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

Principle Investigator: Dr. Cameron Murray

Graduate Assistant: Andrew Deschenes

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- University of Arkansas
  - Fayetteville, Arkansas
  - ~350 undergraduates (B.S.C.E.)
  - ~55 graduate students
- My research:
  - Prestressed concrete
  - Reinforced concrete
  - Mixture proportioning
  - Alternative cements (BCSA)

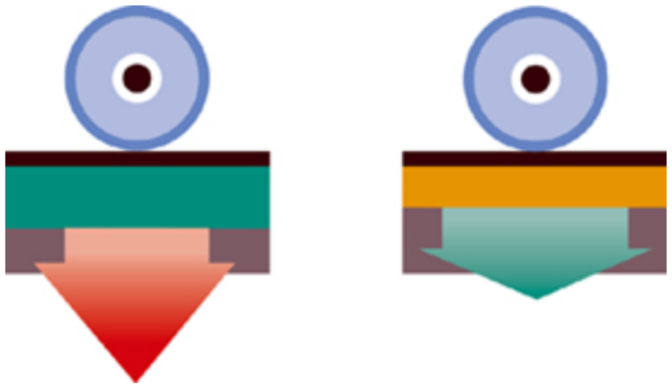
Introduction

- 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

Introduction

- 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

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- CSB improves
  - Strength
  - Stiffness
  - Durability
  - Load distribution
  - Binds fines underneath roadways
    - Prevents loss of fines
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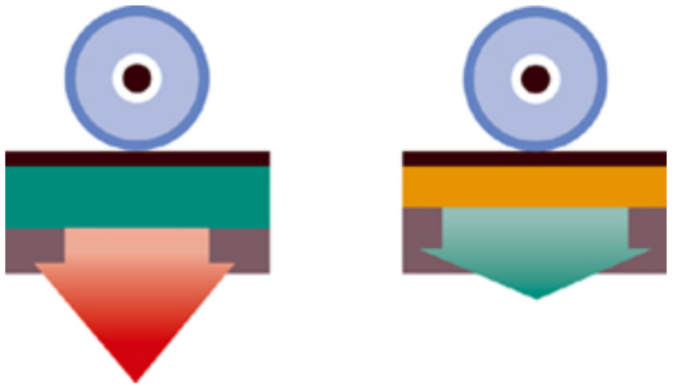
Focus of this study

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



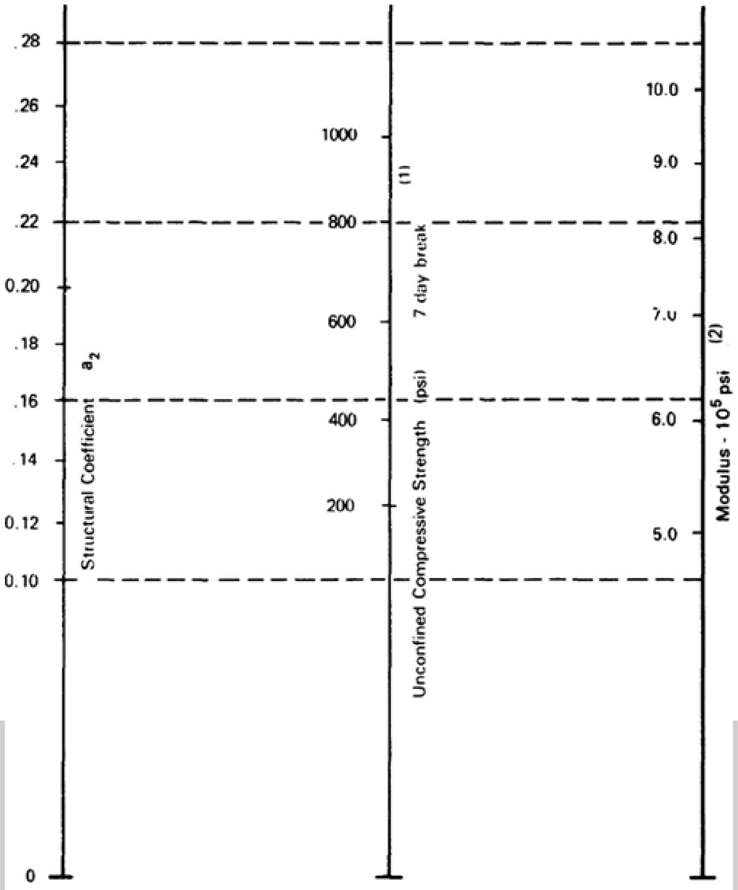
Portland Cement Association (PCA), cement.org

How CSB Works

- 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

How Designers See CSB

From AASHTO 1993 Guide



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

Illinois

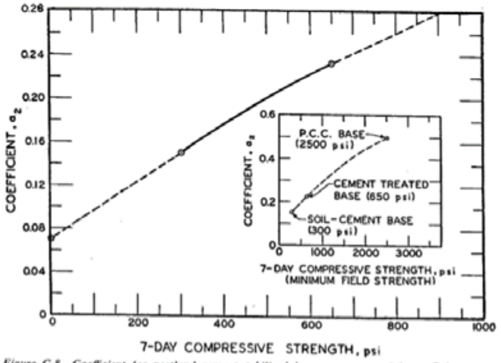
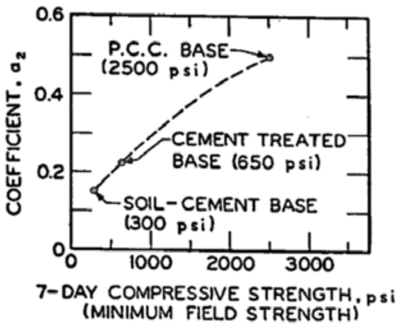


Figure C-8. Coefficient for portland cement-stabilized base course materials vs 7-day compressive strength.



Texas

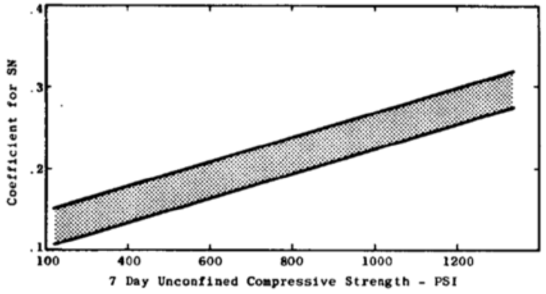


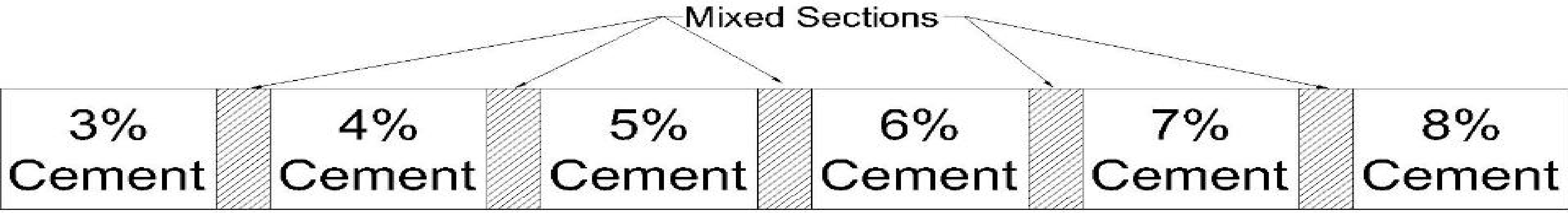
Figure C-15. Cement-treated materials.

Louisiana

PAVEMENT COEFFICIENTS FOR FLEXIBLE SECTION DESIGN, LOUISIANA

ITEM	STRENGTH	COEFFICIENT
I. *Surface Course*		
Asphaltic concrete		
Types 1, 2, and 4 BC and WC	1000+	0.40
Types 3 WC	1800+	0.44
BC	1500+	0.43
II. *Base Course*		
Untreated:		
Iron ore—Grade B	3.7—	0.06
Sand clay gravel—Grade A	3.3—	0.08
Sand clay gravel—Grade B	3.5—	0.07
Shell and sand shell	2—	0.13
Cement stabilized:		
Soil cement	300 psi+	0.15
Iron ore—Grade B	300 psi+	0.15
Sand clay gravel—Grade B	500 psi+	0.17
Shell and sand shell	900 psi+	0.23
Lime stabilized:		
Sand shell	1.0	0.14
Sand clay gravel—Grade B	2.0—	0.12
Iron ore—Grade B	2.2—	0.11
Asphalt stabilized:		
Hot-mix base course (Type 3)	1200+	0.34
III. *Subbase Course*		
Lime-treated sand clay gravel—Grade B	2.0—	0.14
Lime-treated sand shell	1.0	0.15
Shell and sand-shell	2.0—	0.14
Sand clay gravel—Grade B	3.5—	0.11
Iron ore—Grade B	3.7—	0.10
Lime-treated soil	3.5—	0.11
Suitable material—A-6 (PI=15—)	—	0.04
Old gravel or shell roadbed (8-in. thickness)	—	0.11
Sand (*R*-value)	55+	0.10
IV. *Coefficients for Bituminous Concrete Overlay*		
Base course:		
Bituminous concrete pavement		
New		0.40
Old		0.24
Portland cement concrete pavement		
New		0.50
Old, fair condition		0.40
Old, failed		0.20
Old, pumping		0.10

The Site



- Weaver-Bailey Contractors

The Test Site

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The Site

Types of Testing

- Falling Weight Deflectometer (FWD)
- Static Plate Load Testing (StPT)
- Density/compaction testing
- Unconfined compression strength
- Modulus of elasticity
- Cement content

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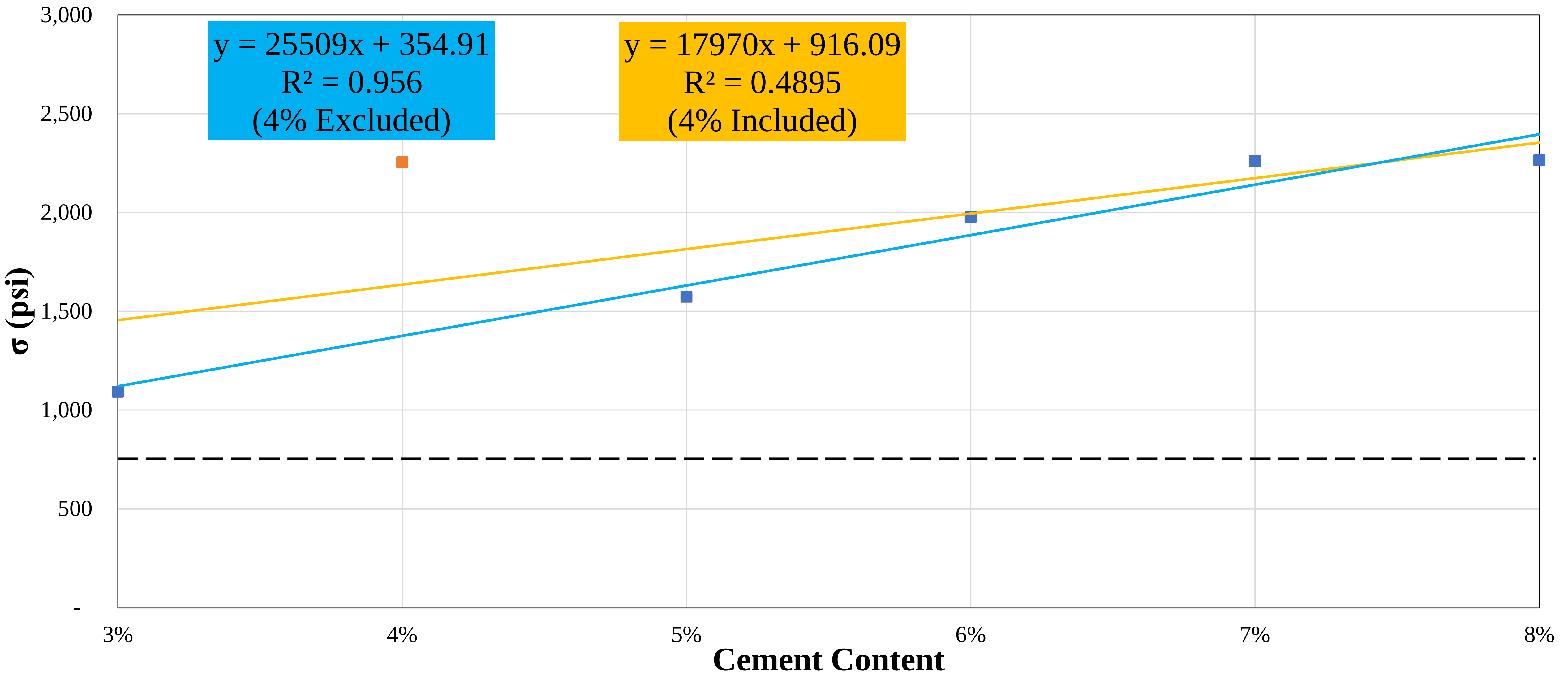
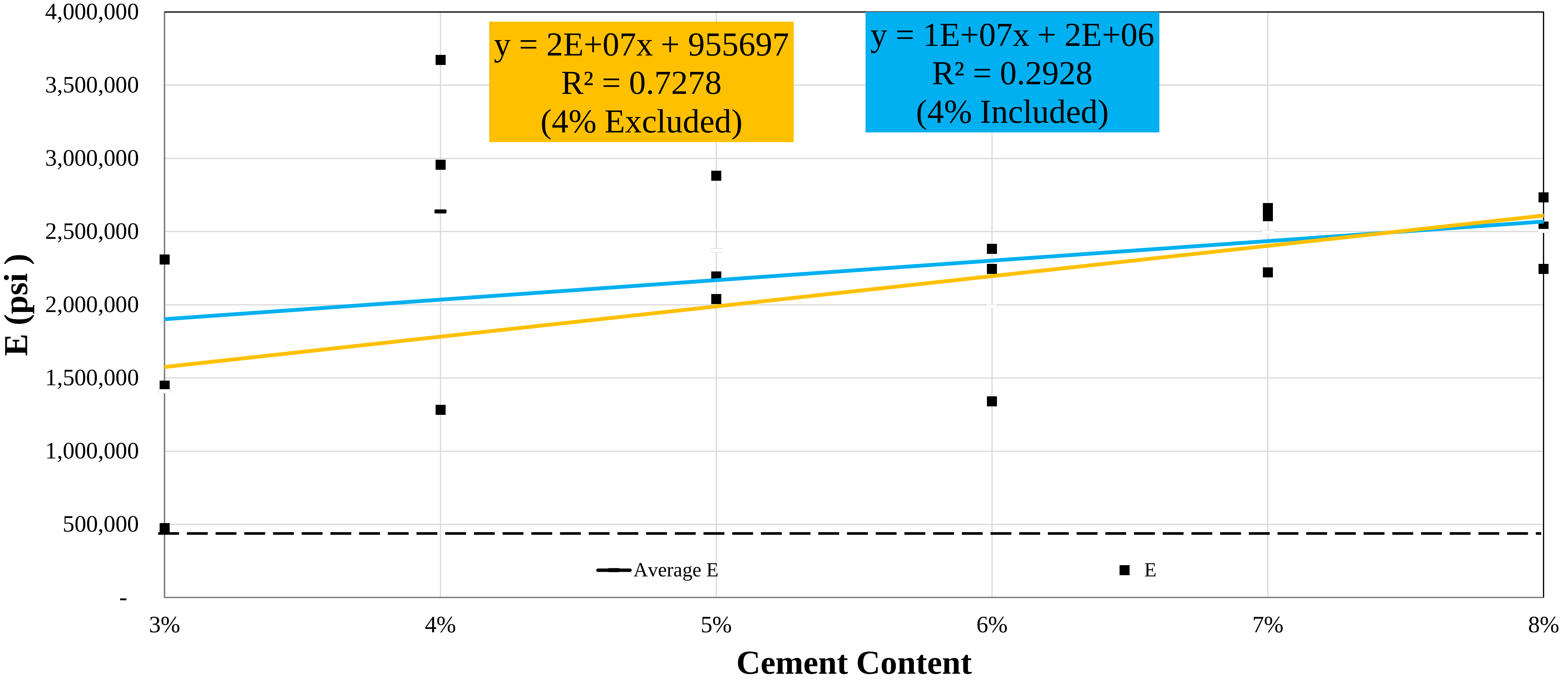
Falling Weight Deflectometer (FWD)

Cores/Static Plate Load Tests

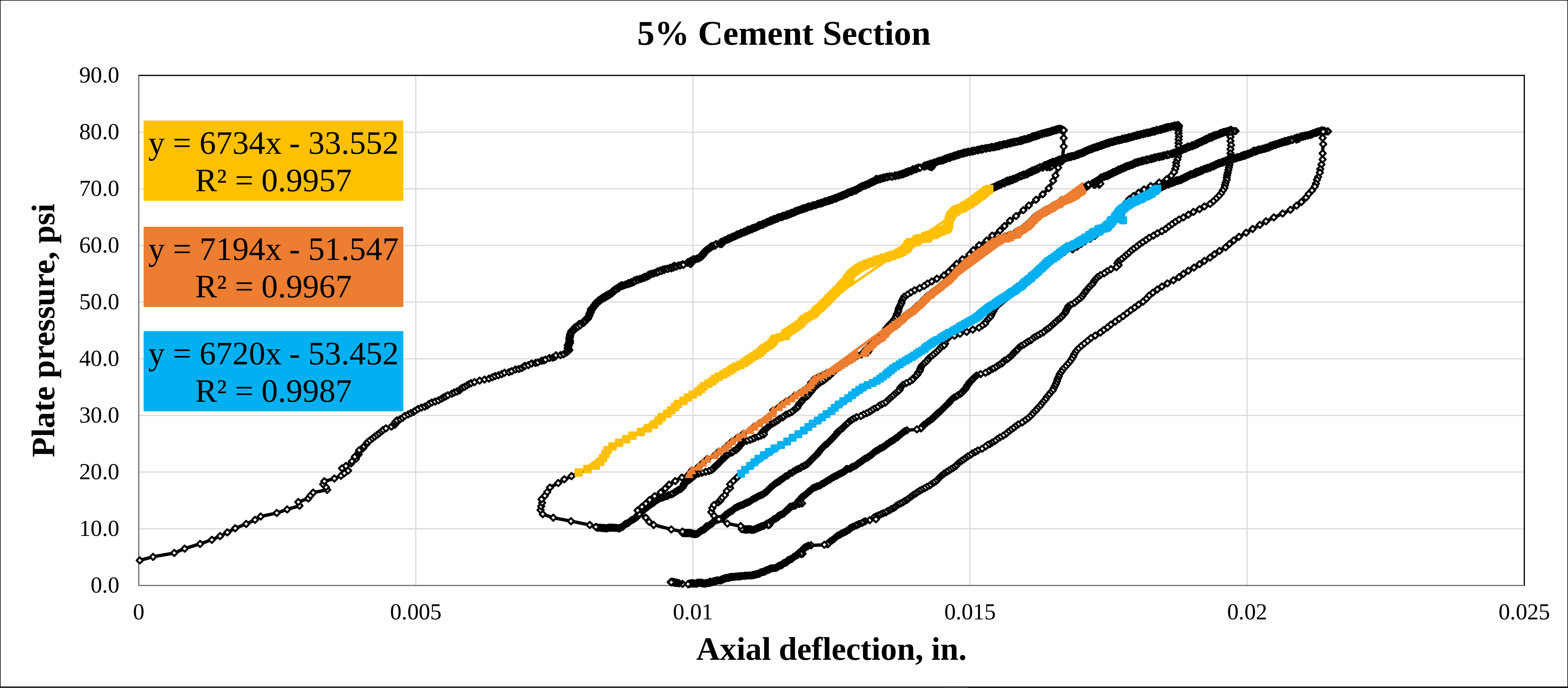
Static Plate Load Tests



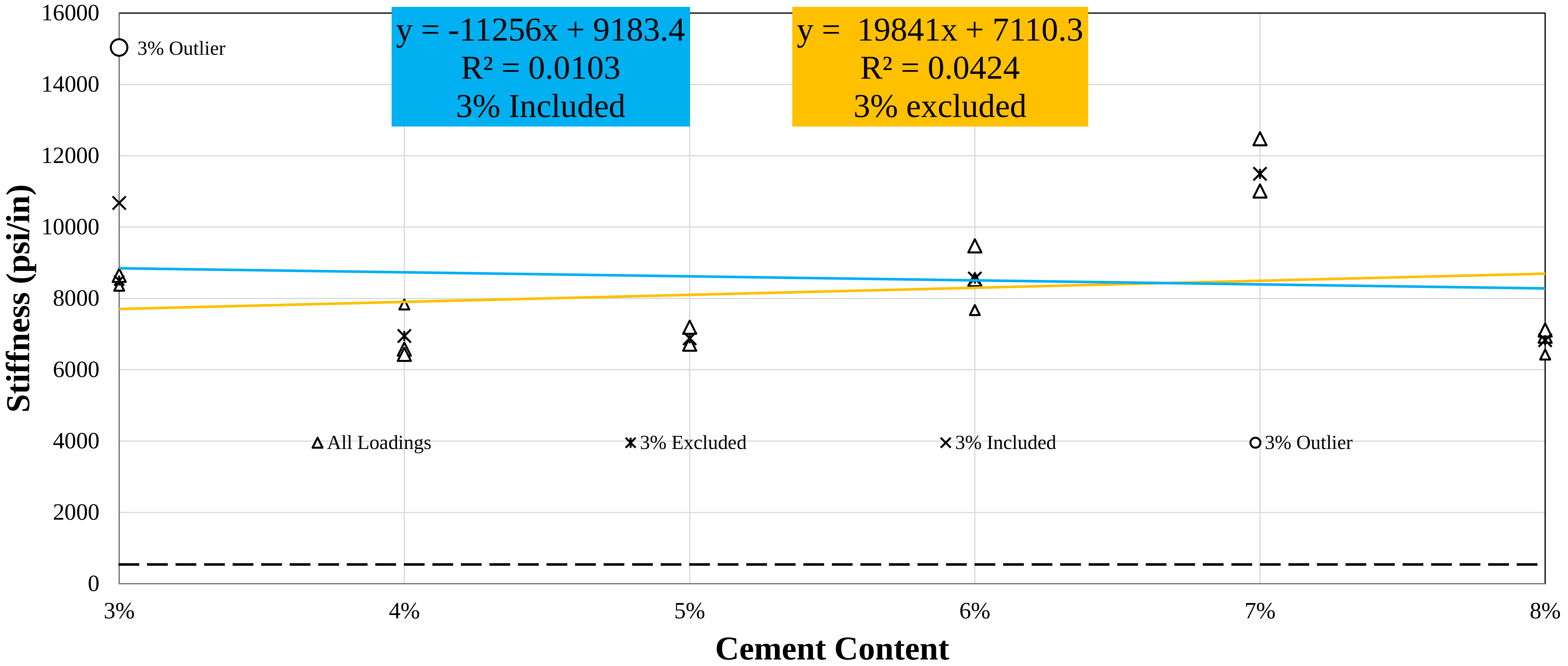
Compressive Strength



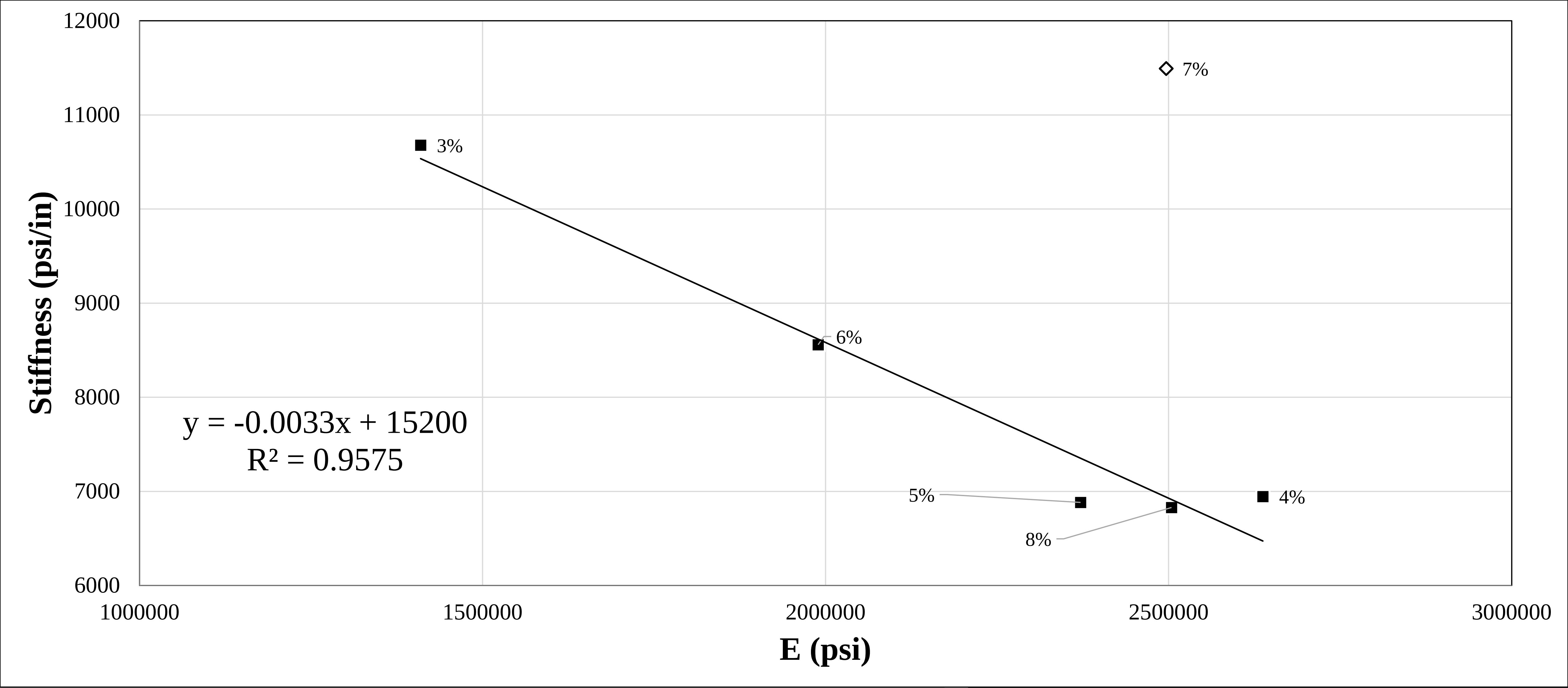
Modulus of Elasticity



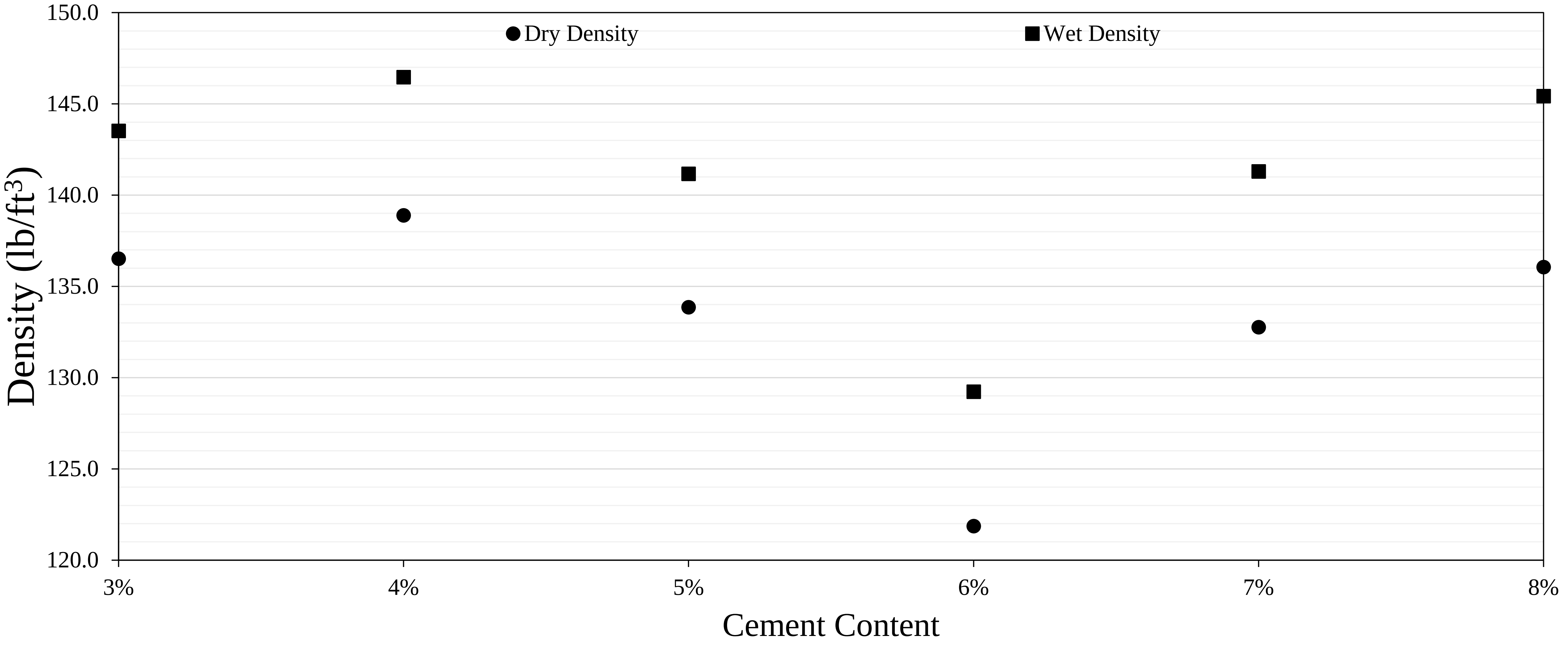
StPT Graphed Data



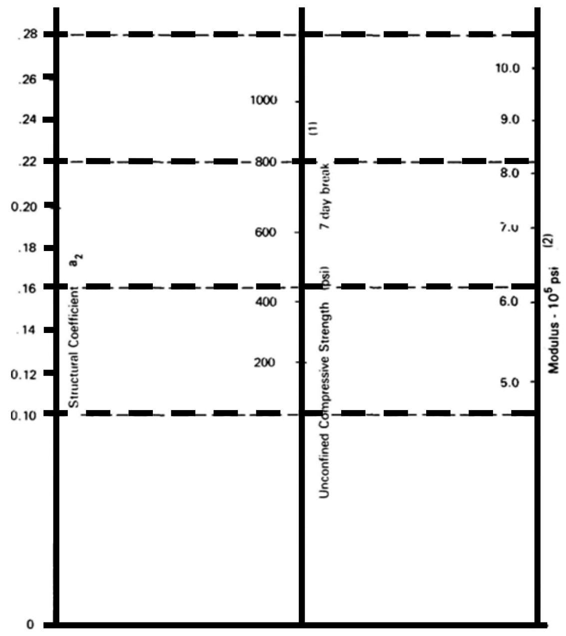
StPT vs. Cement Content



Relation Between StPT and E



Density Testing Results



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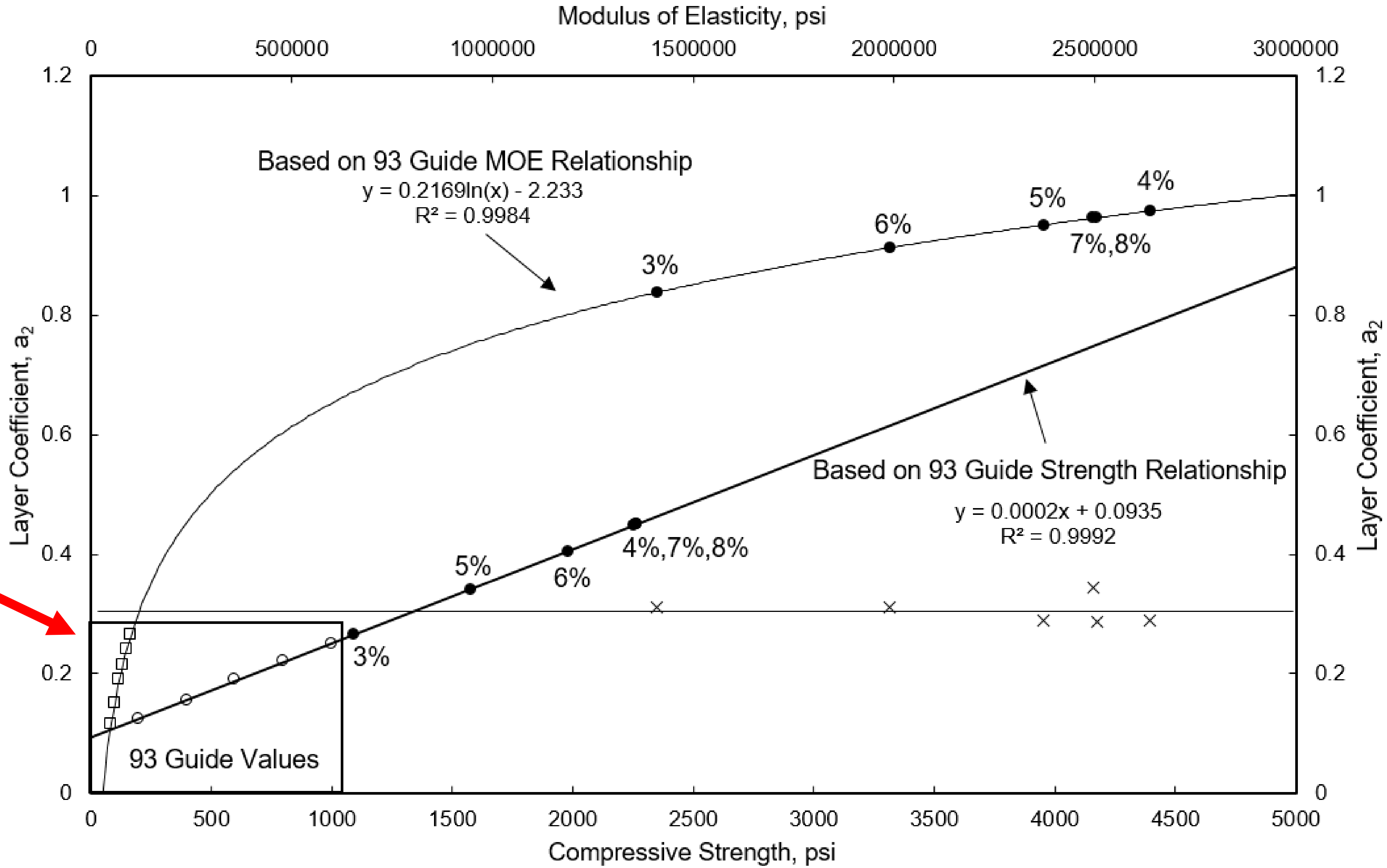

Conclusions

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

Future Testing

Comments or questions?

Thank you.

Conclusions