MDOT
Michigan Department of Transportation

IDENTIFY CAUSES FOR UNDER PERFORMING RUBBLIZED CONCRETE PAVEMENT PROJECTS

PRCE

PHASE II

FINAL REPORT
VOLUME II - APPENDICES

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Michigan State University
Pavement Research Center of Excellence
Department of Civil and Environmental Engineering
East Lansing, Michigan 48824-1226

TESTING AND RESEARCH SECTION
CONSTRUCTION & TECHNOLOGY DIVISION
RESEARCH REPORT - RC 1416 (APPENDICES)

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16. Abstract

When an asphalt concrete is placed on top of an existing concrete pavement, within a relatively short time period (3 to 5 years depending on the thickness of the AC overlay and the pre-overlay repairs of the original concrete pavement), the resulting composite pavement would typically exhibit reflective cracking from the underlying concrete pavement. Since 1986, the Michigan Department of Transportation (MDOT) and other State Highway Agencies are rubblizing concrete pavements to prevent reflective cracking through the bituminous surfaces. Over time, special provisions for rubblizing concrete pavements have evolved (see Appendix A). However, some rubblized pavement projects are very successful and are expected to last their intended design life. Others are under performing and have shown a reduced service life. The under performing pavement sections have shown various types of distress including cracking, rutting and raveling. The overall objective of this study is to determine the causes of under performance of rubblized concrete pavements.

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APPENDIX A

SPECIAL PROVISION FOR RUBBLIZING PORTLAND CEMENT CONCRETE PAVEMENTS

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
RUBBLIZING PORTLAND
CEMENT CONCRETE PAVEMENT

C&T:VTB 1 of 4 07-15-01

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a. Description. This work consists of shattering a reinforced or non-reinforced PCC pavement to construct a rubblized base. Section 304 of the 1996 Standard Specifications for Construction is deleted and replaced by this special provision.

b. Materials. Filler aggregate shall meet the following requirements:

Dense-Graded Aggregate 21AA 902

c. Construction.

1. **Equipment.** Suppress dust generated from the pavement shattering operation with an approved water system. Two general types of equipment may be used to rubblize the pavement.

   A. A self-contained, self-propelled pavement breaking machine that uses a resonant frequency to produce a low amplitude breaking force varying from 8000 to 10,000 Newtons at an impact rate of not less than 44 blows per second.

   B. A self-contained, self-propelled pavement breaking machine with multiple impact hammers directly adjacent to each other. Each hammer shall be capable of lifting and falling in an independent, adjustable, random sequence and to vary the force of impact. Each individual hammer shall not exceed 545 kg in weight, except wing-hammer weights (maximum 680 kg). The breaking width may vary from 0.915m to 4.3 m. The number of hammers and their spacing arrangement may vary depending on the desired width of each rubblizing pass.

2. **Preparation Work.** The following work activities must be completed prior to commencing pavement rubblizing.

   A. A relief joint shall be saw cut full depth, where the rubblizing abuts the concrete pavement remaining in place or being removed for other purposes.

   B. Any pavement widening or shoulder work that has progressed to match the elevation of the adjacent pavement to be rubblized.

   C. The drainage system for the new pavement structure, including the outlet

endings, shall be entirely completed.

D. Remove any pavement designated by the plans or as directed by the Engineer over utilities or pipes with less than 0.5 m of granular material cover, as measured from the bottom of the pavement to the top of the utility or pipe. The limits for pavement removal should extend to 1.0 m beyond each edge of the utility or pipe. The removal area should be backfilled with filler aggregate (maximum 150 mm lift) and thoroughly compacted. Removal of any concrete pavement shall be paid for separately under the Pavement Removal pay Item.

3. **Quality Control Checks.** The following checks will be performed by the Contractor to assure the specified rubblizing requirements are being achieved. Provide documentation of the check items to the Engineer on the day performed.

A. At the initiation of and during rubblizing, establish, demonstrate and document the proper operating characteristics of the equipment, including specifically the machine's speed and impact frequency, to achieve the specified result.

B. At a minimum frequency of once per lane per 0.5 km, inspect the rubblized pavement to determine whether the reinforcement is de-bonded and the specified particle size has been achieved as described in Item 6.B. An inspection site should avoid areas containing a transverse joint or working crack. When inspecting above the reinforcement, the removal of rubblized material shall only be by manual methods, so as not to further break the pavement particles. Once debonding of the reinforcement is determined, mechanized equipment may be used to facilitate inspection below the reinforcement. Inspection sites shall be restored with filler aggregate and compacted. The Engineer may adjust the inspection frequency depending on their results.

C. The completed finished surface shall have a uniform appearance without unbroken strips of pavement, exposed reinforcement, or visible joint filler and bituminous patching material.

4. **Compaction.** Before the bituminous mixture is placed, the rubblized pavement shall be uniformly compacted by both vibratory steel-wheeled and pneumatic-tired rollers in the following sequence:

A. One pass with a vibratory roller

B. One pass with a pneumatic-tired roller

C. Two passes with a vibratory roller. The second pass, to ensure compaction, shall be conducted on the same day that the bituminous pavement is placed and timed to occur just before the paving operation.

A pass is defined as down and back in the same path. Each roller shall have a nominal gross weight of not less than 9 metric ton. The vibratory rollers shall be operated in the maximum vibration mode. The rollers shall be operated at a speed not to exceed 2 m/s.

When required to aid in compaction, water shall be uniformly applied just before the third roller pass at a maximum rate of 14 kiloliters per lane km.

After compaction, the finished surface shall be within a level grade tolerance of ± 25 mm using a 3 meter straightedge (between any two contacts with the surface). Voids and depressions shall be filled with filler aggregate and compacted.

5. **Miscellaneous.** Vehicular traffic will not be allowed on the rubblized pavement before the bituminous pavement is placed, unless exceptions are required to maintain traffic. Portions of the rubblized pavement used for crossroad or ramp traffic shall be maintained in a compacted state.

   In part-width construction areas, rubblize to a distance not less than 0.5 m beyond the centerline or lane line.

6. **Acceptance Criteria.** The PCC pavement shall be completely shattered full-depth, in a uniform manner by rubblizing. The following criteria will be used by the Engineer to determine whether the rubblizing work is acceptable:

   A. The reinforcement, if present, has been de-bonded from the concrete to allow the pavement to function as an unbound aggregate base.

   B. The non-reinforced PCC pavement is reduced to unbound particles with a nominal diameter of less than 200 mm. When reinforcement is present the nominal diameter for particles above the reinforcement shall range from 50 mm to 125 mm. Sporadic particles, exceeding 250 mm are allowable below the reinforcement, if de-bonding of the reinforcement in the vicinity of the particle is verified (see Quality Control Checks). No oversize particles are present at the surface for any PCC Pavement.

   C. All exposed reinforcement at the surface has been removed by cutting it off below the surface. Embedded reinforcement may remain in place.

   D. After rubblizing and prior to compaction, all loose joint materials, including any expansion fiber, and bituminous patching material have been removed, and the resulting voids were filled with filler aggregate and compacted.

   E. All concrete pavement patches were rubblized as specified in item B.

   F. Any cracks having a nominal width > 10 mm at the surface and joints are

no longer distinguishable to eliminate the possibility of reflective cracking through the bituminous pavement.

G. The underlying base or subgrade has not been displaced.

d. Measurement and Payment.

Contract Item (Pay Item)	**Pay Unit**
Rubblized Pavement	square meter
Filler Aggregate, LM	cubic meter
Water	kiloliter
Steel, Hand Pick	metric ton

The quantity of **Filler Aggregate, LM** shall be measured before placement and compacting. The unit price of **Filler Aggregate, LM** shall include the cost of producing, delivering, placing, leveling and compacting the aggregate at required locations in the rubblized pavement.

The unit price for **Rubblized Pavement** shall include the cost of performing all required quality control work items, furnishing labor, materials, and equipment necessary to saw, rubblize, suppress dust, remove joint fillers, breakdown or remove and dispose of oversized pieces of rubblized pavement, and compact and maintain the compacted condition of the rubblized pavement until the bituminous pavement is placed.

The unit price of **Water** includes all costs for procuring, hauling, and placing on the rubblized pavement.

The unit price of **Steel, Hand Pick** will include cutting exposed steel, then loading, hauling, and disposing of the steel, and immediate restoration of any disturbed rubblized concrete.

APPENDIX B

FIELD INVESTIGATION
DURING THE RUBBLIZATION OPERATION

APPENDIX B

FIELD INVESTIGATION DURING THE RUBBLIZATION OPERATION

B.1 GENERAL

Table B.1provides a list of the fifteen projects investigated during the rubblization operation. As a part of the investigation, various types of project-related data were collected as shown in the table. Table B.2 provides a list of the asphalt mix type and thickness and the average daily traffic (ADT) for each project. The construction and rehabilitation history for each project was obtained from MDOT records and is summarized in table B.3. The project history is divided into one or more rehabilitation actions. The first period expresses the time in years between the original construction and the first rehabilitation. Subsequent periods indicate the time span between fixes. For example, four periods are identified for the US-31 project (control section 10032). The first period of 25 years designates the time between the original construction (1928) and the overlay of 1953. The second period (19 years) designates the time between the 1953 and the 1972 AC overlays. The third period of 10 years designates the time between the second overlay and the mill, crack and seat and overlay action. Finally, the period between the last action (mill, crack and seat and overlay) and rubblization is 17 years. The total project history from construction in 1928 to rubblization in 1999 is 71 years.

B.2 TRENCHES

For each of the twelve-rubblized projects investigated during this study, several trenches were made across the lane at mid-slab, transverse joint and/or crack locations. Each trench was approximately 3-ft wide and 7- to 8-ft long across the lane. The trenches were made by carefully removing the rubblized material (loose material) with scraping and brooming actions until a fractured concrete was encountered. In general, the rubblization process produced two distinctive layers in the original concrete slab, a rubblized concrete or loose materials and a fractured concrete layer. The rubblized layer consists mainly of rubblized materials that vary in size from dust to about 4-inch with some pieces larger than 6-inch. The thickness of the rubblized layer varies from 0 to about 5-inch. The fractured concrete layer consists of a continuous concrete with a network of tight cracks. Some of the cracks extend throughout the fractured concrete layer and some others meander in the horizontal directions. In all projects, the fractured concrete layer was found at depths ranging from the pavement surface to just below the temperature steel and extending to the top of the base/subbase layer. The surface of the fractured concrete can best be described as uneven with elevation differences between peaks and valleys ranging from 1- to 5-in. The distribution of these peaks and valleys was documented by taking digital images as shown in figures B.1 through B.24. After removing the loose rubblized material and brooming the surface of the fractured concrete to remove dust and small particles, its depth along with the depth of the temperature steel (if present or found) were measured. In addition, during the trenching operation, the size of the rubblized materials, the dimension of the fractured concrete and the amount of

dust were documented. After removing the loose materials and cleaning the fractured concrete by brooming, drainability tests were conducted in one or two trenches at each of eight projects. For each test, about 50 liters (15 gallons) of water were placed on a 2.0-m^2 (21-ft^2) area on the surface of the fractured concrete. The water pooled and its depths with time were measured. The results of the investigations are detailed below.

B.2.1 US-131 Southbound (Cedar Springs)

A construction project along US-131, north of Grand Rapids (between Cedar Springs and Howard City), was visited on April 29 and May 6, 1999. The original 229-mm (9-in) thick jointed reinforced concrete pavement (JRCP) was constructed in 1973 at 22.0-m (72-ft) joint spacing. Joint repairs were made to the pavement in 1992. In 1999, the concrete was rubblized using a resonant frequency pavement breaker (sonic).

On the first visit, the rubblization process was observed and one trench was made in the rubblized concrete pavement across the southbound passing lane. The purpose of trenching was to investigate the uniformity and the effective depth of the rubblization process. During the second field trip, two trenches were made in the rubblized concrete pavement across the southbound traffic lane. One trench was dug at a transverse joint and the other at mid-slab. In general, it was observed that:

- Strips of fine and coarse rubblized materials were almost evenly spaced 175-mm (7-in) apart (almost the width of the sonic shoe).
- At a transverse joint, the trench contained large pieces (0- to 250-mm (0- to 10-in), with an average size of approximately 100-mm (4-in) of rubblized material above the temperature steel.
- The trench at mid-slab consisted of small pieces (0- to 125-mm (0- to 5-in), with an average size of approximately 50-mm (2-in) of rubblized material above the temperature steel.
- The rubblized concrete beneath the temperature steel appeared to be fractured concrete.
- The surface of the fractured concrete consists of peaks and valleys that extend in both the longitudinal and transverse directions.

B.2.2 M-50 Eastbound (Dundee)

A construction project along M-50, between Dundee and Monroe, was visited on May 27, 1999. The original 203-mm (8-in) thick jointed reinforced concrete pavement (JRCP) was constructed in 1959 at 30.2-m (99-ft) joint spacing. The pavement showed numerous longitudinal, transverse and diagonal cracks. However, most transverse joints were almost in perfect condition. In 1999, the concrete was rubblized using a multi headed guillotine breaker (multi-headed breaker).

The pavement breaking process was viewed and four trenches were made in the rubblized areas. All trenches were located in the eastbound lane at stations 10+441, 10+803, 11+151

and 12+000. The first three trenches were at mid-slab locations and the fourth trench was at a transverse joint. In general, it was observed that:

- The rubblization process produced a well rubblized concrete above the temperature steel and a fractured concrete under the steel.
- The vertical cracks in the fractured concrete beneath the steel were spaced at 100 to 125-mm (4 to 5-in) in the longitudinal direction. The same spacing was measured between the drop hammers.
- In at least one location, the original aggregate base was exposed underneath the rubblized concrete near a transverse joint.
- Slag aggregate was used in the concrete.
- The large pieces of rubblized concrete that were removed for more detailed inspection showed internal fractures.
- Peaks and valleys in the fractured concrete existed longitudinally and across the lane.

B.2.3 US-31 Northbound (Honor)

A construction project along US-31, between Honor and Traverse City, was visited on July 9, 1999. The original 229- 178- 229-mm (9- 7- 9-in) thick jointed plain concrete pavement (JPCP), (eventually it was 7-in pavement with edges thickened to 9-inch), was constructed in 1928 on the subgrade with 30.5-m (100-ft) joint spacing. The pavement was overlaid three times, once in 1953, a second time in 1972 and again in 1982. During the 1982 construction, the asphalt overlay was milled and the concrete pavement was cracked and seated prior to overlay. The project also included a lane widening. In 1999, the asphalt overlay was milled and the concrete was rubblized using a multi headed guillotine breaker (multi-headed breaker).

Four trenches were made in the northbound lane. Two trenches were at mid-slab sections and two were made at transverse joints. Drainability tests were performed in the two mid-slab trenches. After removing the top 75- to 100-mm (3- to 4-in) of the rubblized material and exposing the fractured concrete over an approximately 2.2-m^2 (24-ft^2) area, 50 liters (15 gallons) of water was placed on the first excavation at station 26+652. The water dissipated completely within 11 minutes through the fractured concrete. The crack network in the fractured concrete was extensive, which made the complete removal of the concrete possible. In some areas, the fractured concrete was removed and the original sandy subgrade was exposed. At the second trenching area at station 26+680, 50 liters (15 gallons) of water was placed on the surface of the rubblized concrete before any material was removed. Another 65 liters (17 gallons) of water were placed on the surface 12 minutes later. Five minutes after placing the 65 liters (17 gallons), a trench was made on an area of approximately 2.2-m^2 (24-ft^2). The rubblized concrete was found to be dry on top and moist at the fractured concrete layer. There was a small amount of water sitting or trapped on top of the fractured concrete layer.

The third trench was made at a transverse joint at station 27+324. The concrete was well rubblized to a depth of about 125-mm (5-in) below where fractured concrete was found. The fourth trench was also made at a transverse joint at station 27+385. It appeared that the joint

experienced deterioration and it had been patched or filled with sandy material. The bottom of the rubblized concrete was reached at this location. In general, it was observed that:

- In certain areas, the milling process did not completely remove the bituminous overlay. These areas absorbed a large percent of the energy delivered by the rubblizing equipment. Hence, large pieces of the rubblized concrete were found on the pavement surface that required further breaking by a hydraulic hammer.
- In several areas along the project, the strength of the subgrade material was exceeded. Hence, bearing capacity failure was evident, which was caused by the impact of the hammers. In some areas, large pieces of the concrete penetrated the roadbed soil. Stated differently, permanent damage was delivered to the subgrade material by the rubblizing process.
- The previous cracking and seating of the concrete produced 0.6-m (2-ft) spaced cracks. Such cracks hindered the rubblizing process by absorbing part of the energy. Hence, the concrete was poorly rubblized.
- Since the concrete was 71 years old and had been covered with asphalt for 46 years, extensive horizontal cracks were developed throughout its thickness. This further decreases the energy level delivered by the rubblizing equipment. The rubblizing energy is mainly used to close the cracks and perhaps extend them in the horizontal direction.
- A large percentage of the aggregate was shattered indicating that the strength of the aggregate is less than that of the bond between the aggregate and the mortar.

B.2.4 M-53 Northbound (Almont)

A construction project along M-53, between Almont and Imlay City, was visited on July 12, 1999. The original 229- 178- 229-mm (9- 7- 9-in) thick, 6.1-m (20-ft) wide, jointed reinforced concrete pavement (JRCP) was constructed in 1930 at 30.2-m (99-ft) joint spacing. No dowel bars were used. The pavement was overlaid twice, once in 1963 along with a 1.2-m (4-ft) concrete widening and a second time in 1975. In 1999, the asphalt overlay was milled and the concrete was rubblized using a multi headed guillotine breaker (multi-headed breaker).

Four trenches were made in the northbound lane. Three trenches were made at mid-slab locations, away from transverse cracks and joints, and one trench at a transverse joint. The first trench at station 53+621 revealed poorly rubblized concrete (the depth of the rubblized concrete was very shallow). This could be related to the high speed (260- to 290-m/hr (850- to 950-ft/hr)) of the rubblizing equipment. After examining the material in the trench, the operator of the equipment reduced the speed to 245-m/hr (800-ft/hr). Another trench was then made at station 53+900 where better rubblized concrete was found. A drainability test was performed at this trench. After the 100-mm (4- in) of loose rubblized concrete material were removed, 75 liters (20 gallons) of water were placed on top of the fractured concrete in the trench. The water dissipated very slowly and it was ponding after twenty minutes. However, air bubbles were observed coming out of various cracks in the fractured concrete. The third trench was also made at mid-slab at station 54+210 where good and full depth rubblized material was noted.

A fourth trench was made at a transverse joint at station 53+886. The joint appeared to be badly deteriorated and filled with loose material. Rubblization of the concrete to the aggregate subbase was achieved at this location. The following general comments can be made relative to the four trenches:

- The height of drop of the outer hammers (the hammers that are closer to the shoulder) was more than the other hammers. This was intentionally set as to breakup the relatively newer and thicker concrete at the widening strip. Although this action was feasible, it did not break the newer concrete as well as the original concrete.
- Some of the rubblized concrete was not fully debonded from the steel, as peaks of fractured concrete material protruded above the steel, encasing the wire mesh tightly.
- The cracks in the fractured concrete area did not appear to be well developed.
- The drainability tests revealed high potential of water trapping under the asphalt surface.

B.2.5 M-18 Northbound (Beaverton)

A construction project along M-18, between Beaverton and Gladwin, was visited on July 15, 1999. The original 229- 178- 229-mm (9- 7- 9-in) thick, 6.7-m (22-ft) wide, jointed reinforced concrete pavement (JRCP) was constructed in 1940 at 18.3-m (60-ft) joint spacing. Expansion joints were spaced at 36.6-m (120-ft) and dummy joints were spaced at 9.1-m (30-ft) interval. Various sections of the projects were overlaid with AC and some of the joints were repaired in 1973, 1976 and 1977. In 1999, the asphalt overlay was milled and the concrete was rubblized using a multi headed guillotine breaker (multi-headed breaker) operated at 180- to 210-m/hr (600- to 700-ft/hr).

Three trenches were made in the northbound lane. Two trenches were at mid-slab locations at stations 3+180 and 3+194 away from transverse cracks and joints. It was observed that the area was poorly rubblized (large pieces of concrete) above the steel. No fractures were observed in the fractured concrete. It was also observed that about 100-mm (4-in) of the concrete was rubblized in the vicinity of the centerline and only 50-mm (2-in) were rubblized along the shoulder.

One drainability test was performed at each trench. In the first trench, 50 liters (15 gallons) of water was placed on the fractured concrete in an area of approximately 1.9-m^2 (20-ft^2). In the second trench, 75 liters (20 gallons) of water was placed on top of the fractured concrete in an area of approximately 2.2-m^2 (24-ft^2). In both tests, the water did not infiltrate into the fractured concrete and no air bubbles were observed coming out of it. Indeed, forty minutes into the test, the water was still ponding. One further observation was made is that the loose rubblized material appears to contain a high amount of dust. The water did not permeate through this material in the horizontal direction.

The third trench was at a transverse joint at station 4+034. The joint sealant material was weathered. The recovered dowel bars showed severe corrosion and necking under the joint.

One dowel bar was split into two pieces. The rubblization above the temperature steel was relatively good. In general, it was observed that:

- Debonding was poor in some locations.
- The rubblized concrete had powder size particles (- number 200 sieve) in the upper 75-mm (3- in).
- Traffic was allowed on the rubblized concrete, which created high dust. No water was being used to prevent the dust. The traffic and the loss of fine particles are two factors that may have affected the rubblized concrete prior to trenching.
- The drainability tests revealed high potential of water trapping under the asphalt surface.

B.2.6 Old US-131 (Wolverine Blvd.) Northbound (Rockford)

A construction project along Old US-131, northeast of Grand Rapids (between Grand Rapids and Rockford), was visited on July 22, 1999. The original 22.9-cm (9-in) thick, 6.7-m (22-ft) wide, jointed reinforced concrete pavement (JRCP) was constructed in 1956 at 30.2-m (99-ft) joint spacing. On October 29, 1969, the road jurisdiction was changed from MDOT to the Kent County Road Commission. In 1999, extensive joint and crack deterioration existed along the length of the project. Hence, the concrete was rubblized using a resonant frequency pavement breaker (sonic). The sonic rubblizer utilized a 175-mm (7-in) shoe with a 450-mm (18-in) beam. The frequency of the sonic shoe was either 44 or 46 cycles/second. A downward pressure of 135- to 180-kg (300- to 400-pounds) was applied to the pavement. The velocity of the rubblizer was approximately 3.2- to 4.8-km/hr (2- to 3-miles/hr).

To check the depth and uniformity of the rubblized concrete, three trenches were made in the northbound passing lane at mid-slab locations. The first trench was made at station 9+858 where the temperature steel overlapped by 300-mm (12-in), which decreased the energy delivered to the fractured concrete beneath the temperature steel. Hence, the breakup of the concrete beneath the temperature steel was limited. However, the concrete above the temperature steel was rubblized throughout its thickness. The second trench was made at station 10+690, where it was evident that the road was constructed as a cut section. Upon trenching, the temperature steel was found de-bonded and exposed across the trench, except for one peak of intact, but well fractured, material, which extended to the surface of the concrete. The concrete was rubblized to a depth of 50-mm (2-in) beneath the temperature steel. A third trench was made at station 11+641 where very shallow rubblization was found. The temperature steel was mainly bonded and the concrete above the temperature steel was fractured in different areas.

Drainability tests were performed at the first and third trenches. Fifty liters (15 gallons) of water were placed on top of the fractured concrete surface in both trenches on areas of 2.0-m^2 (21-ft^2). The rubblized concrete in the first trench was very moist from rain the previous day, while the rubblized concrete in the third trench was dry, due to drying from the sun and trenching at a later time of the day. The first trench resulted in about a 25-mm (1-in) draw down of the water, which occurred within the first six minutes. Air bubbles were observed coming out of the cracks in the fractured concrete. The third trench resulted in about 20-mm

(0.75-in) draw down of the water. The majority of the filtration took place during the first five minutes. An additional draw down of 5-mm (0.20-in) occurred over the next 12 minutes.

During the trenching operation, the following general observations were made:

- Strips of fine and coarse rubblized materials were almost evenly spaced 175-mm (7-in) apart (almost the width of the sonic shoe).
- Large aggregate was used in the concrete pavement.
- Complete breakage of the adhesion between most of the aggregate and the mortar occurred.
- The material in the trench above the temperature steel consisted of 0- to 75-mm (0- to 3-in) pieces with an average size of approximately 50-mm (2-in).
- The rubblized concrete beneath the temperature steel appeared to be fractured concrete.

B.2.7 US-10 Eastbound (Evart)

A construction project along US-10, west of Evart, was visited on August 9, 1999. The original 229- 178- 229-mm (9- 7- 9-in) thick, 6.1-m (20-ft) wide, jointed reinforced concrete pavement (JRCP) was constructed in 1933 at 30.5-m (100-ft) joint spacing. The pavement was overlaid twice, once in 1958 along with a 1.2-m (4-ft) concrete widening and a second time in 1980. In 1999, the asphalt overlay was milled and the concrete was rubblized using a multi-headed guillotine breaker (multi-headed breaker). The multi-headed breaker utilized a 3.8-m (12.5-ft) rubblizing width. The velocity of the rubblizer was approximately 180- to 210-m/hr (600- to 700-ft/hr). The hammers which were striking the concrete widening on the outside of the lane were only being raised approximately 0.6-m (2-ft), while the hammers over the original concrete were being dropped from a height of approximately 1-m (3-ft). Hence, more energy was delivered to the original concrete compared to that delivered to the widening strip.

Three trenches were made on the project in mid-slab locations. A trench at station 19+867 yielded a good rubblization in the concrete widening and a poor rubblization in the original concrete. The concrete in the widening strip was rubblized down to the depth of the longitudinal #4 re-bar at 100-mm (4-in). The original concrete was only rubblized to 200- by 300-mm (8- by 12-in) pieces or larger, which had vertical fractures around the edges of the pieces extending only to a depth from 0- to 125-mm (0- to 5-in). However, these vertical fractures did not facilitate the movement of the rubblized concrete as a large mass. No temperature steel was exposed in the original concrete at this location.

A better rubblized concrete was found in the second trench at station 20+144. Here the original concrete was rubblized to the temperature steel, which was only 50- to 85-mm (2- to 3.5-in) deep. Occasionally, above the temperature steel, fractured concrete was found, which extended to the original pavement surface. The widening concrete strip was only rubblized to a depth of 12- to 50-mm (0.5- to 2-in) and no temperature steel was exposed.

At station 20+389, the original concrete was poorly rubblized to a shallow depth and the original concrete surface remained almost intact across over half of the lane. The temperature steel was exposed only in very limited areas. The widening concrete strip showed a slightly better rubblization.

A drainability test was performed at station 20+144. A good draw down of water was evident here, where 50-liters (15-gallons) of water was placed on the fractured concrete surface of the rubblized concrete. The water filtrated vertically in 23 minutes, at a rate of 25-mm/10 minutes (1-in/10 minutes). No air bubbles were observed coming out of the rubblized material. It should be noted that the majority of the seepage occurred at the middle of the lane.

Prior to the start of the rubblization operation on August 12, 1999, eight pavement cores were taken on US-10 in the eastbound lane. Six of the cores were taken before the asphalt overlay was milled. Four cores were taken from the original concrete lane and four from the 1.2-m (4-ft) widening strip on the south edge of the eastbound lane. The cores were subjected to unconfined strength test and the results are tabulated below. It can be seen that the compressive strength of the original concrete (constructed in 1933) is about twice that of the concrete in the widening strip (constructed in 1956). This strength difference gives the reason for the decreased hammer drop required over the widening portion of the lane. The compressive strength of the cores is summarized in the table on the following page.

Compressive strength					
Original 6.1-m (20-ft) concrete (1933)			1.2-m (4-ft) concrete widening (1958)		
Sample	psi	kPa	Sample	psi	kPa
1	7940	54744	A	4430	30544
2	7970	54951	B	4960	34198
3	8340	57502	C	3540	24407
4	8650	59640	D	2850	19650
Averages	8225	56709	Averages	3945	27200

During the trenching operation, the following general observations were made:

- The original concrete pavement was not well rubblized. Large pieces of the original pavement surface remained in many locations along the project.
- On some hammer drops, the concrete was observed breaking off at approximately 450-mm (18-in) ahead of the front row of the multi-headed breaker's hammers.
- The maximum aggregate size used in the original concrete was about twice that used in the concrete widening strip.

B.2.8 Old US-10 (Saginaw Road) Eastbound (North Bradley)

A construction project along Old US-10, northwest of Sanford (between Sanford and North Bradley), was visited on August 12, 1999. The original 229- 178- 229-mm (9- 7- 9-in) thick, 6.1-m (20-ft) wide, jointed reinforced concrete pavement (JRCP) was constructed in 1932 at 30.5-m (100-ft) joint spacing. On December 20, 1961, the road jurisdiction was shifted from MDOT to the Midland County Road Commission. A 50-mm (2-in) overlay was constructed in 1962. In 1999, the asphalt overlay was milled and the concrete was rubblized using a resonant frequency pavement breaker (sonic). The sonic rubblizer utilized a 229-mm (9-in) shoe with a 447-mm (18-in) beam. The frequency of the sonic shoe was either 44 or 46 cycles/second. A downward pressure of 90- to 227-kg (200- to 500-pounds) was applied to the pavement. The velocity of the rubblizer was approximately 3.2- to 4.8-km/hr (2- to 3-miles/hr).

Two trenches were made at mid-slab locations in the concrete (stations 25+064 and 25+594). Both trenches consisted of an excellent rubblization to depths below the temperature steel, which was low. The concrete was very well rubblized across the lane width to depths of 25- to 50-mm (1- to 2-in) beneath the temperature steel. A couple pieces of concrete, 75- by 100-mm (3- by 4-in) in size were still bonded to the temperature steel in the first trench (station 25+064). However, this did not affect the depth of rubblization throughout the trench. The rubblized concrete below the temperature steel was easily removed all the way down to the base material. Although the temperature steel was found overlapping by about 225-mm (9-in) in the second trench, the quality of rubblization was not affected.

A drainability test was performed at the first location, station 25+064. A good drainage occurred, where 50-liters (15-gallons) of water drained from all but one valley in 9 minutes and completely from the trench in 11.5 minutes.

During the trenching operation, the following general observations were made:

- After milling the asphalt, broken pieces of the concrete surface were observed on the pavement surface at the west end of the project. This is evidence of the state of the concrete surface deterioration.
- The temperature steel was positioned at or lower than the mid-depth of the concrete slab. The relatively deeper steel appeared to facilitate the rubblization process.
- No longitudinal pattern lines were observed on the surface of the rubblized concrete.
- No edge drain was placed on this project.
- After rubblization, 63-mm (2.5-in) of leveling course and 63-mm (2.5-in) of surface course were placed west of the Salt Creek. 75-mm (3-in) of leveling course and 50-mm (2-in) of surface course were placed east of the Salt Creek.

B.2.9 US-31 Southbound (Elk Rapids)

A construction project along US-31, south of Elk Rapids, was visited on August 25, 1999. The original 203-mm (8-in) thick, 6.7-m (22-ft) wide, jointed reinforced concrete pavement (JRCP) was constructed in 1953 at 30.2-m (99-ft) joint spacing. In 1980, the pavement was

widened by the addition of two 0.3-m (1-ft) wide bituminous strips, the shoulders were repaved and some concrete joints were repaired. In 1999, the concrete was rubblized using a multi-headed guillotine breaker (multi-headed breaker). The multi-headed breaker utilized a 3.8-m (12.5-ft) rubblizing width. The height of the hammer drops was approximately 85-90 percent [105- to 110-cm (41- to 43-in)] of the full capacity.

Two trenches were made in the southbound lane at mid-slab locations. The first trench was made at station 2+200, where the pavement is on a super-elevated curve and the velocity of the rubblizer was approximately 300-m/hr (975-ft/hr). The temperature steel was exposed in the trench across portions of the lane. A few areas with large fractured concrete were found in the outer part of the lane above the temperature steel.

The second trench was made at station 2+637, where the velocity of the multi-headed guillotine breaker was approximately 365-m/hr (1200-ft/hr). The higher rubblizer speed produced a poorer rubblization. In various locations, the surface of the rubblized concrete contained very large and intact pieces of concrete. Although some of the temperature steel was exposed (at a depth of 100-mm (4-in) from the surface), on the average, the steel debonding was poor.

A drainability test was made at station 2+200. However, due to the fact that the trench was on a super-elevated curve, the results at this location are not comparable to other projects. Fifty-liters (15-gallons) of water were placed on the fractured concrete surface. Water flowed very fast across the trench and down the super-elevation. All of the water was gone from the trench in 5 minutes. The majority of the water was lost to horizontal seepage through the top loose rubblized concrete, as evidenced by the trenching next to the trench on the lower side of the super-elevated curve.

It should be noted that because of various problems encountered on the southbound lane, the northbound lane was not rubblized. These problems include:

- Proper compaction of the AC overlay was not achieved.
- The rubblized material was not stable (the material moved in a wave-like pattern ahead of the roller), which caused waves in the AC base course.
- Intrusion of the temperature steel through the AC base course.
- Intrusion of large concrete pieces through the AC base course.

B.2.10 M-21 Westbound (Flint)

A construction project along M-21, west of Flint, was visited on September 10, 1999. The original 254- 203- 254-mm (10- 8- 10-in) thick, 6.1-m (20-ft) wide, jointed reinforced concrete pavement (JRCP) was constructed in 1938 at 18.3-m (60-ft) joint spacing (Dummy joints were placed at 9.1-m (30-ft) with no dowel bars or joint filler material). In 1957, a 1.2-m (4-ft) wide and 200-mm (8-in) thick reinforced concrete widening strip was added to the outside of both concrete lanes. The entire pavement was then overlaid. A 3.7-m (12-ft) 200-mm (8-in) JRCP lane was added on the outside of both of the 1.2-m (4-ft) concrete widening. The concrete base course widening and the JRCP lanes were built on a 75-mm (3-in) thick

selected base and a 225-mm (9-in) thick subbase. In 1972, the inside lanes were resurfaced. In 1978, concrete joint repairs were performed on the outer lanes. In 1999, the concrete was rubblized using a multi headed guillotine breaker (multi-headed breaker).

The multi-headed breaker utilized a 3.8-m (12.5-ft) rubblizing width. The inner lane was rubblized at a velocity of approximately 200-m/hr (650-ft/hr). The hammers were raised to full height [120-cm (48-in)] over the original concrete and the wing hammer over the concrete widening was raised to 80 percent [100-cm (38-in)] of its capacity. The concrete in the outer lane was rubblized one day earlier at a velocity of 250-m/hr (800-ft/hr).

Four trenches were made in the westbound lanes. Three of these trenches were located in the inner lane and one trench was made in the outer lane adjacent to a trench in the inner lane (station 1+200). The first trench was made in the inner lane at station 1+200, where the original concrete was only rubblized to a depth of 25- to 50-mm (1- to 2-in). The concrete in the widening strip was well rubblized down to the depth of the temperature steel (square diamond bar pattern). The original concrete was hard and it did not fracture very well. A second trench was then made in the outer lane at the same station. The material in this trench showed a better rubblization than the inner lane. The temperature steel was exposed in portions of the lane, however fractured concrete peaks still existed above the temperature steel.

A third trench was made at a tight transverse crack (open less than 6-mm (0.25-in)) in the inner lane (station 1+309). The original concrete material in the trench was poorly rubblized again to an effective depth of only 12- to 25-mm (0.5- to 1-in). Only one piece of longitudinal steel was exposed which was corroded and was located near the longitudinal widening joint. The concrete widening was rubblized to the depth of the temperature steel with occasional fractured concrete peaks above the steel, one of which extended to the original surface. The transverse crack in the trench did not affect the rubblization of the concrete.

The fourth trench was made in the inner lane at station 1+684. The original concrete showed a slightly better rubblization, as two pieces of longitudinal steel were exposed. However at the middle of the lane, the concrete was a fractured concrete slab. The concrete in the widening strip was rubblized very well to the depth of the temperature steel.

A drainability test in the inner lane at station 1+200 showed good drainage through the concrete widening and poor drainage in the original concrete. Most of the water placed on the original concrete ran off into the concrete widening. However some of the water perched on top of the concrete and a small amount filtrated horizontally through the top loose rubblized material towards the centerline. A drainability test on the outer lane yielded worse results, as some of the 50-liters (15-gallons) of water ran off the concrete to the rubblized widening strip of the inner lane. However, the water that remained did permeate through the fractured concrete.

The investigation of the rubblized material in the four trenches revealed that:

- The concrete in the widening strips was well rubblized. The original concrete in the inside lane was hardly rubblized. The concrete in the outside lane was only slightly better rubblized than that in the inside lane.
- In order to enhance the pavement cross-slope, aggregate will be placed on top of the rubblized concrete. The aggregate will be placed at approximately 150-mm (6-in) in thickness at the centerline of the pavement and will be feathered to nothing at the outside edge. This additional aggregate should enhance the cross-slope of the pavement.

B.2.11 US-23 Southbound (Alpena)

A construction project along US-23, south of Alpena, was visited on September 15, 1999. The original 229- 178- 229-mm (9- 7- 9-in) thick, 6.1-m (20-ft) wide, jointed reinforced concrete pavement (JRCP) was constructed in 1933 at 30.5-m (100-ft) joint spacing. A 1.2-m (4-ft) concrete widening strip was added and a bituminous overlay was placed over the entire pavement in 1966. In 1999, the asphalt overlay was milled and the concrete was rubblized using a resonant frequency pavement breaker (sonic). The sonic rubblizer utilized a 229-mm (9-in) wide shoe with a 447-mm (18-in) beam. The frequency of the sonic shoe was either 44 or 46 cycles/second. A downward pressure of 90- to 227-kg (200- to 500-pounds) was applied to the pavement. The velocity of the rubblizer was approximately 4.8-km/hr (3-miles/hr).

Two trenches were made in the rubblized concrete. One trench (station 465+21) was located at mid-slab and the other (station 465+85.5) at a transverse joint. In the mid-slab trench, the concrete was rubblized to the depth of the temperature steel or less, a few fractured concrete peaks extended above the temperature steel. However, the concrete beneath the temperature steel was well fractured. At a randomly selected location in the trench, the rubblized material was successfully removed down to the original subbase layer. The concrete in the widening strip was not well rubblized as large fractured concrete remained in the strip to the elevation of the original pavement surface.

In the trench at the transverse joint, the high temperature steel decreased the effective depth of rubblization. The temperature steel was debonded and exposed in only a small area of the trench. Large areas of the trench contained large fractured concrete masses. At one location in the trench, removing a 150- by 305- by 305-mm (6- by 12- by 12-in) concrete piece exposed the sand subbase.

In addition, the following general observations were made:

- Wood timbers were found underneath the pavement in several areas along the project.
- Several areas of the project required aggregate filler to be placed on top of the rubblized concrete to either enhance the cross-slope or to fill in depressions that were created during rubblization (in some areas where the roadbed and/or subbase materials were soft, the concrete penetrated the soft material leaving noticeable depression on the surface of the rubblized concrete).

- The resonant breaker pushed down the fractured concrete and the rubblized concrete in the widening strip (near the longitudinal joint). After rubblization, the elevation of the surface of the widening strip was about 20- to 50- mm (1- to 2-in) below that of the pavement surface.
- In various locations along the project, the roadbed soil was soft (estimated modulus of 3000 psi or less). At those locations, the energy delivered by the sonic breaker caused the concrete to penetrate the roadbed soil. In some of these soft areas, the surface of the rubblized material had depressions.

B.2.12 Portage Road Northbound (Portage)

A construction project along Portage Road, in Portage, was visited on October 18, 1999. The original 200-mm (8-in) thick, 5.5-m (18-ft) wide, jointed plain concrete pavement (JPCP) was constructed in the 1920s. The pavement was widened and overlaid with asphalt in the 1940s, 1960s and 1980s. Part of the original concrete road was removed in the late 1960s during the construction of a sanitary sewer along the project. In 1999, the asphalt overlay was milled and the concrete was rubblized using a resonant frequency breaker (sonic). The sonic rubblizer utilized a 254-mm (10-in) wide shoe with a 447-mm (18-in) beam. The frequency of the sonic shoe was either 44 or 46 cycles/second. A downward pressure of 90- to 227-kg (200- to 500-pounds) was applied to the pavement. The velocity of the rubblizer was approximately 4.0-km/hr (2.5-miles/hr).

Two trenches were made in the rubblized concrete at mid-slab locations (station 3+609 and 3+901.5). In both trenches, the concrete was rubblized to mid-depth of the original slab and well fractured below that depth. Hence, a complete removal of the rubblized and fractured concrete was accomplished down to the roadbed soil. The fractured concrete in the lower half of the slab contained many large pieces of 150- to 200-mm (6- to 8-in) broken concrete. Finally, the operators of the rubblizer stated that the concrete was weak and the base was strong.

Three pieces of information relevant to this project are:

- A minimum of 25-mm (1-in) of recycled asphalt pavement (RAP) was placed on top of the rubblized concrete before the asphalt overlay. The thickness of the RAP was variable and in locations, where a grade change was needed, up to 305-mm (12-in) thick RAP was placed.

- The original joints in the concrete pavements were not detectible from the surface of the rubblized concrete.

- The rubblized concrete width was 2.4 - to 2.9-m (8- to 9.5-ft). The width of the new road surface was 16.75-m (55-ft) wide (5 lanes at 11 ft/lane). The rubblized concrete became the base of the northbound inner lane.

B.3 REFERENCE LOCATION

Table B.4 provides references to the exact trench location for each project investigated during the rubblization operation. Physical references are given to objects in distances. Cracks and joints in the pavement were also referenced in relation to the trench for future performance investigation. In some instances, wooden stakes (2-in x 4-in x 4-ft) were driven into the ground at the specified distance off the shoulder, which are also referenced. For each trench location, the station and control section milepost (CSMP) at that location are given, if the old stationing was known it was also included. The stationing and CSMP for the nearest road intersection are also given to assist in locating the trenches in the future. One can proportion the distance from the road intersection to the trench location.

Table B.1 Data for projects investigated during the rubblization operation

Project	Control section	Job number	Region	CSMP		Rubblizing equipment	Type of investigation		
				POB	POE		Trenching at station	Coring	FWD tests
US-131	41133 59012	33914	Grand	3.200 0.000	8.691 4.214	Resonant	37+558.5 - MS N/A - TJ N/A - MS	None	9-1-99 30 tests
M-50	58042	43523	University	0.143	4.521	Multi-headed	10+441 -MS 10+803 - MS 11+151 -MS 12+000 - TJ	None	None
US-31	10032	44113	North	11.430 13.905	13.874 14.340	Multi-headed	26+130 - MS 26+652 - MS 26+680 - MS 27+324 - TJ 27+385 - TJ	None	None
M-53	50012 44031	36021	Metro Bay	4.438 0.000 2.820 6.466	4.458 1.588 6.130 6.940	Multi-headed	53+621 - MS 53+886 - TJ 53+900 - MS 54+210 - MS	None	11-2-99 45 tests
M-18	26011	45410	North	4.860	12.000	Multi-headed	3+180 - MS 3+194 - MS 4+034 - TJ	None	None
Old US-131	41401 41013[1]	49321 45797	Grand	2.669 0.000	2.820 2.232	Resonant	9+858 - MS 10+690 - MS 11+641 - MS	None	None

[1] Transfered from MDOT to county jurisdiction 10-29-69 TJ = Transverse joint MS = Mid-slab

Table B.1 Data for projects investigated during the rubblization operation (continued)

Project	Control section	Job number	Region	CSMP		Rubblizing equipment	Type of investigation		
				POB	POE		Trenching at station	Coring	FWD testing
US-10	67022	44986	North	9.657	12.087	Multi-headed	19+867 - MS 20+144 - MS 20+389 - MS	8-12-99 8 cores	None
Old US-10	56555 56041[1]	48370	Bay	7.114	9.513	Resonant	25+064 - MS 25+594 - MS	None	None
US-31	05011	44109	North	0.923	3.019	Multi-headed	2+200 - MS 2+637 -MS	None	None
M-21	25081	38028	Bay	4.981	7.285	Multi-headed	1+200 IL - MS 1+200 OL - MS 1+309 IL - TC 1+684 IL -MS	None	None
US-23	01052 04031 04031 04031 04031	32335 32335 32335 32335 44350	North	16.369 0.000 0.449 1.404 4.218	16.393 0.241 0.908 2.248 7.893	Resonant	465+21 -MS 465+85.5 - TJ	None	None
Portage Road	39405	49551	Southwest	0.000	1.125	Resonant	3+609 - MS 3+901.5 - MS	None	None

[1] Transfered from MDOT to county jurisdiction 12-20-61

IL = Inner lane OL = Outer lane TJ = Transverse joint
MS = Mid-slab TC = Transverse crack

Table B.1 Data for projects investigated during the rubblization operation (continued)

Project	Control section	Original contract job number	Pavement type	Joint type (E, C, D) and spacing (m/ft)	Thickness (mm/in)			Load transfer (mm/in)	Construction history
					Concrete	Base	Subbase		
US-131	41133 59012	00607 00608 03964	JRCP	22.0/72-C	229/9	100/4	254/10	32x405/ 1.25x16	1973 Construction 1992 Joint repairs
M-50	58042	42-C1	JRCP	30.2/99-C	203/8	75/3	305/12	25x?/1x?	1959 Construction
US-31	10032	7-C1 7-C2 04771 17791	JPCP	30.5/100-E 0-C 0-D	229-178-229/ 9-7-9	None	None	None	1928 Construction 1953 Overlay 1972 Overlay 1982 Mill, crack and seat, overlay
M-53	50012 44031	19-C1 31-C1 07692	JRCP	30.5/100-E 0-C 0-D	229-178-229/ 9-7-9	None	None	None	1930 Construction 1963 Widening and overlay 1975 Overlay
M-18	26011	1-C6 1-C7 1-C8 11032 04773 09294	JRCP	36.6/120-E 18.3/60-C 9.1/30-D	229-178-229/ 9-7-9	None	None	19x380/ 0.75x15	1940 Construction 1976 Joint repairs and overlay
Old US-131	41401 41013[1]	90-C4	JRCP	30.2/99-C	229/9	305/12	None	N/A	1956 Construction

[1] Transfered from MDOT to county jurisdiction 10-29-69 E = Expansion C = Contraction D = Dummy

Table B.1 Data for projects investigated during the rubblization operation (continued)

Project	Control section	Original contract job number	Pavement type	Joint type (E, C, D) and spacing (m/ft)	Thickness (mm/in)			Load transfer (mm/in)	Construction history
					Concrete	Base	Subbase		
US-10	67022	31-C2 31-C3 22-C1 17402 14225	JRCP	30.5/100-E 0-C 0-D	229-178-229/ 9-7-9	None	None	None	1933 Construction 1958 Widening and overlay 1980 Overlay
Old US-10	56555 56041[1]	15-C3 C1R	JRCP	30.5/100-E 0-C 0-D	229-178-229/ 9-7-9	None	None	None	1932 Construction 1962 Overlay
US-31	05011	28-C1 28-C2 17338	JRCP	120.7/396-E 30.2/99-C 0-D	203/8	225/9	None	25x457 1x18	1953 Construction 1980 Bit Widening
M-21	25081	27-C4 81-C1 01782 13045	JRCP	18.3/60-E 0-C 9.1/30-D	254-203-254/ 10-8-10 (IL) 203/8 (OL)	None (IL) 75/3 (OL)	None (IL) 225/9 (OL)	TEJB[3] (IL) 25/1 (OL)	1938 Construction 1957 Concrete widening (OL), overlay (IL) 1972 Overlay (IL) 1978 Joint repairs
US-23	01052 04031	15-C3 11-C1 11-C2 31-C1	JRCP	30.5/100-E 0-C 0-D	229-178-229/ 9-7-9	None	None	None	1933 Construction 1966 Widening and overlay
Portage Road	39405	N/A	JPCP	N/A	200/8	None	None	None	1920s Construction 1940s, 1960s & 1980s Overlay?

[1] Transfered from MDOT to county jurisdiction 12-20-61 TEJB[3] = Translode expansion joint base IL = Inner lane
OL = Outer lane E = Expansion C = Contraction D = Dummy

Table B.2 ADT and asphalt mixes used on rubblized projects during the study.

Project	Control section	Asphalt course	Mix	Thickness (mm/in)	ADT
US-131	41133 59012	Surface Leveling Base	4E10 3E10 3E10	38/1.5 57/2.25 57/2.25	13000
M-50	58042	Surface Leveling Base	4E3 3E3 3E3	38/1.5 51-89/2-3.5 77/3	7450
US-31	10032	Surface Leveling Base	4E3 4E3 3E3	38/1.5 45/1.75 57-97/2.25-3.75	8500
M-53	50012 44031	Surface Leveling Base	4B 3B 3B	38/1.5 114/4.5 114/4.5	15300
M-18	26011	Surface Leveling Base	13A 13A 13A	38/1.5 51/2 51/2	7500-4700
Old US-131	41401 41013[1]	Surface Leveling Base	4C 3C 2B	38/1.5 38/1.5 64/2.5	14800
US-10	67022	Surface Leveling Base	5E3 4E3 3E3	32/1.25 45-59/1.75-2.33 57/2.25	6150
Old US-10	56555 56041[2]	Surface Leveling	13A 13A	64/2.5 (51/2[3]) 64/2.5 (77/3[3])	2100
US-31	05011	Surface Leveling Base	4E3 3E3 3E3	38/1.5 51/2 51/2	11000
M-21	25081	Surface Leveling Base	5E3 4E3 3E3	38/1.5 51/2 64/2.5	11800-14500
US-23	01052 04031	Surface Leveling Base	4C 3C 2C	38/1.5 38/1.5 51/2	6800
Portage Road	39405	Surface Leveling Base	4C 3C 2C	38/1.5 38/1.5 77/3	10000

[1] Transfered from MDOT to county jurisdiction 10-29-69
[2] Transfered from MDOT to county jurisdiction 12-20-61
[3] East of Salt Creek

Table B.3 Project construction history of rubblized concrete pavements included in the study

Project	Control Section	Construction history				Period between fixes (years)			
		First	Second	Third	Fourth	First	Second	Third	Fourth
US-131	41133	C 1973-99				26			
M-50	58042	C 1959-99				40			
US-31	10032	C 1928-53	OL 1953-72	OL 1972-82	M CS OL 1982-99	25	19	10	17
M-53	44031	C 1930-63	OL 1963-75	OL 1975-99		33	12	24	
M-18	26011	C 1940-76	OL 1976-99			36	23		
Wolverine Blvd (Old US-131)	41401 41013[1]	C 1956-99				43			
US-10	67022	C 1933-58	OL 1958-80	OL 1980-99		25	22	19	
Saginaw Rd (Old US-10)	56555 56041[2]	C 1932-62	OL 1962-99			30	37		
US-31	05011	C 1953-99				46			
M-21 IL M-21 OL	25081	C 1938-57 C 1957-99	OL 1957-72	OL 1972-99		19 42	15	27	
US-23	01052 04031	C 1933-66	OL 1966-99			33	33		
Portage Road	39405	C 1920-40	OL 1940-60	OL 1960-80	OL 1980-99	20	20	20	19

[1] Transfered from MDOT to county jurisdiction 10-29-69 [2] Transfered from MDOT to county jurisdiction12-20-61 C = Concrete construction

OL = Asphalt overlay M = Mill asphalt CS = Crack and seat concrete

Table B.4 Trench reference location

US-131 SOUTHBOUND
➢ US-131 NB - M-46, Station 36+873.0797, CSMP 3.059 ➢ US-131 SB - M-46, Station 36+873.0797, CSMP 3.064 ➢ Trench, Station 37+558.5 [1232+16 English, engraved in the concrete], CSMP 3.490 2248.75 ft north of the M-46 overpass, 170 ft south of the large exit sign for Cedar Springs (exit 104), 40 ft east (from old centerline) to wood 2x4 post (in the median ditch centerline)
M-50 EASTBOUND
➢ Geiger Road. Station 12+051, CSMP 1.274 {Plans Station 12+055, CSMP 1.277} ➢ Nichols Road, Station 10+359, CSMP 0.233 {Plans Station 10+364, CSMP 0.226} ➢ Trench, Station 10+441, CSMP 0.274 @ Telephone pole/Ameritech riser #7953 (south side of road), 36, 136 and 236 ft west to transverse joints, 269 ft east of the centerline of Nichols Road ➢ Trench, Station 10+803, CSMP 0.499, 6 ft west of mailbox #7772 (south side of road) ➢ Trench, Station 11+151, CSMP 0.715, 67 ft east of centerline of gravel drive to north at house #7650, 83 ft east of transverse joint and mailbox #7650 (TJ in good condition), 17 ft west of transverse joint (TJ in good condition), 6 ft west of transverse crack (tight), 3 ft east of transverse crack (tight) ➢ Trench, Station 12+000, CSMP 1.243 (Transverse Joint), 168 ft west of the centerline of Geiger Road (to the south)m, 163 ft east of the centerline of a 10-ft gravel drive (to the south), Wood 2x4 post set on south side of road in ditch centerline
US-31 NORTHBOUND
➢ Carmean Road, Station 29+622, CSMP 11.399, N. Reynolds Road, Station 24+707, CSMP 14.354, S. Reynolds Road, Station 24+710, CSMP 14.352 ➢ Trench, Station 26+652, CSMP 13.145 ➢ Trench, Station 26+680, CSMP 13.128, 59.5 ft west to guy pole, 53.5 ft west to power pole (#IT3 133 16), Wood 2x4 post set on south side of road ➢ Trench, Station 27+324, CSMP 12.728 (Transverse Joint), Midway between two drives for trailer park and power poles, 35 ft west to Mich-con gas markers ➢ Trench, Station 27+385, CSMP 12.690 (Transverse Joint)

Table B.4 Trench reference location (continued)

M-53 NORTHBOUND
➢ Dryden Road, Station 53+474.32, CSMP 4.256, Hollow Corner Road, Station 55+084.55, CSMP 5.256 ➢ Trench, Station 53+621, CSMP 4.347, 482 ft north of Dryden Road ➢ Trench, Station 53+900, CSMP 4.520, 14 ft north of power pole with GTE riser #3865 @ SW corner of VRD ("Vehicle Research and Development, Inc."), 38 ft north of transverse crack, 45 ft north of transverse joint (Station 53+886, CSMP 4.511), 44 ft south of transverse joint ➢ Trench, Station 54+210, CSMP 4.713, (0.5-mile south of Hollow Corner Road), @ Power pole (23 ft east of edge of bit shoulder), 5.5 ft north of gas pipeline marker "Consumers Power Company", 6 ft south of transverse crack, 30 ft south of power pole, 27 ft south of transverse joint, 118 ft south of centerline of concrete drive for "Square Deal Building Supply" (#3777)
M-18 NORTHBOUND
➢ Roberson Road, Station 3+986, CSMP 5.534 ➢ Trench, Station 3+180, CSMP 5.033, 10 ft north of power pole in front of "Brown Machine" ➢ Trench, Station 3+194, CSMP 5.041, 58 ft north of power pole in front of "Brown Machine" ➢ Trench, Station 4+034, CSMP 5.563 (Transverse Joint), 94 ft north of the centerline of Roberson Road, Wood 2x4 post set on east side of road at edge of ditch/cattails

Table B.4 Trench reference location (continued)

OLD US-131 NORTHBOUND (WOLVERINE BLVD)

- Wolverine Blvd, Control Section 41401, CSMP POB 0.000, Old US-131, Control Section 41013, CSMP POB 2.669, 10 Mile Road, Station 12+000, CSMP (41013) 5.027, CSMP (41401) 2.207, Kroes Road (Cortland Drive), Station 9+320, CSMP (41013) 3.362, CSMP (41401) 0.542

- Trench, Station 9+858 (0.3-miles north of Kroes Road), [160+63 stenciled English], CSMP (41013) 3.696, CSMP (41401) 0.867, 23.5 and 30 ft south of bit patch at old transverse joint, 35, 41.5 and 56 ft north of transverse crack, with bit, 39 ft north of 6-in outlet in median for southbound, 46.5 ft north of 6-in outlet in median for northbound, 70 and 72.5 ft north of bit patch at old transverse joint, 38 ft west (from old centerline) to wood 2x4 post

- Trench, Station 10+690 (0.8-miles north of Kroes Road and 0.8-miles south of 10 Mile Road) [187+93 stenciled English], CSMP (41013) 4.213, CSMP (41401) 1.393, 16.5 and 22 ft south of bit patch at old transverse joint, 30.5 ft north of transverse crack, with bit, 76 and 81 ft north of bit patch at old transverse joint, 79 ft north of 6-in outlet in median for northbound, 46 ft west (from old centerline) to wood 2x4 post

- Trench, Station 11+641 (1.3-miles north of Kroes Road and 0.3-miles south of 10 Mile Road) [219+15 stenciled English], CSMP (41013) 4.804, CSMP (41401) 1.984 , 17 ft north of 6-in outlet to east & north end of guardrail, 67 and 70 ft north of bit patch at old transverse joint, 29 and 34 ft south of bit patch at old transverse joint, 35 ft south of "Welcome to ROCKFORD" sign

US-10 EASTBOUND

- 100th Ave, Station 20+116, CSMP 11.839

- Trench, Station 19+867, CSMP 11.684, 55 ft east of transverse joint, 8, 21, 38 and 70 ft east of transverse cracks, 119 ft east of east end of concrete curb, 182 ft east of centerline of drive, 8, 16, 30, 58 and 81 ft west of transverse crack, 34 ft west of "No Passing Zone" sign, 45 ft west of transverse joint, 75 ft south (from old centerline) to wood 2x4 post

- Trench, Station 20+144, CSMP 11.856, 55 ft east of transverse crack, 90 ft east of transverse joint, 93 ft east of centerline of 100th Avenue and section corner, 11 ft west of transverse joint, 12 ft west of "Evart City Limit" sign

- Trench, Station 20+389, CSMP 12.008, 20.5 ft east of transverse crack, 45 ft east of fire hydrant, 79.5 ft east of transverse joint, 117 ft east of "Evart Industrial Park" brick and wood sign, 22.5 ft west of transverse joint, 56 ft west of power pole in front of industrial building

Table B.4 Trench reference location (continued)

OLD US-10 EASTBOUND (SAGINAW ROAD)

- Castor Road, Station 24+948, CSMP 7.098, Bergman Road, Station 25+818.806, CSMP 7.640
- Trench, Station 25+064, CSMP 7.171, 33 ft east of transverse joint, 381.5 ft east of the centerline/centerline of Castor Road, 69 ft west of transverse joint, 102 ft west light pole post, 33 ft south (from old centerline) to wood 2x4 post
- Trench, Station 25+594, CSMP 7.500, @ Power pole and Ameritech riser (74 ft north from old centerline), 64 ft east of transverse joint, 37 ft west of transverse joint, 50 ft south (from old centerline) to wood 2x4 post

US-31 SOUTHBOUND

- S. Bayshore Drive, Station 20+091.4, CSMP 1.601
- Trench, Station 2+637, CSMP 1.940, 9.5 and 15 ft north of transverse joint, concrete patch, 11, 25, 37, 52 and 70 ft south of transverse crack, 83 and 91 ft south of transverse joint, concrete patch, 65 ft north of centerline of bit drive for building #10268, 78 ft south of centerline of bit drive for building #10268
- Trench, Station 2+200, CSMP 1.670, 3 ft south of "Pass With Care" sign, 54 and 60 ft north of transverse joint, concrete patch, 38 and 44 ft south of transverse joint, concrete patch, 365 ft north of centerline/centerline of S. Bayshore Drive

M-21 WESTBOUND

- Morrish Road, Station 0+719, CSMP 4.943, Elms Road, Station 2+281.476, CSMP 5.914 Cole Creek, Station 1+216.5, CSMP 5.252
- Trench, Station 1+200, CSMP 5.242, 75 ft east of transverse joint, 13 ft west of transverse joint, 41 ft west of west end of concrete headwall over Cole Creek, 68 ft west of east end of concrete headwall over Cole Creek, 84 ft west of centerline of gravel drive for house #7330, 35 ft north (from north edge of concrete) to wood 2x4 post
- Trench, Station 1+309, CSMP 5.310 (Transverse Crack), 16 ft west of centerline of gravel drive for house #7316, 25 ft west of power pole, 16, 46, 76 and 106 ft west of transverse joints (WBIL), 14, 44 and 66 ft east of transverse joints (WBIL), 63 and 69 ft east of transverse joint, concrete patch (WBOL), 103.5 and 107.5 ft west of transverse joint, concrete patch (WBOL)
- Trench, Station 1+684, CSMP 5.543, 9 ft west of power pole #7191, 19, 55 and 85 ft west of transverse joints (WBIL), 16, 40.5, 66 and 96 ft east of transverse joints (WBIL), 9 ft east of transverse joint (WBOL), 83.5 and 87 ft west of transverse joint, concrete patch (WBOL), 25 ft north (from north edge of concrete) to short wood 2x4 post (even with power pole)

Table B.4 Trench reference location (continued)

US-23 SOUTHBOUND
➢ Ossineke Road, Station 456+58.05, CSMP 5.234 ➢ Trench, Station 465+21, CSMP 5.397, 9 and 22 ft north of transverse crack, 36.5 ft north of transverse joint, 15.5 ft south of transverse crack, 17 ft south of centerline bit drive for house #9910, 64.5 ft south of transverse joint, 106 ft south of the south end of filler aggregate placed on rubblized surface ➢ Trench, Station 465+85.5, CSMP 5.410 (Transverse Joint), 49 ft north of transverse crack, 47.5 ft north of centerline bit drive for house #9910, 41.5 ft south of the south end of filler aggregate placed on rubblized surface
PORTAGE ROAD
➢ Forest Road, Station 3+474, Zylman Ave, Station 4+128, The roadway stationing is stenciled into the easterly concrete curb. ➢ Trench, Station 3+609, 16.4 ft west of B/C to east edge of concrete, 11 ft north of power pole on east side, 46 ft north of centerline bit drive for building #8811, 26.5 ft south of power pole on east side, 84.5 ft south of fire hydrant on east side ➢ Trench, Station 3+901.5, 16.3 ft west of B/C to east edge of concrete, 34 ft north of telephone pole (Bell riser) on east side, 91 ft north of fire hydrant on east side, 124 ft north of centerline bit drive for building #8675

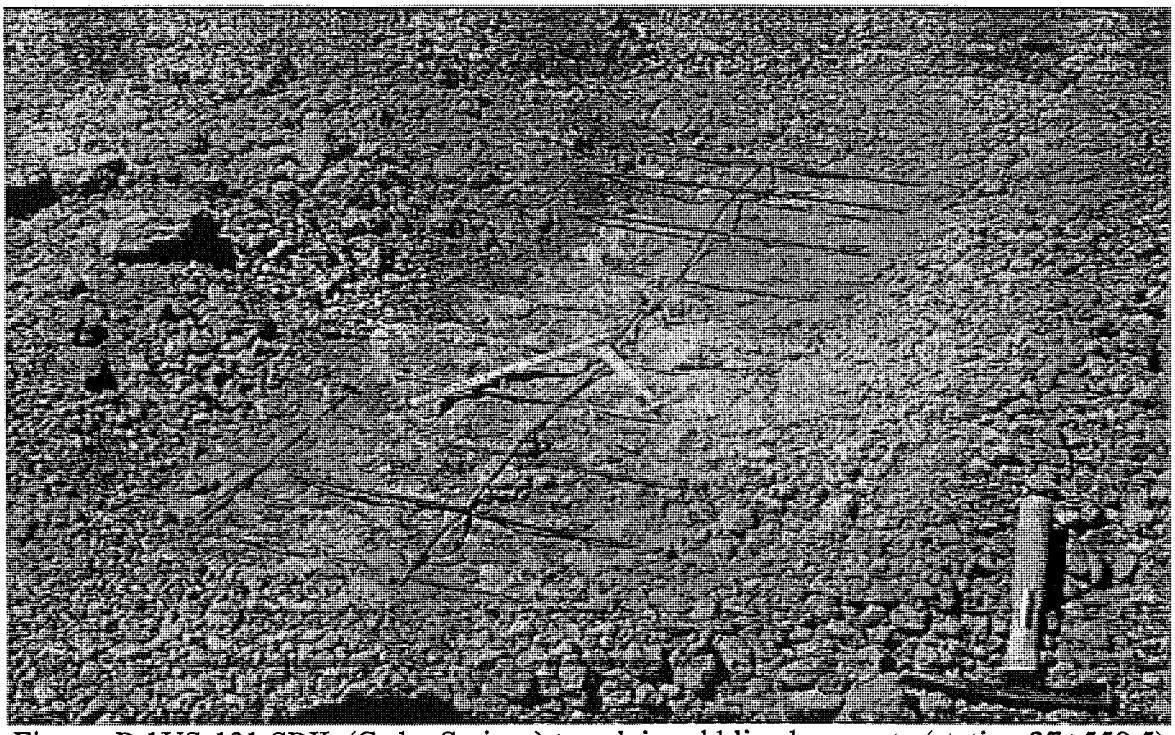

Figure B.1US-131 SBIL (Cedar Springs) trench in rubblized concrete (station 37+558.5) resonant breaker

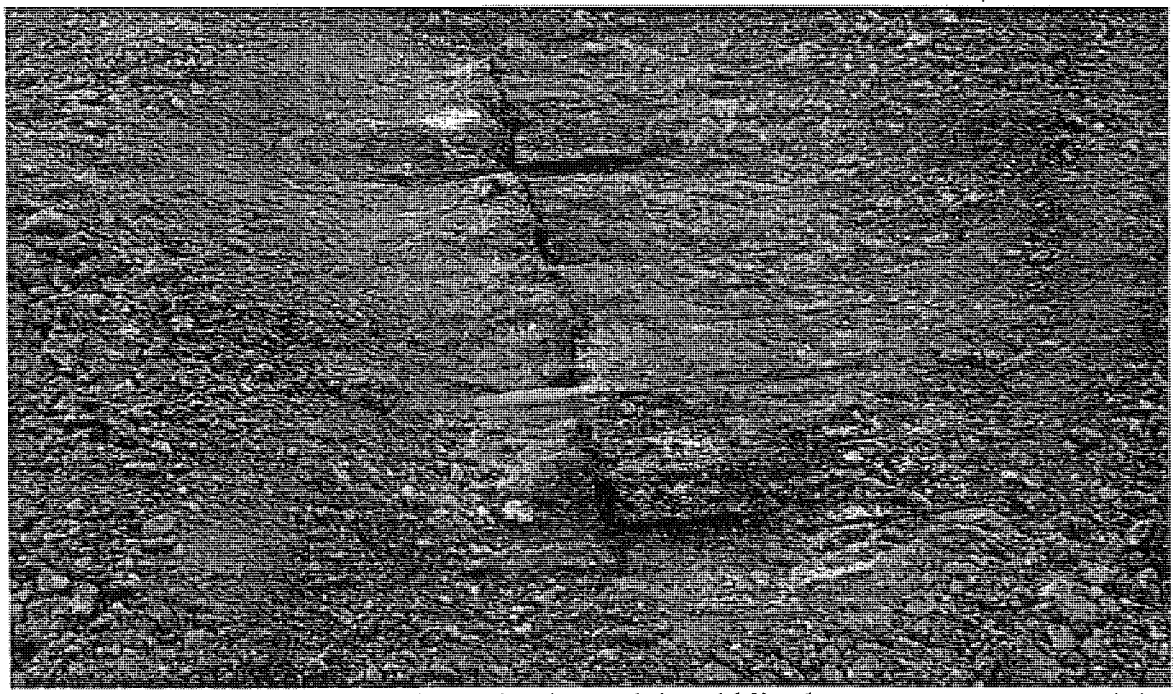

Figure B.2 US-131 SBOL (Cedar Springs) trench in rubblized concrete at transverse joint resonant breaker

Figure B.3 M-50 EB (Dundee) trench in rubblized concrete at transverse joint (station 12+000) badger breaker

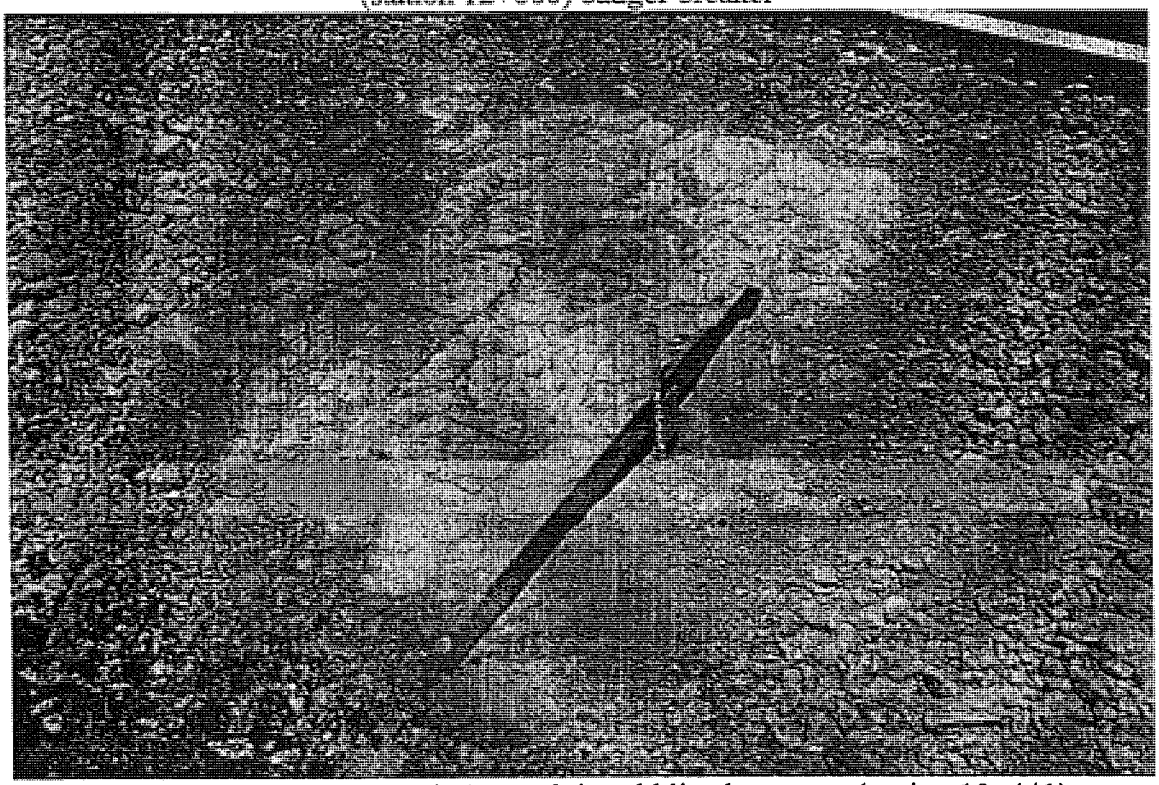

Figure B.4 M-50 EB (Dundee) trench in rubblized concrete (station 10+441) badger breaker

Figure B.5 US-31 SB (Honor) trench in rubblized concrete (station 26+130) badger breaker

Figure B.6 US-31 SB (Honor) trench in rubblized concrete (station 26+652) badger breaker

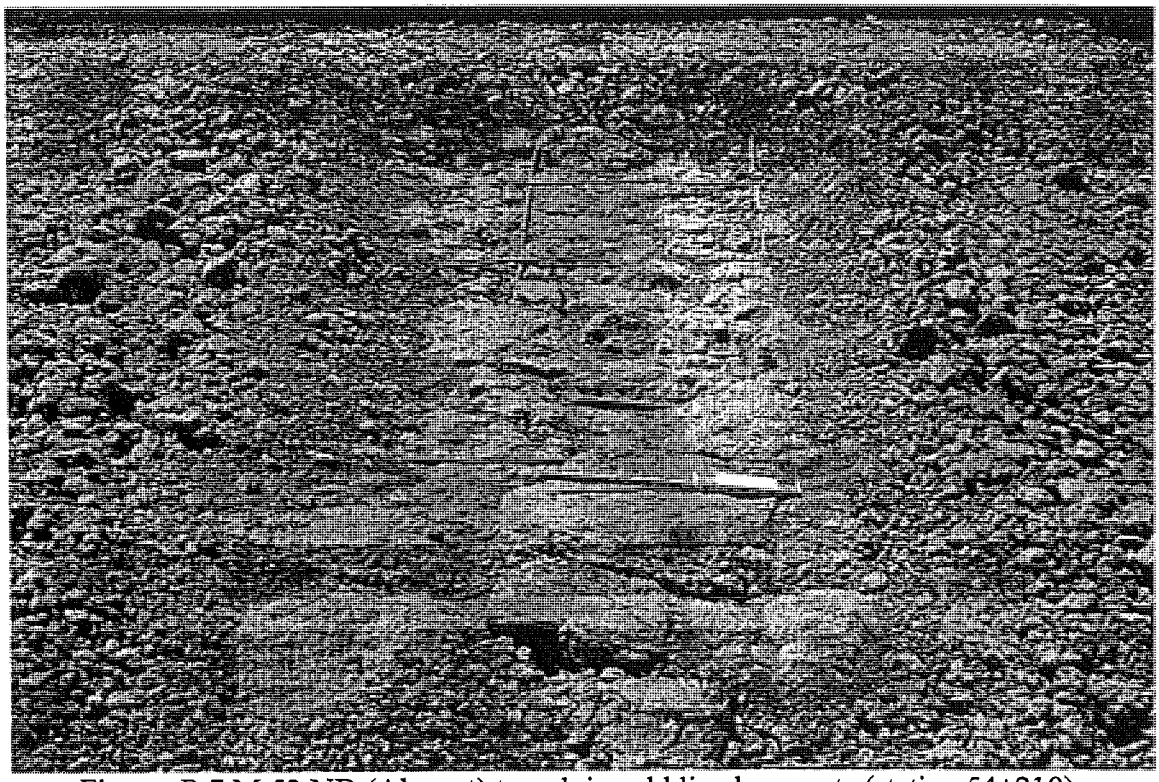

Figure B.7 M-53 NB (Almont) trench in rubblized concrete (station 54+210) badger breaker

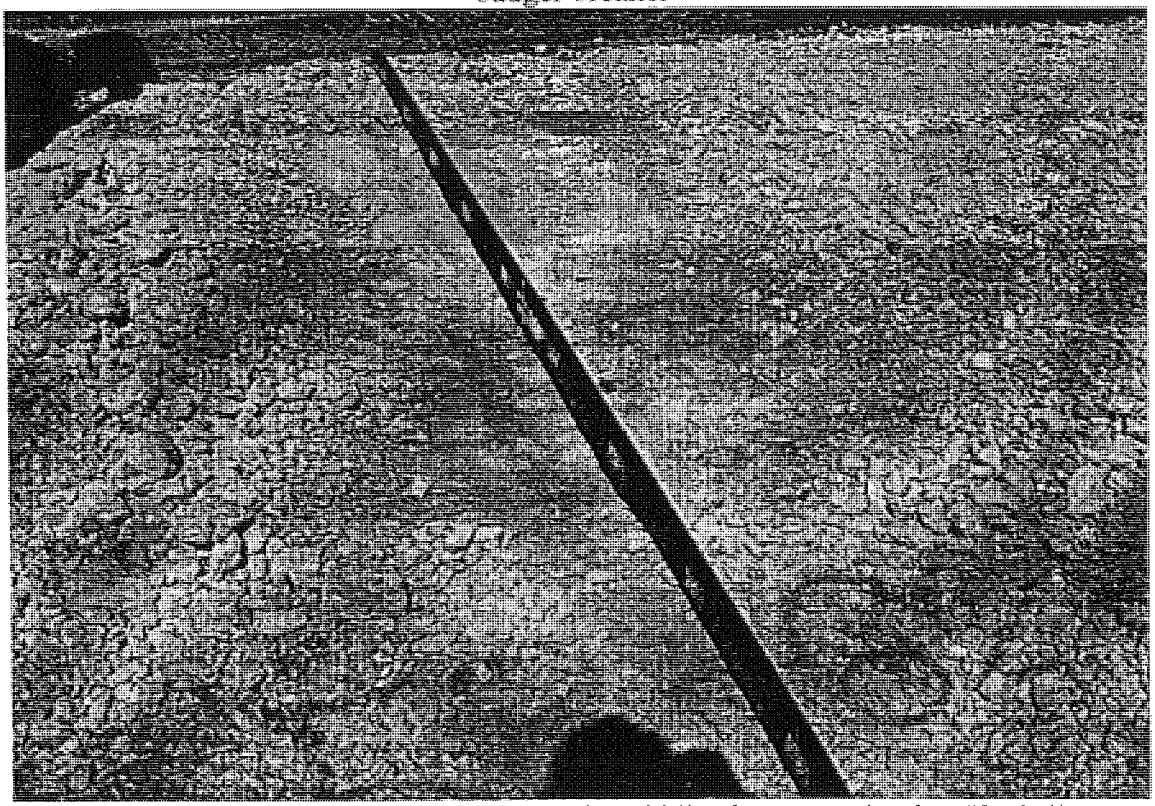

Figure B.8 M-53 NB (Almont) trench in rubblized concrete (station 53+621) badger breaker

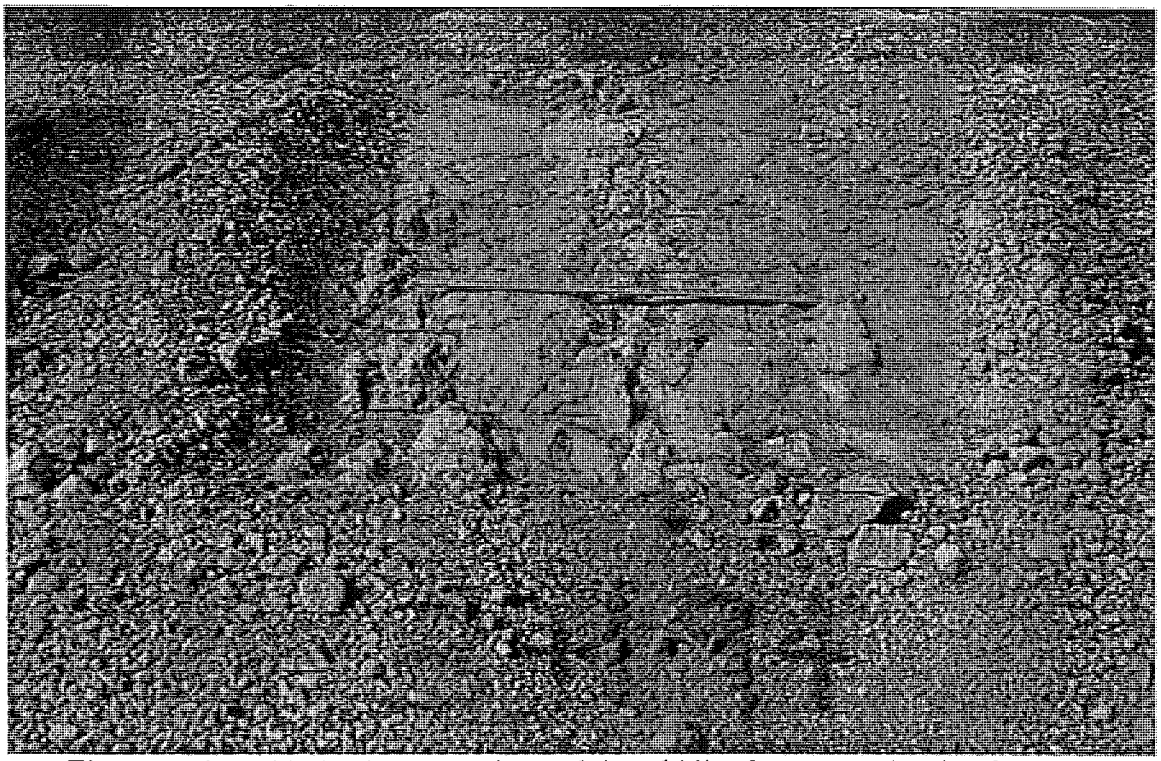

Figure B.9 M-18 NB (Beaverton) trench in rubblized concrete (station 3+194) badger breaker

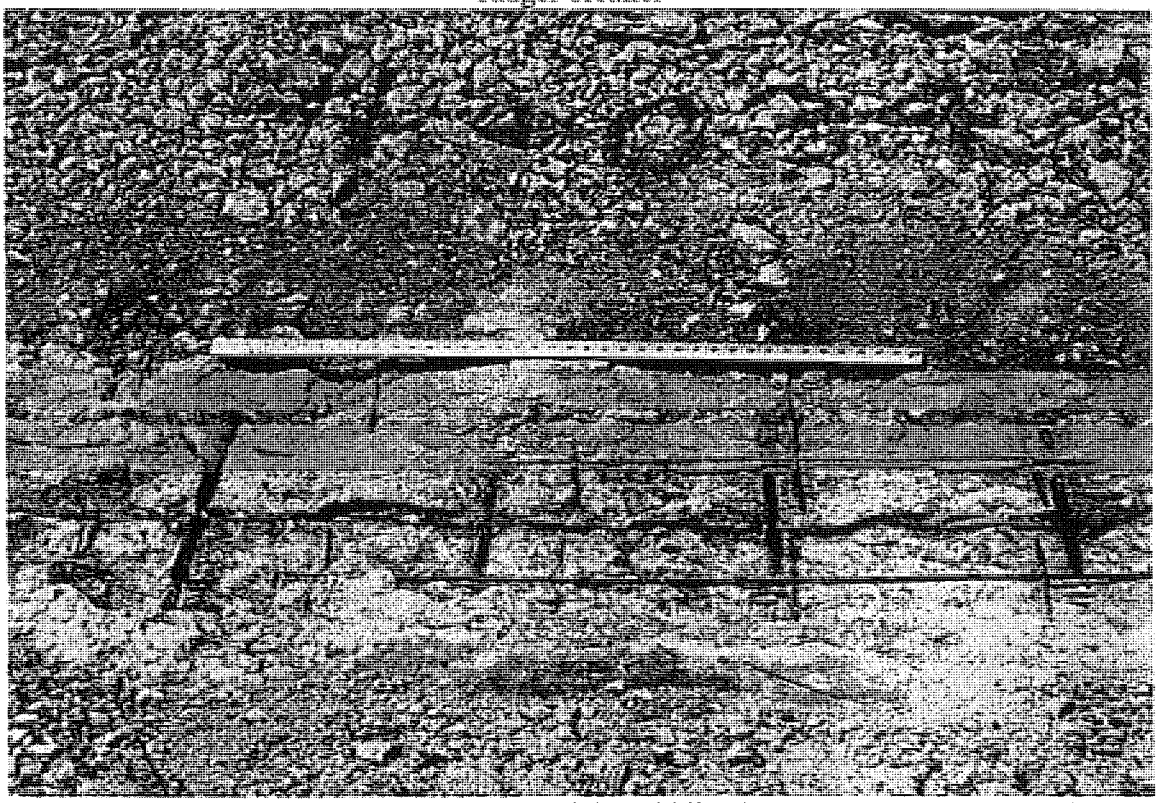

Figure B.10 M-18 NB (Beaverton) trench in rubblized concrete at transverse joint (station 4+034) badger breaker

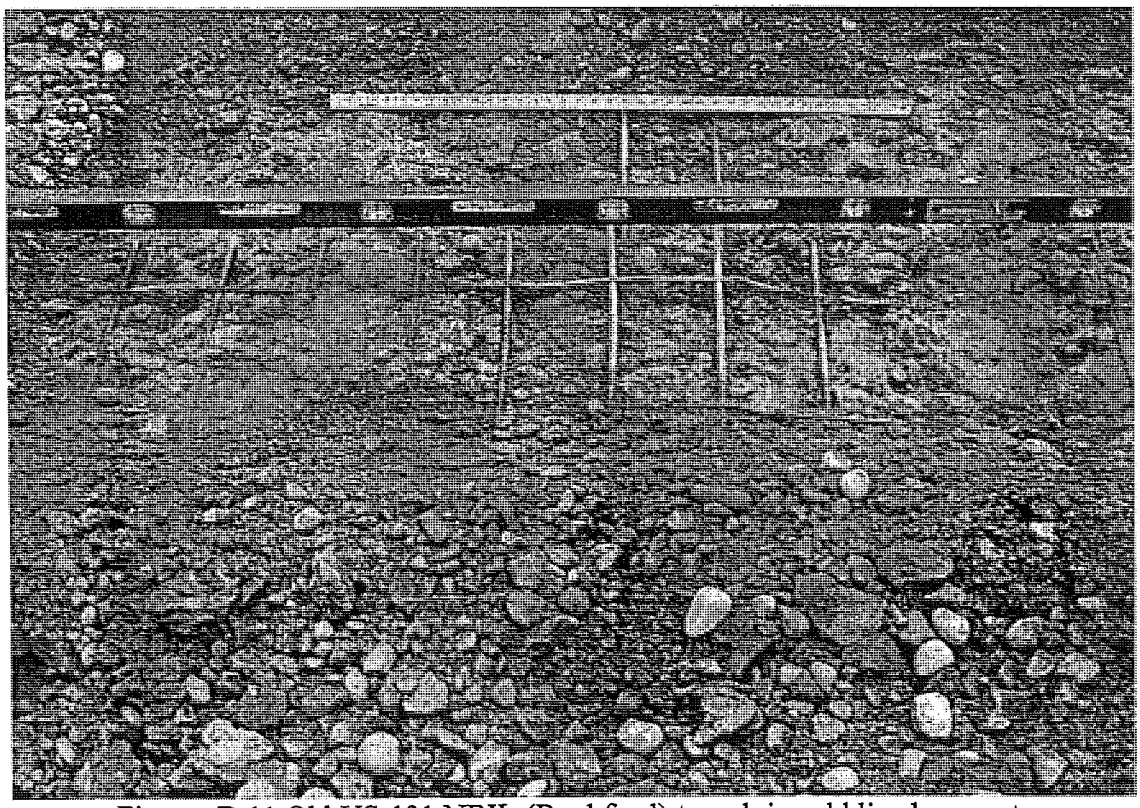

Figure B.11 Old US-131 NBIL (Rockford) trench in rubblized concrete (station 9+858) resonant breaker

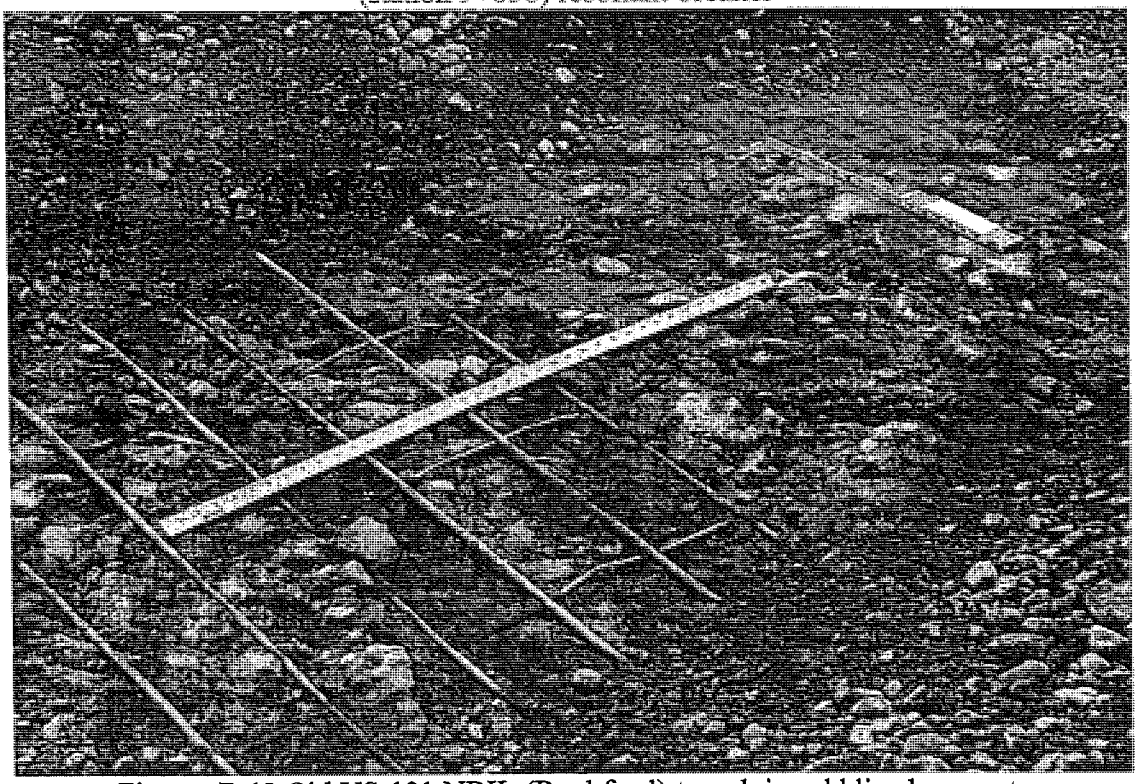

Figure B.12 Old US-131 NBIL (Rockford) trench in rubblized concrete (station 10+690) resonant breaker

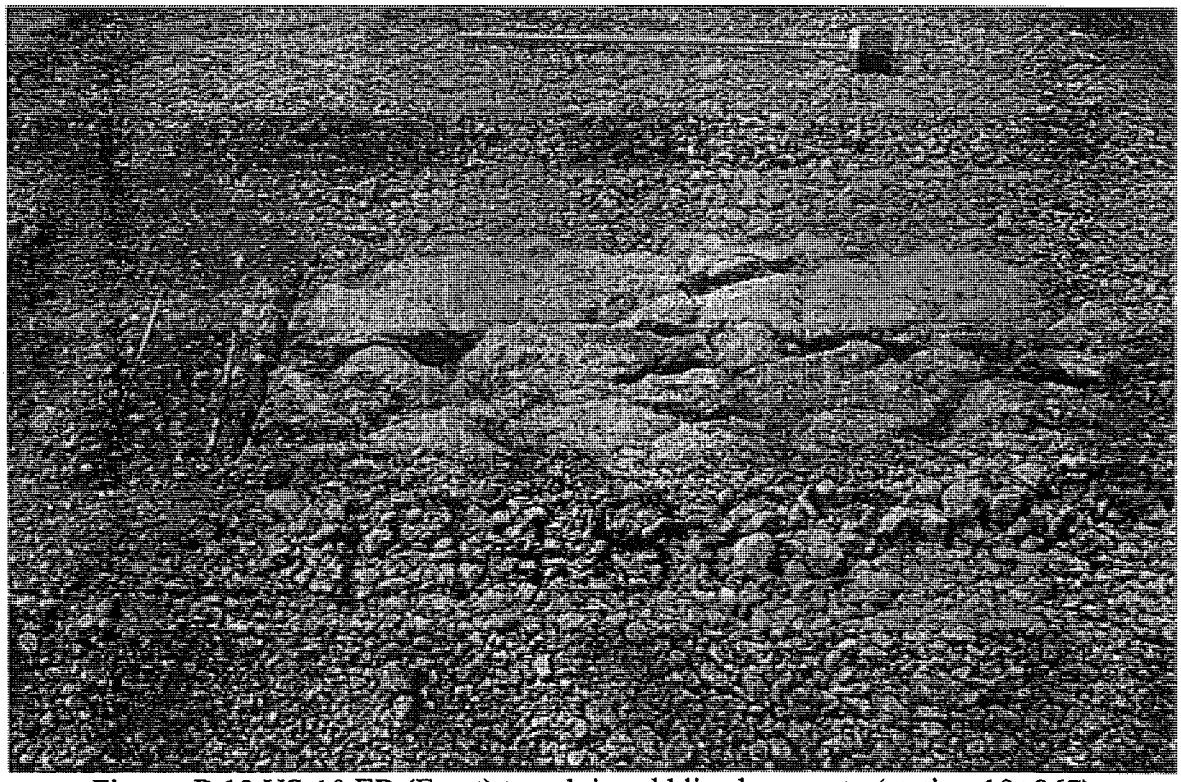

Figure B.13 US-10 EB (Evart) trench in rubblized concrete (station 19+867) badger breaker

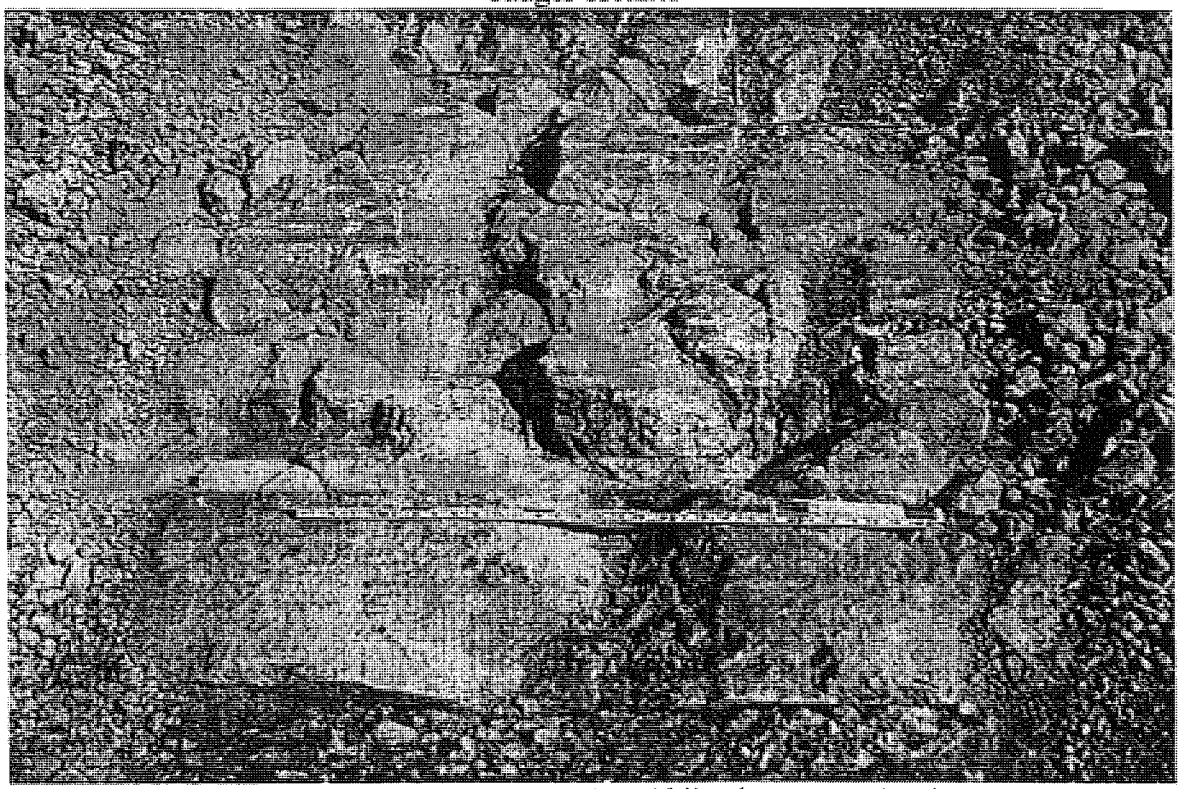

Figure B.14 US-10 EB (Evart) trench in rubblized concrete (station 20+389) badger breaker

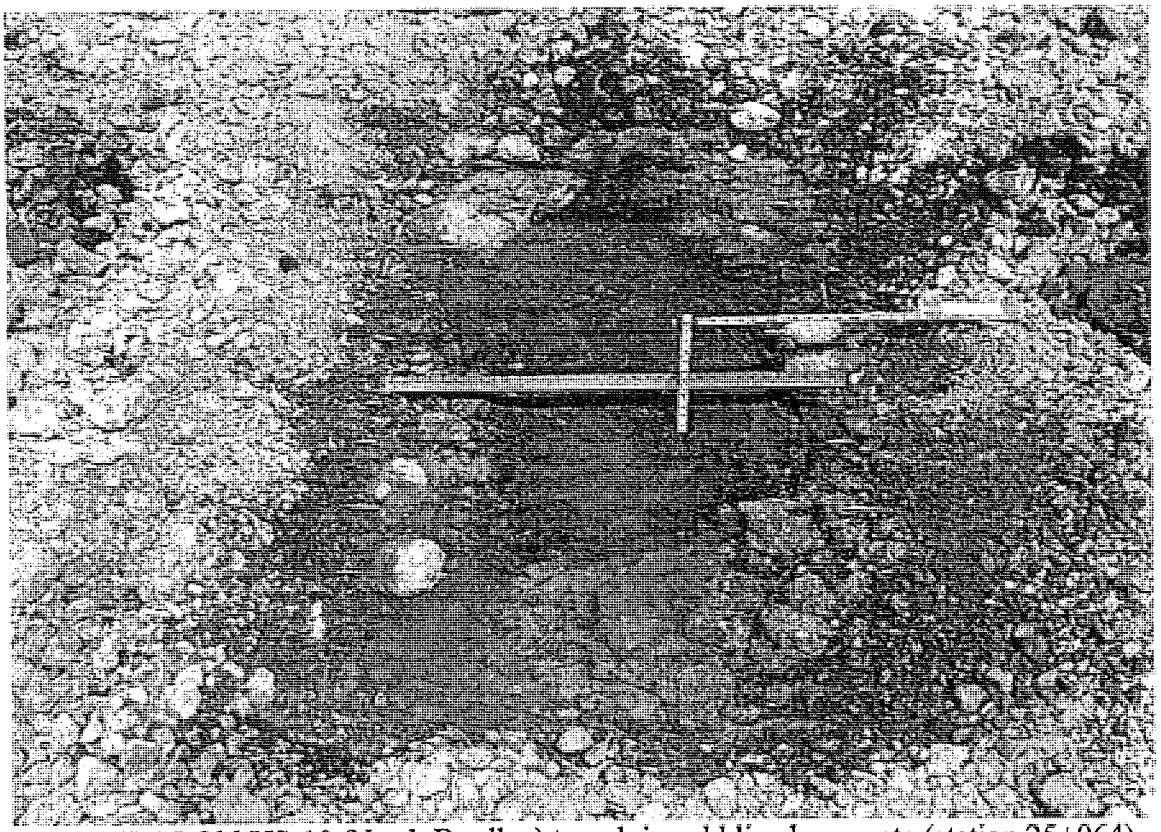

Figure B.15 Old US-10 (North Bradley) trench in rubblized concrete (station 25+064) resonant breaker

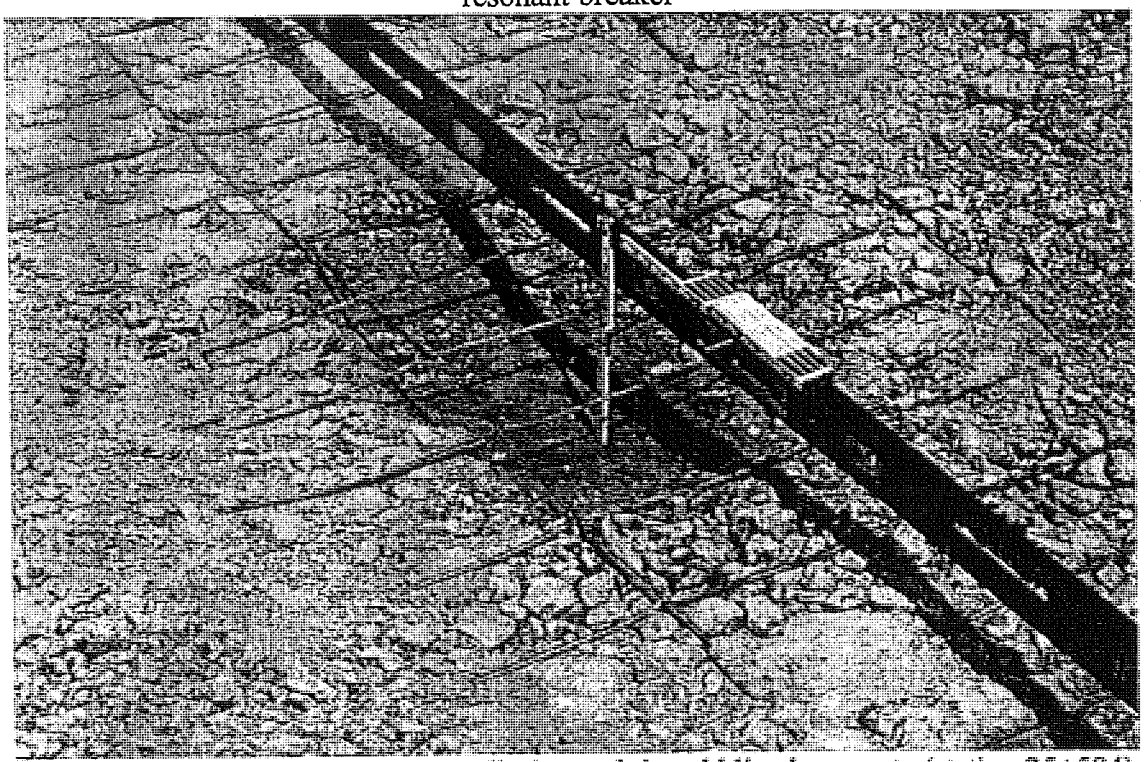

Figure B.16 Old US-10 (North Bradley) trench in rubblized concrete (station 25+594) resonant breaker

Figure B.17 US-31 SB (Elk Rapids) trench in rubblized concrete (station 2+200) badger breaker

Figure B.18 US-31 SB (Elk Rapids) trench in rubblized concrete (station 2+637) badger breaker

Figure B.19 M-21 WBIL (Flint) trench in rubblized concrete (station 1+200) badger breaker

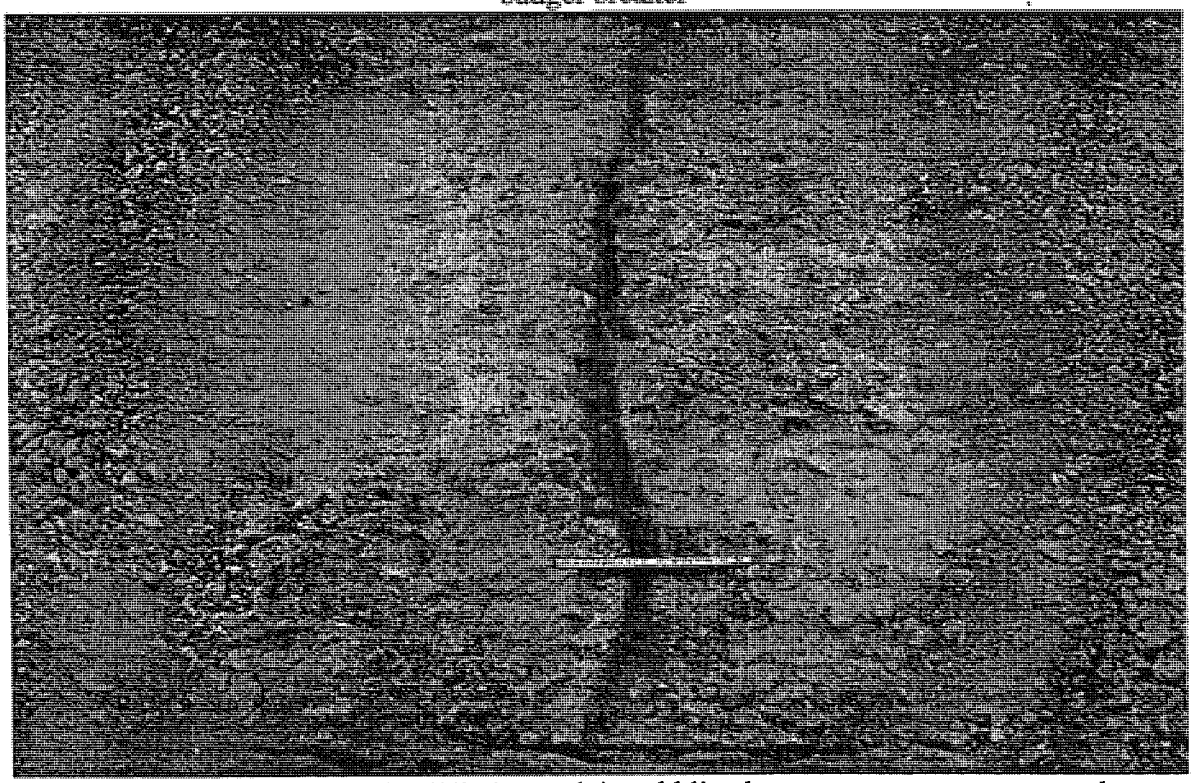

Figure B.20 M-21 WBIL (Flint) trench in rubblized concrete at transverse crack (station 1+309) badger breaker

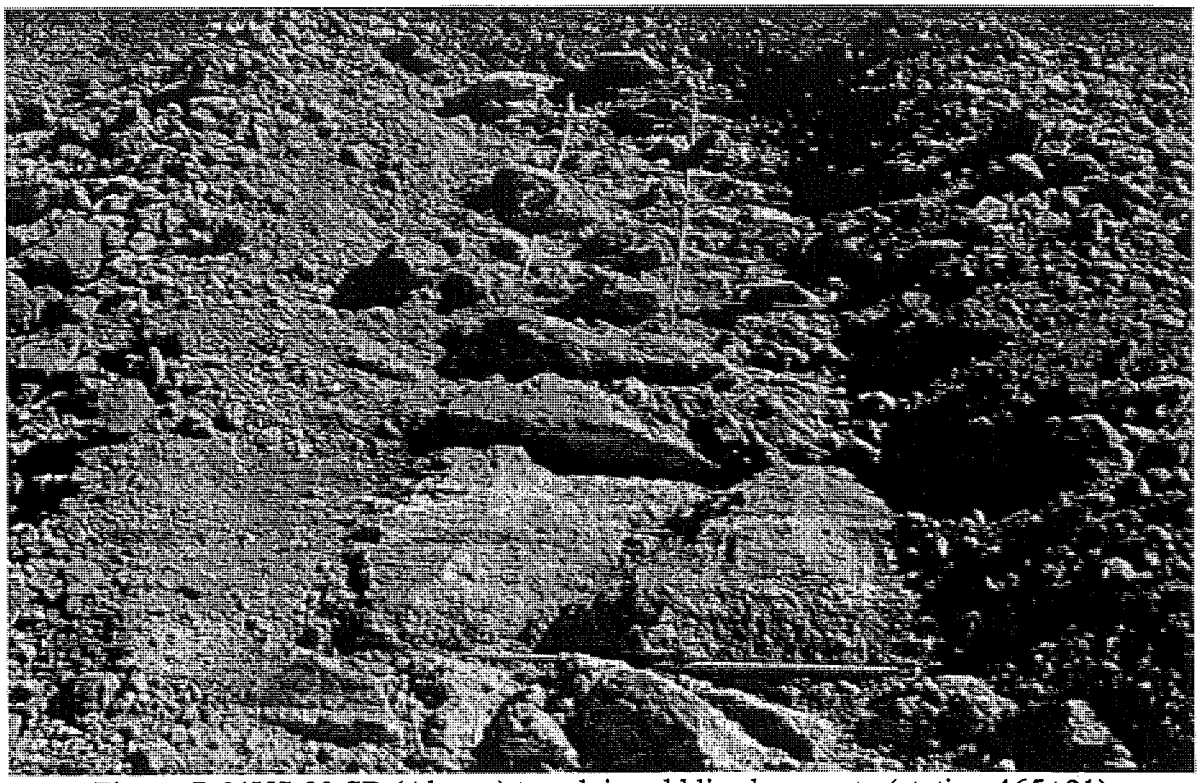

Figure B.21US-23 SB (Alpena) trench in rubblized concrete (station 465+21) resonant breaker

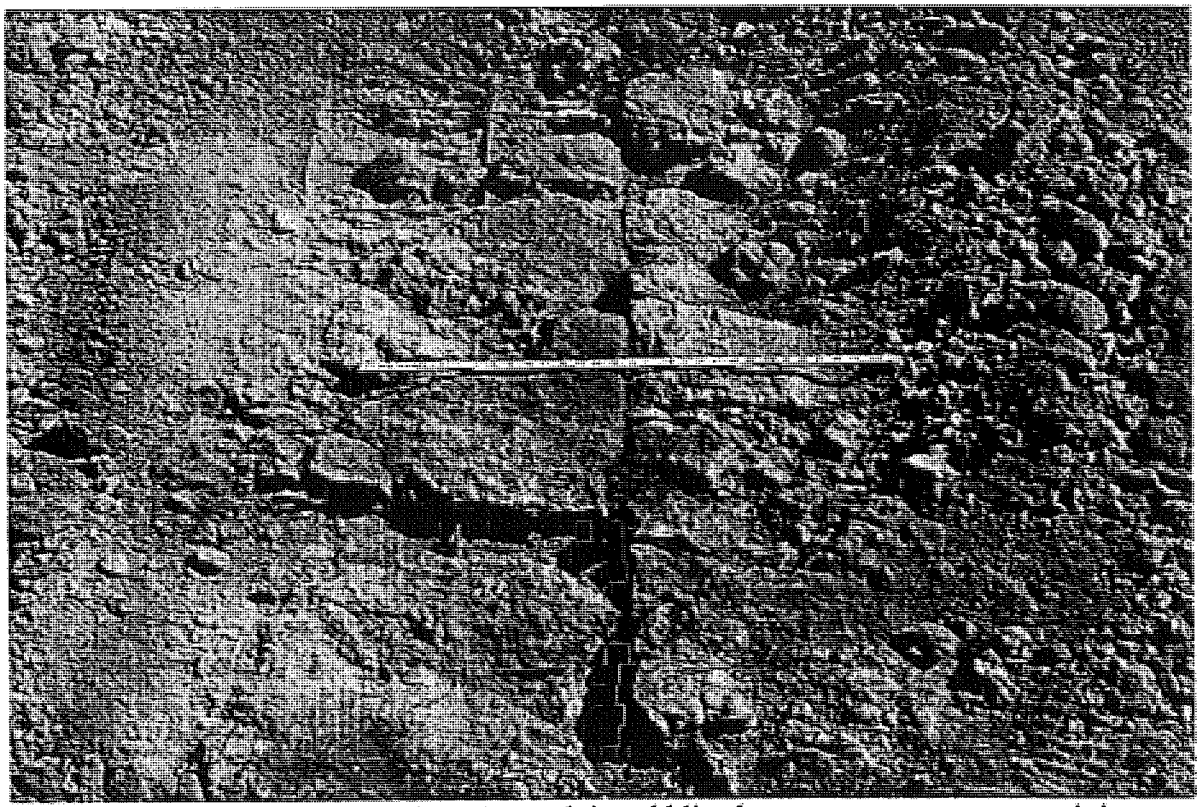

Figure B.22 US-23 SB (Alpena) trench in rubblized concrete at a transverse joint (station 465+85.5) resonant breaker

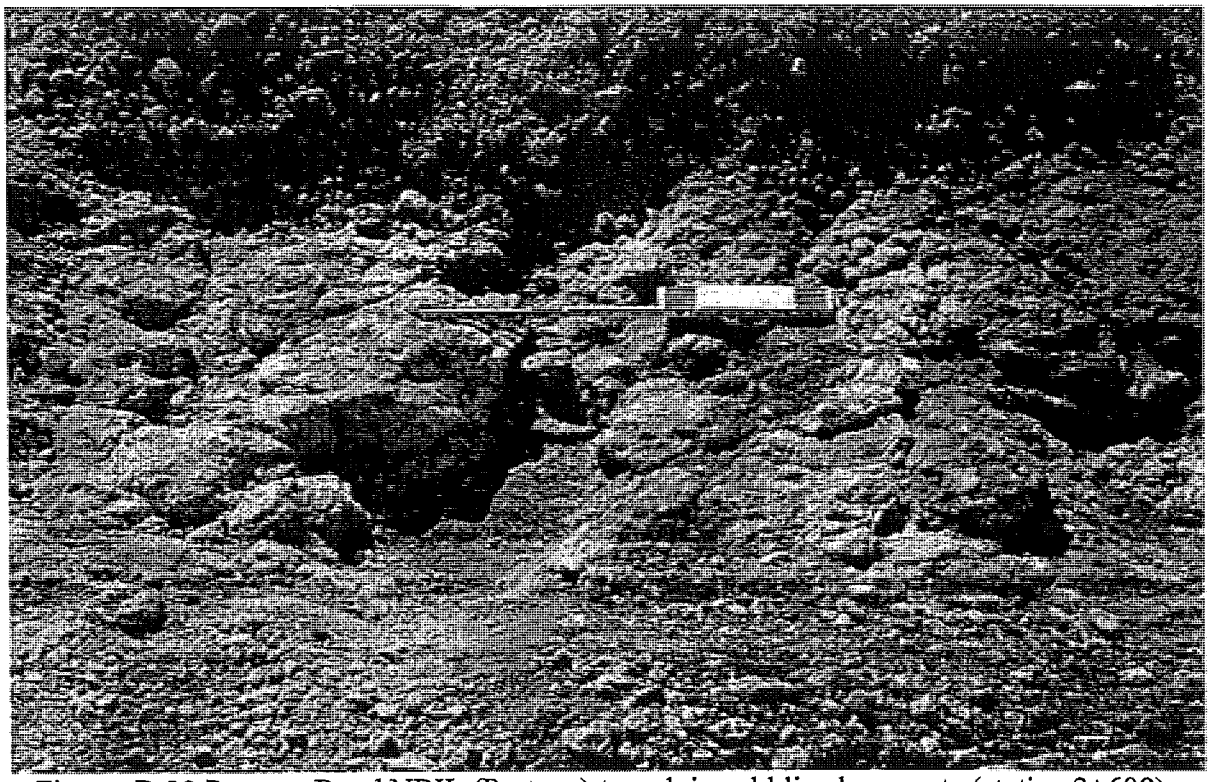

Figure B.23 Portage Road NBIL (Portage) trench in rubblized concrete (station 3+609) resonant breaker

Figure B.24 Portage Road NBIL (Portage) trench in rubblized concrete (station 3+901.5) resonant breaker

APPENDIX C

FIELD INVESTIGATION OF RUBBLIZED PAVEMENTS AFTER OPENING THE PAVEMENTS TO TRAFFIC

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FIELD INVESTIGATION OF RUBBLIZED PAVEMENTS AFTER OPENING THE PAVEMENTS TO TRAFFIC

This appendix presents the detailed information of various rubblized pavement test sites that were investigated after the completion of construction on during the Phase II Study. A rubblized pavement project may be divided into one or more test sections and each section may be divided into one or more test sites.

Nondestructive deflection tests were conducted on 18 rubblized pavement test sites during the Phase II Study. All tests were conducted using approximately 9,000-lb load. Each test consisted of four drops. The first drop was for instrument seating, which was not recorded while the last three drops were recorded. The majority of the FWD tests were conducted according to the test location layout shown in figure C.1. The letter "X" in the figure indicates an FWD test location while the letter "O" indicates a core location. At some test sites, the standard FWD tests and cores layout was slightly modified by adding few core locations (e.g., over a crack) and/or conducting additional FWD tests when required (e.g., repeatability and linearity). The objectives of the tests were to:

1. Examine the structural capacity of the pavements.

2. Analyze the variation in the deflection data and hence in the structural capacity along and across the pavements.

3. Backcalculate the pavement layer and roadbed soil moduli.

4. Relate, if possible, variations in the deflection data to variation in the quality of rubblized pavements.

5. Compare the rubblized pavement responses to load to those of conventional flexible pavements.

At the conclusion of the FWD tests, several 6-inch diameter asphalt cores were extracted from the pavement. Some cores were located over a crack to verify whether or not the crack is a top-down crack. For these cores, the extent of the crack into the leveling and base course was also measured. The other cores were mostly located under the center of the load plate of the FWD.

Detailed information of the 18 rubblized pavement test sites were presented below.

1.0 I-69 eastbound section 1 test sites 1 and 2 (10692-11 and 10692-12) , control section 76023 job number 36020

This rubblized project was investigated on June 12, 2001. The test section was located at I-69 EB mile marker 127. This section consisted of 2 test sites. Test site 2 was located 100 ft. east of test site 1. Standard FWD tests and coring layout was used for this test

section. Forty FWD tests were conducted and twelve cores were extracted from each test site. (figures C.2 and C.3). The repeatability test was conducted at test site 2 (figure C.4.) using 10 drops at 5500-lb, 20 drops at 9000-lb, 10 drops at 16000-lb and 10 drops at 21000-lb. There were some small scratches on the pavement in the test section area. There were also signs of segregation in this test section; non-uniformly distributed aggregate size, visible air voids and missing aggregates on the AC surface (figure C.5). There were longitudinal crack and intersection of longitudinal and transverse cracks in the traffic lane near the outer edge of the pavement (figure C.6). Rut depths and widths of rut channels were measured in both sites as reported in the table C.1

2.0 I-75 southbound section 1 test sites 1 and 2 (10753-11 and 10753-12) , control section 16092 job number 25559

This rubblized project was investigated on October 24, 2001. This test section was located on I-75 SB about 0.5-mi north of the US-131 overpass south of Mackinaw City. The general terrain is low rolling hills. Another significant observation was that the water table was at approximately 4-ft below the pavement surface. This section consisted of 2 test sites. The test site 2 was located 100-ft south of test site 1. Standard FWD test sand coring layout was used at both test sites with 2 and 3 additional cores at test sites 1 and 2 (figures C.6 and C.7). FWD tests were also conducted at the additional core locations. Forty two and forty three FWD tests were conducted at the test sites 1 and 2 respectively. Fourteen and fifteen cores were extracted from the test sites 1and 2 respectively. Several distresses were observed on the pavement. The most prominent feature was a continuous strip of "drip and chip" sealant along the inside edge of the right wheel path. Also, tight networks of inter-connected longitudinal and transverse cracks were noted throughout the pavement section. Most of the cracks had been routed and sealed. A maximum rut of 3/8-in was measured in the inner wheel path.

3.0 I-194 northbound section 1 test sites 1 and 2 (1194-11 and 11941-12), control section 13033 job number 29670

This rubblized project was investigated on November 7, 2001. The test section was located about 0.5 miles north of the I-94 interchange and south of Battle Creek. The general terrain consists of very gently rolling hills. This section consisted of 2 test sites. Test site 2 was 100-ft north of test site 1. The two test sites were established according to the standard FWD tests and cores layout in the north-bound outer lane on a mild upward grade. Three FWD tests and cores were added to the two test sites.

The primary distress on the section is longitudinal cracking occurring randomly within the inner wheel path (see figures C.9 and C.10). Full lane width transverse cracking is also visible (figure C.11). Finally, mild strip segregation was noted near the lane centerline. Upon coring, it was discovered that the joints had been milled out and replaced with aggregate.

4.0 US-10 eastbound section 1 test sites 1 and 2 (20102-11 and 20102-12), control section 53022 job number 37974

This rubblized project was investigated on June 28, 2001. The test section was located on US-10 EB east of Custer city. This section consisted of 2 test sites. Test site 2 was 100-ft east of test site 1 (figures C.12 and C.13).The standard layout for FWD tests and coring was used for both sites. Forty FWD tests were conducted and twelve 6-inch diameter cores were extracted from each test site. The repeatability test was conducted at test site 1 using 10 drops 5500-lb, 20 drops at 9000-lb, 10 drops at 16000-lb and 10 drops at 21000-lb. Neither distress nor measurable rutting was found on the two test sites.

5.0 US-23 southbound section 1 test sites 1 and 2 (20233-11 and 20233-12), control section 04031 job number 44350 (6/14/01)

This rubblized project was investigated on June 14, 2001. The test section was located on US-23 SB 833 ft. north of Ossineke Rd (figure C.14.). The test section was located based on the location of trench that had been investigated when this pavement was being rubblized. The trench was located in the southbound lane at station 465+21, which according to the MDOT road drawing, was located at 833 ft. north of the center line of Ossineke Rd. on US-23. The 833 ft offset from the centerline of Ossineke Rd. was measured by MDOT distance measuring wheel and the trip odometer of the FWD machine. Those equipments gave 2 locations about 5 ft. apart. The test location was selected based on the location obtained from the MDOT distance-measuring wheel together with another reference that the trench was located just north of driveway of house address 9911 (figure C.15). According to MDOT inventory data; there is a 4-ft widening strip in a southbound lane at the test location. Therefore some modifications were made on typical FWD tests and cores layout for US-23 test sections to insure that the FWD tests would be conducted on the rubblized concrete mainline slab not the widening strip. The modified layout is shown in figure C.16. Test site 1 was located to cover the trench area. Test site 2 was located 100 ft south of test site 1. Further from the modifications as shown in figure C.16, three longitudinal rows of total 24 FWD tests and one core were added over the trench area (figure C.17). There was no distress observed in the test section areas. The rut depths and widths of rut channels of test sites 1 and 2 were measured and reported in table C.2.

6.0 US-27 southbound section 2 test site 1 (20273-21) control section 37013 job number 28116

This rubblized project was investigated on June 4, 2001. The test section was located on US-27 SB at mile marker 157. This section consisted of only one test site. The pavement exhibited a lot of transverse and longitudinal cracks. There were one joint reflective transverse crack and a series of intermittent longitudinal cracks in the test site area. Standard FWD tests and coring layout was used for this test site. Forty FWD tests were conducted and sixteen cores were obtained from the test section. Five additional cores (TD1, TD2, TD3, TJ1, and TJ2) from those in the typical layout were marked but only four were cored. Core TJ1 was extracted over the transverse crack (figure C.18). The core

was completely broken. The core TJ2 was considered as redundant and was not cored since core TJ1 had already proven that the existing transverse crack is a joint reflective crack. Three additional cores (TD1- TD3) were taken from two longitudinal cracks. Core TD1 was over one crack and cores TD2 and TD3 were over another crack (see figure C.19). Core TD1 had a tight crack. Core TD2 was broken into pieces. Core TD3 showed a longitudinal crack wider at the bottom. Drainability test were conducted at TD2 and TD3 core holes. It took 30 minutes for water to completely drain from TD3 and 20 minutes for TD2. Repeatability test for FWD machine was conducted at 80 ft. south of the south edge of site 2. The repeatability test was conducted using 20 drops at 9000-lb, 10 drops at 16000-lb and 10 drops at 21000-lb. The maximum rut depth measured in this test section was 3/16 inches. Special distress survey was conducted on June 6th, 2001 from mile marker 159 to mile marker 156.5 to cover this test site. The transverse cracks were observed on both lanes in the southbound direction. There were 240 low to medium severity transverse cracks with 20 branches and 108 medium to high severity transverse cracks with 28 branches. The longitudinal cracks near the outer wheel path on the outer lane were observed. There were about 4300 ft of longitudinal crack in this surveyed section, which is equal to 32 percent of the section length.

7.0 US-27 southbound section 3 test site 1 (20273-31), control section 37013 job number 38205 at MP 156 (6/06/01)

This rubblized project was investigated on June 6, 2001. The section was located on US-27 SB FWD mile marker 156.4. The standard FWD tests and coring was used for this test site. Forty FWD tests were conducted and twelve 6-inch cores were extracted from the test section. No distress was found in the vicinity of the test section. There is no measurable rut depth (less than 1/8 inches) in this section (figure C.20). The FWD tests were conducted on the same day that the site was investigated but pavement cores were extracted later on July 12, 2001.

8.0 US-27 southbound section 4 test site 1 (20273-31) control section 37014 job number 38205

The rubblized project was investigated on July 12, 2001. The section was located on US-27 SB before the exit to M-20 (figure C.21). The standard layout for FWD tests and coring was used for this test site. Forty FWD tests were conducted and twelve 6-inch diameter cores were extracted. The distress survey indicated that the pavement has neither distress nor measurable rut.

9.0 US-31 northbound section 1 test site 1 (20311-11), control section 70013 job number 38179

This rubblized project was investigated on June 26, 2001. The section was located on US-31 NB before the intersection between US-31 and M-45 (Agnew Rd.). This section consisted of only one test site (figure C.22). The standard layout for FWD tests and coring was used for this test section. Forty FWD tests were conducted and twelve 6-inch

diameter cores were obtained. The distress survey indicated that the pavement has no other distress except shallow rut channels, which are reported in table C.3.

10.0 M-15 southbound section 1 test site 1 (30153-11) control section 25092 job number 45534

This rubblized project was investigated on November 14, 2001. The section was located on M-15 southbound approximately ½ mile north of the village of Otisville. The pavement itself consisted of two lanes (one lane in each direction) with 3-ft asphalt shoulders. The pavement is located on relatively flat terrain with low embankments beyond the drainage ditches on either side of the road. This section consisted of only one test site. The standard layout for FWD tests and coring was used for this test section. The predominant distress was longitudinal cracking. Two relatively straight, medium to high severity cracks appear on the center of lane side of each wheel path (figure C.23). Low to Medium severity segregation was also noted on the pavement surface. Finally, occasional short transverse cracks were noted throughout the pavement surface. The maximum rut depth was measured as 1/8-in.

11.0 M-37 southbound section 5 test sites 1 and 2 (30373-51 and 30373-52), control section 41033 job number 38190

This rubblized project was investigated on June 19, 2001. The section was located on M-37 southbound between Waterloo St. and Fruit Ridge Rd., south of Newaygo city. This section consisted of two test sites. Test site 2 was 100 ft south of test site 1. The standard FWD tests and coring layout was used for both sites (figures C.24 and C.25). Forty FWD tests were conducted and twelve 6-inch diameter cores were extracted from each site. The distress survey indicated that the pavement has neither distress nor measurable rut.

12.0 M-37 southbound section 6 test site 1 (30373-61), control section 41033 job number 26691

This rubblized project was investigated on November 6, 2001. The section was located on M-37 southbound south of the intersection between M-37 and 10 mile road. The dominant distresses on this section are longitudinal top-down cracks (figure C.26). This section consisted of only one test site. Standard FWD tests and coring layout was used for this test site. Five cores and two FWD tests were added to the standard layout in this test site. The repeatability test was conducted at test site 2 using 10 drops at 5500-lb, 20 drops at 9000-lb, 10 drops at 16000-lb and 10 drops at 21000-lb.

Table C.1 Rut depths and widths of rut channels on I-69 EB section 1 test sites 1 and 2

Location	Maximum rut depth (inches)	Width of rut channel
Site 1 Outer wheel path	3/16 to 5/16	3 ft-6 in to 3 ft-9 in
Site 1 Inner wheel path	3/16 to 4/16	3 ft-4 in to 3 ft-8 in
Site 2 Outer wheel path	3/16	3 ft-3 in to 3 ft-4 in
Site 2 Inner wheel path	2/16 to 3/16	3 ft-4 in to 4 ft

Table C.2 Rut depths and widths of rut channels on US-23 SB section 1 test sites 1 and 2

Location	Maximum Rut depth (inches)	Width of rut channel
Site 1 Outer wheel path	4/16	4 ft to 4 ft-4 in
Site 1 Inner wheel path	3/16	3 ft-6 in to 4 ft
Site 2 Outer wheel path	3/16	3 ft to 4 ft
Site 2 Inner wheel path	4/16 to 5/16	3 ft-6 in to 4 ft-10 in

Table C.3. Rut depths and widths of rut channels on US-31 NB section 1 test site 1

Location	Maximum Rut depth (inches)	Width of rut channel
Outer wheel path	5/16 to 12/16	4 ft-5 in to 4 ft-8 in
Inner wheel path	3/16 to 4/16	3 ft-7 in to 4 ft

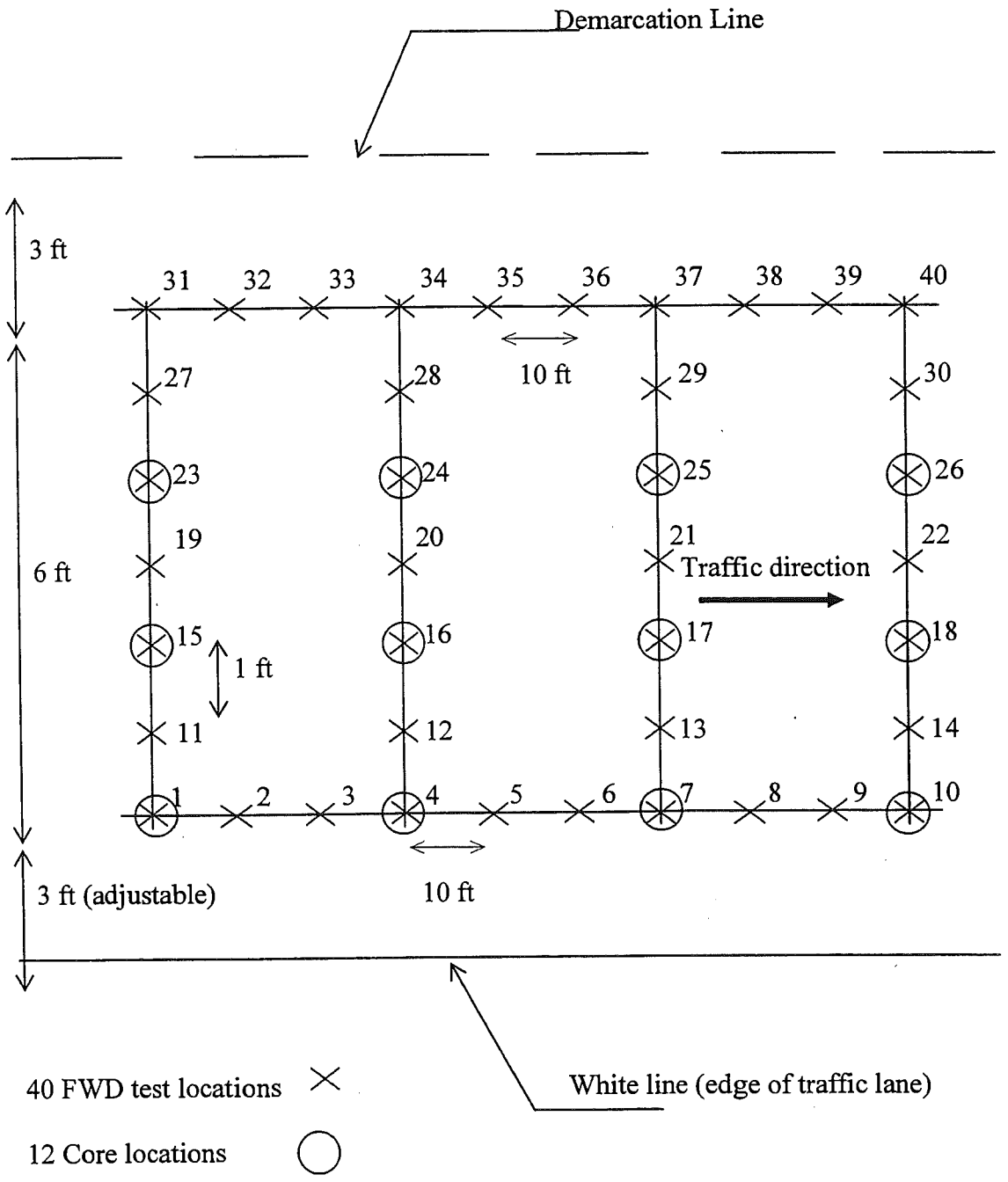


Figure C.1 Standard layout of the FWD tests and coring used in this study

Figure C.2 I-69 EB section test site 1 at mile marker 127

Figure C.3 I-69 EB section test site 2 at mile marker 127

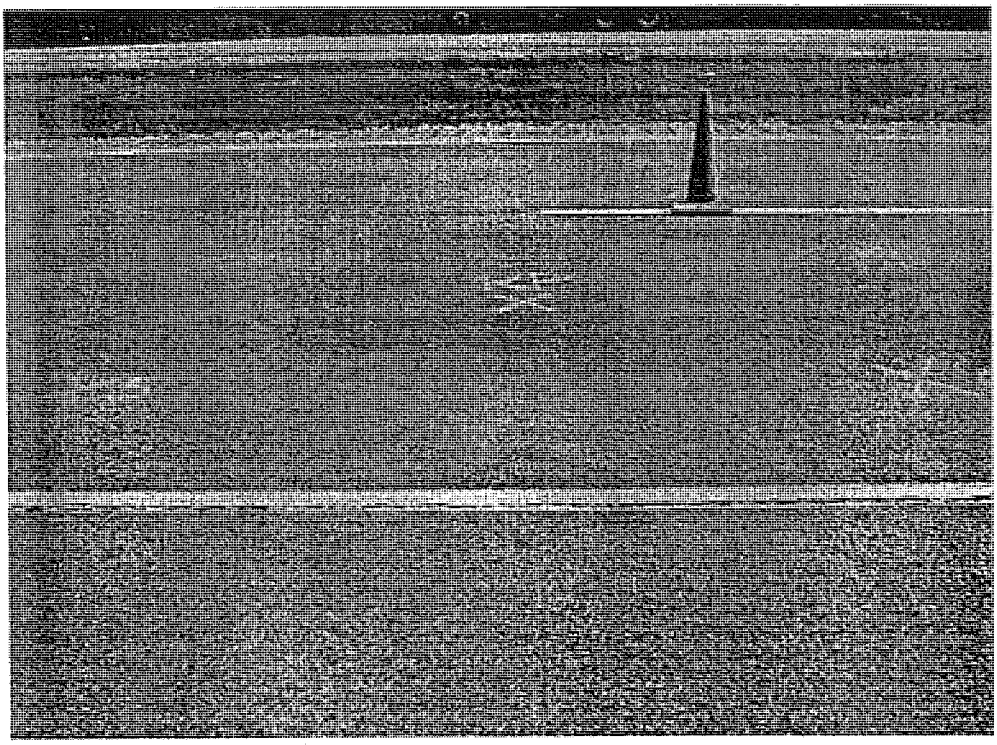


Figure C.4 Location of repeatability test on I-69 section 1 test site 2

Figure C.6 I-75 SB section 1 test site 1 north of US-31 interchange

Figure C.7 I-75 SB section 1 test site 2 north of US-31 interchange

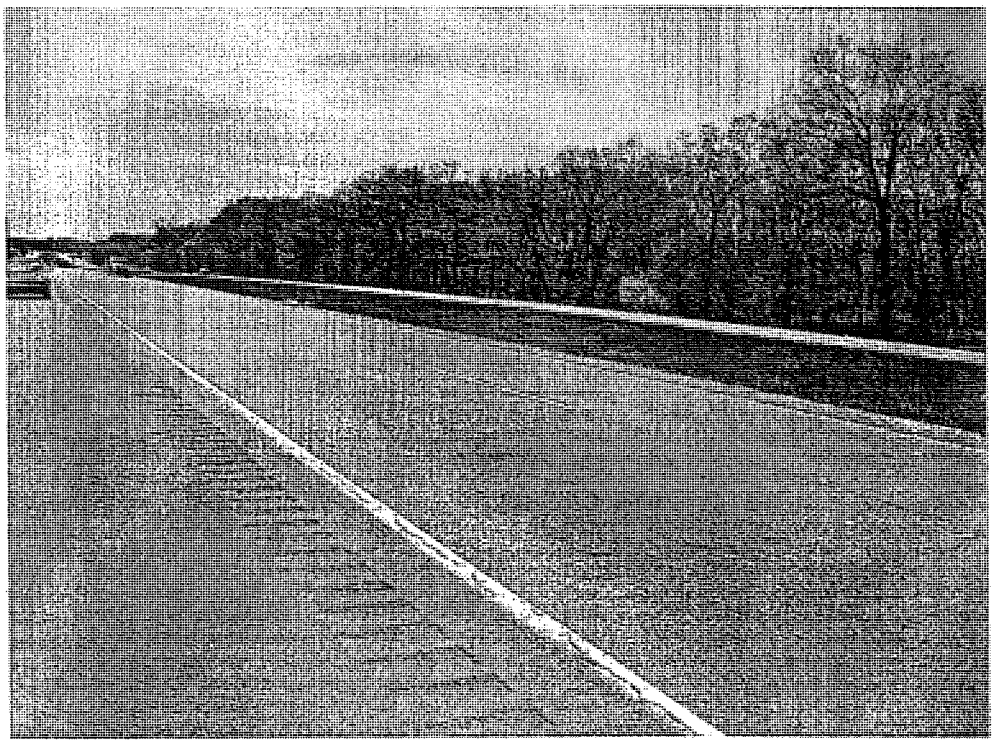


Figure C.8 I-194 NB section test site 1 north of I-94 interchange

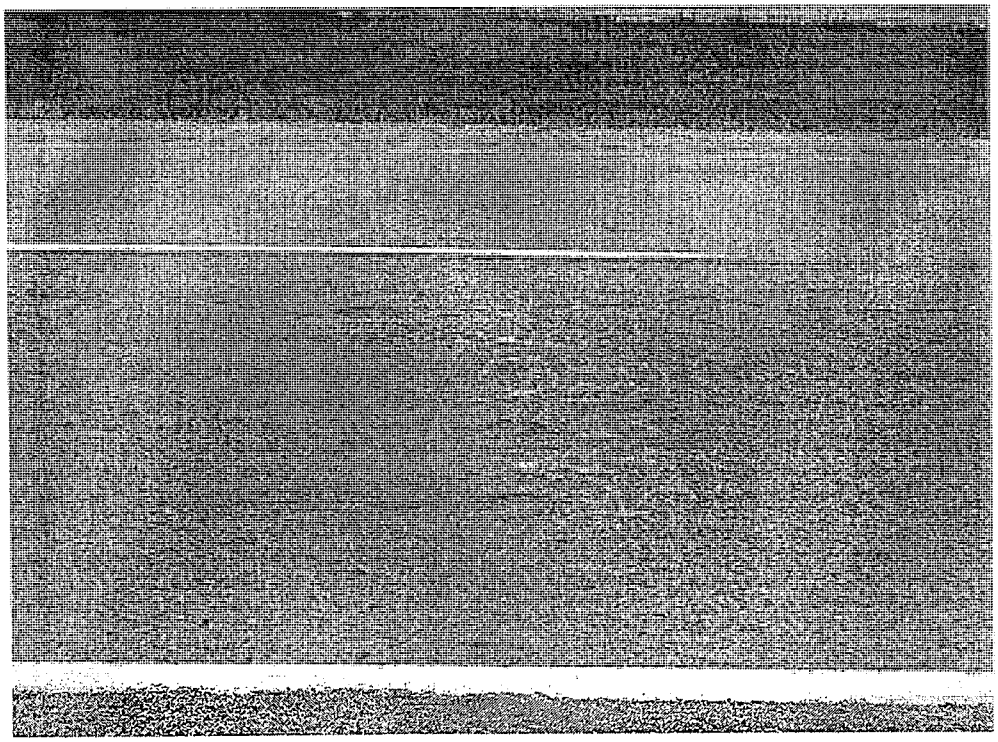


Figure C.10 I-194 NB section 1 test site 2 north of I-94 interchange

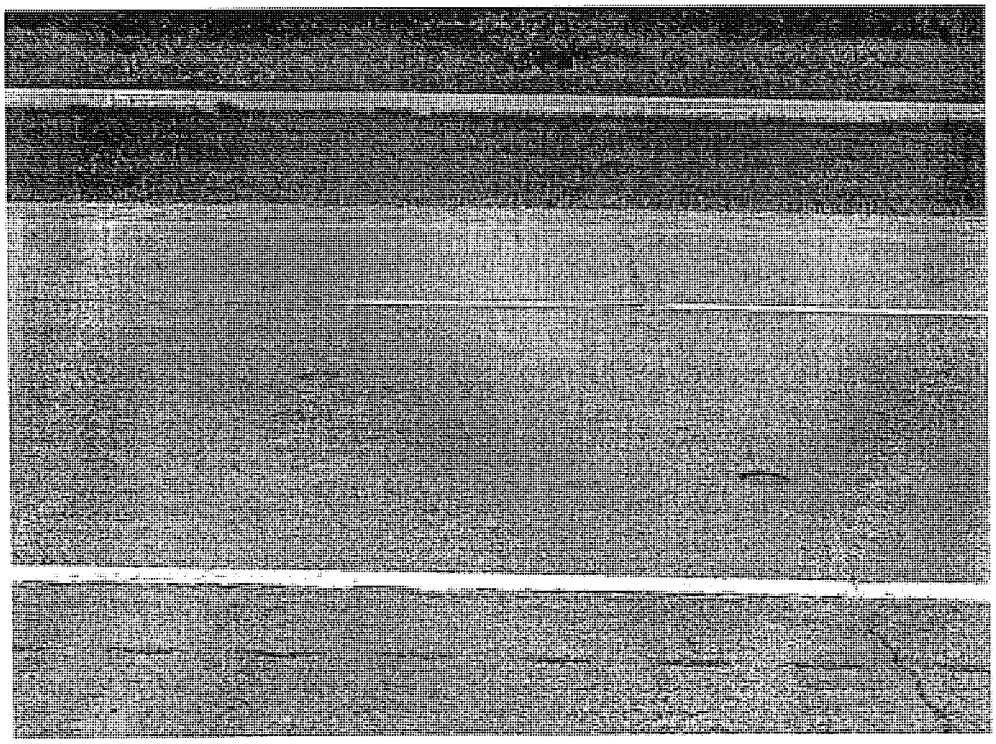


Figure C.11 Transverse crack across lanes on I-194 NB section 1 test site 2

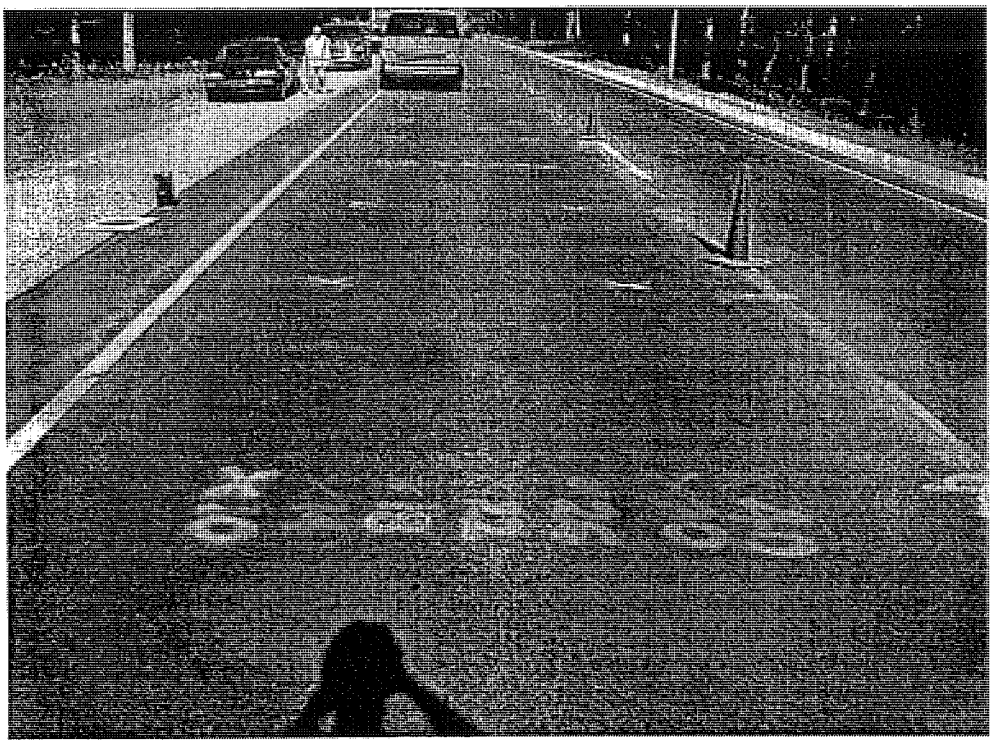


Figure C.12 US-10 EB section 1 test site 1 east of Custer city

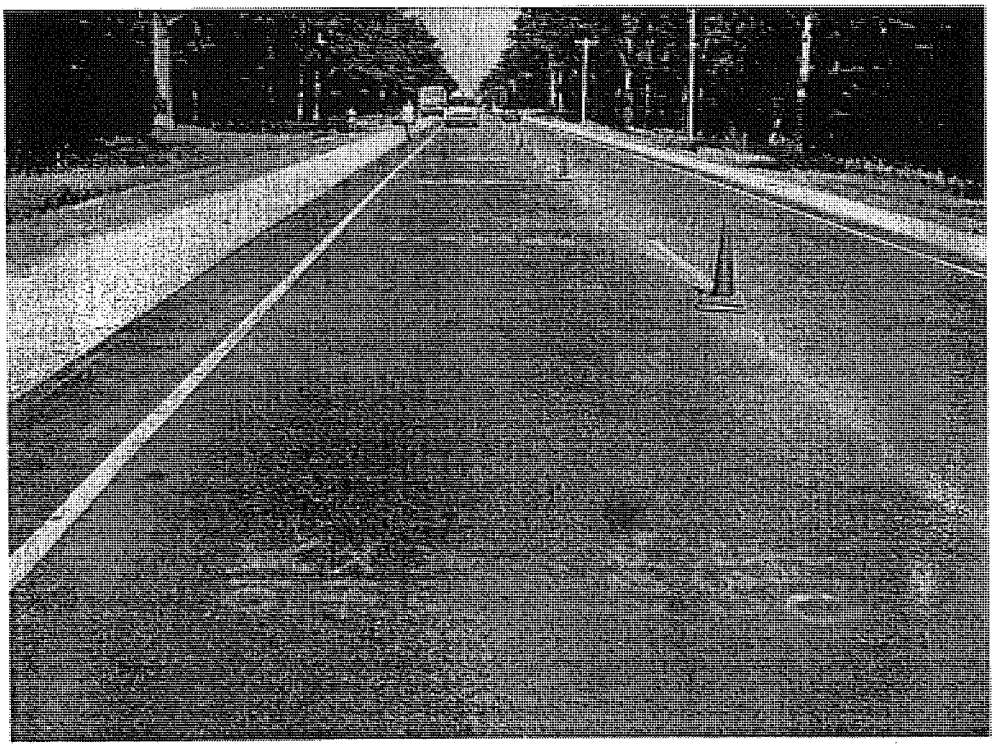


Figure C.13 US-10 EB section 1 test site 2 east of Custer city

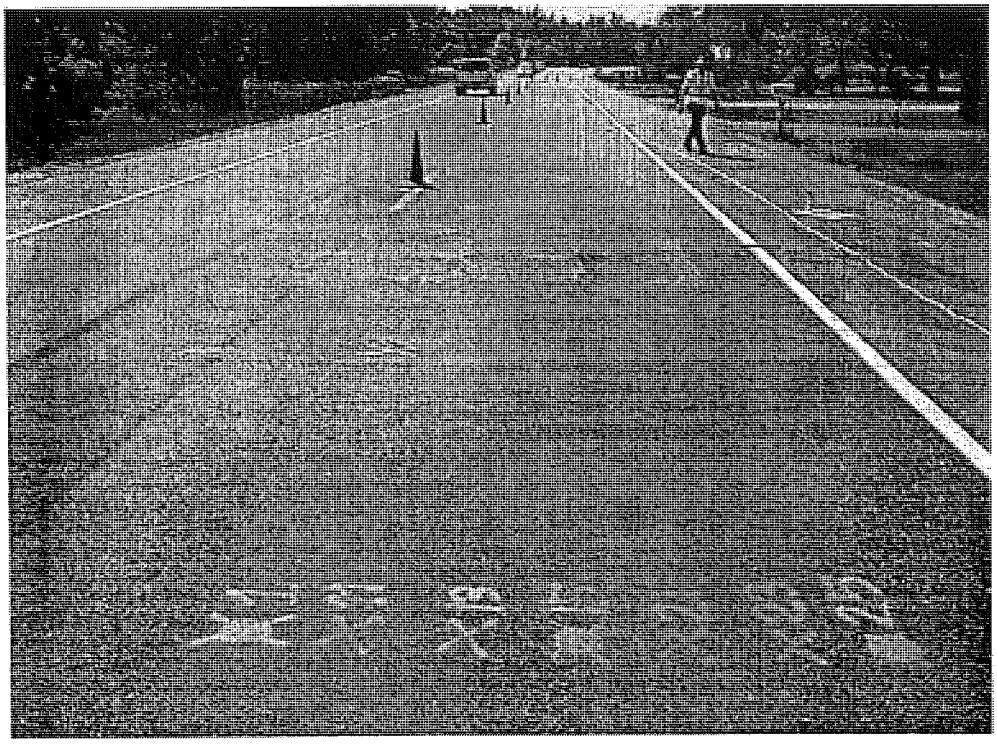


Figure C.13 US-23 SB section 1 test site 1 833 ft north of Ossineke Rd

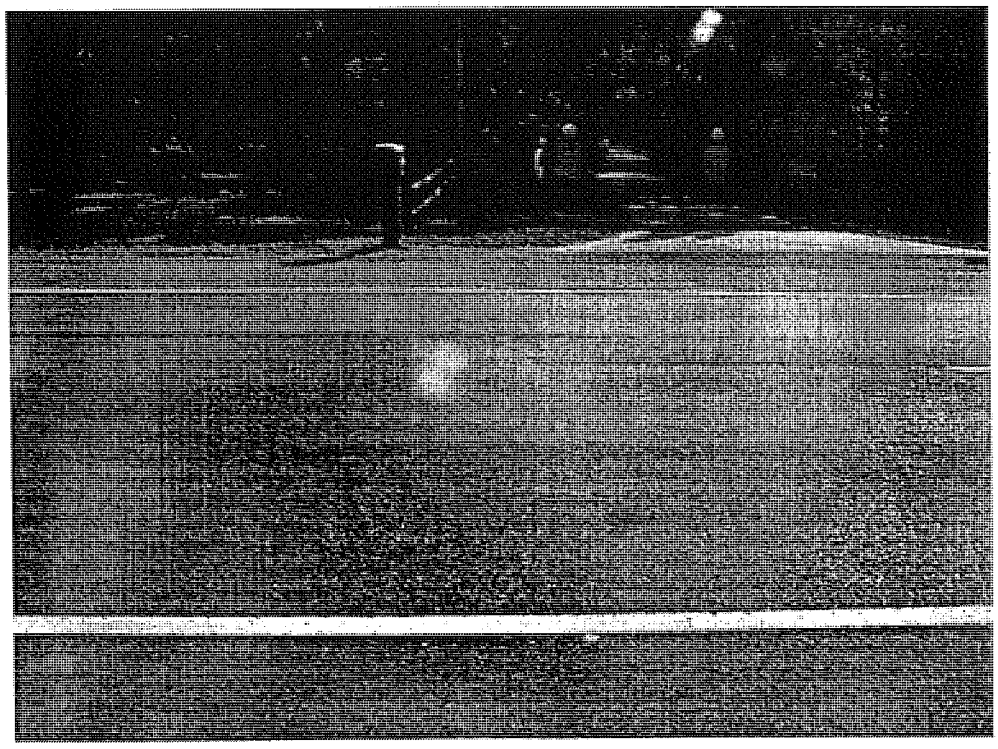


Figure C.15 Location where a trench had been made during the rubblization of this project, just north of driveway of house address 9911

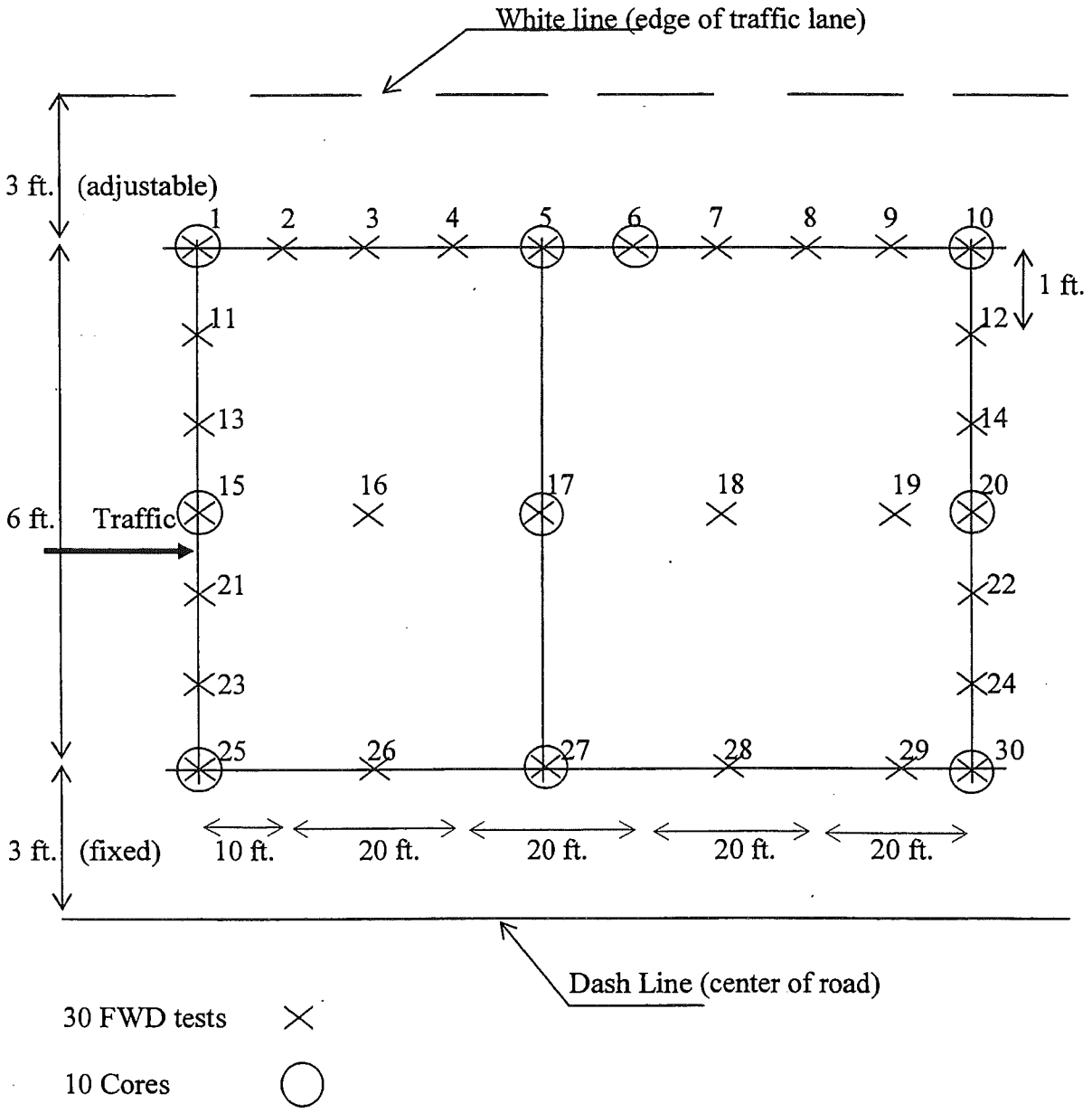


Figure C.16 FWD tests and coring layout used for US-23 section

Figure C.17 Twenty four additional FWD tests and one additional core over trench area on the US-23 SB section 1 test site 1

Figure C.18 Transverse joint reflective crack on US-27 SB section 2 test site 1

Figure C.19 Cores TD2 and TD3 over an alligator crack on US-27 SB section test site 1

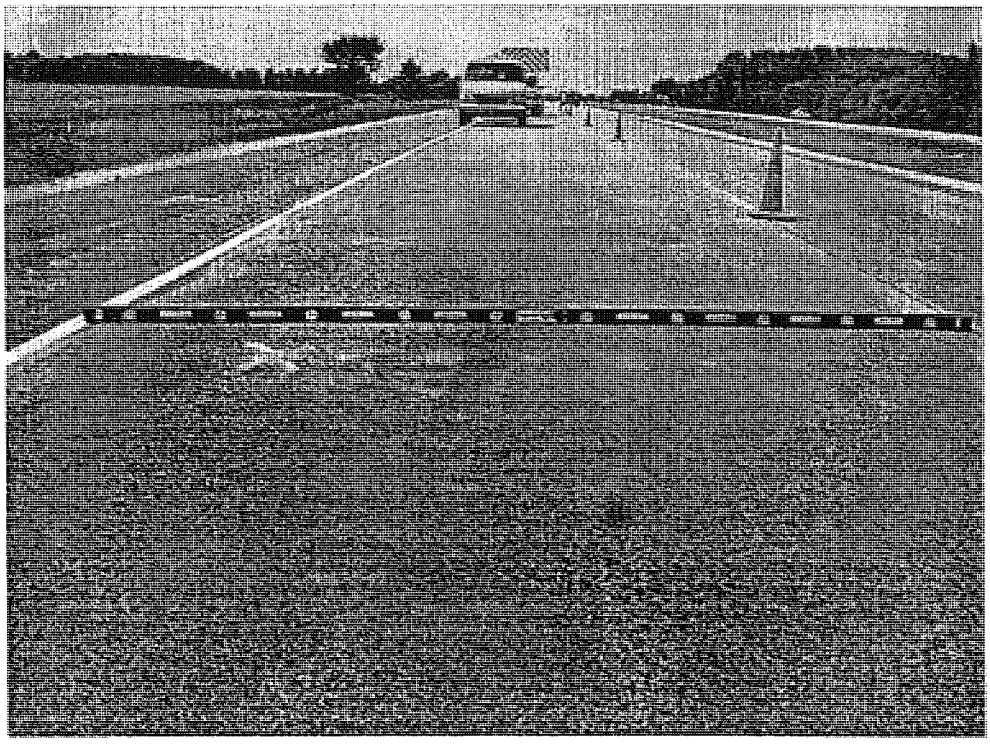


Figure C.20 No measurable rut on US-27 SB section 3 test site 1

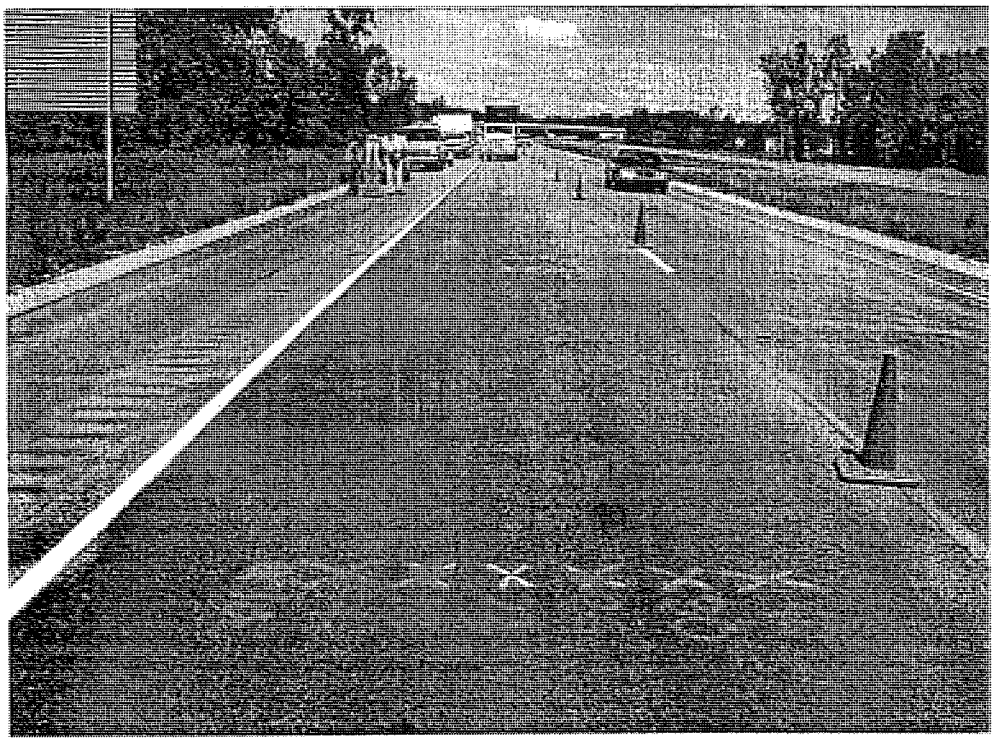


Figure C.21 US-27 SB section 4 test site 1 before the exit to M-20

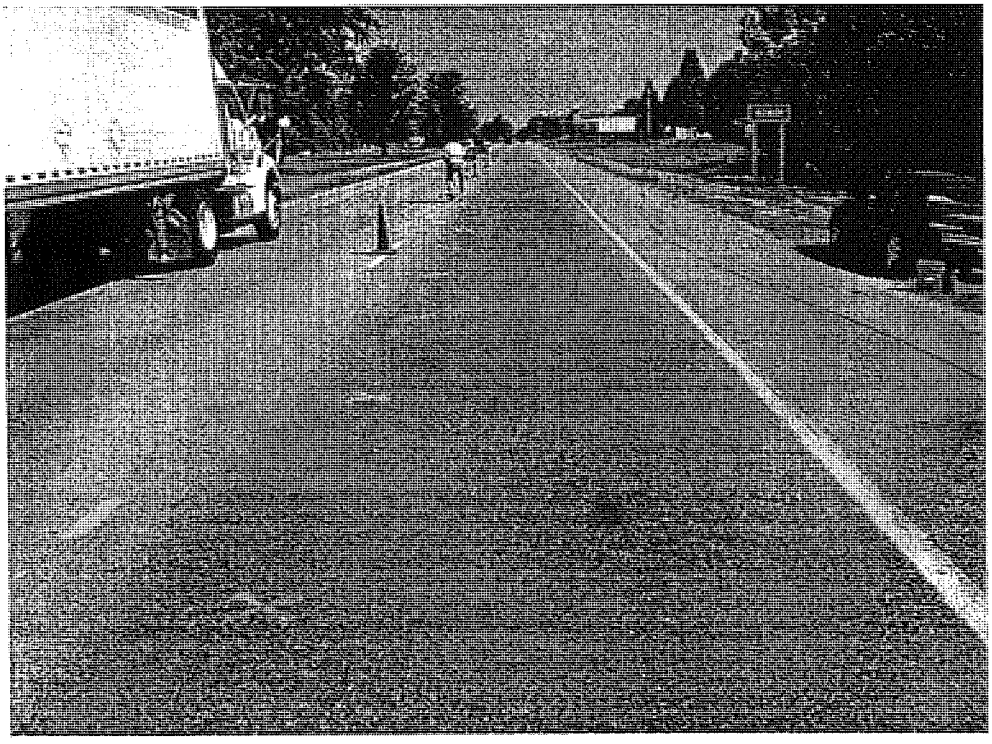


Figure C.22 US-31 NB section 1 test site 1 before the intersection between US-31 and M-45

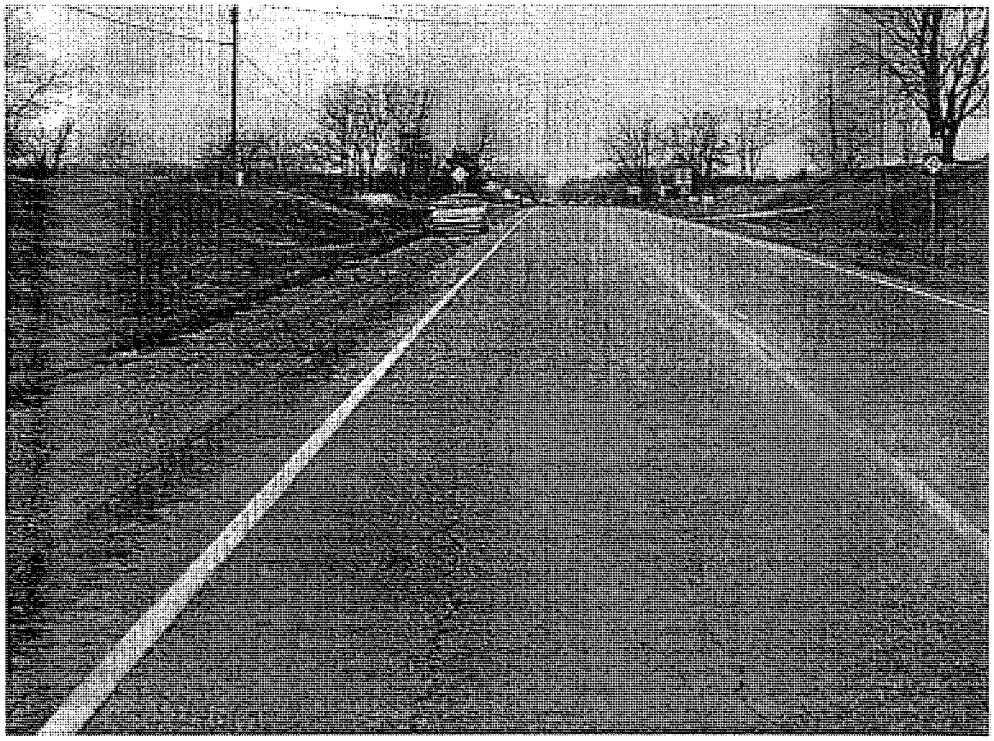


Figure C.23 M-15 SB section 1 test site 1 north of Otisville village

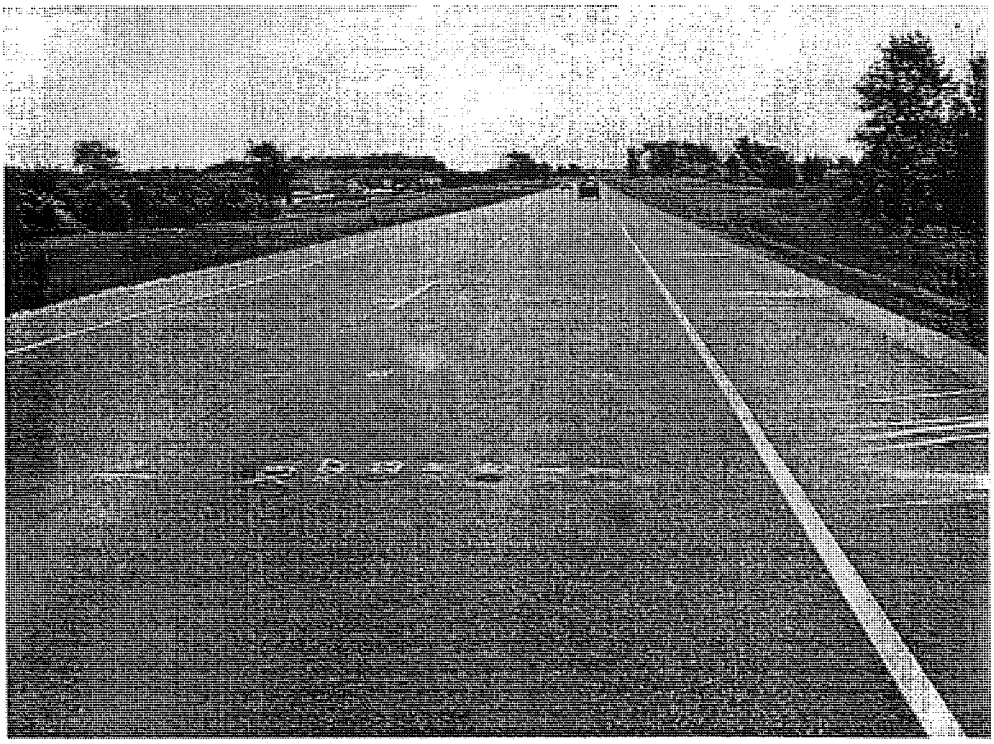


Figure C.24 M-37 SB section 5 test site 1 south of Newaygo village

Figure C.25 M-37 SB section 5 test site 2 south of Newaygo village

Figure C.26 M-37 SB section 6 test site 1 south of intersection between M-37 and 10 mile Rd.

APPENDIX D

DEFLECTION DATA

APPENDIX D
DEFLECTION DATA

This appendix presents the deflection data measured on various rubblized pavement projects. A project may be divided into one or more test sections and each section may be divided into one or more test sites.

Table D.1 Deflections D1 through D7, I-69 EB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	10.76	8.20	7.03	5.67	4.57	2.82	1.23
2	11.41	8.74	7.49	6.10	4.87	2.97	1.16
3	10.45	8.04	6.90	5.57	4.50	2.86	1.21
4	10.62	8.24	7.11	5.79	4.72	2.98	1.28
5	10.19	7.63	6.57	5.44	4.54	3.01	1.34
6	9.96	7.55	6.42	5.24	4.36	2.95	1.44
7	9.88	7.52	6.55	5.44	4.56	3.17	1.55
8	8.58	6.80	5.97	4.98	4.24	3.00	1.57
9	9.30	7.14	6.30	5.27	4.48	3.16	1.58
10	8.70	6.36	5.53	4.67	4.00	2.85	1.41
11	9.77	7.14	6.06	4.97	4.08	2.72	1.20
12	10.09	7.40	6.38	5.28	4.36	2.88	1.32
13	9.84	7.32	6.39	5.30	4.47	3.14	1.56
14	8.42	6.10	5.28	4.50	3.90	2.84	1.43
15	8.89	6.59	5.66	4.69	3.91	2.66	1.24
16	9.65	7.22	6.31	5.18	4.33	2.89	1.34
17	8.92	6.65	5.85	4.97	4.28	3.11	1.62
18	7.94	5.71	4.91	4.22	3.71	2.79	1.44
19	8.58	6.44	5.56	4.60	3.86	2.69	1.27
20	9.40	7.16	6.24	5.12	4.29	2.87	1.33
21	8.84	6.64	5.80	4.97	4.28	3.13	1.60
22	7.68	5.52	4.81	4.12	3.62	2.75	1.47
23	8.66	6.38	5.49	4.55	3.84	2.69	1.27
24	9.29	6.99	6.07	4.98	4.19	2.86	1.35
25	8.90	6.79	5.96	5.05	4.33	3.20	1.66
26	7.55	5.71	4.89	4.19	3.68	2.77	1.45
27	9.01	6.61	5.69	4.67	3.92	2.74	1.25
28	9.70	7.44	6.46	5.34	4.48	2.97	1.36
29	9.07	6.94	6.11	5.23	4.51	3.28	1.64
30	7.82	5.87	5.12	4.36	3.82	2.81	1.43
31	8.83	6.70	5.79	4.75	3.96	2.72	1.26
32	9.70	7.39	6.33	5.13	4.23	2.70	1.15
33	9.05	6.92	6.00	4.91	4.10	2.76	1.25
34	9.62	7.46	6.59	5.39	4.51	3.01	1.38
35	8.92	6.88	6.01	5.02	4.22	2.93	1.43
36	9.22	7.04	6.18	5.15	4.36	3.06	1.58
37	9.02	6.94	6.09	5.20	4.52	3.27	1.64
38	8.36	6.51	5.78	4.95	4.30	3.17	1.69
39	8.66	6.58	5.72	4.78	4.11	3.06	1.63
40	8.07	6.26	5.43	4.59	3.98	2.89	1.48
Average	9.18	6.94	6.02	5.01	4.23	2.93	1.41
CV (%)	9	10	10	9	7	6	11

Table D.2 Deflections D1 through D7, I-69 EB - section 1 test site 2

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	9.00	6.58	5.63	4.60	3.71	2.33	0.99
2	8.91	6.45	5.45	4.41	3.64	2.35	1.03
3	9.59	7.16	6.03	4.85	3.96	2.57	1.10
4	9.72	7.19	6.18	5.07	4.18	2.81	1.31
5	9.19	6.72	5.76	4.67	3.87	2.60	1.25
6	8.72	6.34	5.46	4.55	3.85	2.62	1.28
7	9.61	7.14	6.16	5.03	4.11	2.71	1.25
8	9.51	7.08	6.00	4.83	3.98	2.64	1.17
9	8.26	6.06	5.21	4.25	3.53	2.32	1.01
10	8.81	6.29	5.28	4.22	3.41	2.17	0.91
11	8.63	5.99	5.09	4.14	3.43	2.23	1.02
12	9.25	6.66	5.75	4.73	3.95	2.69	1.30
13	9.16	6.44	5.56	4.63	3.88	2.70	1.33
14	8.30	5.73	4.83	3.90	3.22	2.15	0.95
15	7.85	5.30	4.47	3.76	3.16	2.20	1.02
16	8.73	6.24	5.36	4.47	3.82	2.70	1.28
17	8.50	6.03	5.17	4.36	3.76	2.71	1.35
18	7.63	5.21	4.35	3.61	3.04	2.08	0.95
19	7.47	4.99	4.24	3.51	3.01	2.15	1.02
20	8.53	6.04	5.19	4.35	3.74	2.64	1.29
21	8.31	5.80	4.94	4.19	3.65	2.65	1.38
22	7.38	5.03	4.19	3.50	2.97	2.10	1.00
23	7.35	5.07	4.27	3.54	3.00	2.17	1.05
24	8.39	6.13	5.21	4.36	3.72	2.65	1.27
25	7.99	5.66	4.94	4.18	3.59	2.65	1.40
26	7.12	5.14	4.43	3.71	3.15	2.18	1.06
27	7.58	5.22	4.33	3.65	3.11	2.22	1.03
28	8.72	6.33	5.46	4.60	3.90	2.75	1.26
29	7.73	5.78	5.03	4.27	3.69	2.75	1.41
30	7.34	5.37	4.65	3.92	3.31	2.29	1.09
31	7.10	5.21	4.50	3.75	3.16	2.22	1.04
32	7.14	5.20	4.54	3.76	3.17	2.23	1.08
33	7.66	5.88	5.12	4.27	3.64	2.55	1.22
34	8.40	6.31	5.55	4.62	3.90	2.73	1.28
35	8.16	6.03	5.32	4.58	3.93	2.86	1.51
36	7.48	5.81	5.17	4.43	3.86	2.88	1.55
37	7.70	5.99	5.27	4.49	3.87	2.80	1.51
38	7.84	5.94	5.16	4.47	3.84	2.82	1.44
39	7.70	5.97	5.25	4.37	3.72	2.59	1.33
40	7.44	5.60	4.92	4.16	3.50	2.41	1.17
Average	8.25	5.98	5.14	4.27	3.60	2.50	1.20
CV (%)	9	10	11	10	10	10	15

Table D.3 Deflections D1 through D7, I-75 SB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	9.46	8.29	7.45	6.22	5.30	3.67	2.03
2	10.02	8.59	7.69	6.47	5.48	3.82	2.12
3	9.62	8.48	7.78	6.47	5.17	3.64	2.03
4	9.52	8.17	7.22	5.93	4.96	3.51	1.92
5	9.73	8.44	7.53	6.25	5.22	3.59	1.85
6	9.56	8.07	7.13	5.92	4.98	3.50	1.90
7	9.88	8.25	7.35	6.14	5.17	3.67	1.97
8	9.32	8.18	7.36	6.18	5.31	3.82	2.02
9	9.01	7.81	7.09	6.03	5.11	3.70	2.02
10	9.07	7.78	6.94	5.86	4.78	3.31	1.79
11	9.67	8.39	7.50	6.24	5.20	3.50	1.92
12	8.76	7.85	6.77	5.62	4.73	3.34	1.86
13	9.24	7.73	6.89	5.80	4.93	3.58	1.92
14	9.00	7.76	6.95	5.82	4.89	3.17	1.72
16	8.12	7.22	6.44	5.42	4.58	3.27	1.85
17	8.22	6.97	6.27	5.34	4.60	3.38	1.87
18	8.90	7.78	6.98	5.84	4.90	3.15	1.73
19	7.77	6.70	6.04	5.16	4.50	3.40	1.81
20	7.68	6.63	6.03	5.16	4.44	3.34	1.95
21	7.22	6.21	5.60	4.87	4.26	3.29	1.87
22	8.57	7.55	6.81	5.67	4.74	3.21	1.73
23	7.43	6.47	5.89	5.12	4.48	3.46	1.84
24	7.49	6.53	5.90	5.11	4.45	3.39	1.99
25	6.87	5.93	5.40	4.78	4.21	3.32	1.91
26	8.50	7.46	6.69	5.57	4.62	3.20	1.74
27	6.92	6.10	5.64	4.98	4.45	3.51	1.89
28	6.65	5.96	5.53	4.91	4.33	3.35	2.01
29	6.49	5.69	5.25	4.72	4.19	3.33	1.94
30	8.30	7.30	6.58	5.52	4.62	3.26	1.75
31	7.07	6.20	5.65	4.92	4.34	3.40	1.94
32	6.05	5.48	5.14	4.68	4.22	3.50	2.12
33	9.70	8.16	7.24	6.18	5.26	3.87	1.99
34	7.26	6.29	5.66	4.89	4.25	3.31	1.98
35	7.89	7.09	6.42	5.70	4.53	3.27	1.90
36	8.29	6.89	6.21	5.24	4.45	3.26	1.82
37	7.06	6.11	5.57	4.90	4.28	3.30	1.94
38	6.36	5.66	5.28	4.80	4.32	3.44	1.99
39	6.76	5.96	5.55	5.02	4.49	3.62	2.12
40	8.47	7.33	6.55	5.54	4.67	3.27	1.77
50	10.06	8.69	7.41	5.79	4.91	3.61	2.04
51	7.76	6.30	5.68	4.88	4.27	3.28	1.89
15	10.30	8.47	7.26	5.96	5.02	3.52	1.90
Average	8.25	7.17	6.46	5.51	4.70	3.43	1.91
CV (%)	14	13	12	10	8	5	6

Pavements at stations 50, 51 and 15 have cracks; hence the deflections at these stations have not been included in the calculations of the average deflection and the coefficient of standard variation.. .

Table D.4 Deflections D1 through D7, I-75 SB - section 1 test site 2

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	10.45	8.53	7.37	5.95	4.87	3.45	1.89
2	9.30	7.84	6.92	5.74	4.80	3.46	1.83
3	9.98	8.42	7.38	6.08	5.07	3.51	1.78
4	8.38	7.15	6.41	5.45	4.68	3.34	1.66
5	10.55	8.38	7.07	5.61	4.60	3.26	1.68
6	9.12	7.68	6.74	5.53	4.56	3.14	1.60
8	10.83	8.70	7.35	5.82	4.61	2.93	1.25
9	9.33	7.49	6.49	4.89	4.07	2.81	1.41
10	7.85	6.66	5.85	4.82	3.95	2.72	1.42
11	9.31	7.62	6.68	5.51	4.63	3.40	1.83
12	8.37	7.50	6.54	5.39	4.57	3.23	1.70
13	9.40	7.23	6.22	4.91	4.03	2.74	1.36
14	6.86	6.05	5.37	4.50	3.80	2.70	1.45
15	8.09	6.57	5.81	4.97	4.25	3.22	1.84
16	8.17	7.05	6.29	5.34	4.55	3.24	1.72
18	6.16	5.40	4.90	4.24	3.64	2.69	1.42
19	7.68	5.99	5.27	4.52	3.93	3.09	1.81
20	8.03	6.93	6.29	5.50	4.85	3.26	1.76
21	8.63	6.41	5.51	4.48	3.72	2.60	1.36
22	6.79	5.96	5.25	4.32	3.63	2.62	1.41
23	7.22	5.82	5.19	4.50	3.95	3.14	1.87
24	7.89	6.82	6.23	5.51	4.89	3.35	1.79
25	7.52	6.08	5.20	4.26	3.59	2.58	1.40
26	7.16	6.22	5.48	4.49	3.74	2.18	1.34
27	6.47	5.72	5.18	4.58	4.08	3.24	1.92
28	8.08	7.05	6.37	5.60	4.96	3.37	1.80
29	7.53	6.22	5.32	4.41	3.76	2.79	1.54
30	7.52	6.46	5.70	4.67	3.88	2.68	1.37
31	6.57	5.69	5.14	4.47	3.91	3.13	1.89
32	6.53	5.77	5.34	4.72	4.11	3.18	1.82
33	7.26	6.38	5.78	4.94	4.24	3.20	1.80
34	8.73	7.58	6.82	5.88	5.11	3.42	1.74
35	5.93	5.27	4.84	4.28	3.77	2.97	1.67
36	6.65	5.84	5.28	4.53	3.92	2.97	1.65
37	7.65	6.31	5.51	4.58	3.90	2.89	1.57
38	7.20	6.21	5.63	4.89	4.30	3.17	1.69
39	10.54	7.66	6.54	5.28	4.47	3.26	1.80
40	8.40	6.82	5.99	4.92	4.05	2.81	1.42
50	8.98	7.39	6.44	5.24	4.31	2.90	1.46
51	6.79	5.80	5.12	4.37	3.77	2.80	1.50
52	10.30	8.34	7.11	5.58	4.45	2.82	1.29
7	10.01	8.00	6.85	5.43	4.33	2.85	1.32
17	9.03	6.76	5.78	4.66	3.88	2.68	1.35
Average	8.11	6.78	5.98	5.00	4.25	3.05	1.64
CV (%)	16	13	12	11	11	10	12

Pavements at stations 7, 17, 50, 51 and 52 have cracks; hence the deflections at these stations have not been included in the calculations of the average deflection and the coefficient of variation.

Table D.5 Deflections D1 through D7, I-194 NB - section 2 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	4.38	4.38	3.99	3.35	3.35	3.03	1.69
2	4.85	4.85	4.40	3.66	3.66	3.28	1.80
3	5.19	5.19	4.69	3.93	3.93	3.55	1.96
5	4.94	4.94	4.42	3.67	3.67	3.24	1.79
6	5.11	5.11	4.48	3.65	3.65	3.29	1.80
7	5.13	5.13	4.58	3.72	3.72	3.35	1.87
8	5.28	5.28	4.75	3.91	3.91	3.50	1.83
9	5.03	5.03	4.51	3.78	3.78	3.40	1.78
10	5.31	5.31	4.68	3.85	3.85	3.43	1.85
11	4.42	4.42	3.98	3.30	3.30	3.01	1.67
12	5.31	5.31	4.89	4.17	4.17	3.82	1.88
13	4.99	4.99	4.42	3.66	3.66	3.31	1.87
14	4.96	4.96	4.36	3.64	3.64	3.27	1.77
17	4.81	4.81	4.20	3.54	3.54	3.23	1.87
18	4.74	4.74	4.22	3.58	3.58	3.24	1.81
19	4.69	4.69	4.04	3.32	3.32	3.02	1.72
20	5.08	5.08	4.71	4.06	4.06	3.72	1.75
21	4.64	4.64	4.17	3.54	3.54	3.24	1.87
22	4.74	4.74	4.29	3.63	3.63	3.29	1.83
23	4.54	4.54	4.07	3.42	3.42	3.15	1.76
24	5.05	5.05	4.72	4.09	4.09	3.76	1.87
25	4.87	4.87	4.32	3.57	3.57	3.27	1.89
26	4.94	4.94	4.42	3.71	3.71	3.39	1.89
27	4.63	4.63	4.14	3.48	3.48	3.15	1.79
28	5.17	5.17	4.81	4.21	4.21	3.84	1.76
29	5.01	5.01	4.45	3.65	3.65	3.28	1.86
30	5.20	5.20	4.62	3.87	3.87	3.49	1.95
31	4.78	4.78	4.22	3.53	3.53	3.18	1.79
32	4.82	4.82	4.28	3.56	3.56	3.20	1.80
33	5.24	5.24	4.68	3.86	3.86	3.47	1.90
34	5.32	5.32	4.92	4.27	4.27	3.90	1.89
35	5.02	5.02	4.45	3.54	3.54	3.17	1.80
36	5.67	5.67	4.71	3.69	3.69	3.28	1.78
37	6.11	6.11	5.01	3.86	3.86	3.40	1.79
38	5.53	5.53	4.93	4.03	4.03	3.59	1.90
39	4.90	4.90	4.42	3.75	3.75	3.38	1.86
40	5.28	5.28	4.65	3.85	3.85	3.43	1.87
50	6.10	6.10	5.11	3.97	3.97	3.55	1.86
51	9.27	9.27	6.97	5.12	5.12	4.45	1.99
52	5.94	5.94	5.06	3.95	3.95	3.54	1.86
4	5.52	5.52	5.12	4.35	4.35	3.94	1.91
15	4.86	4.86	4.11	3.31	3.31	2.98	1.68
16	5.45	5.45	4.87	4.09	4.09	3.73	1.71
Average	5.02	5.02	4.48	3.73	3.73	3.37	1.83
CV (%)	7	7	6	7	7	7	4

Pavements at stations 50, 51, 52, 4, 15 and 16 have cracks; hence the deflections at these stations have not been included in the calculations of average deflection and the coefficient of variation.

Table D.6 Deflections D1 through D7, I-194 NB - section 2 test site 2

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	5.81	5.30	4.91	4.48	4.05	3.32	2.17
2	5.52	5.06	4.76	4.36	3.94	3.29	2.21
3	5.68	5.12	4.75	4.28	3.89	3.19	2.10
4	5.93	5.35	4.94	4.41	3.91	3.13	2.02
5	6.53	6.04	5.59	5.05	4.48	3.48	2.05
6	5.85	5.34	4.93	4.48	4.02	3.32	2.19
7	5.47	5.01	4.67	4.27	3.92	3.25	2.19
8	6.71	5.92	5.39	4.82	4.30	3.45	2.25
9	6.17	5.64	5.23	4.78	4.32	3.48	2.28
10	6.28	5.80	5.40	4.95	4.46	3.60	2.31
11	5.59	5.02	4.70	4.26	3.84	3.17	2.10
12	5.75	5.09	4.69	4.17	3.73	3.00	1.96
13	5.47	4.96	4.59	4.22	3.86	3.26	2.18
14	6.08	5.51	5.12	4.67	4.24	3.43	2.24
15	5.46	4.88	4.52	4.13	3.76	3.08	2.08
16	5.65	4.97	4.56	4.04	3.58	2.86	1.90
19	5.38	4.86	4.52	4.14	3.75	3.12	2.10
20	5.58	4.96	4.56	4.03	3.59	2.90	1.95
21	5.92	5.18	4.78	4.34	3.92	3.23	2.20
22	6.00	5.42	5.03	4.58	4.15	3.41	2.21
24	5.69	5.01	4.57	4.09	3.66	2.95	1.96
26	6.09	5.53	5.14	4.64	4.19	3.42	2.23
27	5.62	5.05	4.65	4.21	3.78	3.06	2.05
28	5.71	5.04	4.64	4.17	3.69	2.98	1.97
29	6.73	5.72	5.15	4.55	4.02	3.26	2.20
30	6.29	5.65	5.21	4.68	4.20	3.38	2.22
31	6.41	5.37	4.82	4.25	3.76	3.03	2.00
32	5.62	4.94	4.47	3.98	3.53	2.87	1.95
33	5.77	5.01	4.58	4.11	3.62	2.88	1.93
34	5.95	5.19	4.73	4.20	3.71	2.97	1.94
35	7.07	6.33	5.81	5.08	4.37	3.26	1.97
36	5.75	5.04	4.63	4.20	3.78	3.14	2.16
37	6.73	5.73	5.16	4.56	3.99	3.18	2.18
38	6.68	5.76	5.19	4.58	4.00	3.20	2.11
39	6.61	5.88	5.39	4.79	4.22	3.39	2.21
40	6.91	5.87	5.28	4.67	4.15	3.32	2.18
50	6.46	5.40	4.80	4.19	3.71	2.96	1.96
51	9.09	6.89	5.99	5.02	4.33	3.28	2.04
52	7.24	6.13	5.32	4.69	4.17	3.31	2.15
18	5.98	5.40	5.03	4.56	4.15	3.39	2.21
17	5.59	5.01	4.62	4.22	3.85	3.21	2.17
23	5.55	4.99	4.62	4.20	3.80	3.14	2.11
25	6.53	5.54	5.02	4.49	3.98	3.27	2.21
Average	6.01	5.35	4.92	4.42	3.95	3.20	2.11
CV (%)	8	7	7	7	7	6	6

Pavements at stations 50, 51, 52, 18, 17, 23 and 25 have cracks; hence the deflections at these stations have not been included in the calculations of the average deflection and the coefficient of variation.

Table D.7 Deflections D1 through D7, US-10 EB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	9.93	8.52	7.51	6.23	5.28	3.84	2.21
2	10.24	8.70	7.62	6.32	5.35	3.85	2.16
3	9.89	8.40	7.40	6.18	5.26	3.84	2.17
4	9.47	8.09	7.07	5.87	5.00	3.65	2.13
5	10.66	9.14	8.17	6.88	5.81	4.21	2.28
6	10.51	9.03	8.02	6.71	5.62	3.95	2.25
7	9.73	8.23	7.34	6.24	5.37	3.98	2.29
8	10.90	9.16	8.01	6.61	5.52	3.96	2.23
9	10.48	8.92	7.91	6.67	5.74	4.31	2.43
10	11.66	9.66	8.43	6.92	5.86	4.21	2.34
11	9.54	8.10	7.08	5.85	4.94	3.62	2.12
12	9.53	8.11	7.09	5.77	4.78	3.50	2.03
13	9.62	8.08	7.09	5.90	5.05	3.75	2.20
14	11.29	9.43	8.21	6.76	5.75	4.15	2.29
15	9.36	7.98	6.99	5.83	4.87	3.55	2.07
16	9.26	7.82	6.88	5.72	4.81	3.52	2.00
17	9.39	7.81	6.85	5.74	4.89	3.65	2.15
18	10.87	9.09	7.95	6.54	5.48	3.98	2.24
19	9.39	7.99	7.06	5.87	4.92	3.51	2.03
20	9.21	7.76	6.80	5.72	4.84	3.56	2.02
21	9.15	7.60	6.57	5.57	4.86	3.69	2.17
22	10.44	8.80	7.65	6.35	5.34	3.91	2.20
23	9.58	8.04	6.98	5.79	4.85	3.45	1.96
24	9.06	7.69	6.76	5.65	4.78	3.51	1.95
25	9.00	7.45	6.56	5.54	4.78	3.55	2.13
26	10.30	8.69	7.59	6.30	5.33	3.86	2.21
27	9.76	8.26	7.22	5.91	4.87	3.44	1.91
28	9.42	7.94	6.92	5.72	4.80	3.48	1.93
29	9.13	7.62	6.65	5.55	4.76	3.53	2.09
30	10.52	8.84	7.79	6.42	5.43	3.91	2.24
31	10.20	8.55	7.37	6.01	4.94	3.41	1.91
32	10.34	8.65	7.54	6.13	5.07	3.60	1.97
33	10.04	8.43	7.29	5.95	4.90	3.44	1.97
34	9.90	8.16	7.04	5.77	4.78	3.40	1.88
35	10.90	8.87	7.65	6.21	5.09	3.58	2.02
36	10.64	8.88	7.72	6.24	5.13	3.52	1.96
37	9.63	7.95	6.90	5.67	4.71	3.42	2.05
38	10.95	8.89	7.68	6.21	5.16	3.66	2.07
39	10.97	9.11	7.92	6.60	5.57	4.06	2.29
40	11.05	9.23	8.04	6.64	5.53	3.96	2.24
Average	10.05	8.44	7.38	6.11	5.15	3.72	2.12
CV (%)	7	7	7	7	7	7	6

Table D.8 Deflections D1 through D7, US-10 EB - section 1 test site 2

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	13.49	11.22	9.85	8.03	6.64	4.50	2.27
2	11.91	10.22	8.93	7.33	6.07	4.18	2.21
3	10.57	8.72	7.66	6.37	5.35	3.83	2.06
4	11.39	9.37	8.19	6.65	5.55	3.97	2.17
5	10.94	9.16	8.06	6.70	5.63	4.07	2.15
6	11.39	9.56	8.38	6.85	5.73	4.03	2.17
7	13.04	10.71	9.30	7.66	6.41	4.52	2.32
8	12.25	10.23	8.87	7.20	5.95	4.23	2.31
9	11.08	9.02	7.80	6.40	5.34	3.87	2.18
10	13.26	11.06	9.49	7.36	5.88	3.94	2.16
11	13.32	11.06	9.54	7.79	6.40	4.34	2.24
12	11.29	9.36	8.13	6.59	5.47	3.94	2.16
13	12.78	10.58	9.12	7.43	6.16	4.33	2.28
14	12.72	10.57	8.99	7.00	5.65	3.91	2.19
15	13.29	11.05	9.50	7.67	6.24	4.28	2.23
16	10.83	8.81	7.61	6.17	5.12	3.76	2.14
17	12.80	10.40	8.88	7.22	5.98	4.19	2.26
18	11.61	9.53	8.09	6.40	5.31	3.81	2.18
19	13.53	11.07	9.44	7.54	6.13	4.17	2.16
20	10.68	8.84	7.48	6.06	5.08	3.70	2.08
21	12.35	10.16	8.74	7.03	5.77	4.03	2.21
22	11.36	9.21	7.84	6.22	5.17	3.79	2.12
23	13.72	11.17	9.47	7.54	6.15	4.16	2.17
24	11.01	8.93	7.63	6.17	5.10	3.73	2.10
25	12.37	9.90	8.57	6.97	5.68	3.98	2.20
26	11.41	9.40	8.03	6.36	5.28	3.78	2.12
27	13.66	11.37	9.79	7.77	6.21	4.11	2.12
28	11.07	8.93	7.67	6.27	5.23	3.80	2.08
29	12.28	9.85	8.49	6.84	5.63	3.88	2.14
30	11.41	9.38	8.10	6.56	5.40	3.80	2.14
31	13.80	11.52	9.86	7.72	6.21	4.08	2.16
32	12.66	10.35	8.93	7.22	5.89	4.03	2.14
33	11.59	9.24	7.90	6.32	5.23	3.64	2.02
34	12.34	9.86	8.47	6.75	5.52	3.80	2.12
35	11.68	9.43	8.12	6.56	5.32	3.64	2.06
36	13.21	10.59	9.06	7.26	5.83	3.88	2.04
37	12.44	10.01	8.60	6.92	5.65	3.90	2.19
38	12.21	10.00	8.63	6.97	5.84	4.11	2.28
39	11.20	9.02	7.80	6.33	5.25	3.69	2.15
40	11.62	9.45	8.12	6.56	5.41	3.81	2.13
Average	12.14	9.96	8.58	6.92	5.70	3.98	2.17
CV (%)	8	8	8	8	7	6	3

Table D.9 Deflections D1 through D7, US-23 SB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	14.98	11.43	9.57	7.69	6.24	4.33	2.37
2	15.61	11.97	10.09	7.90	6.40	4.37	2.31
3	14.90	11.37	9.53	7.60	6.22	4.31	2.31
4	14.20	10.83	9.24	7.50	6.12	4.29	2.39
5	16.57	12.61	10.55	8.33	6.74	4.60	2.44
6	15.73	12.10	10.47	8.40	6.88	4.70	2.43
7	13.98	11.06	9.62	7.54	6.08	4.15	2.21
8	14.30	11.02	9.53	7.77	6.35	4.43	2.36
9	15.57	11.20	9.66	7.90	6.52	4.52	2.43
10	14.83	11.49	10.10	8.20	6.76	4.71	2.60
12	14.87	11.33	9.73	7.93	6.54	4.56	2.54
13	15.51	12.05	10.35	8.44	6.72	4.46	2.36
15	15.14	11.94	10.18	8.11	6.55	4.40	2.38
16	15.26	11.63	9.73	7.67	6.18	4.22	2.28
17	15.24	11.86	9.85	7.71	6.30	4.30	2.34
18	12.92	10.16	8.75	7.00	5.78	3.95	2.16
19	14.28	11.26	9.40	7.46	6.15	4.33	2.33
20	14.23	11.20	9.51	7.72	6.34	4.47	2.45
21	13.97	11.23	9.62	7.68	6.29	4.29	2.28
22	13.60	10.61	9.06	7.30	6.01	4.30	2.39
23	12.70	10.00	8.69	7.18	5.93	4.17	2.25
24	12.39	9.63	8.36	7.02	5.91	4.17	2.30
25	12.05	9.61	8.37	6.87	5.68	3.98	2.19
26	11.03	8.69	7.48	6.40	5.35	3.72	2.14
27	12.12	9.22	7.96	6.61	5.56	3.98	2.20
28	11.48	9.29	7.93	6.38	5.29	3.78	2.08
29	12.46	9.46	8.22	6.80	5.66	4.00	2.17
30	12.31	9.71	8.39	6.86	5.73	4.07	2.27
16N1	15.02	11.58	9.76	7.82	6.29	4.24	2.26
16N2	14.42	11.58	9.94	7.91	6.32	4.21	Error
16S1	14.55	11.53	9.69	7.51	6.07	4.11	2.26
16S2	15.14	11.80	9.74	7.63	6.08	4.12	2.26
26N1	11.25	8.67	7.69	6.53	5.31	3.72	2.14
26N2	11.51	9.02	7.89	6.36	5.22	3.73	2.19
26N3	11.55	9.06	7.63	6.21	5.17	3.70	2.14
26N4	11.80	8.82	7.52	6.22	5.18	3.75	2.12
26N5	11.58	8.98	7.69	6.25	5.26	3.78	2.15
26S1	11.03	8.69	7.59	6.21	5.24	3.76	2.12
26S2	11.05	8.66	7.42	6.22	5.19	3.77	2.13
26S3	11.22	8.90	7.56	6.18	5.20	3.75	2.17
26S4	11.53	8.80	7.66	6.27	5.23	3.74	2.19
26S5	11.62	8.81	7.50	6.22	5.17	3.71	2.16
3N1	14.66	11.31	9.56	7.67	6.31	4.31	2.30
3N2	15.22	11.58	9.87	7.92	6.44	4.35	2.34
3N4	15.60	12.11	10.22	8.16	6.56	4.35	2.35
3N4	15.19	11.79	10.02	8.04	6.49	4.33	2.31
3N5	16.13	12.50	10.68	8.31	6.59	4.37	2.39

Table D.9 (continued) Deflections D1 through D7, US-23 SB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
3S1	14.82	11.23	9.44	7.62	6.18	4.29	2.32
3S1	14.19	10.69	9.28	7.49	6.17	4.21	2.36
3S2	14.49	11.31	9.40	7.44	6.14	4.32	2.33
3S2	13.95	10.92	9.42	7.65	6.10	4.24	2.35
3S3	14.48	11.30	9.56	7.45	6.04	4.28	2.35
Average	13.74	10.65	9.09	7.33	6.00	4.17	2.29
CV (%)	12	12	11	10	8	7	5

Error = No Value recorded, negative value

Table D.10 Deflections D1 through D7, US-23 SB - section 1 test site2

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	16.14	11.60	9.43	7.49	6.24	4.38	2.43
2	15.80	11.48	9.30	7.52	6.21	4.36	2.43
3	16.21	11.28	9.42	7.94	6.68	4.61	2.44
4	16.43	11.32	9.26	7.62	6.15	4.19	2.28
5	16.23	11.50	9.58	7.87	6.40	4.42	error
6	15.50	11.48	9.44	7.50	6.21	4.38	2.43
7	15.58	10.87	9.04	7.51	6.38	4.59	2.47
8	16.94	12.09	9.95	7.98	6.66	4.60	2.51
9	17.89	12.96	10.95	9.04	7.56	5.37	2.91
10	17.19	12.29	10.49	8.87	7.47	5.32	2.83
11	16.35	11.51	9.41	7.64	6.34	4.49	error
12	17.43	12.13	10.50	8.81	7.41	5.33	2.92
13	14.64	10.56	9.18	7.64	6.40	4.61	error
14	18.11	11.85	10.68	8.91	7.42	5.30	2.90
16	16.94	11.69	9.69	8.10	6.66	4.70	2.55
17	15.49	10.48	8.93	7.42	6.26	4.47	2.46
18	14.92	10.75	9.36	7.82	6.60	4.73	2.55
19	17.08	13.47	11.55	9.59	8.16	6.01	3.30
20	16.93	12.35	10.33	8.35	7.04	5.20	error
21	15.67	10.81	9.00	7.40	6.36	4.63	error
22	16.89	12.27	10.37	8.34	7.08	5.18	2.90
23	15.00	9.96	8.62	7.42	6.41	4.65	2.55
24	15.26	11.52	9.99	8.39	7.14	5.23	2.95
25	14.64	9.88	8.29	7.24	6.27	4.64	2.52
26	14.47	9.55	8.24	7.38	6.29	4.61	2.42
28	12.75	9.80	8.39	7.29	6.31	4.65	error
29	16.05	11.39	10.34	9.03	7.87	5.92	3.30
30	14.64	10.14	9.22	8.03	6.78	5.08	2.87
15	14.13	10.55	9.23	7.62	6.42	4.57	2.50
Average	15.89	11.26	9.55	7.97	6.72	4.83	2.67
CV (%)	8	9	9	8	8	10	11

Table D.11 Deflections D1 through D7, US-27 SB - section 2 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	8.41	7.10	6.16	4.97	4.07	2.83	1.46
2	8.35	7.03	6.12	4.84	3.98	2.71	1.41
3	7.74	6.63	5.80	4.68	3.87	2.70	1.42
4	7.92	6.73	5.83	4.64	3.83	2.68	1.42
5	8.39	6.93	5.96	4.68	3.86	2.65	1.40
6	8.09	6.74	5.86	4.68	3.90	2.73	1.45
8	8.20	6.72	5.74	4.55	3.75	2.66	1.41
9	8.70	7.05	6.01	4.63	3.75	2.53	1.39
10	8.03	6.72	5.84	4.63	3.81	2.60	1.39
11	7.49	6.42	5.66	4.59	3.86	2.71	1.47
12	7.23	6.23	5.48	4.44	3.69	2.61	1.42
13	8.63	7.42	6.24	4.94	4.07	2.56	1.29
14	7.43	6.36	5.59	4.53	3.73	2.61	1.39
15	7.00	5.98	5.30	4.40	3.70	2.71	1.49
16	6.84	5.86	5.12	4.17	3.52	2.58	1.43
17	8.13	7.11	6.25	4.99	4.03	2.44	1.31
18	6.85	5.80	5.06	4.16	3.53	2.57	1.42
19	6.63	5.60	4.96	4.15	3.55	2.65	1.46
20	6.60	5.59	4.83	3.99	3.37	2.53	1.41
21	7.99	6.91	6.12	4.99	4.01	2.49	1.32
22	6.52	5.51	4.82	3.96	3.35	2.53	1.41
23	6.47	5.49	4.84	4.07	3.49	2.69	1.44
24	6.39	5.43	4.82	3.98	3.38	2.55	1.41
25	7.75	6.77	6.01	4.94	4.02	2.61	1.33
26	6.49	5.49	4.83	3.95	3.36	2.50	1.42
27	6.72	5.74	5.11	4.31	3.66	2.72	1.48
28	6.40	5.52	4.90	4.07	3.43	2.55	1.42
29	7.93	7.01	6.15	5.00	4.09	2.66	1.35
30	6.98	5.79	5.05	4.09	3.47	2.51	1.38
31	7.15	6.18	5.54	4.70	3.97	2.87	1.53
32	7.52	6.35	5.64	4.63	3.93	2.83	1.56
33	6.79	5.93	5.28	4.35	3.69	2.70	1.49
34	7.13	6.08	5.30	4.32	3.64	2.64	1.42
35	7.95	6.83	5.88	4.71	3.92	2.71	1.40
36	7.26	6.16	5.44	4.47	3.74	2.63	1.45
37	7.94	7.09	6.19	5.03	4.15	2.80	1.40
38	6.73	5.82	5.20	4.27	3.60	2.66	1.48
39	6.65	5.68	5.04	4.14	3.51	2.60	1.42

Table D.11 (continued) Deflections D1 through D7, US-27 SB - section 2 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
40	6.92	5.84	5.09	4.15	3.52	2.55	1.41
TD1	8.23	6.86	5.93	4.74	3.89	2.64	1.33
TD2	9.27	7.37	6.14	4.69	3.74	2.49	1.36
TD3	8.59	6.90	5.86	4.56	3.79	2.59	1.40
TJ1	11.70	9.15	7.42	5.20	4.13	2.62	1.30
TJ2	10.87	9.30	7.40	5.14	4.02	2.64	1.34
7	9.75	7.91	6.68	5.18	4.09	2.66	1.31
Average	7.39	6.30	5.51	4.48	3.74	2.64	1.42
CV (%)	10	9	9	8	6	4	4

Test station numbers TD1, TD2, TD3 and 7 are located over cracks and TJ1, TJ2 are located over joint reflective transverse crack; therefore the deflections at these stations have not been included in the calculations of the average calculation and the coefficient of variation.

Table D.12 Deflections D1 through D7, US-27 SB - section 3 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	12.70	10.38	9.00	7.34	6.11	4.21	2.04
2	12.35	10.17	8.91	7.41	6.17	4.18	2.00
3	12.20	10.04	8.69	7.06	5.81	3.94	1.90
4	11.80	9.97	8.75	7.26	5.94	3.98	1.93
5	12.87	10.58	9.27	7.65	6.25	4.08	1.88
6	12.52	10.34	9.08	7.54	6.20	4.16	1.93
7	13.53	10.89	9.41	7.70	6.37	4.19	1.90
8	12.61	10.34	8.99	7.33	5.91	3.90	1.87
9	12.05	9.90	8.57	7.03	5.83	4.05	2.02
10	11.70	9.69	8.50	7.20	6.04	4.18	2.11
11	12.41	10.14	8.83	7.26	6.08	4.21	2.07
12	11.74	9.77	8.58	7.10	5.88	3.97	1.97
13	13.20	10.72	9.25	7.67	6.30	4.13	1.89
14	11.27	9.21	8.04	6.78	5.74	4.03	2.07
15	12.05	9.86	8.67	7.25	6.06	4.24	2.10
16	12.86	10.17	8.73	7.10	5.78	3.90	1.88
17	11.48	9.39	8.28	6.95	5.79	3.89	1.90
18	10.95	8.83	7.76	6.48	5.42	3.86	2.02
19	12.03	9.65	8.47	7.13	6.01	4.23	2.09
20	11.34	9.08	7.94	6.71	5.63	3.84	1.89
21	12.57	9.99	8.46	6.87	5.65	3.82	1.83
22	10.84	8.68	7.58	6.39	5.35	3.83	2.01
23	12.21	9.84	8.70	7.39	6.21	4.29	2.14
24	11.38	9.15	8.05	6.79	5.69	3.85	1.84
25	12.16	9.86	8.56	6.95	5.71	3.78	1.83
26	10.71	8.66	7.70	6.53	5.54	3.89	2.01
27	12.21	10.00	8.77	7.36	6.13	4.23	2.13
28	11.04	9.25	8.18	6.94	5.74	3.83	1.83
29	12.21	10.00	8.58	7.06	5.72	3.76	1.80
30	10.91	8.89	7.87	6.65	5.56	3.83	2.00
31	12.62	10.29	8.94	7.40	6.08	4.14	2.11
32	12.45	9.99	8.69	7.11	5.80	3.87	1.96
33	11.77	9.43	8.20	6.76	5.58	3.80	1.92
34	11.19	9.15	8.10	6.83	5.68	3.78	1.86
35	11.88	9.58	8.32	6.80	5.55	3.67	1.79
36	11.54	9.37	8.16	6.66	5.41	3.51	1.74
37	12.44	10.07	8.63	6.97	5.62	3.61	1.77
38	11.87	9.55	8.25	6.75	5.54	3.73	1.81
39	11.31	9.21	8.02	6.59	5.43	3.73	1.88
40	11.30	9.07	7.87	6.63	5.50	3.79	1.97
Average	11.96	9.73	8.48	7.03	5.82	3.95	1.94
CV (%)	6	6	5	5	5	5	6

Table D.13 Deflections D1 through D7, US-27 SB - section 4 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	6.87	5.09	4.43	3.78	3.25	2.45	1.42
2	6.96	5.11	4.43	3.82	3.32	2.52	1.44
3	6.74	4.83	4.23	3.71	3.21	2.43	1.41
4	7.42	5.32	4.49	3.83	3.27	2.47	1.39
5	6.92	4.76	4.13	3.64	3.22	2.48	1.38
6	6.77	4.82	4.17	3.65	3.16	2.36	1.36
7	7.03	5.24	4.64	4.11	3.64	2.78	1.53
8	6.90	4.94	4.30	3.80	3.35	2.51	1.45
9	7.67	5.54	4.81	4.08	3.47	2.56	1.47
10	7.43	5.33	4.59	3.93	3.41	2.60	1.49
11	6.24	4.40	3.95	3.49	3.09	2.37	1.42
12	7.21	4.97	4.29	3.71	3.20	2.46	1.41
13	6.62	4.86	4.37	3.98	3.55	2.75	1.57
14	7.03	4.97	4.34	3.80	3.32	2.59	1.48
15	6.28	4.11	3.70	3.34	2.95	2.34	1.42
16	5.94	4.09	3.66	3.30	2.93	2.36	1.44
17	6.47	4.57	4.12	3.82	3.44	2.75	1.56
18	6.38	4.24	3.79	3.39	3.04	2.44	1.49
19	5.90	3.98	3.52	3.19	2.86	2.29	1.38
20	5.79	3.86	3.41	3.12	2.80	2.27	1.41
21	6.21	4.05	3.79	3.54	3.23	2.62	1.56
22	6.32	4.03	3.54	3.24	2.91	2.41	1.48
23	5.69	3.68	3.36	3.10	2.79	2.30	1.38
24	5.86	3.73	3.31	3.09	2.83	2.30	1.44
25	6.21	4.25	3.88	3.56	3.21	2.59	1.52
26	6.02	3.81	3.42	3.16	2.89	2.39	1.49
27	5.64	3.67	3.33	3.09	2.79	2.26	1.38
28	5.87	3.78	3.42	3.18	2.87	2.31	1.42
29	6.19	4.12	3.74	3.51	3.23	2.60	1.49
30	6.01	3.82	3.44	3.21	2.90	2.38	1.44
31	5.81	4.01	3.55	3.21	2.88	2.31	1.41
32	5.92	4.19	3.72	3.39	2.99	2.40	1.43
33	5.83	3.74	3.34	3.10	2.81	2.29	1.38
34	6.42	4.17	3.73	3.39	3.03	2.39	1.41
35	6.70	4.39	3.72	3.31	2.95	2.36	1.38
36	6.35	4.07	3.55	3.25	2.89	2.28	1.34
37	6.83	4.53	3.95	3.68	3.30	2.64	1.43
38	6.33	4.18	3.63	3.28	2.92	2.33	1.37
39	6.26	4.20	3.74	3.41	3.00	2.44	1.43
40	6.17	4.07	3.56	3.28	2.97	2.43	1.45
Average	6.43	4.39	3.88	3.49	3.10	2.45	1.44
CV (%)	8	12	11	9	7	6	4

Table D.14 Deflections D1 through D7, US-31 SB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	6.27	5.14	4.64	3.94	3.35	2.46	1.50
2	6.58	5.42	4.82	4.11	3.56	2.68	1.57
3	6.51	5.52	4.88	4.17	3.60	2.79	1.61
4	6.90	5.64	4.97	4.27	3.70	2.89	1.71
5	6.92	5.54	4.93	4.26	3.70	2.83	1.69
6	5.97	4.86	4.36	3.87	3.44	2.79	1.73
7	6.30	5.12	4.64	4.07	3.61	2.88	1.75
8	6.14	5.06	4.50	3.99	3.51	2.75	1.70
9	6.73	5.46	4.79	3.95	3.34	2.43	1.43
10	7.11	5.69	4.96	4.11	3.49	2.48	1.36
11	6.22	4.93	4.38	3.80	3.19	2.46	1.52
12	6.64	5.36	4.76	4.17	3.65	2.87	1.79
13	5.83	4.75	4.30	3.88	3.47	2.84	1.81
14	6.47	5.24	4.61	3.89	3.29	2.47	1.39
15	5.67	4.63	4.10	3.55	3.08	2.42	1.55
16	5.68	4.62	4.19	3.83	3.43	2.83	1.79
17	5.53	4.53	4.15	3.76	3.42	2.86	1.81
18	6.19	5.02	4.47	3.77	3.24	2.44	1.41
19	5.32	4.30	3.90	3.44	2.97	2.40	1.53
20	5.33	4.29	3.95	3.64	3.32	2.74	1.79
21	5.29	4.26	3.94	3.69	3.42	2.89	1.86
22	6.23	4.96	4.28	3.64	3.18	2.46	1.43
23	5.20	4.16	3.79	3.37	2.92	2.40	1.56
24	4.90	4.18	3.83	3.58	3.32	2.84	1.85
25	5.15	4.24	3.92	3.66	3.41	2.90	1.85
26	5.63	4.59	4.02	3.47	3.10	2.44	1.47
27	5.09	4.12	3.76	3.34	2.96	2.40	1.59
28	5.03	4.14	3.85	3.60	3.33	2.80	1.85
29	5.37	4.30	3.98	3.74	3.43	2.91	1.87
30	5.39	4.48	3.98	3.44	3.03	2.40	1.43
31	5.29	4.20	3.80	3.39	2.98	2.46	1.59
32	5.56	4.43	4.00	3.62	3.24	2.64	1.63
33	5.57	4.48	4.07	3.69	3.39	2.81	1.79
34	5.54	4.45	4.12	3.77	3.46	2.89	1.88
35	6.10	4.97	4.54	4.04	3.61	2.91	1.85
36	6.83	5.47	4.89	4.30	3.81	3.04	1.91
37	5.65	4.55	4.16	3.83	3.49	2.92	1.87
38	5.59	4.49	4.08	3.70	3.35	2.76	1.77
39	5.76	4.84	4.24	3.64	3.14	2.44	1.51
40	5.71	4.66	4.09	3.46	2.99	2.35	1.42
Average	5.88	4.78	4.29	3.79	3.35	2.67	1.66
CV (%)	10	10	9	7	7	8	10

Table D.15 Deflections D1 through D7, M-15 SB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	8.63	7.61	6.82	5.73	4.76	3.31	1.75
2	7.95	7.02	6.37	5.34	4.51	3.20	1.78
3	7.07	6.27	5.74	5.03	4.46	3.51	2.03
4	8.06	7.02	6.34	5.33	4.57	3.39	2.03
5	7.99	7.03	6.34	5.38	4.58	3.33	1.85
6	7.49	6.48	5.86	5.00	4.29	3.20	1.84
7	7.54	6.70	6.00	5.03	4.20	2.91	1.61
8	8.17	7.14	6.42	5.32	4.43	3.02	1.50
9	8.68	7.53	6.73	5.67	4.74	3.27	1.56
10	8.06	7.18	6.52	5.57	4.75	3.36	1.84
11	8.64	7.65	6.79	5.64	4.67	3.27	1.75
12	7.54	6.59	5.95	5.08	4.37	3.30	1.99
13	7.32	6.46	5.80	4.86	4.06	2.85	1.56
14	7.59	6.70	6.10	5.24	4.47	3.21	1.77
15	8.31	7.31	6.54	5.42	4.55	3.19	1.75
16	7.35	6.43	5.80	4.91	4.20	3.15	1.92
17	7.17	6.27	5.69	4.75	3.99	2.79	1.53
18	7.51	6.66	6.03	5.15	4.39	3.17	1.70
19	8.25	7.25	6.46	5.37	4.51	3.23	1.80
20	7.34	6.37	5.74	4.86	4.17	3.12	1.85
21	7.35	6.38	5.73	4.78	3.99	2.76	1.51
22	7.87	6.89	6.24	5.25	4.43	3.13	1.69
23	8.31	7.30	6.54	5.48	4.55	3.21	1.78
24	7.33	6.37	5.77	4.88	4.15	3.14	1.91
25	7.45	6.51	5.81	4.86	4.04	2.79	1.51
26	8.21	7.17	6.39	5.34	4.49	3.14	1.64
27	8.18	7.24	6.52	5.46	4.60	3.25	1.77
28	7.26	6.38	5.76	4.87	4.18	3.15	1.86
29	7.44	6.56	5.85	4.89	4.08	2.81	1.48
30	8.06	7.03	6.30	5.28	4.44	3.13	1.58
31	7.87	7.03	6.34	5.34	4.55	3.26	1.79
32	7.53	6.65	6.07	5.17	4.40	3.16	1.72
33	6.30	5.54	5.04	4.38	3.86	2.99	1.77
34	7.13	6.20	5.61	4.78	4.14	3.11	1.87
35	7.53	6.66	5.98	5.02	4.30	3.14	1.83
36	7.26	6.37	5.80	4.95	4.22	3.10	1.79
37	7.47	6.51	5.87	4.87	4.06	2.82	1.51
38	8.12	7.18	6.44	5.29	4.32	2.93	1.45
39	8.48	7.31	6.57	5.43	4.49	3.03	1.54
40	7.97	6.97	6.30	5.31	4.44	3.08	1.60
50	9.51	8.12	7.19	5.91	4.90	3.36	1.69
51	7.98	6.75	5.92	4.89	4.10	2.96	1.65
52	7.87	6.79	6.10	5.18	4.47	3.23	1.66
Average	7.74	6.80	6.12	5.16	4.36	3.12	1.73
CV	7%	7%	6%	6%	5%	6%	9%

Table D.16 Deflections D1 through D7, M-37 SB - section 2 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	7.78	6.76	6.14	5.25	4.45	3.28	1.73
2	8.41	7.09	6.25	5.26	4.46	3.27	1.75
3	9.09	7.49	6.49	5.39	4.55	3.31	1.78
4	8.49	7.43	6.62	5.44	4.57	3.30	1.77
5	9.12	7.97	7.02	5.78	4.81	3.43	1.81
6	9.02	7.83	7.03	5.94	5.00	3.54	1.85
7	9.57	8.15	7.39	6.27	5.21	3.61	1.95
8	14.04	11.27	9.52	7.38	5.88	3.77	2.03
9	7.83	6.66	5.95	5.02	4.32	3.25	1.93
10	8.01	6.90	6.11	5.11	4.37	3.26	1.94
12	8.37	7.20	6.43	5.44	4.59	3.34	1.94
14	9.05	7.95	7.16	5.96	4.96	3.54	1.98
15	9.35	8.22	7.42	6.12	5.08	3.61	2.00
16	14.43	11.43	9.58	7.37	5.83	3.86	2.05
18	10.11	8.36	7.19	5.88	4.83	3.45	2.06
19	10.09	8.10	7.08	5.85	4.89	3.51	2.04
20	9.18	7.85	6.93	5.80	4.96	3.66	2.09
21	12.70	10.51	8.76	6.95	5.64	3.84	2.11
22	11.42	9.71	8.41	6.65	5.45	3.77	2.12
23	11.51	9.75	8.43	6.83	5.53	3.83	2.16
24	9.97	8.74	7.66	6.38	5.29	3.69	2.03
13	9.36	7.92	6.99	5.84	4.86	3.45	1.94
17	8.06	6.91	6.12	5.15	4.44	3.35	2.02
Average	9.82	8.30	7.27	5.97	4.96	3.52	1.96
CV (%)	19	17	15	12	10	6	7

Pavements at stations 13 and 17 have cracks; hence the deflections at these stations have not been included in the calculations of the average deflection and the coefficient of variation.

Table D.17 Deflections D1 through D7, M-37 SB - section 5 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	8.80	7.33	6.53	5.66	4.90	3.75	2.08
2	7.95	6.55	5.83	5.08	4.47	3.53	2.07
3	7.33	6.07	5.51	4.97	4.42	3.55	2.13
4	8.91	7.22	6.39	5.46	4.75	3.65	2.13
5	8.70	7.07	6.26	5.41	4.81	3.83	2.25
6	8.96	7.31	6.49	5.67	4.99	3.90	2.31
7	8.50	6.92	6.19	5.47	4.83	3.84	2.30
8	8.95	7.32	6.48	5.66	5.01	3.99	2.35
9	9.25	7.50	6.65	5.70	4.99	3.90	2.32
10	8.63	7.02	6.23	5.41	4.82	3.82	2.27
11	8.74	7.17	6.37	5.47	4.75	3.66	2.07
12	8.36	6.85	6.05	5.20	4.55	3.56	2.12
13	8.15	6.56	5.87	5.14	4.58	3.63	2.22
14	8.40	6.76	5.99	5.24	4.66	3.76	2.26
15	8.71	6.97	6.19	5.30	4.63	3.59	2.03
16	8.22	6.51	5.74	5.03	4.46	3.54	2.13
17	8.10	6.44	5.75	5.06	4.49	3.57	2.17
18	8.46	6.65	5.85	5.08	4.51	3.64	2.23
19	8.16	6.68	5.96	5.19	4.58	3.51	2.00
20	7.61	6.15	5.54	4.93	4.42	3.53	2.12
21	7.84	6.23	5.59	4.92	4.38	3.48	2.15
22	8.01	6.52	5.81	5.08	4.52	3.62	2.24
23	7.63	6.28	5.68	5.00	4.41	3.44	1.96
24	7.42	6.02	5.43	4.86	4.37	3.49	2.12
25	7.73	6.15	5.53	4.89	4.32	3.43	2.11
26	7.98	6.51	5.83	5.09	4.53	3.63	2.24
27	7.46	6.10	5.51	4.85	4.28	3.32	1.89
28	7.62	6.05	5.47	4.84	4.31	3.49	2.13
29	7.71	6.10	5.49	4.77	4.21	3.35	2.09
30	8.07	6.44	5.70	4.90	4.33	3.47	2.17
31	7.10	5.87	5.31	4.66	4.13	3.21	1.87
32	7.14	5.65	5.07	4.47	3.98	3.18	1.93
33	6.96	5.72	5.22	4.71	4.20	3.36	2.06
34	7.36	5.82	5.28	4.71	4.22	3.48	2.14
35	7.75	6.16	5.53	4.82	4.28	3.38	2.08
36	7.47	5.86	5.28	4.59	4.05	3.24	2.01
37	7.67	6.00	5.40	4.69	4.16	3.27	2.02
38	8.26	6.58	5.87	5.12	4.54	3.61	2.20
39	8.10	6.32	5.65	4.88	4.28	3.39	2.11
40	8.04	6.33	5.66	4.85	4.29	3.44	2.12
Average	8.06	6.49	5.80	5.07	4.48	3.55	2.13
CV (%)	7	8	7	6	6	5	5

Table D.18 Deflections D1 through D7, M-37 SB - section 5 test site 2

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	9.40	7.64	6.72	5.55	4.63	3.33	1.92
2	9.22	7.29	6.49	5.58	4.88	3.76	2.17
3	8.97	7.16	6.35	5.55	4.85	3.78	2.18
4	10.12	8.25	7.27	6.03	5.12	3.85	2.16
5	9.34	7.59	6.81	5.92	5.20	4.09	2.44
6	11.37	9.11	7.99	6.70	5.80	4.46	2.57
7	11.49	9.16	8.09	6.94	6.03	4.59	2.56
8	13.14	10.91	9.64	8.08	6.80	4.84	2.50
9	12.59	10.40	9.22	7.73	6.55	4.80	1.71
10	13.71	11.24	9.67	7.84	6.54	4.67	2.53
11	9.22	7.47	6.59	5.51	4.65	3.35	1.94
12	9.75	8.02	7.07	5.86	4.97	3.75	2.15
13	11.30	9.07	7.97	6.82	5.92	4.53	2.56
14	13.64	10.88	9.34	7.58	6.35	4.56	2.50
15	9.24	7.33	6.39	5.39	4.57	3.36	1.96
16	10.03	8.01	6.94	5.69	4.80	3.64	2.13
17	11.37	9.06	7.88	6.71	5.81	4.47	2.55
18	13.30	10.66	9.06	7.27	6.11	4.42	2.46
19	8.91	7.20	6.39	5.39	4.56	3.37	1.96
20	9.73	7.77	6.86	5.72	4.84	3.61	2.07
21	11.32	8.91	7.83	6.68	5.79	4.50	2.53
22	12.52	10.01	8.78	7.16	6.02	4.34	2.45
23	8.89	7.16	6.33	5.35	4.56	3.37	1.95
24	9.52	7.61	6.77	5.66	4.81	3.60	2.10
25	11.03	8.72	7.74	6.61	5.75	4.39	2.45
26	12.29	9.82	8.55	7.06	5.98	4.37	2.45
27	9.58	7.36	6.38	5.29	4.46	3.31	1.96
28	9.37	7.53	6.63	5.56	4.73	3.55	2.06
29	10.85	8.52	7.52	6.45	5.59	4.26	2.44
30	12.39	9.77	8.48	6.96	5.93	4.34	2.41
31	9.33	7.16	6.12	4.99	4.21	3.14	1.89
32	8.11	6.17	5.51	4.78	4.24	3.35	2.01
33	8.30	6.39	5.64	4.90	4.32	3.42	2.07
34	9.33	7.27	6.41	5.39	4.58	3.50	2.05
35	9.16	7.06	6.19	5.31	4.66	3.67	2.23
36	10.33	8.05	7.06	6.03	5.24	4.06	2.39
37	10.65	8.29	7.32	6.29	5.48	4.21	2.45
38	11.59	9.46	8.33	6.98	5.92	4.34	2.39
39	11.05	8.80	7.76	6.66	5.75	4.36	2.41
40	12.12	9.67	8.44	6.96	5.91	4.37	2.43
Average	10.59	8.45	7.41	6.22	5.32	3.99	2.25
CV (%)	15	16	15	14	14	13	11

Table D.19 Deflections D1 through D7, M-37 SB - section 6 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	6.00	5.35	4.92	4.31	3.76	2.86	1.59
2	5.59	5.01	4.62	4.09	3.65	2.85	1.63
3	5.71	5.01	4.63	4.05	3.56	2.75	1.60
4	5.60	5.03	4.68	4.15	3.70	2.92	1.67
5	6.98	6.27	5.76	5.01	4.37	3.23	1.56
6	7.08	6.19	5.58	4.84	4.19	3.14	1.71
8	5.39	4.91	4.55	4.00	3.56	2.84	1.58
9	5.80	5.02	4.62	4.07	3.62	2.88	1.68
10	5.78	5.09	4.68	4.12	3.67	2.92	1.41
11	5.50	4.94	4.54	4.00	3.56	2.77	1.54
12	5.12	4.63	4.31	3.88	3.52	2.79	1.63
13	5.79	5.20	4.79	4.19	3.59	2.57	1.45
14	5.38	4.83	4.46	3.97	3.58	2.83	1.40
15	5.32	4.79	4.44	3.91	3.48	2.69	1.50
16	5.04	4.55	4.23	3.80	3.42	2.72	1.60
17	5.61	5.06	4.63	4.03	3.47	2.50	1.39
18	5.24	4.73	4.37	3.88	3.50	2.80	1.37
19	5.19	4.68	4.35	3.86	3.40	2.66	1.47
20	5.10	4.58	4.23	3.78	3.40	2.73	1.58
21	5.65	5.09	4.67	4.04	3.43	2.42	1.37
22	5.19	4.67	4.35	3.86	3.48	2.80	1.38
23	5.32	4.81	4.47	3.90	3.42	2.62	1.45
24	5.27	4.70	4.36	3.87	3.47	2.78	1.57
25	5.77	5.17	4.72	4.04	3.40	2.40	1.38
26	5.11	4.66	4.33	3.86	3.46	2.77	1.33
27	5.81	5.23	4.81	4.15	3.62	2.70	1.48
28	5.61	4.97	4.56	4.03	3.59	2.79	1.59
29	6.05	5.40	4.90	4.18	3.52	2.44	1.37
30	5.18	4.69	4.36	3.88	3.47	2.71	1.32
31	6.80	6.07	5.50	4.66	3.96	2.83	1.48
32	6.53	5.74	5.19	4.44	3.81	2.85	1.59
33	6.63	5.76	5.20	4.42	3.83	2.90	1.64
34	5.96	5.29	4.85	4.16	3.63	2.74	1.51
35	7.13	6.38	5.83	5.01	4.19	2.87	1.31
36	6.62	5.80	5.22	4.40	3.77	2.76	1.47
37	6.37	5.68	5.20	4.41	3.72	2.55	1.36
38	5.04	4.44	4.10	3.64	3.26	2.60	1.46
39	5.72	4.96	4.49	3.89	3.42	2.68	1.54
40	5.68	5.10	4.70	4.16	3.68	2.76	1.25
41	5.50	4.78	4.41	3.86	3.44	2.69	1.59
42	5.95	5.16	4.75	4.12	3.64	2.81	1.54
7	5.94	5.31	4.94	4.28	3.67	2.66	1.45
Average	5.75	5.13	4.72	4.12	3.61	2.75	1.50
CV (%)	10	10	9	8	6	6	8

Table D.20 Deflections D1 through D7, US-27 SB - section 1 test site 1 (FLEXIBLE)

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
1	7.50	6.48	5.81	4.91	4.18	2.93	1.43
2	7.39	6.36	5.68	4.79	4.07	2.86	1.44
3	7.33	6.34	5.69	4.80	4.07	2.85	1.37
4	7.58	6.48	5.80	4.85	4.11	2.86	1.36
5	7.32	6.27	5.64	4.75	4.03	2.84	1.40
6	7.49	6.39	5.72	4.85	4.12	2.91	1.41
7	7.68	6.60	5.90	4.97	4.24	2.99	1.47
8	7.51	6.45	5.78	4.91	4.15	2.95	1.44
9	7.58	6.41	5.80	4.93	4.18	2.94	1.46
10	7.43	6.34	5.71	4.84	4.12	2.90	1.46
11	7.39	6.35	5.73	4.89	4.14	2.91	1.43
12	7.44	6.34	5.66	4.75	3.99	2.80	1.36
13	7.49	6.37	5.73	4.87	4.15	2.90	1.44
14	7.24	6.22	5.59	4.75	4.03	2.87	1.44
15	7.23	6.23	5.60	4.71	4.03	2.82	1.43
16	7.32	6.20	5.55	4.64	3.93	2.75	1.35
17	7.28	6.30	5.65	4.79	4.10	2.91	1.42
18	7.12	6.12	5.51	4.69	3.98	2.78	1.44
19	7.05	6.14	5.53	4.68	3.97	2.85	1.41
20	7.16	6.13	5.48	4.60	3.93	2.74	1.34
21	7.09	6.11	5.50	4.71	3.98	2.86	1.45
22	7.13	6.09	5.50	4.66	3.97	2.81	1.44
23	7.03	6.08	5.46	4.64	3.96	2.86	1.45
24	7.17	6.12	5.47	4.62	3.93	2.79	1.39
25	7.06	6.07	5.48	4.67	4.01	2.86	1.46
26	7.22	6.20	5.60	4.72	4.04	2.86	1.48
28	7.14	6.20	5.57	4.69	4.01	2.80	1.38
29	7.15	6.19	5.58	4.75	4.05	2.93	1.45
30	7.27	6.25	5.65	4.80	4.07	2.94	1.49
31	7.17	6.22	5.60	4.75	4.06	2.89	1.45
31	7.32	6.30	5.68	4.79	4.07	2.87	1.44
32	7.43	6.41	5.80	4.93	4.15	2.93	1.45
33	7.23	6.26	5.66	4.81	4.10	2.88	1.43
35	7.06	6.10	5.47	4.67	3.97	2.79	1.39
36	7.10	6.13	5.53	4.73	4.04	2.88	1.42
37	7.31	6.29	5.69	4.83	4.13	2.91	1.44
38	7.22	6.21	5.58	4.72	4.02	2.85	1.45
39	7.15	6.18	5.56	4.75	4.02	2.88	1.49
40	7.51	6.43	5.76	4.89	4.15	2.92	1.45
Average	7.29	6.27	5.63	4.77	4.06	2.87	1.43
CV (%)	2	2	2	2	2	2	3

Table D.21 Deflections D1 through D7, I-96 EB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	6.24	4.90	4.19	3.58	2.98	2.10	1.08
A2	5.97	4.85	4.14	3.55	2.96	2.08	1.07
A3	5.77	4.81	4.09	3.51	2.92	2.07	1.06
A4	5.65	4.77	4.04	3.49	2.90	2.07	1.06
A5	5.62	4.72	3.99	3.45	2.87	2.06	1.04
A6	5.49	4.69	3.97	3.42	2.83	2.05	1.05
A7	5.12	4.64	3.93	3.40	2.81	2.03	1.04
A8	4.93	4.59	3.90	3.36	2.79	2.00	1.04
A9	4.64	4.54	3.86	3.31	2.75	1.97	1.04
A10	4.65	4.53	3.81	3.29	2.74	1.93	1.04
A11	4.85	4.50	3.77	3.25	2.71	1.92	1.05
B1	5.73	4.47	3.73	3.22	2.68	1.91	1.04
B2	5.49	4.44	3.69	3.20	2.66	1.90	1.04
B3	5.27	4.41	3.68	3.20	2.65	1.92	1.04
B4	5.12	4.41	3.67	3.18	2.65	1.92	1.03
B5	5.09	4.42	3.66	3.17	2.64	1.92	1.03
B6	4.69	4.39	3.65	3.16	2.64	1.90	1.02
B7	4.64	4.31	3.58	3.09	2.60	1.87	1.01
B8	4.57	4.23	3.52	3.06	2.57	1.86	1.01
B9	4.51	4.15	3.46	3.02	2.55	1.84	1.01
B10	4.51	4.09	3.40	2.98	2.50	1.84	1.02
B11	4.64	4.02	3.36	2.98	2.50	1.84	1.03
A5	5.62	3.94	3.32	2.95	2.49	1.82	1.03
B5	5.09	3.85	3.27	2.92	2.47	1.81	1.03
C5	4.99	3.75	3.21	2.87	2.47	1.79	1.01
D5	5.62	3.75	3.18	2.85	2.45	1.78	1.01
E5	5.47	3.73	3.14	2.83	2.43	1.77	1.00
A11	4.85	3.69	3.10	2.82	2.40	1.76	0.99
B11	4.64	3.67	3.09	2.81	2.38	1.77	1.00
C11	4.47	3.59	3.06	2.77	2.36	1.77	0.98
D11	4.82	3.52	3.02	2.74	2.34	1.77	0.98
E11	4.26	3.46	2.98	2.69	2.32	1.76	0.98
Average	5.09	4.24	3.58	3.13	2.63	1.90	1.03
CV (%)	10	10	10	8	7	6	2

Table D.22 Deflections D1 through D7, I-96 EB - section 2 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	6.90	5.47	4.70	4.11	3.50	2.55	1.39
A2	6.40	5.09	4.36	3.86	3.29	2.47	1.39
A3	5.97	4.91	4.23	3.74	3.16	2.38	1.34
A4	5.83	4.83	4.16	3.60	3.07	2.31	1.33
A5	5.45	4.34	3.78	3.39	2.90	2.18	1.30
A6	5.03	4.19	3.64	3.27	2.85	2.15	1.33
A7	4.88	4.06	3.54	3.20	2.78	2.15	1.33
A8	4.82	3.95	3.48	3.15	2.76	2.15	1.34
A9	4.74	3.91	3.39	3.12	2.74	2.14	1.31
A10	4.91	3.96	3.49	3.19	2.78	2.19	1.33
A11	5.16	4.23	3.70	3.36	2.90	2.28	1.39
B10	4.92	3.94	3.41	3.12	2.77	2.15	1.34
B11	5.26	4.30	3.71	3.37	2.91	2.23	1.40
C10	4.99	3.98	3.46	3.19	2.72	2.18	1.34
C11	5.37	4.33	3.78	3.36	2.93	2.24	1.36
D10	5.26	4.03	3.49	3.16	2.76	2.14	1.34
D11	5.49	4.45	3.87	3.44	2.93	2.26	1.38
D2	6.47	5.13	4.42	3.92	3.39	2.51	1.44
D4	5.68	4.63	4.08	3.57	3.11	2.28	1.34
D6	5.07	4.17	3.65	3.23	2.80	2.19	1.33
D8	4.90	3.96	3.45	3.14	2.72	2.11	1.34
E10	5.31	4.13	3.58	3.23	2.77	2.15	1.35
E11	5.58	4.55	3.92	3.53	2.99	2.34	1.36
F2	6.50	5.07	4.34	3.85	3.29	2.43	1.42
F4	5.72	4.63	4.11	3.61	3.10	2.32	1.36
F6	5.00	4.11	3.64	3.20	2.81	2.14	1.31
F8	4.82	3.98	3.48	3.15	2.68	2.07	1.30
F10	5.01	4.11	3.60	3.24	2.73	2.11	1.30
F11	5.35	4.46	3.90	3.45	2.95	2.24	1.36
Average	5.41	4.38	3.81	3.40	2.93	2.24	1.35
CV (%)	11	10	9	8	8	6	3

Table D.23 Deflections D1 through D7, I-96 EB - section 3 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	6.42	5.14	4.42	3.85	3.27	2.39	1.38
A2	6.67	5.24	4.48	3.83	3.16	2.24	1.33
A3	7.09	5.42	4.63	3.91	3.22	2.24	1.30
A4	6.75	5.05	4.33	3.78	3.08	2.18	1.30
A5	6.35	4.99	4.30	3.70	3.06	2.20	1.29
B1	6.50	5.18	4.46	3.87	3.22	2.35	1.38
B2	6.75	5.25	4.49	3.86	3.15	2.24	1.30
B3	7.22	5.46	4.67	3.94	3.15	2.27	1.30
B4	6.67	5.13	4.38	3.74	3.10	2.22	1.33
B5	6.18	5.07	4.36	3.73	3.10	2.18	1.29
C1	6.50	5.24	4.54	3.88	3.20	2.38	1.36
C2	6.73	5.35	4.58	3.88	3.22	2.28	1.33
C3	7.11	5.47	4.62	3.95	3.20	2.26	1.27
C4	6.61	5.13	4.44	3.79	3.14	2.22	1.29
C5	6.22	5.01	4.34	3.70	3.15	2.20	1.27
D1	6.42	5.20	4.48	3.92	3.25	2.35	1.39
D2	6.68	5.20	4.55	3.88	3.23	2.28	1.33
D3	6.90	5.39	4.59	3.92	3.22	2.24	1.30
D4	6.73	5.10	4.55	3.85	3.14	2.23	1.29
D5	6.33	5.03	4.36	3.79	3.12	2.24	1.27
E3	7.07	5.59	4.71	3.99	3.29	2.36	1.38
E4	6.94	5.30	4.48	3.88	3.23	2.34	1.39
E5	6.50	3.95	3.43	2.97	2.48	1.80	1.09
E6	5.92	4.71	4.06	3.54	3.04	2.19	1.33
F6	6.14	4.86	4.12	3.56	2.97	2.13	1.27
F7	6.30	4.87	4.17	3.56	2.94	2.14	1.26
F8	6.60	5.13	4.40	3.67	3.06	2.17	1.23
G1	6.89	5.25	4.48	3.90	3.23	2.34	1.36
G2	7.05	5.41	4.65	3.91	3.22	2.30	1.36
G3	7.19	5.54	4.66	3.90	3.18	2.23	1.34
G5	6.38	5.13	4.37	3.66	3.03	2.14	1.27
G6	6.25	5.00	4.30	3.65	2.99	2.13	1.29
G7	6.14	4.96	4.21	3.60	2.95	2.10	1.23
G8	6.64	5.28	4.45	3.74	3.07	2.13	1.23
G9	6.84	5.38	4.58	3.82	3.04	2.17	1.23
G4	7.41	5.62	4.78	3.96	3.25	2.27	1.33
E1	7.05	5.29	4.59	3.95	3.29	2.39	1.44
E2	7.11	5.41	4.58	3.98	3.28	2.39	1.42
Average	6.62	5.15	4.42	3.78	3.12	2.22	1.30
CV (%)	5	6	5	5	5	5	5

Pavements at stations G4, E1and E2 have cracks; hence the deflections at these stations have not been included in the calculations of the average deflection and the coefficient of variation.

Table D.24 Deflections D1 through D7, I-96 EB - section 5 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	4.58	4.16	3.81	3.54	3.12	2.44	1.50
A2	4.52	4.08	3.69	3.43	3.01	2.38	1.47
A3	4.52	4.07	3.67	3.38	3.00	2.32	1.40
A4	4.51	4.06	3.65	3.40	2.97	2.24	1.41
A5	4.55	4.09	3.64	3.33	2.89	2.18	1.30
A6	4.60	4.14	3.63	3.35	2.89	2.19	1.32
A7	4.69	4.13	3.71	3.31	2.86	2.20	1.29
A8	4.75	4.24	3.74	3.34	2.89	2.15	1.29
A9	4.88	4.24	3.72	3.34	2.84	2.13	1.25
A11	4.88	4.29	3.75	3.33	2.87	2.16	1.24
A13	4.90	4.33	3.80	3.37	2.85	2.12	1.22
A14	4.96	4.44	3.94	3.52	2.93	2.17	1.22
B1	4.76	4.36	3.95	3.64	3.18	2.52	1.55
B2	4.87	4.33	3.91	3.58	3.09	2.43	1.50
B3	4.89	4.31	3.86	3.53	3.11	2.38	1.49
B4	4.78	4.29	3.86	3.53	3.10	2.34	1.42
B5	4.89	4.36	3.86	3.54	3.03	2.25	1.32
B6	4.91	4.34	3.92	3.49	3.00	2.23	1.34
B7	4.90	4.39	3.92	3.52	3.00	2.23	1.31
B8	5.00	4.44	3.94	3.50	2.99	2.24	1.33
B9	5.25	4.55	4.02	3.59	3.00	2.22	1.30
B11	5.04	4.41	3.92	3.48	3.00	2.21	1.28
B12	4.92	4.39	3.85	3.41	2.94	2.17	1.25
B13	4.85	4.32	3.81	3.37	2.85	2.11	1.23
B14	5.10	4.46	3.94	3.47	2.93	2.14	1.25
C5	4.48	4.06	3.66	3.44	2.97	2.29	1.35
C13	4.66	4.10	3.59	3.28	2.81	2.12	1.22
D5	4.47	4.06	3.63	3.34	2.92	2.30	1.42
D13	4.86	4.25	3.76	3.30	2.82	2.08	1.24
E5	4.60	4.11	3.70	3.41	2.95	2.25	1.37
E13	4.97	4.29	3.79	3.39	2.91	2.17	1.29
F5	4.69	4.19	3.76	3.42	2.96	2.27	1.36
F13	5.04	4.39	3.89	3.48	3.00	2.22	1.29
A10	4.99	4.26	3.73	3.32	2.88	2.12	1.25
A12	5.02	4.30	3.78	3.31	2.83	2.12	1.26
B10	5.28	4.51	3.95	3.55	2.98	2.22	1.26
Average	4.80	4.26	3.80	3.43	2.96	2.24	1.33
CV (%)	4	3	3	3	3	5	7

Pavements at stations A10, A12 and B10 have cracks; hence the deflections at these stations have not been included in the calculations of the average deflection and the coefficient of variation.

Table D.25 Deflections D1 through D7, US-131 SB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	10.81	8.25	6.88	5.39	4.03	2.40	0.94
A2	10.70	8.20	6.77	5.31	4.02	2.39	0.96
A3	10.51	8.15	6.69	5.22	3.96	2.36	0.96
A4	10.41	8.14	6.61	5.16	3.92	2.35	0.96
A5	10.30	8.06	6.57	5.13	3.88	2.34	0.94
A6	10.13	7.99	6.56	5.13	3.90	2.34	0.96
A7	9.95	7.94	6.55	5.12	3.90	2.34	0.96
A8	9.72	7.90	6.51	5.13	3.90	2.32	0.97
A9	9.82	7.87	6.46	5.14	3.87	2.32	0.97
A10	10.38	7.82	6.39	5.16	3.86	2.32	0.98
A11	11.09	7.74	6.36	5.10	3.82	2.31	0.97
B1	10.92	7.68	6.31	5.05	3.79	2.28	0.97
B2	10.43	7.64	6.29	4.99	3.77	2.27	0.97
B3	10.45	7.61	6.23	4.92	3.74	2.23	0.97
B4	10.41	7.55	6.21	4.88	3.71	2.22	0.97
B5	10.51	7.48	6.14	4.86	3.69	2.20	0.94
B6	10.29	7.43	6.12	4.86	3.69	2.20	0.94
B7	10.14	7.39	6.08	4.83	3.66	2.18	0.93
B8	10.07	7.32	6.05	4.79	3.64	2.14	0.93
B9	10.55	7.27	6.01	4.79	3.65	2.15	0.94
B10	10.75	7.24	5.98	4.80	3.66	2.17	0.96
B11	10.97	7.22	5.97	4.80	3.67	2.19	0.96
C3	10.42	7.17	5.94	4.80	3.73	2.17	0.92
C11	10.62	7.91	6.47	5.03	3.74	2.19	0.93
D3	10.21	7.35	6.05	4.87	3.71	2.17	0.92
D11	10.63	7.99	6.51	5.08	3.82	2.26	0.92
E3	10.94	7.53	6.18	4.92	3.74	2.18	0.94
E11	10.63	8.08	6.56	5.13	3.90	2.31	0.93
F3	11.18	7.66	6.29	4.97	3.74	2.18	0.96
F11	11.19	8.16	6.65	5.21	3.99	2.38	0.96
Average	10.50	7.73	6.35	5.02	3.80	2.26	0.95
CV (%)	4	4	4	3	3	4	2

Table D.26 Deflections D1 through D7, US-131 NB – section 2 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	8.55	7.35	6.48	5.67	4.78	3.54	1.92
A2	8.25	7.09	6.35	5.58	4.68	3.41	1.87
A3	7.38	6.50	5.85	5.19	4.38	3.23	1.79
A4	7.04	6.27	5.63	5.05	4.32	3.19	1.78
A5	6.77	6.06	5.48	4.94	4.20	3.13	1.75
A6	6.66	6.01	5.34	4.79	4.12	3.06	1.72
A7	6.71	5.90	5.22	4.70	4.06	3.05	1.70
A8	6.73	5.80	5.11	4.61	3.99	2.97	1.70
A9	6.65	5.71	5.07	4.55	3.89	2.92	1.69
A10	6.24	5.45	4.84	4.35	3.78	2.84	1.66
A11	6.26	5.42	4.81	4.35	3.76	2.85	1.63
A12	6.19	5.46	4.82	4.40	3.85	2.93	1.67
A13	6.19	5.46	4.86	4.42	3.88	2.94	1.68
B1	8.72	7.62	6.77	5.94	5.03	3.58	1.92
B2	8.35	7.32	6.48	5.76	4.84	3.47	1.88
B3	7.18	6.52	5.88	5.27	4.51	3.28	1.82
B4	6.85	6.34	5.68	5.17	4.42	3.27	1.77
B5	6.66	6.09	5.56	5.04	4.36	3.12	1.73
B6	6.54	5.93	5.33	4.86	4.20	3.09	1.71
B7	6.52	5.80	5.22	4.74	4.12	3.03	1.67
B8	6.48	5.71	5.16	4.70	4.06	3.00	1.70
B9	6.44	5.71	5.12	4.69	4.04	3.03	1.72
B10	6.32	5.55	4.96	4.57	3.95	2.95	1.66
B11	6.34	5.55	4.97	4.52	3.90	2.93	1.68
B12	6.35	5.59	5.01	4.55	3.96	2.96	1.64
B13	6.33	5.62	5.03	4.62	3.99	2.97	1.68
C5	6.43	5.83	5.24	4.79	4.14	3.16	1.83
C12	5.97	5.32	4.72	4.39	3.88	3.01	1.75
D5	6.39	5.81	5.25	4.76	4.16	3.23	1.91
D12	6.48	5.64	5.03	4.51	3.95	3.04	1.78
E5	6.64	5.96	5.36	4.89	4.28	3.22	1.84
E12	6.16	5.50	4.88	4.54	3.97	3.11	1.80
F5	6.31	5.71	5.14	4.69	4.08	3.14	1.92
F12	6.14	5.35	4.72	4.34	3.79	2.95	1.81
Average	6.74	5.97	5.33	4.82	4.16	3.11	1.76
CV (%)	11	10	10	9	8	6	5

Table D.27 Deflections D1 through D7, US-131 NB - section 3 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	3.88	3.38	3.03	2.82	2.48	1.96	1.31
A2	3.72	3.31	3.04	2.85	2.50	2.06	1.40
A3	3.61	3.24	2.95	2.75	2.47	2.03	1.37
A4	3.66	3.22	2.92	2.78	2.47	2.06	1.38
A5	3.59	3.17	2.91	2.73	2.42	2.00	1.38
A6	3.55	3.17	2.89	2.71	2.48	2.02	1.38
A7	3.50	3.07	2.85	2.70	2.39	1.99	1.36
A8	3.47	3.08	2.78	2.63	2.40	1.96	1.38
A9	3.49	3.02	2.75	2.63	2.33	1.94	1.37
A10	3.48	2.95	2.71	2.59	2.31	1.93	1.34
A11	3.52	3.06	2.77	2.61	2.33	1.95	1.35
A12	3.58	3.06	2.80	2.63	2.32	1.93	1.34
A13	3.67	3.19	2.90	2.73	2.40	2.03	1.41
B1	3.80	3.37	2.99	2.84	2.52	2.08	1.41
B2	3.72	3.25	2.95	2.79	2.50	2.06	1.41
B3	3.64	3.19	2.91	2.71	2.48	2.04	1.42
B4	3.58	3.15	2.86	2.71	2.41	2.04	1.38
B5	3.48	3.11	2.85	2.66	2.37	1.98	1.38
B6	3.49	3.10	2.83	2.66	2.43	1.97	1.38
B7	3.42	2.99	2.77	2.61	2.36	1.94	1.39
B8	3.41	3.04	2.75	2.60	2.35	1.93	1.36
B9	3.41	2.98	2.75	2.61	2.31	1.92	1.37
B10	3.51	3.05	2.77	2.65	2.32	1.98	1.38
B11	3.49	2.99	2.76	2.61	2.29	1.87	1.26
B12	3.63	3.10	2.82	2.64	2.32	1.93	1.30
B13	3.64	3.18	2.90	2.73	2.34	1.98	1.31
C1	3.83	3.35	2.98	2.81	2.48	2.03	1.41
C2	3.65	3.22	2.92	2.74	2.43	1.98	1.37
C3	3.55	3.18	2.87	2.74	2.39	1.98	1.36
C4	3.51	3.15	2.87	2.69	2.37	1.98	1.37
C5	3.52	3.12	2.88	2.68	2.35	1.92	1.34
C6	3.48	3.11	2.83	2.66	2.38	1.93	1.35
C7	3.53	3.07	2.81	2.67	2.33	1.92	1.35
C8	3.44	3.05	2.76	2.61	2.29	1.89	1.32
C9	3.48	3.02	2.77	2.61	2.28	1.89	1.31
C10	3.57	3.11	2.78	2.66	2.34	1.97	1.38
C11	3.60	3.11	2.80	2.63	2.33	1.90	1.34
C12	3.67	3.20	2.90	2.67	2.35	1.97	1.29
C13	3.77	3.30	2.97	2.76	2.39	1.98	1.33
D3	3.62	3.20	2.93	2.76	2.42	2.03	1.39
D5	3.50	3.05	2.81	2.63	2.36	1.95	1.35
D8	3.31	2.86	2.60	2.46	2.19	1.84	1.30
D12	3.34	2.90	2.64	2.49	2.16	1.86	1.30
E3	3.65	3.23	2.93	2.76	2.45	2.02	1.35

Table D.27 (continued) Deflections D1 through D7, US-131 NB - section 3 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
E5	3.67	3.12	2.87	2.69	2.43	1.96	1.35
E8	3.25	2.86	2.63	2.49	2.23	1.84	1.31
E12	3.37	2.88	2.62	2.49	2.13	1.86	1.19
F3	3.40	3.10	2.83	2.64	2.35	1.93	1.38
F5	3.54	3.12	2.85	2.69	2.40	1.93	1.31
F8	3.32	2.93	2.66	2.53	2.21	1.81	1.23
F12	3.25	2.86	2.58	2.46	2.11	1.75	1.22
Average	3.55	3.11	2.83	2.66	2.36	1.95	1.35
CV (%)	4	4	4	4	4	3	4

Table D.28 Deflections D1 through D7, M-37 NB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	10.05	8.37	7.21	6.01	4.77	3.13	1.55
A2	8.37	7.19	6.27	5.25	4.23	2.81	1.43
A3	7.25	6.24	5.39	4.59	3.68	2.53	1.34
A4	7.05	6.00	5.20	4.42	3.57	2.46	1.33
A5	6.90	5.82	5.02	4.23	3.42	2.38	1.30
A6	7.05	5.85	4.94	4.14	3.36	2.35	1.27
A7	7.50	5.93	4.93	4.10	3.32	2.34	1.22
A8	7.85	5.97	4.94	4.18	3.38	2.35	1.24
A10	7.30	5.76	4.82	4.04	3.29	2.27	1.18
A11	7.30	5.72	4.75	4.01	3.23	2.23	1.17
A12	7.44	5.73	4.78	4.00	3.25	2.24	1.22
A13	7.45	5.67	4.67	3.92	3.19	2.19	1.22
B1	8.03	7.03	6.17	5.30	4.38	3.01	1.49
B2	7.11	6.32	5.60	4.82	4.03	2.80	1.38
B3	6.35	5.64	5.00	4.42	3.68	2.57	1.32
B4	6.17	5.44	4.85	4.28	3.57	2.52	1.29
B5	6.00	5.34	4.64	4.07	3.38	2.42	1.26
B6	6.13	5.35	4.67	4.06	3.39	2.35	1.20
B7	6.18	5.37	4.64	4.02	3.33	2.35	1.20
B8	6.30	5.35	4.61	3.99	3.30	2.35	1.17
B9	6.31	5.32	4.55	3.99	3.25	2.34	1.19
B10	5.91	5.17	4.43	3.84	3.21	2.25	1.13
B11	6.16	5.22	4.50	3.94	3.24	2.26	1.15
B12	6.45	5.35	4.61	3.97	3.29	2.30	1.17
B13	6.63	5.43	4.63	3.99	3.31	2.32	1.19
C5	5.99	5.24	4.60	4.01	3.33	2.41	1.31
C12	6.53	5.40	4.58	3.91	3.20	2.24	1.26
C13	6.83	5.55	4.69	3.96	3.17	2.21	1.27
D5	6.39	5.56	4.83	4.19	3.41	2.44	1.32
D12	7.55	6.04	5.00	4.18	3.36	2.31	1.28
D13	7.76	6.12	5.10	4.17	3.37	2.28	1.29
E5	6.31	5.53	4.84	4.29	3.51	2.45	1.26
E12	5.73	5.08	4.44	3.89	3.26	2.28	1.17
E13	5.94	5.17	4.48	3.87	3.21	2.24	1.20
F5	6.22	5.44	4.76	4.16	3.52	2.58	1.44
F12	5.92	5.13	4.45	3.89	3.24	2.35	1.35
F13	6.27	5.21	4.47	3.88	3.24	2.33	1.34
G5	6.29	5.51	4.85	4.26	3.59	2.64	1.48
G12	7.06	5.88	5.06	4.34	3.64	2.54	1.42
G13	7.46	6.04	5.11	4.34	3.52	2.50	1.39
H1	7.20	6.24	5.50	4.82	4.02	2.96	1.63
H2	6.65	5.92	5.23	4.65	3.89	2.82	1.57
H3	6.31	5.56	4.96	4.41	3.70	2.72	1.48
H4	6.34	5.56	4.91	4.31	3.68	2.65	1.53
H5	6.37	5.54	4.90	4.30	3.55	2.57	1.45

Table D.28 (continued) Deflections D1 through D7, M-37 NB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
H6	6.70	5.72	4.97	4.27	3.50	2.53	1.41
H8	6.95	5.76	4.89	4.21	3.47	2.45	1.38
H9	6.67	5.61	4.80	4.22	3.40	2.45	1.35
H10	6.54	5.55	4.78	4.15	3.40	2.44	1.35
H11	6.51	5.52	4.77	4.14	3.42	2.44	1.35
H12	6.74	5.56	4.83	4.17	3.42	2.45	1.35
H13	6.65	5.60	4.81	4.15	3.42	2.42	1.39
I5	6.13	5.36	4.71	4.14	3.45	2.55	1.41
I12	6.09	5.15	4.50	3.92	3.25	2.35	1.40
I13	6.00	5.11	4.43	3.82	3.21	2.33	1.33
J5	6.70	5.75	5.00	4.33	3.56	2.55	1.40
J12	8.04	6.31	5.08	4.10	3.29	2.29	1.31
J13	7.55	6.17	5.11	4.13	3.28	2.33	1.32
K5	6.51	5.64	4.95	4.32	3.66	2.67	1.44
K12	6.24	5.41	4.75	4.20	3.54	2.57	1.33
K13	6.18	5.40	4.67	4.14	3.46	2.49	1.31
L5	6.62	5.75	5.06	4.43	3.69	2.65	1.47
L12	6.48	5.58	4.88	4.20	3.45	2.45	1.35
L13	6.38	5.56	4.82	4.11	3.42	2.38	1.35
M2	7.84	6.73	5.86	4.96	4.06	2.73	1.45
M4	8.38	6.88	5.91	4.97	3.98	2.67	1.37
M5	8.67	6.97	5.95	4.96	3.96	2.65	1.33
M6	8.60	6.93	5.92	4.93	3.89	2.56	1.29
M8	9.03	7.08	6.00	4.92	3.91	2.50	1.29
M9	8.98	7.04	5.94	4.95	3.86	2.49	1.28
M10	9.33	7.22	5.99	4.95	3.86	2.48	1.24
M12	9.78	7.26	5.98	4.85	3.76	2.38	1.19
M13	9.69	7.44	6.12	4.87	3.66	2.35	1.21
N2	8.21	7.09	6.10	5.06	4.06	2.76	1.39
N4	8.96	7.25	5.91	4.73	3.77	2.54	1.34
N5	9.17	7.29	5.84	4.70	3.70	2.46	1.29
N6	9.62	7.19	5.73	4.60	3.58	2.38	1.25
N8	9.57	6.76	5.36	4.33	3.42	2.25	1.20
N9	9.51	6.61	4.99	4.07	3.26	2.18	1.15
N10	9.78	6.27	5.13	4.11	3.26	2.19	1.16
N12	9.15	8.63	5.49	4.17	3.22	2.13	1.15
A9	8.02	6.03	4.83	4.07	3.35	2.35	1.26
N13	8.80	7.49	5.83	4.39	3.34	2.15	1.15
Average	7.27	6.01	5.10	4.33	3.52	2.45	1.31
CV (%)	16	13	11	9	9	8	8

Pavements at stations A9 and N13 have cracks; hence the deflections at these stations have not been included in the calculations of the average deflection and the coefficient of variation.

Table D.29 Deflections D1 through D7, M-53 NB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	10.80	9.45	8.42	7.35	6.10	4.32	2.17
A2	10.20	9.04	8.15	7.09	5.93	4.23	2.19
A3	9.64	8.63	7.78	6.88	5.83	4.24	2.15
A4	9.34	8.40	7.62	6.76	5.69	4.15	2.15
A5	9.15	8.24	7.52	6.66	5.65	4.13	2.16
A6	8.90	8.10	7.38	6.62	5.63	4.12	2.21
A7	8.69	7.90	7.20	6.53	5.56	4.14	2.24
A8	8.54	7.75	7.05	6.36	5.48	4.08	2.18
A9	8.46	7.71	7.04	6.35	5.51	4.10	2.20
A10	8.43	7.70	7.03	6.41	5.52	4.15	2.21
A11	8.48	7.71	7.01	6.39	5.53	4.12	2.21
A12	8.47	7.70	7.05	6.43	5.57	4.13	2.24
B1	10.31	9.04	8.10	7.10	5.94	4.23	2.08
B2	9.96	8.85	7.96	7.02	5.90	4.22	2.08
B3	9.35	8.34	7.55	6.75	5.70	4.12	2.09
B4	9.11	8.15	7.46	6.63	5.64	4.07	2.08
B5	8.87	7.93	7.21	6.54	5.59	4.05	2.08
B6	8.56	7.71	7.07	6.35	5.43	4.01	2.09
B7	8.59	7.72	6.98	6.37	5.44	4.02	2.12
B8	8.57	7.66	6.97	6.30	5.43	3.98	2.13
B9	8.63	7.73	7.04	6.34	5.45	4.03	2.12
B10	8.64	7.69	7.00	6.34	5.49	4.06	2.14
B11	8.57	7.72	7.02	6.38	5.47	4.03	2.12
B12	8.58	7.70	7.02	6.34	5.44	4.04	2.14
C1	10.51	9.23	8.25	7.15	5.94	4.13	2.02
C2	9.98	8.83	7.94	7.03	5.83	4.10	2.04
C3	9.21	8.29	7.55	6.71	5.65	4.04	2.06
C4	9.04	8.13	7.46	6.64	5.59	4.04	2.09
C5	8.77	7.99	7.26	6.55	5.60	4.05	2.08
C6	8.63	7.84	7.19	6.46	5.54	4.06	2.13
C7	8.50	7.64	7.02	6.35	5.44	4.02	2.19
C8	8.43	7.62	6.99	6.34	5.42	3.99	2.14
C9	8.50	7.70	7.01	6.32	5.45	3.98	2.13
C10	8.46	7.73	7.00	6.37	5.45	4.00	2.11
C11	8.56	7.76	7.05	6.40	5.51	4.03	2.12
C12	8.46	7.69	7.02	6.37	5.47	3.97	2.07
D5	8.66	7.93	7.20	6.51	5.58	4.05	2.04
D8	8.38	7.48	6.81	6.15	5.29	3.91	2.04
D12	8.37	7.51	6.85	6.22	5.35	3.94	2.05
E5	8.51	7.69	7.04	6.39	5.59	4.07	2.12
E8	8.34	7.56	6.91	6.23	5.36	3.96	2.10
E12	8.36	7.58	6.92	6.26	5.34	3.90	2.02
F5	8.29	7.47	6.83	6.21	5.39	3.90	2.09

Table D.29 (continued) Deflections D1 through D7, M-53 NB - section 1 test site 1

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
F8	7.97	7.17	6.53	5.98	5.14	3.81	2.07
F12	8.03	7.23	6.56	5.96	5.12	3.77	2.00
Average	8.86	7.97	7.24	6.51	5.56	4.05	2.12
CV (%)	7	7	6	5	4	3	3

Table D.30 Deflections D1 through D7, I-96 EB - section 4 test site 1 (FLEXIBLE)

FWD Station	Deflections (mils)						
	D1	D2	D3	D4	D5	D6	D7
A1	6.72	5.46	4.76	4.06	3.31	2.20	1.10
A2	6.93	5.56	4.79	4.08	3.29	2.23	1.09
A3	6.99	5.54	4.75	4.03	3.28	2.19	1.09
A4	7.03	5.60	4.83	4.16	3.35	2.26	1.13
A5	7.02	5.63	4.82	4.16	3.33	2.19	1.08
A6	7.11	5.71	4.92	4.19	3.39	2.24	1.08
A7	6.88	5.55	4.87	4.15	3.36	2.22	1.05
A8	6.88	5.51	4.87	4.25	3.37	2.24	1.10
A9	6.76	5.51	4.83	4.11	3.33	2.26	1.10
A10	6.72	5.45	4.71	4.03	3.28	2.23	1.08
A11	6.72	5.34	4.71	4.03	3.31	2.17	1.08
A12	6.71	5.43	4.75	4.06	3.29	2.20	1.02
A13	6.86	5.68	4.91	4.21	3.40	2.23	1.04
B1	7.35	5.83	4.96	4.11	3.31	2.23	1.05
B2	7.22	5.75	4.88	4.17	3.31	2.22	1.06
B3	6.97	5.63	4.82	4.11	3.31	2.23	1.08
B4	7.09	5.68	4.88	4.23	3.39	2.24	1.06
B5	7.13	5.73	4.97	4.25	3.43	2.24	1.06
B6	7.05	5.71	4.95	4.27	3.45	2.26	1.09
B7	6.86	5.55	4.88	4.17	3.41	2.26	1.06
B8	6.71	5.51	4.76	4.15	3.36	2.22	1.08
B9	6.65	5.43	4.75	4.12	3.36	2.24	1.08
B10	6.68	5.33	4.65	3.99	3.28	2.23	1.05
B11	6.64	5.29	4.58	3.98	3.25	2.20	1.04
B12	6.60	5.34	4.66	4.04	3.33	2.20	1.05
B13	6.75	5.51	4.83	4.08	3.39	2.24	1.02
C5	7.17	5.87	5.04	4.29	3.45	2.26	1.06
C12	6.98	5.59	4.84	4.13	3.32	2.22	1.06
D5	7.39	6.00	5.14	4.37	3.53	2.27	1.09
D12	6.99	5.71	4.87	4.16	3.37	2.23	1.05
E5	7.51	6.00	5.17	4.40	3.50	2.28	1.06
E12	7.11	5.75	4.95	4.20	3.43	2.24	1.10
F5	7.60	6.00	5.17	4.36	3.49	2.24	1.06
F12	7.07	5.66	4.95	4.23	3.40	2.20	1.08
Average	6.97	5.61	4.86	4.16	3.36	2.23	1.07
CV (%)	4	3	3	3	2	1	2

Figure D.1. Variation of the measured peak deflection (D1) across and along I-69 EB – section 1 test site 1.

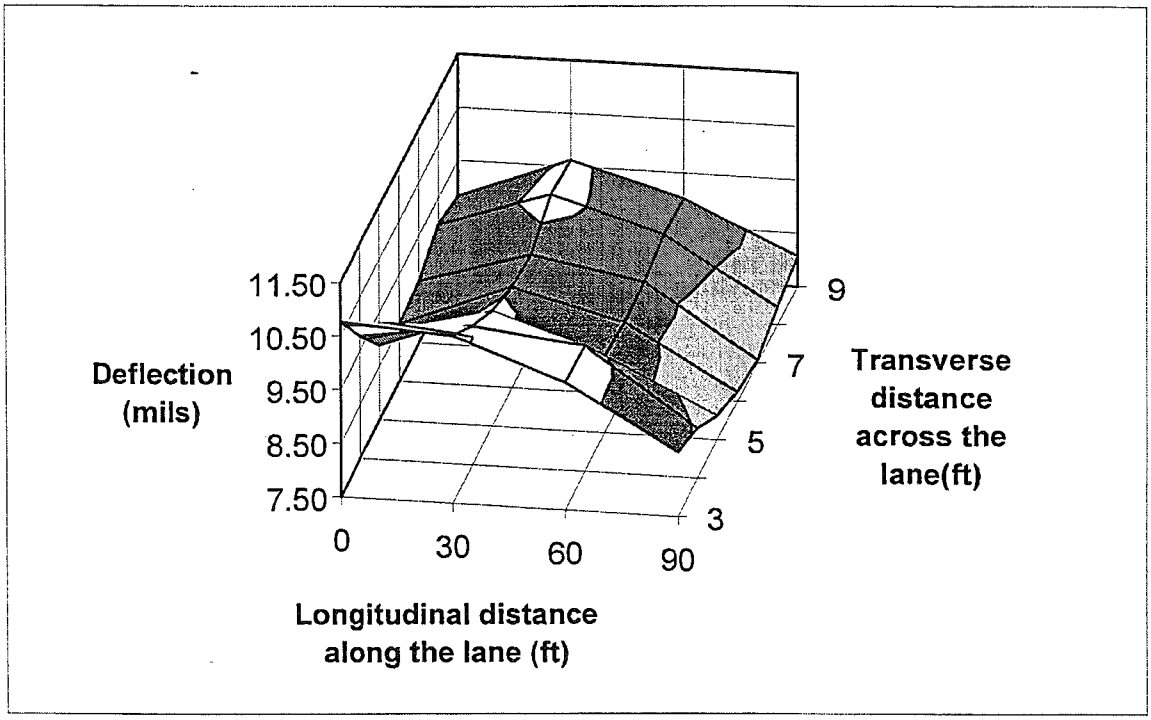


Figure D.2 Variation of the measured peak deflection (D1) across and along I-69 EB – section 1 test site 2.

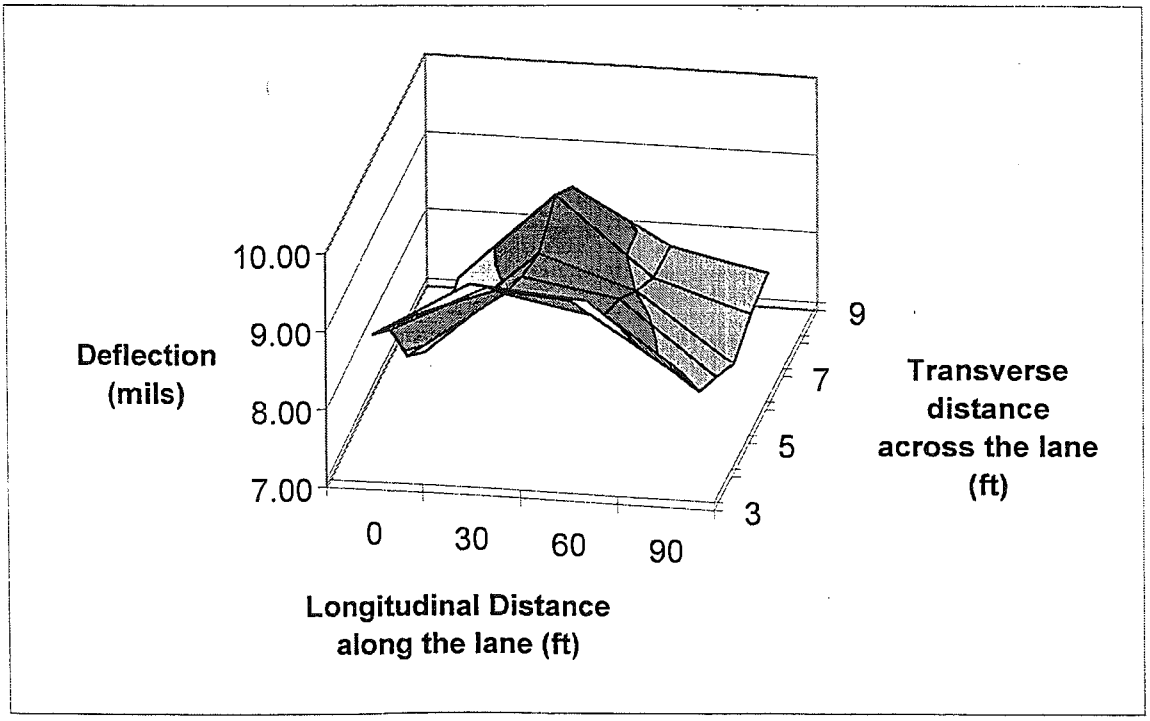


Figure D.3. Variation of the measured peak deflection (D1) across and along I-75 SB – section 1 test site 1

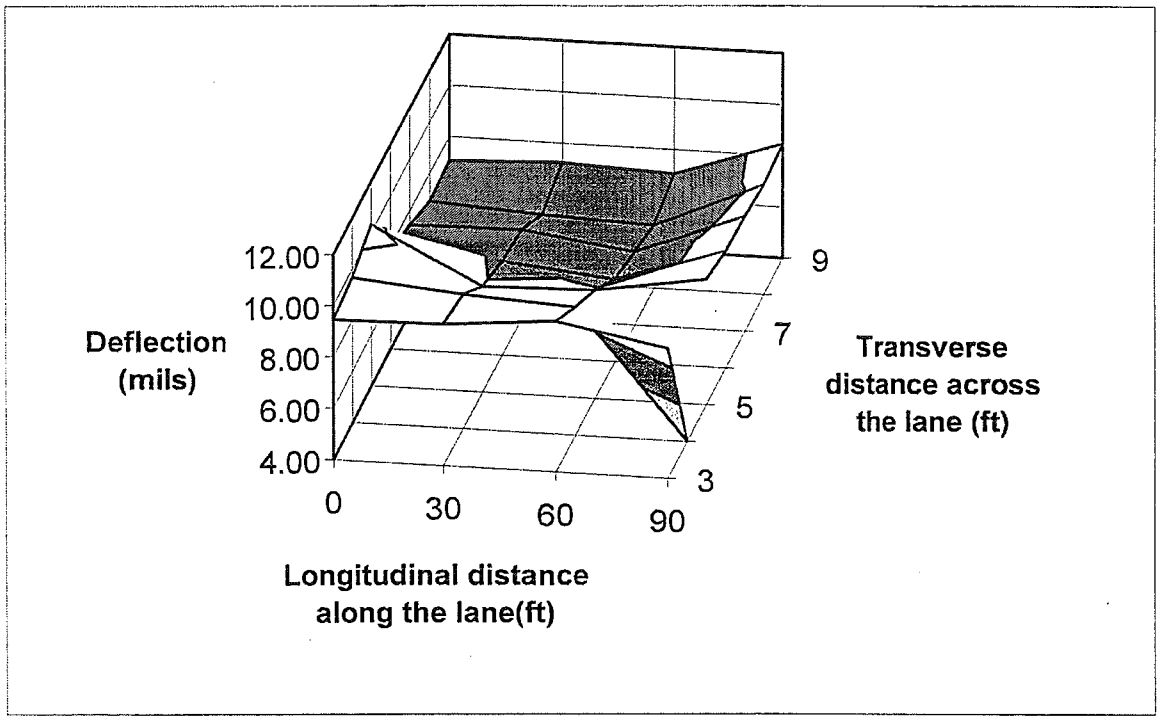


Figure D.4. Variation of the measured peak deflection (D1) across and along I-75 SB -section 1 test site 2.

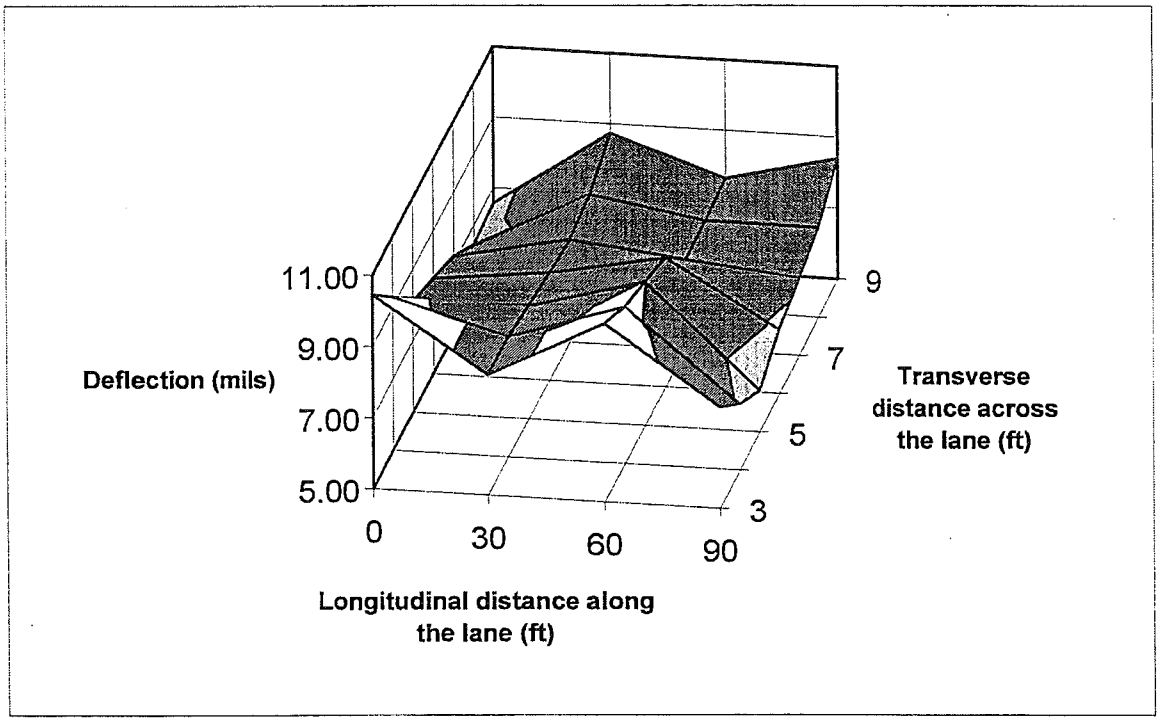


Figure D.5. Variation of the measured peak deflection (D1) across and along I-194 NB - section 1 test site 1.

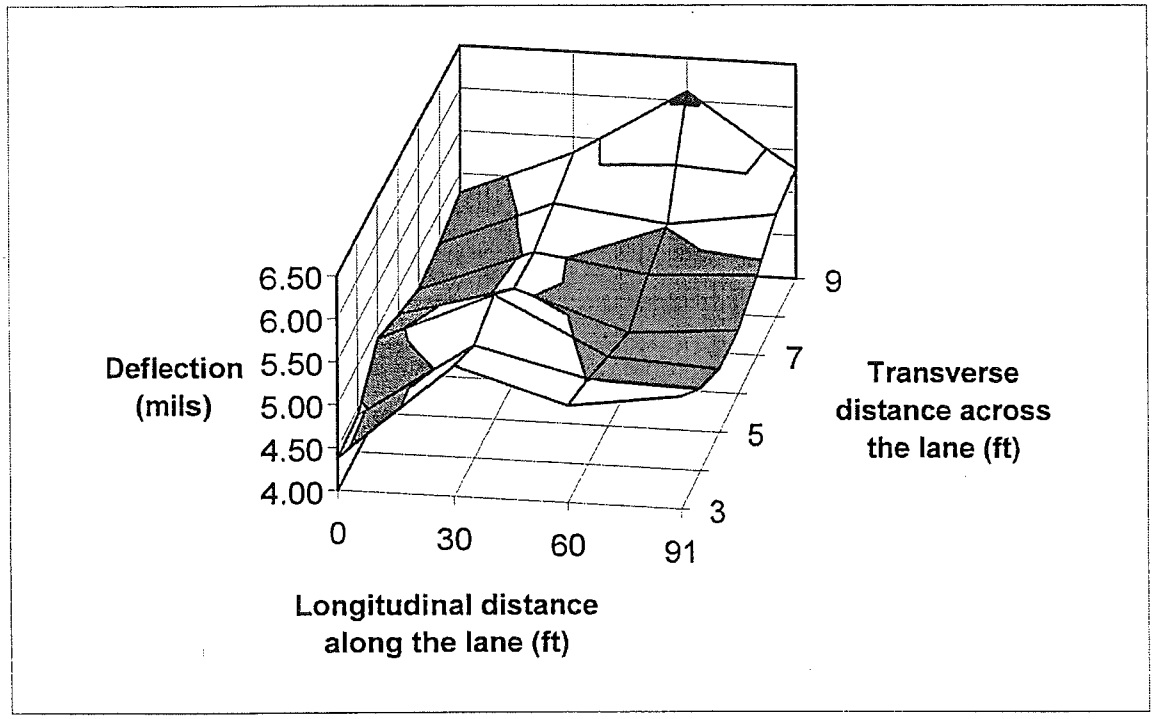


Figure D.6. Variation of the measured peak deflection (D1) across and along I-194 NB -section 1 test site 2.

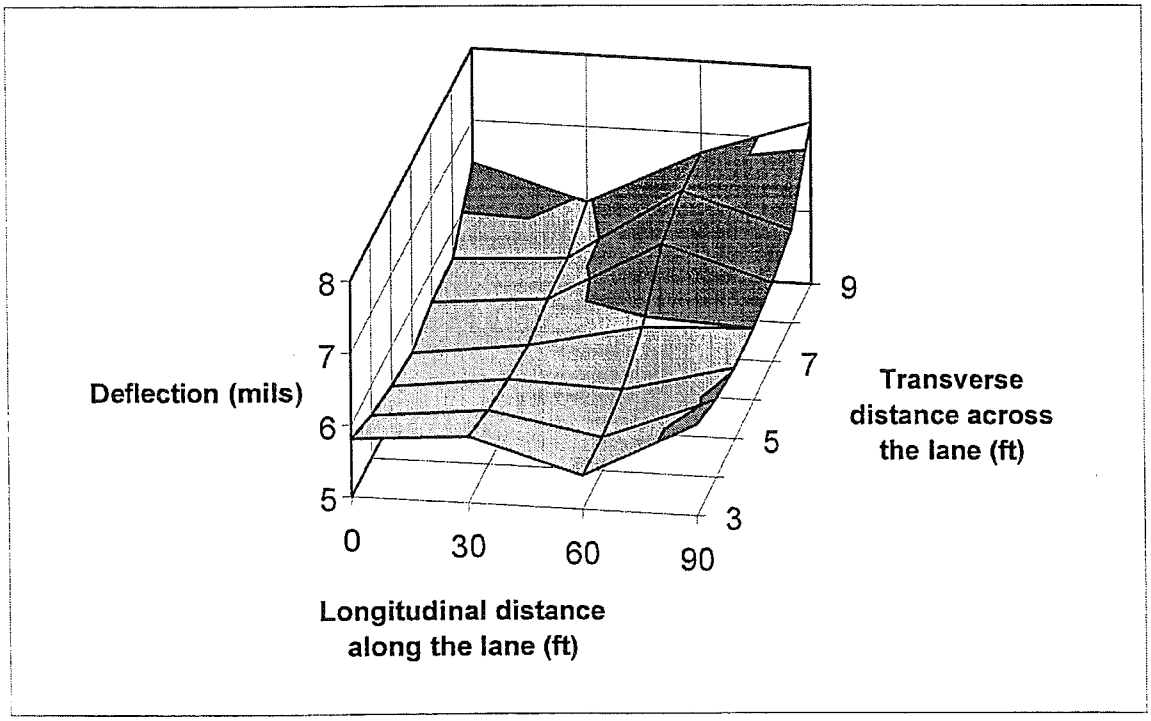


Figure D.7 Variation of the measured peak deflection (D1) across and along US-10 EB - section 1 test site 2.

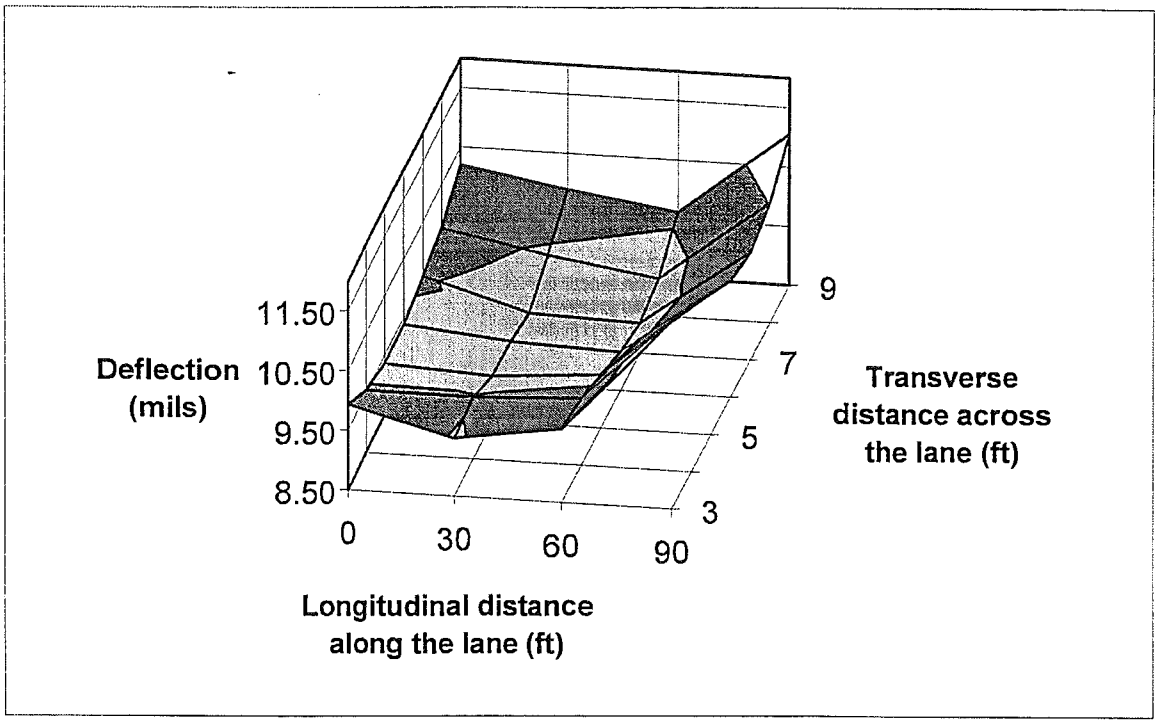


Figure D.8 Variation of the measured peak deflection (D1) across and along US-10 EB - section 1 test site 2.

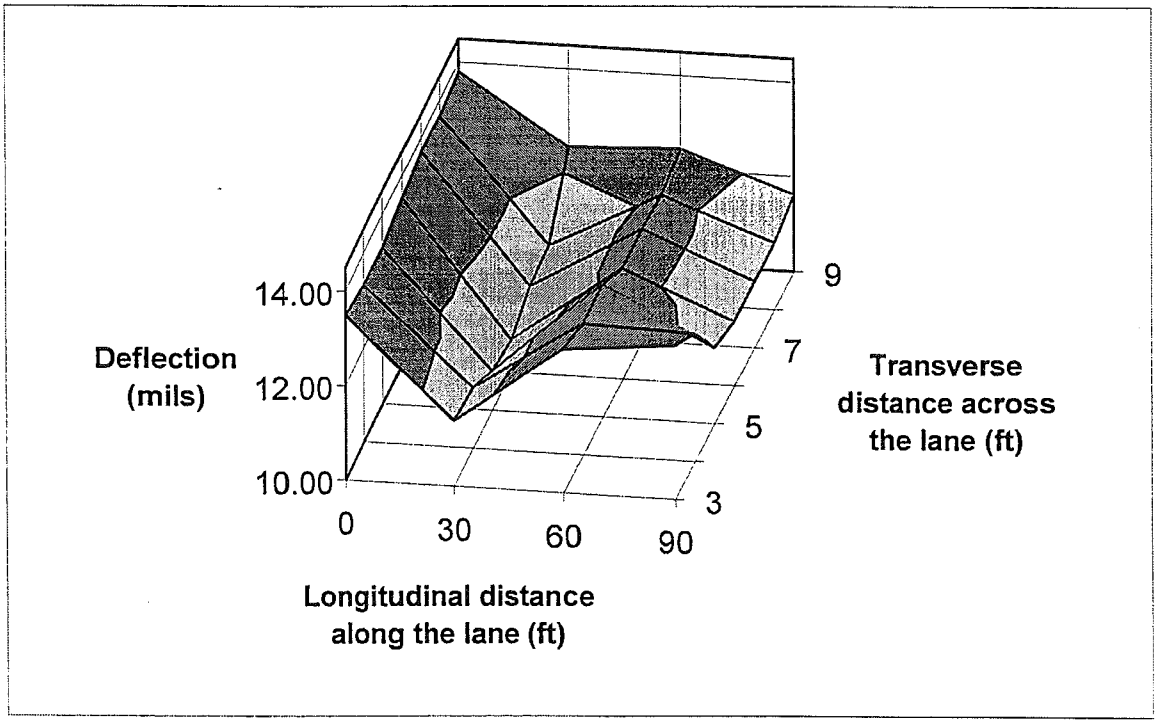


Figure D.9 Variation of the measured peak deflection (D1) across and along US-23 SB - section 1 test site 1.

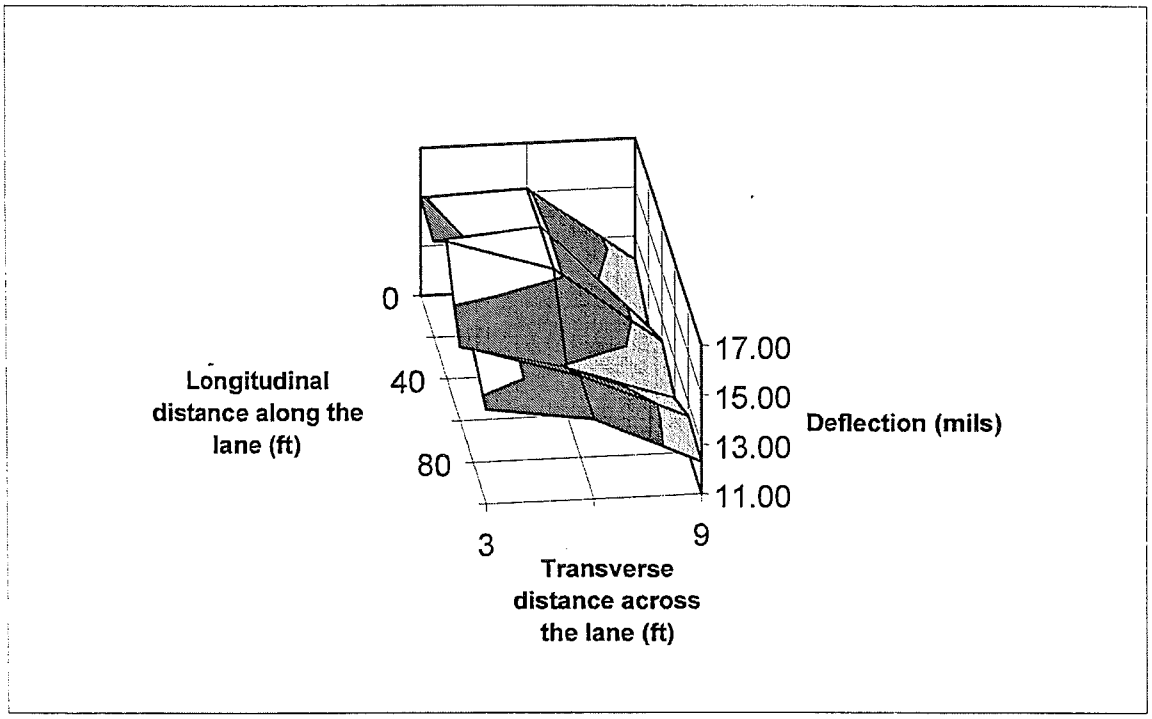


Figure D.10 Variation of the measured peak deflection (D1) across and along US-23 SB - section 1 test site 2.

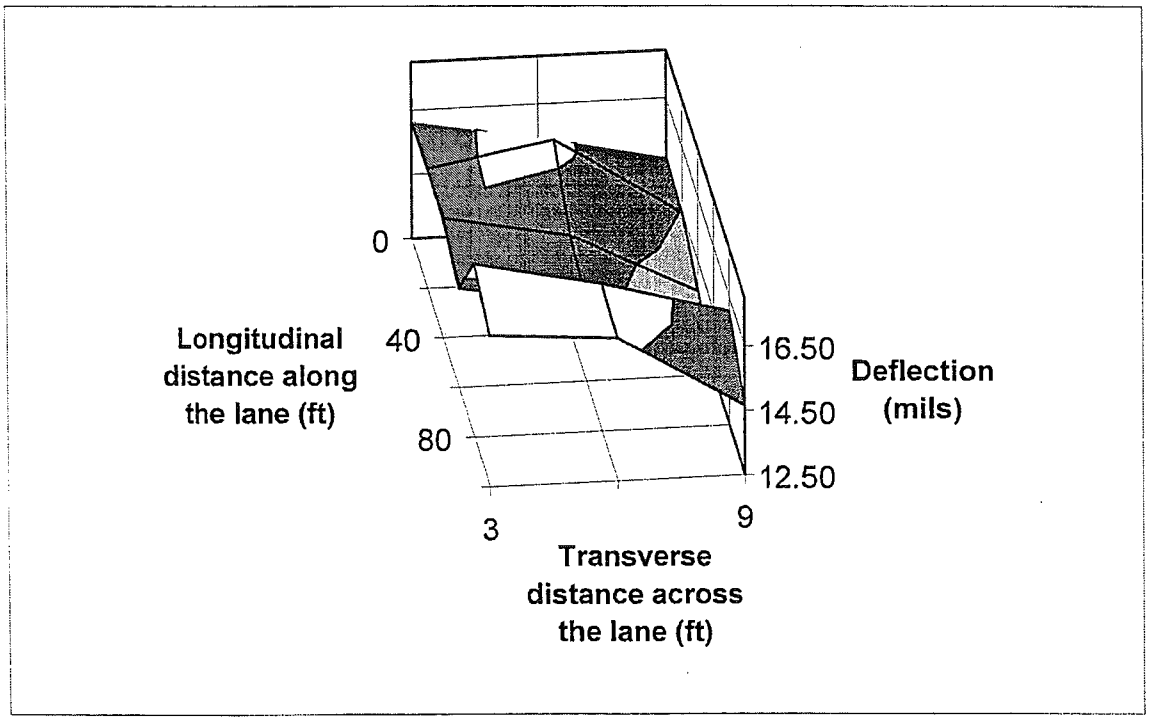


Figure D.11 Variation of the measured peak deflection (D1) across and along US-27 SB - section 2 test site 1.

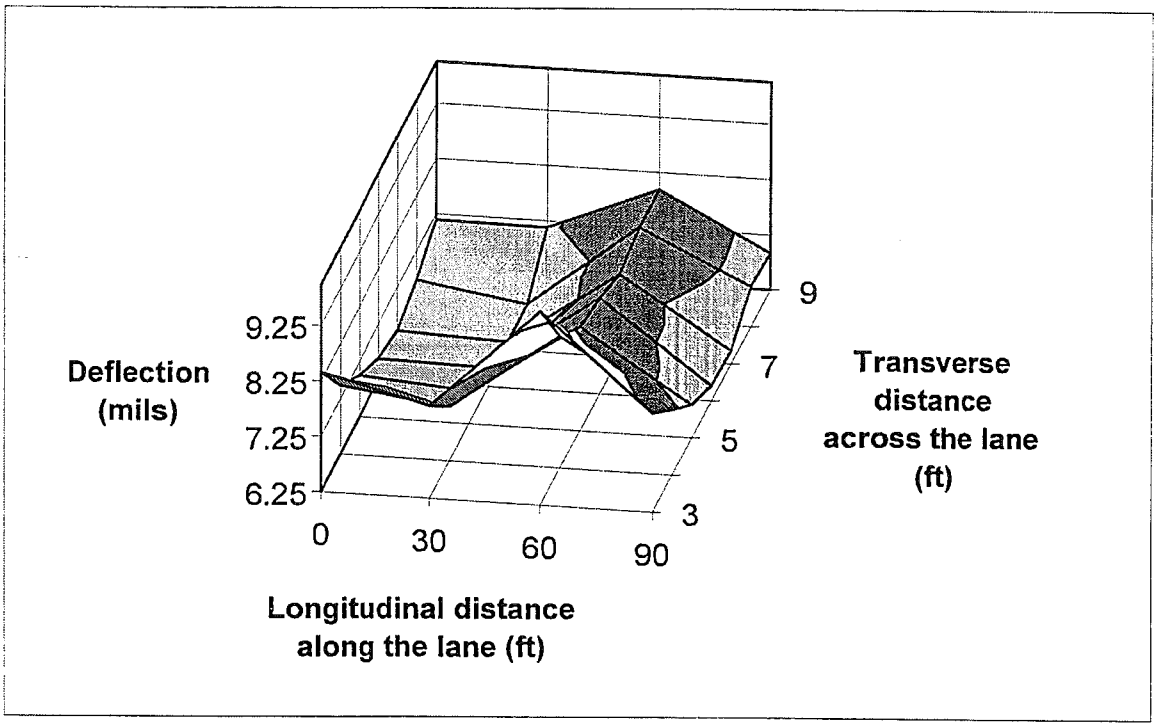


Figure D.12 Variation of the measured peak deflection (D1) across and along US-27 SB - section 3 test site 1.

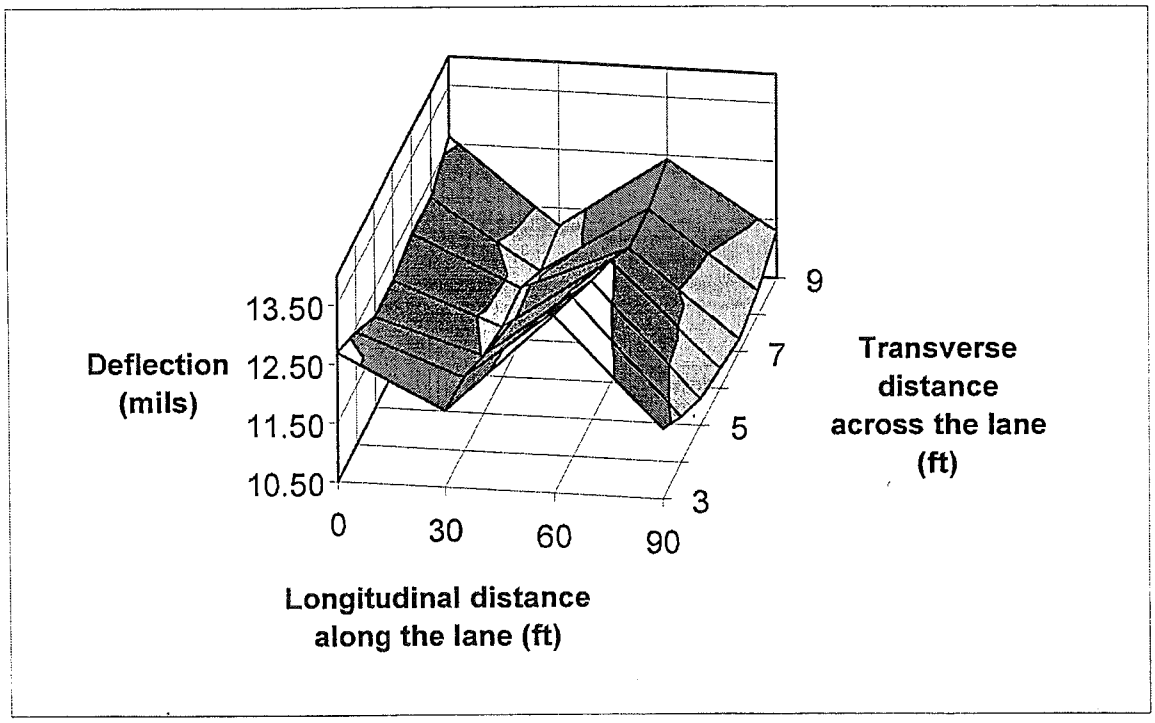


Figure D.13 Variation of the measured peak deflection (D1) across and along US-27 SB -section 4 test site 1

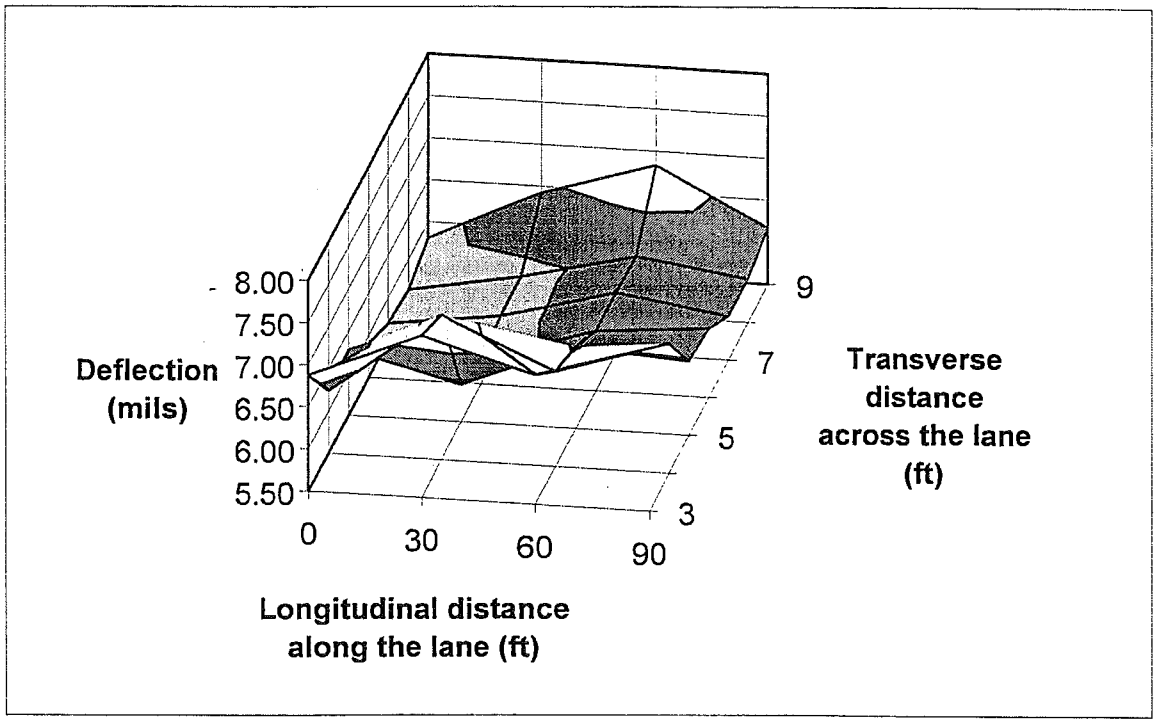


Figure D.14 Variation of the measured peak deflection (D1) across and along US-31 NB - section 1 test site 1

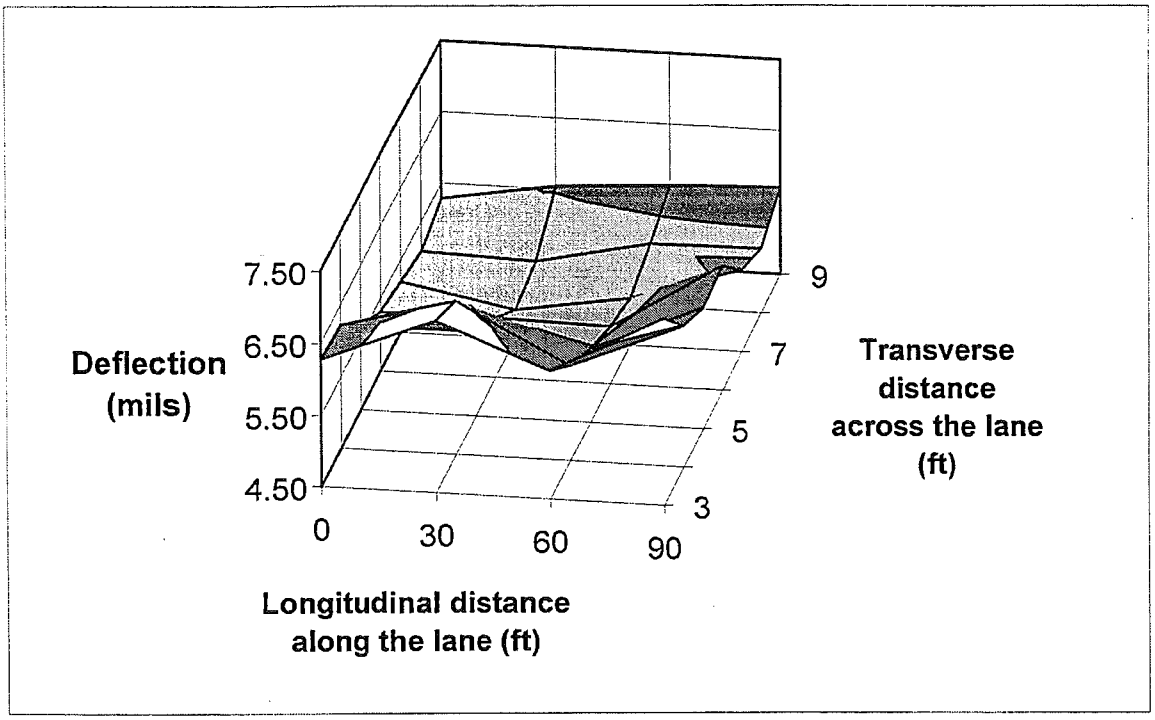


Figure D.15 Variation of the measured peak deflection (D1) across and along M-15 NB - section 1 test site 1

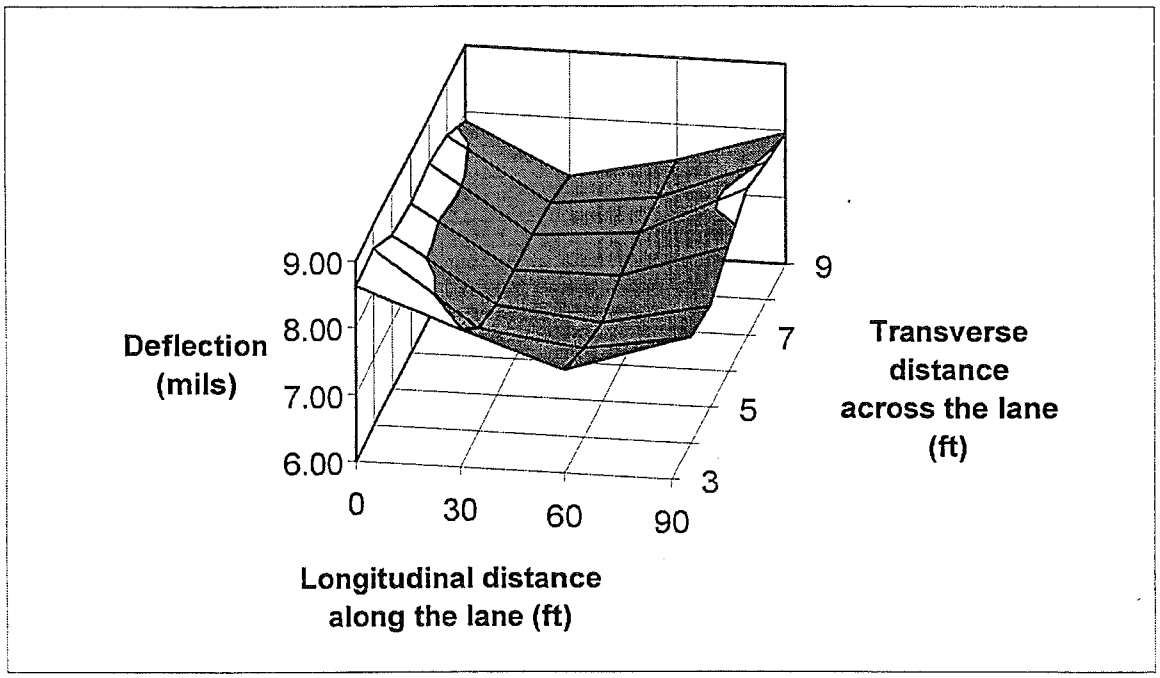


Figure D.16 Variation of the measured peak deflection (D1) across and along M-37 SB - section 5 test site 1

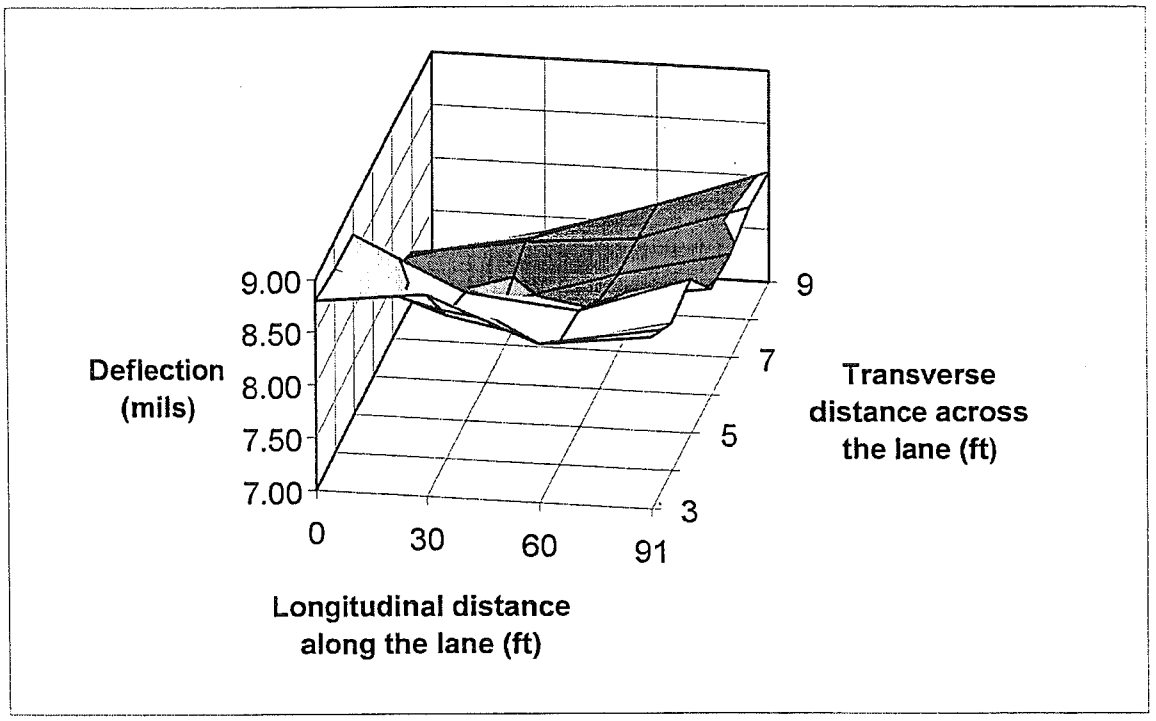


Figure D.17 Variation of the measured peak deflection (D1) across and along M-37 SB - section 5 test site 2

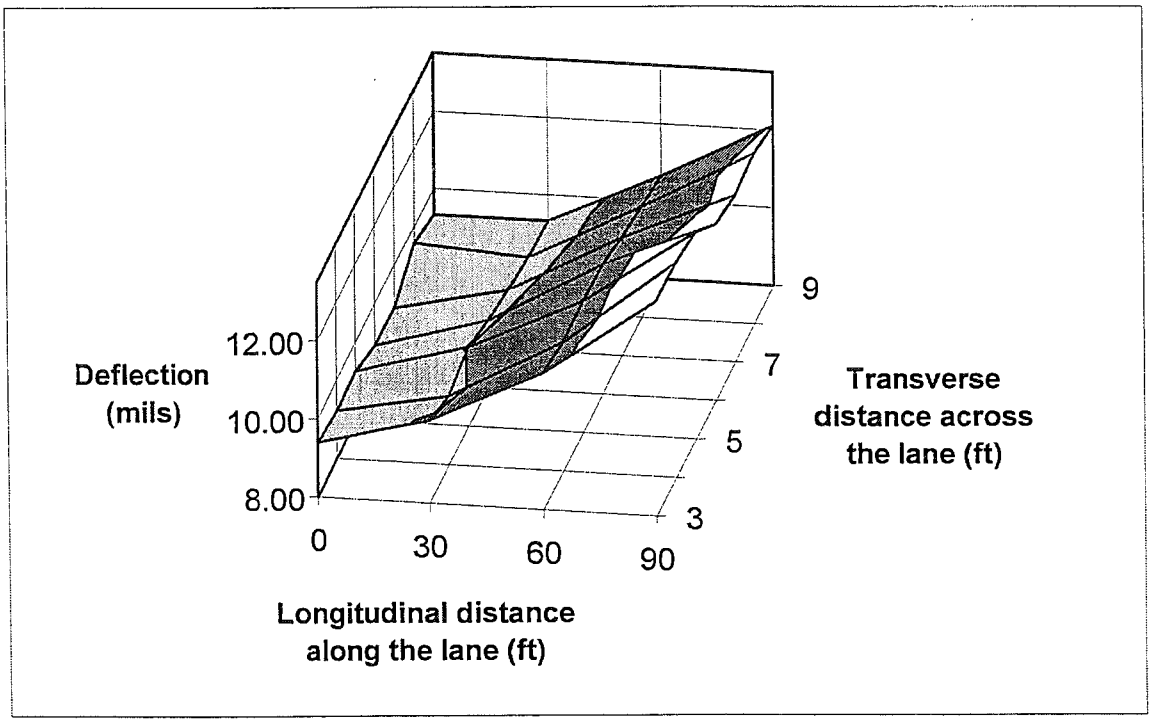


Figure D.18 Variation of the measured peak deflection (D1) across and along M-37 SB - section 6 test site 1

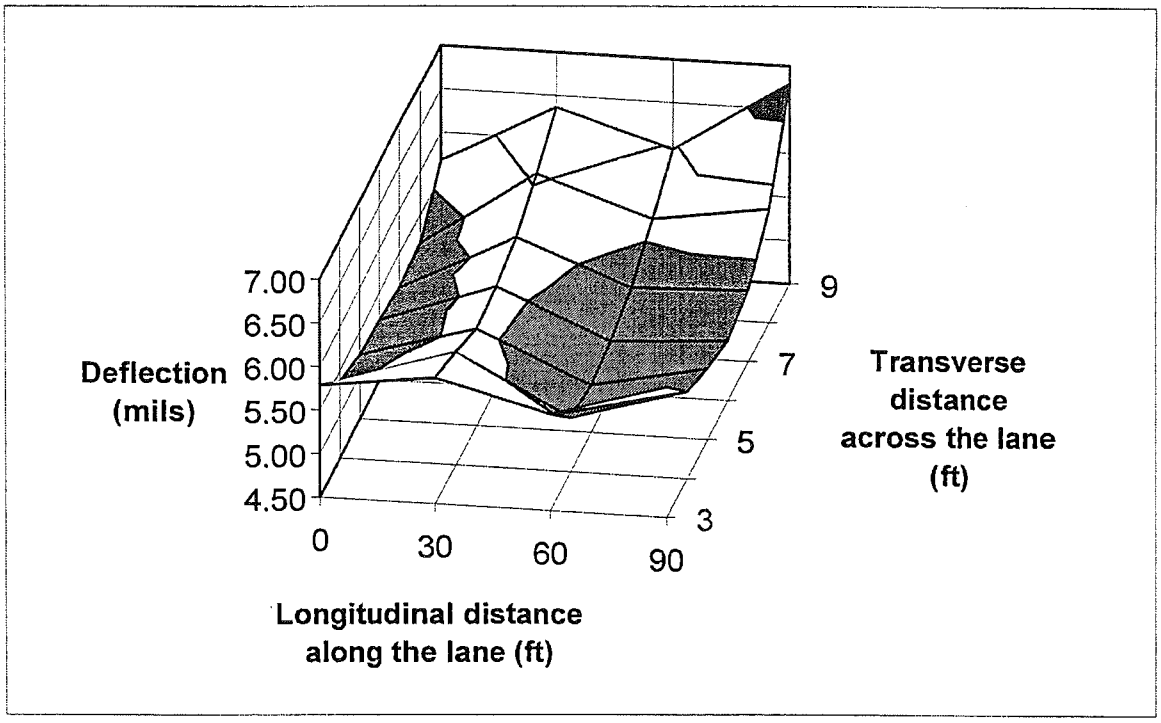
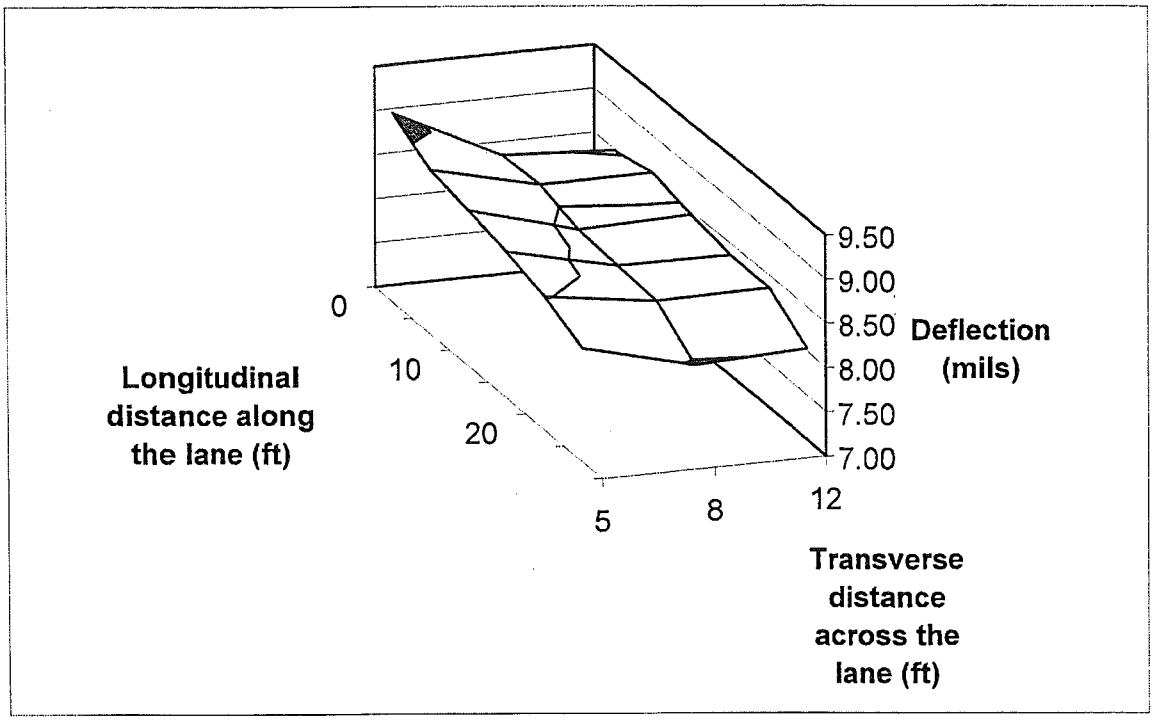


Figure D.19 Variation of the measured peak deflection (D1) across and along M-53 NB - section 1 test site 1



APPENDIX E

REPEATABILITY AND LINEARITY TESTS

APPENDIX E
REPEATABILITY AND LINEARITY TESTS

This appendix presents the deflection data and the results for the repeatability and linearity tests on various rubblized pavement projects. A project may be divided into one or more test sections and each section may be divided into one or more test sites.

Table E.1 Deflection data from repeatability and linearity tests on I-69 EB – section 1 test site 2

Target load (lb)	Normalized deflections (mils) to target load						
	D1	D2	D3	D4	D5	D6	D7
5500	5.09	3.44	2.88	2.44	2.09	1.57	0.83
5500	4.91	3.34	2.79	2.35	2.05	1.54	0.79
5500	4.97	3.44	2.88	2.41	2.10	1.57	0.83
5500	4.90	3.37	2.84	2.41	2.06	1.55	0.83
5500	4.90	3.37	2.84	2.41	2.06	1.55	0.87
5500	4.95	3.45	2.92	2.49	2.14	1.62	0.91
5500	4.89	3.40	2.84	2.45	2.09	1.50	0.83
5500	4.90	3.40	2.84	2.41	2.10	1.55	0.79
5500	4.85	3.37	2.81	2.42	2.08	1.56	0.82
5500	4.89	3.40	2.88	2.45	2.14	1.57	0.83
9000	8.04	5.64	4.88	4.20	3.60	2.60	1.36
9000	7.99	5.64	4.83	4.15	3.59	2.60	1.36
9000	8.02	5.63	4.87	4.19	3.59	2.64	1.36
9000	8.02	5.63	4.87	4.19	3.59	2.60	1.36
9000	8.01	5.62	4.86	4.14	3.58	2.59	1.36
9000	8.05	5.62	4.86	4.18	3.58	2.63	1.40
9000	8.01	5.66	4.86	4.18	3.58	2.63	1.36
9000	7.96	5.61	4.85	4.14	3.58	2.63	1.36
9000	7.99	5.64	4.85	4.17	3.57	2.63	1.35
9000	7.99	5.65	4.89	4.17	3.58	2.63	1.35
9000	8.00	5.61	4.89	4.18	3.58	2.63	1.36
9000	7.97	5.62	4.86	4.14	3.59	2.59	1.36
9000	8.09	5.70	4.94	4.22	3.63	2.63	1.40
9000	7.76	5.44	4.71	4.05	3.47	2.55	1.31
9000	8.00	5.65	4.89	4.18	3.58	2.63	1.36
9000	8.04	5.66	4.90	4.18	3.58	2.63	1.40
9000	8.03	5.69	4.89	4.21	3.58	2.63	1.39
9000	8.01	5.62	4.90	4.18	3.58	2.63	1.40
9000	8.01	5.66	4.86	4.18	3.58	2.63	1.36
9000	8.03	5.67	4.87	4.19	3.59	2.64	1.40
16000	14.40	10.28	8.93	7.66	6.62	4.80	2.58
16000	14.37	10.25	8.86	7.58	6.60	4.80	2.58
16000	14.31	10.23	8.84	7.57	6.59	4.79	2.58
16000	14.32	10.25	9.10	7.60	6.57	4.78	2.57
16000	14.31	10.18	8.82	7.51	6.52	4.73	2.50
16000	14.34	10.19	8.84	7.57	6.54	4.72	2.50
16000	14.36	10.24	8.89	7.62	6.59	4.80	2.58
16000	14.32	10.22	9.04	7.58	6.56	4.73	2.57
16000	14.37	10.25	9.07	7.56	6.57	4.75	2.53
16000	14.40	10.32	8.93	7.62	6.59	4.76	2.54
21000	18.51	13.29	11.46	9.83	8.52	6.21	3.35
21000	18.52	13.29	11.50	9.83	8.52	6.18	3.37
21000	18.62	13.37	11.62	9.86	8.59	6.24	3.34
21000	18.63	13.39	11.55	9.87	8.56	6.23	3.36
21000	18.62	13.38	11.83	9.84	8.57	6.23	3.34
21000	18.59	13.38	11.56	9.85	8.54	6.21	3.37
21000	18.57	13.39	11.53	9.82	8.55	6.22	3.37
21000	18.64	13.38	11.52	9.85	8.55	6.21	3.33
21000	18.66	13.41	11.66	9.76	8.58	6.25	3.40
21000	18.64	13.39	11.58	9.79	8.57	6.20	3.40

Table E.2 Averages and standard deviations of deflections D1 through D7 at different load levels on I-69 EB - section 1 test site 2

Target load (lb)	Number of drops	Statistics	Deflection (mils)						
			D1	D2	D3	D4	D5	D6	D7
5500	10	Average	4.93	3.40	2.85	2.42	2.09	1.56	0.84
		STDEV (mils)	0.07	0.04	0.04	0.04	0.03	0.03	0.04
		CV (%)	1.4	1.1	1.3	1.5	1.5	1.9	4.4
9000	20	Average	8.00	5.63	4.87	4.17	3.58	2.62	1.37
		STDEV (mils)	0.06	0.05	0.04	0.04	0.03	0.02	0.02
		CV (%)	0.8	0.9	0.9	0.9	0.8	0.9	1.6
16000	10	Average	14.35	10.24	8.93	7.59	6.58	4.77	2.55
		STDEV (mils)	0.04	0.04	0.10	0.04	0.03	0.03	0.03
		CV (%)	0.3	0.4	1.2	0.5	0.4	0.7	1.3
21000	10	Average	18.60	13.37	11.58	9.83	8.55	6.22	3.36
		STDEV (mils)	0.05	0.04	0.10	0.03	0.02	0.02	0.03
		CV (%)	0.3	0.3	0.9	0.3	0.3	0.3	0.8

STDEV = Standard deviation
CV = Coefficient of variation = standard deviation as a percent of the average

Table E.3 Average deflections D1 through D7 1 at different load levels normalized to the average deflection at 9,000-lb load on I-69 EB - section 1 test site 2

Target load (lb)	Deflection (mils)						
	D1	D2	D3	D4	D5	D6	D7
5500	4.93	3.40	2.85	2.42	2.09	1.56	0.84
9000	8.00	5.63	4.87	4.17	3.58	2.62	1.37
16000	14.35	10.24	8.93	7.59	6.58	4.77	2.55
21000	18.60	13.37	11.58	9.83	8.55	6.22	3.36
Normalized load	Normalized deflection						
	D1	D2	D3	D4	D5	D6	D7
0.6	0.62	0.60	0.59	0.58	0.58	0.60	0.61
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.8	1.79	1.82	1.84	1.82	1.84	1.82	1.87
2.3	2.33	2.37	2.38	2.36	2.39	2.38	2.46

Table E.4 Deflection data from repeatability and linearity tests on US-10 EB – section 1 test site 1

Target load (lb)	Normalized deflections (mils) to target load						
	D1	D2	D3	D4	D5	D6	D7
5500	5.09	3.44	2.88	2.44	2.09	1.57	0.83
5500	4.91	3.34	2.79	2.35	2.05	1.54	0.79
5500	4.97	3.44	2.88	2.41	2.10	1.57	0.83
5500	4.90	3.37	2.84	2.41	2.06	1.55	0.83
5500	4.90	3.37	2.84	2.41	2.06	1.55	0.87
5500	4.95	3.45	2.92	2.49	2.14	1.62	0.91
5500	4.89	3.40	2.84	2.45	2.09	1.50	0.83
5500	4.90	3.40	2.84	2.41	2.10	1.55	0.79
5500	4.85	3.37	2.81	2.42	2.08	1.56	0.82
5500	4.89	3.40	2.88	2.45	2.14	1.57	0.83
9000	8.04	5.64	4.88	4.20	3.60	2.60	1.36
9000	7.99	5.64	4.83	4.15	3.59	2.60	1.36
9000	8.02	5.63	4.87	4.19	3.59	2.64	1.36
9000	8.02	5.63	4.87	4.19	3.59	2.60	1.36
9000	8.01	5.62	4.86	4.14	3.58	2.59	1.36
9000	8.05	5.62	4.86	4.18	3.58	2.63	1.40
9000	8.01	5.66	4.86	4.18	3.58	2.63	1.36
9000	7.96	5.61	4.85	4.14	3.58	2.63	1.36
9000	7.99	5.64	4.85	4.17	3.57	2.63	1.35
9000	7.99	5.65	4.89	4.17	3.58	2.63	1.35
9000	8.00	5.61	4.89	4.18	3.58	2.63	1.36
9000	7.97	5.62	4.86	4.14	3.59	2.59	1.36
9000	8.09	5.70	4.94	4.22	3.63	2.63	1.40
9000	7.76	5.44	4.71	4.05	3.47	2.55	1.31
9000	8.00	5.65	4.89	4.18	3.58	2.63	1.36
9000	8.04	5.66	4.90	4.18	3.58	2.63	1.40
9000	8.03	5.69	4.89	4.21	3.58	2.63	1.39
9000	8.01	5.62	4.90	4.18	3.58	2.63	1.40
9000	8.01	5.66	4.86	4.18	3.58	2.63	1.36
9000	8.03	5.67	4.87	4.19	3.59	2.64	1.40
16000	14.40	10.28	8.93	7.66	6.62	4.80	2.58
16000	14.37	10.25	8.86	7.58	6.60	4.80	2.58
16000	14.31	10.23	8.84	7.57	6.59	4.79	2.58
16000	14.32	10.25	9.10	7.60	6.57	4.78	2.57
16000	14.31	10.18	8.82	7.51	6.52	4.73	2.50
16000	14.34	10.19	8.84	7.57	6.54	4.72	2.50
16000	14.36	10.24	8.89	7.62	6.59	4.80	2.58
16000	14.32	10.22	9.04	7.58	6.56	4.73	2.57
16000	14.37	10.25	9.07	7.56	6.57	4.75	2.53
16000	14.40	10.32	8.93	7.62	6.59	4.76	2.54
21000	18.51	13.29	11.46	9.83	8.52	6.21	3.35
21000	18.52	13.29	11.50	9.83	8.52	6.18	3.37
21000	18.62	13.37	11.62	9.86	8.59	6.24	3.34
21000	18.63	13.39	11.55	9.87	8.56	6.23	3.36
21000	18.62	13.38	11.83	9.84	8.57	6.23	3.34
21000	18.59	13.38	11.56	9.85	8.54	6.21	3.37
21000	18.57	13.39	11.53	9.82	8.55	6.22	3.37
21000	18.64	13.38	11.52	9.85	8.55	6.21	3.33
21000	18.66	13.41	11.66	9.76	8.58	6.25	3.40
21000	18.64	13.39	11.58	9.79	8.57	6.20	3.40

Table E.5 Averages and standard deviations of deflections D1 through D7 at different load levels on US-10 EB – section 1 test site 1

Target load (lb)	Number of drops	Statistics	Deflection (mils)						
			D1	D2	D3	D4	D5	D6	D7
5500	10	Average	7.03	4.93	4.61	3.87	3.15	2.23	1.26
		STDEV (mils)	0.19	0.10	0.08	0.07	0.04	0.04	0.02
		CV (%)	2.7	2.0	1.8	1.8	1.3	1.6	1.7
9000	20	Average	11.16	7.83	7.45	6.35	5.25	3.72	2.11
		STDEV (mils)	0.02	0.03	0.03	0.03	0.02	0.03	0.02
		CV (%)	0.2	0.3	0.4	0.5	0.4	0.8	0.8
16000	10	Average	19.32	13.39	12.73	11.04	9.24	6.58	3.85
		STDEV (mils)	0.07	0.07	0.26	0.09	0.03	0.03	0.03
		CV (%)	0.4	0.5	2.0	0.8	0.3	0.5	0.9
21000	10	Average	24.65	16.92	16.25	13.97	11.75	8.44	4.97
		STDEV (mils)	0.07	0.05	0.22	0.05	0.03	0.03	0.02
		CV (%)	0.3	0.3	1.4	0.3	0.3	0.4	0.5

STDEV = Standard deviation
CV = Coefficient of variation = standard deviation as a percent of the average

Table E.6 Average deflections D1 through D7 1 at different load levels normalized to the average deflection at 9,000-lb load on US-10 EB – section 1 test site 1

Target load (lb)	Deflection (mils)						
	D1	D2	D3	D4	D5	D6	D7
5500	7.03	4.93	4.61	3.87	3.15	2.23	1.26
9000	11.16	7.83	7.45	6.35	5.25	3.72	2.11
16000	19.32	13.39	12.73	11.04	9.24	6.58	3.85
21000	24.65	16.92	16.25	13.97	11.75	8.44	4.97
Normalized load	Normalized deflection						
	D1	D2	D3	D4	D5	D6	D7
0.6	0.63	0.63	0.62	0.61	0.60	0.60	0.60
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.8	1.73	1.71	1.71	1.74	1.76	1.77	1.82
2.3	2.21	2.16	2.18	2.20	2.24	2.27	2.35

Table E.7 Deflection data from repeatability and linearity tests on US-27 SB – section 2 test site 1

Target load (lb)	Normalized deflections (mils) to target load						
	D1	D2	D3	D4	D5	D6	D7
9000	6.35	5.35	4.74	3.94	3.36	2.56	1.46
9000	6.34	5.38	4.76	3.96	3.38	2.54	1.46
9000	6.32	5.35	4.74	3.97	3.39	2.54	1.47
9000	6.36	5.36	4.74	3.97	3.39	2.58	1.47
9000	6.32	5.35	4.73	3.97	3.38	2.54	1.47
9000	6.32	5.35	4.77	3.97	3.38	2.58	1.47
9000	6.32	5.32	4.75	3.95	3.37	2.57	1.46
9000	6.32	5.32	4.75	3.98	3.37	2.57	1.46
9000	6.31	5.35	4.74	3.97	3.36	2.52	1.46
9000	6.26	5.38	4.73	3.97	3.36	2.56	1.45
9000	6.34	5.37	4.76	3.96	3.37	2.57	1.46
9000	6.28	5.36	4.75	3.95	3.37	2.57	1.46
9000	6.28	5.35	4.74	3.94	3.36	2.57	1.46
9000	6.31	5.35	4.78	3.97	3.40	2.56	1.46
9000	6.31	5.35	4.77	3.97	3.40	2.56	1.46
9000	6.34	5.34	4.76	3.96	3.38	2.58	1.46
9000	6.34	5.37	4.76	3.99	3.37	2.53	1.42
9000	6.30	5.34	4.72	3.96	3.38	2.54	1.46
9000	6.32	5.35	4.74	3.93	3.36	2.58	1.47
9000	6.31	5.35	4.73	3.97	3.38	2.54	1.47
16000	11.12	9.46	8.37	7.06	6.04	4.54	2.64
16000	11.15	9.49	8.36	7.05	6.04	4.49	2.64
16000	11.10	9.44	8.35	7.01	6.03	4.49	2.63
16000	11.11	9.48	8.35	7.00	6.06	4.51	2.64
16000	11.13	9.47	8.37	7.06	6.05	4.50	2.64
16000	11.13	9.46	8.37	7.02	6.05	4.50	2.64
16000	11.15	9.49	8.35	7.01	6.04	4.53	2.63
16000	11.13	9.47	8.35	7.04	6.03	4.49	2.63
16000	11.13	9.51	8.37	7.02	6.05	4.50	2.64
16000	11.12	9.46	8.37	7.02	6.04	4.50	2.64
21000	14.42	12.27	10.88	9.17	7.89	5.90	3.50
21000	14.44	12.30	10.86	9.11	7.88	5.89	3.47
21000	14.54	12.42	11.01	9.16	7.92	5.91	3.50
21000	14.46	12.39	10.80	9.20	7.90	5.90	3.47
21000	14.54	12.42	10.95	9.15	7.91	5.91	3.48
21000	14.56	12.45	10.98	9.21	7.94	5.91	3.51
21000	14.56	12.44	10.97	9.18	7.93	5.91	3.51
21000	14.54	12.39	10.96	9.17	7.92	5.90	3.50
21000	14.52	12.41	10.91	9.16	7.91	5.89	3.47
21000	14.59	12.43	10.95	9.16	7.88	5.88	3.48

Table E.8 Averages and standard deviations of deflections D1 through D7 at different load levels on US-27 SB – section 2 test site 1

Target load (lb)	Number of drops	Statistics	Deflection (mils)						
			D1	D2	D3	D4	D5	D6	D7
9000	20	Average	6.32	5.35	4.75	3.96	3.37	2.56	1.46
		STDEV (mils)	0.02	0.02	0.02	0.01	0.01	0.02	0.01
		CV (%)	0.4	0.3	0.3	0.3	0.4	0.7	0.7
16000	10	Average	11.13	9.47	8.36	7.03	6.04	4.51	2.64
		STDEV (mils)	0.01	0.02	0.01	0.02	0.01	0.02	0.00
		CV (%)	0.1	0.2	0.1	0.3	0.1	0.4	0.1
21000	10	Average	14.52	12.39	10.93	9.17	7.91	5.90	3.49
		STDEV (mils)	0.06	0.06	0.06	0.03	0.02	0.01	0.02
		CV (%)	0.4	0.5	0.6	0.3	0.3	0.2	0.5

STDEV = Standard deviation
CV = Coefficient of variation = standard deviation as a percent of the average

Table E.9 Average deflections D1 through D7 1 at different load levels normalized to the average deflection at 9,000-lb load on US-27 SB – section 2 test site 1

Target load (lb)	Deflection (mils)						
	D1	D2	D3	D4	D5	D6	D7
9000	6.32	5.35	4.75	3.96	3.37	2.56	1.46
16000	11.13	9.47	8.36	7.03	6.04	4.51	2.64
21000	14.52	12.39	10.93	9.17	7.91	5.90	3.49
Normalized load	Normalized deflection						
	D1	D2	D3	D4	D5	D6	D7
1.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1.8	1.761	1.770	1.761	1.774	1.791	1.761	1.807
2.3	2.298	2.315	2.302	2.313	2.344	2.306	2.390

Table E.10 Deflection data from repeatability and linearity tests on M-37 SB – section 5 test site 2

Target load (lb)	Normalized deflections (mils) to target load						
	D1	D2	D3	D4	D5	D6	D7
5500	5.52	4.14	3.51	2.99	2.64	2.17	Error
5500	5.51	4.16	3.57	3.05	2.70	2.22	1.31
5500	5.48	4.21	3.58	3.06	2.67	2.22	1.31
5500	5.53	4.21	3.58	3.06	2.75	2.26	Error
5500	5.54	4.22	3.58	3.07	2.71	2.31	1.32
5500	5.53	4.26	3.62	3.06	2.71	2.22	1.31
5500	5.50	4.18	3.58	3.07	2.67	2.23	1.32
5500	5.50	4.23	3.59	3.07	2.72	2.27	1.32
5500	5.45	4.14	3.50	2.98	2.63	2.20	Error
5500	5.50	4.23	3.63	3.07	2.68	2.27	1.32
9000	8.90	6.77	5.96	5.15	4.55	3.71	2.17
9000	8.85	6.72	5.91	5.12	4.55	3.63	2.17
9000	8.87	6.74	5.93	5.13	4.52	3.64	2.18
9000	8.88	6.78	5.97	5.17	4.56	3.72	2.18
9000	8.86	6.76	5.96	5.15	4.55	3.63	2.17
9000	8.89	6.76	5.95	5.15	4.55	3.67	2.21
9000	8.89	6.78	5.94	5.14	4.53	3.68	2.18
9000	8.90	6.79	5.94	5.14	4.53	3.68	2.18
9000	8.85	6.76	5.95	5.15	4.55	3.66	2.21
9000	8.85	6.75	5.94	5.14	4.53	3.64	2.18
9000	8.87	6.77	5.96	5.16	4.56	3.63	2.18
9000	8.89	6.79	5.94	5.14	4.53	3.68	2.22
9000	8.86	6.76	5.92	5.12	4.51	3.67	2.17
9000	8.86	6.73	5.92	5.13	4.55	3.63	2.17
9000	8.86	6.76	5.92	5.12	4.51	3.63	2.17
9000	8.90	6.77	5.96	5.15	4.55	3.67	2.21
9000	8.91	6.77	5.96	5.16	4.52	3.67	2.21
9000	8.87	6.73	5.92	5.13	4.52	3.63	2.18
9000	8.87	6.77	5.97	5.13	4.56	3.67	2.18
9000	8.87	6.78	5.97	5.16	4.52	3.64	2.18
16000	15.36	11.58	10.23	8.79	7.80	6.12	3.78
16000	15.21	11.45	10.10	8.67	7.73	6.06	3.80
16000	15.18	11.49	10.09	8.66	7.71	6.08	3.82
16000	15.21	11.46	10.07	8.67	7.68	6.05	3.78
16000	15.15	11.40	10.06	8.60	7.69	6.03	3.79
16000	15.16	11.41	10.03	8.60	7.70	6.04	3.79
16000	15.17	11.45	10.02	8.59	7.69	6.06	3.80
16000	15.23	11.47	10.07	8.64	7.70	6.02	3.81
16000	15.15	11.37	10.03	8.57	7.63	6.02	3.78
16000	15.17	11.42	10.04	8.61	7.71	6.04	3.79
21000	19.18	14.37	12.59	10.78	9.55	7.54	4.70
21000	19.20	14.42	12.57	10.75	9.57	7.55	4.71
21000	19.22	14.38	12.52	10.71	9.49	7.48	4.69
21000	19.25	14.42	12.56	10.70	9.47	7.49	4.72
21000	19.20	14.38	12.57	10.71	9.49	7.47	4.71
21000	19.18	14.34	12.49	10.64	9.42	7.44	4.69
21000	19.25	14.40	12.54	10.69	9.47	7.49	4.70
21000	19.21	14.37	12.48	10.67	9.41	7.44	4.69
21000	19.24	14.33	12.45	10.60	9.38	7.42	4.68
21000	19.23	14.36	12.47	10.62	9.40	7.39	4.69

Table E.11 Averages and standard deviations of deflections D1 through D7 at different load levels on M-37 SB – section 5 test site 2

Target load (lb)	Number of drops	Statistics	Deflection (mils)						
			D1	D2	D3	D4	D5	D6	D7
5500	10	Average	5.51	4.20	3.57	3.05	2.69	2.24	1.31
		STDEV (mils)	0.02	0.04	0.04	0.03	0.04	0.04	0.00
		CV (%)	0.4	1.0	1.2	1.1	1.3	1.8	0.2
9000	20	Average	8.88	6.76	5.95	5.14	4.54	3.66	2.19
		STDEV (mils)	0.02	0.02	0.02	0.01	0.02	0.03	0.02
		CV (%)	0.2	0.3	0.3	0.3	0.4	0.7	0.8
16000	10	Average	15.20	11.45	10.07	8.64	7.70	6.05	3.79
		STDEV (mils)	0.06	0.06	0.06	0.06	0.04	0.03	0.01
		CV (%)	0.4	0.5	0.6	0.7	0.5	0.5	0.3
21000	10	Average	19.22	14.38	12.52	10.69	9.46	7.47	4.70
		STDEV (mils)	0.03	0.03	0.05	0.06	0.06	0.05	0.01
		CV (%)	0.1	0.2	0.4	0.5	0.7	0.7	0.3

STDEV = Standard deviation
CV = Coefficient of variation = standard deviation as a percent of the average

Table E.12 Average deflections D1 through D7 1 at different load levels normalized to the average deflection at 9,000-lb load on M-37 SB – section 5 test site 2

Target load (lb)	Deflection (mils)						
	D1	D2	D3	D4	D5	D6	D7
5500	5.51	4.20	3.57	3.05	2.69	2.24	1.31
9000	8.88	6.76	5.95	5.14	4.54	3.66	2.19
16000	15.20	11.45	10.07	8.64	7.70	6.05	3.79
21000	19.22	14.38	12.52	10.69	9.46	7.47	4.70
Normalized load	Normalized deflection						
	D1	D2	D3	D4	D5	D6	D7
0.6	0.62	0.62	0.60	0.59	0.59	0.61	0.60
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.8	1.71	1.69	1.69	1.68	1.70	1.65	1.74
2.3	2.17	2.13	2.11	2.08	2.09	2.04	2.15