CENTER FOR
PORTLAND CEMENT CONCRETE
PAVEMENT TECHNOLOGY

Design and Construction Procedures for Concrete Overlay and Widening of Existing Pavements

Final Report
September 2005

IOWA STATE UNIVERSITY

Sponsored by
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The Center for Portland Cement Concrete Pavement Technology (PCC Center) is housed at the Center for Transportation Research and Education (CTRE) at Iowa State University. The mission of the PCC Center is to advance the state of the art of portland cement concrete pavement technology. The center focuses on improving design, materials science, construction, and maintenance in order to produce a durable, cost-effective, sustainable pavement.

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16. Abstract

State Highway Departments and local street and road agencies are currently faced with aging highway systems and a need to extend the life of some of the pavements. The agency engineer should have the opportunity to explore the use of multiple surface types in the selection of a preferred rehabilitation strategy. This study was designed to look at the portland cement concrete overlay alternative and especially the design of overlays for existing composite (portland cement and asphaltic cement concrete) pavements.

Existing design procedures for portland cement concrete overlays deal primarily with an existing asphaltic concrete pavement with an underlying granular base or stabilized base. This study reviewed those design methods and moved to the development of a design for overlays of composite pavements. It deals directly with existing portland cement concrete pavements that have been overlaid with successive asphaltic concrete overlays and are in need of another overlay due to poor performance of the existing surface.

The results of this study provide the engineer with a way to use existing deflection technology coupled with materials testing and a combination of existing overlay design methods to determine the design thickness of the portland cement concrete overlay. The design methodology provides guidance for the engineer, from the evaluation of the existing pavement condition through the construction of the overlay. It also provides a structural analysis of various joint and widening patterns on the performance of such designs. This work provides the engineer with a portland cement concrete overlay solution to composite pavements or conventional asphaltic concrete pavements that are in need of surface rehabilitation.

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DESIGN AND CONSTRUCTION PROCEDURES FOR CONCRETE OVERLAY AND WIDENING OF EXISTING PAVEMENTS

Final Report
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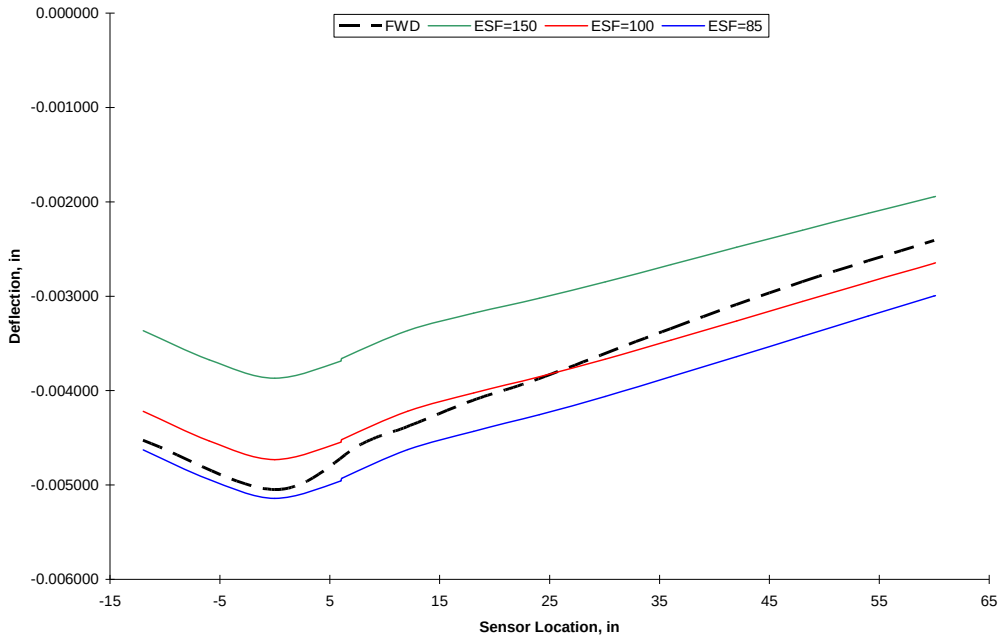


Figure 16. Deflection comparison for pavement with 3.5″ whitetopping and 4.5 ft joint spacing

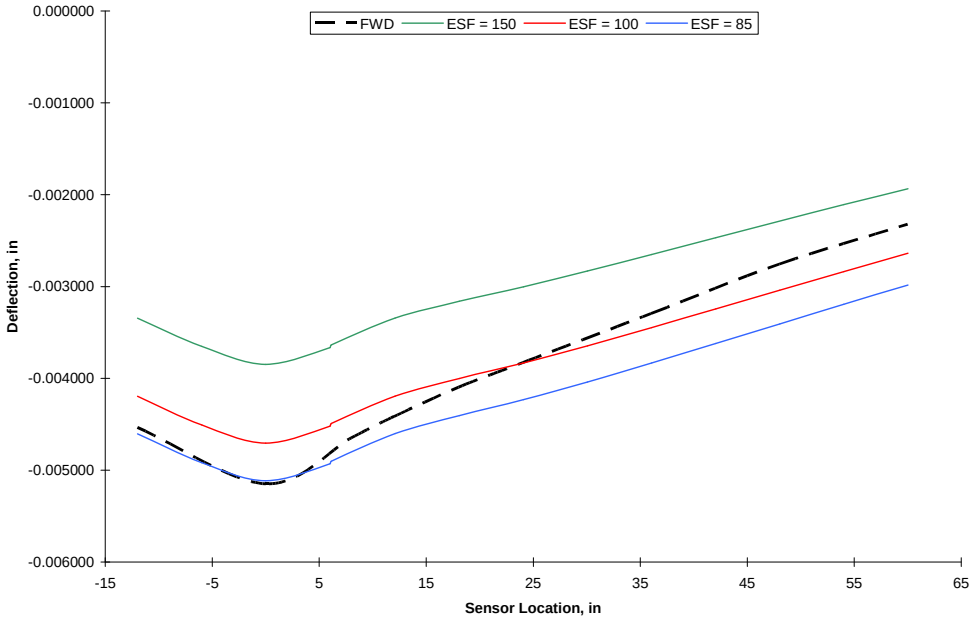


Figure 17. Deflection comparison for pavement with 3.5″ whitetopping and 6 ft joint spacing

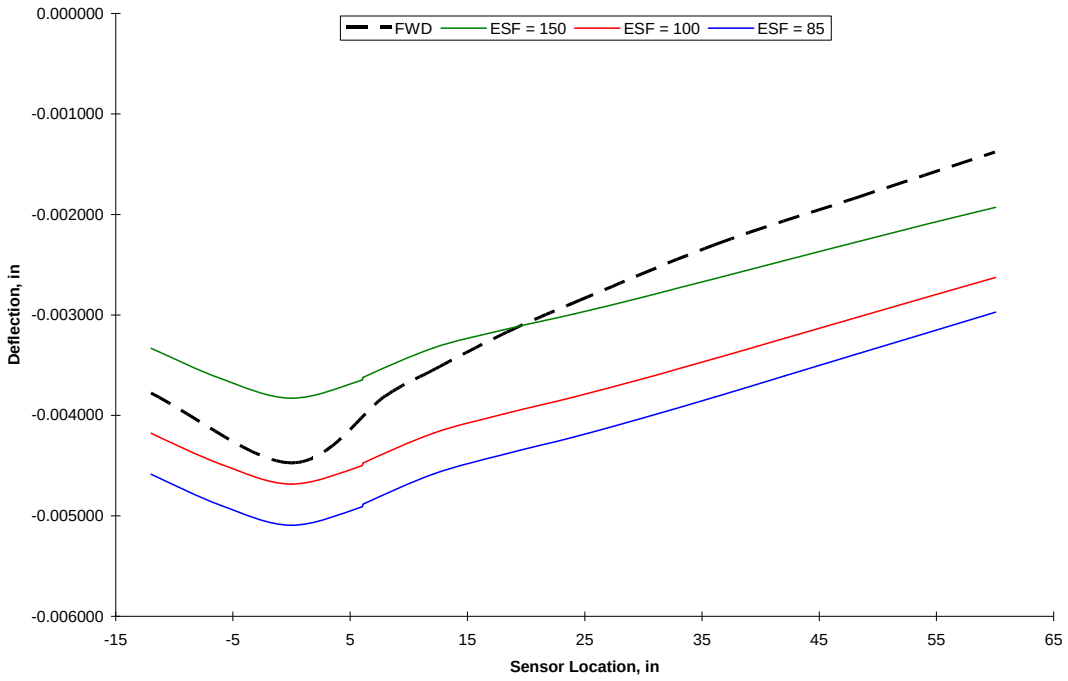


Figure 18. Deflection comparison for pavement with 3.5″ whitetopping and 9 ft joint spacing

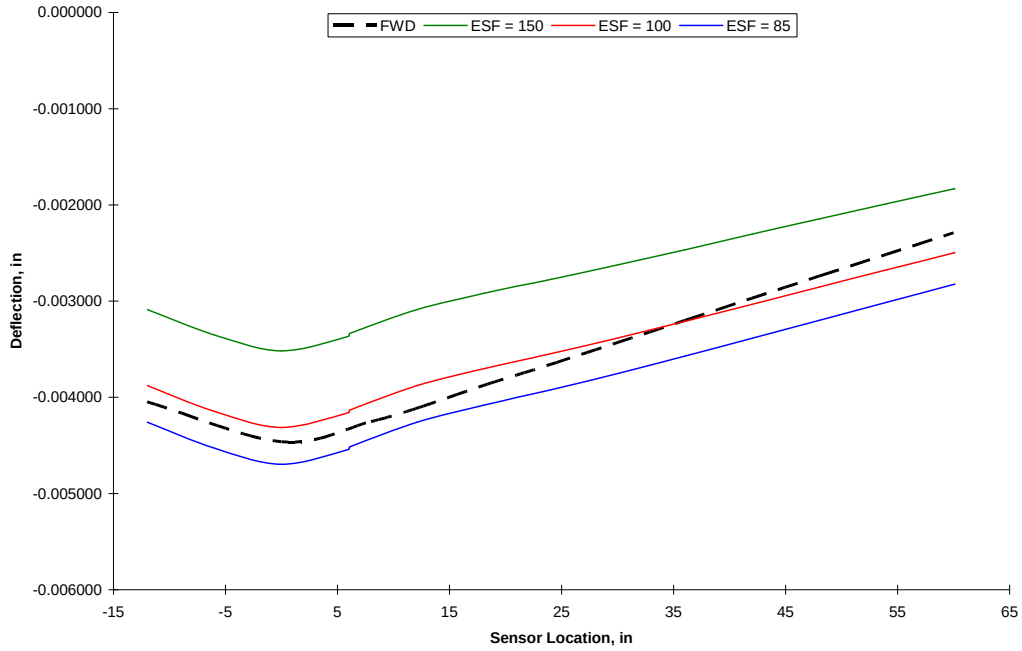


Figure 19. Deflection comparison for pavement with 4.5″ whitetopping and 4.5 ft joint spacing

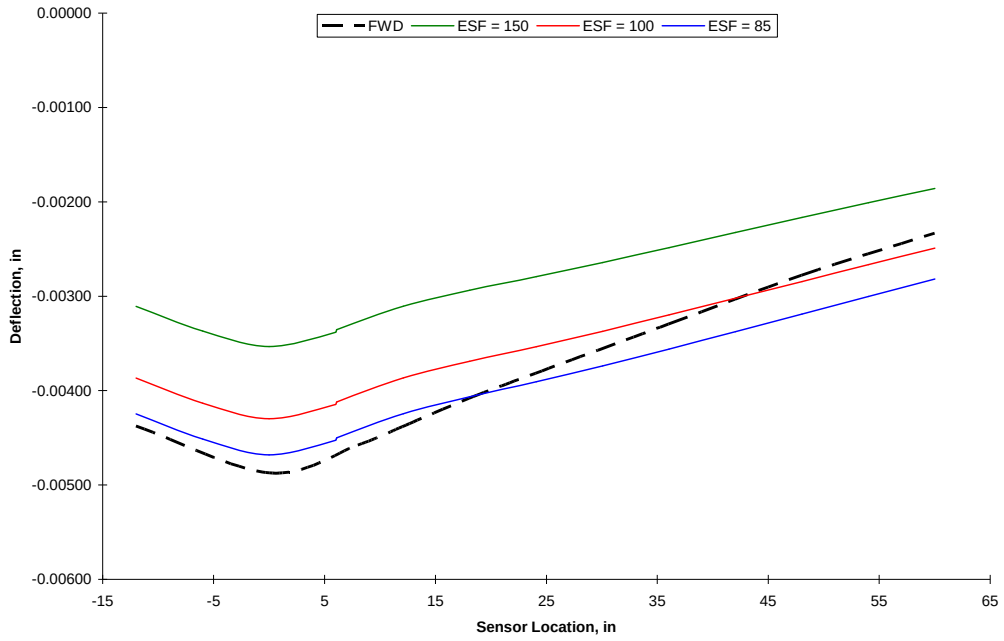


Figure 20. Deflection comparison for pavement with 4.5″ whitetopping and 6 ft joint spacing

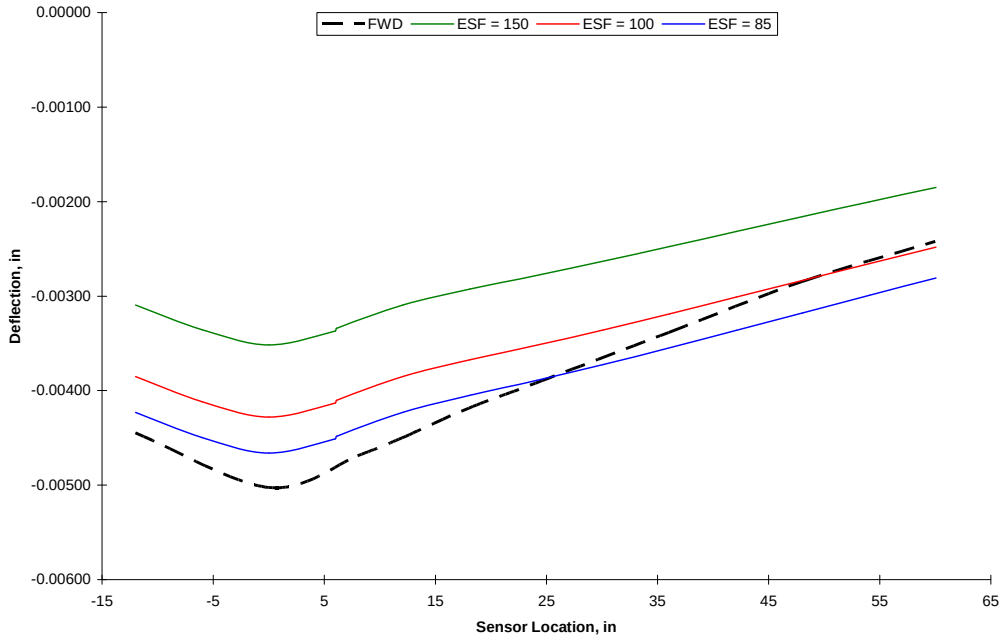


Figure 21. Deflection comparison for pavement with 4.5″ whitetopping and 9 ft joint spacing

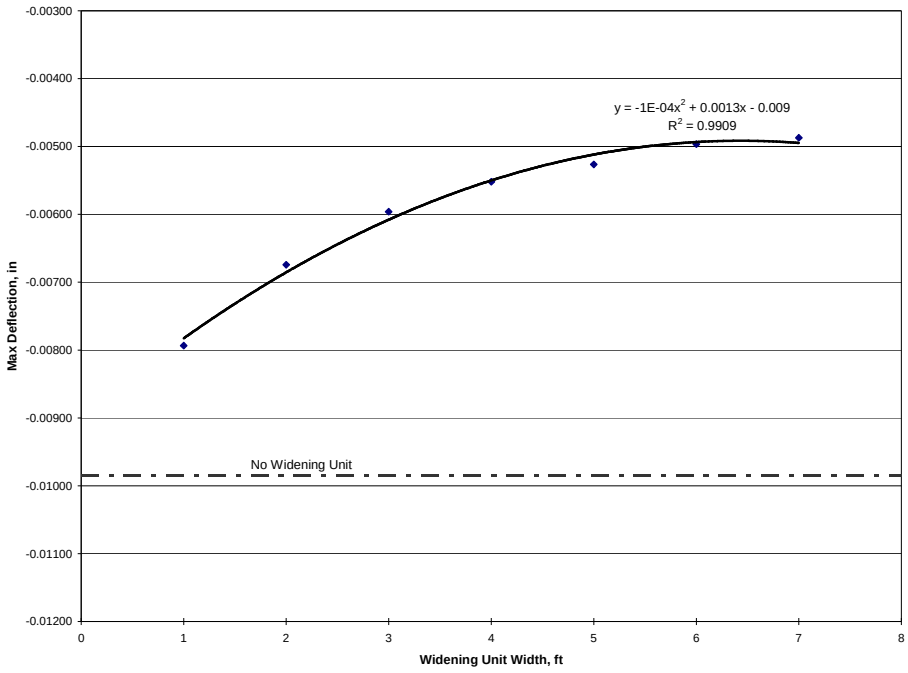


Figure 25. Maximum deflections—varying widening unit widths (9-kip load)

The effect of different depths of the widening units on deflections was also investigated by varying the edge thicknesses of the widening units. Widening units with thicknesses of 6, 8, 10, 12, and 15 inches were analyzed in conjunction with widths of 1 and 2 feet. The maximum deflections that were induced in the pavement are plotted in Figure 26.

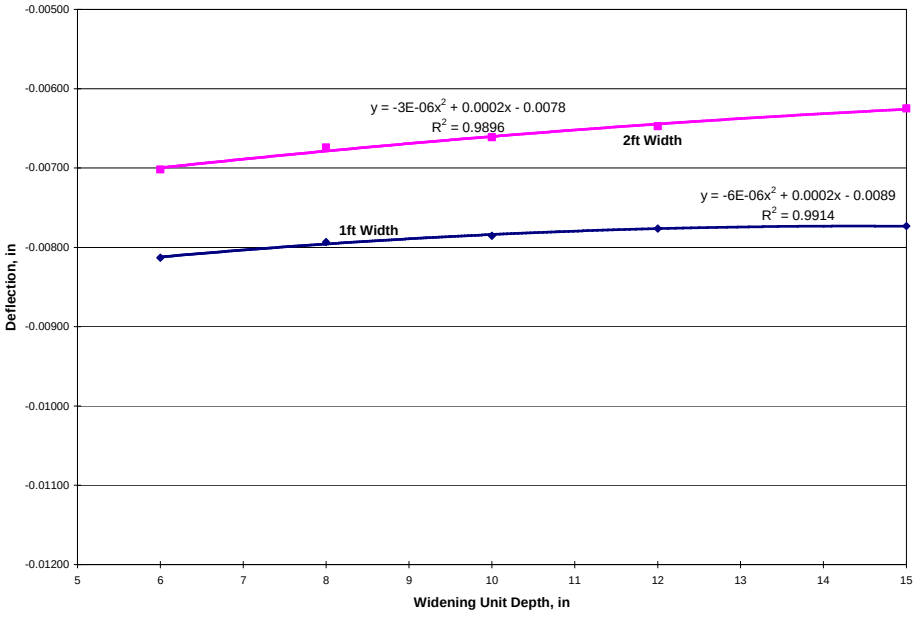


Figure 26. Maximum deflections—varying widening unit depths (9-kip load)

APPENDIX A: STRAIN GAGE DATA

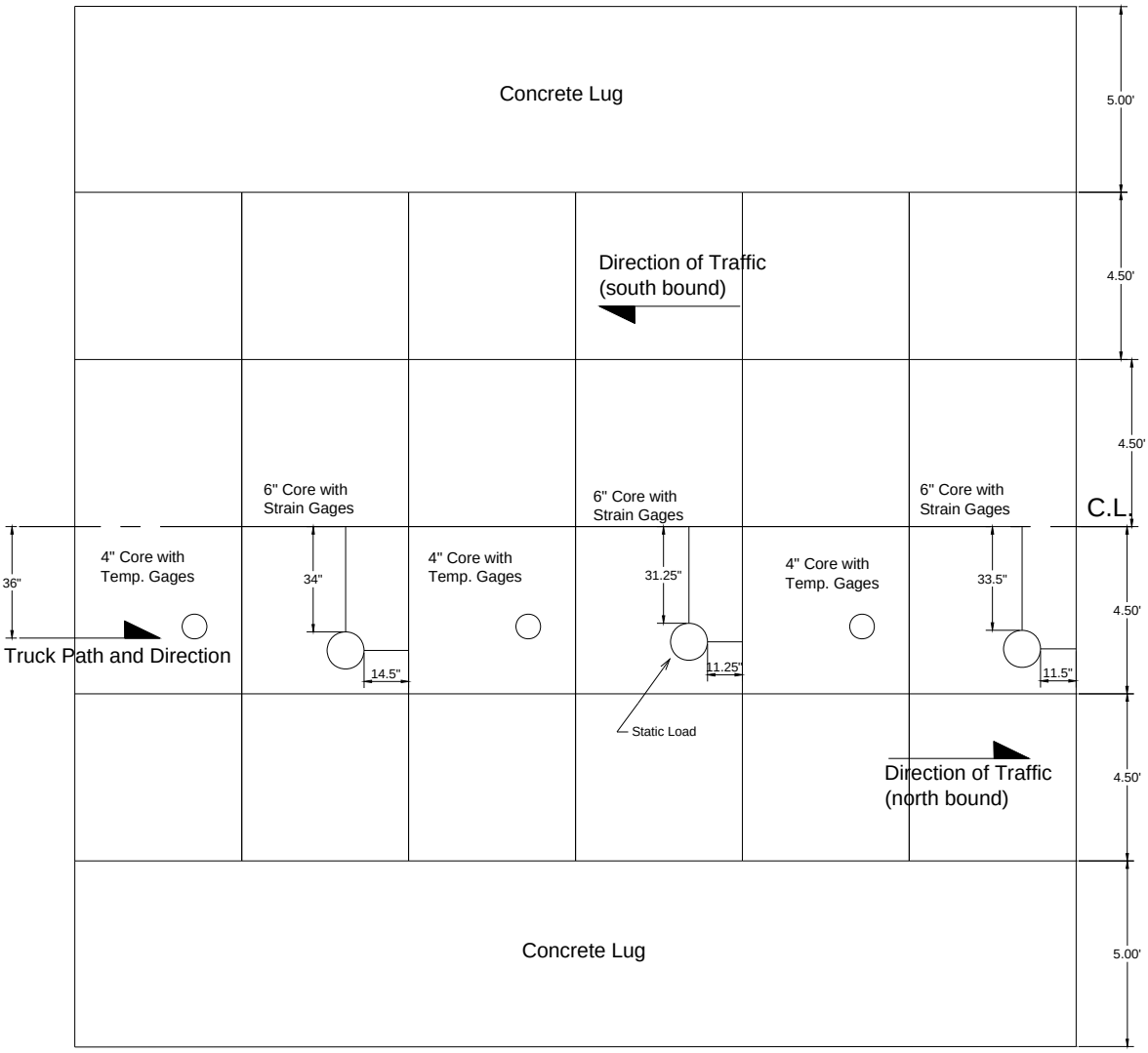
Date: 9-10-2004 Truck speed 1- 2 mph

Site: # 1

Station: 439+10

Slab size: 4.5' x 4.5'

Gage orientation: longitudinal



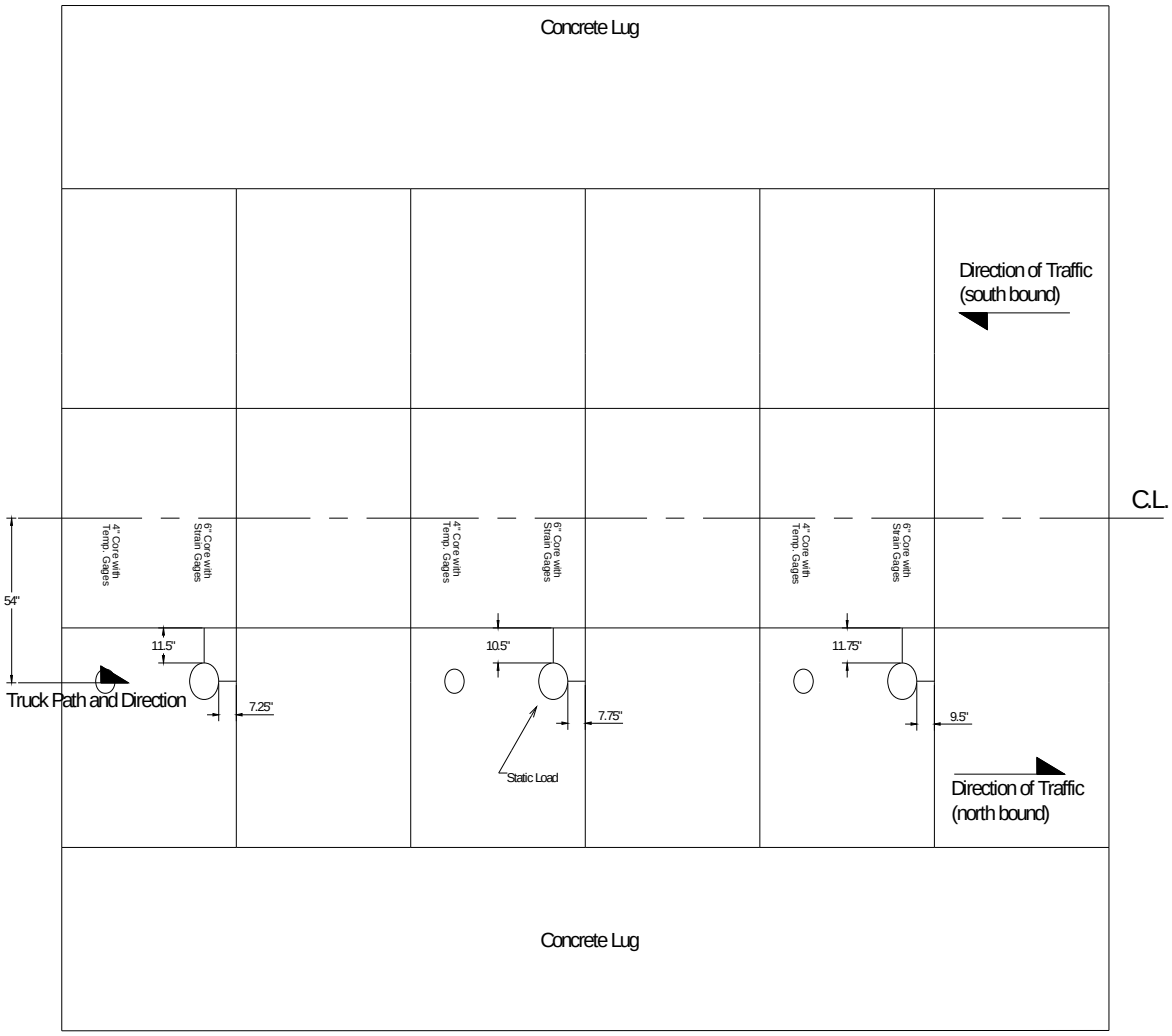
Date: 9-10-2004 Truck speed 1- 2 mph

Site: # 2

Station:

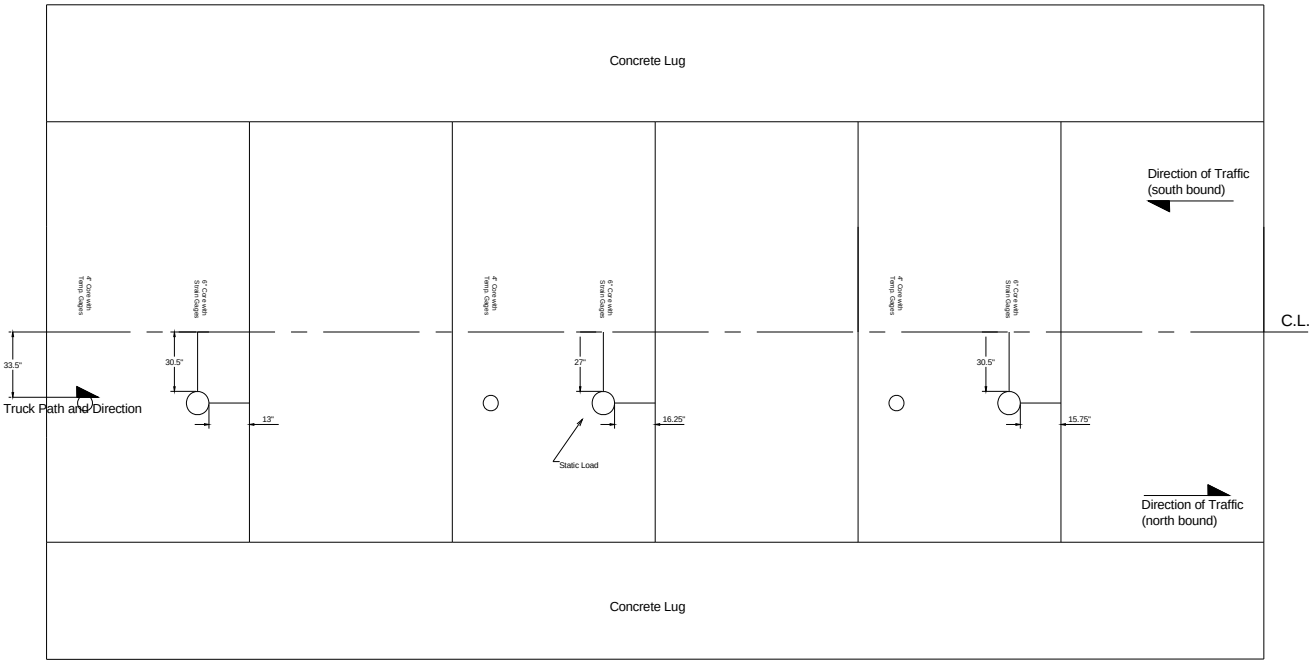
Slab size: 6' x 6'

Gage orientation: transverse



Date: 9-10-2004
Site: # 3
Station: 495+00
Slab size: 9' x 9'
Gage orientation: longitudinal

Truck speed 1- 2 mph



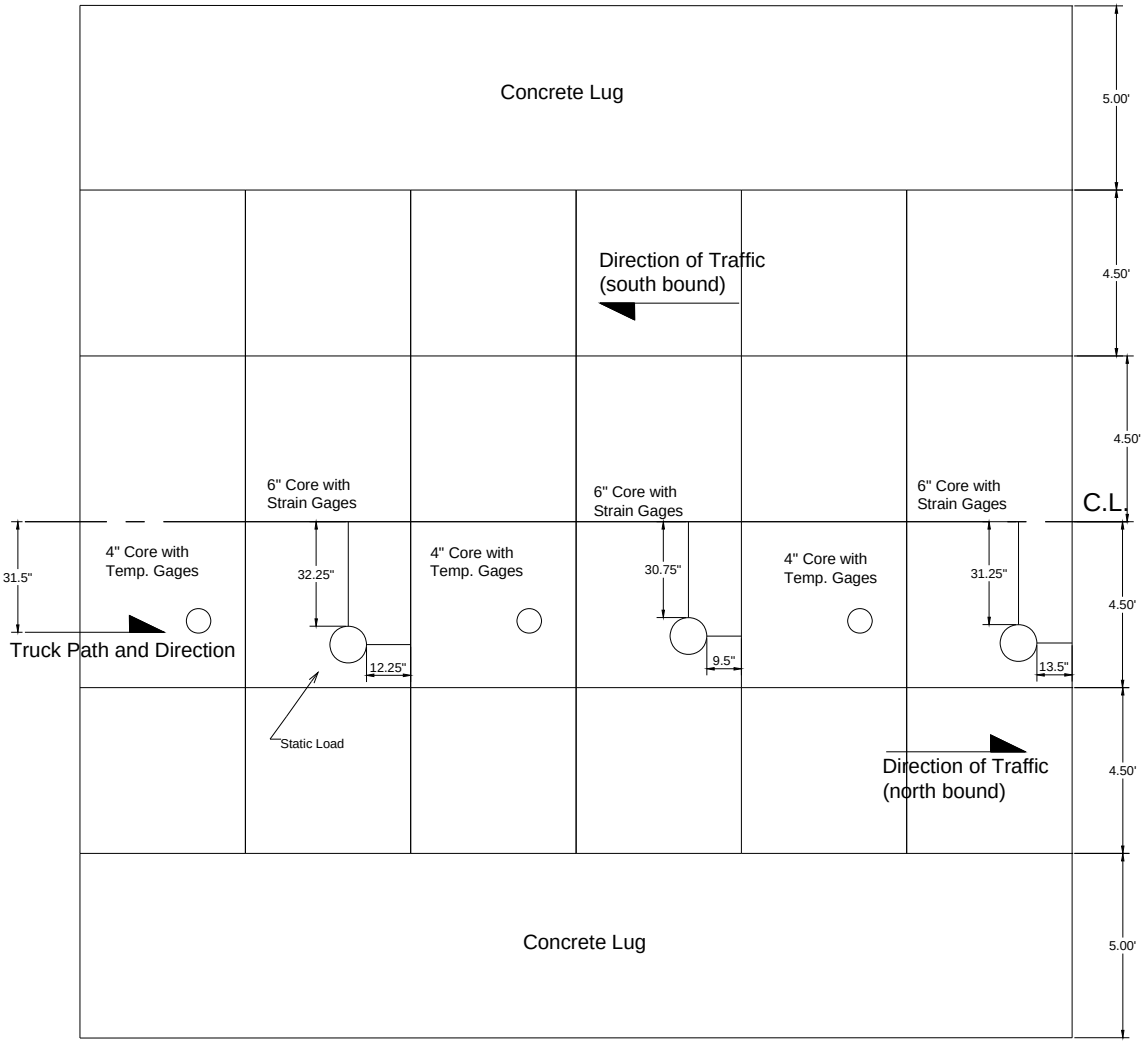
Date: 9-10-2004 Truck speed 1- 2 mph

Site: # 4

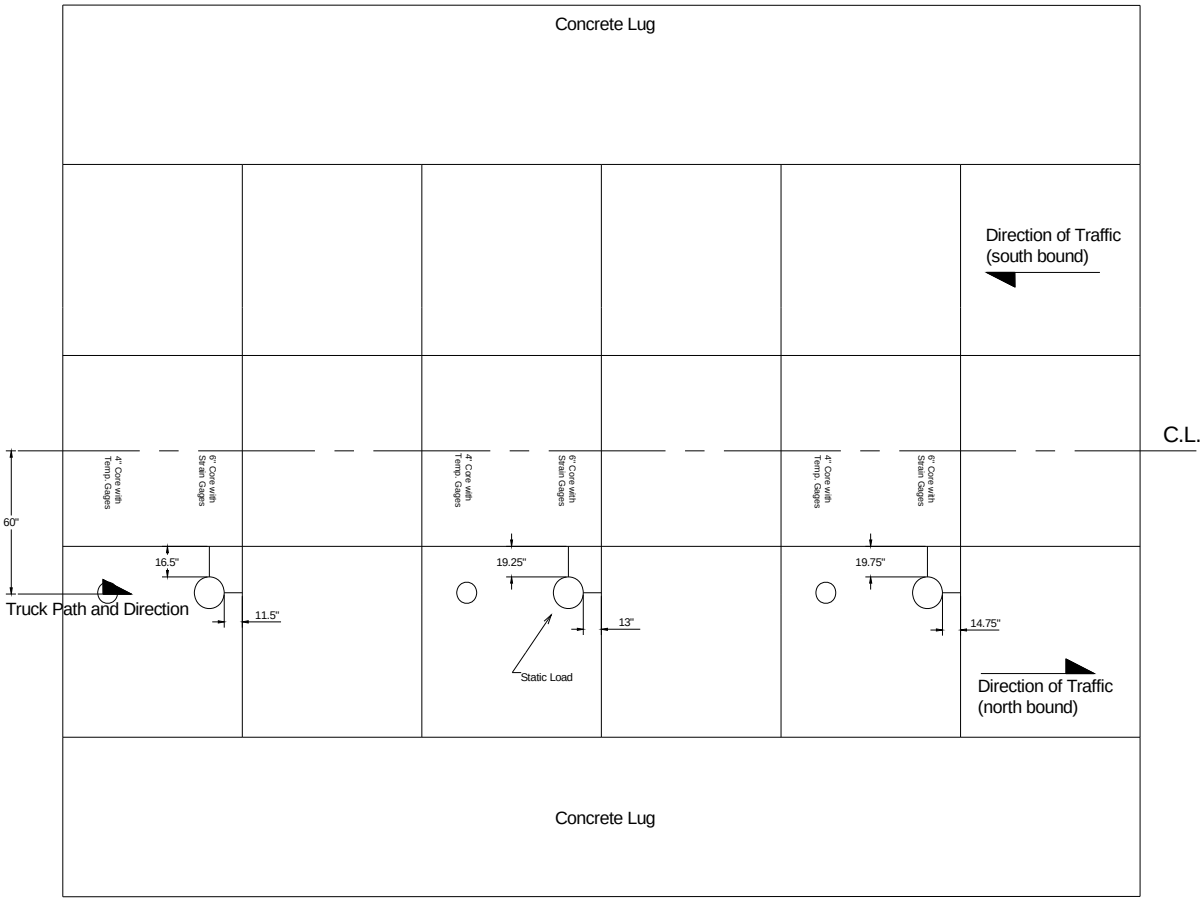
Station: 500+10

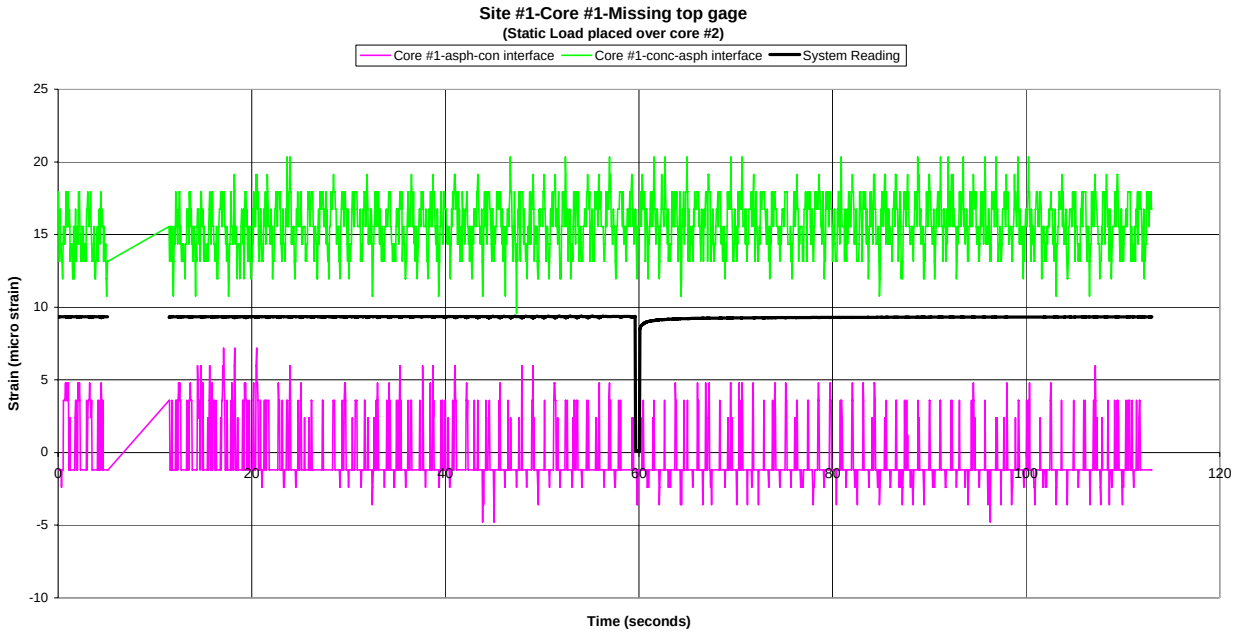
Slab size: 4.5' x 4.5'

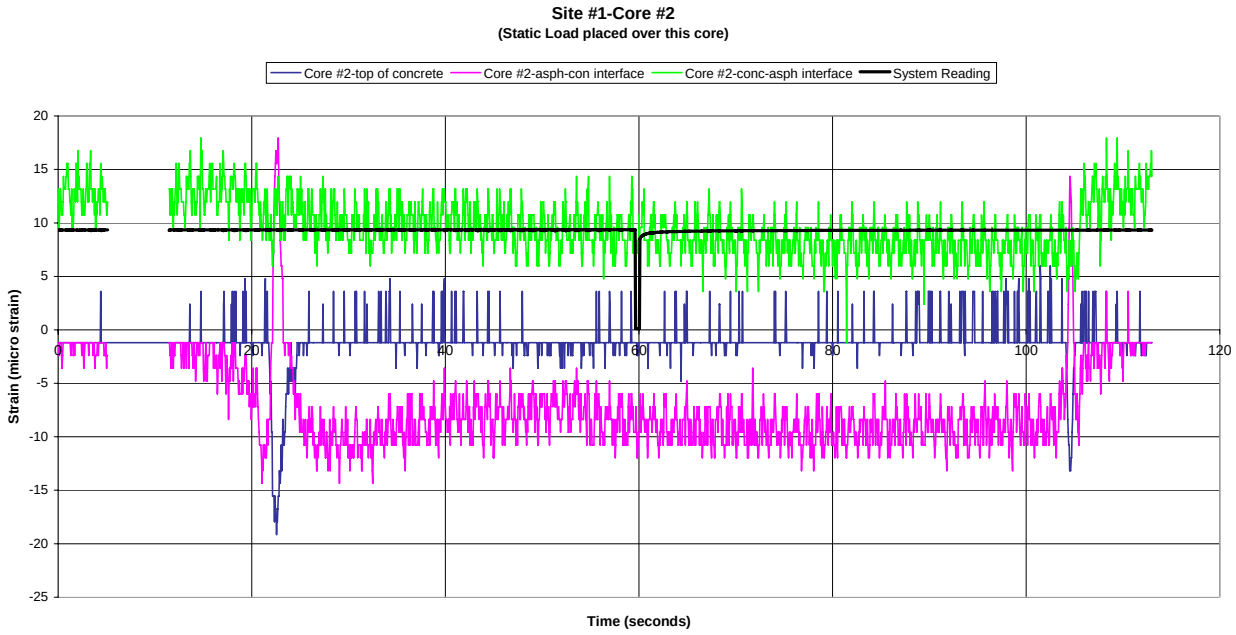
Gage orientation: transverse



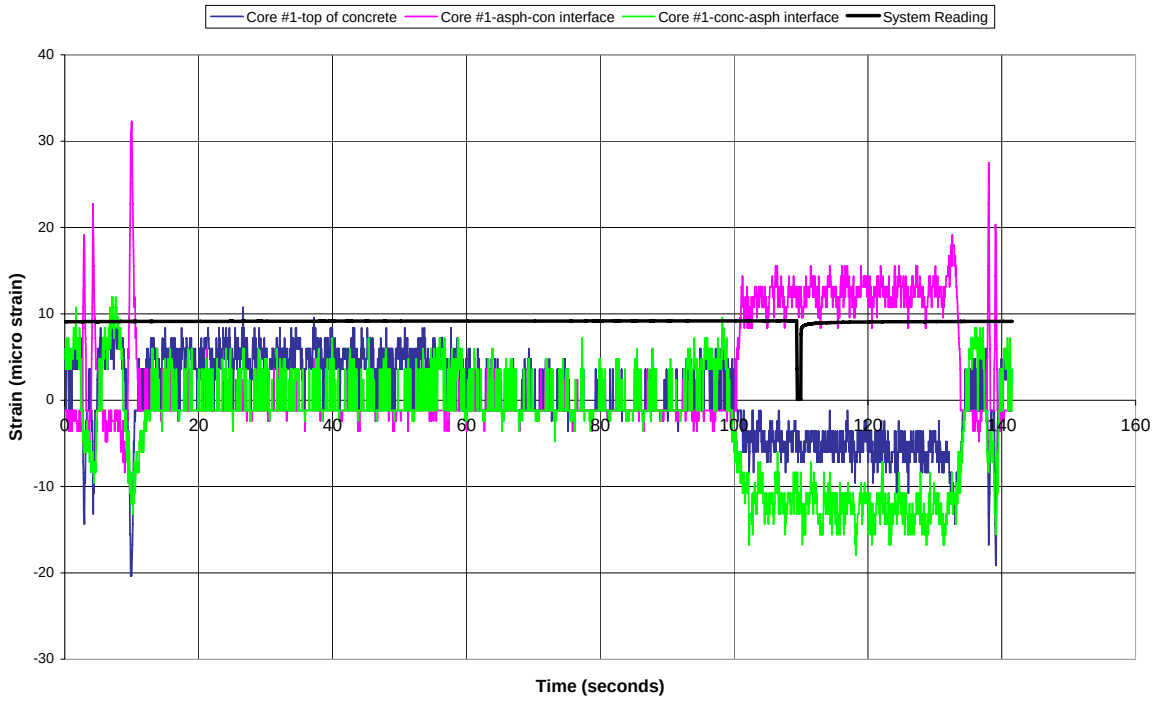
Date: 9-10-2004 Truck speed 1- 2 mph
Site: # 5
Station: 507+10
Slab size: 6' x 6'
Gage orientation: longitudinal



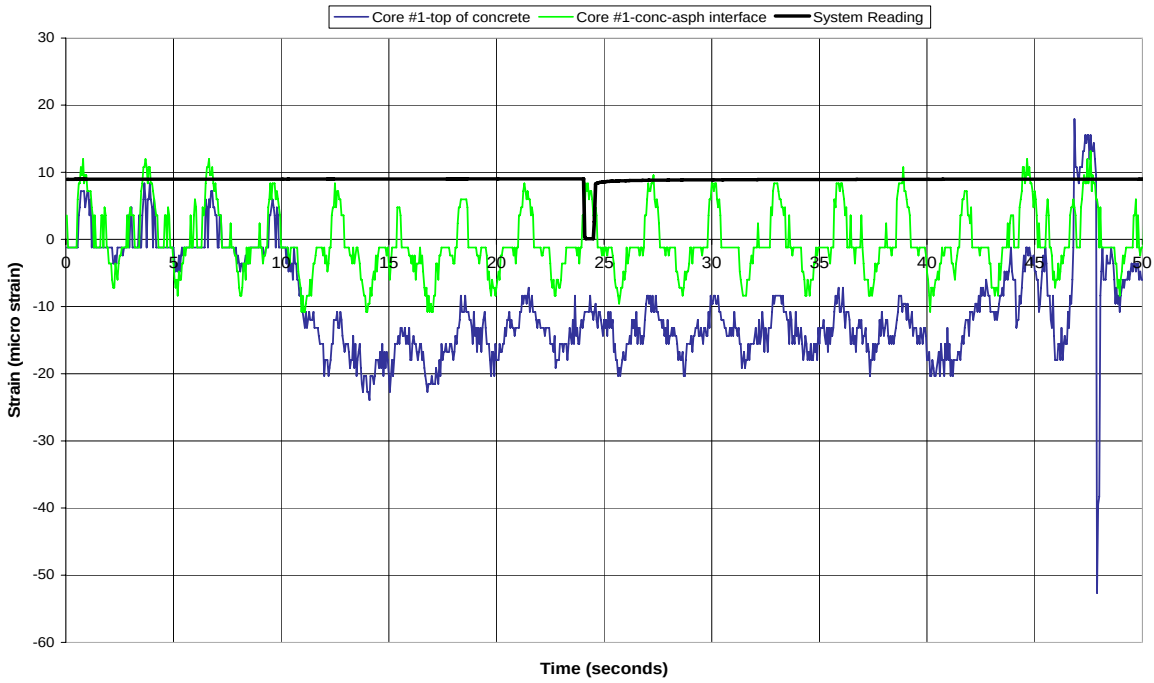

Site #1-Core #1-Missing top gage
(Static Load placed over core #2)
Core #1-asph-con interface
Core #1-conc-asph interface
System Reading
Strain (micro strain)
Time (seconds)


Site #1-Core #2
(Static Load placed over this core)
Core #2-top of concrete
Core #2-asph-con interface
Core #2-conc-asph interface
System Reading
Strain (micro strain)
Time (seconds)

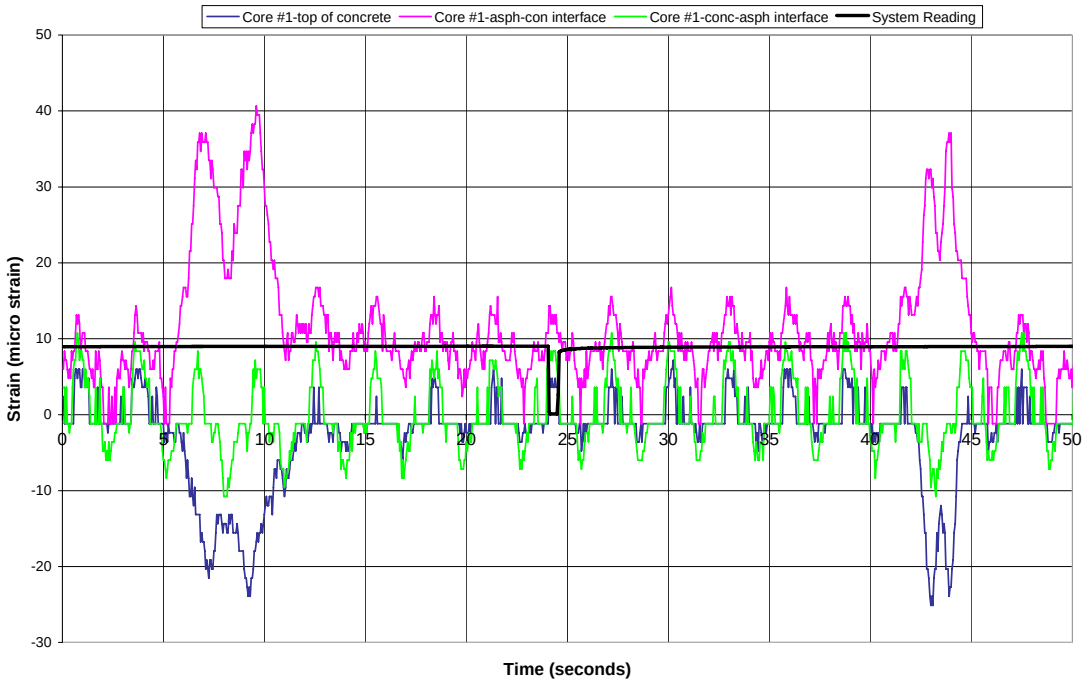
Site #3-Core #3
(Static Load placed over core #2)



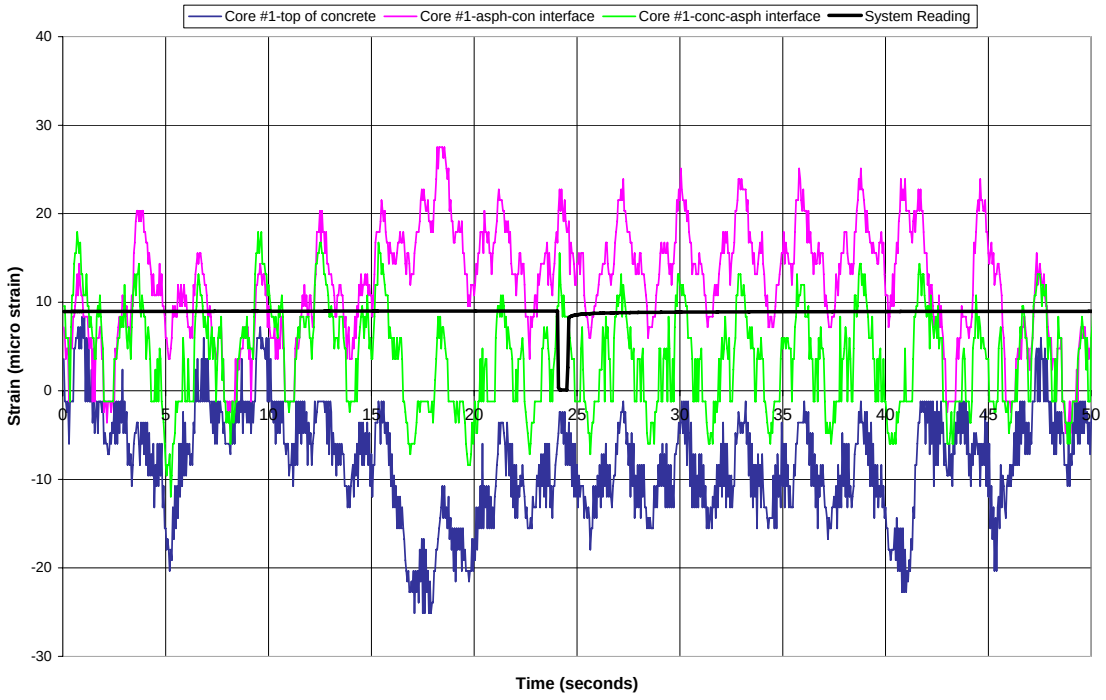
Site #4
Core #1-Transverse gage orientation
(Static Load placed over this core)



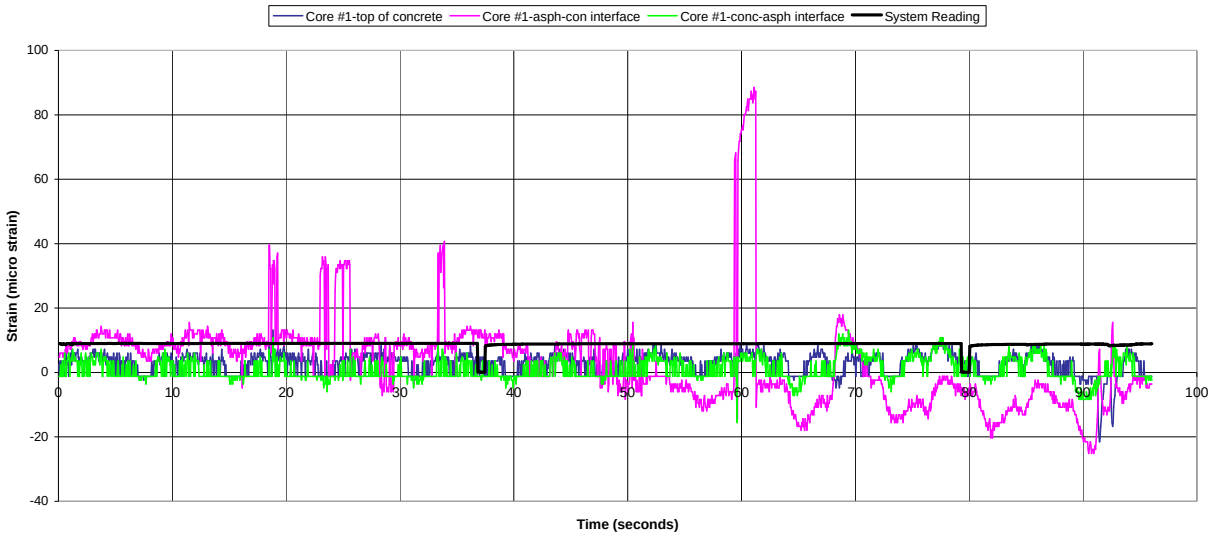
Site #4
Core #2-Longitudinal gage orientation
(Static Load placed over core #1)



Site #4
Core #3-Longitudinal gage orientation
(Static Load placed over core #1)



Site #5
Core #3-Longitudinal gage orientation
(Static Load placed over core #2)



APPENDIX B: IOWA 175 DESIGN EXAMPLE