Demonstration and Field Evaluation of Alternative Portland Cement Concrete Pavement Reinforcement Materials

Iowa DOT Project HR-1069
FHWA Work Order No. DTFH71-97-TE030-IA-48

Sponsored by
the Iowa Department of Transportation,
the Iowa Highway Research Board, and
the Federal Highway Administration

Department of Civil, Construction
and Environmental Engineering
Iowa State University

Final Report • June 2003

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Abstract

Transverse joints are placed in Portland cement concrete pavements to control the development of random cracking due to stresses induced by moisture and thermal gradients and restrained slab movement. These joints are strengthened through the use of load transfer devices, typically dowel bars, designed to transfer load across the joint from one pavement slab to the next. Epoxy coated steel bars are the materials of choice at the present time, but have experienced some difficulties with resistance to corrosion from deicing salts.

The research project investigated the use of alternative materials, dowel size and spacing to determine the benefits and limitations of each material. In this project two types of fiber composite materials, stainless steel solid dowels and epoxy coated dowels were tested for five years in side by side installation in a portion of U.S. 65 near Des Moines Iowa between 1997 and 2002. The work was directed at analyzing the load transfer characteristics of 8 inch vs. 12 inch spacing of the dowels and the alternative dowel materials, fiber composite (1.5 and 1.88 inch diameter) and stainless steel (1.5 inch diameter), compared to typical 1.5 inch diameter epoxy-coated steel dowels placed on 12 inch spacing. Data was collected biannually within each series of joints and variables in terms of load transfer in each lane (outer wheel path), visual distress, joint openings, and faulting in each wheel path.

After five years of performance the following observations were made from the data collected. Each of the dowel materials are performing equally in terms of load transfer, joint movement and faulting. Stainless steel dowels are providing load transfer performance equal to or greater than epoxy-coated steel dowels at the end of five years. FRP dowels of the sizes and materials tested should be spaced no greater than 8 inches apart to achieve comparable performance to epoxy coated dowels. No evidence of deterioration due to road salts was identified on any of the products tested. The relatively high cost of stainless steel solid and FRP dowels was a limitation at the time of this study conclusion. Work is continuing with the subject materials in lab studies to determine the proper shape, spacing, chemical composition and testing specification to make the FRP and stainless (clad or solid) dowels a viable alternative joint load transfer material for long lasting Portland cement concrete pavements.

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ACKNOWLEDGMENTS

This project is the combined efforts of Iowa State University, the Iowa Department of Transportation, Iowa Concrete Paving Association, and Federal Highway Administration. The researchers would like to acknowledge the Iowa Department of Transportation Office of Materials Special Investigations Unit, ERES Consultants of Champaign, Illinois, and RUST Engineering of Sheboygan, Wisconsin, for contributing their time and effort in collecting and analyzing specialized field data.

This research would not have been possible without the cooperation of the Flynn Construction Company of Dubuque, Iowa, and their staff. Their paving knowledge along with the materials contributions of Hughes Brothers, Inc., RJD Industries, Inc., and Talley Meadow, Inc., made the test area possible. This is another example of how the construction industry benefits from cooperative research efforts.

INTRODUCTION

Background

In the field of concrete paving, slab joints continue to be an important consideration in the construction and long-term performance of concrete pavements. Research has demonstrated the need for some type of positive load transfer across transverse joints. The same research has directed pavement designers to the use of round dowels spaced at regular intervals across the transverse joint to distribute the vehicle loads both longitudinally and transversely across the joint. The utilization of transverse joints in portland cement concrete (PCC) pavement is a method to control the development of random cracking due to the stresses induced by moisture and thermal gradients, and restrained slab movement. The transverse joints create points of weakness that may be strengthened through the use of load transfer devices, typically dowel bars, designed to transfer the load across the joint from one pavement slab to the next. The most commonly used dowel bars are made of steel. However, their susceptibility to corrosion has resulted in severe pavement problems that are directly related to the volumetric increase of corroded steel. The corrosion of the steel dowels reduces load transfer efficiency and may prevent horizontal slab movement, which in turn causes joint spalling and cracking.

Research has been conducted to develop a protective coating to cover the steel dowel bars in an effort to prevent corrosion. Although generally effective, the coatings can increase the corrosive damage to steel dowels through pitted corrosion. Pitted corrosion occurs if the steel bars have uncoated areas resulting from flaws in the coating process or scratches from careless stacking, storing, handling, or placement of dowels during construction. The corrosion develops in the shape of a semi-circular pit within the dowel, reducing the area capable of carrying a load, thus reducing the load transfer efficiency. Research has also shown that protective coatings can affect the bond strength of the dowel bars. In addition, limited research results are available that describe the performance characteristics of the protective coatings, which may affect the service life of the load transfer and, ultimately, the pavement.

Continuing questions and problems associated with steel dowel bars and protective coatings suggest the need for continued research. The research should investigate the use of new methods and materials to improve the performance of dowel bars and eliminate pavement damage due to deterioration of the dowel material, hence improved long-term performance of the joints and the pavement structure. Stainless steel materials have been used in the commercial industry since the 1920s and fiber composite materials have been utilized in the aerospace and aeronautic industries. Although these materials have been used in other industries, the construction industry has been reluctant to utilize them.

The biggest barrier for stainless steel and fiber composite dowel bars appears to be the initial increased material cost and limited amount of knowledge of material properties. Dowels are also a cost factor in the pavement costs when joint spacings are reduced in an effort to control curl and warping distress in pavements. It is the desire of the designer to place adequate but not excessive numbers of dowels spaced at the proper locations to handle the anticipated loads and bearing stresses for the design life of the pavement.

This final report is the last of three reports issued on the demonstration and evaluation of alternative PCC pavement reinforcement materials in field testing under the Federal Highway Administration (FHWA) project. It documents the installation of pavement test sections constructed with epoxy-coated steel, stainless steel, and fiber composite dowel bars. The test site location, dowel material types, and details of the location are identified, along with biannual test results from the fall of 1997 through the spring of 2002. It documents the results of deflection and visual distress surveys as they relate to the original laboratory work. The report also identifies and compares the first five years of performance of the various dowel arrangements, serves to look at the correlation of the results to those of the laboratory studies, and estimates the long-term performance of the various dowel materials and configurations.

Research Objectives

The primary goal of this research was to compare the behavior of highway joints reinforced with fiber composite dowel bars to that of conventional steel and stainless steel bars under the same design criteria and field conditions. Specifically, this research was directed at analyzing the load transfer characteristics of: (a) 8-inch (203 mm) versus 12-inch (305 mm) dowel bar spacing and (b) alternative dowel materials, fiber composite and stainless steel, compared to typical 1.5-inch (38 mm) diameter epoxy-coated steel dowels placed at 12-inch (305 mm) spacing. This research sought to evaluate field performance and provide recommendations on design, materials, construction practices and performance characteristics of stainless steel and fiber composite dowel bars. The project included monitoring the installation of the dowel bars during construction, conducting visual distress surveys after construction, and evaluating pavement performance as means for thorough research.

Research Approach

The project duration extended over a five-year period from the fall of 1997 through the spring of 2003. Year 1, first summarized in the construction report of August 1998, involved the installation of dowel bars in the field according to the layout outlined in Table 1. The construction project chosen for the field research, US 65 in Iowa's Polk and Warren Counties (Project NHS-500-1(96)-19-77), provided the opportunity needed to fulfill the research objectives. Test section length accounted for approximately 0.46 miles (0.74 km) of the 2.69-mile (4.33 km) PCC paving project. The construction project's contractor, Flynn Construction Company of Dubuque, Iowa, and materials suppliers—Hughes Brothers, Inc., RJD Industries, Inc., and Tally Meadows, Inc.—provided the resources necessary to implement the research.

Years 2–5 provided an evaluation period through which the performance of the pavement could be monitored. Project test sections were tested twice a year, beginning in the fall of 1997, with the final tests in the spring of 2002. Testing was not able to be performed in the fall of 2000. The biannual testing was performed once in the spring, March or April, to represent the weakest foundation condition and once in late summer, August or September, to typify a relatively dry foundation. All tests were conducted during similar times of the day to ensure comparable results.

The testing consisted of performing falling weight deflectometer (FWD) tests, measuring joint faulting, monitoring joint movement, conducting a visual distress survey in accordance with the Strategic Highway Research Program (SHRP) and obtaining core samples for visual analysis of deterioration. Under the direction of the principal investigator, research staff from Iowa State University and the Iowa DOT provided the support necessary for the testing program. The ERES Consultants of Champaign, Illinois, performed FWD testing. The Iowa Department of Transportation (Iowa DOT) Office of Materials Special Investigations Unit also obtained the coring samples. RUST Engineering of Sheboygan, Wisconsin, was responsible for the employment of ground penetrating radar (GPR) in the location of fiber reinforced polymer (FRP) dowels. The remainder of the tests were performed concurrently by Iowa State University research staff. The interim report of January 2002 documented preliminary results of such testing through the fall of 2001. This final report provides a comprehensive summary of the project's research, including installation, evaluation, and subsequent conclusions and recommendations.

TESTING PROGRAM

Location, Construction History, and Layout

The test site is located southeast of Des Moines, Iowa, as part of the relocation of US 65 from the US 65/69 interchange in Warren County to the IA 5 interchange in Polk County. The site consists of 2,432 feet (741.3 m) of continuous pavement, the westbound lanes between stations 620+03 to 644+35. See Figure 1. The typical cross section for this project can be found in Figure A.1 (Appendix A).

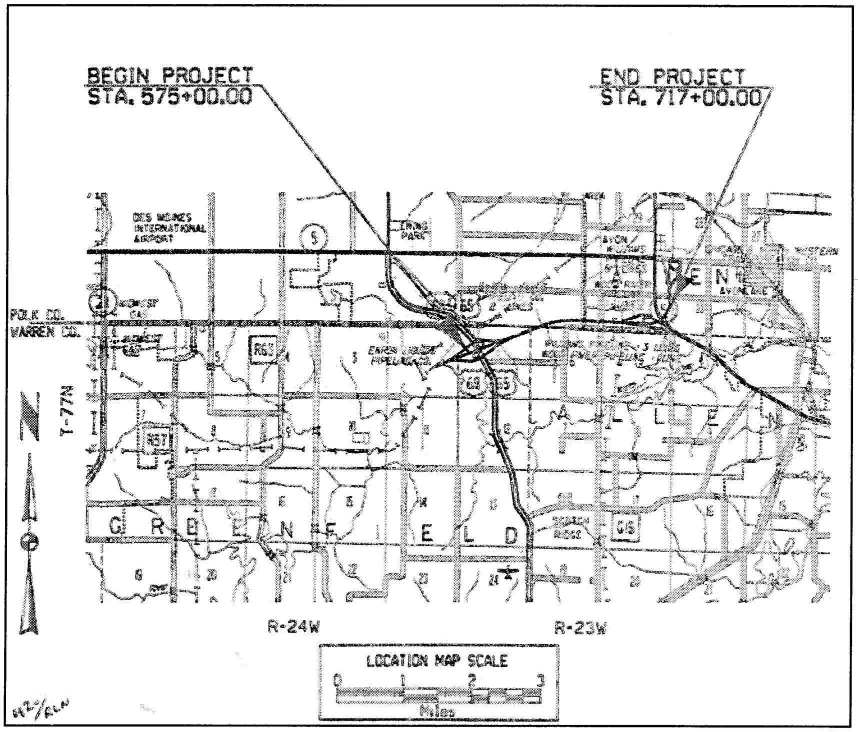

Figure 1. Project Site Map

The pavement was divided into four different test sections: two sections incorporating fiber composite dowels, one stainless steel dowel section, and a control section containing standard epoxy-coated bars. Three sections were further subdivided to provide test sections with 8-inch (203 mm) and 12-inch (305 mm) spacing for both the stainless steel and fiber composite dowel bars. The epoxy-coated bars were spaced at 12 inches (305 mm). The locations, material, dowel bar characteristics, and spacing of each test section is provided in Table 1. Figure 2 displays the site layout of the test sections.

Table 1. Stationing, Spacing, and Dowel Bar Characteristics

Begin Station	End Station	Material	Manufacturer	Diameter, in. (mm)	Spacing, in. (mm)
620+03	624+43	Fiber Composite A	Hughes Bros.	1 7/8 (48)	8 (203)
624+63	628+80	Fiber Composite A	Hughes Bros.	1 7/8 (48)	12 (305)
629+00	630+00	Fiber Composite B	RJD Ind.	1 ½ (38)	8 (203)
630+20	631+00	Fiber Composite B	RJD Ind.	1 ½ (38)	12 (305)
631+20	633+42	Stainless Steel	Tally Meadow	1 ½ (38)	8 (203)
633+82	639+38	Stainless Steel	Tally Meadow	1 ½ (38)	12 (305)
639+58	644+35	Epoxy-Coated Steel		1 ½ (38)	12 (305)

Note: The alternative materials used to fabricate the dowels meet the Iowa DOT specifications for flexure, shear, and moment that are required by Iowa DOT specification #4151, Steel Reinforcement.

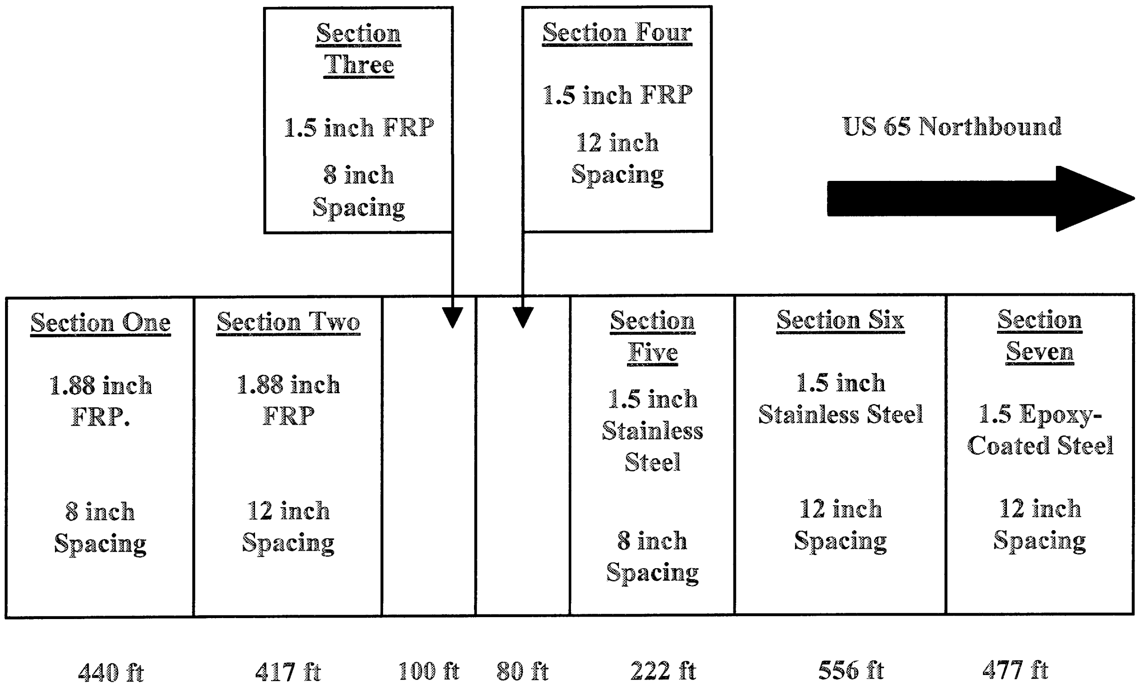

Figure 2. Site Layout of Test Sections

Soils and Base Types

Based on soil surveys taken by the United States Department of Agriculture, the composition of the local soil is primarily of the Downs-Fayette, Ladoga-Gara-Armstrong, and Sharpsburg-Shebly-Lamoni Associations. Of loess and glacial till origins, these soils are moderately well-drained and considered "moderate" in terms of their suitability for road construction. These soils generally exhibit low strength, moderate shrink/swell properties, and moderate freeze/thaw action. Corrosion to concrete due to the chemistry of these soil types is also considered to be moderate.

Climate Conditions

Climate conditions and weather patterns over the research period were obtained through the National Climactic Data Center's online weather data inventory (http://www.ncdc.noaa.gov/oa/ncdc.html). The data sets were taken from a weather observation station (Automated Surface Observation System) managed by the National Weather Service at the Des Moines International Airport. Though the station is not located immediately adjacent to the test site, its close proximity to the project allows for a general understanding of local weather patterns and future comparisons between pavement distress and climatic extremes. It should be noted that no distress was noted at the test site that can be attributed to climate at this time. Data tables displaying monthly precipitation averages and temperature extremes can be found in Tables B.1 through B.5 in Appendix B.

Traffic Data

An automatic weight in motion (WIM) device is located north of this test site on US 65 and was used to estimate the number of equivalent single axle loads (ESALs) that the site experienced. The site is not located immediately adjacent to the test site. This allows for some error due to interchange of traffic at three interchanges between the WIM site and the test site. It should be noted that no distress was noted at the test site that can be attributed to traffic loadings at this time. The estimated number of ESALs for the test site (both lanes), as developed from the WIM data, is listed in Table B.6 in Appendix B.

Deflections

The FWD tests were conducted by ERES Consultants of Champaign, Illinois (see Figure 3). Tests were made on three transverse joints and three mid-panel locations per test section per lane. Testing was performed in the outside wheel-path, 2 feet (0.6 m) from the outer edge, in each lane. FWD tests utilized seven deflection sensors placed at 0, 12, 24, 36, 48, 60, and 72 inches (0, 305, 710, 914, 1219, 1524, and 1829 mm) from the center of the load plate. Three test drops were conducted at each test location with one drop per target load: 9,000, 12,000, and 16,000 force pounds (40.033 kN, 53.378 kN, and 71.171 kN). As indicated in the data tables, actual loads generated from the falling weights varied slightly from target loads due to variations in pavement stiffness. Therefore, deflection measurements at each sensor were normalized for comparison between different test locations. The normalization was performed using linear interpolation.

Ultimately, the results of the FWD testing were interpreted through calculating load transfer efficiency. Load transfer efficiency for this project is defined as the ratio of the deflection of an unloaded pavement to that of the adjacent loaded pavement, denoted as a percentage. The deflection load transfer efficiency was measured with the FWD by placing the load plate at the edge of the pavement section so only one of the slabs was loaded. Deflection sensors were placed equidistant from the joint, and with one under the load and the remainder on the opposite side of the joint and spaced at 12-inch intervals. The resulting assessment and statistical relationships derived from the FWD tests are outlined under "Analysis and Results," with sample test data in Appendix B.

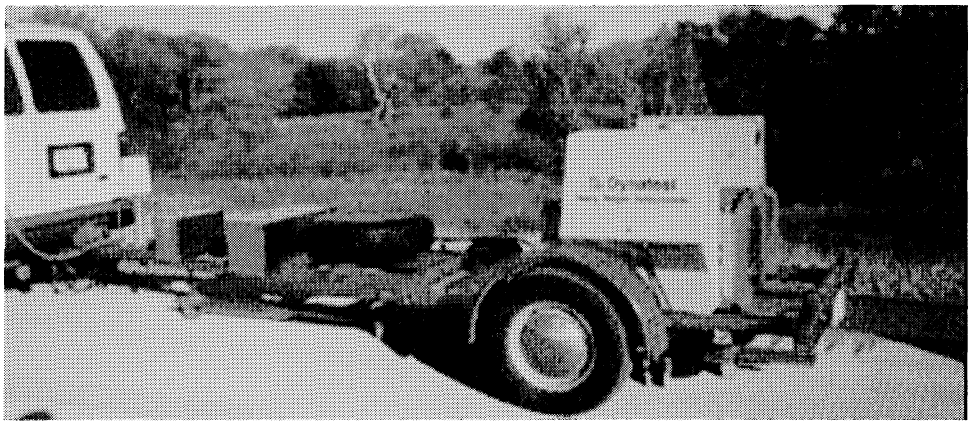

Figure 3. Falling Weight Deflectometer

Faulting

The Georgia fault-meter was used to measure faulting at the inside and outside wheel paths of the driving lane (see Figure 4). The digital readout of the fault-meter indicates positive or negative faulting in millimeters. To obtain the readings, the fault-meter was set on the pavement in the direction of traffic, on the "leave side" of the joint, and the measuring probe was in contact with the approach slab. Movement of the probe was then transmitted to a linear variance displacement transducer (LVDT) to measure the difference in elevation between the two sides of the joint or amount of faulting. A slab that is lower on the leave side of the joint indicates positive faulting, and a slab leaving the joint that is higher, will register as a negative fault. Faulting was measured in both the inside and outside wheel-paths of the driving lane at 30 inches (762 mm) and 18 inches (457 mm) from the edge, respectively. Results of the faulting measurements are discussed under "Analysis and Results," with actual measurement data in Appendix B.

Figure 4. Georgia Fault-Meter

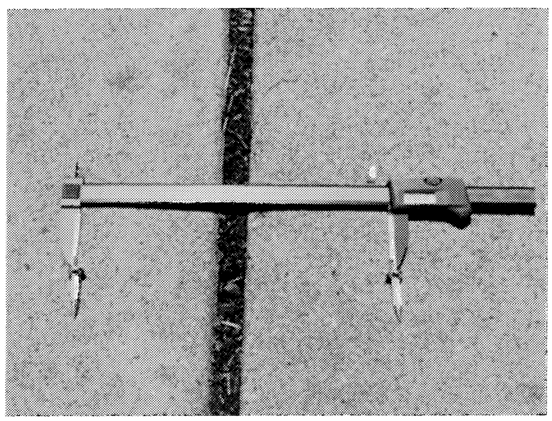

Figure 5. Calipers and Surveyor Nails (Nails Not Installed)

Joint Openings

For the purpose of monitoring the transverse joint opening, surveyor mag-nails were placed in the wet concrete (flush with the surface) on either side of joints in the outside lane to serve as a point of reference for measurement. Transverse joint movement was monitored at 10 consecutive joints in the middle of each test section. At these locations, nails were placed into the concrete within the first hour of paving 12 inches (305 mm) in from the edge of the slab with 10 inches (254 mm) between nails (5 inches [127 mm] offset either side of the joint). Initial measurements between the nails shortly after the paving served as a benchmark for future joint movement. Joint opening measurements were made at the same time as faulting and visual distress surveys. Measurements from each joint opening survey can be found in Appendix B, and graphs displaying the trends are in Appendix C.

Visual Distress Surveys

Visual distress surveys were performed concurrently with the biannual joint opening and faulting measurements by Iowa State University research staff. Completed in accordance with SHRP, the visual distress surveys consisted of a visual evaluation of the pavement surface for any signs of horizontal slab movement, spalling, or cracking. A discussion of the survey's results can be found in "Analysis and Results."

Coring

Coring was utilized for two purposes on this project. Samples were initially taken in 1997 shortly after construction in conjunction with GPR research to confirm location of the FRP dowels. Traditionally, metal detectors are used to locate the steel dowel bars within the concrete; however, alternative methods of bar location were necessary for the fiber composite bars. RUST Engineering provided their ground penetrating radar device to assist in locating the dowel bars. The coring proved helpful in the analysis of the GPR data.

Core samples of the pavement and joint reinforcement were obtained in 2002, from each type of joint reinforcement, in order to examine possible deterioration of joint and/or pavement material. The Iowa DOT Office of Materials Special Investigations Unit drilled the 4-inch (102 mm) diameter core samples. To assist in this sampling, the principal investigator used duct tape to adhere common roof gutter nails to fiber composite bars selected for the 2002 core samples. Traditional metal detection techniques were then applied to locate all bars chosen for coring. Cores were taken in a fashion such that the core sample included a cross section of the reinforcing dowel. The resulting core allowed analysts to observe deterioration of the dowel or surrounding concrete due to metal corrosion from road salts, hollowing of the concrete at the dowel ends due to excessive bearing stresses on the dowel, and pavement cracking at the end of the dowels usually associated with construction processes, thus the effectiveness of the joint over time.

Laboratory testing of the cores consisted of detailed examination through the use of a scanning electron microscope. Figure 6 displays typical core samples. Results of the coring samples are discussed under "Analysis and Results." Core length measurements and pictures of the cores can be found in Appendix D. Note that samples of joints reinforced with stainless steel dowels (core #s 4, 5, 6) were not obtained due to the coring bit being unable to cut through such material.

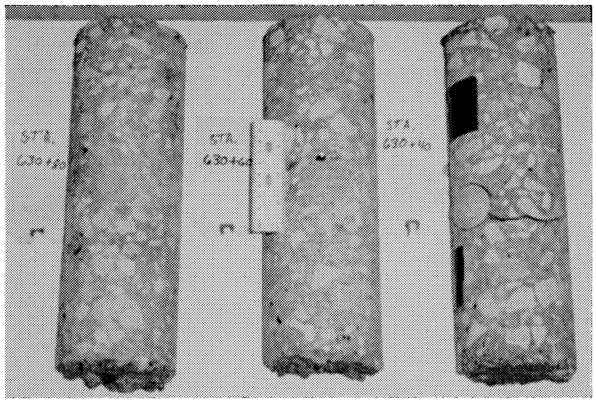

Figure 6. Typical Core Samples

ANALYSIS AND RESULTS

Falling Weight Deflectometer Results

The results of the load transfer analysis are illustrated in Figure 7 below and Figures C.1 and C.2 in Appendix C. Figure 7 shows the research period lifetime average for each dowel bar and configuration for the driving and passing lanes. Figures C.1 and C.2 present lines graphs that represent the average transfer efficiency of the driving and passing lane for each test section over the data collection period. The dowel bars are labeled according to their material and spacing: standard epoxy (std. epoxy), stainless steel (S.S.), fiber composite B (1.5" FRP), and fiber composite A (1.88" FRP). Along with these figures, a preliminary statistical analysis was performed through the use of sample *t*-tests.

Utilizing epoxy-coated steel spaced at 12 inches (305 mm) on center as the experimental control and current standard, Figure 7 indicates that there is not a significant advantage to the alternative dowel bars. Stainless steel dowel bars spaced at 8 inches (203 mm) were the only alternative to outperform the standard coated steel dowels. Figure 7 shows the RJD fiber composite dowels (1.5 inch diameter FRP [38 mm]) spaced at 8 inches (203 mm) performed similar to the standard dowels, but performed consistently lower in each testing period.

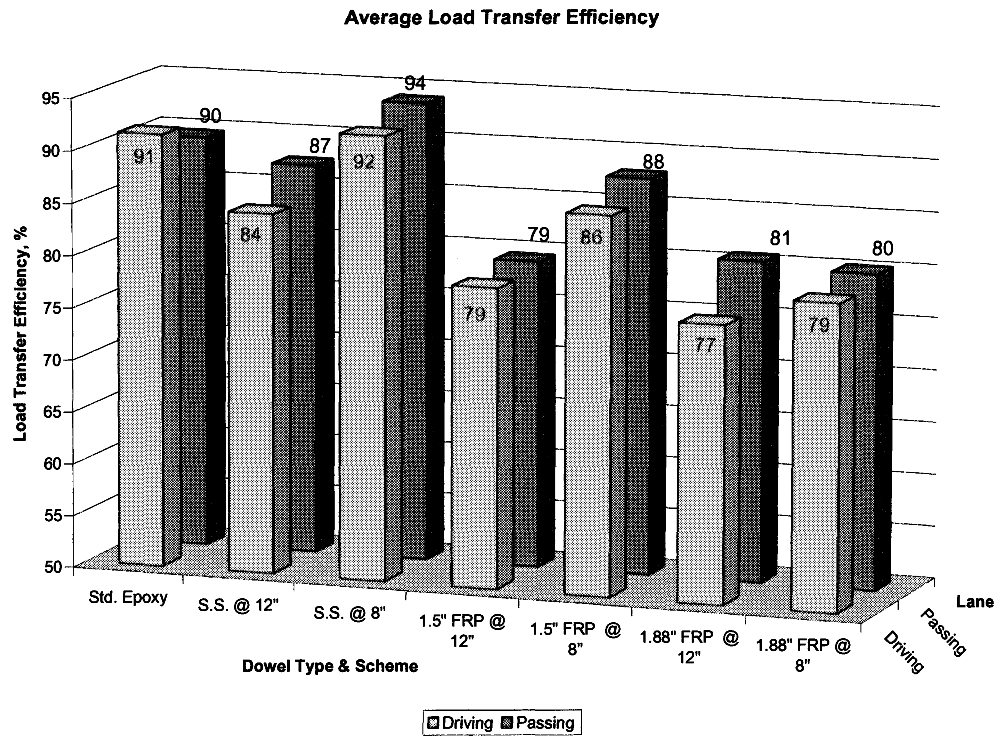

Figure 7. Average Load Transfer Efficiency

Of the three dowel alternatives investigated, stainless steel dowels displayed the best ability for load transfer. Stainless steel bars, spaced at 8 inches (203 mm), outperformed the 12-inch (305 mm) spacing, and also are the only alternative dowel bar and spacing currently outperforming the standard epoxy-coated steel dowels. Figures C.1 and C.2 in Appendix C indicate the stainless steel dowel with 8-inch (203 mm) spacing performed as well (within 1 percent) or better than the epoxy-coated steel bars. The figures also indicate no significant change in performance of the stainless steel bars over time. However, the figures show seasonal variation for the 12-inch (305 mm) spacing, with the spring testing periods generally producing lower load transfer ability with the exception of the fall of 2000.

Figure 7 indicates that the 1½-inch (48 mm) diameter, fiber composite B dowels with 12-inch (305 mm) spacing were outperformed by the standard epoxy-coated steel bars with 12-inch (305 mm) spacing. The figure also shows fiber composite B dowels with 8-inch (203 mm) spacing outperformed the same dowels with a 12-inch (305 mm) spacing. Figures C.1 and C.2 indicate the 8-inch (203 mm) and 12-inch (305 mm) spacings performed similarly during the first three data collection periods, but since then the 8-inch (203 m) spacing has significantly outperformed the 12-inch (305 mm) spacing. When compared to the standard epoxy-coated steel dowel bars, the fiber composite B dowels with 8-inch (203 mm) spacing performed similarly in the passing lane but did not perform as well in the driving lane. Figure C.1 shows the fiber composite B dowels with 8-inch (203 mm) spacing in the driving lane initially performed similarly to the standard epoxy-coated steel for the first three testing periods, after which the standard bars significantly outperformed the fiber composite B bars with the exception of the latest testing period. Figure C.2 illustrates that fiber composite B dowels with 8-inch (203 mm) spacing in the passing lane performed comparably to the standard bars. Figures C.1 and C.2 also show no significant change in load transfer performance over time except for the aforementioned drop in performance after the third testing period in the driving lane. Statistical *t*-test analysis also indicates that the fiber composite B dowels with 8-inch (203 mm) spacing outperformed those with 12-inch (305 mm) spacing, but the standard epoxy-coated steel bars consistently outperformed both.

The fiber composite A bars' load transfer efficiency performance was slightly lower than that of the standard epoxy-coated steel bars. Figure 7 also indicates no significant difference between 12-inch (305 mm) and 8-inch (203 mm) spacings for the 1 7/8 inch fiber composite B bars, with the passing lane performing better than the driving lane in each case. Figures C.1 and C.2 validate Figure 7 and show similar results for both spacings within each testing period. Figure C.1 displays a trend of decreasing performance for the Hughes Brothers dowel bars from the fall of 1998 through the fall of 2000 within the driving lane; however, the dowels displayed a significant improvement in the spring of 2001 with a steady decline since. Figures C.1 and C.2 do not show any significant difference between the 8-inch (203 mm) and 12-inch (305 mm) spacings over time.

FWD Statistical Relationships

A statistical comparison between the fiber composite bars (fiber composite A ~ FCA and fiber composite B ~ FCB) indicated similar performance between the two. Statistical *t*-tests revealed a significant difference between the 12-inch (305 mm) spacing for testing periods of fall 1997 (FCA < FCB), spring 1999 (FCA > FCB), and fall 2000 (FCA < FCB) for the driving lane and only the fall 1999 (FCA < FCB) for the passing lane. For the 8-inch (203 mm) spacing, a significant difference between the average load transfer for the fiber composite A and B dowels existed in the fall 1999, spring 2000, and fall 2000 for the driving lane, and during the last five testing periods (spring and fall 1999, spring and fall 2000, and spring 2001) for the passing lane. In all cases, the fiber composite B dowels outperformed the fiber composite A dowels. Based on the smaller diameter dowel bar (1½ inch fiber composite B) slightly outperforming the larger bar (1 7/8 inch fiber composite A), it appears the composition of the fiber composite dowel bars is more significant than the size of diameter. The analysis also provides evidence that the 8-inch (203 mm) spacing outperformed the 12-inch (305 mm) spacing.

Deflection Basins (AREA) and Modulus of Subgrade Reaction, k

The FWD was also used to test mid-slab sections primarily to analyze the deflection basins and the modulus of subgrade reaction. The deflection basins are reported as deflection areas and were calculated using the following equation:

$$AREA = 6 + 12(d_{12}/d_0) + 12(d_{24}/d_0) + 12(d_{36}/d_0) + 12(d_{48}/d_0) + 12(d_{60}/d_0) + 6(d_{72}/d_0)$$

where d_r = deflection measured r inches from the applied load.

The AREA can then be used to estimate the radius of relative stiffness, l_k, by using the following equation:

$$l_k = \left[\frac{\ln\left(\frac{72 - AREA}{242.385}\right)}{-0.442} \right]^{2.205}$$

Once the radius of relative stiffness is known the modulus of subgrade reaction, k, can be estimated from the measured deflections with the following equation:

$$k = \frac{P d_r^*}{d_r l_k^2}$$

where: P = load magnitude

d_r = measured deflection at distance r from the load plate

d_r^* = non-dimensional deflection coefficient for radial distance r:

= a Exp [–b Exp (–c l_k)]

where a, b, and c are constants based on the distance from the applied load.

The deflection AREAs changed with the testing season, with the AREA for the fall testing period generally larger than the adjacent spring testing periods. The modulus of subgrade reaction has also varied over time, but a seasonal trend has not developed. The column charts do indicate an inverse relationship between the modulus of subgrade reaction and the AREA. As the modulus of subgrade reaction increased, the AREA generally decreased, and vice versa. Also, the modulus of subgrade reaction was typically lower in the passing lane than in the driving lane. The lower modulus of subgrade reaction for the passing lane contrasts with the load transfer values, in which the load transfer of the passing lane outperformed the driving lanes. A review of the subgrade reaction values for the different test sections indicates the subgrade for all test sections performed relatively equal (100–200 pci) with an exception of stainless steel dowels with 8-inch (203 mm) spacing in the passing lane. During three testing periods (fall 1998, spring 1999, and fall 1999) this test section experienced a modulus of subgrade reaction of approximately 50 pci. The average load transfer efficiency for the same test section was the highest over the same testing periods produced.

The average AREAs for the test sections are provided below in Table 2. When the average AREA values are compared to the average load transfer, the test sections with the higher load transfer generally have a higher AREA average. This trend follows for every test section with the exception of the fiber composite A dowels spaced at 12 inches (305 mm). Based on the other test sections, an average AREA similar to the 8-inch (203 millimeters) spacing and fiber composite B 12-inch (305 mm) spacing would be expected.

Table 2. Average AREA per Lane for Each Test Section

Lane	Std. Epoxy	SS @ 12"	SS @ 8"	FCB @ 12"	FCB @ 8"	FCA @ 12"	FCA @ 8"
Driving	55.30	53.84	54.36	51.84	53.00	54.06	52.35
Passing	55.22	53.82	55.42	52.74	53.77	54.25	53.30

Faulting Measurements

The analysis of the faulting data revealed no significant correlation between faulting magnitude and dowel bar type. However, the data did indicate the inside wheel paths experienced less faulting than the outside wheel path. The data also indicated a slight tendency for the joints to experience increased negative faulting over time. In many cases, the faulting was less than 1/10th of a millimeter, which exceeded the accuracy of the measuring device, thus exhibiting zero faulting. Graphs depicting the significance of the faulting measurements are shown in Appendix C. Figures C.3 and C.4 display average faulting for each type of material in the inside and outside wheel paths, respectively. Figure C.5 displays the overall average of faulting over the period of research. Figure C.6 shows the effect of grade (i.e., uphill, downhill, or flat) on faulting. It can be noted from this graph that faulting was less common on uphill grades. Such results could be related to soils and drainage, but there is not detailed information enough to make any further conclusions. Figure C.7 shows the seasonal effect on faulting through the change of seasons (i.e., spring vs. gall). In the case of seasonal faulting, the measurements were so small, that no statistical relationship could be made between them.

Joint Opening Measurements

Figure 8 illustrates changes in joint openings over the pavement's lifetime. All joints exhibited free movement through the change of seasons, indicative of a properly operative joint. The change in joint opening generally correlated with changes in temperature between testing periods. An increase in temperature tended to produce a decrease in joint opening as the pavement slabs expanded, while a decrease in temperature resulted in the joint openings increasing due to contraction of the slabs. Reviewing Figure 8 will also show the movement for the majority of the test sections was within 0.004 inches (0.1 mm). The exceptions were the stainless steel sections of 8-inch (203 mm) and 12-inch (305 mm) spacing. Both these test sections exhibited a larger difference in joint opening between data collection periods, with changes up to 0.01 inches (0.25 mm).

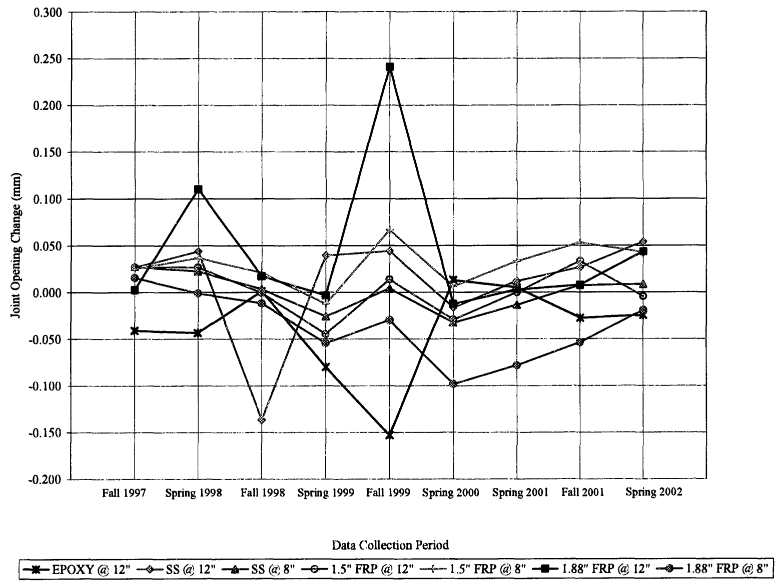

Figure 8. Joint Opening Trends

Visual Survey Results

Biannual visual surveys of this project resulted in only minor corner cracking being noted on the outside edge of the pavement immediately after construction. Such cracks were few in number and minor in size; likely the result of tight blading to the edge of the pavement in preparation for the addition of asphaltic concrete shoulders. There are no visible signs of pavement distress that can be associated with joint reinforcement or typical highway loading over the five years of surveys.

Lab Tests of Cores

The results of the laboratory testing of the cores obtained in 2002 indicated no significant amount of visible deterioration at the interface between the dowel and the concrete on any of the bars tested. The fact that this was a five-year study and one of relatively mild winters may be the reason for these results as mild winters result in only small amounts of chemicals being applied to the pavement. The results do show that each of the bars resisted well any salts that did penetrate the joints. No evidence of scaling or deterioration was noted. No predictions can be made from these data on the long-term impact of road deicers on each of the dowel material types in this section. Core length measurements and pictures of the core samples can be found in Appendix D. Images produced by the scanning electron microscope are available, but not included in the report.

Material Comparisons

Based on the deflection data, there is no statistical difference in the performance of the various types of dowels over the five-year analysis period. A visual look at the data averages does indicate that the stainless steel dowels are performing equal to or slightly better in load transfer than the reference epoxy-coated dowels. From the test data it appears that a longer period of time (10 to 20 years) would be necessary to draw any conclusions on the relative performance of the material types.

SUMMARY AND CONCLUSIONS

The following summaries and conclusions have been reached based on the data gathered during the study:

- All dowel materials tested are performing equally in terms of load transfer, joint movement, and faulting over the five-year analysis period.
- Stainless steel dowels do provide load transfer performance equal to or greater than epoxy-coated steel dowels in this study on the average over five years.
- FRP dowels of the sizes tested in this research should be spaced no greater than 8 inches (203 mm) apart to gain load transfer performance at the same level as epoxy-coated steel dowels at 12-inch (305 mm) spacing.
- No deterioration due to road deicers was found on any of the dowel materials retrieved in the 2002 coring operation.

FUTURE RESEARCH NEEDS AND IMPLEMENTATION

Future research in the area of alternative dowel materials should consider the following items:

- Field research is needed on the methods of securing FRP dowels into basket assemblies for construction.
- Efforts must be made to reduce the cost of FRP and stainless steel solid dowels to make them cost competitive with epoxy-coated steel dowels if they are to be included in highway work.
- Laboratory work in the area of consideration of shape, spacing, and chemical composition of the FRP dowels is essential for specification development in the future.

Appendix A

Typical Project Cross Section

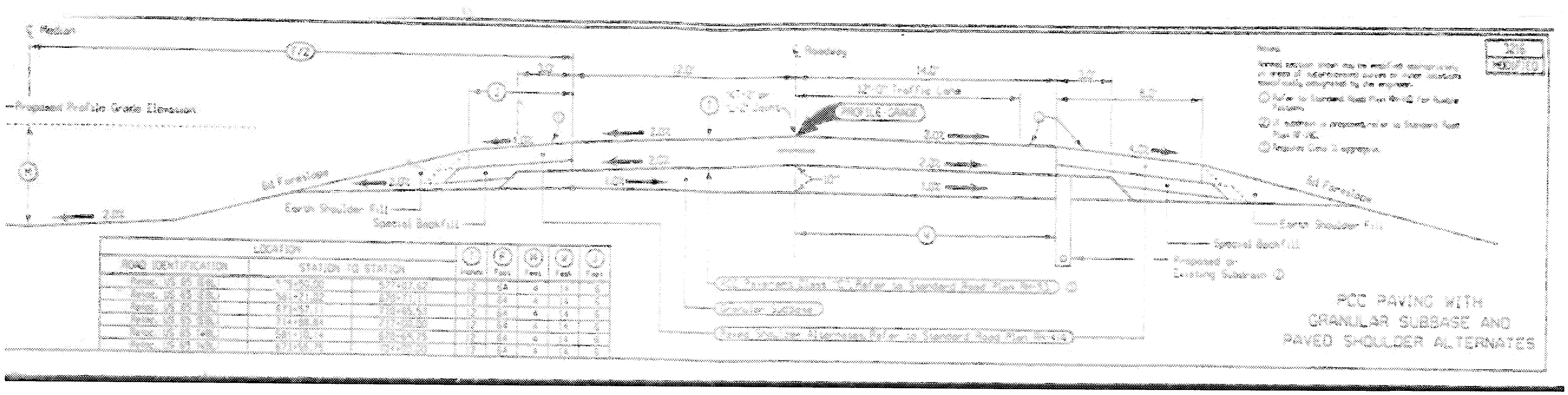

Figure A.1. Typical Project Cross Section

Appendix B

Data Tables

Table B.1. Average Monthly Minimum Temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	7.2	20.8	28.5	36.2	45	61.8	66	63.1	56.1	44	27.7	23.5
1998	18.7	29.9	26.5	41.5	56.7	59.2	66.9	67	59.9	44.8	33.4	20.7
1999	13.1	27	28.8	42.2	52.2	61.8	69.8	63.1	51.4	41	36	20.2
2000	16.7	27.8	33.9	39.7	53.8	59.3	65.2	66.3	55.1	47.8	25.4	4.1
2001	16.1	12.1	24.9	44	52.7	60.8	68.8	65.2	53.6	41.8	40	23.5
2002	20.8	22.4	23.8	40.1	48.2	64.7	68.7	63.3	56.9	38.7	26.7	21.5

Table B.2. Average Monthly Maximum Temperature (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	27.7	34.3	51.5	55.6	66.7	82.4	85.1	81	76.6	63.4	41.3	34
1998	33.1	42.6	40.7	60.1	76.2	76.9	83.9	83.3	80.8	63.1	51.4	39.9
1999	27.3	43.4	48.6	60.5	70.3	79.6	89.5	81.6	74.4	66.3	58.7	39.5
2000	34.1	45.2	56.3	64.2	75.8	79.2	82.3	84.6	79.3	67.6	42.3	19
2001	31.1	28.5	39.5	68.4	70.7	80.3	87.1	85.2	73.4	62.5	59.5	41.3
2002	41.2	41.6	44.9	61.1	70.3	84.3	87.6	82.2	79.4	56	45.6	41.3

Table B.3. Average Monthly Precipitation (in.)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1997	0.04	0.77	0.85	4.11	3.95	4.9	2.89	2.36	2.14	4.62	1.13	0.77	28.53
1998	0.6	1.23	3.03	1.79	4.97	9.95	4.28	5.65	0.69	3.39	2.09	0.03	37.7
1999	0.26	0.63	0.9	4.43	5.82	3.46	2.78	4.56	2.32	0.36	1.28	0.35	27.15
2000	0.27	1.32	0.35	2.36	3.37	7.6	4.12	1.71	1.84	1.07	1.57	0.56	26.14
2001	1.31	2.08	1.08	2.2	7.46	2.61	1.04	2.22	4.77	2.12	0.86	0.7	28.45
2002	0.82	0.82	1.13	3.93	3.39	2.7	3.8	3.51	1.09	3.11	0.23	0	24.53

Table B.4. Yearly Last Days Below a Given Temperature

	Last Day Below 14 °F		Last Day Below 20 °F		Last Day Below 24 °F		Last Day Below 28 °F		Last Day Below 32 °F	
	Date	Temp (°F)	Date	Temp (°F)	Date	Temp (°F)	Date	Temp (°F)	Date	Temp (°F)
1996	26-Mar	9	6-Apr	20	6-Apr	20	16-Apr	28	30-Apr	32
1997	15-Mar	10	9-Apr	19	14-Apr	24	17-Apr	26	13-May	32
1998	14-Mar	12	14-Mar	12	21-Mar	23	24-Mar	25	17-Apr	32
1999	21-Feb	13	12-Mar	19	15-Mar	24	26-Mar	27	18-Apr	31
2000	20-Feb	14	20-Feb	14	8-Apr	22	12-Apr	28	12-Apr	28
2001	27-Mar	14	27-Mar	16	27-Mar	16	1-Apr	28	18-Apr	31
2002	22-Mar	12	4-Apr	17	4-Apr	17	5-Apr	28	9-Apr	31

Table B.5. Yearly Last Days Above a Given Temperature

	Last Day Above 14 °F		Last Day Above 20 °F		Last Day Above 24 °F		Last Day Above 28 °F		Last Day Above 32 °F	
	Date	Temp (°F)	Date	Temp (°F)	Date	Temp (°F)	Date	Temp (°F)	Date	Temp (°F)
1996	12-Nov	16	2-Nov	17	1-Nov	21	30-Oct	26	30-Oct	26
1997	15-Nov	16	27-Oct	18	27-Oct	18	22-Oct	28	14-Oct	32
1998	19-Dec	15	7-Dec	19	20-Nov	22	6-Nov	27	4-Nov	30
1999	16-Dec	8	6-Dec	19	3-Nov	24	23-Oct	28	4-Oct	29
2000	20-Nov	8	15-Nov	18	8-Oct	24	7-Oct	28	6-Oct	30
2001	24-Dec	11	23-Dec	17	27-Oct	21	26-Oct	26	6-Oct	32
2002	25-Nov	14	1-Nov	20	31-Oct	22	20-Oct	26	13-Oct	32

Table B.6. Traffic Data

Date	Days in Month	West Bound		East Bound	
		ESALs/ Day	ESALs	ESALs/ Day	ESALs
Jan-99	31	1020	31620	951	29481
Feb-99	28	1118	31304	993	27804
Mar-99	31	1388	43028	1146	35526
Apr-99	30	1232	36960	1300	39000
May-99	31	589	18259	702	21762
Jun-99	30	1382	41460	1454	43620
Jul-99	31	2338	72478	1868	57908
Aug-99	31	3226	100006	1882	58342
Sep-99	30	2124	63720	2262	67860
Oct-99	31	2692	83452	2046	63426
Nov-99	30	2528	75840	1988	59640
Dec-99	31	1726	53506	1760	54560
Annual Total			651633		558929
Jan-00	31	1152	35712	1429	44299
Feb-00	28	1367	38276	1614	45192
Mar-00	31	2650	82150	1853	57443
Apr-00	30	3148	94440	560	16800
May-00	31	3472	107632	1041	32271
Jun-00	30	2390	71700	1852	55560
Jul-00	31	1458	45198	1431	44361
Aug-00	31	2040	63240	1837	56947
Sep-00	30	1223	36690	1198	35940
Oct-00	31	656	20336	552	17112
Nov-00	30	1271	38130	1318	39540

Dec-00	31	1416	43896	1266	39246
Annual Total			677400		484711
1-Jan	31	1549	48019	1468	45508
1-Feb	28	2065	57820	1677	46956
1-Mar	31	2167	67177	1722	53382
1-Apr	30	N/A	N/A	N/A	N/A
1-May	31	N/A	N/A	N/A	N/A
1-Jun	30	N/A	N/A	N/A	N/A
1-Jul	31	N/A	N/A	N/A	N/A
1-Aug	31	N/A	N/A	N/A	N/A
1-Sep	30	N/A	N/A	N/A	N/A
1-Oct	31	N/A	N/A	N/A	N/A
1-Nov	30	N/A	N/A	N/A	N/A
1-Dec	31	N/A	N/A	N/A	N/A
Annual Total			173016		145846
2-Jan	31	1997	61907	1803	55893
2-Feb-02	28	2003	56084	2103	58884
2-Mar-02	31	2083	64573	2755	85405
2-Apr-02	30	2641	79230	3881	116430
2-May-02	31	2913	90303	4758	147498
2-Jun	30	3860	115800	4728	141840
2-Jul	31	3280	101680	1139	35309
2-Aug	31	2499	77469	709	21979
2-Sep	30	2205	66150	961	28830
2-Oct	31	2804	86924	1169	36239
2-Nov	30	2576	77280	1127	33810

2-Dec	31	2358	73098	1564	48484
Annual Total			950498		301601
3-Jan	31	2266	70246	1644	50964
3-Feb	28	2291	64148	1099	30772
3-Mar	31	2128	65968	845	26195
3-Apr	30	2197	65910	695	20850
3-May	31	2114	65534	800	24800
Annual Total			331806		153581
Project Total			2784353		2153668

Table B.7. Falling Weight Deflectometer Sample Results

Material	Sta.	Sta.	Lane	Load	Raw Deflection, mils							Load	Normalized Deflections, mils							Load
	Joint	Mid		lbf	D0	D12	D24	D36	D48	D60	D72	lbf	D0	D12	D24	D36	D48	D60	D72	Transfer,%
Std. Epoxy		64206	Driving	9,404	3.56	3.26	3.06	2.79	2.47	2.17	1.85	9000	3.41	3.12	2.93	2.67	2.36	2.08	1.77	
Std. Epoxy		64206	Driving	12,487	4.69	4.34	4.09	3.71	3.29	2.86	2.39	12000	4.51	4.17	3.93	3.57	3.16	2.75	2.30	
Std. Epoxy		64206	Driving	16,284	5.83	5.41	5.07	4.61	4.07	3.53	3.02	16000	5.73	5.32	4.98	4.53	4.00	3.47	2.97	
Std. Epoxy	64196		Driving	9,382	6.67	6.09	5.23	4.39	3.60	2.96	2.37	9000	6.40	5.84	5.02	4.21	3.45	2.84	2.27	91.30
Std. Epoxy	64196		Driving	12,476	8.78	8.09	6.94	5.79	4.74	3.87	3.11	12000	8.44	7.78	6.68	5.57	4.56	3.72	2.99	92.14
Std. Epoxy	64196		Driving	16,339	11.06	10.14	8.63	7.23	5.93	4.83	3.91	16000	10.83	9.93	8.45	7.08	5.81	4.73	3.83	91.68
Std. Epoxy		64186	Driving	9,393	3.29	3.06	2.85	2.55	2.24	1.91	1.57	9000	3.15	2.93	2.73	2.44	2.15	1.83	1.50	
Std. Epoxy		64186	Driving	12,432	4.31	4.06	3.75	3.38	2.95	2.56	2.10	12000	4.16	3.92	3.62	3.26	2.85	2.47	2.03	
Std. Epoxy		64186	Driving	16,306	5.39	5.07	4.69	4.24	3.67	3.13	2.66	16000	5.29	4.97	4.60	4.16	3.60	3.07	2.61	
Std. Epoxy	64176		Driving	9,272	6.74	5.79	4.92	4.12	3.39	2.81	2.30	9000	6.54	5.62	4.78	4.00	3.29	2.73	2.23	85.91
Std. Epoxy	64176		Driving	12,378	8.81	7.78	6.61	5.56	4.54	3.81	3.06	12000	8.54	7.54	6.41	5.39	4.40	3.69	2.97	88.31
Std. Epoxy	64176		Driving	16,141	11.07	9.69	8.24	6.93	5.65	4.72	3.82	16000	10.97	9.61	8.17	6.87	5.60	4.68	3.79	87.53
Std. Epoxy		64166	Driving	9,272	3.41	3.24	3.09	2.76	2.45	2.03	1.85	9000	3.31	3.14	3.00	2.68	2.38	1.97	1.80	
Std. Epoxy		64166	Driving	12,334	4.50	4.36	4.15	3.76	3.28	2.72	2.46	12000	4.38	4.24	4.04	3.66	3.19	2.65	2.39	
Std. Epoxy		64166	Driving	16,163	5.66	5.41	5.01	4.57	3.99	3.51	2.86	16000	5.60	5.36	4.96	4.52	3.95	3.47	2.83	
Std. Epoxy	64156		Driving	9,272	6.06	5.32	4.49	3.76	3.08	2.52	2.04	9000	5.88	5.16	4.36	3.65	2.99	2.45	1.98	87.79
Std. Epoxy	64156		Driving	12,257	8.08	7.13	6.03	5.02	4.08	3.41	2.69	12000	7.91	6.98	5.90	4.91	3.99	3.34	2.63	88.24
Std. Epoxy	64156		Driving	15,966	10.07	8.89	7.49	6.25	5.11	4.19	3.36	16000	10.09	8.91	7.51	6.26	5.12	4.20	3.37	88.28
S.S. @ 12"		63512	Driving	9,195	3.39	3.07	2.82	2.51	2.14	1.82	1.50	9000	3.32	3.00	2.76	2.46	2.09	1.78	1.47	
S.S. @ 12"		63512	Driving	12,312	4.43	4.13	3.79	3.37	2.88	2.42	2.00	12000	4.32	4.03	3.69	3.28	2.81	2.36	1.95	
S.S. @ 12"		63512	Driving	16,097	5.55	5.10	4.69	4.22	3.61	3.04	2.50	16000	5.52	5.07	4.66	4.19	3.59	3.02	2.48	
S.S. @ 12"	63502		Driving	9,130	7.27	5.53	4.72	3.97	3.25	2.63	2.09	9000	7.17	5.45	4.65	3.91	3.20	2.59	2.06	76.07
S.S. @ 12"	63502		Driving	12,169	9.77	7.38	6.33	5.33	4.35	3.54	2.81	12000	9.63	7.28	6.24	5.26	4.29	3.49	2.77	75.54
S.S. @ 12"	63502		Driving	15,999	12.30	9.26	7.93	6.66	5.47	4.46	3.53	16000	12.30	9.26	7.93	6.66	5.47	4.46	3.53	75.28
S.S. @ 12"		63494	Driving	9,184	3.22	2.93	2.68	2.41	2.04	1.73	1.39	9000	3.16	2.87	2.63	2.36	2.00	1.70	1.36	
S.S. @ 12"		63494	Driving	12,246	4.31	4.01	3.67	3.29	2.81	2.35	1.94	12000	4.22	3.93	3.60	3.22	2.75	2.30	1.90	
S.S. @ 12"		63494	Driving	16,097	5.43	5.01	4.59	4.20	3.50	2.93	2.43	16000	5.40	4.98	4.56	4.17	3.48	2.91	2.42	
S.S. @ 12"	63484		Driving	9,151	6.61	5.44	4.62	3.86	3.13	2.52	2.00	9000	6.50	5.35	4.54	3.80	3.08	2.48	1.97	82.30
S.S. @ 12"	63484		Driving	11,993	8.81	7.30	6.19	5.24	4.20	3.38	2.70	12000	8.81	7.30	6.19	5.24	4.20	3.38	2.70	82.86
S.S. @ 12"	63484		Driving	15,856	11.08	9.17	7.80	6.48	5.26	4.26	3.37	16000	11.18	9.25	7.87	6.54	5.31	4.30	3.40	82.76
S.S. @ 12"		63474	Driving	9,075	3.31	2.87	2.64	2.40	2.08	1.78	1.53	9000	3.28	2.85	2.62	2.38	2.06	1.77	1.52	

S.S. @ 12"		63474	Driving	12,136	4.25	3.89	3.58	3.25	2.83	2.43	2.07	12000	4.20	3.85	3.54	3.21	2.80	2.40	2.05	
S.S. @ 12"		63474	Driving	15,999	5.38	4.86	4.50	4.08	3.57	3.06	2.57	16000	5.38	4.86	4.50	4.08	3.57	3.06	2.57	
S.S. @ 12"	63464		Driving	9,042	7.17	5.71	4.90	4.11	3.38	2.76	2.18	9000	7.14	5.68	4.88	4.09	3.36	2.75	2.17	79.64
S.S. @ 12"	63464		Driving	11,939	9.55	7.69	6.65	5.67	4.61	3.80	3.00	12000	9.60	7.73	6.68	5.70	4.63	3.82	3.02	80.52
S.S. @ 12"	63464		Driving	15,790	11.98	9.68	8.33	7.13	5.78	4.75	3.76	16000	12.14	9.81	8.44	7.22	5.86	4.81	3.81	80.80
S.S. @ 8"		63210	Driving	9,075	2.80	2.44	2.25	1.93	1.72	1.46	1.26	9000	2.78	2.42	2.23	1.91	1.71	1.45	1.25	
S.S. @ 8"		63210	Driving	11,917	3.71	3.25	2.98	2.65	2.31	1.99	1.68	12000	3.74	3.27	3.00	2.67	2.33	2.00	1.69	
S.S. @ 8"		63210	Driving	15,790	4.55	4.09	3.76	3.24	2.91	2.45	2.08	16000	4.61	4.14	3.81	3.28	2.95	2.48	2.11	
S.S. @ 8"	63200		Driving	9,195	3.77	3.45	3.00	2.58	2.15	1.78	1.50	9000	3.69	3.38	2.94	2.53	2.10	1.74	1.47	91.51
S.S. @ 8"	63200		Driving	11,917	5.00	4.61	4.00	3.48	2.88	2.39	1.97	12000	5.03	4.64	4.03	3.50	2.90	2.41	1.98	92.20
S.S. @ 8"	63200		Driving	15,735	6.34	5.84	5.06	4.34	3.59	2.98	2.47	16000	6.45	5.94	5.15	4.41	3.65	3.03	2.51	92.11
S.S. @ 8"		63190	Driving	9,173	2.85	2.64	2.43	2.20	1.90	1.61	1.37	9000	2.80	2.59	2.38	2.16	1.86	1.58	1.34	
S.S. @ 8"		63190	Driving	11,928	3.77	3.54	3.23	2.90	2.52	2.18	1.86	12000	3.79	3.56	3.25	2.92	2.54	2.19	1.87	
S.S. @ 8"		63190	Driving	15,626	4.73	4.43	4.06	3.64	3.15	2.70	2.31	16000	4.84	4.54	4.16	3.73	3.23	2.76	2.37	
S.S. @ 8"	63180		Driving	9,097	3.70	3.38	2.92	2.50	2.11	1.74	1.42	9000	3.66	3.34	2.89	2.47	2.09	1.72	1.40	91.35
S.S. @ 8"	63180		Driving	11,917	4.97	4.56	3.98	3.38	2.86	2.35	1.92	12000	5.00	4.59	4.01	3.40	2.88	2.37	1.93	91.75
S.S. @ 8"	63180		Driving	15,658	6.29	5.74	4.98	4.26	3.56	2.97	2.41	16000	6.43	5.87	5.09	4.35	3.64	3.03	2.46	91.26
S.S. @ 8"		63170	Driving	9,195	2.78	2.38	2.15	1.90	1.67	1.42	1.19	9000	2.72	2.33	2.10	1.86	1.63	1.39	1.16	
S.S. @ 8"		63170	Driving	11,884	3.62	3.18	2.88	2.54	2.24	1.89	1.59	12000	3.66	3.21	2.91	2.56	2.26	1.91	1.61	
S.S. @ 8"		63170	Driving	15,461	4.50	4.00	3.69	3.27	2.82	2.41	2.04	16000	4.66	4.14	3.82	3.38	2.92	2.49	2.11	
S.S. @ 8"	63160		Driving	9,173	3.53	3.20	2.73	2.40	1.95	1.68	1.28	9000	3.46	3.14	2.68	2.35	1.91	1.65	1.26	90.65
S.S. @ 8"	63160		Driving	12,004	4.66	4.25	3.67	3.07	2.58	2.08	1.76	12000	4.66	4.25	3.67	3.07	2.58	2.08	1.76	91.20
S.S. @ 8"	63160		Driving	15,988	6.04	5.52	4.72	4.03	3.34	2.77	2.25	16000	6.04	5.52	4.72	4.03	3.34	2.77	2.25	91.39
RJD @ 12"		63070	Driving	9,437	3.23	2.74	2.46	2.14	1.80	1.46	1.17	9000	3.08	2.61	2.35	2.04	1.72	1.39	1.12	
RJD @ 12"		63070	Driving	12,279	4.24	3.65	3.28	2.86	2.41	1.96	1.54	12000	4.14	3.57	3.21	2.80	2.36	1.92	1.51	
RJD @ 12"		63070	Driving	15,680	5.10	4.56	4.05	3.56	2.96	2.38	1.89	16000	5.20	4.65	4.13	3.63	3.02	2.43	1.93	
RJD @ 12"	63060		Driving	9,283	6.02	3.76	3.07	2.53	2.00	1.67	1.28	9000	5.84	3.65	2.98	2.45	1.94	1.62	1.24	62.46
RJD @ 12"	63060		Driving	12,103	7.93	5.00	4.12	3.40	2.67	2.11	1.79	12000	7.86	4.96	4.08	3.37	2.65	2.09	1.77	63.05
RJD @ 12"	63060		Driving	15,582	9.78	6.16	5.08	4.18	3.29	2.65	2.09	16000	10.04	6.33	5.22	4.29	3.38	2.72	2.15	62.99
RJD @ 12"		63050	Driving	9,316	3.19	2.88	2.58	2.27	1.89	1.51	1.18	9000	3.08	2.78	2.49	2.19	1.83	1.46	1.14	
RJD @ 12"		63050	Driving	12,070	4.17	3.77	3.44	2.98	2.48	2.06	1.57	12000	4.15	3.75	3.42	2.96	2.47	2.05	1.56	
RJD @ 12"		63050	Driving	15,571	5.08	4.66	4.20	3.68	3.13	2.56	2.00	16000	5.22	4.79	4.32	3.78	3.22	2.63	2.06	
RJD @ 12"	63040		Driving	9,327	5.00	4.37	3.54	2.87	2.24	1.77	1.38	9000	4.82	4.22	3.42	2.77	2.16	1.71	1.33	87.40
RJD @ 12"	63040		Driving	12,125	6.63	5.81	4.72	3.81	3.00	2.38	1.81	12000	6.56	5.75	4.67	3.77	2.97	2.36	1.79	87.63
RJD @ 12"	63040		Driving	15,615	8.26	7.19	5.87	4.71	3.71	2.94	2.33	16000	8.46	7.37	6.01	4.83	3.80	3.01	2.39	87.05

RJD @ 12"		63030	Driving	9,173	3.05	2.70	2.39	2.11	1.73	1.42	1.10	9000	2.99	2.65	2.34	2.07	1.70	1.39	1.08	
RJD @ 12"		63030	Driving	12,081	4.06	3.60	3.22	2.83	2.34	1.89	1.49	12000	4.03	3.58	3.20	2.81	2.32	1.88	1.48	
RJD @ 12"		63030	Driving	15,735	5.00	4.54	4.05	3.54	2.94	2.37	1.85	16000	5.08	4.62	4.12	3.60	2.99	2.41	1.88	
RJD @ 12"	63020		Driving	9,184	6.12	3.63	3.02	2.48	1.93	1.56	1.24	9000	6.00	3.56	2.96	2.43	1.89	1.53	1.22	59.31
RJD @ 12"	63020		Driving	11,906	8.00	4.81	4.00	3.26	2.62	2.09	1.65	12000	8.06	4.85	4.03	3.29	2.64	2.11	1.66	60.13
RJD @ 12"	63020		Driving	15,483	10.00	6.09	5.09	4.14	3.30	2.65	2.09	16000	10.33	6.29	5.26	4.28	3.41	2.74	2.16	60.90
RJD @ 8"		62970	Driving	9,206	3.04	2.77	2.48	2.17	1.83	1.50	1.15	9000	2.97	2.71	2.42	2.12	1.79	1.47	1.12	
RJD @ 8"		62970	Driving	11,972	3.96	3.65	3.28	2.93	2.39	1.94	1.55	12000	3.97	3.66	3.29	2.94	2.40	1.94	1.55	
RJD @ 8"		62970	Driving	15,505	4.94	4.56	4.12	3.61	2.99	2.41	1.90	16000	5.10	4.71	4.25	3.73	3.09	2.49	1.96	
RJD @ 8"	62960		Driving	9,250	4.84	3.98	3.29	2.68	2.19	1.76	1.43	9000	4.71	3.87	3.20	2.61	2.13	1.71	1.39	82.23
RJD @ 8"	62960		Driving	12,213	6.54	5.33	4.41	3.58	2.91	2.34	1.91	12000	6.43	5.24	4.33	3.52	2.86	2.30	1.88	81.50
RJD @ 8"	62960		Driving	15,483	8.12	6.56	5.46	4.38	3.58	2.85	2.39	16000	8.39	6.78	5.64	4.53	3.70	2.95	2.47	80.79
RJD @ 8"		62950	Driving	9,338	3.02	2.67	2.45	2.16	1.91	1.60	1.32	9000	2.91	2.57	2.36	2.08	1.84	1.54	1.27	
RJD @ 8"		62950	Driving	12,125	3.89	3.51	3.20	2.92	2.48	2.15	1.77	12000	3.85	3.47	3.17	2.89	2.45	2.13	1.75	
RJD @ 8"		62950	Driving	15,494	4.76	4.32	4.02	3.55	3.07	2.58	2.09	16000	4.92	4.46	4.15	3.67	3.17	2.66	2.16	
RJD @ 8"	62940		Driving	9,239	4.89	4.02	3.37	2.85	2.30	1.89	1.52	9000	4.76	3.92	3.28	2.78	2.24	1.84	1.48	82.21
RJD @ 8"	62940		Driving	12,147	6.54	5.36	4.50	3.76	3.07	2.50	2.00	12000	6.46	5.30	4.45	3.71	3.03	2.47	1.98	81.96
RJD @ 8"	62940		Driving	15,647	8.15	6.68	5.61	4.75	3.81	3.11	2.47	16000	8.33	6.83	5.74	4.86	3.90	3.18	2.53	81.96
RJD @ 8"		62930	Driving	9,228	3.11	2.84	2.57	2.24	1.91	1.58	1.27	9000	3.03	2.77	2.51	2.18	1.86	1.54	1.24	
RJD @ 8"		62930	Driving	12,070	4.14	3.78	3.42	3.04	2.54	2.05	1.66	12000	4.12	3.76	3.40	3.02	2.53	2.04	1.65	
RJD @ 8"		62930	Driving	15,395	5.10	4.66	4.31	3.74	3.12	2.50	2.01	16000	5.30	4.84	4.48	3.89	3.24	2.60	2.09	
RJD @ 8"	62920		Driving	9,338	5.41	4.54	3.79	3.08	2.44	1.98	1.54	9000	5.21	4.38	3.65	2.97	2.35	1.91	1.48	83.92
RJD @ 8"	62920		Driving	12,224	7.16	6.08	5.00	4.13	3.28	2.59	2.07	12000	7.03	5.97	4.91	4.05	3.22	2.54	2.03	84.92
RJD @ 8"	62920		Driving	15,812	9.00	7.59	6.28	5.15	4.10	3.28	2.59	16000	9.11	7.68	6.35	5.21	4.15	3.32	2.62	84.33
H.B. @ 12"		62513	Driving	9,250	3.59	3.13	2.85	2.55	2.21	1.87	1.52	9000	3.49	3.05	2.77	2.48	2.15	1.82	1.48	
H.B. @ 12"		62513	Driving	11,972	4.74	4.12	3.79	3.37	2.93	2.44	2.00	12000	4.75	4.13	3.80	3.38	2.94	2.45	2.00	
H.B. @ 12"		62513	Driving	15,593	5.91	5.22	4.76	4.24	3.66	3.08	2.50	16000	6.06	5.36	4.88	4.35	3.76	3.16	2.57	
H.B. @ 12"	62503		Driving	9,228	6.59	3.94	3.31	2.74	2.30	1.91	1.49	9000	6.43	3.84	3.23	2.67	2.24	1.86	1.45	59.79
H.B. @ 12"	62503		Driving	12,125	8.71	5.16	4.35	3.62	2.98	2.44	1.99	12000	8.62	5.11	4.31	3.58	2.95	2.41	1.97	59.24
H.B. @ 12"	62503		Driving	15,615	10.97	6.46	5.46	4.52	3.76	3.11	2.54	16000	11.24	6.62	5.59	4.63	3.85	3.19	2.60	58.89
H.B. @ 12"		62493	Driving	9,261	3.50	3.10	2.84	2.40	2.15	1.82	1.43	9000	3.40	3.01	2.76	2.33	2.09	1.77	1.39	
H.B. @ 12"		62493	Driving	12,191	4.62	4.20	3.82	3.33	2.89	2.37	1.93	12000	4.55	4.13	3.76	3.28	2.84	2.33	1.90	
H.B. @ 12"		62493	Driving	15,593	5.86	5.26	4.81	4.23	3.63	3.00	2.41	16000	6.01	5.40	4.94	4.34	3.72	3.08	2.47	
H.B. @ 12"	62483		Driving	9,217	5.71	4.26	3.59	2.96	2.42	1.99	1.56	9000	5.58	4.16	3.51	2.89	2.36	1.94	1.52	74.61
H.B. @ 12"	62483		Driving	12,169	7.63	5.67	4.73	3.95	3.22	2.62	2.12	12000	7.52	5.59	4.66	3.90	3.18	2.58	2.09	74.31

H.B. @ 12"	62483		Driving	15,593	9.61	7.11	5.94	4.97	4.00	3.28	2.61	16000	9.86	7.30	6.10	5.10	4.10	3.37	2.68	73.99
H.B. @ 12"		62473	Driving	9,250	3.04	2.90	2.63	2.33	2.03	1.73	1.41	9000	2.96	2.82	2.56	2.27	1.98	1.68	1.37	
H.B. @ 12"		62473	Driving	12,312	4.06	3.89	3.56	3.21	2.77	2.26	1.93	12000	3.96	3.79	3.47	3.13	2.70	2.20	1.88	
H.B. @ 12"		62473	Driving	15,845	5.10	4.86	4.44	3.95	3.40	2.87	2.39	16000	5.15	4.91	4.48	3.99	3.43	2.90	2.41	
H.B. @ 12"	62463		Driving	9,140	5.66	4.21	3.58	2.98	2.51	2.09	1.69	9000	5.57	4.15	3.52	2.93	2.47	2.06	1.66	74.38
H.B. @ 12"	62463		Driving	11,950	7.77	5.63	4.78	4.01	3.33	2.76	2.24	12000	7.80	5.65	4.80	4.03	3.34	2.77	2.25	72.46
H.B. @ 12"	62463		Driving	15,604	9.77	7.10	6.02	5.02	4.20	3.43	2.81	16000	10.02	7.28	6.17	5.15	4.31	3.52	2.88	72.67
H.B. @ 8"		62313	Driving	9,294	2.87	2.32	2.13	1.73	1.45	1.27	1.07	9000	2.78	2.25	2.06	1.68	1.40	1.23	1.04	
H.B. @ 8"		62313	Driving	12,224	3.83	3.13	2.78	2.39	1.99	1.64	1.35	12000	3.76	3.07	2.73	2.35	1.95	1.61	1.33	
H.B. @ 8"		62313	Driving	15,669	4.68	3.91	3.55	2.91	2.45	2.06	1.71	16000	4.78	3.99	3.62	2.97	2.50	2.10	1.75	
H.B. @ 8"	62303		Driving	9,239	4.24	3.60	2.95	2.42	1.89	1.60	1.26	9000	4.13	3.51	2.87	2.36	1.84	1.56	1.23	84.91
H.B. @ 8"	62303		Driving	12,301	5.70	4.77	3.95	3.20	2.59	2.05	1.65	12000	5.56	4.65	3.85	3.12	2.53	2.00	1.61	83.68
H.B. @ 8"	62303		Driving	15,615	7.21	6.01	4.95	4.04	3.22	2.53	2.04	16000	7.39	6.16	5.07	4.14	3.30	2.59	2.09	83.36
H.B. @ 8"		62293	Driving	9,272	3.01	2.52	2.26	1.98	1.72	1.46	1.10	9000	2.92	2.45	2.19	1.92	1.67	1.42	1.07	
H.B. @ 8"		62293	Driving	12,246	3.96	3.38	3.13	2.70	2.31	1.94	1.49	12000	3.88	3.31	3.07	2.65	2.26	1.90	1.46	
H.B. @ 8"		62293	Driving	15,637	4.84	4.24	3.85	3.33	2.85	2.34	1.86	16000	4.95	4.34	3.94	3.41	2.92	2.39	1.90	
H.B. @ 8"	62283		Driving	9,173	5.39	3.52	2.93	2.32	2.00	1.46	1.24	9000	5.29	3.45	2.87	2.28	1.96	1.43	1.22	65.31
H.B. @ 8"	62283		Driving	12,070	7.09	4.71	3.85	3.16	2.47	2.06	1.59	12000	7.05	4.68	3.83	3.14	2.46	2.05	1.58	66.43
H.B. @ 8"	62283		Driving	15,538	8.93	5.87	4.91	4.03	3.17	2.54	2.02	16000	9.20	6.04	5.06	4.15	3.26	2.62	2.08	65.73
H.B. @ 8"		62273	Driving	9,261	2.78	2.57	2.30	2.05	1.70	1.38	1.12	9000	2.70	2.50	2.24	1.99	1.65	1.34	1.09	
H.B. @ 8"		62273	Driving	12,224	3.76	3.46	3.11	2.75	2.29	1.87	1.57	12000	3.69	3.40	3.05	2.70	2.25	1.84	1.54	
H.B. @ 8"		62273	Driving	15,615	4.74	4.43	3.91	3.32	2.79	2.28	1.85	16000	4.86	4.54	4.01	3.40	2.86	2.34	1.90	
H.B. @ 8"	62263		Driving	9,239	4.54	3.64	2.96	2.36	1.93	1.54	1.23	9000	4.42	3.55	2.88	2.30	1.88	1.50	1.20	80.18
H.B. @ 8"	62263		Driving	12,136	6.15	4.87	3.98	3.16	2.57	2.06	1.66	12000	6.08	4.82	3.94	3.12	2.54	2.04	1.64	79.19
H.B. @ 8"	62263		Driving	15,505	7.73	6.19	4.98	3.81	3.24	2.57	2.05	16000	7.98	6.39	5.14	3.93	3.34	2.65	2.12	80.08
Std. Epoxy		64206	Passing	9,162	4.43	4.06	3.72	3.41	2.94	2.48	2.15	9000	4.35	3.99	3.65	3.35	2.89	2.44	2.11	
Std. Epoxy		64206	Passing	11,895	5.87	5.43	4.99	4.54	3.95	3.38	2.82	12000	5.92	5.48	5.03	4.58	3.98	3.41	2.84	
Std. Epoxy		64206	Passing	15,735	7.43	6.84	6.31	5.74	4.99	4.26	3.57	16000	7.56	6.96	6.42	5.84	5.07	4.33	3.63	
Std. Epoxy	64196		Passing	8,965	7.19	5.87	4.83	3.94	3.14	2.55	2.02	9000	7.22	5.89	4.85	3.96	3.15	2.56	2.03	81.64
Std. Epoxy	64196		Passing	11,818	9.65	8.01	6.57	5.18	4.27	3.39	2.72	12000	9.80	8.13	6.67	5.26	4.34	3.44	2.76	83.01
Std. Epoxy	64196		Passing	15,406	12.00	10.06	8.20	6.37	5.31	4.23	3.39	16000	12.46	10.45	8.52	6.62	5.51	4.39	3.52	83.83
Std. Epoxy		64186	Passing	9,031	4.45	4.12	3.79	3.36	2.96	2.55	2.12	9000	4.43	4.11	3.78	3.35	2.95	2.54	2.11	
Std. Epoxy		64186	Passing	11,873	5.96	5.53	5.10	4.67	4.06	3.44	2.85	12000	6.02	5.59	5.15	4.72	4.10	3.48	2.88	
Std. Epoxy		64186	Passing	15,505	7.36	6.92	6.38	5.70	5.00	4.31	3.61	16000	7.60	7.14	6.58	5.88	5.16	4.45	3.73	
Std. Epoxy	64176		Passing	8,910	7.48	6.19	5.11	4.17	3.35	2.69	2.17	9000	7.56	6.25	5.16	4.21	3.38	2.72	2.19	82.75

Std. Epoxy	64176		Passing	11,763	9.97	8.19	6.81	5.56	4.45	3.59	2.85	12000	10.17	8.35	6.95	5.67	4.54	3.66	2.91	82.15
Std. Epoxy	64176		Passing	15,538	12.65	10.45	8.72	7.09	5.69	4.59	3.70	16000	13.03	10.76	8.98	7.30	5.86	4.73	3.81	82.61
Std. Epoxy		64166	Passing	8,943	4.26	3.82	3.45	3.06	2.59	2.18	1.77	9000	4.29	3.84	3.47	3.08	2.61	2.19	1.78	
Std. Epoxy		64166	Passing	11,708	5.67	5.21	4.68	4.12	3.50	2.94	2.38	12000	5.81	5.34	4.80	4.22	3.59	3.01	2.44	
Std. Epoxy		64166	Passing	15,669	7.17	6.59	5.93	5.19	4.43	3.68	2.97	16000	7.32	6.73	6.06	5.30	4.52	3.76	3.03	
Std. Epoxy	64156		Passing	8,965	6.18	5.31	4.30	3.41	2.72	2.14	1.66	9000	6.20	5.33	4.32	3.42	2.73	2.15	1.67	85.92
Std. Epoxy	64156		Passing	11,862	8.43	7.22	5.85	4.71	3.72	2.96	2.31	12000	8.53	7.30	5.92	4.76	3.76	2.99	2.34	85.65
Std. Epoxy	64156		Passing	15,494	10.70	9.08	7.35	5.90	4.67	3.70	2.93	16000	11.05	9.38	7.59	6.09	4.82	3.82	3.03	84.86
S.S. @ 12"		63512	Passing	8,987	3.89	3.57	3.25	2.85	2.36	2.06	1.55	9000	3.90	3.58	3.25	2.85	2.36	2.06	1.55	
S.S. @ 12"		63512	Passing	11,807	5.19	4.82	4.43	3.87	3.30	2.65	2.17	12000	5.27	4.90	4.50	3.93	3.35	2.69	2.21	
S.S. @ 12"		63512	Passing	15,582	6.56	6.10	5.50	4.86	4.08	3.44	2.75	16000	6.74	6.26	5.65	4.99	4.19	3.53	2.82	
S.S. @ 12"	63502		Passing	9,009	5.98	5.13	4.17	3.33	2.60	2.03	1.55	9000	5.97	5.12	4.17	3.33	2.60	2.03	1.55	85.79
S.S. @ 12"	63502		Passing	11,785	8.05	6.94	5.66	4.56	3.54	2.75	2.14	12000	8.20	7.07	5.76	4.64	3.60	2.80	2.18	86.21
S.S. @ 12"	63502		Passing	15,702	10.31	8.86	7.20	5.81	4.52	3.53	2.74	16000	10.51	9.03	7.34	5.92	4.61	3.60	2.79	85.94
S.S. @ 12"		63494	Passing	9,053	4.05	3.78	3.47	3.07	2.68	2.28	1.84	9000	4.03	3.76	3.45	3.05	2.66	2.27	1.83	
S.S. @ 12"		63494	Passing	11,961	5.52	5.11	4.71	4.19	3.65	3.11	2.57	12000	5.54	5.13	4.73	4.20	3.66	3.12	2.58	
S.S. @ 12"		63494	Passing	15,615	7.01	6.48	5.94	5.32	4.59	3.91	3.20	16000	7.18	6.64	6.09	5.45	4.70	4.01	3.28	
S.S. @ 12"	63484		Passing	9,086	7.07	6.01	4.94	3.97	3.15	2.49	1.94	9000	7.00	5.95	4.89	3.93	3.12	2.47	1.92	85.01
S.S. @ 12"	63484		Passing	11,950	9.39	7.96	6.53	5.33	4.21	3.29	2.60	12000	9.43	7.99	6.56	5.35	4.23	3.30	2.61	84.77
S.S. @ 12"	63484		Passing	15,549	11.76	10.00	8.23	6.69	5.24	4.17	3.25	16000	12.10	10.29	8.47	6.88	5.39	4.29	3.34	85.03
S.S. @ 12"		63474	Passing	8,965	4.27	3.97	3.64	3.18	2.85	2.40	1.98	9000	4.29	3.99	3.65	3.19	2.86	2.41	1.99	
S.S. @ 12"		63474	Passing	11,884	5.72	5.35	4.92	4.39	3.85	3.28	2.71	12000	5.78	5.40	4.97	4.43	3.89	3.31	2.74	
S.S. @ 12"		63474	Passing	15,560	7.25	6.76	6.22	5.59	4.87	4.14	3.44	16000	7.46	6.95	6.40	5.75	5.01	4.26	3.54	
S.S. @ 12"	63464		Passing	8,943	7.35	6.10	5.03	4.14	3.27	2.57	2.02	9000	7.40	6.14	5.06	4.17	3.29	2.59	2.03	82.99
S.S. @ 12"	63464		Passing	11,884	9.80	8.26	6.85	5.59	4.44	3.54	2.75	12000	9.90	8.34	6.92	5.64	4.48	3.57	2.78	84.29
S.S. @ 12"	63464		Passing	15,395	12.30	10.35	8.57	7.03	5.57	4.40	3.44	16000	12.78	10.76	8.91	7.31	5.79	4.57	3.58	84.15
S.S. @ 8"		63210	Passing	8,987	4.89	4.74	4.41	3.98	3.50	3.05	2.54	9000	4.90	4.75	4.42	3.99	3.51	3.05	2.54	
S.S. @ 8"		63210	Passing	11,818	6.57	6.35	5.88	5.39	4.67	4.07	3.42	12000	6.67	6.45	5.97	5.47	4.74	4.13	3.47	
S.S. @ 8"		63210	Passing	15,593	8.35	8.01	7.43	6.83	5.94	5.19	4.37	16000	8.57	8.22	7.62	7.01	6.10	5.33	4.48	
S.S. @ 8"	63200		Passing	9,031	7.09	6.32	5.30	4.39	3.59	2.94	2.40	9000	7.07	6.30	5.28	4.38	3.58	2.93	2.39	89.14
S.S. @ 8"	63200		Passing	11,851	9.53	8.46	7.13	5.98	4.88	4.03	3.30	12000	9.65	8.57	7.22	6.06	4.94	4.08	3.34	88.77
S.S. @ 8"	63200		Passing	15,417	12.02	10.66	8.98	7.48	6.10	5.02	4.09	16000	12.47	11.06	9.32	7.76	6.33	5.21	4.24	88.69
S.S. @ 8"		63190	Passing	8,976	4.85	4.52	4.22	3.84	3.37	2.91	2.51	9000	4.86	4.53	4.23	3.85	3.38	2.92	2.52	
S.S. @ 8"		63190	Passing	11,873	6.49	6.16	5.73	5.24	4.64	4.04	3.38	12000	6.56	6.23	5.79	5.30	4.69	4.08	3.42	
S.S. @ 8"		63190	Passing	15,494	8.18	7.75	7.22	6.61	5.80	5.04	4.32	16000	8.45	8.00	7.46	6.83	5.99	5.20	4.46	

S.S. @ 8"	63180		Passing	9,162	6.63	6.19	5.22	4.40	3.64	3.00	2.45	9000	6.51	6.08	5.13	4.32	3.58	2.95	2.41	93.36
S.S. @ 8"	63180		Passing	11,950	8.81	8.23	6.97	5.87	4.82	4.00	3.26	12000	8.85	8.26	7.00	5.89	4.84	4.02	3.27	93.42
S.S. @ 8"	63180		Passing	15,384	10.93	10.22	8.65	7.31	5.99	4.96	4.04	16000	11.37	10.63	9.00	7.60	6.23	5.16	4.20	93.50
S.S. @ 8"		63170	Passing	8,899	4.85	4.16	3.83	3.42	2.98	2.54	2.12	9000	4.90	4.21	3.87	3.46	3.01	2.57	2.14	
S.S. @ 8"		63170	Passing	11,818	6.33	5.70	5.23	4.72	4.09	3.50	2.93	12000	6.43	5.79	5.31	4.79	4.15	3.55	2.98	
S.S. @ 8"		63170	Passing	15,439	7.94	7.11	6.53	5.92	5.14	4.37	3.69	16000	8.23	7.37	6.77	6.14	5.33	4.53	3.82	
S.S. @ 8"	63160		Passing	8,965	5.67	5.16	4.34	3.63	2.95	2.39	1.95	9000	5.69	5.18	4.36	3.64	2.96	2.40	1.96	91.01
S.S. @ 8"	63160		Passing	11,818	7.66	6.98	5.96	4.94	4.00	3.33	2.64	12000	7.78	7.09	6.05	5.02	4.06	3.38	2.68	91.12
S.S. @ 8"	63160		Passing	15,395	9.63	8.84	7.49	6.27	5.06	4.08	3.40	16000	10.01	9.19	7.78	6.52	5.26	4.24	3.53	91.80
RJD @ 12"		63070	Passing	9,140	3.79	3.50	3.16	2.79	2.41	1.99	1.62	9000	3.73	3.45	3.11	2.75	2.37	1.96	1.60	
RJD @ 12"		63070	Passing	11,983	5.08	4.71	4.30	3.76	3.23	2.68	2.22	12000	5.09	4.72	4.31	3.77	3.23	2.68	2.22	
RJD @ 12"		63070	Passing	15,527	6.37	5.88	5.33	4.74	4.00	3.37	2.71	16000	6.56	6.06	5.49	4.88	4.12	3.47	2.79	
RJD @ 12"	63060		Passing	8,954	6.38	4.50	3.68	2.90	2.29	1.81	1.45	9000	6.41	4.52	3.70	2.91	2.30	1.82	1.46	70.53
RJD @ 12"	63060		Passing	11,785	8.72	6.10	4.94	4.11	3.19	2.53	1.93	12000	8.88	6.21	5.03	4.18	3.25	2.58	1.97	69.95
RJD @ 12"	63060		Passing	15,340	10.96	7.68	6.32	5.04	3.94	3.15	2.50	16000	11.43	8.01	6.59	5.26	4.11	3.29	2.61	70.07
RJD @ 12"		63050	Passing	9,053	4.19	3.70	3.35	2.94	2.57	2.13	1.79	9000	4.17	3.68	3.33	2.92	2.56	2.12	1.78	
RJD @ 12"		63050	Passing	11,785	5.52	4.95	4.49	3.99	3.42	2.88	2.37	12000	5.62	5.04	4.57	4.06	3.48	2.93	2.41	
RJD @ 12"		63050	Passing	15,549	6.98	6.30	5.73	5.11	4.33	3.67	2.98	16000	7.18	6.48	5.90	5.26	4.46	3.78	3.07	
RJD @ 12"	63040		Passing	9,097	6.83	5.26	4.26	3.40	2.66	2.08	1.61	9000	6.76	5.20	4.21	3.36	2.63	2.06	1.59	77.01
RJD @ 12"	63040		Passing	11,917	9.12	7.07	5.74	4.66	3.56	2.81	2.14	12000	9.18	7.12	5.78	4.69	3.58	2.83	2.15	77.52
RJD @ 12"	63040		Passing	15,450	11.56	8.91	7.21	5.80	4.50	3.50	2.72	16000	11.97	9.23	7.47	6.01	4.66	3.62	2.82	77.08
RJD @ 12"		63030	Passing	9,097	4.14	3.76	3.42	3.01	2.56	2.12	1.70	9000	4.10	3.72	3.38	2.98	2.53	2.10	1.68	
RJD @ 12"		63030	Passing	11,928	5.51	5.06	4.59	4.10	3.48	2.87	2.35	12000	5.54	5.09	4.62	4.12	3.50	2.89	2.36	
RJD @ 12"		63030	Passing	15,494	6.95	6.38	5.79	5.16	4.36	3.61	2.96	16000	7.18	6.59	5.98	5.33	4.50	3.73	3.06	
RJD @ 12"	63020		Passing	9,064	6.92	4.61	3.69	2.91	2.35	1.76	1.39	9000	6.87	4.58	3.66	2.89	2.33	1.75	1.38	66.62
RJD @ 12"	63020		Passing	11,906	9.10	6.13	5.02	3.96	3.08	2.37	1.85	12000	9.17	6.18	5.06	3.99	3.10	2.39	1.86	67.36
RJD @ 12"	63020		Passing	15,241	11.36	7.67	6.23	4.97	3.84	3.00	2.33	16000	11.93	8.05	6.54	5.22	4.03	3.15	2.45	67.52
RJD @ 8"		62970	Passing	9,075	4.30	3.61	3.31	2.95	2.59	2.15	1.79	9000	4.26	3.58	3.28	2.93	2.57	2.13	1.78	
RJD @ 8"		62970	Passing	11,906	5.74	4.91	4.52	4.10	3.49	2.98	2.44	12000	5.79	4.95	4.56	4.13	3.52	3.00	2.46	
RJD @ 8"		62970	Passing	15,593	6.85	6.12	5.62	5.04	4.37	3.67	3.05	16000	7.03	6.28	5.77	5.17	4.48	3.77	3.13	
RJD @ 8"	62960		Passing	9,108	6.48	5.57	4.59	3.72	2.97	2.33	1.84	9000	6.40	5.50	4.54	3.68	2.93	2.30	1.82	85.96
RJD @ 8"	62960		Passing	11,939	8.69	7.49	6.19	5.07	4.02	3.18	2.50	12000	8.73	7.53	6.22	5.10	4.04	3.20	2.51	86.19
RJD @ 8"	62960		Passing	15,351	11.04	9.43	7.81	6.36	5.06	4.02	3.15	16000	11.51	9.83	8.14	6.63	5.27	4.19	3.28	85.42
RJD @ 8"		62950	Passing	9,140	4.20	3.93	3.62	3.26	2.86	2.43	2.06	9000	4.14	3.87	3.56	3.21	2.82	2.39	2.03	
RJD @ 8"		62950	Passing	11,917	5.58	5.24	4.84	4.40	3.82	3.26	2.74	12000	5.62	5.28	4.87	4.43	3.85	3.28	2.76	

RJD @ 8"		62950	Passing	15,472	7.02	6.61	6.11	5.58	4.80	4.16	3.43	16000	7.26	6.84	6.32	5.77	4.96	4.30	3.55	
RJD @ 8"	62940		Passing	9,064	6.26	5.34	4.37	3.51	2.74	2.24	1.71	9000	6.22	5.30	4.34	3.49	2.72	2.22	1.70	85.30
RJD @ 8"	62940		Passing	11,873	8.51	7.20	5.90	4.78	3.76	2.97	2.31	12000	8.60	7.28	5.96	4.83	3.80	3.00	2.33	84.61
RJD @ 8"	62940		Passing	15,395	10.74	9.11	7.45	6.04	4.71	3.78	2.93	16000	11.16	9.47	7.74	6.28	4.90	3.93	3.05	84.82
RJD @ 8"		62930	Passing	9,075	4.20	3.86	3.55	3.12	2.70	2.29	1.89	9000	4.17	3.83	3.52	3.09	2.68	2.27	1.87	
RJD @ 8"		62930	Passing	11,928	5.61	5.20	4.74	4.28	3.62	3.09	2.50	12000	5.64	5.23	4.77	4.31	3.64	3.11	2.52	
RJD @ 8"		62930	Passing	15,384	7.01	6.52	5.96	5.32	4.57	3.90	3.18	16000	7.29	6.78	6.20	5.53	4.75	4.06	3.31	
RJD @ 8"	62920		Passing	8,987	6.34	5.25	4.26	3.46	2.71	2.13	1.63	9000	6.35	5.26	4.27	3.47	2.71	2.13	1.63	82.81
RJD @ 8"	62920		Passing	11,873	8.55	7.10	5.80	4.69	3.70	2.89	2.24	12000	8.64	7.18	5.86	4.74	3.74	2.92	2.26	83.04
RJD @ 8"	62920		Passing	15,318	10.87	9.02	7.38	5.94	4.67	3.67	2.87	16000	11.35	9.42	7.71	6.20	4.88	3.83	3.00	82.98
H.B. @ 12"		62513	Passing	9,119	3.98	3.49	3.19	2.84	2.48	2.13	1.78	9000	3.93	3.44	3.15	2.80	2.45	2.10	1.76	
H.B. @ 12"		62513	Passing	11,961	5.30	4.69	4.30	3.88	3.35	2.88	2.42	12000	5.32	4.71	4.31	3.89	3.36	2.89	2.43	
H.B. @ 12"		62513	Passing	15,439	6.50	5.88	5.37	4.83	4.20	3.60	3.03	16000	6.74	6.09	5.57	5.01	4.35	3.73	3.14	
H.B. @ 12"	62503		Passing	9,009	6.04	4.67	3.85	3.15	2.55	2.08	1.65	9000	6.03	4.67	3.85	3.15	2.55	2.08	1.65	77.32
H.B. @ 12"	62503		Passing	11,884	8.11	6.24	5.19	4.24	3.44	2.73	2.20	12000	8.19	6.30	5.24	4.28	3.47	2.76	2.22	76.94
H.B. @ 12"	62503		Passing	15,220	10.22	7.83	6.49	5.31	4.30	3.42	2.78	16000	10.74	8.23	6.82	5.58	4.52	3.60	2.92	76.61
H.B. @ 12"		62493	Passing	9,108	4.48	3.89	3.56	3.12	2.72	2.30	1.91	9000	4.43	3.84	3.52	3.08	2.69	2.27	1.89	
H.B. @ 12"		62493	Passing	11,993	5.87	5.22	4.77	4.27	3.67	3.12	2.50	12000	5.87	5.22	4.77	4.27	3.67	3.12	2.50	
H.B. @ 12"		62493	Passing	15,209	7.17	6.50	5.94	5.31	4.59	3.89	3.23	16000	7.54	6.84	6.25	5.59	4.83	4.09	3.40	
H.B. @ 12"	62483		Passing	9,108	6.43	5.15	4.21	3.38	2.73	2.07	1.68	9000	6.35	5.09	4.16	3.34	2.70	2.05	1.66	80.09
H.B. @ 12"	62483		Passing	11,862	8.52	6.82	5.60	4.59	3.61	2.90	2.31	12000	8.62	6.90	5.67	4.64	3.65	2.93	2.34	80.05
H.B. @ 12"	62483		Passing	15,329	10.67	8.58	7.05	5.76	4.54	3.59	2.87	16000	11.14	8.96	7.36	6.01	4.74	3.75	3.00	80.41
H.B. @ 12"		62473	Passing	9,140	4.17	3.60	3.33	2.85	2.61	2.18	1.90	9000	4.11	3.54	3.28	2.81	2.57	2.15	1.87	
H.B. @ 12"		62473	Passing	11,862	5.44	4.80	4.44	3.89	3.47	2.91	2.57	12000	5.50	4.86	4.49	3.94	3.51	2.94	2.60	
H.B. @ 12"		62473	Passing	15,231	6.74	6.02	5.53	4.98	4.37	3.75	3.15	16000	7.08	6.32	5.81	5.23	4.59	3.94	3.31	
H.B. @ 12"	62463		Passing	9,020	6.53	5.08	4.19	3.40	2.72	2.21	1.74	9000	6.52	5.07	4.18	3.39	2.71	2.21	1.74	77.79
H.B. @ 12"	62463		Passing	11,862	8.79	6.85	5.67	4.61	3.74	2.95	2.39	12000	8.89	6.93	5.74	4.66	3.78	2.98	2.42	77.93
H.B. @ 12"	62463		Passing	15,220	11.02	8.59	7.09	5.80	4.66	3.72	3.00	16000	11.59	9.03	7.45	6.10	4.90	3.91	3.15	77.95
H.B. @ 8"		62313	Passing	9,097	3.48	3.25	3.04	2.78	2.48	2.17	1.83	9000	3.44	3.22	3.01	2.75	2.45	2.15	1.81	
H.B. @ 8"		62313	Passing	12,026	4.65	4.39	4.13	3.80	3.35	2.91	2.45	12000	4.64	4.38	4.12	3.79	3.34	2.90	2.44	
H.B. @ 8"		62313	Passing	15,187	5.86	5.54	5.20	4.79	4.23	3.70	3.12	16000	6.17	5.84	5.48	5.05	4.46	3.90	3.29	
H.B. @ 8"	62303		Passing	9,042	5.03	3.77	3.06	2.45	1.93	1.57	1.19	9000	5.01	3.75	3.05	2.44	1.92	1.56	1.18	74.95
H.B. @ 8"	62303		Passing	11,983	6.78	5.13	4.21	3.35	2.64	2.11	1.64	12000	6.79	5.14	4.22	3.35	2.64	2.11	1.64	75.66
H.B. @ 8"	62303		Passing	15,165	8.56	6.44	5.22	4.23	3.30	2.65	2.09	16000	9.03	6.79	5.51	4.46	3.48	2.80	2.21	75.23
H.B. @ 8"		62293	Passing	9,009	3.36	3.10	2.86	2.48	2.17	1.84	1.48	9000	3.36	3.10	2.86	2.48	2.17	1.84	1.48	

H.B. @ 8"		62293	Passing	11,763	4.47	4.17	3.82	3.41	2.92	2.44	2.00	12000	4.56	4.25	3.90	3.48	2.98	2.49	2.04	
H.B. @ 8"		62293	Passing	15,220	5.67	5.27	4.82	4.32	3.70	3.11	2.52	16000	5.96	5.54	5.07	4.54	3.89	3.27	2.65	
H.B. @ 8"	62283		Passing	8,943	6.22	4.32	3.53	2.79	2.24	1.78	1.34	9000	6.26	4.35	3.55	2.81	2.25	1.79	1.35	69.45
H.B. @ 8"	62283		Passing	11,708	8.28	5.65	4.66	3.78	3.01	2.30	1.88	12000	8.49	5.79	4.78	3.87	3.09	2.36	1.93	68.24
H.B. @ 8"	62283		Passing	15,209	10.54	7.09	5.84	4.78	3.77	2.93	2.36	16000	11.09	7.46	6.14	5.03	3.97	3.08	2.48	67.27
H.B. @ 8"		62273	Passing	8,998	3.51	3.16	2.87	2.58	2.30	1.88	1.56	9000	3.51	3.16	2.87	2.58	2.30	1.88	1.56	
H.B. @ 8"		62273	Passing	11,763	4.64	4.21	3.84	3.43	2.95	2.51	2.08	12000	4.73	4.29	3.92	3.50	3.01	2.56	2.12	
H.B. @ 8"		62273	Passing	15,285	5.88	5.34	4.87	4.37	3.76	3.20	2.65	16000	6.15	5.59	5.10	4.57	3.94	3.35	2.77	
H.B. @ 8"	62263		Passing	9,053	5.22	3.81	3.12	2.52	2.02	1.62	1.31	9000	5.19	3.79	3.10	2.51	2.01	1.61	1.30	72.99
H.B. @ 8"	62263		Passing	11,840	6.96	5.09	4.15	3.44	2.68	2.17	1.74	12000	7.05	5.16	4.21	3.49	2.72	2.20	1.76	73.13
H.B. @ 8"	62263		Passing	15,176	8.88	6.49	5.30	4.30	3.44	2.73	2.17	16000	9.36	6.84	5.59	4.53	3.63	2.88	2.29	73.09

Table B.8. Joint Measurements

Field Measurements

9/1/1997 Demonstration and Field Evaluation of Alternative PCC Pavement Reinforcement Materials

Used Whittemore Strain Gage Serial Number 1169 Constant 0500

*Indicates the Joint Station that ERES Tested with the FWD on 10/3/97

Morning Temp. 96.5°F; Afternoon Temp. 98°F; Clear, Sunny and Windy

Tests were taken 4' from the edge in the driving lane and 2' from the edge in the passing lane (the wheelpath).

All Corner Crack measurements are taken in the north and east directions, unless otherwise indicated.

^Indicates the Joint Station that RUST tested using the ground penetration radar on 10/7/97.

All core measurements are taken from the east edge of pavement.

						9/1/1997						9/1/1997		
Center Line	Joint	Bar	Manufacturer	Spacing	Nail	Joint Opening		Load Transfer		Jt. Movement		Corner Crack		Core Location
Bar Type	Station	Diameter			Top/Bottom	Test Date	Amount	Test Date	%	Test Date	Amount	N	E	Test Date 10/7/97
Hughes Brothers	620+03	1 7/8"	Hughes Brothers	8"								1 1/2"	3"	
Hughes Brothers	620+23	1 7/8"	Hughes Brothers	8"								1 1/2"	4"	
Hughes Brothers	620+43	1 7/8"	Hughes Brothers	8"		10/3/1997	0.0009					--	--	
Hughes Brothers	620+63	1 7/8"	Hughes Brothers	8"		10/3/1997	N/A					--	--	
Hughes Brothers	620+83	1 7/8"	Hughes Brothers	8"		10/3/1997	0.0009					2"	3"	
Hughes Brothers	621+03	1 7/8"	Hughes Brothers	8"		10/3/1997	0.0770					1 1/2"	4"	
Hughes Brothers	621+23	1 7/8"	Hughes Brothers	8"		10/3/1997	0.0202					--	--	
Hughes Brothers	^621+43	1 7/8"	Hughes Brothers	8"		10/3/1997	N/A					--	--	
Hughes Brothers	^621+63	1 7/8"	Hughes Brothers	8"		10/3/1997	N/A					--	--	cl of core 68"
Hughes Brothers	^621+83	1 7/8"	Hughes Brothers	8"		10/3/1997	N/A					--	--	
Hughes Brothers	622+03	1 7/8"	Hughes Brothers	8"		10/3/1997	0.0837					1 1/2"	7"	
Hughes Brothers	622+23	1 7/8"	Hughes Brothers	8"		10/3/1997	0.0143					1 (S)	3"	
Hughes Brothers	622+43	1 7/8"	Hughes Brothers	8"								--	--	
Hughes Brothers	*622+63	1 7/8"	Hughes Brothers	8"	Top							--	--	
Hughes Brothers	*622+73	Mid-panel test location										N/A	N/A	
Hughes Brothers	*622+83	1 7/8"	Hughes Brothers	8"	Top							1 1/2"	3"	
Hughes Brothers	*622+93	Mid-panel test location										N/A	N/A	
Hughes Brothers	*623+03	1 7/8"	Hughes Brothers	8"	Top							--		
Hughes Brothers	*623+13	Mid-panel test location										N/A	N/A	
Hughes Brothers	623+23	1 7/8"	Hughes Brothers	8"	Top							1 1/2"(S)	3"	

Standard Bars	623+43	1 7/8"	Hughes Brothers	8"	Top							--	--	
Standard Bars	623+63	1 7/8"	Hughes Brothers	8"	Bottom							1 1/2"	5"	
Standard Bars	623+83	1 7/8"	Hughes Brothers	8"	Bottom							--	--	
Standard Bars	624+03	1 7/8"	Hughes Brothers	8"	Bottom	10/3/1997	N/A					--	--	
Standard Bars	624+23	1 7/8"	Hughes Brothers	8"	Bottom	10/3/1997	0.0600					--	--	
Standard Bars	624+43	1 7/8"	Hughes Brothers	8"	Bottom	10/3/1997	N/A					--	--	
Standard Bars	*624+63	1 7/8"	Hughes Brothers	12"		10/3/1997	0.0270					--	--	
Standard Bars	*624+73	Mid-panel test location				N/A	N/A					N/A	N/A	
Standard Bars	*624+83	1 7/8"	Hughes Brothers	12"		10/3/1997	0.0080					--	--	
Standard Bars	*624+93	Mid-panel test location				N/A	N/A					N/A	N/A	
Standard Bars	*625+03	1 7/8"	Hughes Brothers	12"		10/3/1997	N/A					2"	4"	
Standard Bars	*625+13	Mid-panel test location				N/A	N/A					N/A	N/A	
Standard Bars	625+23	1 7/8"	Hughes Brothers	12"		10/3/1997	0.0335					--	--	
Standard Bars	625+43	1 7/8"	Hughes Brothers	12"		10/3/1997	0.0165					1 1/2"	3 1/2"	
Standard Bars	^625+63	1 7/8"	Hughes Brothers	12"		10/3/1997	N/A					--	--	
Standard Bars	^625+83	1 7/8"	Hughes Brothers	12"		10/3/1997	0.0340					--	--	
Standard Bars	^626+03	1 7/8"	Hughes Brothers	12"		10/3/1997	N/A					--	--	cl of core '48"
Standard Bars	626+23	1 7/8"	Hughes Brothers	12"								--	--	
Standard Bars	626+43	1 7/8"	Hughes Brothers	12"								1 1/2"	3 1/2"	
Standard Bars	626+63	1 7/8"	Hughes Brothers	12"								1"	4"	
Standard Bars	626+83	1 7/8"	Hughes Brothers	12"								--	--	
Standard Bars	627+00	1 7/8"	Hughes Brothers	12"	Bottom							--	--	
Standard Bars	627+20	1 7/8"	Hughes Brothers	12"	Bottom							--	--	
Standard Bars	627+40	1 7/8"	Hughes Brothers	12"	Bottom							1"	4"	
Standard Bars	627+60	1 7/8"	Hughes Brothers	12"	Bottom							--	--	
Standard Bars	627+80	1 7/8"	Hughes Brothers	12"	Bottom							--	--	
Standard Bars	628+00	1 7/8"	Hughes Brothers	12"	Top							--	--	
Standard Bars	628+20	1 7/8"	Hughes Brothers	12"	Top							--	--	
Standard Bars	628+40	1 7/8"	Hughes Brothers	12"	Top							--	--	
Standard Bars	628+60	1 7/8"	Hughes Brothers	12"	Top							1 1/2"	5"	
Marshall	628+80	1 7/8"	Hughes Brothers	12"	Top							--	--	
Marshall	629+00	1 1/2"	RJD	8"	Bottom	10/3/1997	N/A					--	--	
Marshall	*^629+20	1 1/2"	RJD	8"	Bottom	10/3/1997	N/A					--	--	cl of core 106"
Marshall	*629+30	Mid-panel test location				N/A	N/A					N/A	N/A	cl of core 129" & 153"

Marshall	*^629+40	1 1/2"	RJD	8"	Bottom	10/3/1997	0.0440					--	--	
Marshall	*629+50	Mid-panel test location				N/A	N/A					N/A	N/A	
Marshall	*^629+60	1 1/2"	RJD	8"	Top	10/3/1997	0.0930					--	--	
Marshall	*629+70	Mid-panel test location				N/A	N/A					N/A	N/A	
Marshall	629+80	1 1/2"	RJD	8"	Top	10/3/1997	0.0028					1 1/2"	5"	
Marshall	630+00	1 1/2"	RJD	8"	Top	10/3/1997	N/A					--	--	
Marshall	*630+20	1 1/2"	RJD	12"	Bottom	10/3/1997	0.0009					--	--	
Marshall	*630+30	Mid-panel test location				N/A	N/A					N/A	N/A	
Marshall	*630+40	1 1/2"	RJD	12"	Bottom	10/3/1997	0.0694					--	--	
Marshall	*630+50	Mid-panel test location				N/A	N/A					N/A	N/A	
Marshall	*^630+60	1 1/2"	RJD	12"	Top	10/3/1997	0.0297					2"	5"	
Marshall	*630+70	Mid-panel test location				N/A	N/A					N/A	N/A	
Marshall	^630+80	1 1/2"	RJD	12"	Top	10/3/1997	0.0923					--	--	
Standard Bars	^631+00	1 1/2"	RJD	12"	Top	10/3/1997	N/A					2"	5"	
Standard Bars	631+20	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	0.0120					--	--	
Standard Bars	631+40	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	0.0828					--	--	
Standard Bars	*631+60	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	0.0425					--	--	
Standard Bars	*631+70	Mid-panel test location				N/A	N/A					N/A	N/A	
Standard Bars	*631+80	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	0.0465					--	--	
Standard Bars	*631+90	Mid-panel test location				N/A	N/A					N/A	N/A	
Standard Bars	*632+00	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	N/A					--	--	
Standard Bars	*632+10	Mid-panel test location				N/A	N/A					N/A	N/A	
Standard Bars	632+20	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	0.0700					--	--	
Standard Bars	^632+40	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	N/A					--	--	
Standard Bars	632+42													cl of core 130" & 155"
Standard Bars	^632+60	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	N/A					--	--	
Standard Bars	^632+80	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	N/A					--	--	
Standard Bars	633+02	1 1/2"	Stainless Steel	8"	2@12+2center	10/3/1997	0.0868					1"	4"	
Standard Bars	633+22	1 1/2"	Stainless Steel	8"	2@12+2center							--	--	
Standard Bars	633+42	1 1/2"	Stainless Steel	8"	2@12+2center							1 1/2"	2"	
Standard Bars	633+62	1 1/2"	Epoxy Coated	1'	std. 14' and 12'							--	--	
Standard Bars	633+82	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	634+00	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	634+22	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	

Standard Bars	634+37	Location of Header										N/A	N/A	
Standard Bars	634+44	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	*634+64	1 1/2"	Stainless Steel	1'	std. 14' and 12'							2"	3"	
Standard Bars	*634+74	Mid-panel test location										N/A	N/A	
Standard Bars	*634+84	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	*634+94	Mid-panel test location										N/A	N/A	
Standard Bars	*635+02	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	0.0520					--	--	
Standard Bars	*635+12	Mid-panel test location				N/A	N/A					N/A	N/A	
Standard Bars	635+22	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	0.0684					--	--	
Standard Bars	635+42	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	N/A					--	--	
Standard Bars	635+62	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	0.0850					--	--	
Standard Bars	635+82	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	0.0120					--	--	
Standard Bars	635+98	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	0.0645					--	--	
Standard Bars	636+18	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	0.0440					--	--	
Standard Bars	636+38	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	0.0540					--	--	
Standard Bars	636+58	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	N/A					--	--	
Standard Bars	636+78	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	0.0445					--	--	
Standard Bars	^636+98	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	^637+18	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	^637+38	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	637+58	1 1/2"	Stainless Steel	1'	std. 14' and 12'							2"	5"	
Standard Bars	637+78	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	637+98	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	638+18	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	638+38	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	638+58	1 1/2"	Stainless Steel	1'	std. 14' and 12'							1 1/2"	4"	
Standard Bars	638+78	1 1/2"	Stainless Steel	1'	std. 14' and 12'							--	--	
Standard Bars	638+98	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	N/A					2"	4"	
Standard Bars	639+18	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	N/A					--	--	
Standard Bars	639+38	1 1/2"	Stainless Steel	1'	std. 14' and 12'	10/3/1997	0.0072					3 1/2"	7"	
Standard Bars	639+58	1 1/2"	Standard Epoxy	1'		10/3/1997	0.0530					--	--	
Standard Bars	639+78	1 1/2"	Standard Epoxy	1'		10/3/1997	0.0185					1"	3"	cl of core 67 1/2"
Standard Bars	^639+98	1 1/2"	Standard Epoxy	1'		10/3/1997	N/A					--	--	
Standard Bars	^640+18	1 1/2"	Standard Epoxy	1'		10/3/1997	0.0215					--	--	

Standard Bars	^640+38	1 1/2"	Standard Epoxy	1'		10/3/1997	N/A					--	--	
Standard Bars	640+58	1 1/2"	Standard Epoxy	1'		10/3/1997	0.0286					--	--	
Standard Bars	640+78	1 1/2"	Standard Epoxy	1'		10/3/1997	0.0070					--	--	
Standard Bars	640+96	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	641+16	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	641+36	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	*641+56	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	*641+66	Mid-panel test location										N/A	N/A	
Standard Bars	*641+76	1 1/2"	Standard Epoxy	1'								1 1/2"	5"	
Standard Bars	*641+86	Mid-panel test location										N/A	N/A	
Standard Bars	*641+96	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	*641+06	Mid-panel test location										N/A	N/A	
Standard Bars	642+16	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	642+36	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	642+56	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	642+76	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	642+96	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	643+15	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	643+35	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	643+55	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	643+75	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	643+95	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	644+15	1 1/2"	Standard Epoxy	1'								--	--	
Standard Bars	644+35	1 1/2"	Standard Epoxy	1'								--	--	

Field Measurements

DATE 9/25/98 | Temperature : °C | Start Time: 7:45 a.m. | Conditions: Windy, cloudy, partly sunny. | Finished Time: 9:00 a.m.

*Indicates the Joint Station that ERES Tested with the FWD on 10/3/97

Tests were taken 4' from the edge in the driving lane and 2' from the edge in the passing lane (the wheelpath).

Used Whittemore Strain Gage Serial Number 1169 Constant 0500

All core measurements are taken from the east edge of pavement.

					9/31/97		4/21/98		9/25/98		9/31/97		9/25/1998		4/21/98			9/25/98		
Center Line	Joint	Bar	Manufacturer	Spacing	Joint Opening		Joint Opening		Joint Opening		Corner Crack		Corner Crack		Faulting, mm		Pavement	Faulting, mm		Pavement
Bar Type	Station	Diameter			Test Date		Test Date		Test Date	Amount	N	E			0.3 m (18")	0.75 m (2.5')	Temp, °C	0.3 m (18")	0.75 m (2.5')	Temp, °C
Hughes Brothers	620+03	1 7/8"	Hughes Brothers	8"							1 1/2"	3"						-0.3	0.0	79
Hughes Brothers	620+23	1 7/8"	Hughes Brothers	8"							1 1/2"	4"						0.2	-0.9	76
Hughes Brothers	620+43	1 7/8"	Hughes Brothers	8"	9/31/97	9.9799	4/21/98	9.9795	9/25/98	9.9005	--	--			-0.7	-0.5	67	0.3	-0.9	76
Hughes Brothers	620+63	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.8720	--	--			0.0	0.0	67	0.2	-0.8	76
Hughes Brothers	620+83	1 7/8"	Hughes Brothers	8"	9/31/97	9.9799	4/21/98	9.9795	9/25/98	9.9835	2"	3"			0.9	-0.1	67	0.3	-0.5	76
Hughes Brothers	621+03	1 7/8"	Hughes Brothers	8"	9/31/97	10.0560	4/21/98	10.0018	9/25/98	9.9270	1 1/2"	4"			0.8	0.2	67	-0.5	-0.4	76
Hughes Brothers	621+23	1 7/8"	Hughes Brothers	8"	9/31/97	9.9992	4/21/98	10.0004	9/25/98	9.9470	--	--			0.0	0.2	66	0.0	0.1	76
Hughes Brothers	^621+43	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1020	--	--			-0.1	-0.5	66	0.1	0.0	76
Hughes Brothers	^621+63	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.7140	--	--			0.5	-0.3	66	-0.8	-0.8	76
Hughes Brothers	^621+83	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.8380	--	--			-0.3	0.2	66	0.2	0.4	76
Hughes Brothers	622+03	1 7/8"	Hughes Brothers	8"	9/31/97	10.0627	4/21/98	10.0382	9/25/98	9.9990	1 1/2"	7"			1.0	0.6	65	0.2	1.0	76
Hughes Brothers	622+23	1 7/8"	Hughes Brothers	8"	9/31/97	9.9933	4/21/98	9.9873	9/25/98	9.9470	1 (S)	3"			0.8	0.3	65	0.0	-0.8	76
Hughes Brothers	622+43	1 7/8"	Hughes Brothers	8"							--	--						-1.0	-1.8	76
Hughes Brothers	*622+63	1 7/8"	Hughes Brothers	8"							--	--			0.3	0.3	65	-0.5	-1.3	76
Hughes Brothers	*622+73	Mid-panel test location									N/A	N/A								
Hughes Brothers	*622+83	1 7/8"	Hughes Brothers	8"							1 1/2"	3"			-0.2	-0.4	65	0.4	-0.8	76
Hughes Brothers	*622+93	Mid-panel test location									N/A	N/A								
Hughes Brothers	*623+03	1 7/8"	Hughes Brothers	8"							--				0.8	0.0	65	0.0	-1.2	76
Hughes Brothers	*623+13	Mid-panel test location									N/A	N/A								
Hughes Brothers	623+23	1 7/8"	Hughes Brothers	8"							1 1/2"(S)	3"						-0.2	-0.3	76

Standard Bars	623+43	1 7/8"	Hughes Brothers	8"							--	--						0.0	-0.3	76
Standard Bars	623+63	1 7/8"	Hughes Brothers	8"							1 1/2"	5"						-0.2	-0.3	76
Standard Bars	623+83	1 7/8"	Hughes Brothers	8"							--	--						0.1	-0.5	76
Standard Bars	624+03	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.9630	--	--			0.4	0.5	66	-0.3	-1.1	80
Standard Bars	624+23	1 7/8"	Hughes Brothers	8"	9/31/97	10.0390	4/21/98	10.0073	9/25/98	9.6600	--	--			1.4	-0.3	66	0.7	-0.5	80
Standard Bars	624+43	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.9950	--	--			-0.3	-0.2	66	-0.9	-0.7	80
Standard Bars	*624+63	1 7/8"	Hughes Brothers	12"	9/31/97	10.0060	4/21/98	10.3940	9/25/98	9.9560	--	--			0.4	0.0	66	-0.5	0.0	80
Standard Bars	*624+73	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	--	N/A	N/A								
Standard Bars	*624+83	1 7/8"	Hughes Brothers	12"	9/31/97	9.9870	4/21/98	9.9928	9/25/98	9.9275	--	--			0.2	0.2	66	0.3	-0.3	80
Standard Bars	*624+93	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	--	N/A	N/A								
Standard Bars	*625+03	1 7/8"	Hughes Brothers	12"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1320	2"	4"			-0.1	0.3	66	0.1	-0.5	80
Standard Bars	*625+13	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	--	N/A	N/A								
Standard Bars	625+23	1 7/8"	Hughes Brothers	12"	9/31/97	10.0125	4/21/98	10.0118	9/25/98	9.9820	--	--			-1.8	-0.6	67	0.5	0.0	80
Standard Bars	625+43	1 7/8"	Hughes Brothers	12"	9/31/97	9.9955	4/21/98	10.1380	9/25/98	9.9075	1 1/2"	3 1/2"			0.6	0.0	67	0.9	-0.8	80
Standard Bars	^625+63	1 7/8"	Hughes Brothers	12"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.2180	--	--			0.7	-0.1	67	-0.4	0.1	80
Standard Bars	^625+83	1 7/8"	Hughes Brothers	12"	9/31/97	10.0130	4/21/98	10.0158	9/25/98	9.9320	--	--			0.0	-0.2	67	-1.1	-0.3	80
Standard Bars	^626+03	1 7/8"	Hughes Brothers	12"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.0835	--	--			0.3	0.2	67	-0.2	0.0	80
Standard Bars	626+23	1 7/8"	Hughes Brothers	12"							--	--						0.2	-0.5	80
Standard Bars	626+43	1 7/8"	Hughes Brothers	12"							1 1/2"	3 1/2"						-0.1	0.5	80
Standard Bars	626+63	1 7/8"	Hughes Brothers	12"							1"	4"						-0.7	-0.3	80
Standard Bars	626+83	1 7/8"	Hughes Brothers	12"							--	--						-0.3	-0.4	80
Standard Bars	627+00	1 7/8"	Hughes Brothers	12"							--	--						-0.1	-0.5	79
Standard Bars	627+20	1 7/8"	Hughes Brothers	12"							--	--						-0.3	0.0	79
Standard Bars	627+40	1 7/8"	Hughes Brothers	12"							1"	4"						0.5	-0.3	79
Standard Bars	627+60	1 7/8"	Hughes Brothers	12"							--	--						-0.1	0.3	79
Standard Bars	627+80	1 7/8"	Hughes Brothers	12"							--	--						-0.3	-0.4	79
Standard Bars	628+00	1 7/8"	Hughes Brothers	12"							--	--						-0.3	-0.3	79
Standard Bars	628+20	1 7/8"	Hughes Brothers	12"							--	--						-0.7	0.5	79
Standard Bars	628+40	1 7/8"	Hughes Brothers	12"							--	--						-0.3	-1.0	79
Standard Bars	628+60	1 7/8"	Hughes Brothers	12"							1 1/2"	5"						-0.6	-0.2	79
Marshall	628+80	1 7/8"	Hughes Brothers	12"							--	--						-0.5	-0.5	79
Marshall	629+00	1 1/2"	RJD	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.2255	--	--			0.2	0.6	72	-0.5	0.6	79
Marshall	*^629+20	1 1/2"	RJD	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1175	--	--			-0.3	0.2	72	-1.2	-0.3	79
Marshall	*629+30	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								

Marshall	*^629+40	1 1/2"	RJD	8"	9/31/97	10.0230	4/21/98	10.0225	9/25/98	10.0090	--	--			0.0	0.3	70	-1.5	-0.9	79
Marshall	*629+50	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	*^629+60	1 1/2"	RJD	8"	9/31/97	10.0720	4/21/98	10.0698	#######	9.9995	--	--			0.9	0.2	70	0.4	0.2	79
Marshall	*629+70	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	629+80	1 1/2"	RJD	8"	9/31/97	9.9818	4/21/98	10.0184	9/25/98	9.9095	1 1/2"	5"			0.2	-0.2	70	0.0	0.5	79
Marshall	630+00	1 1/2"	RJD	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.8650	--	--			-0.5	-1.0	70	0.3	-1.3	79
Marshall	*630+20	1 1/2"	RJD	12"	9/31/97	9.9799	4/21/98	9.9796	9/25/98	9.9050	--	--			0.0	0.0	65	-0.3	-1.0	79
Marshall	*630+30	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	*630+40	1 1/2"	RJD	12"	9/31/97	10.0484	4/21/98	10.0551	9/25/98	10.0185	--	--			0.0	0.0	65	0.2	0.6	79
Marshall	*630+50	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	*^630+60	1 1/2"	RJD	12"	9/31/97	10.0087	4/21/98	9.9970	9/25/98	9.9680	2"	5"			-0.5	-0.2	65	-0.4	-0.3	79
Marshall	*630+70	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	^630+80	1 1/2"	RJD	12"	9/31/97	10.0713	4/21/98	10.0759	9/25/98	10.0320	--	--			-0.8	-0.2	65	0.0	-1.0	79
Standard Bars	^631+00	1 1/2"	RJD	12"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.0735	2"	5"			0.7	-0.2	71	0.7	-0.1	79
Standard Bars	631+20	1 1/2"	Stainless Steel	8"	9/31/97	9.9910	4/21/98	9.9932	9/25/98	9.9665	--	--			0.9	-0.4	71	-0.5	0.4	77
Standard Bars	631+40	1 1/2"	Stainless Steel	8"	9/31/97	10.0618	4/21/98	10.0478	9/25/98	10.0170	--	--			-0.1	-0.3	71	-0.3	0.2	77
Standard Bars	*631+60	1 1/2"	Stainless Steel	8"	9/31/97	10.0215	4/21/98	10.0014	9/25/98	9.9890	--	--			0.7	0.5	71	0.0	0.0	77
Standard Bars	*631+70	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Standard Bars	*631+80	1 1/2"	Stainless Steel	8"	9/31/97	10.0255	4/21/98	10.0273	9/25/98	10.0345	--	--			-0.1	-0.5	71	0.5	-0.9	77
Standard Bars	*631+90	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Standard Bars	*632+00	1 1/2"	Stainless Steel	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.7585	--	--			0.2	-0.3	71	0.2	1.0	77
Standard Bars	*632+10	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Standard Bars	632+20	1 1/2"	Stainless Steel	8"	9/31/97	10.0490	4/21/98	10.0435	9/25/98	10.0005	--	--			0.3	-0.3	71	-0.5	0.2	77
Standard Bars	^632+40	1 1/2"	Stainless Steel	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1785	--	--			0.4	-0.1	71	0.2	-1.1	77
Standard Bars	632+42					9.9790		9.9790												
Standard Bars	^632+60	1 1/2"	Stainless Steel	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1005	--	--			0.7	-0.4	71	0.0	0.5	77
Standard Bars	^632+80	1 1/2"	Stainless Steel	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.9775	--	--			0.6	0.2	71	1.1	-0.2	77
Standard Bars	633+02	1 1/2"	Stainless Steel	8"	9/31/97	10.0658	4/21/98	10.0670	9/25/98	10.0115	1"	4"	4"N; 3"S	7"E; 11"W	0.3	0.1	71	-0.2	-0.3	77
Standard Bars	633+22	1 1/2"	Stainless Steel	8"							--	--						0.1	0.0	76
Standard Bars	633+42	1 1/2"	Stainless Steel	8"							1 1/2"	2"						-0.3	-1.8	76
Standard Bars	633+62	1 1/2"	Epoxy Coated	1'							--	--						0.2	0.5	76
Standard Bars	633+82	1 1/2"	Stainless Steel	1'							--	--						-0.3	-1.3	76
Standard Bars	634+00	1 1/2"	Stainless Steel	1'							--	--						-0.3	-0.9	76

Standard Bars	634+22	1 1/2"	Stainless Steel	1'							--	--						-0.8	-0.3	75
Standard Bars	634+37	Location of Header									N/A	N/A								
Standard Bars	634+44	1 1/2"	Stainless Steel	1'							--	--						0.1	0.4	75
Standard Bars	*634+64	1 1/2"	Stainless Steel	1'							2"	3"			0.2	0.6	71	0.4	-0.4	75
Standard Bars	*634+74	Mid-panel test location									N/A	N/A								
Standard Bars	*634+84	1 1/2"	Stainless Steel	1'							--	--			-0.2	0.4	71	-0.3	-0.8	75
Standard Bars	*634+94	Mid-panel test location									N/A	N/A								
Standard Bars	*635+02	1 1/2"	Stainless Steel	1'	9/31/97	10.0310	4/21/98	10.0080	9/25/98	9.8525	--	--			0.9	1.4	71	0.5	0.1	75
Standard Bars	*635+12	Mid-panel test location			N/A	N/A	4/21/98	N/A	9/25/98	N/A	N/A	N/A								
Standard Bars	635+22	1 1/2"	Stainless Steel	1'	9/31/97	10.0474	4/21/98	10.0645	9/25/98	9.8985	--	--			0.8	1.2	71	-0.2	-0.1	75
Standard Bars	635+42	1 1/2"	Stainless Steel	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	10.0860	--	--			1.0	0.8	71	-0.8	-0.1	75
Standard Bars	635+62	1 1/2"	Stainless Steel	1'	9/31/97	10.0640	4/21/98	10.0768	9/25/98	9.9285	--	--			0.3	-1.1	74	0.3	-0.8	75
Standard Bars	635+82	1 1/2"	Stainless Steel	1'	9/31/97	9.9910	4/21/98	10.0018	9/25/98	9.8620	--	--			0.2	-0.9	74	-0.7	-0.2	73
Standard Bars	635+98	1 1/2"	Stainless Steel	1'	9/31/97	10.0435	4/21/98	10.0660	9/25/98	9.8895	--	--			0.4	0.3	74	-0.3	-1.1	73
Standard Bars	636+18	1 1/2"	Stainless Steel	1'	9/31/97	10.0230	4/21/98	10.0735	9/25/98	9.9515	--	--			-0.2	0.0	74	0.1	0.0	73
Standard Bars	636+38	1 1/2"	Stainless Steel	1'	9/31/97	10.0330	4/21/98	10.0640	9/25/98	9.9040	--	--			0.0	0.7	74	-1.0	-0.5	73
Standard Bars	636+58	1 1/2"	Stainless Steel	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	9.4450	--	--			0.5	0.3	74	0.0	0.9	73
Standard Bars	636+78	1 1/2"	Stainless Steel	1'	9/31/97	10.0235	4/21/98	10.0342	9/25/98	9.8655	--	--			0.5	0.2	74	0.6	0.6	73
Standard Bars	^636+98	1 1/2"	Stainless Steel	1'							--	--						0.3	0.6	73
Standard Bars	^637+18	1 1/2"	Stainless Steel	1'							--	--						-0.8	-0.2	73
Standard Bars	^637+38	1 1/2"	Stainless Steel	1'							--	--						0.2	-0.4	73
Standard Bars	637+58	1 1/2"	Stainless Steel	1'							2"	5"						0.3	-0.9	73
Standard Bars	637+78	1 1/2"	Stainless Steel	1'							--	--						-0.6	-0.6	73
Standard Bars	637+98	1 1/2"	Stainless Steel	1'							--	--						0.2	0.5	73
Standard Bars	638+18	1 1/2"	Stainless Steel	1'							--	--						-0.6	-0.5	73
Standard Bars	638+38	1 1/2"	Stainless Steel	1'							--	--						0.0	-0.3	73
Standard Bars	638+58	1 1/2"	Stainless Steel	1'							1 1/2"	4"						-0.2	-0.5	73
Standard Bars	638+78	1 1/2"	Stainless Steel	1'							--	--						-0.2	-0.7	71
Standard Bars	638+98	1 1/2"	Stainless Steel	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	9.9645	2"	4"			0.0	-0.2	77	0.4	-1.3	71
Standard Bars	639+18	1 1/2"	Stainless Steel	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	9.7470	--	--			0.0	-0.7	77	0.8	0.0	71
Standard Bars	639+38	1 1/2"	Stainless Steel	1'	9/31/97	9.9862	4/21/98	10.0071	9/25/98	9.8320	3 1/2"	7"			0.5	0.0	77	0.4	0.6	71
Standard Bars	639+58	1 1/2"	Standard Epoxy	1'	9/31/97	10.0320	4/21/98	10.0370	9/25/98	9.9065	--	--			0.2	0.0	77	0.2	0.2	71
Standard Bars	639+78	1 1/2"	Standard Epoxy	1'	9/31/97	9.9975	4/21/98	9.9990	9/25/98	9.8100	1"	3"			0.7	0.6	77	0.3	-0.3	71
Standard Bars	^639+98	1 1/2"	Standard Epoxy	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	10.0800	--	--			0.3	0.3	74	0.8	0.2	71

Standard Bars	^640+18	1 1/2"	Standard Epoxy	1'	9/31/97	10.0005	4/21/98	10.0075	9/25/98	9.8210	--	--			0.1	-0.3	74	-0.3	0.0	71
Standard Bars	^640+38	1 1/2"	Standard Epoxy	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	9.6915	--	--			0.5	0.8	74	0.3	-0.3	71
Standard Bars	640+58	1 1/2"	Standard Epoxy	1'	9/31/97	10.0076	4/21/98	10.0069	9/25/98	9.8525	--	--			-0.3	0.0	74	0.1	0.5	71
Standard Bars	640+78	1 1/2"	Standard Epoxy	1'	9/31/97	9.9860	4/21/98	10.0145	9/25/98	9.7665	--	--			0.6	0.0	74	-0.4	-1.5	70
Standard Bars	640+96	1 1/2"	Standard Epoxy	1'							--	--						-0.4	-1.0	70
Standard Bars	641+16	1 1/2"	Standard Epoxy	1'							--	--						0.9	0.5	70
Standard Bars	641+36	1 1/2"	Standard Epoxy	1'							--	--						0.0	0.0	70
Standard Bars	*641+56	1 1/2"	Standard Epoxy	1'							--	--			0.2	0.7	74	-0.3	-0.1	70
Standard Bars	*641+66	Mid-panel test location									N/A	N/A								
Standard Bars	*641+76	1 1/2"	Standard Epoxy	1'							1 1/2"	5"			0.0	-0.1	74	0.6	-0.5	70
Standard Bars	*641+86	Mid-panel test location									N/A	N/A								
Standard Bars	*641+96	1 1/2"	Standard Epoxy	1'							--	--			-1.1	0.0	74	-0.5	-0.8	70
Standard Bars	*641+06	Mid-panel test location									N/A	N/A								
Standard Bars	642+16	1 1/2"	Standard Epoxy	1'							--	--						0.5	0.7	73
Standard Bars	642+36	1 1/2"	Standard Epoxy	1'							--	--						-0.5	-0.6	73
Standard Bars	642+56	1 1/2"	Standard Epoxy	1'							--	--						0.2	0.0	73
Standard Bars	642+76	1 1/2"	Standard Epoxy	1'							--	--						0.7	0.5	73
Standard Bars	642+96	1 1/2"	Standard Epoxy	1'							--	--						1.0	0.5	73
Standard Bars	643+15	1 1/2"	Standard Epoxy	1'							--	--						0.2	-0.2	73
Standard Bars	643+35	1 1/2"	Standard Epoxy	1'							--	--						0.2	-0.6	73
Standard Bars	643+55	1 1/2"	Standard Epoxy	1'							--	--						0.4	-0.6	73
Standard Bars	643+75	1 1/2"	Standard Epoxy	1'							--	--						0.5	0.4	73
Standard Bars	643+95	1 1/2"	Standard Epoxy	1'							--	--						0.9	0.2	73
Standard Bars	644+15	1 1/2"	Standard Epoxy	1'							--	--						0.4	-0.1	73
Standard Bars	644+35	1 1/2"	Standard Epoxy	1'							--	--						0.9	-0.1	73

Field Measurements

DATE 9/25/98 | Temperature : °C | Start Time: 7:45 a.m. | Conditions: Windy, cloudy, partly sunny. | Finished Time: 9:00 a.m.

*Indicates the Joint Station that ERES Tested with the FWD on 10/3/97

Tests were taken 4' from the edge in the driving lane and 2' from the edge in the passing lane (the wheelpath).

Used Whittemore Strain Gage Serial Number 1169 Constant 0500

All core measurements are taken from the east edge of pavement.

					9/31/97		4/21/98		9/25/98		9/31/97		9/25/1998		4/21/98			9/25/98		
Center Line	Joint	Bar	Manufacturer	Spacing	Joint Opening		Joint Opening		Joint Opening		Corner Crack		Corner Crack		Faulting, mm		Pavement	Faulting, mm		Pavement
Bar Type	Station	Diameter			Test Date		Test Date		Test Date	Amount	N	E			0.3 m (18")	0.75 m (2.5')	Temp, °C	0.3 m (18")	0.75 m (2.5')	Temp, °C
Hughes Brothers	620+03	1 7/8"	Hughes Brothers	8"							1 1/2"	3"						-0.3	0.0	79
Hughes Brothers	620+23	1 7/8"	Hughes Brothers	8"							1 1/2"	4"						0.2	-0.9	76
Hughes Brothers	620+43	1 7/8"	Hughes Brothers	8"	9/31/97	9.9799	4/21/98	9.9795	9/25/98	9.9005	--	--			-0.7	-0.5	67	0.3	-0.9	76
Hughes Brothers	620+63	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.8720	--	--			0.0	0.0	67	0.2	-0.8	76
Hughes Brothers	620+83	1 7/8"	Hughes Brothers	8"	9/31/97	9.9799	4/21/98	9.9795	9/25/98	9.9835	2"	3"			0.9	-0.1	67	0.3	-0.5	76
Hughes Brothers	621+03	1 7/8"	Hughes Brothers	8"	9/31/97	10.0560	4/21/98	10.0018	9/25/98	9.9270	1 1/2"	4"			0.8	0.2	67	-0.5	-0.4	76
Hughes Brothers	621+23	1 7/8"	Hughes Brothers	8"	9/31/97	9.9992	4/21/98	10.0004	9/25/98	9.9470	--	--			0.0	0.2	66	0.0	0.1	76
Hughes Brothers	^621+43	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1020	--	--			-0.1	-0.5	66	0.1	0.0	76
Hughes Brothers	^621+63	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.7140	--	--			0.5	-0.3	66	-0.8	-0.8	76
Hughes Brothers	^621+83	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.8380	--	--			-0.3	0.2	66	0.2	0.4	76
Hughes Brothers	622+03	1 7/8"	Hughes Brothers	8"	9/31/97	10.0627	4/21/98	10.0382	9/25/98	9.9990	1 1/2"	7"			1.0	0.6	65	0.2	1.0	76
Hughes Brothers	622+23	1 7/8"	Hughes Brothers	8"	9/31/97	9.9933	4/21/98	9.9873	9/25/98	9.9470	1 (S)	3"			0.8	0.3	65	0.0	-0.8	76
Hughes Brothers	622+43	1 7/8"	Hughes Brothers	8"							--	--						-1.0	-1.8	76
Hughes Brothers	*622+63	1 7/8"	Hughes Brothers	8"							--	--			0.3	0.3	65	-0.5	-1.3	76
Hughes Brothers	*622+73	Mid-panel test location									N/A	N/A								
Hughes Brothers	*622+83	1 7/8"	Hughes Brothers	8"							1 1/2"	3"			-0.2	-0.4	65	0.4	-0.8	76
Hughes Brothers	*622+93	Mid-panel test location									N/A	N/A								
Hughes Brothers	*623+03	1 7/8"	Hughes Brothers	8"							--				0.8	0.0	65	0.0	-1.2	76
Hughes Brothers	*623+13	Mid-panel test location									N/A	N/A								

Hughes Brothers	623+23	1 7/8"	Hughes Brothers	8"							1 1/2"(S)	3"						-0.2	-0.3	76
Standard Bars	623+43	1 7/8"	Hughes Brothers	8"							--	--						0.0	-0.3	76
Standard Bars	623+63	1 7/8"	Hughes Brothers	8"							1 1/2"	5"						-0.2	-0.3	76
Standard Bars	623+83	1 7/8"	Hughes Brothers	8"							--	--						0.1	-0.5	76
Standard Bars	624+03	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.9630	--	--			0.4	0.5	66	-0.3	-1.1	80
Standard Bars	624+23	1 7/8"	Hughes Brothers	8"	9/31/97	10.0390	4/21/98	10.0073	9/25/98	9.6600	--	--			1.4	-0.3	66	0.7	-0.5	80
Standard Bars	624+43	1 7/8"	Hughes Brothers	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.9950	--	--			-0.3	-0.2	66	-0.9	-0.7	80
Standard Bars	*624+63	1 7/8"	Hughes Brothers	12"	9/31/97	10.0060	4/21/98	10.3940	9/25/98	9.9560	--	--			0.4	0.0	66	-0.5	0.0	80
Standard Bars	*624+73	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	--	N/A	N/A								
Standard Bars	*624+83	1 7/8"	Hughes Brothers	12"	9/31/97	9.9870	4/21/98	9.9928	9/25/98	9.9275	--	--			0.2	0.2	66	0.3	-0.3	80
Standard Bars	*624+93	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	--	N/A	N/A								
Standard Bars	*625+03	1 7/8"	Hughes Brothers	12"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1320	2"	4"			-0.1	0.3	66	0.1	-0.5	80
Standard Bars	*625+13	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	--	N/A	N/A								
Standard Bars	625+23	1 7/8"	Hughes Brothers	12"	9/31/97	10.0125	4/21/98	10.0118	9/25/98	9.9820	--	--			-1.8	-0.6	67	0.5	0.0	80
Standard Bars	625+43	1 7/8"	Hughes Brothers	12"	9/31/97	9.9955	4/21/98	10.1380	9/25/98	9.9075	1 1/2"	3 1/2"			0.6	0.0	67	0.9	-0.8	80
Standard Bars	^625+63	1 7/8"	Hughes Brothers	12"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.2180	--	--			0.7	-0.1	67	-0.4	0.1	80
Standard Bars	^625+83	1 7/8"	Hughes Brothers	12"	9/31/97	10.0130	4/21/98	10.0158	9/25/98	9.9320	--	--			0.0	-0.2	67	-1.1	-0.3	80
Standard Bars	^626+03	1 7/8"	Hughes Brothers	12"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.0835	--	--			0.3	0.2	67	-0.2	0.0	80
Standard Bars	626+23	1 7/8"	Hughes Brothers	12"							--	--						0.2	-0.5	80
Standard Bars	626+43	1 7/8"	Hughes Brothers	12"							1 1/2"	3 1/2"						-0.1	0.5	80
Standard Bars	626+63	1 7/8"	Hughes Brothers	12"							1"	4"						-0.7	-0.3	80
Standard Bars	626+83	1 7/8"	Hughes Brothers	12"							--	--						-0.3	-0.4	80
Standard Bars	627+00	1 7/8"	Hughes Brothers	12"							--	--						-0.1	-0.5	79
Standard Bars	627+20	1 7/8"	Hughes Brothers	12"							--	--						-0.3	0.0	79
Standard Bars	627+40	1 7/8"	Hughes Brothers	12"							1"	4"						0.5	-0.3	79
Standard Bars	627+60	1 7/8"	Hughes Brothers	12"							--	--						-0.1	0.3	79
Standard Bars	627+80	1 7/8"	Hughes Brothers	12"							--	--						-0.3	-0.4	79
Standard Bars	628+00	1 7/8"	Hughes Brothers	12"							--	--						-0.3	-0.3	79
Standard Bars	628+20	1 7/8"	Hughes Brothers	12"							--	--						-0.7	0.5	79
Standard Bars	628+40	1 7/8"	Hughes Brothers	12"							--	--						-0.3	-1.0	79
Standard Bars	628+60	1 7/8"	Hughes Brothers	12"							1 1/2"	5"						-0.6	-0.2	79
Marshall	628+80	1 7/8"	Hughes Brothers	12"							--	--						-0.5	-0.5	79
Marshall	629+00	1 1/2"	RJD	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.2255	--	--			0.2	0.6	72	-0.5	0.6	79
Marshall	*^629+20	1 1/2"	RJD	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1175	--	--			-0.3	0.2	72	-1.2	-0.3	79

Marshall	*629+30	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	*^629+40	1 1/2"	RJD	8"	9/31/97	10.0230	4/21/98	10.0225	9/25/98	10.0090	--	--			0.0	0.3	70	-1.5	-0.9	79
Marshall	*629+50	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	*^629+60	1 1/2"	RJD	8"	9/31/97	10.0720	4/21/98	10.0698	#######	9.9995	--	--			0.9	0.2	70	0.4	0.2	79
Marshall	*629+70	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	629+80	1 1/2"	RJD	8"	9/31/97	9.9818	4/21/98	10.0184	9/25/98	9.9095	1 1/2"	5"			0.2	-0.2	70	0.0	0.5	79
Marshall	630+00	1 1/2"	RJD	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.8650	--	--			-0.5	-1.0	70	0.3	-1.3	79
Marshall	*630+20	1 1/2"	RJD	12"	9/31/97	9.9799	4/21/98	9.9796	9/25/98	9.9050	--	--			0.0	0.0	65	-0.3	-1.0	79
Marshall	*630+30	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	*630+40	1 1/2"	RJD	12"	9/31/97	10.0484	4/21/98	10.0551	9/25/98	10.0185	--	--			0.0	0.0	65	0.2	0.6	79
Marshall	*630+50	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	*^630+60	1 1/2"	RJD	12"	9/31/97	10.0087	4/21/98	9.9970	9/25/98	9.9680	2"	5"			-0.5	-0.2	65	-0.4	-0.3	79
Marshall	*630+70	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Marshall	^630+80	1 1/2"	RJD	12"	9/31/97	10.0713	4/21/98	10.0759	9/25/98	10.0320	--	--			-0.8	-0.2	65	0.0	-1.0	79
Standard Bars	^631+00	1 1/2"	RJD	12"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.0735	2"	5"			0.7	-0.2	71	0.7	-0.1	79
Standard Bars	631+20	1 1/2"	Stainless Steel	8"	9/31/97	9.9910	4/21/98	9.9932	9/25/98	9.9665	--	--			0.9	-0.4	71	-0.5	0.4	77
Standard Bars	631+40	1 1/2"	Stainless Steel	8"	9/31/97	10.0618	4/21/98	10.0478	9/25/98	10.0170	--	--			-0.1	-0.3	71	-0.3	0.2	77
Standard Bars	*631+60	1 1/2"	Stainless Steel	8"	9/31/97	10.0215	4/21/98	10.0014	9/25/98	9.9890	--	--			0.7	0.5	71	0.0	0.0	77
Standard Bars	*631+70	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Standard Bars	*631+80	1 1/2"	Stainless Steel	8"	9/31/97	10.0255	4/21/98	10.0273	9/25/98	10.0345	--	--			-0.1	-0.5	71	0.5	-0.9	77
Standard Bars	*631+90	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Standard Bars	*632+00	1 1/2"	Stainless Steel	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.7585	--	--			0.2	-0.3	71	0.2	1.0	77
Standard Bars	*632+10	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Standard Bars	632+20	1 1/2"	Stainless Steel	8"	9/31/97	10.0490	4/21/98	10.0435	9/25/98	10.0005	--	--			0.3	-0.3	71	-0.5	0.2	77
Standard Bars	^632+40	1 1/2"	Stainless Steel	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1785	--	--			0.4	-0.1	71	0.2	-1.1	77
Standard Bars	632+42					9.9790		9.9790												
Standard Bars	^632+60	1 1/2"	Stainless Steel	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	10.1005	--	--			0.7	-0.4	71	0.0	0.5	77
Standard Bars	^632+80	1 1/2"	Stainless Steel	8"	9/31/97	N/A	4/21/98	N/A	9/25/98	9.9775	--	--			0.6	0.2	71	1.1	-0.2	77
Standard Bars	633+02	1 1/2"	Stainless Steel	8"	9/31/97	10.0658	4/21/98	10.0670	9/25/98	10.0115	1"	4"	4"N; 3"S	7"E; 11"W	0.3	0.1	71	-0.2	-0.3	77
Standard Bars	633+22	1 1/2"	Stainless Steel	8"							--	--						0.1	0.0	76
Standard Bars	633+42	1 1/2"	Stainless Steel	8"							1 1/2"	2"						-0.3	-1.8	76
Standard Bars	633+62	1 1/2"	Epoxy Coated	1'							--	--						0.2	0.5	76
Standard Bars	633+82	1 1/2"	Stainless Steel	1'							--	--						-0.3	-1.3	76

Standard Bars	634+00	1 1/2"	Stainless Steel	1'							--	--						-0.3	-0.9	76
Standard Bars	634+22	1 1/2"	Stainless Steel	1'							--	--						-0.8	-0.3	75
Standard Bars	634+37	Location of Header									N/A	N/A								
Standard Bars	634+44	1 1/2"	Stainless Steel	1'							--	--						0.1	0.4	75
Standard Bars	*634+64	1 1/2"	Stainless Steel	1'							2"	3"			0.2	0.6	71	0.4	-0.4	75
Standard Bars	*634+74	Mid-panel test location									N/A	N/A								
Standard Bars	*634+84	1 1/2"	Stainless Steel	1'							--	--			-0.2	0.4	71	-0.3	-0.8	75
Standard Bars	*634+94	Mid-panel test location									N/A	N/A								
Standard Bars	*635+02	1 1/2"	Stainless Steel	1'	9/31/97	10.0310	4/21/98	10.0080	9/25/98	9.8525	--	--			0.9	1.4	71	0.5	0.1	75
Standard Bars	*635+12	Mid-panel test location			N/A	N/A	4/21/98	N/A	9/25/98	N/A	N/A	N/A								
Standard Bars	635+22	1 1/2"	Stainless Steel	1'	9/31/97	10.0474	4/21/98	10.0645	9/25/98	9.8985	--	--			0.8	1.2	71	-0.2	-0.1	75
Standard Bars	635+42	1 1/2"	Stainless Steel	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	10.0860	--	--			1.0	0.8	71	-0.8	-0.1	75
Standard Bars	635+62	1 1/2"	Stainless Steel	1'	9/31/97	10.0640	4/21/98	10.0768	9/25/98	9.9285	--	--			0.3	-1.1	74	0.3	-0.8	75
Standard Bars	635+82	1 1/2"	Stainless Steel	1'	9/31/97	9.9910	4/21/98	10.0018	9/25/98	9.8620	--	--			0.2	-0.9	74	-0.7	-0.2	73
Standard Bars	635+98	1 1/2"	Stainless Steel	1'	9/31/97	10.0435	4/21/98	10.0660	9/25/98	9.8895	--	--			0.4	0.3	74	-0.3	-1.1	73
Standard Bars	636+18	1 1/2"	Stainless Steel	1'	9/31/97	10.0230	4/21/98	10.0735	9/25/98	9.9515	--	--			-0.2	0.0	74	0.1	0.0	73
Standard Bars	636+38	1 1/2"	Stainless Steel	1'	9/31/97	10.0330	4/21/98	10.0640	9/25/98	9.9040	--	--			0.0	0.7	74	-1.0	-0.5	73
Standard Bars	636+58	1 1/2"	Stainless Steel	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	9.4450	--	--			0.5	0.3	74	0.0	0.9	73
Standard Bars	636+78	1 1/2"	Stainless Steel	1'	9/31/97	10.0235	4/21/98	10.0342	9/25/98	9.8655	--	--			0.5	0.2	74	0.6	0.6	73
Standard Bars	^636+98	1 1/2"	Stainless Steel	1'							--	--						0.3	0.6	73
Standard Bars	^637+18	1 1/2"	Stainless Steel	1'							--	--						-0.8	-0.2	73
Standard Bars	^637+38	1 1/2"	Stainless Steel	1'							--	--						0.2	-0.4	73
Standard Bars	637+58	1 1/2"	Stainless Steel	1'							2"	5"						0.3	-0.9	73
Standard Bars	637+78	1 1/2"	Stainless Steel	1'							--	--						-0.6	-0.6	73
Standard Bars	637+98	1 1/2"	Stainless Steel	1'							--	--						0.2	0.5	73
Standard Bars	638+18	1 1/2"	Stainless Steel	1'							--	--						-0.6	-0.5	73
Standard Bars	638+38	1 1/2"	Stainless Steel	1'							--	--						0.0	-0.3	73
Standard Bars	638+58	1 1/2"	Stainless Steel	1'							1 1/2"	4"						-0.2	-0.5	73
Standard Bars	638+78	1 1/2"	Stainless Steel	1'							--	--						-0.2	-0.7	71
Standard Bars	638+98	1 1/2"	Stainless Steel	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	9.9645	2"	4"			0.0	-0.2	77	0.4	-1.3	71
Standard Bars	639+18	1 1/2"	Stainless Steel	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	9.7470	--	--			0.0	-0.7	77	0.8	0.0	71
Standard Bars	639+38	1 1/2"	Stainless Steel	1'	9/31/97	9.9862	4/21/98	10.0071	9/25/98	9.8320	3 1/2"	7"			0.5	0.0	77	0.4	0.6	71
Standard Bars	639+58	1 1/2"	Standard Epoxy	1'	9/31/97	10.0320	4/21/98	10.0370	9/25/98	9.9065	--	--			0.2	0.0	77	0.2	0.2	71
Standard Bars	639+78	1 1/2"	Standard Epoxy	1'	9/31/97	9.9975	4/21/98	9.9990	9/25/98	9.8100	1"	3"			0.7	0.6	77	0.3	-0.3	71

Standard Bars	^639+98	1 1/2"	Standard Epoxy	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	10.0800	--	--			0.3	0.3	74	0.8	0.2	71
Standard Bars	^640+18	1 1/2"	Standard Epoxy	1'	9/31/97	10.0005	4/21/98	10.0075	9/25/98	9.8210	--	--			0.1	-0.3	74	-0.3	0.0	71
Standard Bars	^640+38	1 1/2"	Standard Epoxy	1'	9/31/97	N/A	4/21/98	N/A	9/25/98	9.6915	--	--			0.5	0.8	74	0.3	-0.3	71
Standard Bars	640+58	1 1/2"	Standard Epoxy	1'	9/31/97	10.0076	4/21/98	10.0069	9/25/98	9.8525	--	--			-0.3	0.0	74	0.1	0.5	71
Standard Bars	640+78	1 1/2"	Standard Epoxy	1'	9/31/97	9.9860	4/21/98	10.0145	9/25/98	9.7665	--	--			0.6	0.0	74	-0.4	-1.5	70
Standard Bars	640+96	1 1/2"	Standard Epoxy	1'							--	--						-0.4	-1.0	70
Standard Bars	641+16	1 1/2"	Standard Epoxy	1'							--	--						0.9	0.5	70
Standard Bars	641+36	1 1/2"	Standard Epoxy	1'							--	--						0.0	0.0	70
Standard Bars	*641+56	1 1/2"	Standard Epoxy	1'							--	--			0.2	0.7	74	-0.3	-0.1	70
Standard Bars	*641+66	Mid-panel test location									N/A	N/A								
Standard Bars	*641+76	1 1/2"	Standard Epoxy	1'							1 1/2"	5"			0.0	-0.1	74	0.6	-0.5	70
Standard Bars	*641+86	Mid-panel test location									N/A	N/A								
Standard Bars	*641+96	1 1/2"	Standard Epoxy	1'							--	--			-1.1	0.0	74	-0.5	-0.8	70
Standard Bars	*641+06	Mid-panel test location									N/A	N/A								
Standard Bars	642+16	1 1/2"	Standard Epoxy	1'							--	--						0.5	0.7	73
Standard Bars	642+36	1 1/2"	Standard Epoxy	1'							--	--						-0.5	-0.6	73
Standard Bars	642+56	1 1/2"	Standard Epoxy	1'							--	--						0.2	0.0	73
Standard Bars	642+76	1 1/2"	Standard Epoxy	1'							--	--						0.7	0.5	73
Standard Bars	642+96	1 1/2"	Standard Epoxy	1'							--	--						1.0	0.5	73
Standard Bars	643+15	1 1/2"	Standard Epoxy	1'							--	--						0.2	-0.2	73
Standard Bars	643+35	1 1/2"	Standard Epoxy	1'							--	--						0.2	-0.6	73
Standard Bars	643+55	1 1/2"	Standard Epoxy	1'							--	--						0.4	-0.6	73
Standard Bars	643+75	1 1/2"	Standard Epoxy	1'							--	--						0.5	0.4	73
Standard Bars	643+95	1 1/2"	Standard Epoxy	1'							--	--						0.9	0.2	73
Standard Bars	644+15	1 1/2"	Standard Epoxy	1'							--	--						0.4	-0.1	73
Standard Bars	644+35	1 1/2"	Standard Epoxy	1'							--	--						0.9	-0.1	73

Field Measurements

DATE 4/27/99 | Temperature: °C | Start Time: 7:45 a.m. | Conditions: Windy, cloudy, partly sunny. | Finished Time: 9:00 a.m.

*Indicates the Joint Station that ERES Tested with the FWD on 10/3/97

Tests were taken 4' from the edge in the driving lane and 2' from the edge in the passing lane (the wheelpath).

Used Whittemore Strain Gage Serial Number 1169 Constant 0500

All core measurements are taken from the east edge of pavement.

Center Line	Joint	Bar	Manufacturer	Spacing	9/31/97 Joint Opening		4/21/98 Joint Opening		9/25/98 Joint Opening		4/27/1999 Joint Opening		9/31/97 Corner Crack		9/25/99 Corner Crack		4/27/1999 Corner Crack		4/21/98 Faulting, mm		Pavement	9/25/98 Faulting, mm		Pavement	4/27/99 Faulting, mm		Pavement
Bar Type	Station	Diameter			Test Date		Test Date		Test Date	Amount	Test Date	Amount	N	E	N	E	N	E	0.3 m (18")	0.75 m (2.5')	Temp, °F	0.3 m (18")	0.75 m (2.5')	Temp, °F	0.3 m (18")	0.75 m (2.5')	Temp, °F
Hughes Brothers	620+03	1 7/8"	Hughes Brothers	8"									1 1/2"	3"								-0.3	0.0	79	-0.5	-0.1	47
Hughes Brothers	620+23	1 7/8"	Hughes Brothers	8"									1 1/2"	4"								0.2	-0.9	76	0.4	-0.3	
Hughes Brothers	620+43	1 7/8"	Hughes Brothers	8"	10/3/1997	9.9799	4/21/1998	9.9795	9/25/98	9.9005	4/27/1999	9.9130	--	--					-0.7	-0.5	67	0.3	-0.9	76	0.1	-0.5	
Hughes Brothers	620+63	1 7/8"	Hughes Brothers	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.8720	4/27/1999	9.8525	--	--					0.0	0.0	67	0.2	-0.8	76	0	0.4	
Hughes Brothers	620+83	1 7/8"	Hughes Brothers	8"	10/3/1997	9.9799	4/21/1998	9.9795	9/25/98	9.9835	4/27/1999	9.9180	2"	3"					0.9	-0.1	67	0.3	-0.5	76	0	-1.4	
Hughes Brothers	621+03	1 7/8"	Hughes Brothers	8"	10/3/1997	10.0560	4/21/1998	10.0018	9/25/98	9.9270	4/27/1999	9.9780	1 1/2"	4"					0.8	0.2	67	-0.5	-0.4	76	-0.3	-0.2	
Hughes Brothers	621+23	1 7/8"	Hughes Brothers	8"	10/3/1997	9.9992	4/21/1998	10.0004	9/25/98	9.9470	4/27/1999	9.9500	--	--					0.0	0.2	66	0.0	0.1	76	-0.3	0.1	
Hughes Brothers	^621+43	1 7/8"	Hughes Brothers	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.1020	4/27/1999	-	--	--					-0.1	-0.5	66	0.1	0.0	76	0.2	-0.6	
Hughes Brothers	^621+63	1 7/8"	Hughes Brothers	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.7140	4/27/1999	-	--	--					0.5	-0.3	66	-0.8	-0.8	76	-0.4	0.1	
Hughes Brothers	^621+83	1 7/8"	Hughes Brothers	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.8380	4/27/1999	9.8935	--	--					-0.3	0.2	66	0.2	0.4	76	0.4	0.5	
Hughes Brothers	622+03	1 7/8"	Hughes Brothers	8"	10/3/1997	10.0627	4/21/1998	10.0382	9/25/98	9.9990	4/27/1999	-	1 1/2"	7"					1.0	0.6	65	0.2	1.0	76	0	0.5	
Hughes Brothers	622+23	1 7/8"	Hughes Brothers	8"	10/3/1997	9.9933	4/21/1998	9.9873	9/25/98	9.9470	4/27/1999	9.8870	1 (S)	3"					0.8	0.3	65	0.0	-0.8	76	0.1	-0.4	
Hughes Brothers	622+43	1 7/8"	Hughes Brothers	8"									--	--								-1.0	-1.8	76	-1.2	-1.5	
Hughes Brothers	*622+63	1 7/8"	Hughes Brothers	8"									--	--					0.3	0.3	65	-0.5	-1.3	76	0.1	-0.9	
Hughes Brothers	*622+73	Mid-panel test location											N/A	N/A													

Hughes Brothers	*622+83	1 7/8"	Hughes Brothers	8"									1 1/2"	3"					-0.2	-0.4	65	0.4	-0.8	76	0.1	0	
Hughes Brothers	*622+93	Mid-panel test location											N/A	N/A													
Hughes Brothers	*623+03	1 7/8"	Hughes Brothers	8"									--						0.8	0.0	65	0.0	-1.2	76	0.4	-0.6	
Hughes Brothers	*623+13	Mid-panel test location											N/A	N/A													
Hughes Brothers	623+23	1 7/8"	Hughes Brothers	8"									1 1/2"(S)	3"								-0.2	-0.3	76	0.1	-0.4	
Standard Bars	623+43	1 7/8"	Hughes Brothers	8"									--	--								0.0	-0.3	76	-1	-0.3	
Standard Bars	623+63	1 7/8"	Hughes Brothers	8"									1 1/2"	5"								-0.2	-0.3	76	-0.3	-0.4	
Standard Bars	623+83	1 7/8"	Hughes Brothers	8"									--	--								0.1	-0.5	76	0.2	-0.6	
Standard Bars	624+03	1 7/8"	Hughes Brothers	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.9630	4/27/1999	10.0190	--	--					0.4	0.5	66	-0.3	-1.1	80	0.1	-0.9	
Standard Bars	624+23	1 7/8"	Hughes Brothers	8"	10/3/1997	10.0390	4/21/1998	10.0073	9/25/98	9.6600	4/27/1999	-	--	--					1.4	-0.3	66	0.7	-0.5	80	0.2	0.3	
Standard Bars	624+43	1 7/8"	Hughes Brothers	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.9950	4/27/1999	10.1005	--	--					-0.3	-0.2	66	-0.9	-0.7	80	0	-1.1	
Standard Bars	*624+63	1 7/8"	Hughes Brothers	12"	10/3/1997	10.0060	4/21/1998	10.3940	9/25/98	9.9560	4/27/1999	9.9735	--	--					0.4	0.0	66	-0.5	0.0	80	-0.3	-0.2	
Standard Bars	*624+73	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	--	4/27/1999	-	N/A	N/A													
Standard Bars	*624+83	1 7/8"	Hughes Brothers	12"	10/3/1997	9.9870	4/21/1998	9.9928	9/25/98	9.9275	4/27/1999	-	--	--					0.2	0.2	66	0.3	-0.3	80	-0.8	-0.7	
Standard Bars	*624+93	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	--	4/27/1999	-	N/A	N/A													
Standard Bars	*625+03	1 7/8"	Hughes Brothers	12"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.1320	4/27/1999	-	2"	4"					-0.1	0.3	66	0.1	-0.5	80	0.2	-1.5	
Standard Bars	*625+13	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	--	4/27/1999	-	N/A	N/A													
Standard Bars	625+23	1 7/8"	Hughes Brothers	12"	10/3/1997	10.0125	4/21/1998	10.0118	9/25/98	9.9820	4/27/1999	9.9330	--	--					-1.8	-0.6	67	0.5	0.0	80	-0.4	0.0	
Standard Bars	625+43	1 7/8"	Hughes Brothers	12"	10/3/1997	9.9955	4/21/1998	10.1380	9/25/98	9.9075	4/27/1999	-	1 1/2"	3 1/2"					0.6	0.0	67	0.9	-0.8	80	-0.3	-1.0	
Standard Bars	^625+63	1 7/8"	Hughes Brothers	12"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.2180	4/27/1999	-	--	--					0.7	-0.1	67	-0.4	0.1	80	0.0	-0.8	
Standard Bars	^625+83	1 7/8"	Hughes Brothers	12"	10/3/1997	10.0130	4/21/1998	10.0158	9/25/98	9.9320	4/27/1999	-	--	--					0.0	-0.2	67	-1.1	-0.3	80	-0.7	-0.2	
Standard Bars	^626+03	1 7/8"	Hughes Brothers	12"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.0835	4/27/1999	10.0840	--	--					0.3	0.2	67	-0.2	0.0	80	0.0	-1.0	
Standard Bars	626+23	1 7/8"	Hughes Brothers	12"									--	--								0.2	-0.5	80	0.0	-0.4	
Standard Bars	626+43	1 7/8"	Hughes Brothers	12"									1 1/2"	3 1/2"								-0.1	0.5	80	-0.4	0.0	
Standard Bars	626+63	1 7/8"	Hughes Brothers	12"									1"	4"								-0.7	-0.3	80	-0.6	-0.8	
Standard Bars	626+83	1 7/8"	Hughes Brothers	12"									--	--								-0.3	-0.4	80	-0.3	-0.7	
Standard Bars	627+00	1 7/8"	Hughes Brothers	12"									--	--								-0.1	-0.5	79	0.2	0.0	
Standard Bars	627+20	1 7/8"	Hughes Brothers	12"									--	--								-0.3	0.0	79	0.1	-0.5	
Standard Bars	627+40	1 7/8"	Hughes Brothers	12"									1"	4"								0.5	-0.3	79	-0.3	0.0	

Standard Bars	627+60	1 7/8"	Hughes Brothers	12"										--	--								-0.1	0.3	79	-0.1	-1.7	
Standard Bars	627+80	1 7/8"	Hughes Brothers	12"										--	--								-0.3	-0.4	79	-0.3	-0.3	
Standard Bars	628+00	1 7/8"	Hughes Brothers	12"										--	--								-0.3	-0.3	79	-0.8	-0.5	
Standard Bars	628+20	1 7/8"	Hughes Brothers	12"										--	--								-0.7	0.5	79	-0.1	0.4	41
Standard Bars	628+40	1 7/8"	Hughes Brothers	12"										--	--								-0.3	-1.0	79	-0.3	-0.3	
Standard Bars	628+60	1 7/8"	Hughes Brothers	12"										1 1/2"	5"								-0.6	-0.2	79	-0.3	0.7	
Marshall	628+80	1 7/8"	Hughes Brothers	12"										--	--								-0.5	-0.5	79	-0.2	-0.9	
Marshall	629+00	1 1/2"	RJD	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.2255	4/27/1999	-	--	--					0.2	0.6	72	-0.5	0.6	79	0.2	0.5	
Marshall	*^629+20	1 1/2"	RJD	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.1175	4/27/1999	-	--	--					-0.3	0.2	72	-1.2	-0.3	79	-0.1	-0.3	
Marshall	*629+30	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	4/27/1999	-	N/A	N/A													
Marshall	*^629+40	1 1/2"	RJD	8"	10/3/1997	10.0230	4/21/1998	10.0225	9/25/98	10.0090	4/27/1999	10.0335	--	--					0.0	0.3	70	-1.5	-0.9	79	0.0	-1.1	
Marshall	*629+50	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	4/27/1999	-	N/A	N/A													
Marshall	*^629+60	1 1/2"	RJD	8"	10/3/1997	10.0720	4/21/1998	10.0698	9/25/98	9.9995	4/27/1999	10.0530	--	--					0.9	0.2	70	0.4	0.2	79	0.0	0.6	
Marshall	*629+70	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	4/27/1999	-	N/A	N/A													
Marshall	629+80	1 1/2"	RJD	8"	10/3/1997	9.9818	4/21/1998	10.0184	9/25/98	9.9095	4/27/1999	9.9915	1 1/2"	5"					0.2	-0.2	70	0.0	0.5	79	0.3	0.5	
Marshall	630+00	1 1/2"	RJD	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.8650	4/27/1999	9.8725	--	--					-0.5	-1.0	70	0.3	-1.3	79	0.2	-1.6	
Marshall	*630+20	1 1/2"	RJD	12"	10/3/1997	9.9799	4/21/1998	9.9796	9/25/98	9.9050	4/27/1999	9.9090	--	--					0.0	0.0	65	-0.3	-1.0	79	-0.3	0.0	
Marshall	*630+30	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	4/27/1999	-	N/A	N/A													
Marshall	*630+40	1 1/2"	RJD	12"	10/3/1997	10.0484	4/21/1998	10.0551	9/25/98	10.0185	4/27/1999	-	--	--					0.0	0.0	65	0.2	0.6	79	0.3	-0.3	
Marshall	*630+50	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	4/27/1999	-	N/A	N/A													
Marshall	*^630+60	1 1/2"	RJD	12"	10/3/1997	10.0087	4/21/1998	9.9970	9/25/98	9.9680	4/27/1999	9.9335	2"	5"					-0.5	-0.2	65	-0.4	-0.3	79	0.0	-0.6	
Marshall	*630+70	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	4/27/1999	-	N/A	N/A													
Marshall	^630+80	1 1/2"	RJD	12"	10/3/1997	10.0713	4/21/1998	10.0759	9/25/98	10.0320	4/27/1999	10.0240	--	--					-0.8	-0.2	65	0.0	-1.0	79	-0.3	-1.0	
Standard Bars	^631+00	1 1/2"	RJD	12"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.0735	4/27/1999	-	2"	5"					0.7	-0.2	71	0.7	-0.1	79	0.4	-1.3	
Standard Bars	631+20	1 1/2"	Stainless Steel	8"	10/3/1997	9.9910	4/21/1998	9.9932	9/25/98	9.9665	4/27/1999	9.9375	--	--					0.9	-0.4	71	-0.5	0.4	77	0.2	0.6	
Standard Bars	631+40	1 1/2"	Stainless Steel	8"	10/3/1997	10.0618	4/21/1998	10.0478	9/25/98	10.0170	4/27/1999	10.0275	--	--					-0.1	-0.3	71	-0.3	0.2	77	0.0	0.2	
Standard Bars	*631+60	1 1/2"	Stainless Steel	8"	10/3/1997	10.0215	4/21/1998	10.0014	9/25/98	9.9890	4/27/1999	-	--	--					0.7	0.5	71	0.0	0.0	77	-0.2	-0.3	
Standard Bars	*631+70	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	4/27/1999	-	N/A	N/A													
Standard Bars	*631+80	1 1/2"	Stainless	8"	10/3/1997	10.025	4/21/1998	10.0	9/25/98	10.0345	4/27/1999	9.72	--	--					-0.1	-0.5	71	0.5	-0.9	77	0.8	-1.2	

			Steel			5		273				75															
Standard Bars	*631+90	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	4/27/1999	-	N/A	N/A													
Standard Bars	*632+00	1 1/2"	Stainless Steel	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.7585	4/27/1999	-	--	--					0.2	-0.3	71	0.2	1.0	77	0.2	0.7	
Standard Bars	*632+10	Mid-panel test location			N/A	N/A	N/A	N/A	N/A	N/A	4/27/1999	-	N/A	N/A													
Standard Bars	632+20	1 1/2"	Stainless Steel	8"	10/3/1997	10.0490	4/21/1998	10.0435	9/25/98	10.0005	4/27/1999	-	--	--					0.3	-0.3	71	-0.5	0.2	77	-0.5	0.0	
Standard Bars	^632+40	1 1/2"	Stainless Steel	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.1785	4/27/1999	10.1385	--	--					0.4	-0.1	71	0.2	-1.1	77	-0.6	-1.2	
Standard Bars	632+42					9.9790		9.9790				-															
Standard Bars	^632+60	1 1/2"	Stainless Steel	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.1005	4/27/1999	-	--	--					0.7	-0.4	71	0.0	0.5	77	0.0	0.7	
Standard Bars	^632+80	1 1/2"	Stainless Steel	8"	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.9775	4/27/1999	-	--	--					0.6	0.2	71	1.1	-0.2	77	0.5	0.1	
Standard Bars	633+02	1 1/2"	Stainless Steel	8"	10/3/1997	10.0658	4/21/1998	10.0670	9/25/98	10.0115	4/27/1999	10.0405	1"	4"	4"N; 3"S	7"E; 11"W			0.3	0.1	71	-0.2	-0.3	77	-0.5	0.1	
Standard Bars	633+22	1 1/2"	Stainless Steel	8"								-	--	--				EW				0.1	0.0	76	-0.4	-0.1	
Standard Bars	633+42	1 1/2"	Stainless Steel	8"								-	1 1/2"	2"			4	448				-0.3	-1.8	76	0.0	-1.5	
Standard Bars	633+62	1 1/2"	Epoxy Coated	1'								-	--	--								0.2	0.5	76	0.2	0.0	
Standard Bars	633+82	1 1/2"	Stainless Steel	1'								-	--	--								-0.3	-1.3	76	0.5	-0.9	
Standard Bars	634+00	1 1/2"	Stainless Steel	1'								-	--	--								-0.3	-0.9	76	0.2	-0.7	
Standard Bars	634+22	1 1/2"	Stainless Steel	1'								-	--	--								-0.8	-0.3	75	0.5	-0.5	
Standard Bars	634+37	Location of Header										-	N/A	N/A													
Standard Bars	634+44	1 1/2"	Stainless Steel	1'								-	--	--								0.1	0.4	75	0.0	0.5	
Standard Bars	*634+64	1 1/2"	Stainless Steel	1'								-	2"	3"					0.2	0.6	71	0.4	-0.4	75	0.7	-0.6	
Standard Bars	*634+74	Mid-panel test location										-	N/A	N/A													
Standard Bars	*634+84	1 1/2"	Stainless Steel	1'								-	--	--					-0.2	0.4	71	-0.3	-0.8	75	-0.4	-0.8	
Standard Bars	*634+94	Mid-panel test location										-	N/A	N/A													
Standard Bars	*635+02	1 1/2"	Stainless Steel	1'	10/3/1997	10.0310	4/21/1998	10.0080	9/25/98	9.8525	4/27/1999	-	--	--					0.9	1.4	71	0.5	0.1	75	0.7	-0.4	
Standard Bars	*635+12	Mid-panel test location			N/A	N/A	4/21/1998	N/A	9/25/98	N/A	4/27/1999	-	N/A	N/A													
Standard Bars	635+22	1 1/2"	Stainless Steel	1'	10/3/1997	10.0474	4/21/1998	10.0645	9/25/98	9.8985	4/27/1999	10.2055	--	--					0.8	1.2	71	-0.2	-0.1	75	-0.3	-0.7	
Standard Bars	635+42	1 1/2"	Stainless Steel	1'	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.0860	4/27/1999	10.0600	--	--					1.0	0.8	71	-0.8	-0.1	75	0.3	0.2	
Standard Bars	635+62	1 1/2"	Stainless Steel	1'	10/3/1997	10.0640	4/21/1998	10.0768	9/25/98	9.9285	4/27/1999	9.9225	--	--					0.3	-1.1	74	0.3	-0.8	75	-0.4	-0.7	
Standard Bars	635+82	1 1/2"	Stainless Steel	1'	10/3/1997	9.9910	4/21/1998	10.0018	9/25/98	9.8620	4/27/1999	-	--	--					0.2	-0.9	74	-0.7	-0.2	73	-0.3	-0.3	
Standard Bars	635+98	1 1/2"	Stainless Steel	1'	10/3/1997	10.0435	4/21/1998	10.0660	9/25/98	9.8895	4/27/1999	10.0630	--	--					0.4	0.3	74	-0.3	-1.1	73	0.2	-1.5	47

Standard Bars	636+18	1 1/2"	Stainless Steel	1'	10/3/1997	10.0230	4/21/1998	10.0735	9/25/98	9.9515	4/27/1999	10.0370	--	--					-0.2	0.0	74	0.1	0.0	73	0.2	-0.5	
Standard Bars	636+38	1 1/2"	Stainless Steel	1'	10/3/1997	10.0330	4/21/1998	10.0640	9/25/98	9.9040	4/27/1999	10.0140	--	--					0.0	0.7	74	-1.0	-0.5	73	-1.0	-1.0	
Standard Bars	636+58	1 1/2"	Stainless Steel	1'	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.4450	4/27/1999	10.0920	--	--					0.5	0.3	74	0.0	0.9	73	-0.3	0.9	
Standard Bars	636+78	1 1/2"	Stainless Steel	1'	10/3/1997	10.0235	4/21/1998	10.0342	9/25/98	9.8655	4/27/1999	9.9825	--	--					0.5	0.2	74	0.6	0.6	73	0.5	0.6	
Standard Bars	^636+98	1 1/2"	Stainless Steel	1'								-	--	--								0.3	0.6	73	-0.3	0.1	
Standard Bars	^637+18	1 1/2"	Stainless Steel	1'								-	--	--								-0.8	-0.2	73	-0.6	-0.4	
Standard Bars	^637+38	1 1/2"	Stainless Steel	1'								-	--	--								0.2	-0.4	73	0.2	-0.3	
Standard Bars	637+58	1 1/2"	Stainless Steel	1'								-	2"	5"								0.3	-0.9	73	0.2	-1.0	
Standard Bars	637+78	1 1/2"	Stainless Steel	1'								-	--	--								-0.6	-0.6	73	-0.1	-0.3	
Standard Bars	637+98	1 1/2"	Stainless Steel	1'								-	--	--								0.2	0.5	73	0.3	-0.5	
Standard Bars	638+18	1 1/2"	Stainless Steel	1'								-	--	--								-0.6	-0.5	73	-0.3	-0.1	
Standard Bars	638+38	1 1/2"	Stainless Steel	1'								-	--	--								0.0	-0.3	73	-0.2	-0.3	
Standard Bars	638+58	1 1/2"	Stainless Steel	1'								-	1 1/2"	4"								-0.2	-0.5	73	-0.5	0.0	
Standard Bars	638+78	1 1/2"	Stainless Steel	1'								-	--	--								-0.2	-0.7	71	-0.3	-0.5	
Standard Bars	638+98	1 1/2"	Stainless Steel	1'	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.9645	4/27/1999	10.1015	2"	4"					0.0	-0.2	77	0.4	-1.3	71	0.1	-0.1	
Standard Bars	639+18	1 1/2"	Stainless Steel	1'	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.7470	4/27/1999	9.9195	--	--					0.0	-0.7	77	0.8	0.0	71	0.5	0.0	
Standard Bars	639+38	1 1/2"	Stainless Steel	1'	10/3/1997	9.9862	4/21/1998	10.0071	9/25/98	9.8320	4/27/1999	-	3 1/2"	7"					0.5	0.0	77	0.4	0.6	71	0.0	-0.7	
Standard Bars	639+58	1 1/2"	Standard Epoxy	1'	10/3/1997	10.0320	4/21/1998	10.0370	9/25/98	9.9065	4/27/1999	10.0205	--	--					0.2	0.0	77	0.2	0.2	71	-0.1	-0.1	
Standard Bars	639+78	1 1/2"	Standard Epoxy	1'	10/3/1997	9.9975	4/21/1998	9.9990	9/25/98	9.8100	4/27/1999	9.9220	1"	3"					0.7	0.6	77	0.3	-0.3	71	0.6	-0.4	
Standard Bars	^639+98	1 1/2"	Standard Epoxy	1'	10/3/1997	N/A	4/21/1998	N/A	9/25/98	10.0800	4/27/1999	-	--	--					0.3	0.3	74	0.8	0.2	71	0.2	0.3	
Standard Bars	^640+18	1 1/2"	Standard Epoxy	1'	10/3/1997	10.0005	4/21/1998	10.0075	9/25/98	9.8210	4/27/1999	9.9310	--	--					0.1	-0.3	74	-0.3	0.0	71	0.2	-0.2	
Standard Bars	^640+38	1 1/2"	Standard Epoxy	1'	10/3/1997	N/A	4/21/1998	N/A	9/25/98	9.6915	4/27/1999	9.8120	--	--					0.5	0.8	74	0.3	-0.3	71	0.0	0.7	
Standard Bars	640+58	1 1/2"	Standard Epoxy	1'	10/3/1997	10.0076	4/21/1998	10.0069	9/25/98	9.8525	4/27/1999	9.9650	--	--					-0.3	0.0	74	0.1	0.5	71	0.2	0.1	
Standard Bars	640+78	1 1/2"	Standard Epoxy	1'	10/3/1997	9.9860	4/21/1998	10.0145	9/25/98	9.7665	4/27/1999	9.8690	--	--					0.6	0.0	74	-0.4	-1.5	70	-0.8	-1.0	
Standard Bars	640+96	1 1/2"	Standard Epoxy	1'									--	--								-0.4	-1.0	70	0.3	-0.7	
Standard Bars	641+16	1 1/2"	Standard Epoxy	1'									--	--								0.9	0.5	70	0.5	0.2	
Standard Bars	641+36	1 1/2"	Standard Epoxy	1'									--	--								0.0	0.0	70	0.0	-0.5	
Standard Bars	*641+56	1 1/2"	Standard Epoxy	1'									--	--			36	12	0.2	0.7	74	-0.3	-0.1	70	0.1	-0.3	
Standard Bars	*641+66	Mid-panel test location											N/A	N/A													
Standard Bars	*641+76	1 1/2"	Standard Epoxy	1'									1 1/2"	5"					0.0	-0.1	74	0.6	-0.5	70	-0.2	0.0	
Standard Bars	*641+86	Mid-panel test location											N/A	N/A													

Standard Bars	*641+96	1 1/2"	Standard Epoxy	1'									--	--					-1.1	0.0	74	-0.5	-0.8	70	0.0	-0.9	
Standard Bars	*641+06	Mid-panel test location ?								?	?		N/A	N/A													
Standard Bars	642+16	1 1/2"	Standard Epoxy	1'									--	--								0.5	0.7	73	0.9	1.0	
Standard Bars	642+36	1 1/2"	Standard Epoxy	1'									--	--								-0.5	-0.6	73	-0.3	-0.3	
Standard Bars	642+56	1 1/2"	Standard Epoxy	1'									--	--								0.2	0.0	73	0.8	0.7	
Standard Bars	642+76	1 1/2"	Standard Epoxy	1'									--	--								0.7	0.5	73	1.0	0.4	
Standard Bars	642+96	1 1/2"	Standard Epoxy	1'									--	--								1.0	0.5	73	0.3	0.4	
Standard Bars	643+15	1 1/2"	Standard Epoxy	1'									--	--								0.2	-0.2	73	-0.3	0.3	
Standard Bars	643+35	1 1/2"	Standard Epoxy	1'									--	--								0.2	-0.6	73	0.1	0.0	
Standard Bars	643+55	1 1/2"	Standard Epoxy	1'									--	--								0.4	-0.6	73	-0.1	-0.3	
Standard Bars	643+75	1 1/2"	Standard Epoxy	1'									--	--			3	2				0.5	0.4	73	1.4	0.7	
Standard Bars	643+95	1 1/2"	Standard Epoxy	1'									--	--								0.9	0.2	73	0.5	0.5	
Standard Bars	644+15	1 1/2"	Standard Epoxy	1'									--	--								0.4	-0.1	73	0.1	0.2	
Standard Bars	644+35	1 1/2"	Standard Epoxy	1'									--	--								0.9	-0.1	73	0.5	-0.6	

Appendix C

Graphs

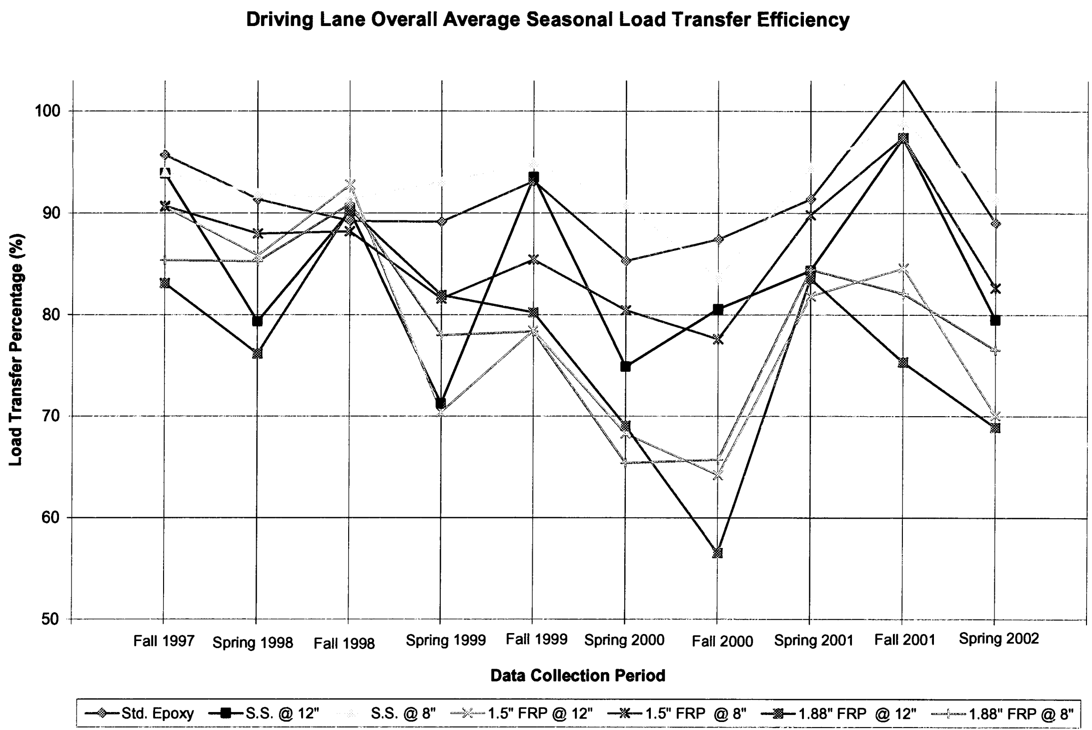

Figure C.1. Driving Lane Overall Average Seasonal Load Transfer Efficiency

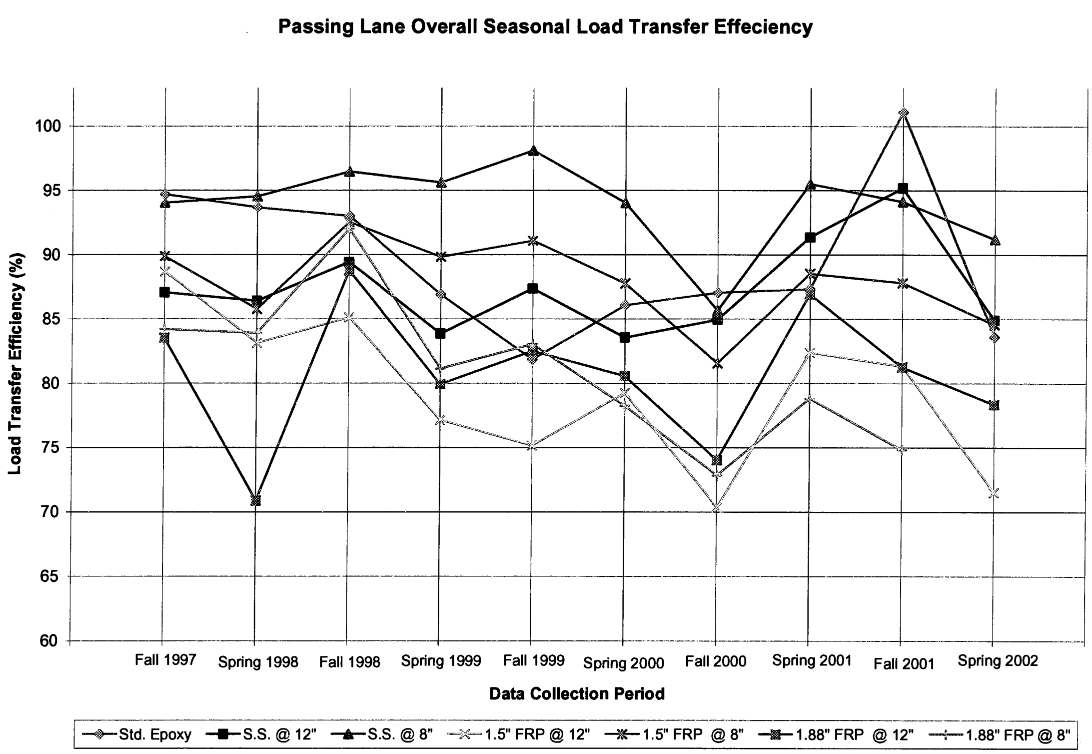

Figure C.2. Passing Lane Overall Seasonal Load Transfer Efficiency

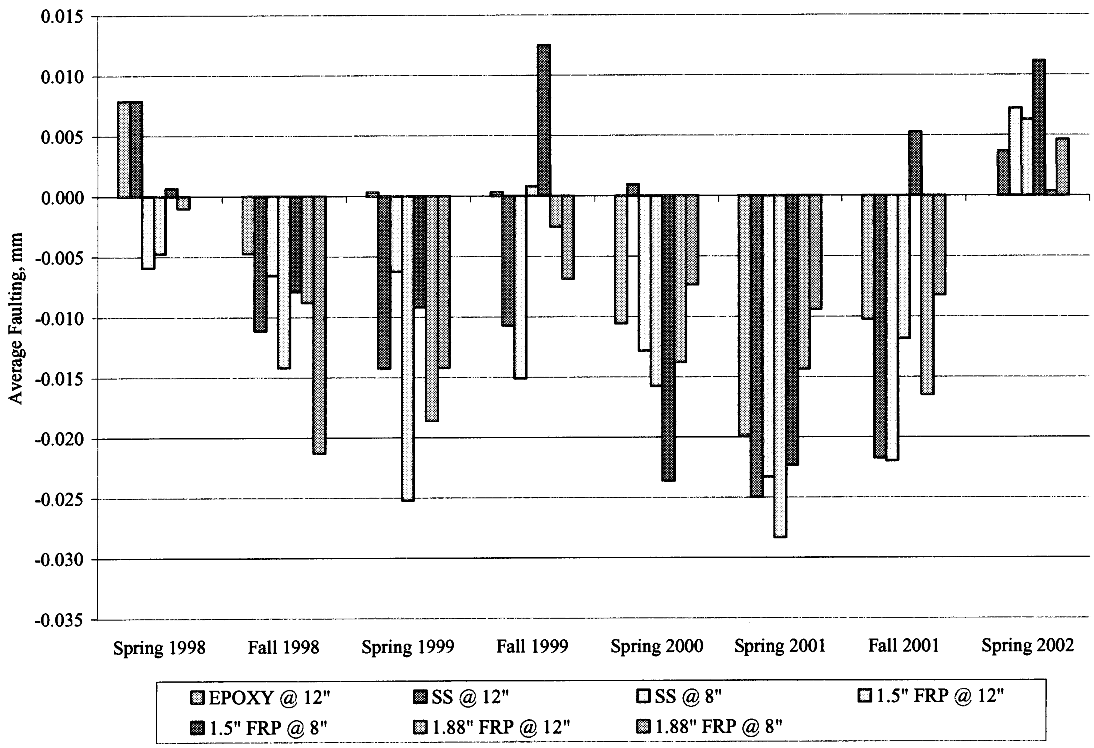

Figure C.3. Average Faulting ~ Inside Wheel Path

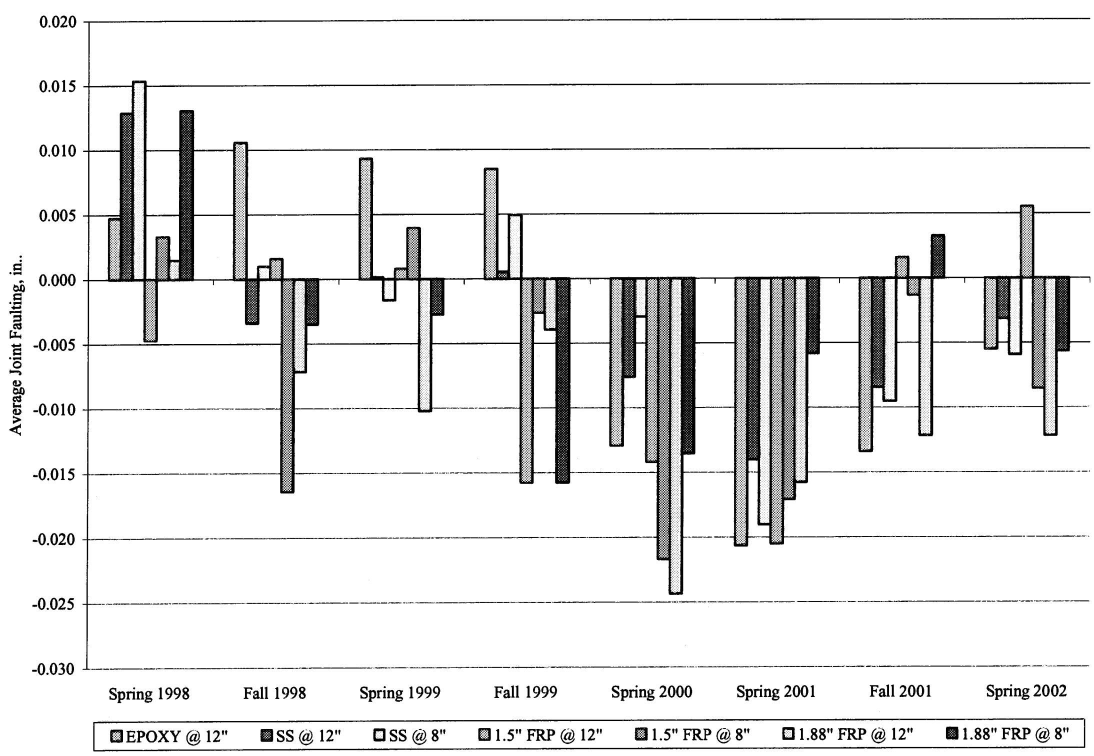

Figure C.4. Average Faulting ~ Outside Wheel Path

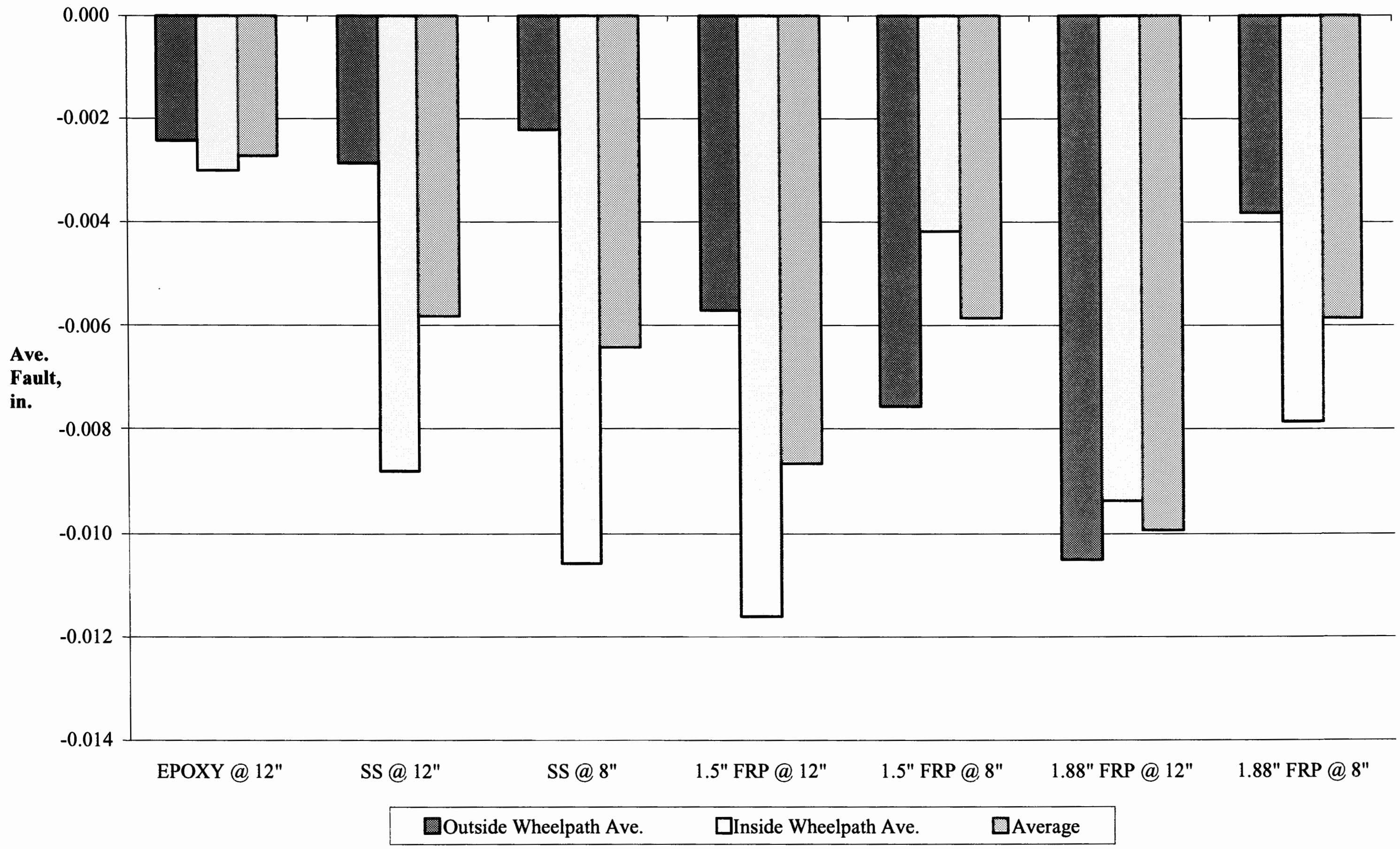

Figure C.5. Average Faulting Over Research Period

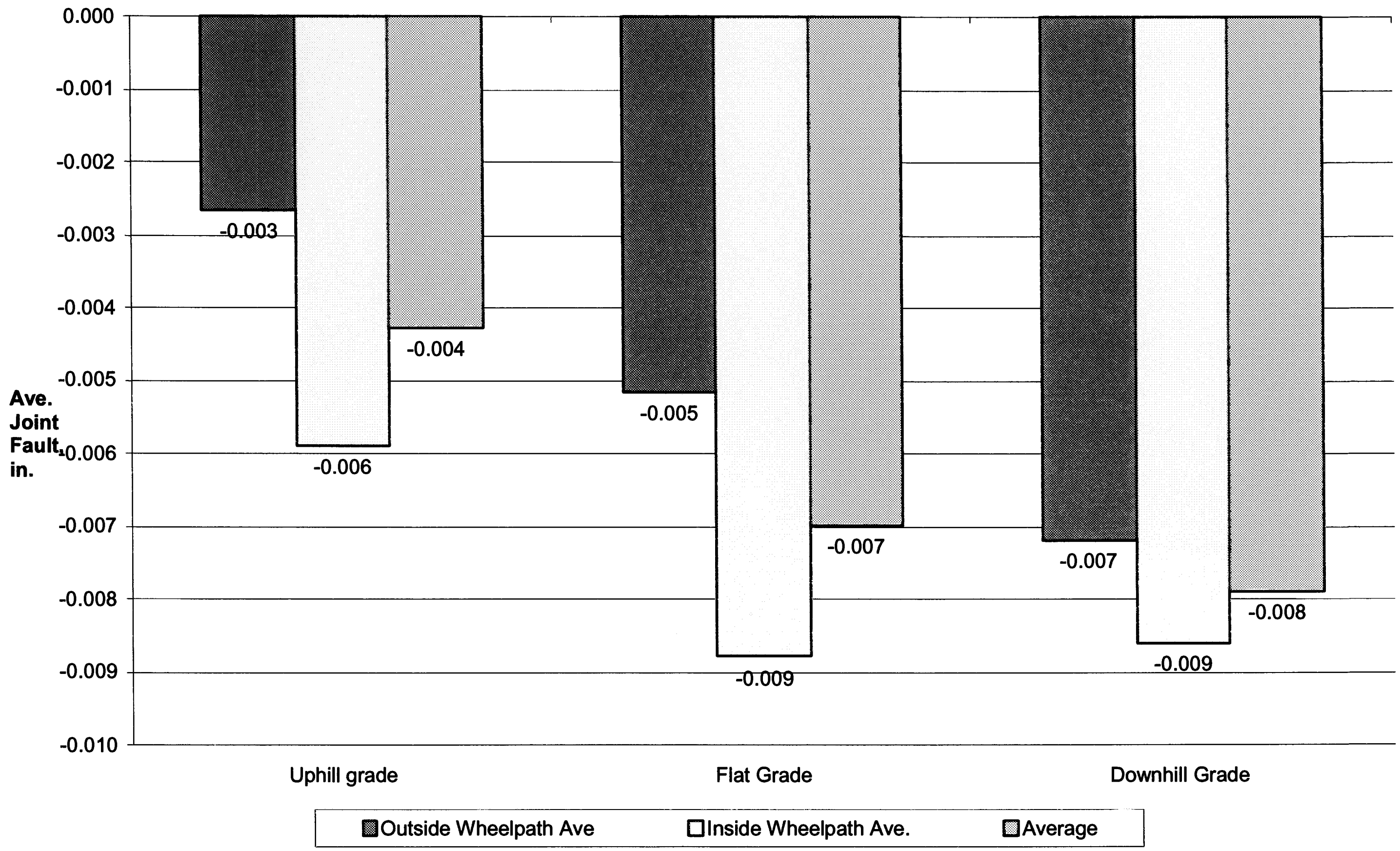

Figure C.6. Grade Effect on Faulting

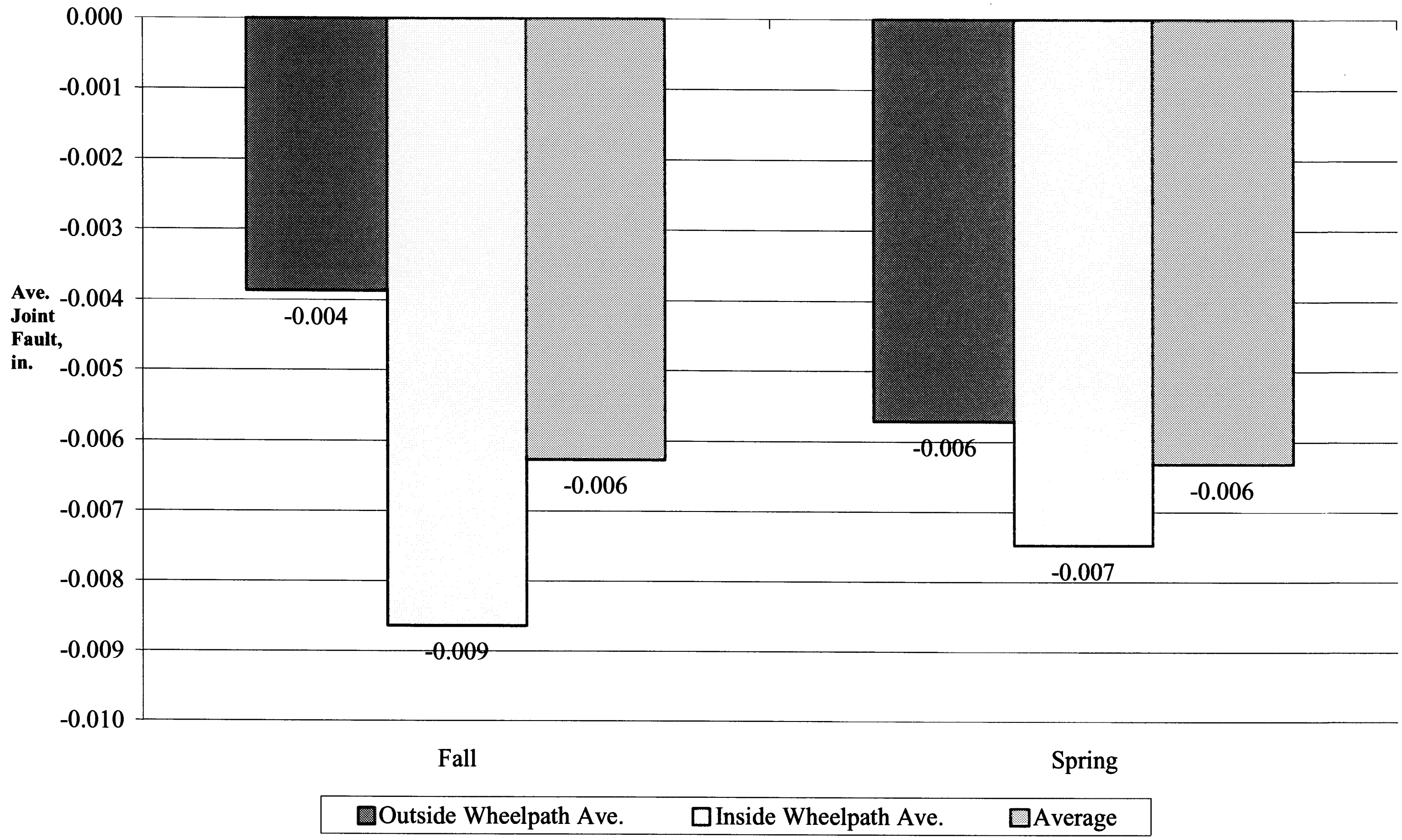

Figure C.7. Seasonal Effect on Faulting

Appendix D

Concrete Core Length Measurements and Samples

Table D.1. Concrete Core Length Measurements

CONCRETE CORE LENGTH MEASUREMENTS (mm)

	1	2	3	4	5	6	7	8	AVE
Sta 639 +98	310	307	308	306	308	307	325	326	312.13
Sta 639 +78	307	315	304	312	305	303	308	307	307.63
Sta 639 +58	302	297	308	306	306	309	308	302	304.75
Sta 630 +80	306	305	307	305	310	306	307	308	306.75
Sta 630 +60	304	300	304	302	301	305	303	302	302.63
Sta 630 +40	312	308	313	309	312	308	310	309	310.13
Sta 623 +03	325	324	325	328	328	324	327	325	325.75
Sta 622 +83	311	310	312	312	314	311	310	312	311.50
Sta 622 +63	311	314	313	312	311	309	311	316	312.13

CONCRETE CORE LENGTH MEASUREMENTS (inches)

	1	2	3	4	5	6	7	8	Average	Std dev.	COV,%
Sta 639 +98	12.20	12.09	12.13	12.05	12.13	12.09	12.80	12.83	12.3	0.33	2.67
Sta 639 +78	12.09	12.40	11.97	12.28	12.01	11.93	12.13	12.09	12.1	0.16	1.32
Sta 639 +58	11.89	11.69	12.13	12.05	12.05	12.17	12.13	11.89	12.0	0.16	1.34
Sta 630 +80	12.05	12.01	12.09	12.01	12.20	12.05	12.09	12.13	12.1	0.07	0.54
Sta 630 +60	11.97	11.81	11.97	11.89	11.85	12.01	11.93	11.89	11.9	0.07	0.56
Sta 630 +40	12.28	12.13	12.32	12.17	12.28	12.13	12.20	12.17	12.2	0.08	0.63
Sta 623 +03	12.80	12.76	12.80	12.91	12.91	12.76	12.87	12.80	12.8	0.07	0.51
Sta 622 +83	12.24	12.20	12.28	12.28	12.36	12.24	12.20	12.28	12.3	0.05	0.42
Sta 622 +63	12.24	12.36	12.32	12.28	12.24	12.17	12.24	12.44	12.3	0.09	0.69

Note: Samples read to the nearest millimeter = 0.04 inches.

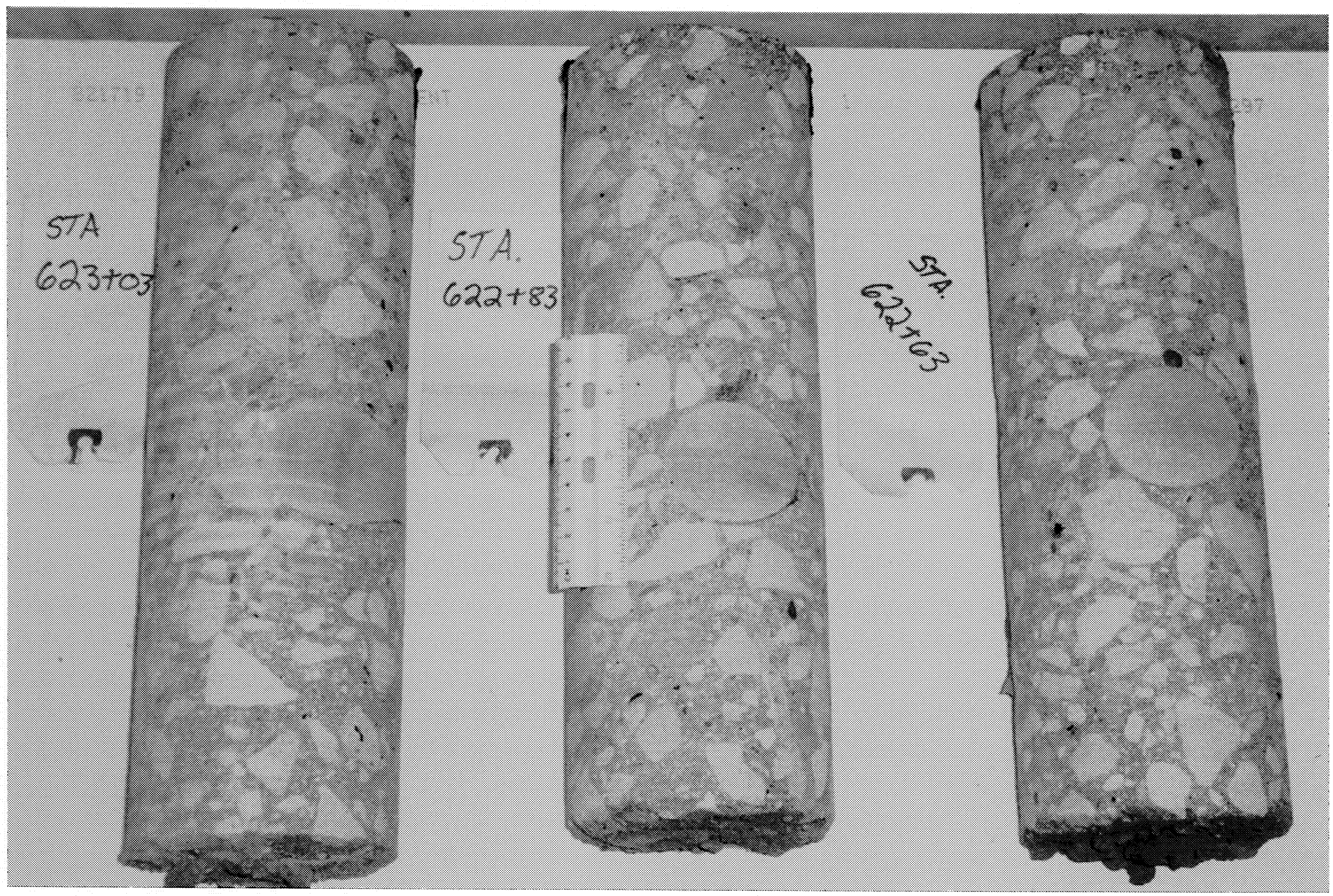

Figure D.1. Fiber Composite A Core Samples #s 10, 11, and 12 (left to right)

Figure D.2. Fiber Composite B Core Samples #s 7, 8, and 9 (left to right)

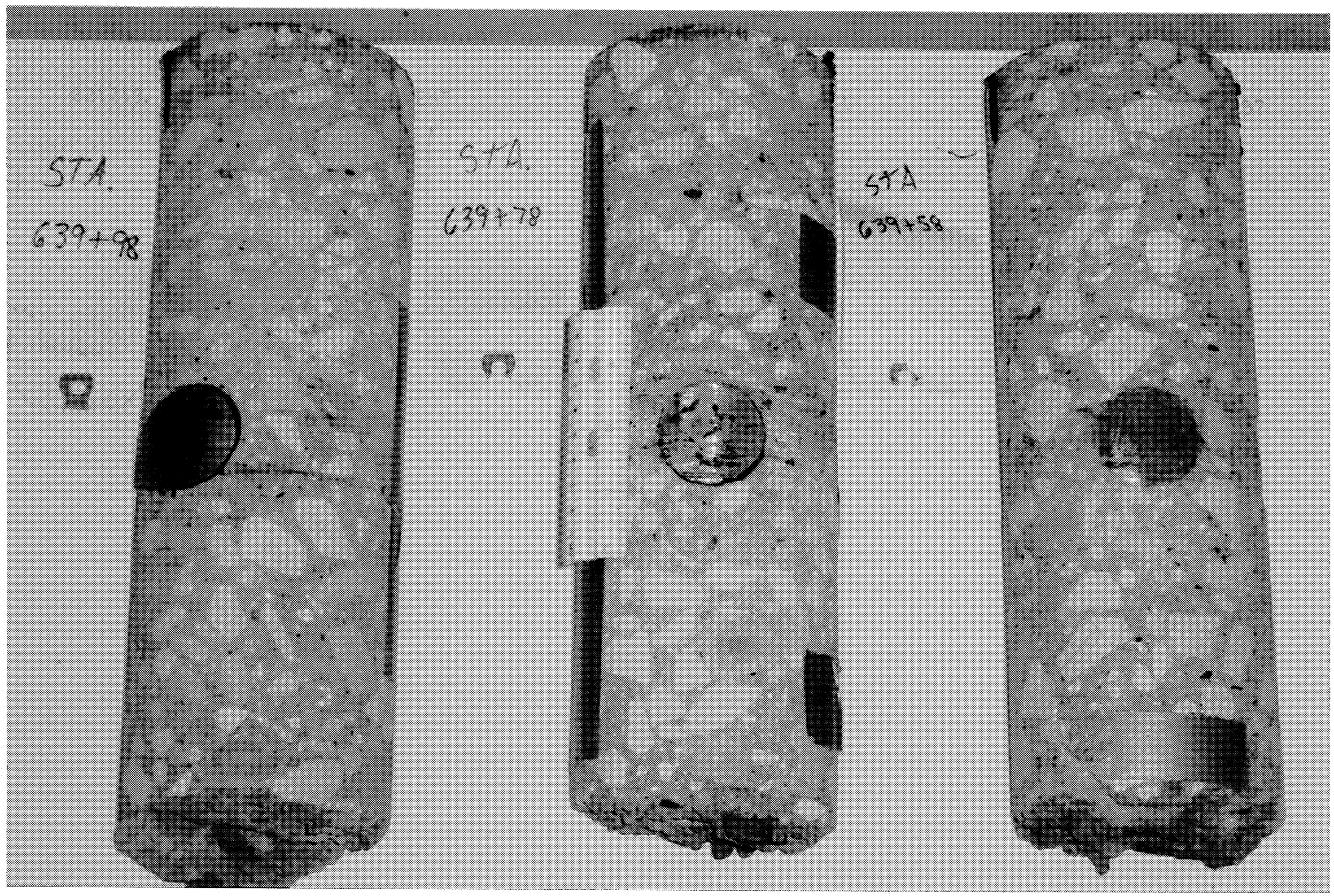

Figure D.3. Epoxy-Coated Steel Core Samples #s 1, 2, and 3 (left to right)