem Statement

SCMs can yield pozzolanic or hydraulic activity to a concrete mixture when added as partial replacement of cement. Using SCMs as a limited replacement of Portland cement is usually efficient, because many SCMs are waste products or naturally occurring, and eco-friendly, as their use reduces Portland cement generation. Most SCMs are either natural materials or industrial byproducts that would otherwise be scrapped in landfills. The most common SCMs used in the concrete industry are fly ash, ground blast furnace slag, silica fume, and natural pozzolans.

## Objectives

The goal of this research project is to evaluate one of the alternative SCMs under consideration for potential acceptance by the NMDOT. This research project will consist of a comprehensive literature review to classify the most crucial properties and characteristics of SCMs, and especially natural pozzolans, in terms of their influence on concrete durability. For the exploratory work to be performed in this study, a suite of concrete mixtures, similar to currently accepted NMDOT mixtures, will be allocated using the natural pozzolan to replace different percentages of fly ash. Concrete produced from these mixtures will be tested for slump, air content, compressive strength, and flexural strength to ensure that the mixtures provide acceptable workability and strength. Then, the durability of the concrete mixtures will be tested by testing their chloride permeability, resistance to freezing and thawing, susceptibility to ASR, and their shrinkage characteristics. Results from mixtures containing the natural pozzolan will be compared to control mixtures produced using NMDOT concrete mixtures containing only class F fly ash.

## Intended Implementation of Research

**Education, Outreach, and Workforce Development:** In addition to the technical aspects of the research, efforts should be made to address education, outreach, and workforce development. To address these issues, the following tasks will also be performed as part of this project:

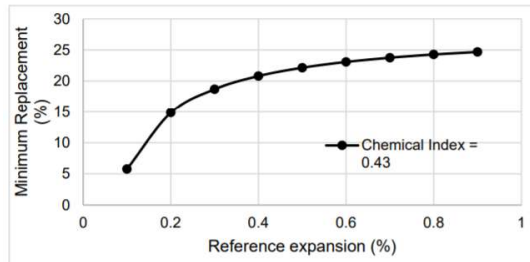
- A PowerPoint presentation containing educational modules to be used in the education and recruitment of high school and community college students interested in transportation engineering careers or interested in pursuing careers in the concrete industry will be created.
- Presentation of the research at annual national conferences, meetings, and



workshops associated with Tran-SET and the transportation engineering community to extend workforce development and continuing education opportunities for people considering transportation related careers and transportation professionals.

## Web links

- Tran-SET's website  
<https://transet.lsu.edu/research-in-progress/>



**Figure 1: Minimum natural pozzolan replacement to mitigate ASR expansion as a function of reference expansion for Specimens produced with only cement (no SCM).**

## Anticipated Impacts/Benefits of Implementation

The main deliverables of the proposed research include:

1. A final report documenting the progression of the research and detailing the methods and results of the research.
2. Quarterly reports monitoring the progress of the project.
3. Suggestions for future research related to natural pozzolans and other alternative SCMs. These will be included in the final report for the project and will also be disseminated through conference presentations to professional groups and researchers.
4. Publications in peer-reviewed journals.
5. A PowerPoint presentation to facilitate educational outreach opportunities in schools and for the public.

## Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

## Learn More

For more information about Tran-SET, please visit [our website](#), LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at [transet@lsu.edu](mailto:transet@lsu.edu).

