Cement Stabilized Crush Stone Base Course (CSCSBC) Strength and Stiffness Analysis

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~350 undergraduates (B.S.C.E.)
~55 graduate students

My research:
- Prestressed concrete
- Reinforced concrete
- Mixture proportioning
- Alternative cements (BCSA)
Gift from the Arkansas/Oklahoma Chapter of ACPA
- Funds concrete research initiatives
- Other work on fly ash air entrainment adsorption, entrained air, LCCA

Advisory group for gift identifies areas for work
- Structural coefficient/K-value for CSCSBC
CSB improves
- Strength
- Stiffness
- Durability
- Load distribution
- Binds fines underneath roadways
  - Prevents loss of fines
  - Extends lifespan of roadway

A stabilized base spread loads and reduces stress on the subgrade.

Unstabilized Granular Base  Cement-Stabilized Base

Portland Cement Association (PCA), cement.org
How CSB Works

- CSB improves
  - Strength
  - Stiffness
  - Durability
  - Load distribution
  - Binds fines underneath roadways
    - Prevents loss of fines
    - Extends lifespan of roadway

Focus of this study
ARDOT 2014 Specifications (308)
- Cement Stabilized Crushed Stone Base Course (CSCSBC)
- Cement content (3-8%) – 308.02a
- Strength (750 psi minimum) – 308.02b

FHWA (NHI-05-037): Structural Coefficients
- Non-Stabilized Base (NSB): 0.06-0.14
- Cement Stabilized Base (CSB): 0.10-0.22
- Bituminous Treated Base (BTB): 0.10-0.34
From AASHTO 1993 Guide

Illinois

Figure C-15. Cement-treated materials.

(1) Scale derived by averaging correlations from Illinois, Louisiana and Texas.
(2) Scale derived on NCHRP project (3)

Louisiana

Texas
The Test Site

- Weaver-Bailey Contractors

Mixed Sections

3% Cement  4% Cement  5% Cement  6% Cement  7% Cement  8% Cement
- Falling Weight Deflectometer (FWD)
- Static Plate Load Testing (StPT)
- Density/compaction testing
- Unconfined compression strength
- Modulus of elasticity
- Cement content
Falling Weight Deflectometer (FWD)
Static Plate Load Tests
Compressive Strength

\[ y = 25509x + 354.91 \]
\[ R^2 = 0.956 \]
(4% Excluded)

\[ y = 17970x + 916.09 \]
\[ R^2 = 0.4895 \]
(4% Included)
Modulus of Elasticity

\[ y = 2 \times 10^7 x + 955697 \]
\[ R^2 = 0.7278 \]
(4% Excluded)

\[ y = 1 \times 10^7 x + 2 \times 10^6 \]
\[ R^2 = 0.2928 \]
(4% Included)
5% Cement Section

- $y = 6734x - 33.552$, $R^2 = 0.9957$
- $y = 7194x - 51.547$, $R^2 = 0.9967$
- $y = 6720x - 53.452$, $R^2 = 0.9987$

Plate pressure, psi vs. Axial deflection, in.
StPT vs. Cement Content

$\text{y} = -11256x + 9183.4$
$R^2 = 0.0103$
$3\%$ Included

$\text{y} = 19841x + 7110.3$
$R^2 = 0.0424$
$3\%$ excluded

Stiffness (psi/in)

Cement Content

3\% 4\% 5\% 6\% 7\% 8\%
Relation Between StPT and $E$

$y = -0.0033x + 15200$
$R^2 = 0.9575$
Density Testing Results

The graph shows the relationship between cement content and density (lb/ft³). The data points represent dry density and wet density for different cement contents. The graph indicates that as the cement content increases from 3% to 8%, the density also increases, with dry density being consistently higher than wet density.
Conclusions
Future Testing

- Cement content
  - CaO testing
- Resilient modulus
  - Subgrade
  - Subbase
- Spring constant
  - Composite
  - Individual
Conclusions

Comments or questions?

Thank you.