Pavement Demonstration Program Project Finalization Low Volume (Thin) Concrete Reconstruction Projects – M-13 & M-99 (MDOT Job Numbers 53356 & 75184)

Final Technical Report

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16. Abstract

All demonstration projects are continually being evaluated to determine whether there is enough information to create appropriate performance curves and/or determine their applicability as an MDOT standard practice. This report summarizes projects for which a final determination can be made to finalize and end their designation as a demonstration project. This document is a final comprehensive report on the "Low Volume (thin) Concrete Reconstruction" projects on M-13 in Bay County and M-99 in Jackson County, with MDOT job numbers 53356 and 75184, respectively. The M-13 and M-99 projects were constructed in 2005 and 2006, respectively. These demonstration projects were designed to assess a cost-effective concrete cross-section alternative for reconstructing roadways with low traffic volumes (both overall and commercial traffic). Typically, MDOT concrete reconstruction consists of jointed plain concrete pavement (JPCP) designed to have a thickness of 8 inches or greater with 12-foot joint spacing and load transfer at the transverse joints. In contrast, these demonstration projects were evaluated using 6-inch jointed plain concrete panels with shorter joint spacing and no load transfer at the transverse joints. Like standard JPCP construction, these demonstration concrete pavements were designed with a 20-year design life. After 16 and 17 years of service for M-99 and M-13, respectively, no major contracted maintenance has been done on these projects. Additionally, the projects continue to provide satisfactory structural and functional performance. Thin concrete pavements provide a cost-effective alternative to traditional 8-inch thick JPCP reconstruction due to their lower initial cost and comparable maintenance costs. Low-volume, thin concrete pavement reconstruction is deemed acceptable, and this fix type is suitable for MDOT use where appropriate on low-volume, non-freeway roadways.

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Table of Contents

List of Tables

List of Figures

Introduction

Public Act 457 of 2016, MCL 247.651h contains what is referred to as the pavement life-cycle law. This law requires the Michigan Department of Transportation (MDOT) to conduct a life-cycle cost analysis (LCCA) on projects with pavement costs of $1.5 million or more. The LCCA process is a tool to select the lowest-cost pavement design over the expected service life of the pavement. By law, the LCCA process must include historical information for initial construction and maintenance costs and performance (service life). This information is unavailable for new pavement design types and technologies. Thus, it cannot be used in the pavement selection process until substantial information has been obtained. Accordingly, Public Act 457 of 2016, MCL 247.651i, the pavement demonstration law, provides a means for trying new and innovative ideas through demonstration projects. These demonstration projects are not subject to an LCCA process. Pavement demonstration outcomes are intended to increase service life, improve pavement condition, improve ride quality, and/or lower service life costs. Future LCCAs may utilize the demonstration projects' cost, performance, and maintenance information. Selection of candidate projects is collaborative among MDOT Construction Field Services pavement personnel, MDOT region personnel, and paving industry groups. Once the demonstration project is identified, it goes to MDOT's Engineering Operations Committee for formal approval. Once approved, the project becomes part of the Pavement Demonstration Program. All costs for the demonstration project are funded by the respective MDOT region's rehabilitation and reconstruction template budget. These projects are monitored until a final decision is made regarding the suitability of adopting them as MDOT standard practice. This report evaluates two projects for the "Low Volume (Thin) Concrete Reconstruction" pavement demonstration fix type on M-13 in Pinconning township, Bay County, and M-99 in Springport Village, Jackson County, with MDOT job numbers 53356 and 75184, respectively.

Project Description

The M-13 and M-99 demonstration projects were constructed in 2005 and 2006, respectively. The M-13 project is from Mary Street to North Street in Pinconning, Michigan. The M-99 project is from Mechanic Street to Pearl Street in Springport, Michigan. Both projects used a 20-year design life to have 6-inch thick concrete panels with tie bars at the longitudinal joints but no dowel bars at the transverse joints. However, they differ in panel dimensions, as M-13 panels are 5.5 feet by 5.5 feet, and M-99 panels are 6 feet by 6 feet. Table 1 shows the description of concrete panels and spacing. Both projects placed the concrete pavement over 6 inches of dense-graded unbounded aggregate base over 12 inches of sand subbase. The cross-section is shown in Appendix Figures A1 and A2, and project descriptions of M-13 and M-99 are provided in Table 2. The maps in Figures 1 and 2 show the locations of M-13 and M-99, as detailed in Table 2.

These demonstration projects are unique from standard MDOT concrete reconstruction in key aspects. Standard concrete reconstruction designs also use a 20-year design life, but commonly, slab thickness is at least 8 inches and utilizes dowel bars at the transverse joints. Standard concrete reconstruction base construction also consists of an open-graded aggregate instead of a dense-graded base, and the sand subbase is 10 inches instead of 12 inches. Finally, standard reconstruction panels are larger, with transverse joints spaced at a minimum of 12 feet (depending on slab thickness), and longitudinal spacing is typically 12 feet.

Table 1. M-13 and M-99 Concrete Panel Summary

Project Location	Plan Panel Depth (inches)	Transverse Joint Spacing (feet)	Longitudinal Joint Spacing (feet)
M-13	6	5.5	5.5
M-99	6	6	6

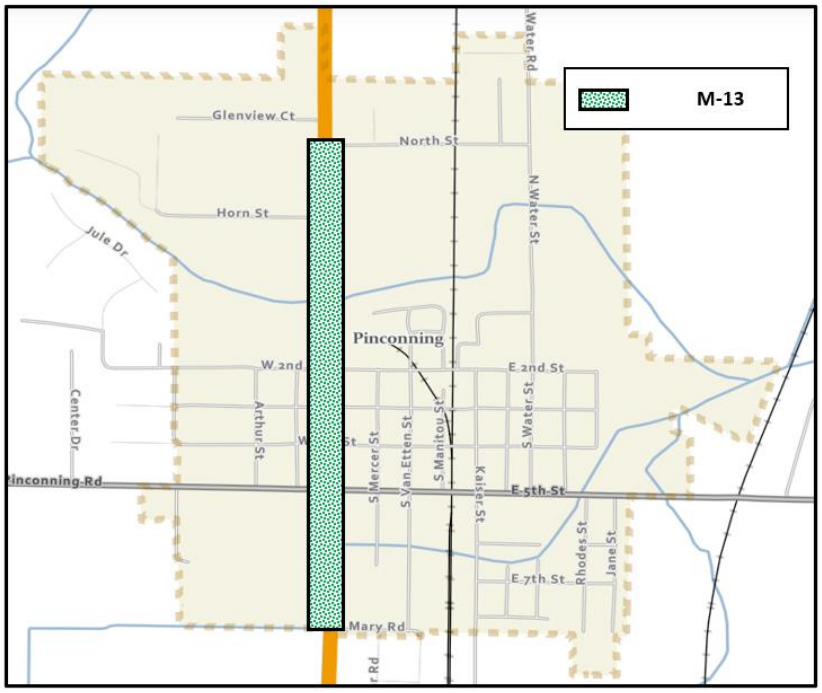


Figure 1. M-13 Demonstration Project Location

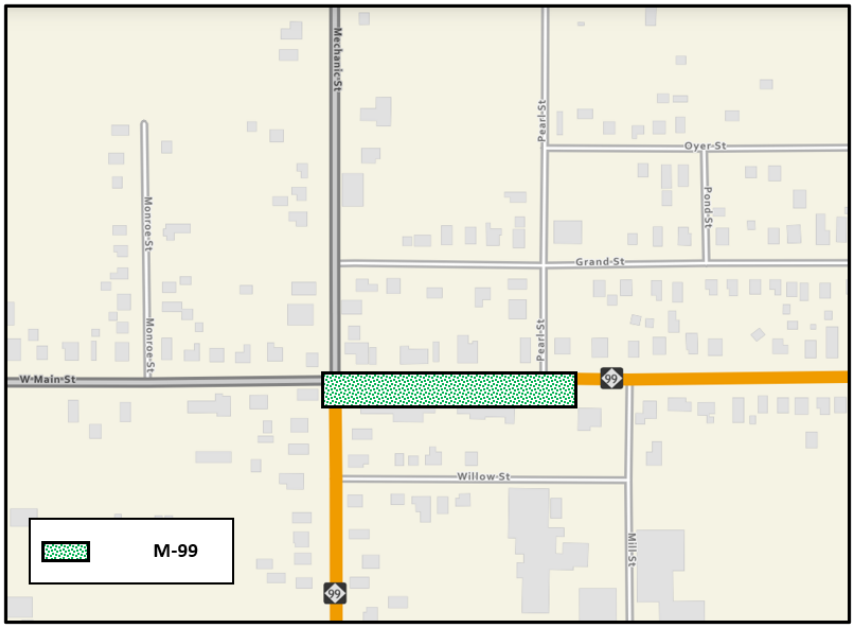


Figure 2. M-99 Demonstration Project Location

Table 2. M-13 and M-99 Demonstration Project Test Section Descriptions

Route	Test Section Description	Length of Test Section (miles)	P.R. Number	PR BMP	PR EMP
M-13	JPCP concrete on dense-graded unbound aggregate base on sand subbase	0.870	767610	22.403	23.273
M-99		1.252	897108	7.934	9.186

** Note: P.R. is Physical Road, BMP is Beginning Mile Point, EMP is Ending Mile Point. P.R. and M.P. information is per PR Version 22.*

For M-99, additional testing beyond standard construction acceptance was conducted for the aggregate base, subbase, and subgrade. This consisted of falling weight deflectometer (FWD), dynamic cone penetrometer (DCP), and density gauge testing. The FWD data is shown in the Appendix in Figures A4 and A5. The DCP results for the base materials are shown in Figures A6 to A24. The densities of the subgrade and subbase materials are presented in Figures A25 to A28. No significant material issues or variations in performance or quality were observed. Furthermore, all materials are considered to have met construction acceptance criteria.

For M-13 and M-99, Ground Penetrating Radar (GPR) data was conducted in 2022 and 2023, respectively. It should be noted that GPR measurements are estimates since core data is not available to confirm them. Nevertheless, this data indicates that almost all tested concrete meets or exceeds the design pavement thickness of 6 inches, with average thickness of approximately 6.5 inches for M-13 and 6.8 inches for M-99. The only notable exception is M-13, where the thickness decreases to approximately 3.5 inches within 200 feet on either side of the Pinconning River bridge.

Traffic Assessment and CESAL Estimation

Traffic loading is a crucial contributing factor to pavement performance and durability. Excessive traffic volumes can initiate or propagate pavement distress, eventually leading to pavement failure. The impact of traffic on the performance of the low-volume concrete reconstruction projects on M-13 and M-99 was evaluated by computing the Concrete Equivalent Standard Axle Load (CESAL). Two-way Commercial Annual Average Daily Traffic (CAADT) data was obtained from MDOT's Transportation Data Management System (TDMS) for CESAL computation input. Both projects were designed for a 20-year design life. The 20-year design CESAL estimation was based on the AASHTO 1993 design method, using the following equation:

$$CESALs_{Estimated} = CAADT \times 365 \times DD \times LD \times TF \times GF$$

Where:
GF = growth factor, $[(1+g)^n - 1]/g$
g = growth rate expressed as a decimal
n = number of years

The design CESAL value was estimated because it was unavailable from the original design and construction records for either project. Accordingly, the directional distribution (DD), lane distribution (LD), and truck factors (TF) were estimated using data from other similar low-volume MDOT projects to make accurate estimations. Therefore, a DD of 51% and TF of 0.78 were used for both routes. A LD of 80% was adopted for M-13, and 100% was used for M-99. As indicated on the project plan cover sheets, the growth rate (g) for M-13 and M-99 were calculated to be 3% and 0.17%, respectively. Similarly, per the project plan cover sheets, the initial year CAADT for M-13 and M-99 were 509 and 103, respectively.

In comparison, the actual CESALs were calculated per the summation of each year's CESAL using the actual measured (or estimated actual measure) CAADT, using the following equation:

$$CESALs_{Actual} = CAADT \times 365 \times DD \times LD \times TF$$

M-13, constructed in 2005, has traffic volume data available on TDMS from 2008 to 2022, excluding 2010 and 2015. To estimate the CAADT values for 2006 and 2007, the design growth rate of 3% was used to depreciate the 2008 value accordingly. For the 2010 and 2015 CAADT values, the surrounding CAADT values of 2009 and 2011, and 2014 and 2016 were averaged, respectively. Future projections of CAADT values from 2023 to 2025 were estimated using the 2022 data and applying a growth rate of 3%.

M-99, constructed in 2006, has TDMS traffic volume data from 2011 to 2022, excluding 2015. Following a similar approach as M-13, the CAADT values for 2014 and 2016 were averaged to estimate the missing 2015 value. For the years before 2011 and beyond 2022 (from 2023 to 2026), a growth rate of 3% was assumed, instead of using the M-99 design growth rate of 0.17%. This decision was made due to the negligible impact of the 0.17% growth rate, which resulted in minimal changes when applied to computations for CAADT values. Additionally, this approach provides a more conservative estimate to avoid underestimating the CAADT values.

The same factors for DD, LD, and TF were assumed to estimate actual CESAL, except the M-13 LD was increased to 90% due to updated general LD assumptions of Michigan roadways. The estimated actual and the initial design CESALs are shown in Table 3. Figures C1, C2, and C3 in the Appendix provide detailed computation of the estimated and actual CESAL values. Over the same 20-year period, both projects are anticipated to have similar actual CESALs as was estimated during the initial design, so these projects appear to be reasonably designed.

Table 3. CESALs for M-13 and M-99 Projects

Route	Location	Period	Estimated Design CESALs	Actual Computed CESALs
M-13	Mary Street to North Street	2006-2025	≈ 1,600,000	≈ 1,200,000
M-99	Mechanic Street to Pearl Street	2007-2026	≈ 300,000	≈ 330,000

Pavement Condition Surveys

The pavement condition of all MDOT demonstration projects is documented annually in the MDOT Pavement Demonstration Program Legislative Status Report, *Pavement Demonstration Program Status Report Public Act 457 of 2016* [4]. Typically, this annual report includes a summary of distress conditions, including scaling, spalling, joint deterioration, cracking, and repairs. These reports are derived from the field survey notes, with the 2022 evaluation notes shown in Appendix Figures A32, A33, and A34. Annual surveys collected data in both directions for demonstration projects. Data were collected on all lanes except for the center left turn lane of M-13. Typical lane configurations of M-99 and M-13 are shown in Figures 3 and 4. It should be noted that the travel lanes of M-99 include outside parking, so these lanes are 4 panels wide to accommodate intermittent street parking along this route, as opposed to 2 panels on M-13. Furthermore, M-13 has two travel lanes in both directions versus one in each direction for M-99. Due to this variation in the number of lanes and panels, the condition and performance of M-99 and M-13 may not be directly comparable.

Figure 3. Lane Configuration for M-13, Google Maps Image 2023

Figure 4. Lane Configuration for M-99, Google Maps Image 2014

Early-Stage Pavement Condition Findings

Annual surveys noted that within the first 5 years of service, the M-13 project experienced minimal overall distress. Still, field surveys observed 9 cracked panels, some faulting along the longitudinal middle joint of the northbound outside lane, and minor intermittent joint spalling/raveling (less than 1" wide and 12" long). Notably, some of the cracked panels were at or near drainage structures. Additionally, the Pinconning Bridge had construction work conducted in 2010, for which heavy equipment (large crane, etc.) was parked on the travel lanes approximately 100 feet south of the bridge. Accordingly, the following year, 16 slabs were found to be cracked in all lanes and both directions of that area. As previously noted, the slab thickness decreases below the design thickness within 200-feet of the bridge. This may have also been a contributing factor along with the construction equipment. Examples of the observed pavement distresses are shown in Figures 5 and 6.

For M-99, several cracks were immediately observed within a few weeks of construction. Accordingly, since early cracking was observed and was within the five-year warranty period, two distress surveys were conducted to evaluate the warranty performance; one was in 2009 (3 years after construction), and the other was in 2011 (5 years after construction). See Appendix Figures B1 and B2 for the distress survey reports, *Warranty Inspection Report SWAD 2870* [1,2]. The concrete pavement was evaluated based on eight distresses: transverse cracking, longitudinal cracking, map cracking, spalling, scaling, corner cracking, joint seal failure, and shattered slabs. All distress types were observed in both surveys, except for map cracking and shattered slabs. Example images of the observed pavement distresses as documented in the warranty reports are shown in Figures 7, 8 and 9. Since the distress exceeded the allowable amount as defined by the

five-year warranty, approximately 3 slabs were replaced, and the remaining cracks and spalls were repaired with crack-sealing techniques.

Figure 5. Field Survey Pictures of M-13

Figure 6. Distress Slabs South of Pinconning Bridge on M-13

Figure 7. Field Survey Pictures of M-99

Figure 8. Transverse and Corner Cracks on M-99 from MDOT Warranty Report SWAD 2870 (2009)

Figure 9. Joint Spalling and Transverse Cracks on M-99 from MDOT Warranty Report SWAD 2870 (2011)

Pavement Condition Findings

According to the April 2022 field survey of M-13, after 17 years of service, approximately 2.4 percent of all concrete panels are cracked or repaired. This percentage is relatively minimal over this timespan. Excluding the cracked and repaired slabs at the south side of the Pinconning River Bridge, this percentage decreases to 1.9 percent. Figure 10 shows the overall trend of crack and repair through the pavement's design life. Otherwise, some intermittent scaling and joint spalling

were observed. This primarily occurred within the first 550 feet of the project's south end within the northbound lanes. To address this, these have been filled with a spray-on asphalt emulsion patching material (commonly referred to by its commercial name AMZ). This joint deterioration is commonly related to the timing of the sawing operation. In both directions, the mid-lane longitudinal joint of the rightmost lane is exhibiting some widening and low levels of faulting at various locations. Accordingly, the field survey described the pavement's overall performance as good*. The April 2022 field survey notes are shown in Appendix Figure A34. Pictures of the current pavement condition on M-13 are shown in Appendix Figure A35.

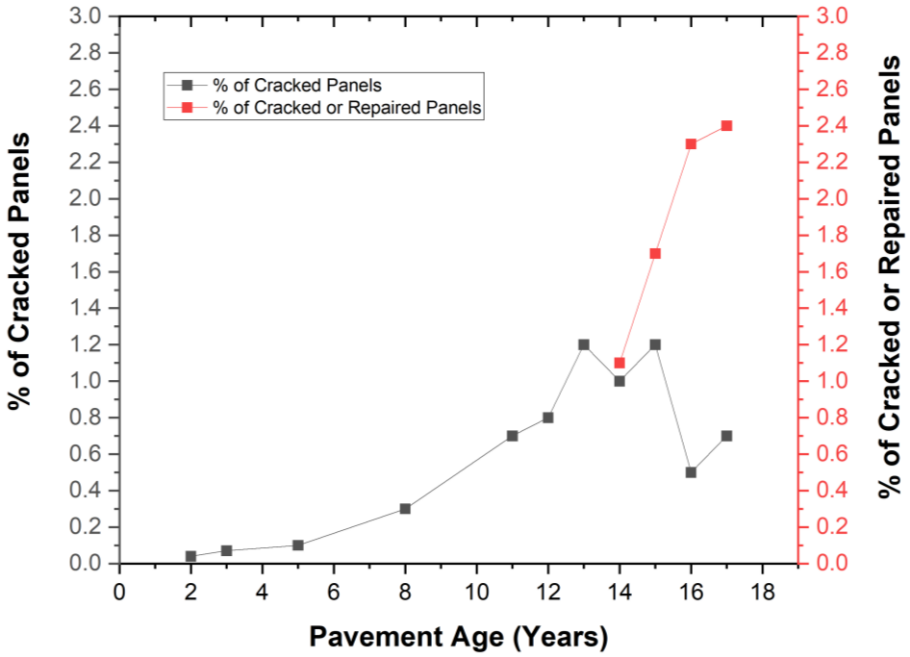


Figure 10. Percentage of Cracked and Repaired Panels for M-13

** Note: "Condition ratings of good/fair/poor have been assigned to each project based on a subjective evaluation of the condition at the time of the latest field visit. Ratings are intended to provide a general sense of the performance (in terms of anticipated distress and ride quality per the design type) of each project and may not reflect future decisions about performance after all relevant information is obtained to make a final determination."*

According to the April 2022 field survey of M-99, after 16 years of service, approximately 7.9 percent of all concrete panels are either cracked or repaired. While this percentage is higher than that of M-13, construction-related issues are at least partly contributing to this, including construction warranty repairs and initial spalling due to late sawing of the joints. This spalling is consistent with observations of the early annual reviews, where cracking was observed within inches of the joint. There are some faults, but they are isolated and minimal. As shown in Figure 11, like M-13, the progression of distress is steady. Accordingly, the field survey described the pavement's overall performance as fair*. The April 2022 field survey notes are shown in the Appendix, Figures A32 and A33. Pictures of the current pavement condition on M-99 are shown in Appendix Figure A36.

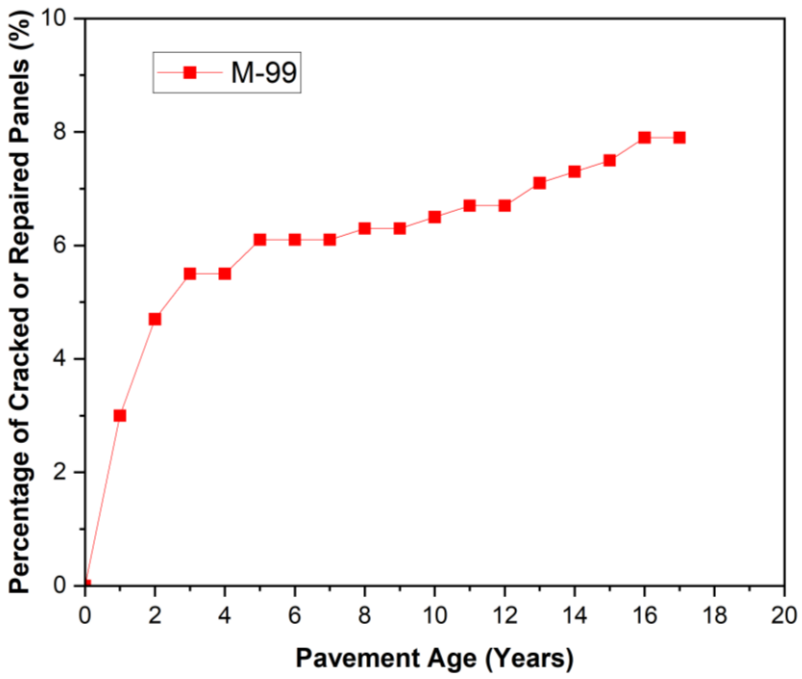


Figure 11. Percentage of cracked and repaired slabs for M-99

** Note: "Condition ratings of good/fair/poor have been assigned to each project based on a subjective evaluation of the condition at the time of the latest field visit. Ratings are intended to provide a general sense of the performance (in terms of anticipated distress and ride quality per the design type) of each project and may not reflect future decisions about performance after all relevant information is obtained to make a final determination."*

Pavement Performance Data Analysis

For MDOT roadways, pavement performance for each project is measured by a variety of methods, including faulting, MDOT's Distress Index (DI), International Roughness Index (IRI), and the Pavement Surface Evaluation and Rating (PASER). Faulting is the difference in elevation across joints (or cracks), measured in inches. The total number of faults is identified by the number of times an elevation difference is observed. The DI measurement is the total accumulated distress point value for a given pavement section normalized to a 0.1-mile length. It is a unitless value that indicates a pavement's 2-dimensional surface distress condition (so faulting and rutting are not included). The IRI measurement is the roughness of the road profile in inches/mile (so that physical distresses such as faulting and rutting can impact its measurement). PASER is a visual method of assessing road conditions on a scale of 1 (failed) to 10 (excellent). Measurements for this data are to be taken in the rightmost lane (outside lane) unless this lane was unavailable due to construction or other lane obstruction. Accordingly, on M-13, the data was collected on the outside lane in the northbound direction. On M-99, the data was obtained on the outside lane in the eastbound direction. Therefore, the performance measurements may not be directly comparable to the annual site condition surveys since performance measurements are taken in one direction and on one lane.

Note that historically through 2019, MDOT network-level data collection for DI, IRI, and rut-or-fault was intended to be obtained every other year for any given route segment (including both directions of divided routes). However, the following is a list of exceptions to that biennial schedule:

- Starting in 2009, the annual IRI collection began in at least one direction of all National Highway System (NHS) routes.
- Starting in 2018, the annual IRI collection on at least one direction of all NHS routes was reduced to only Interstate routes.
- Also, starting in 2018, the annual collection of DI and rut-or-fault began (in addition to IRI) on one direction of the Interstate routes.
- Schedules for data collection are subject to roadway availability, so construction or similar operations may prevent data collection for that anticipated year.

The IRI and DI performance of the demonstration projects on M-13 and M-99 are shown in Tables 4 and 5 and Figures 12 and 13. Both pavements had high initial IRI, partly due to initial construction conditions as observed in the condition surveys, but is also due to their intersections, turning movements, and/or parking conditions. These conditions will cause stopping or slow speeds, which can affect the magnitude of roughness measurements. Therefore, the evaluation of IRI should be based on its relative increase over time instead of comparing it to a single threshold value. Accordingly, the IRI increase over time was very slow for both pavements, where M-13 and M-99 had an average increase of 2.1 and 1.2 inches/mile/year, respectively. Therefore, both projects have provided sufficient ride quality. For DI, Figure 13 shows that for both projects, values remain low, far below 50 DI, which is the value used in the *MDOT Pavement Selection Manual* [3] to approximate the end of service life. This indicates that both projects remain in good to fair condition. Although there was a spike in DI values in years 7 and 11 on M-13, the corresponding drops in years 9 and 13 indicate that maintenance activities may have occurred on the project. Using the PASER rating as an evaluation tool, both projects have a good to fair rating level, with minimal decline over time, as shown in Figure 14. Faulting measurements are shown in Tables 6 and 7 and Figure 15. M-13 has a low average fault height, remaining below 0.1 inch, which is the FHWA condition threshold for good condition (per FHWA 23 CFR 490.313). M-99 has shown some values above 0.1 inches, with a very high average fault height of 0.25 inches at 4 years of age. Still, this value was within the warranty period, so it was likely corrected for, as this value decreased in year 6. The latest value at year 15 shows that the value is 0.13 inches, which is considered fair, as this is below a poor condition of 0.15 inches. Therefore, both sections are performing adequately in terms of faulting.

Table 4. Yearly Progression of IRI and DI for M-13

Data Year (Pavement Age)	Route - M-13	
	IRI (in/mi)	DI
2006 (1)	118	0.028
2007 (2)	116	2.05
2010 (5)	132	1.102
2012 (7)	132	12.613
2014 (9)	142	5.957
2015 (10)	143	-
2016 (11)	143	9.025
2017 (12)	146	-
2018 (13)	147	4.877
2022 (17)	144	-

Table 5.Yearly Progression of IRI and DI for M-99

Data Year (Pavement Age)	Route - M-99	
	IRI (in/mi)	DI
2007 (1)	214	2.596
2010 (4)	232	0.147
2012 (6)	221	2.117
2014 (8)	222	2.018
2015 (9)	219	-
2016 (10)	242	1.284
2017 (11)	240	-
2018 (12)	246	4.515
2022 (16)	224	-

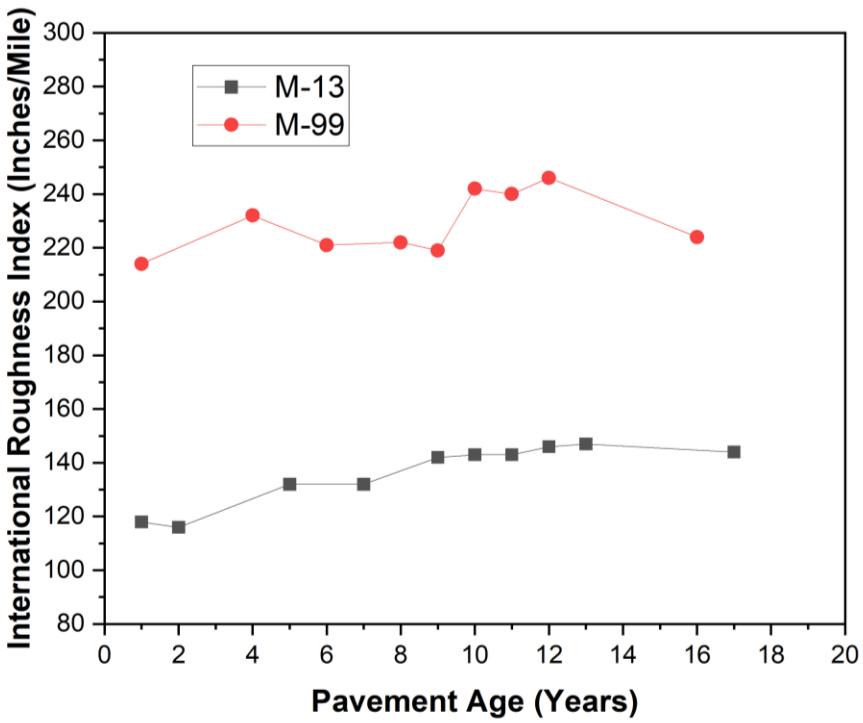


Figure 12. Yearly IRI Performance for M-13 and M-99

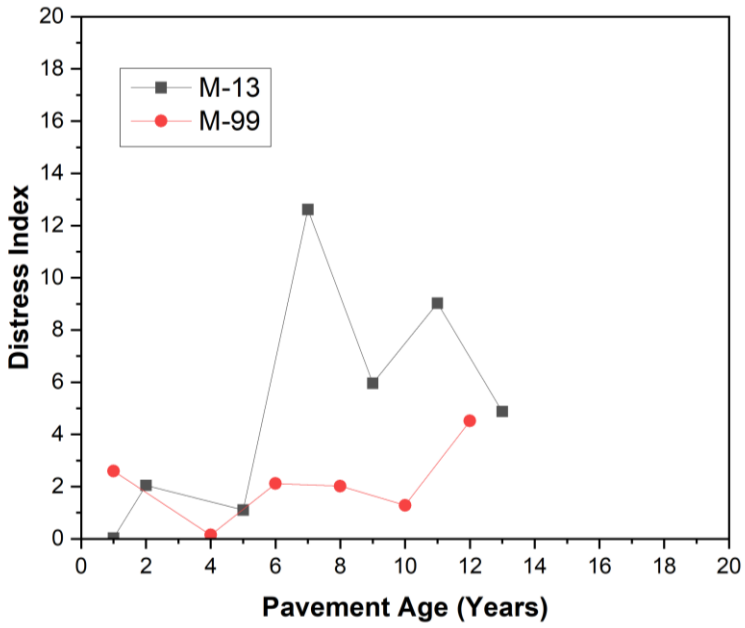


Figure 13. Yearly Distress Index Performance for M-13 and M-99

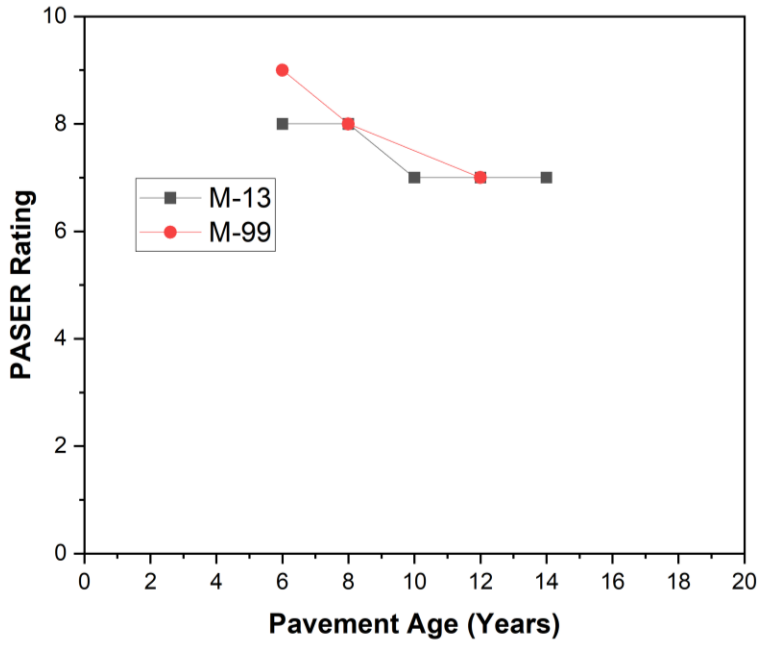


Figure 14. Yearly PASER Performance for M-13 and M-99

Table 6. Yearly Progression of Right Wheel Path Faulting for M-13

Data Year (Pavement Age)	Route - M-13	
	Total No. Faults/Mile	Avg Fault (in)
2006 (1)	3	-
2007 (2)	5	-
2010 (5)	2	-
2012 (7)	292	0.06
2014 (9)	251	0.05
2016 (11)	437	0.09
2018 (13)	266	0.08
2022 (17)	-	0.05

Table 7. Yearly Progression of Right Wheel Path Faulting for M-99

Data Year (Pavement Age)	Route - M-99	
	Total No. Faults/Mile	Avg Fault (in)
2007 (1)	0	0
2010 (4)	1	0.25
2012 (6)	58	0.08
2021 (15)	-	0.13

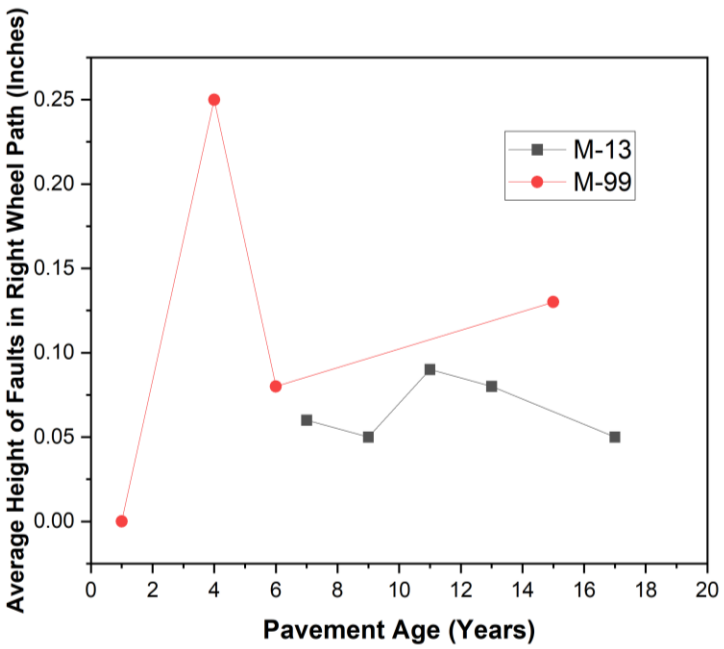


Figure 15. Yearly Average Height of Faults in the Right Wheel Path for M-13 and M-99

Cost Comparison

All costs included in this report have been adjusted to 2019 dollars to enable direct comparison with the standard cost provided in the MDOT Pavement Selection Manual [3]. The cost adjustment followed the procedure described in Chapter 6, Section F of that manual. The initial cost for construction was approximated by using unit prices (per 10/11/2022) and the estimation method for the pavement surface cost (including joints) as described in Chapter 2, Section A of the MDOT Pavement Selection Manual. Note that this method does not consider any base and subbase materials, rubblization, embankment, pre-repair/prep work, or HMA separator layers. Accordingly, see Appendix Figures A37 and A38 for an example of the MDOT LCCA cost estimation spreadsheet used to estimate the initial construction pavement cost.

To facilitate the following comparisons, the low-volume concrete reconstruction demonstration projects will be evaluated against the standard concrete reconstruction performance curves and cost data provided in the MDOT Pavement Selection Manual [3]. The full dataset of standard concrete reconstruction projects was used instead of some subset of its projects, such as non-freeway or low-volume pavements because the subset results were found to be consistent with the overall results. This is likely because all standard concrete reconstruction projects are designed according to their traffic and location characteristics, so their resulting performance should correlate.

The initial construction cost of low-volume concrete pavement reconstruction is estimated at approximately $209,00 per lane-mile in 2019 dollars. This cost assumes 6 inches of pavement having 6-foot transverse and longitudinal joint spacings without dowel bars. Accordingly, the MDOT "Joint, Contraction, C3p" unit price for transverse contraction joints without load transfer was used to approximate the joint construction cost. The "Conc Pavt, Nonreinf, 8-inch, High

Performance" unit price was prorated to the per-inch cost to estimate the cost at 6-inch thickness. In contrast, the estimated pavement cost for a standard reconstruction concrete pavement at 8 inches is $287,00 per lane-mile. Therefore, approximately $78,000 per lane-mile, or about 27% of the initial cost, is saved using a thin concrete reconstruction versus the standard concrete reconstruction. While there is more cost associated with the joint construction for thin concrete, this cost is offset by the costs of dowels and material of the thicker standard concrete reconstruction.

In addition to the pavement's initial cost, its maintenance is a major contributing factor to the overall cost of a pavement. Other than the initial warranty work for M-99, no contracted maintenance activities occurred for either demonstration project. This warranty work should not be included in this assessment because it was needed to facilitate adequate initial construction. Still, intermittent minor repairs have been observed during field surveys. This type of non-contracted minor repair work is commonly conducted on various routes throughout the state, but it isn't easy to compare or assess the relative amount of this work per route because this type of minor repair work is not fully tracked for every roadway segment. Still, to assess the maximum potential cost of maintenance work, considering the total number of repairs observed for each project, it can be approximated that the minor repair work is roughly equal to a single contracted maintenance cycle. In comparison, per the MDOT Pavement Selection Manual, the standard concrete reconstruction indicates that, on average, preventive maintenance cycles occur after 13, 17, and 23 years of service, with a reconstruction or major rehabilitation (R&R) estimated to occur after 36 years. Accordingly, the cost per lane mile of these maintenance fixes is estimated at $44,164, $46,592, and $64,015, respectively, so the total estimated maintenance cost for standard concrete reconstruction is $154,771 per lane mile in 2019 dollars.

Therefore, low-volume concrete reconstruction has a lower initial cost than standard concrete reconstruction. Furthermore, to date, the maintenance costs of the demonstration projects have been much lower. Even if maintenance increases over time to match that of standard reconstruction, due to the initial cost savings, thin concrete reconstruction provides a cost-effective option.

Performance Comparison

The DI values of the demonstration projects and the average DI performance curve for standard concrete are shown in Figure 16. Since the DI values of the demonstration projects are not a broad average of statewide project values, these will have more variability and include the impacts due to maintenance events. The variations in growth trends during the early stage of pavement service life (0-10 years) can be attributed to warranty issues on M-99 and the high severity of pavement distress due to heavy bridge equipment on M-13. After year 10, both M-13 and M-99 appear to follow a similar growth trend compared with the standard concrete reconstruction performance curve. Moreover, so far, both pavements are on track to meet or exceed the estimated service life of a standard concrete reconstruction of 36 years (when a subsequent R&R would occur).

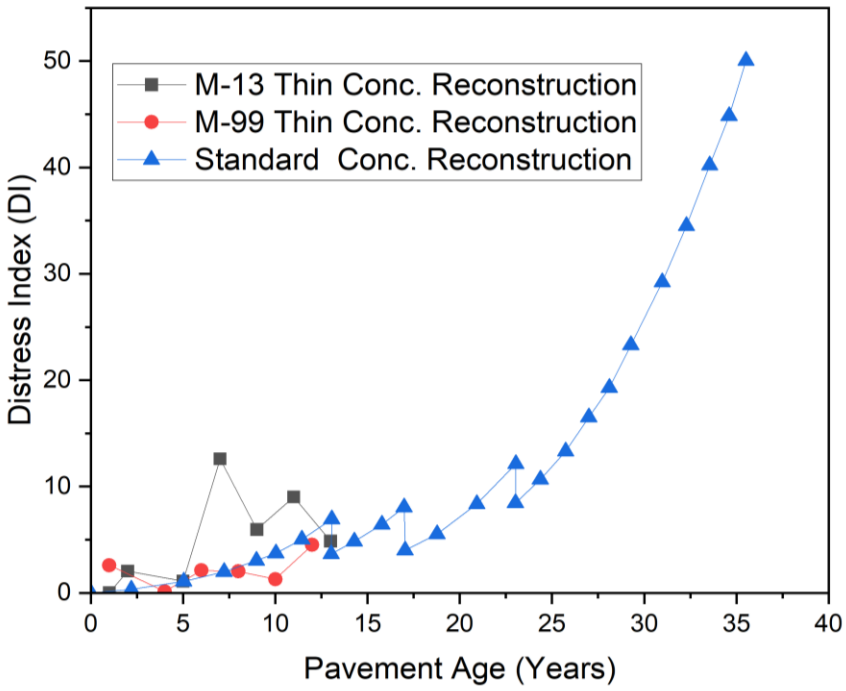


Figure 16. Deterioration Curve of Pavement Preservation Strategy

Conclusions and Recommendations

The performance of both reconstruction projects on M-13 and M-99 is considered acceptable. Both projects were designed for a 20-year design life. After 17 years in service, M-13 has performed well with minimal maintenance. M-99 has comparable performance to M-13 after 16 years. As documented in the warranty inspection, the early development of distress on M-99 can be attributed to construction variability. These demonstration projects have shown that a 6-inch-thick concrete reconstruction can achieve a service life proportional to a standard 8-inch-thick concrete reconstruction, with lower initial construction costs and similar maintenance costs. Most of the observed distress for the demonstration projects can be attributed to joint sawing. Therefore, since thinner concrete pavements are cured more rapidly, saw-cutting must be done immediately after construction.

Per the findings of this report, low-volume, thin concrete reconstruction can provide an acceptable, cost-effective construction approach compared with traditional 8-inch thick JPCP reconstruction, suitable for MDOT use where appropriate. It is recommended that the monitoring of this demonstration project by MDOT be ended, and the project evaluations considered complete. It should be noted that the basis of this conclusion was drawn from low-volume, non-freeway roads. Therefore, this reconstruction fix type may not apply to high-volume and/or freeway roadways. The small panel size requires twice as many joints as standard reconstruction, which may increase noise and potential for joint faulting. Furthermore, since the thin concrete reconstructions do not have dowels, the risk for load transfer distresses, such as faulting or spalling, increases for routes with high traffic volume and larger truck classes.

References

1. Jackson TSC. Warranty Inspection Materials and Workmanship Warranty for New / Reconstructed Jointed Plain Concrete Pavement Interim Inspection SWAD ID : 2870. 2009.
2. Jackson TSC. Warranty Inspection Materials and Workmanship Warranty for New / Reconstructed Jointed Plain Concrete Pavement Interim Inspection SWAD ID : 2870. 2011.
3. Michigan Department of Transportation Pavement Selection Manual. Pavement selection. 2021.
4. Schenkel J. Pavement Demonstration Program Status Report Public Act 457 of 2016 [Internet]. 2022. Available from: https://www.michigan.gov/mdot/about/governmental-affairs

Appendix A: Pavement Design Records, Estimates, and Miscellaneous Notes

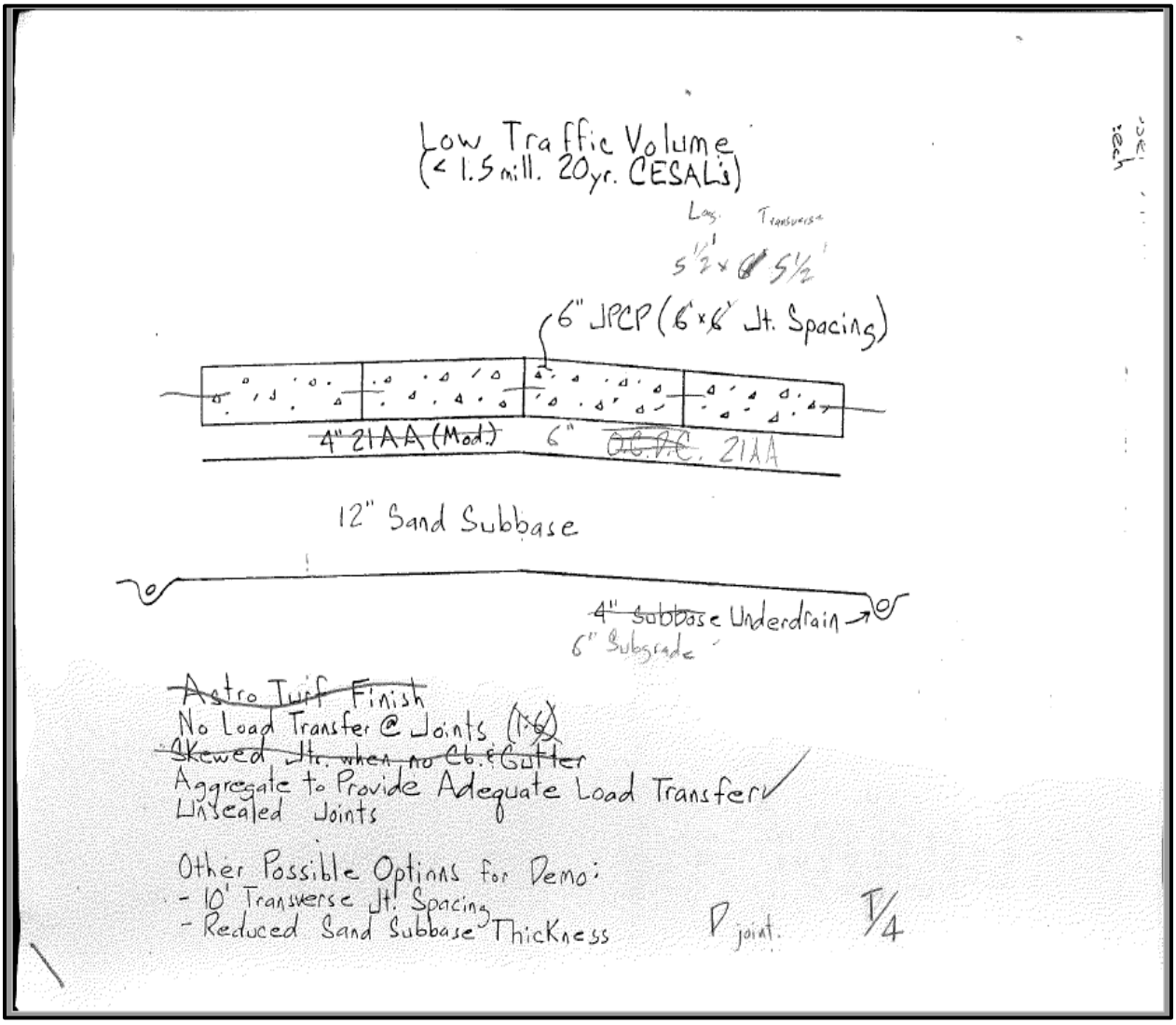


Figure A 1. M-13 Proposed Cross-section Design Notes

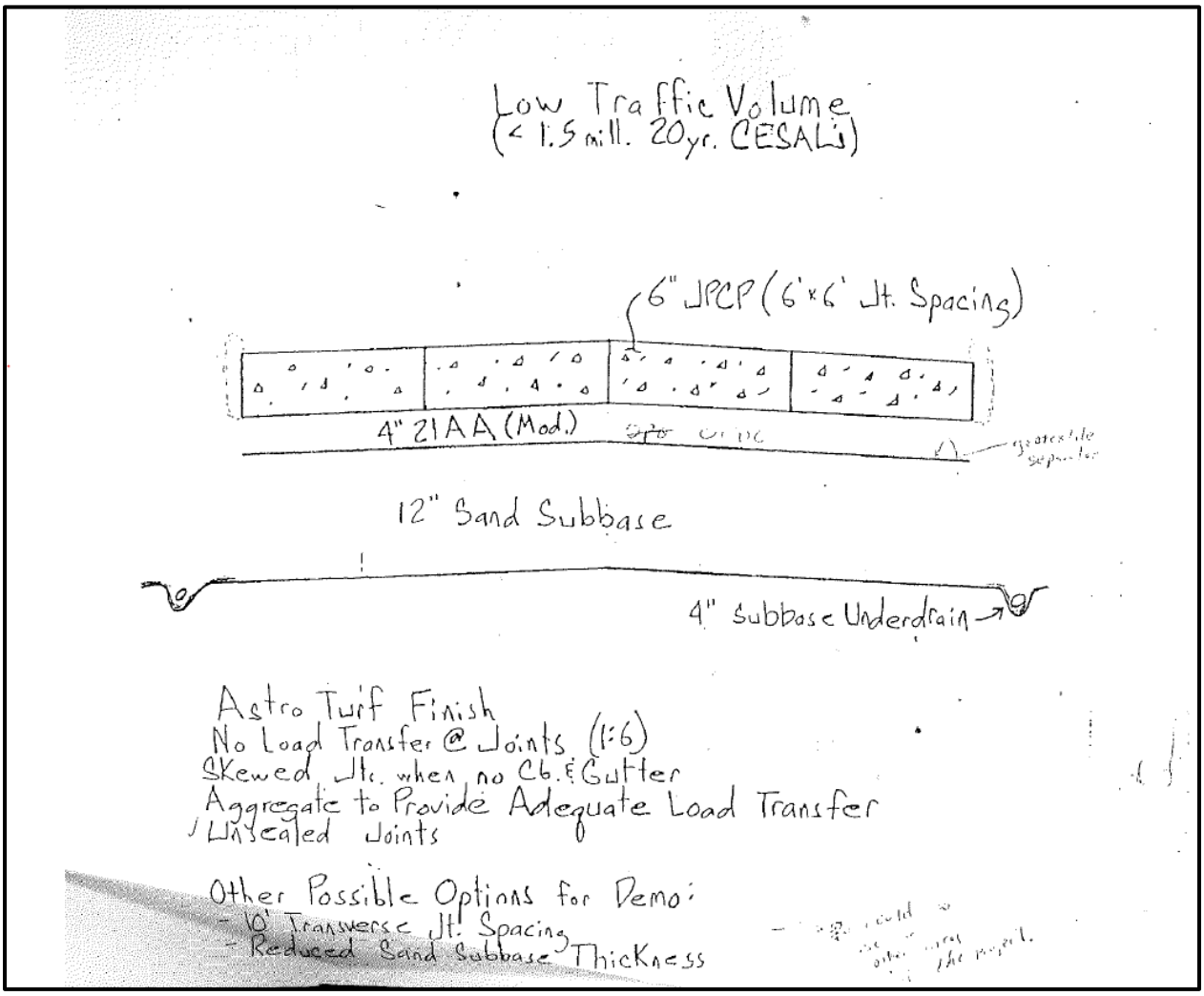


Figure A 2. M-99 Proposed Cross-section and Design Notes

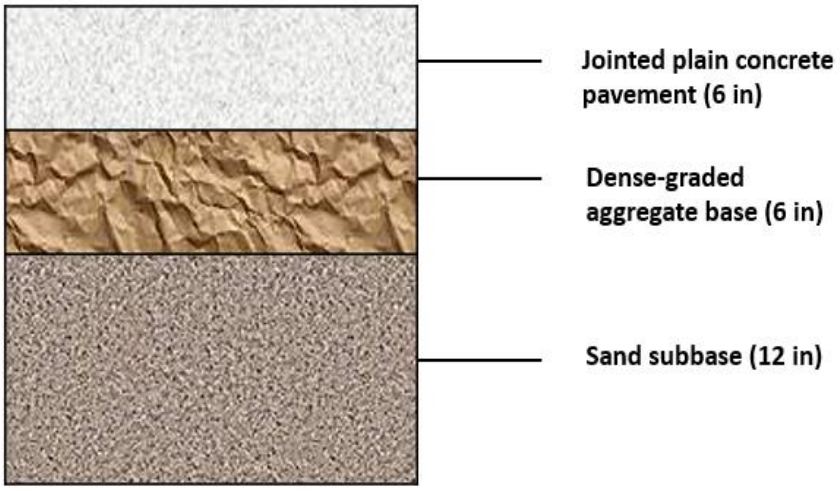


Figure A 3. Cross Section of Low-Volume Concrete on M-13 and M-99

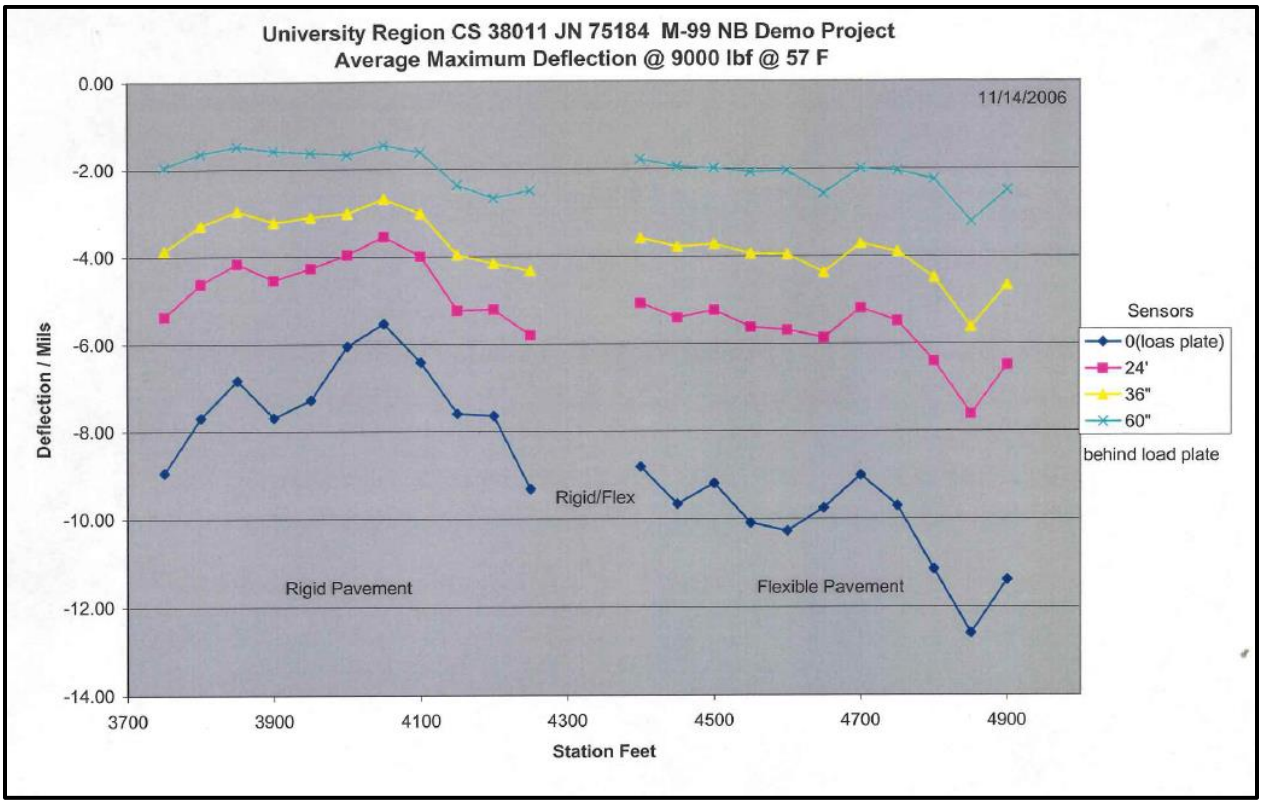


Figure A 4. FWD Test Results on M-99 Northbound

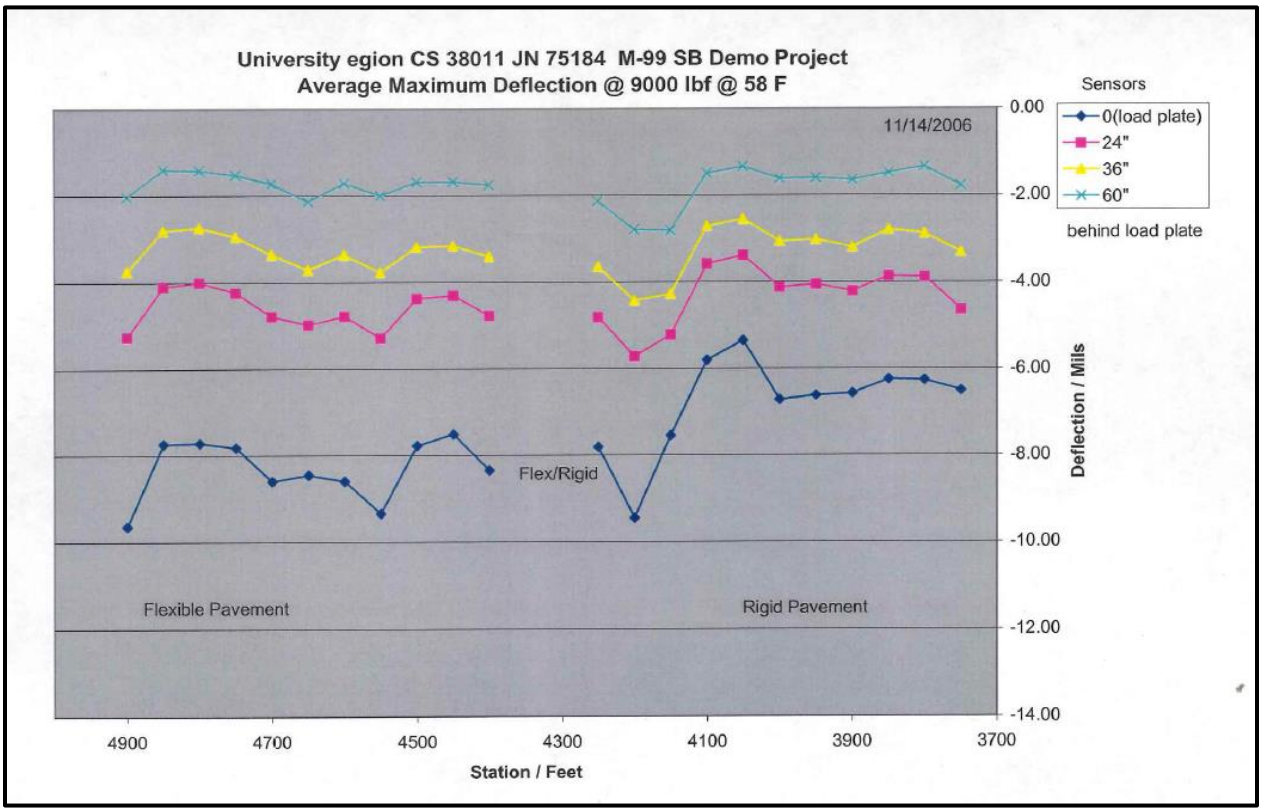
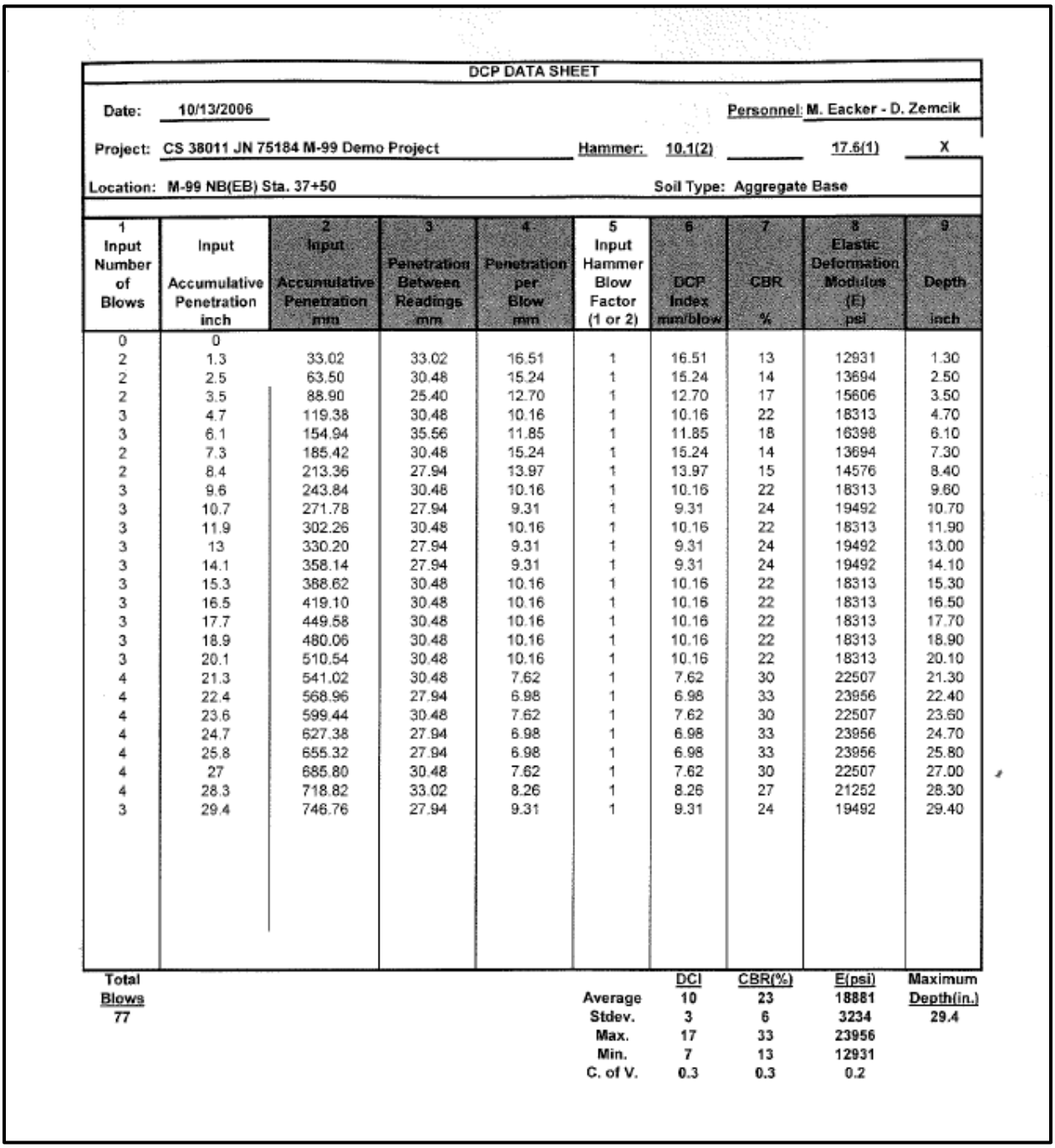


Figure A 5. FWD Test Results on M-99 Southbound



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 NB(EB) Sta. 37+50 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.3	33.02	33.02	16.51	1	16.51	13	12931	1.30
2	2.5	63.50	30.48	15.24	1	15.24	14	13694	2.50
2	3.5	88.90	25.40	12.70	1	12.70	17	15606	3.50
3	4.7	119.38	30.48	10.16	1	10.16	22	18313	4.70
3	6.1	154.94	35.56	11.85	1	11.85	18	16398	6.10
2	7.3	185.42	30.48	15.24	1	15.24	14	13694	7.30
2	8.4	213.36	27.94	13.97	1	13.97	15	14576	8.40
3	9.6	243.84	30.48	10.16	1	10.16	22	18313	9.60
3	10.7	271.78	27.94	9.31	1	9.31	24	19492	10.70
3	11.9	302.26	30.48	10.16	1	10.16	22	18313	11.90
3	13	330.20	27.94	9.31	1	9.31	24	19492	13.00
3	14.1	358.14	27.94	9.31	1	9.31	24	19492	14.10
3	15.3	388.62	30.48	10.16	1	10.16	22	18313	15.30
3	16.5	419.10	30.48	10.16	1	10.16	22	18313	16.50
3	17.7	449.58	30.48	10.16	1	10.16	22	18313	17.70
3	18.9	480.06	30.48	10.16	1	10.16	22	18313	18.90
3	20.1	510.54	30.48	10.16	1	10.16	22	18313	20.10
4	21.3	541.02	30.48	7.62	1	7.62	30	22507	21.30
4	22.4	568.96	27.94	6.98	1	6.98	33	23956	22.40
4	23.6	599.44	30.48	7.62	1	7.62	30	22507	23.60
4	24.7	627.38	27.94	6.98	1	6.98	33	23956	24.70
4	25.8	655.32	27.94	6.98	1	6.98	33	23956	25.80
4	27	685.80	30.48	7.62	1	7.62	30	22507	27.00
4	28.3	718.82	33.02	8.26	1	8.26	27	21252	28.30
3	29.4	746.76	27.94	9.31	1	9.31	24	19492	29.40

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
77	Average	10	23	18881	29.4
	Stdev.	3	6	3234	
	Max.	17	33	23956	
	Min.	7	13	12931	
	C. of V.	0.3	0.3	0.2	

Figure A 6. DCP Results for M-99 Northbound Station 37+50

DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

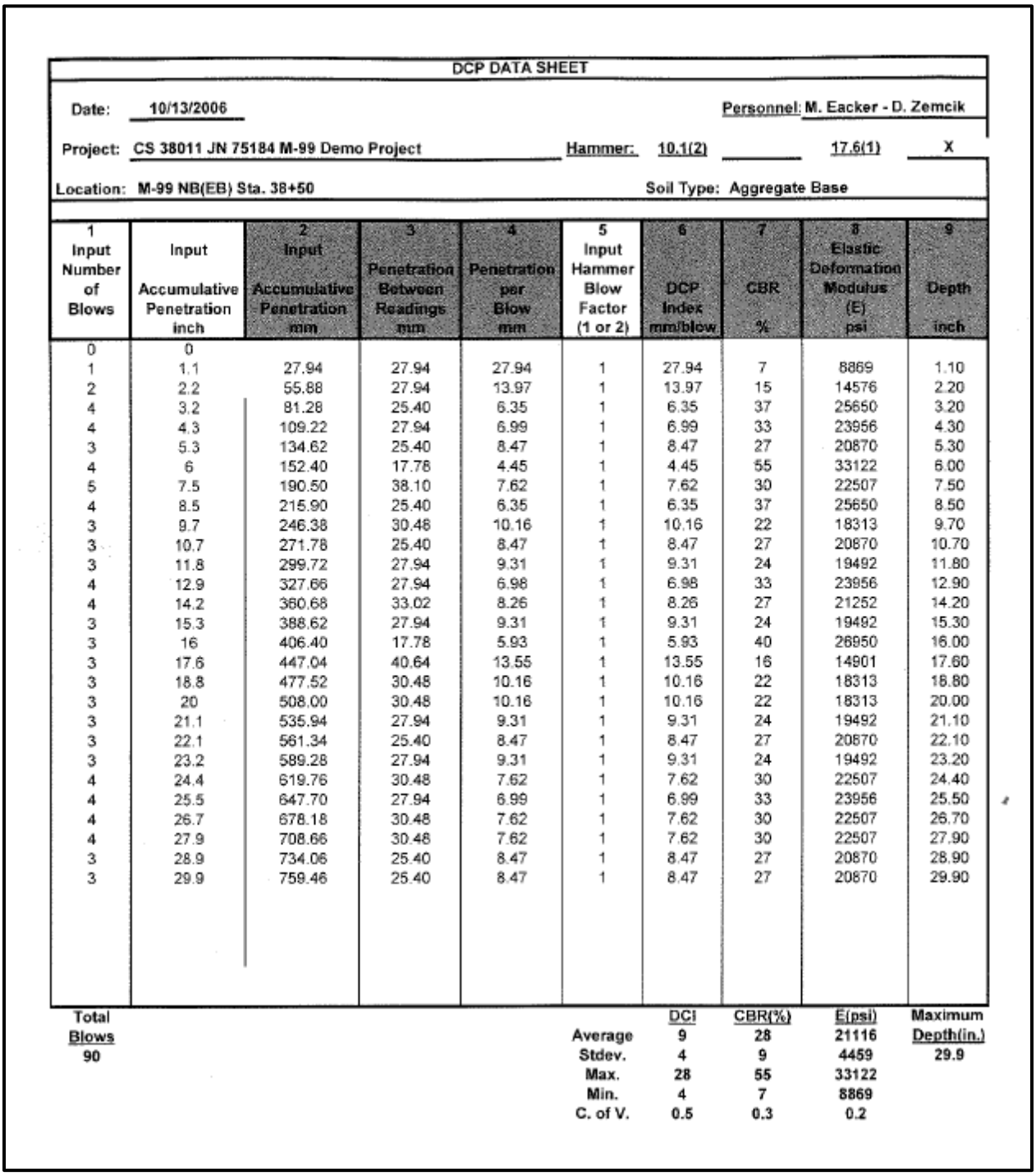
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) ____ 17.6(1) X

Location: M-99 NB(EB) Sta. 38+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.1	27.94	27.94	13.97	1	13.97	15	14576	1.10
3	2.2	55.88	27.94	9.31	1	9.31	24	19492	2.20
4	3.3	83.82	27.94	6.99	1	6.99	33	23956	3.30
4	4.5	114.30	30.48	7.62	1	7.62	30	22507	4.50
4	5.7	144.78	30.48	7.62	1	7.62	30	22507	5.70
3	6.7	170.18	25.40	8.47	1	8.47	27	20870	6.70
3	7.8	198.12	27.94	9.31	1	9.31	24	19492	7.80
3	8.9	226.06	27.94	9.31	1	9.31	24	19492	8.90
3	10	254.00	27.94	9.31	1	9.31	24	19492	10.00
3	11.2	284.48	30.48	10.16	1	10.16	22	18313	11.20
3	12.2	309.88	25.40	8.47	1	8.47	27	20870	12.20
3	13.3	337.82	27.94	9.31	1	9.31	24	19492	13.30
3	14.3	363.22	25.40	8.47	1	8.47	27	20870	14.30
3	15.4	391.16	27.94	9.31	1	9.31	24	19492	15.40
3	16.5	419.10	27.94	9.31	1	9.31	24	19492	16.50
3	17.7	449.58	30.48	10.16	1	10.16	22	18313	17.70
3	18.9	480.06	30.48	10.16	1	10.16	22	18313	18.90
3	20	508.00	27.94	9.31	1	9.31	24	19492	20.00
3	21	533.40	25.40	8.47	1	8.47	27	20870	21.00
5	22.1	561.34	27.94	5.59	1	5.59	43	28111	22.10
4	23.2	589.28	27.94	6.98	1	6.98	33	23956	23.20
4	24.3	617.22	27.94	6.99	1	6.99	33	23956	24.30
4	25.4	645.16	27.94	6.98	1	6.98	33	23956	25.40
4	26.6	675.64	30.48	7.62	1	7.62	30	22507	26.60
4	27.8	706.12	30.48	7.62	1	7.62	30	22507	27.80
4	29	736.60	30.48	7.62	1	7.62	30	22507	29.00

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
88	Average	9	27	20977	29.0
	Stdev.	2	5	2669	
	Max.	14	43	28111	
	Min.	6	15	14576	
	C. of V.	0.2	0.2	0.1	

Figure A 7. DCP Results for M-99 Northbound Station 38+00



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

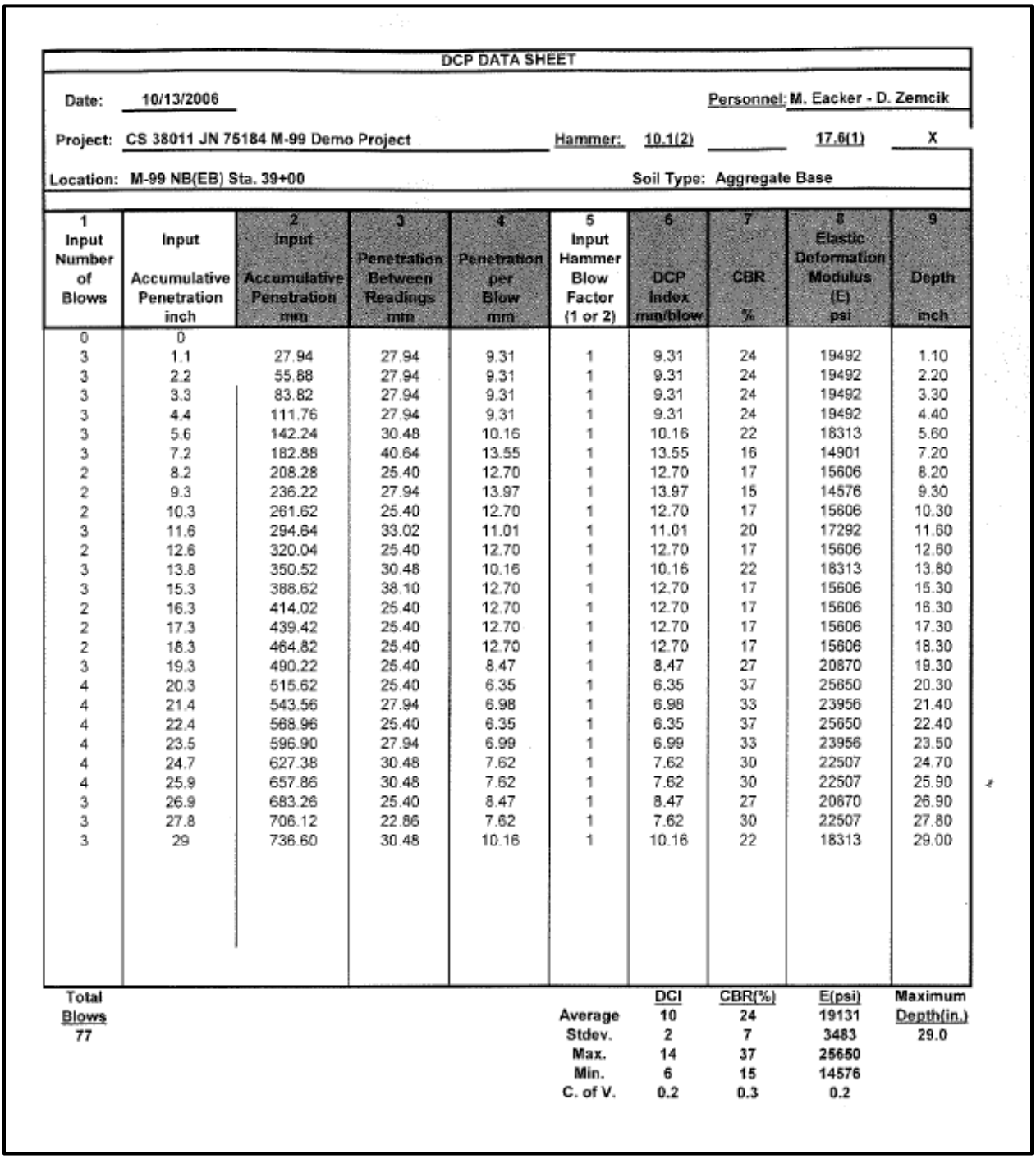
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 NB(EB) Sta. 38+50 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
1	1.1	27.94	27.94	27.94	1	27.94	7	8869	1.10
2	2.2	55.88	27.94	13.97	1	13.97	15	14576	2.20
4	3.2	81.28	25.40	6.35	1	6.35	37	25650	3.20
4	4.3	109.22	27.94	6.99	1	6.99	33	23956	4.30
3	5.3	134.62	25.40	8.47	1	8.47	27	20870	5.30
4	6	152.40	17.78	4.45	1	4.45	55	33122	6.00
5	7.5	190.50	38.10	7.62	1	7.62	30	22507	7.50
4	8.5	215.90	25.40	6.35	1	6.35	37	25650	8.50
3	9.7	246.38	30.48	10.16	1	10.16	22	18313	9.70
3	10.7	271.78	25.40	8.47	1	8.47	27	20870	10.70
3	11.8	299.72	27.94	9.31	1	9.31	24	19492	11.80
4	12.9	327.66	27.94	6.98	1	6.98	33	23956	12.90
4	14.2	360.68	33.02	8.26	1	8.26	27	21252	14.20
3	15.3	388.62	27.94	9.31	1	9.31	24	19492	15.30
3	16	406.40	17.78	5.93	1	5.93	40	26950	16.00
3	17.6	447.04	40.64	13.55	1	13.55	16	14901	17.60
3	18.8	477.52	30.48	10.16	1	10.16	22	18313	18.80
3	20	508.00	30.48	10.16	1	10.16	22	18313	20.00
3	21.1	535.94	27.94	9.31	1	9.31	24	19492	21.10
3	22.1	561.34	25.40	8.47	1	8.47	27	20870	22.10
3	23.2	589.28	27.94	9.31	1	9.31	24	19492	23.20
4	24.4	619.76	30.48	7.62	1	7.62	30	22507	24.40
4	25.5	647.70	27.94	6.99	1	6.99	33	23956	25.50
4	26.7	678.18	30.48	7.62	1	7.62	30	22507	26.70
4	27.9	708.66	30.48	7.62	1	7.62	30	22507	27.90
3	28.9	734.06	25.40	8.47	1	8.47	27	20870	28.90
3	29.9	759.46	25.40	8.47	1	8.47	27	20870	29.90

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
90	Average	9	28	21116	29.9
	Stdev.	4	9	4459	
	Max.	28	55	33122	
	Min.	4	7	8869	
	C. of V.	0.5	0.3	0.2	

Figure A 8. DCP Results for M-99 Northbound Station 38+50



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

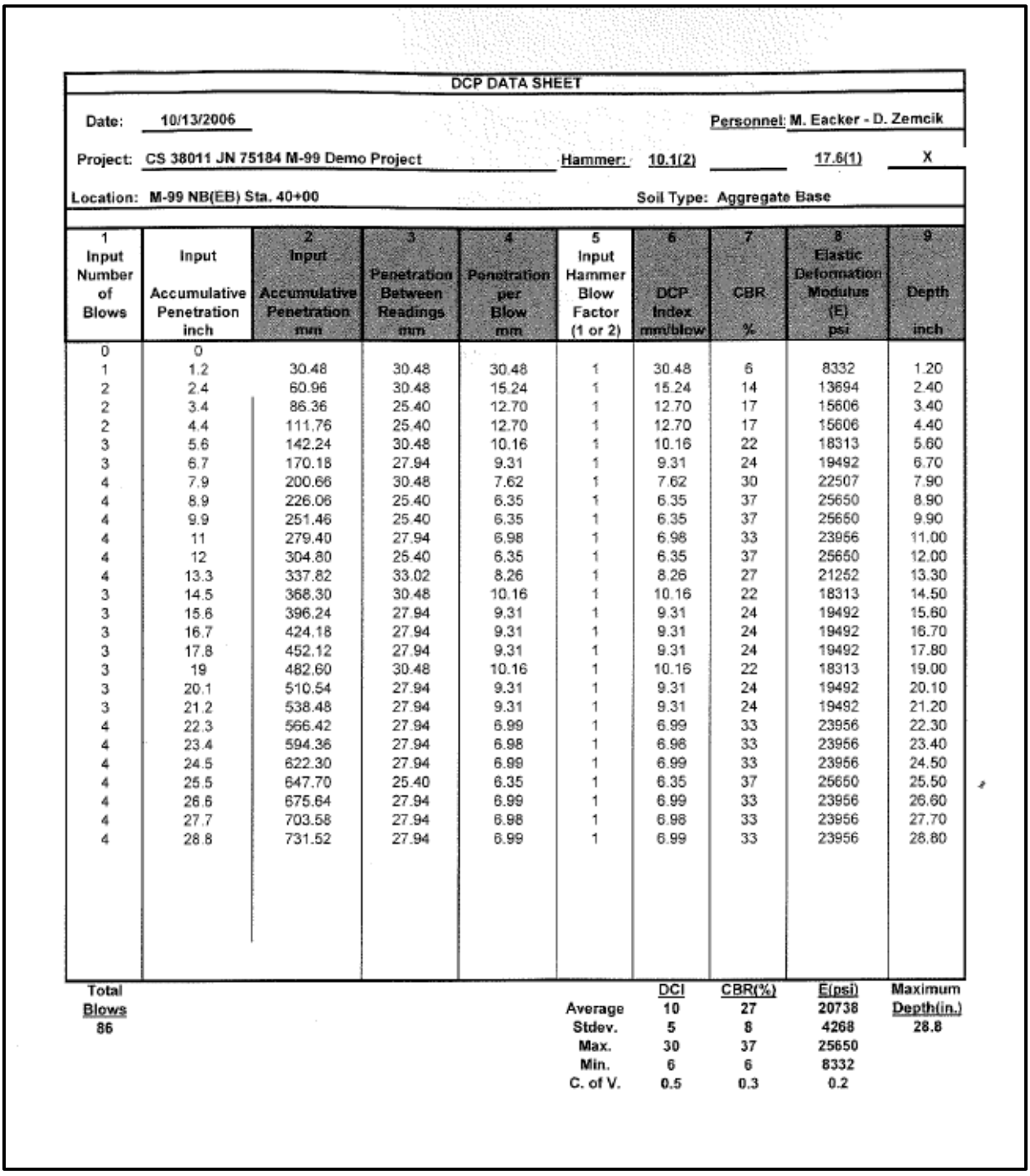
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) ____ 17.6(1) X

Location: M-99 NB(EB) Sta. 39+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
3	1.1	27.94	27.94	9.31	1	9.31	24	19492	1.10
3	2.2	55.88	27.94	9.31	1	9.31	24	19492	2.20
3	3.3	83.82	27.94	9.31	1	9.31	24	19492	3.30
3	4.4	111.76	27.94	9.31	1	9.31	24	19492	4.40
3	5.6	142.24	30.48	10.16	1	10.16	22	18313	5.60
3	7.2	182.88	40.64	13.55	1	13.55	16	14901	7.20
2	8.2	208.28	25.40	12.70	1	12.70	17	15606	8.20
2	9.3	236.22	27.94	13.97	1	13.97	15	14576	9.30
2	10.3	261.62	25.40	12.70	1	12.70	17	15606	10.30
3	11.6	294.64	33.02	11.01	1	11.01	20	17292	11.60
2	12.6	320.04	25.40	12.70	1	12.70	17	15606	12.60
3	13.8	350.52	30.48	10.16	1	10.16	22	18313	13.80
3	15.3	388.62	38.10	12.70	1	12.70	17	15606	15.30
2	16.3	414.02	25.40	12.70	1	12.70	17	15606	16.30
2	17.3	439.42	25.40	12.70	1	12.70	17	15606	17.30
2	18.3	464.82	25.40	12.70	1	12.70	17	15606	18.30
3	19.3	490.22	25.40	8.47	1	8.47	27	20870	19.30
4	20.3	515.62	25.40	6.35	1	6.35	37	25650	20.30
4	21.4	543.56	27.94	6.98	1	6.98	33	23956	21.40
4	22.4	568.96	25.40	6.35	1	6.35	37	25650	22.40
4	23.5	596.90	27.94	6.99	1	6.99	33	23956	23.50
4	24.7	627.38	30.48	7.62	1	7.62	30	22507	24.70
4	25.9	657.86	30.48	7.62	1	7.62	30	22507	25.90
3	26.9	683.26	25.40	8.47	1	8.47	27	20870	26.90
3	27.8	706.12	22.86	7.62	1	7.62	30	22507	27.80
3	29	736.60	30.48	10.16	1	10.16	22	18313	29.00

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
77	Average	10	24	19131	29.0
	Stdev.	2	7	3483	
	Max.	14	37	25650	
	Min.	6	15	14576	
	C. of V.	0.2	0.3	0.2	

Figure A 9. DCP Results for M-99 Northbound Station 39+00



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

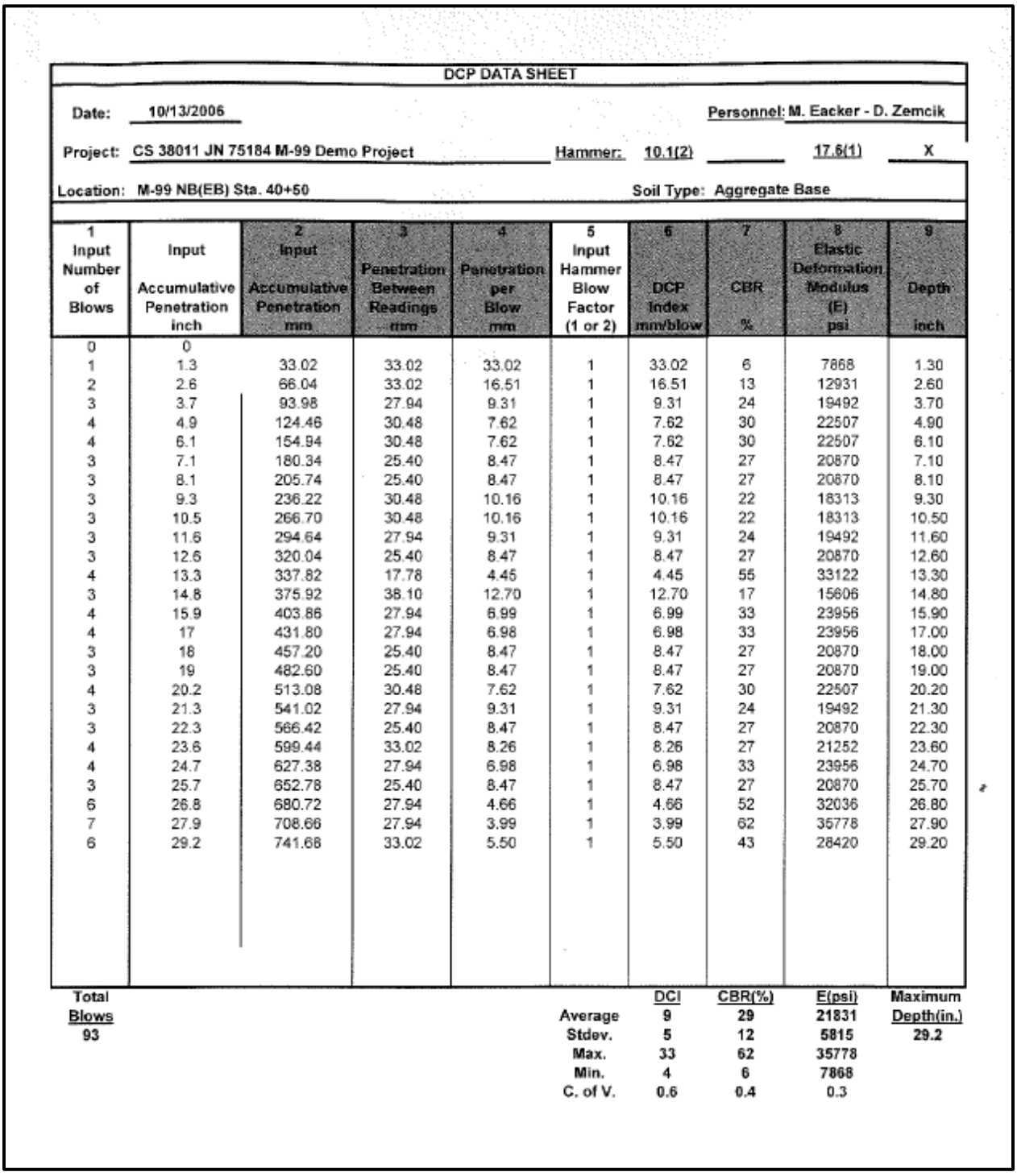
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 NB(EB) Sta. 40+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
1	1.2	30.48	30.48	30.48	1	30.48	6	8332	1.20
2	2.4	60.96	30.48	15.24	1	15.24	14	13694	2.40
2	3.4	86.36	25.40	12.70	1	12.70	17	15606	3.40
2	4.4	111.76	25.40	12.70	1	12.70	17	15606	4.40
3	5.6	142.24	30.48	10.16	1	10.16	22	18313	5.60
3	6.7	170.18	27.94	9.31	1	9.31	24	19492	6.70
4	7.9	200.66	30.48	7.62	1	7.62	30	22507	7.90
4	8.9	226.06	25.40	6.35	1	6.35	37	25650	8.90
4	9.9	251.46	25.40	6.35	1	6.35	37	25650	9.90
4	11	279.40	27.94	6.98	1	6.98	33	23956	11.00
4	12	304.80	25.40	6.35	1	6.35	37	25650	12.00
4	13.3	337.82	33.02	8.26	1	8.26	27	21252	13.30
3	14.5	368.30	30.48	10.16	1	10.16	22	18313	14.50
3	15.6	396.24	27.94	9.31	1	9.31	24	19492	15.60
3	16.7	424.18	27.94	9.31	1	9.31	24	19492	16.70
3	17.8	452.12	27.94	9.31	1	9.31	24	19492	17.80
3	19	482.60	30.48	10.16	1	10.16	22	18313	19.00
3	20.1	510.54	27.94	9.31	1	9.31	24	19492	20.10
3	21.2	538.48	27.94	9.31	1	9.31	24	19492	21.20
4	22.3	566.42	27.94	6.99	1	6.99	33	23956	22.30
4	23.4	594.36	27.94	6.98	1	6.98	33	23956	23.40
4	24.5	622.30	27.94	6.99	1	6.99	33	23956	24.50
4	25.5	647.70	25.40	6.35	1	6.35	37	25650	25.50
4	26.6	675.64	27.94	6.99	1	6.99	33	23956	26.60
4	27.7	703.58	27.94	6.98	1	6.98	33	23956	27.70
4	28.8	731.52	27.94	6.99	1	6.99	33	23956	28.80

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
86	Average	10	27	20738	28.8
	Stdev.	5	8	4268	
	Max.	30	37	25650	
	Min.	6	6	8332	
	C. of V.	0.5	0.3	0.2	

Figure A 10. DCP Results for M-99 Northbound Station 40+00



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

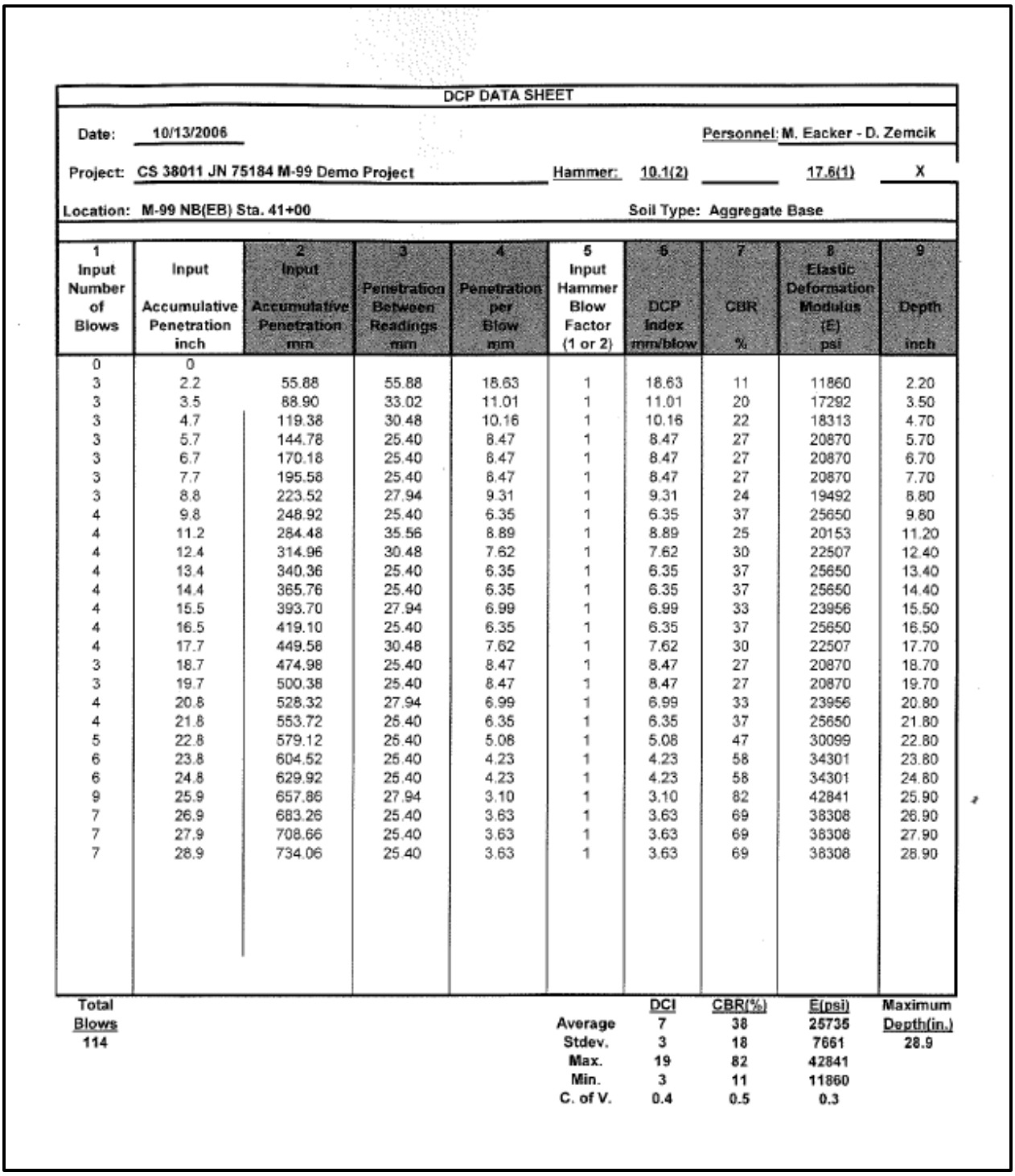
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 NB(EB) Sta. 40+50 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
1	1.3	33.02	33.02	33.02	1	33.02	6	7868	1.30
2	2.6	66.04	33.02	16.51	1	16.51	13	12931	2.60
3	3.7	93.98	27.94	9.31	1	9.31	24	19492	3.70
4	4.9	124.46	30.48	7.62	1	7.62	30	22507	4.90
4	6.1	154.94	30.48	7.62	1	7.62	30	22507	6.10
3	7.1	180.34	25.40	8.47	1	8.47	27	20870	7.10
3	8.1	205.74	25.40	8.47	1	8.47	27	20870	8.10
3	9.3	236.22	30.48	10.16	1	10.16	22	18313	9.30
3	10.5	266.70	30.48	10.16	1	10.16	22	18313	10.50
3	11.6	294.64	27.94	9.31	1	9.31	24	19492	11.60
3	12.6	320.04	25.40	8.47	1	8.47	27	20870	12.60
4	13.3	337.82	17.78	4.45	1	4.45	55	33122	13.30
3	14.8	375.92	38.10	12.70	1	12.70	17	15606	14.80
4	15.9	403.86	27.94	6.99	1	6.99	33	23956	15.90
4	17	431.80	27.94	6.98	1	6.98	33	23956	17.00
3	18	457.20	25.40	8.47	1	8.47	27	20870	18.00
3	19	482.60	25.40	8.47	1	8.47	27	20870	19.00
4	20.2	513.08	30.48	7.62	1	7.62	30	22507	20.20
3	21.3	541.02	27.94	9.31	1	9.31	24	19492	21.30
3	22.3	566.42	25.40	8.47	1	8.47	27	20870	22.30
4	23.6	599.44	33.02	8.26	1	8.26	27	21252	23.60
4	24.7	627.38	27.94	6.98	1	6.98	33	23956	24.70
3	25.7	652.78	25.40	8.47	1	8.47	27	20870	25.70
6	26.8	680.72	27.94	4.66	1	4.66	52	32036	26.80
7	27.9	708.66	27.94	3.99	1	3.99	62	35778	27.90
6	29.2	741.68	33.02	5.50	1	5.50	43	28420	29.20

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
93	Average	9	29	21831	29.2
	Stdev.	5	12	5815	
	Max.	33	62	35778	
	Min.	4	6	7868	
	C. of V.	0.6	0.4	0.3	

Figure A 11. DCP Results for M-99 Northbound Station 40+50



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

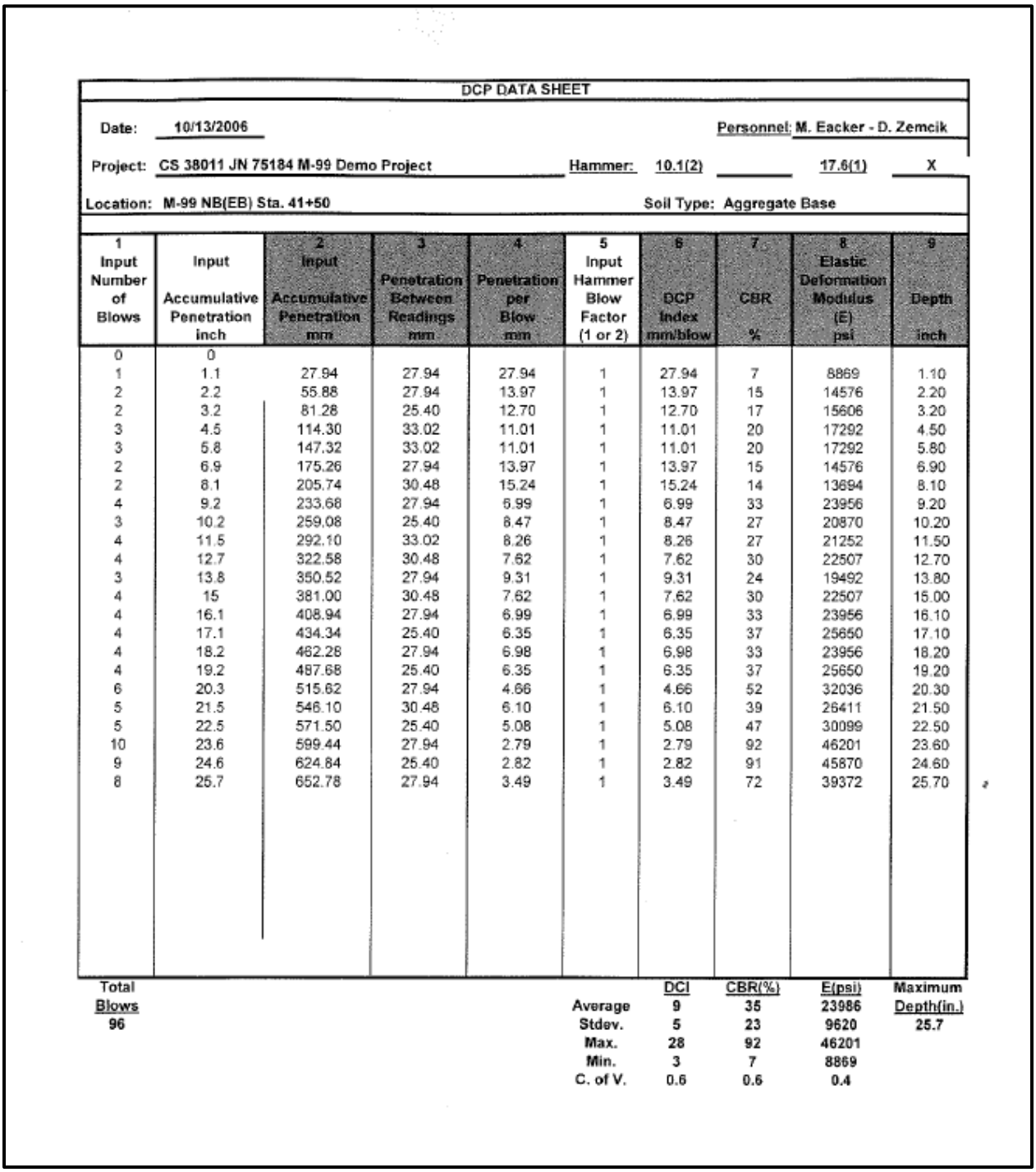
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) ____ 17.6(1) X

Location: M-99 NB(EB) Sta. 41+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
3	2.2	55.88	55.88	18.63	1	18.63	11	11860	2.20
3	3.5	88.90	33.02	11.01	1	11.01	20	17292	3.50
3	4.7	119.38	30.48	10.16	1	10.16	22	18313	4.70
3	5.7	144.78	25.40	8.47	1	8.47	27	20870	5.70
3	6.7	170.18	25.40	8.47	1	8.47	27	20870	6.70
3	7.7	195.58	25.40	8.47	1	8.47	27	20870	7.70
3	8.8	223.52	27.94	9.31	1	9.31	24	19492	8.80
4	9.8	248.92	25.40	6.35	1	6.35	37	25650	9.80
4	11.2	284.48	35.56	8.89	1	8.89	25	20153	11.20
4	12.4	314.96	30.48	7.62	1	7.62	30	22507	12.40
4	13.4	340.36	25.40	6.35	1	6.35	37	25650	13.40
4	14.4	365.76	25.40	6.35	1	6.35	37	25650	14.40
4	15.5	393.70	27.94	6.99	1	6.99	33	23956	15.50
4	16.5	419.10	25.40	6.35	1	6.35	37	25650	16.50
4	17.7	449.58	30.48	7.62	1	7.62	30	22507	17.70
3	18.7	474.98	25.40	8.47	1	8.47	27	20870	18.70
3	19.7	500.38	25.40	8.47	1	8.47	27	20870	19.70
4	20.8	528.32	27.94	6.99	1	6.99	33	23956	20.80
4	21.8	553.72	25.40	6.35	1	6.35	37	25650	21.80
5	22.8	579.12	25.40	5.08	1	5.08	47	30099	22.80
6	23.8	604.52	25.40	4.23	1	4.23	58	34301	23.80
6	24.8	629.92	25.40	4.23	1	4.23	58	34301	24.80
9	25.9	657.86	27.94	3.10	1	3.10	82	42841	25.90
7	26.9	683.26	25.40	3.63	1	3.63	69	38308	26.90
7	27.9	708.66	25.40	3.63	1	3.63	69	38308	27.90
7	28.9	734.06	25.40	3.63	1	3.63	69	38308	28.90

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
114	Average	7	38	25735	28.9
	Stdev.	3	18	7661	
	Max.	19	82	42841	
	Min.	3	11	11860	
	C. of V.	0.4	0.5	0.3	

Figure A 12. DCP Results for M-99 Northbound Station 41+00



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

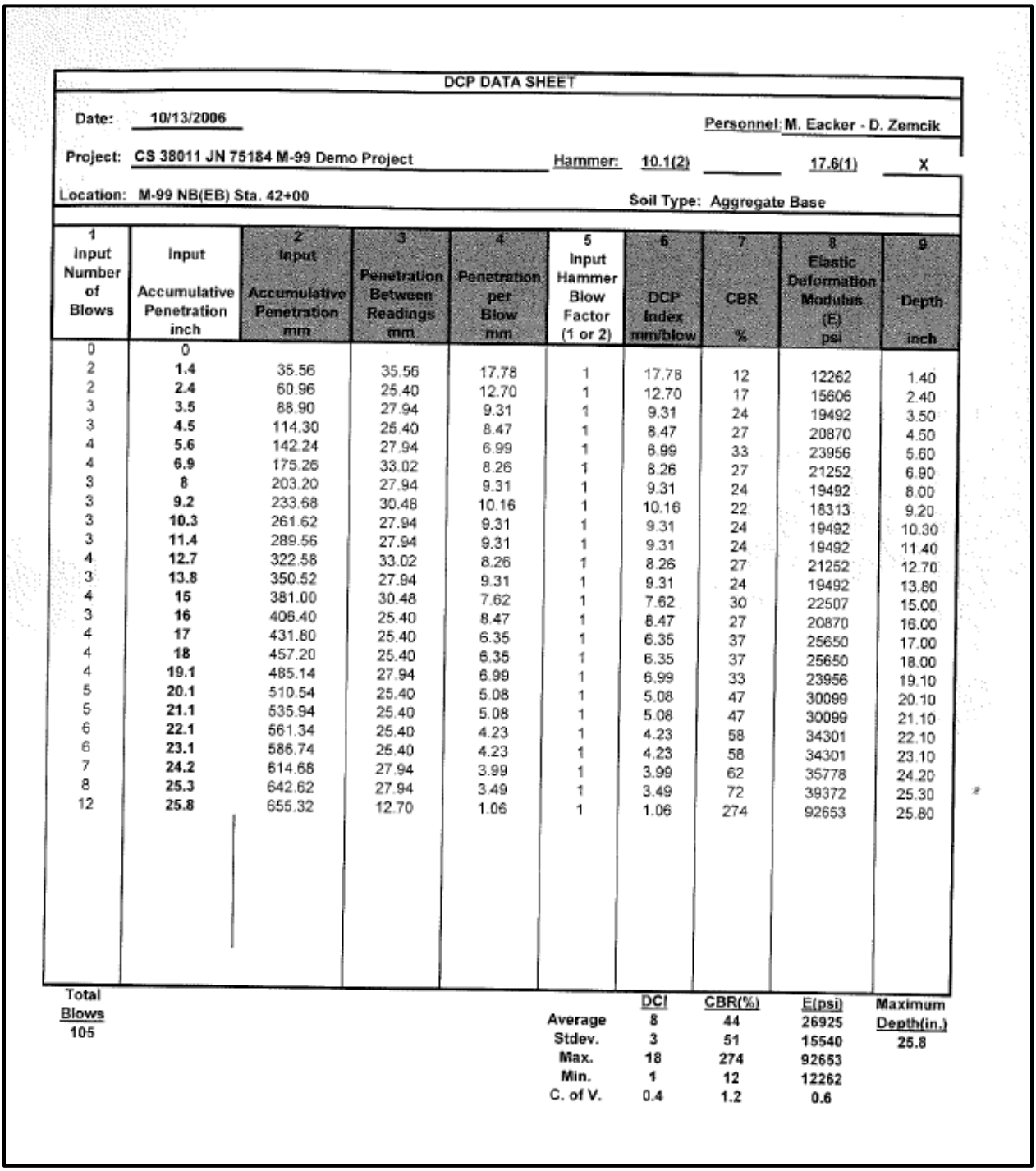
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 NB(EB) Sta. 41+50 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
1	1.1	27.94	27.94	27.94	1	27.94	7	8869	1.10
2	2.2	55.88	27.94	13.97	1	13.97	15	14576	2.20
2	3.2	81.28	25.40	12.70	1	12.70	17	15606	3.20
3	4.5	114.30	33.02	11.01	1	11.01	20	17292	4.50
3	5.8	147.32	33.02	11.01	1	11.01	20	17292	5.80
2	6.9	175.26	27.94	13.97	1	13.97	15	14576	6.90
2	8.1	205.74	30.48	15.24	1	15.24	14	13694	8.10
4	9.2	233.68	27.94	6.99	1	6.99	33	23956	9.20
3	10.2	259.08	25.40	8.47	1	8.47	27	20870	10.20
4	11.5	292.10	33.02	8.26	1	8.26	27	21252	11.50
4	12.7	322.58	30.48	7.62	1	7.62	30	22507	12.70
3	13.8	350.52	27.94	9.31	1	9.31	24	19492	13.80
4	15	381.00	30.48	7.62	1	7.62	30	22507	15.00
4	16.1	408.94	27.94	6.99	1	6.99	33	23956	16.10
4	17.1	434.34	25.40	6.35	1	6.35	37	25650	17.10
4	18.2	462.28	27.94	6.98	1	6.98	33	23956	18.20
4	19.2	487.68	25.40	6.35	1	6.35	37	25650	19.20
6	20.3	515.62	27.94	4.66	1	4.66	52	32036	20.30
5	21.5	546.10	30.48	6.10	1	6.10	39	26411	21.50
5	22.5	571.50	25.40	5.08	1	5.08	47	30099	22.50
10	23.6	599.44	27.94	2.79	1	2.79	92	46201	23.60
9	24.6	624.84	25.40	2.82	1	2.82	91	45870	24.60
8	25.7	652.78	27.94	3.49	1	3.49	72	39372	25.70

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
96	Average	9	35	23986	25.7
	Stdev.	5	23	9620	
	Max.	28	92	46201	
	Min.	3	7	8869	
	C. of V.	0.6	0.6	0.4	

Figure A 13. DCP Results for M-99 Northbound Station 41+50



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) ____ 17.6(1) X

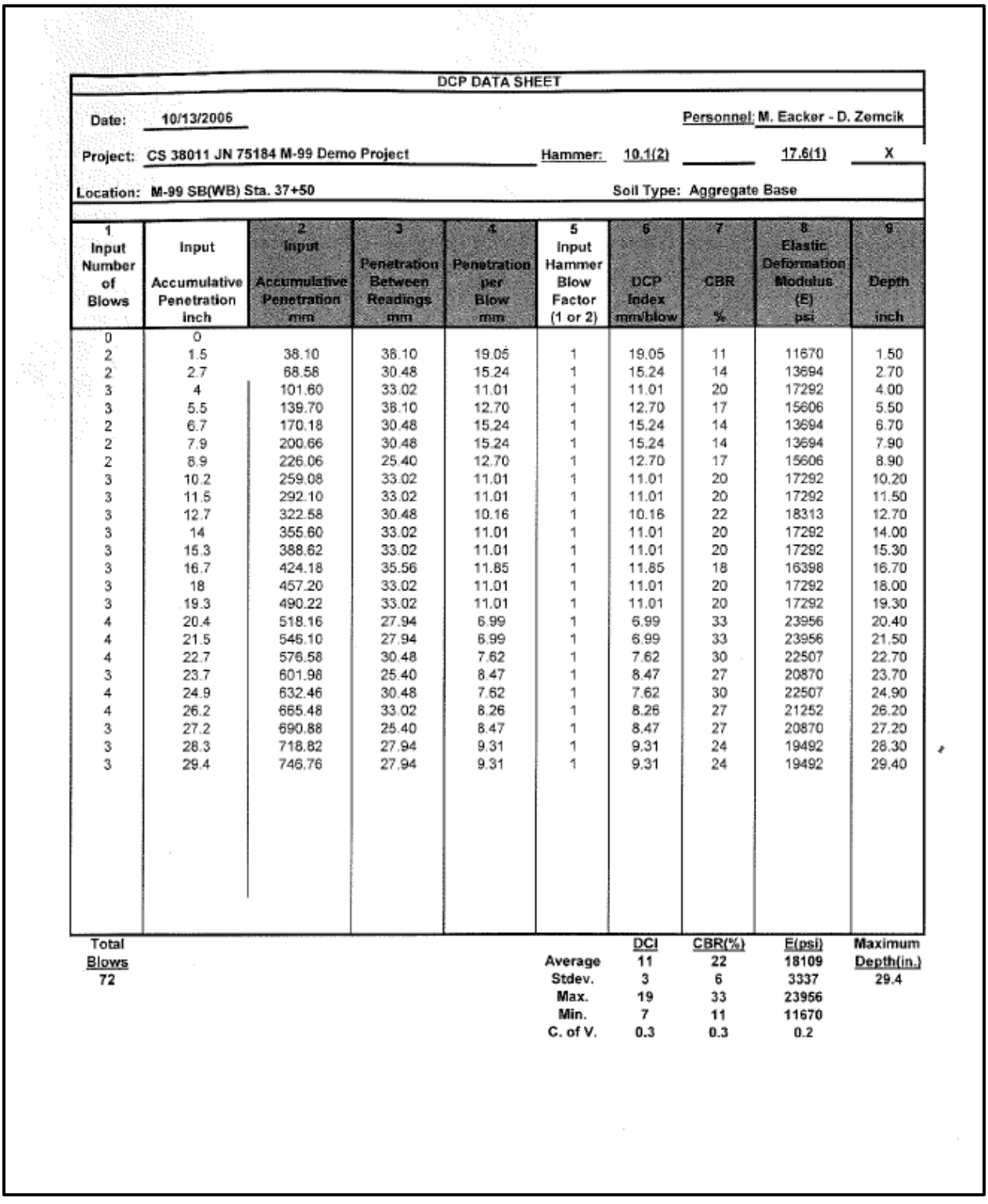
Location: M-99 NB(EB) Sta. 42+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	**1.4**	35.56	35.56	17.78	1	17.78	12	12262	1.40
2	**2.4**	60.96	25.40	12.70	1	12.70	17	15606	2.40
3	**3.5**	88.90	27.94	9.31	1	9.31	24	19492	3.50
3	**4.5**	114.30	25.40	8.47	1	8.47	27	20870	4.50
4	**5.6**	142.24	27.94	6.99	1	6.99	33	23956	5.60
4	**6.9**	175.26	33.02	8.26	1	8.26	27	21252	6.90
3	**8**	203.20	27.94	9.31	1	9.31	24	19492	8.00
3	**9.2**	233.68	30.48	10.16	1	10.16	22	18313	9.20
3	**10.3**	261.62	27.94	9.31	1	9.31	24	19492	10.30
3	**11.4**	289.56	27.94	9.31	1	9.31	24	19492	11.40
4	**12.7**	322.58	33.02	8.26	1	8.26	27	21252	12.70
3	**13.8**	350.52	27.94	9.31	1	9.31	24	19492	13.80
4	**15**	381.00	30.48	7.62	1	7.62	30	22507	15.00
3	**16**	406.40	25.40	8.47	1	8.47	27	20870	16.00
4	**17**	431.80	25.40	6.35	1	6.35	37	25650	17.00
4	**18**	457.20	25.40	6.35	1	6.35	37	25650	18.00
4	**19.1**	485.14	27.94	6.99	1	6.99	33	23956	19.10
5	**20.1**	510.54	25.40	5.08	1	5.08	47	30099	20.10
5	**21.1**	535.94	25.40	5.08	1	5.08	47	30099	21.10
6	**22.1**	561.34	25.40	4.23	1	4.23	58	34301	22.10
6	**23.1**	586.74	25.40	4.23	1	4.23	58	34301	23.10
7	**24.2**	614.68	27.94	3.99	1	3.99	62	35778	24.20
8	**25.3**	642.62	27.94	3.49	1	3.49	72	39372	25.30
12	**25.8**	655.32	12.70	1.06	1	1.06	274	92653	25.80

Total Blows 105

	DCI	CBR(%)	E(psi)	Maximum Depth(in.)
Average	8	44	26925	25.8
Stdev.	3	51	15540	
Max.	18	274	92653	
Min.	1	12	12262	
C. of V.	0.4	1.2	0.6	

Figure A 14. DCP Results for M-99 Northbound Station 42+00



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

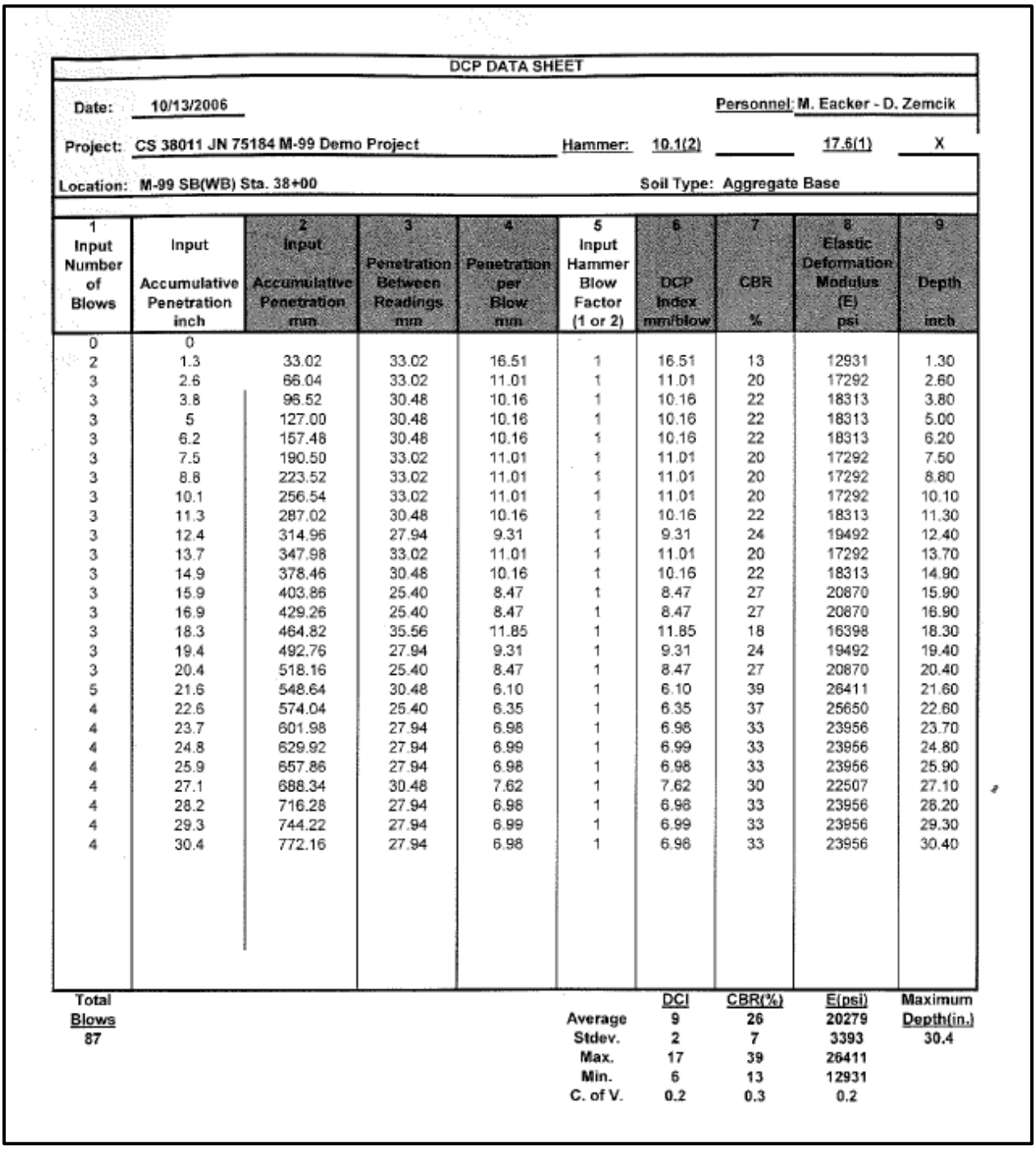
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 SB(WB) Sta. 37+50 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.5	38.10	38.10	19.05	1	19.05	11	11670	1.50
2	2.7	68.58	30.48	15.24	1	15.24	14	13694	2.70
3	4	101.60	33.02	11.01	1	11.01	20	17292	4.00
3	5.5	139.70	38.10	12.70	1	12.70	17	15606	5.50
2	6.7	170.18	30.48	15.24	1	15.24	14	13694	6.70
2	7.9	200.66	30.48	15.24	1	15.24	14	13694	7.90
2	8.9	226.06	25.40	12.70	1	12.70	17	15606	8.90
3	10.2	259.08	33.02	11.01	1	11.01	20	17292	10.20
3	11.5	292.10	33.02	11.01	1	11.01	20	17292	11.50
3	12.7	322.58	30.48	10.16	1	10.16	22	18313	12.70
3	14	355.60	33.02	11.01	1	11.01	20	17292	14.00
3	15.3	388.62	33.02	11.01	1	11.01	20	17292	15.30
3	16.7	424.18	35.56	11.85	1	11.85	18	16398	16.70
3	18	457.20	33.02	11.01	1	11.01	20	17292	18.00
3	19.3	490.22	33.02	11.01	1	11.01	20	17292	19.30
4	20.4	518.16	27.94	6.99	1	6.99	33	23956	20.40
4	21.5	545.10	27.94	6.99	1	6.99	33	23956	21.50
4	22.7	576.58	30.48	7.62	1	7.62	30	22507	22.70
3	23.7	601.98	25.40	8.47	1	8.47	27	20870	23.70
4	24.9	632.46	30.48	7.62	1	7.62	30	22507	24.90
4	26.2	665.48	33.02	8.26	1	8.26	27	21252	26.20
3	27.2	690.88	25.40	8.47	1	8.47	27	20870	27.20
3	28.3	718.82	27.94	9.31	1	9.31	24	19492	28.30
3	29.4	746.76	27.94	9.31	1	9.31	24	19492	29.40

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
72	Average	11	22	18109	29.4
	Stdev.	3	6	3337	
	Max.	19	33	23956	
	Min.	7	11	11670	
	C. of V.	0.3	0.3	0.2	

Figure A 15. DCP Results for M-99 Southbound Station 37+50



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

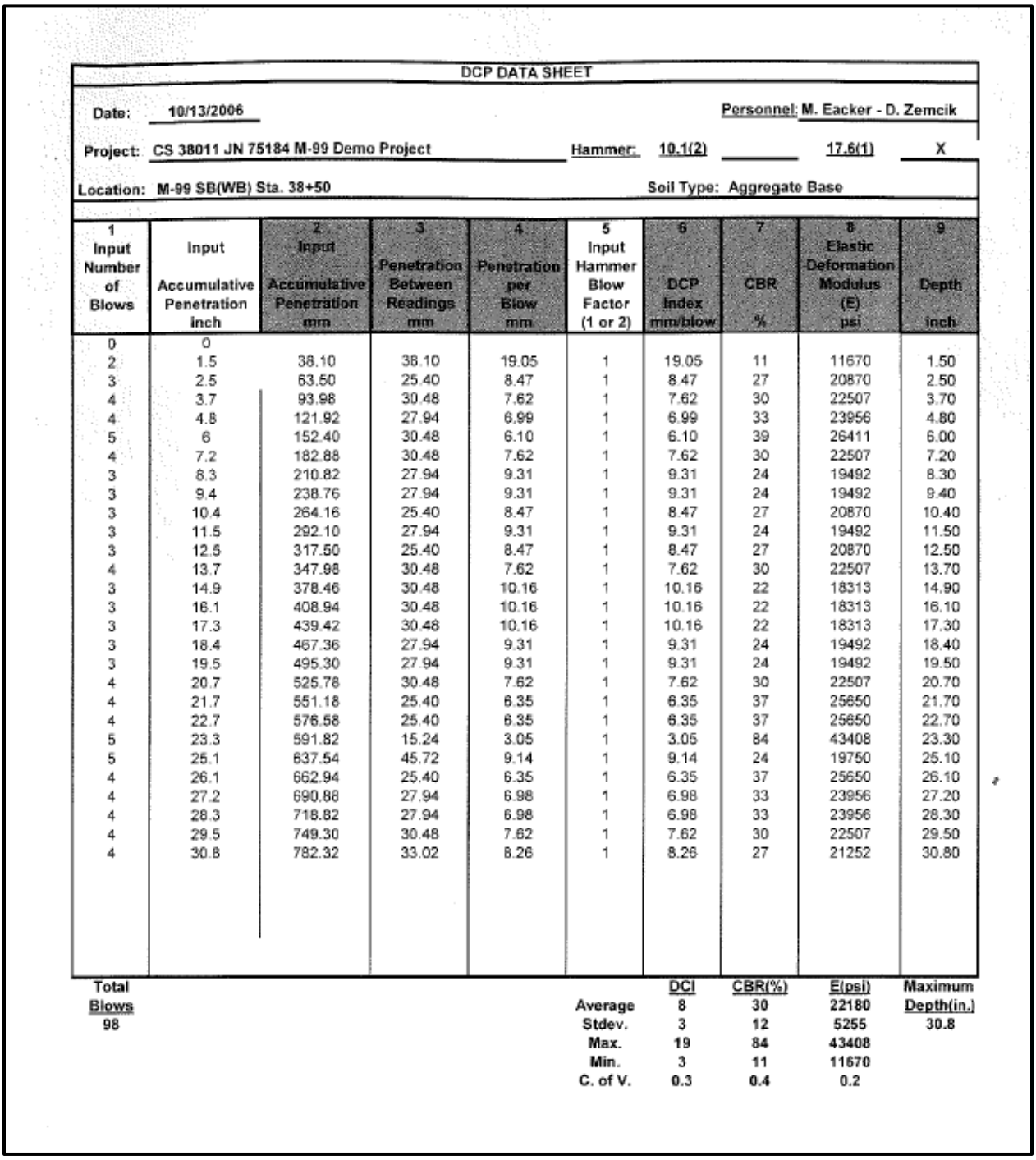
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) ____ 17.6(1) X

Location: M-99 SB(WB) Sta. 38+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.3	33.02	33.02	16.51	1	16.51	13	12931	1.30
3	2.6	66.04	33.02	11.01	1	11.01	20	17292	2.60
3	3.8	96.52	30.48	10.16	1	10.16	22	18313	3.80
3	5	127.00	30.48	10.16	1	10.16	22	18313	5.00
3	6.2	157.48	30.48	10.16	1	10.16	22	18313	6.20
3	7.5	190.50	33.02	11.01	1	11.01	20	17292	7.50
3	8.8	223.52	33.02	11.01	1	11.01	20	17292	8.80
3	10.1	256.54	33.02	11.01	1	11.01	20	17292	10.10
3	11.3	287.02	30.48	10.16	1	10.16	22	18313	11.30
3	12.4	314.96	27.94	9.31	1	9.31	24	19492	12.40
3	13.7	347.98	33.02	11.01	1	11.01	20	17292	13.70
3	14.9	378.46	30.48	10.16	1	10.16	22	18313	14.90
3	15.9	403.86	25.40	8.47	1	8.47	27	20870	15.90
3	16.9	429.26	25.40	8.47	1	8.47	27	20870	16.90
3	18.3	464.82	35.56	11.85	1	11.85	18	16398	18.30
3	19.4	492.76	27.94	9.31	1	9.31	24	19492	19.40
3	20.4	518.16	25.40	8.47	1	8.47	27	20870	20.40
5	21.6	548.64	30.48	6.10	1	6.10	39	26411	21.60
4	22.6	574.04	25.40	6.35	1	6.35	37	25650	22.60
4	23.7	601.98	27.94	6.98	1	6.98	33	23956	23.70
4	24.8	629.92	27.94	6.99	1	6.99	33	23956	24.80
4	25.9	657.86	27.94	6.98	1	6.98	33	23956	25.90
4	27.1	688.34	30.48	7.62	1	7.62	30	22507	27.10
4	28.2	716.28	27.94	6.98	1	6.98	33	23956	28.20
4	29.3	744.22	27.94	6.99	1	6.99	33	23956	29.30
4	30.4	772.16	27.94	6.98	1	6.98	33	23956	30.40

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
87	Average	9	26	20279	30.4
	Stdev.	2	7	3393	
	Max.	17	39	26411	
	Min.	6	13	12931	
	C. of V.	0.2	0.3	0.2	

Figure A 16. DCP Results for M-99 Southbound Station 38+00



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

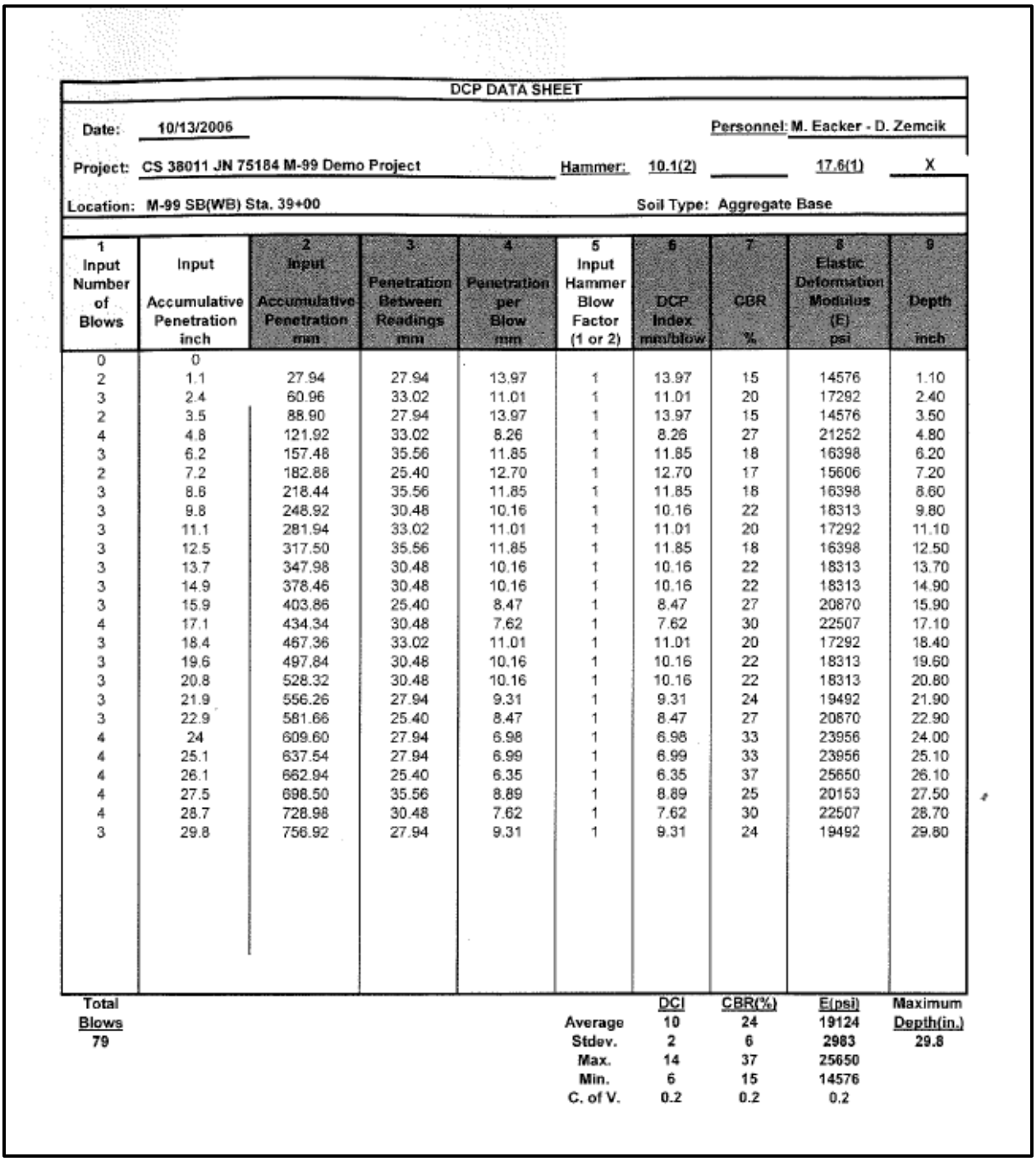
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 SB(WB) Sta. 38+50 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.5	38.10	38.10	19.05	1	19.05	11	11670	1.50
3	2.5	63.50	25.40	8.47	1	8.47	27	20870	2.50
4	3.7	93.98	30.48	7.62	1	7.62	30	22507	3.70
4	4.8	121.92	27.94	6.99	1	6.99	33	23956	4.80
5	6	152.40	30.48	6.10	1	6.10	39	26411	6.00
4	7.2	182.88	30.48	7.62	1	7.62	30	22507	7.20
3	8.3	210.82	27.94	9.31	1	9.31	24	19492	8.30
3	9.4	238.76	27.94	9.31	1	9.31	24	19492	9.40
3	10.4	264.16	25.40	8.47	1	8.47	27	20870	10.40
3	11.5	292.10	27.94	9.31	1	9.31	24	19492	11.50
3	12.5	317.50	25.40	8.47	1	8.47	27	20870	12.50
4	13.7	347.98	30.48	7.62	1	7.62	30	22507	13.70
3	14.9	378.46	30.48	10.16	1	10.16	22	18313	14.90
3	16.1	408.94	30.48	10.16	1	10.16	22	18313	16.10
3	17.3	439.42	30.48	10.16	1	10.16	22	18313	17.30
3	18.4	467.36	27.94	9.31	1	9.31	24	19492	18.40
3	19.5	495.30	27.94	9.31	1	9.31	24	19492	19.50
4	20.7	525.78	30.48	7.62	1	7.62	30	22507	20.70
4	21.7	551.18	25.40	6.35	1	6.35	37	25650	21.70
4	22.7	576.58	25.40	6.35	1	6.35	37	25650	22.70
5	23.3	591.82	15.24	3.05	1	3.05	84	43408	23.30
5	25.1	637.54	45.72	9.14	1	9.14	24	19750	25.10
4	26.1	662.94	25.40	6.35	1	6.35	37	25650	26.10
4	27.2	690.88	27.94	6.98	1	6.98	33	23956	27.20
4	28.3	718.82	27.94	6.98	1	6.98	33	23956	28.30
4	29.5	749.30	30.48	7.62	1	7.62	30	22507	29.50
4	30.8	782.32	33.02	8.26	1	8.26	27	21252	30.80

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
98	Average	8	30	22180	30.8
	Stdev.	3	12	5255	
	Max.	19	84	43408	
	Min.	3	11	11670	
	C. of V.	0.3	0.4	0.2	

Figure A 17. DCP Results for M-99 Southbound Station 38+50



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

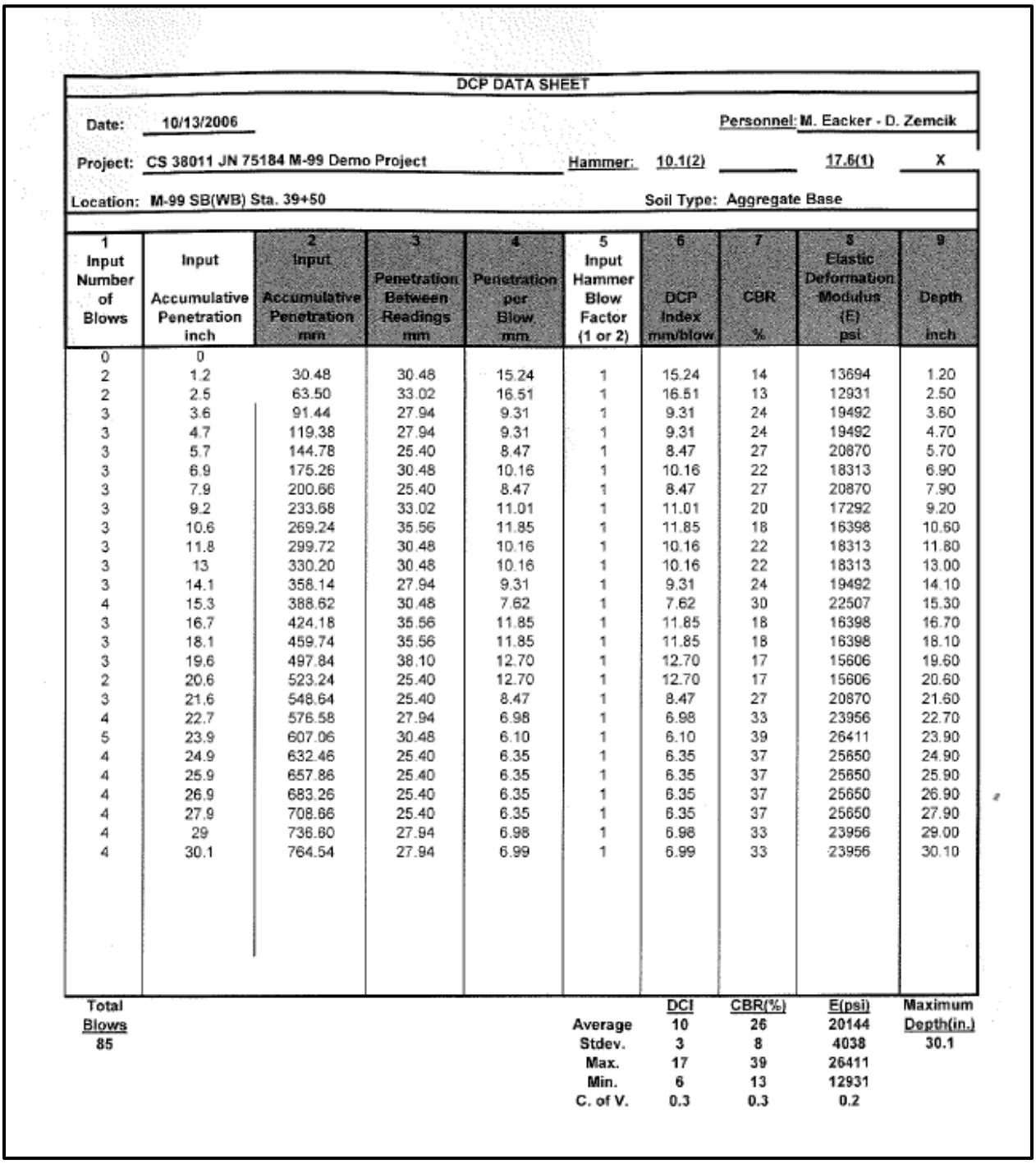
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 SB(WB) Sta. 39+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.1	27.94	27.94	13.97	1	13.97	15	14576	1.10
3	2.4	60.96	33.02	11.01	1	11.01	20	17292	2.40
2	3.5	88.90	27.94	13.97	1	13.97	15	14576	3.50
4	4.8	121.92	33.02	8.26	1	8.26	27	21252	4.80
3	6.2	157.48	35.56	11.85	1	11.85	18	16398	6.20
2	7.2	182.88	25.40	12.70	1	12.70	17	15606	7.20
3	8.6	218.44	35.56	11.85	1	11.85	18	16398	8.60
3	9.8	248.92	30.48	10.16	1	10.16	22	18313	9.80
3	11.1	281.94	33.02	11.01	1	11.01	20	17292	11.10
3	12.5	317.50	35.56	11.85	1	11.85	18	16398	12.50
3	13.7	347.98	30.48	10.16	1	10.16	22	18313	13.70
3	14.9	378.46	30.48	10.16	1	10.16	22	18313	14.90
3	15.9	403.86	25.40	8.47	1	8.47	27	20870	15.90
4	17.1	434.34	30.48	7.62	1	7.62	30	22507	17.10
3	18.4	467.36	33.02	11.01	1	11.01	20	17292	18.40
3	19.6	497.84	30.48	10.16	1	10.16	22	18313	19.60
3	20.8	528.32	30.48	10.16	1	10.16	22	18313	20.80
3	21.9	556.26	27.94	9.31	1	9.31	24	19492	21.90
3	22.9	581.66	25.40	8.47	1	8.47	27	20870	22.90
4	24	609.60	27.94	6.98	1	6.98	33	23956	24.00
4	25.1	637.54	27.94	6.99	1	6.99	33	23956	25.10
4	26.1	662.94	25.40	6.35	1	6.35	37	25650	26.10
4	27.5	698.50	35.56	8.89	1	8.89	25	20153	27.50
4	28.7	728.98	30.48	7.62	1	7.62	30	22507	28.70
3	29.8	756.92	27.94	9.31	1	9.31	24	19492	29.80

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
79	Average	10	24	19124	29.8
	Stdev.	2	6	2983	
	Max.	14	37	25650	
	Min.	6	15	14576	
	C. of V.	0.2	0.2	0.2	

Figure A 18. DCP Results for M-99 Southbound Station 39+00



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

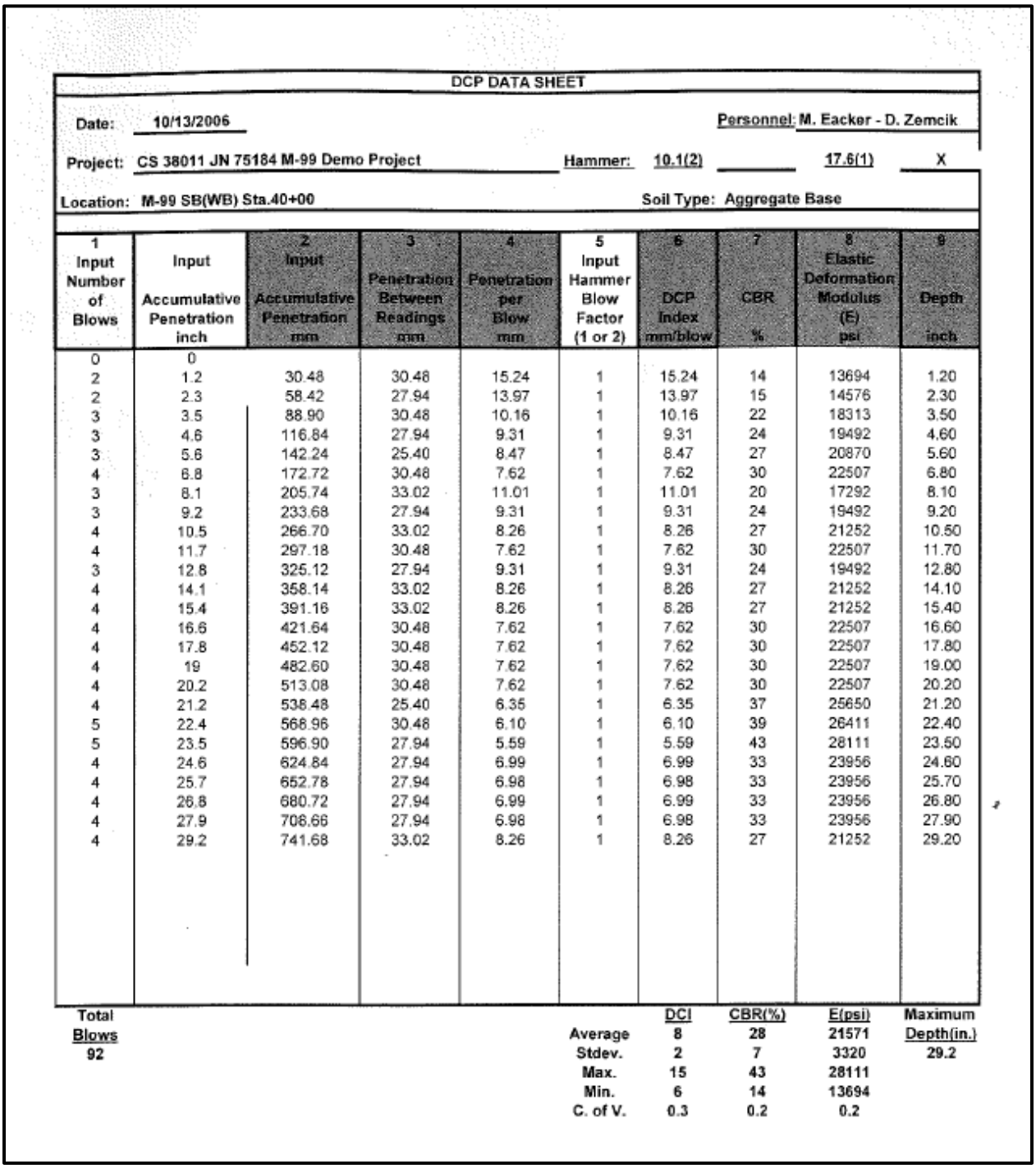
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 SB(WB) Sta. 39+50 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.2	30.48	30.48	15.24	1	15.24	14	13694	1.20
2	2.5	63.50	33.02	16.51	1	16.51	13	12931	2.50
3	3.6	91.44	27.94	9.31	1	9.31	24	19492	3.60
3	4.7	119.38	27.94	9.31	1	9.31	24	19492	4.70
3	5.7	144.78	25.40	8.47	1	8.47	27	20870	5.70
3	6.9	175.26	30.48	10.16	1	10.16	22	18313	6.90
3	7.9	200.66	25.40	8.47	1	8.47	27	20870	7.90
3	9.2	233.68	33.02	11.01	1	11.01	20	17292	9.20
3	10.6	269.24	35.56	11.85	1	11.85	18	16398	10.60
3	11.8	299.72	30.48	10.16	1	10.16	22	18313	11.80
3	13	330.20	30.48	10.16	1	10.16	22	18313	13.00
3	14.1	358.14	27.94	9.31	1	9.31	24	19492	14.10
4	15.3	388.62	30.48	7.62	1	7.62	30	22507	15.30
3	16.7	424.18	35.56	11.85	1	11.85	18	16398	16.70
3	18.1	459.74	35.56	11.85	1	11.85	18	16398	18.10
3	19.6	497.84	38.10	12.70	1	12.70	17	15606	19.60
2	20.6	523.24	25.40	12.70	1	12.70	17	15606	20.60
3	21.6	548.64	25.40	8.47	1	8.47	27	20870	21.60
4	22.7	576.58	27.94	6.98	1	6.98	33	23956	22.70
5	23.9	607.06	30.48	6.10	1	6.10	39	26411	23.90
4	24.9	632.46	25.40	6.35	1	6.35	37	25650	24.90
4	25.9	657.86	25.40	6.35	1	6.35	37	25650	25.90
4	26.9	683.26	25.40	6.35	1	6.35	37	25650	26.90
4	27.9	708.66	25.40	6.35	1	6.35	37	25650	27.90
4	29	736.60	27.94	6.98	1	6.98	33	23956	29.00
4	30.1	764.54	27.94	6.99	1	6.99	33	23956	30.10

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
85	Average	10	26	20144	30.1
	Stdev.	3	8	4038	
	Max.	17	39	26411	
	Min.	6	13	12931	
	C. of V.	0.3	0.3	0.2	

Figure A 19. DCP Results for M-99 Southbound Station 39+50



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

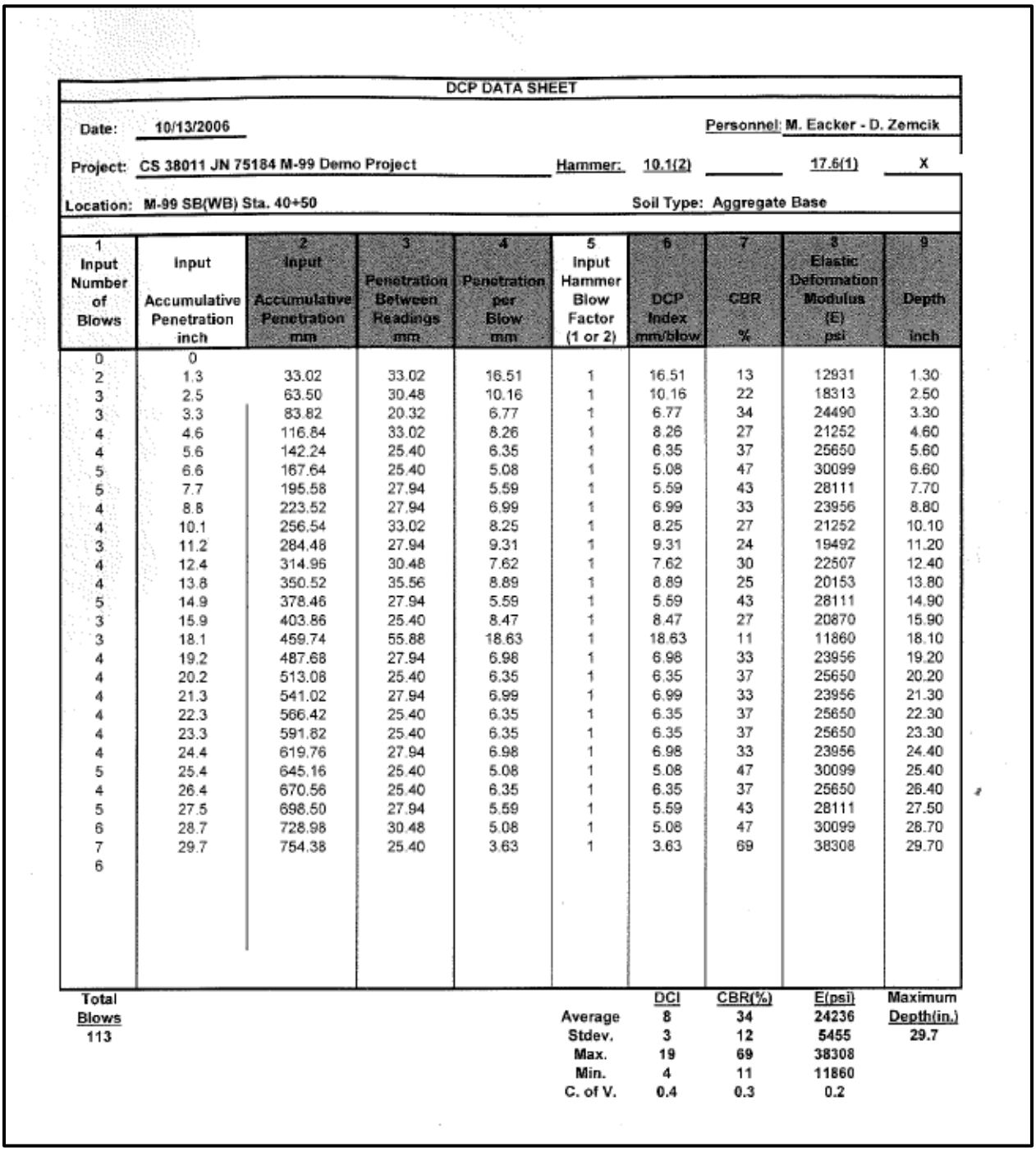
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) ____ 17.6(1) X

Location: M-99 SB(WB) Sta.40+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.2	30.48	30.48	15.24	1	15.24	14	13694	1.20
2	2.3	58.42	27.94	13.97	1	13.97	15	14576	2.30
3	3.5	88.90	30.48	10.16	1	10.16	22	18313	3.50
3	4.6	116.84	27.94	9.31	1	9.31	24	19492	4.60
3	5.6	142.24	25.40	8.47	1	8.47	27	20870	5.60
4	6.8	172.72	30.48	7.62	1	7.62	30	22507	6.80
3	8.1	205.74	33.02	11.01	1	11.01	20	17292	8.10
3	9.2	233.68	27.94	9.31	1	9.31	24	19492	9.20
4	10.5	266.70	33.02	8.26	1	8.26	27	21252	10.50
4	11.7	297.18	30.48	7.62	1	7.62	30	22507	11.70
3	12.8	325.12	27.94	9.31	1	9.31	24	19492	12.80
4	14.1	358.14	33.02	8.26	1	8.26	27	21252	14.10
4	15.4	391.16	33.02	8.26	1	8.26	27	21252	15.40
4	16.6	421.64	30.48	7.62	1	7.62	30	22507	16.60
4	17.8	452.12	30.48	7.62	1	7.62	30	22507	17.80
4	19	482.60	30.48	7.62	1	7.62	30	22507	19.00
4	20.2	513.08	30.48	7.62	1	7.62	30	22507	20.20
4	21.2	538.48	25.40	6.35	1	6.35	37	25650	21.20
5	22.4	568.96	30.48	6.10	1	6.10	39	26411	22.40
5	23.5	596.90	27.94	5.59	1	5.59	43	28111	23.50
4	24.6	624.84	27.94	6.99	1	6.99	33	23956	24.60
4	25.7	652.78	27.94	6.98	1	6.98	33	23956	25.70
4	26.8	680.72	27.94	6.99	1	6.99	33	23956	26.80
4	27.9	708.66	27.94	6.98	1	6.98	33	23956	27.90
4	29.2	741.68	33.02	8.26	1	8.26	27	21252	29.20

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
92	Average	8	28	21571	29.2
	Stdev.	2	7	3320	
	Max.	15	43	28111	
	Min.	6	14	13694	
	C. of V.	0.3	0.2	0.2	

Figure A 20. DCP Results for M-99 Southbound Station 40+00



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

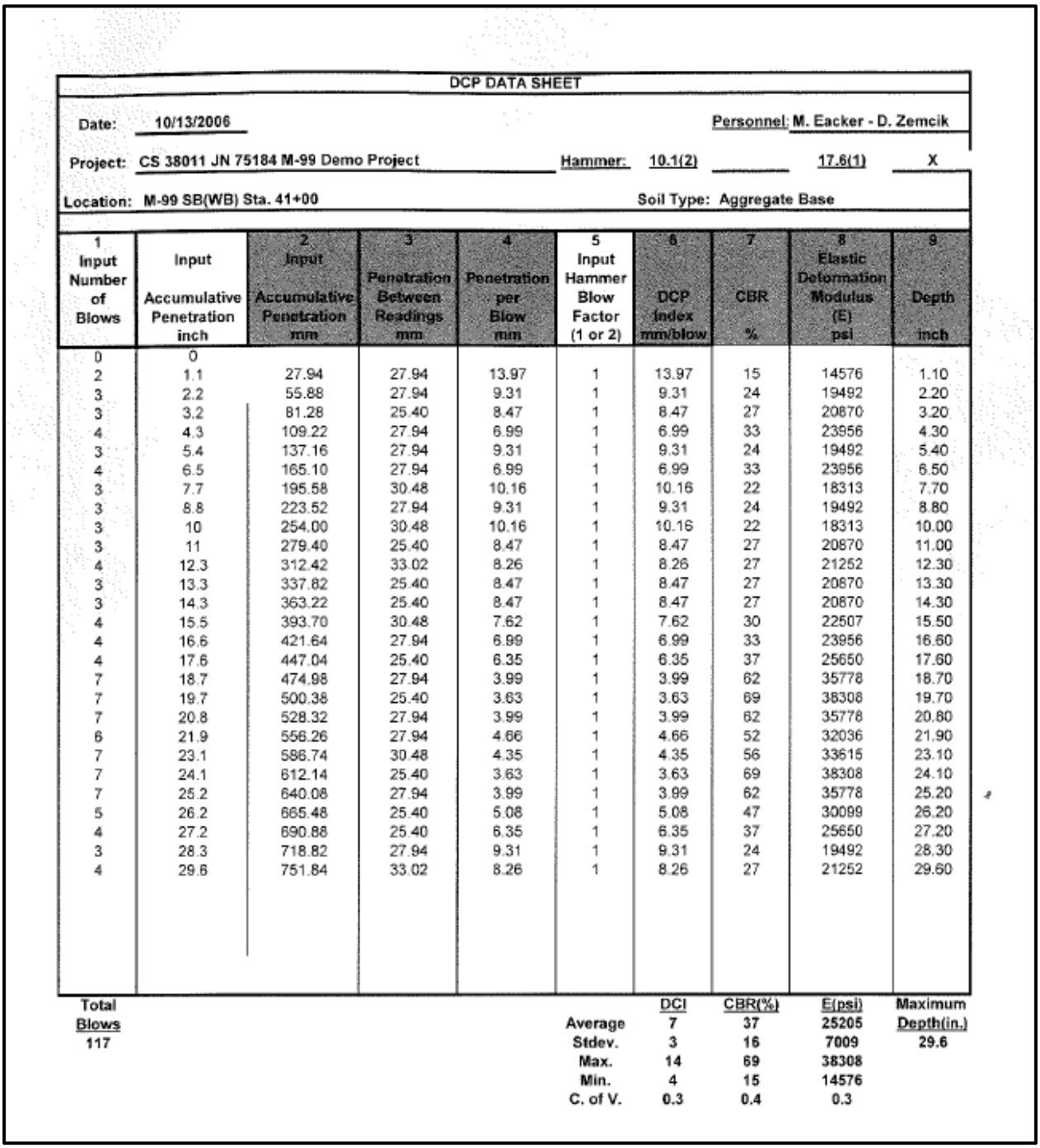
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 SB(WB) Sta. 40+50 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.3	33.02	33.02	16.51	1	16.51	13	12931	1.30
3	2.5	63.50	30.48	10.16	1	10.16	22	18313	2.50
3	3.3	83.82	20.32	6.77	1	6.77	34	24490	3.30
4	4.6	116.84	33.02	8.26	1	8.26	27	21252	4.60
4	5.6	142.24	25.40	6.35	1	6.35	37	25650	5.60
5	6.6	167.64	25.40	5.08	1	5.08	47	30099	6.60
5	7.7	195.58	27.94	5.59	1	5.59	43	28111	7.70
4	8.8	223.52	27.94	6.99	1	6.99	33	23956	8.80
4	10.1	256.54	33.02	8.25	1	8.25	27	21252	10.10
3	11.2	284.48	27.94	9.31	1	9.31	24	19492	11.20
4	12.4	314.96	30.48	7.62	1	7.62	30	22507	12.40
4	13.8	350.52	35.56	8.89	1	8.89	25	20153	13.80
5	14.9	378.46	27.94	5.59	1	5.59	43	28111	14.90
3	15.9	403.86	25.40	8.47	1	8.47	27	20870	15.90
3	18.1	459.74	55.88	18.63	1	18.63	11	11860	18.10
4	19.2	487.68	27.94	6.98	1	6.98	33	23956	19.20
4	20.2	513.08	25.40	6.35	1	6.35	37	25650	20.20
4	21.3	541.02	27.94	6.99	1	6.99	33	23956	21.30
4	22.3	566.42	25.40	6.35	1	6.35	37	25650	22.30
4	23.3	591.82	25.40	6.35	1	6.35	37	25650	23.30
4	24.4	619.76	27.94	6.98	1	6.98	33	23956	24.40
5	25.4	645.16	25.40	5.08	1	5.08	47	30099	25.40
4	26.4	670.56	25.40	6.35	1	6.35	37	25650	26.40
5	27.5	698.50	27.94	5.59	1	5.59	43	28111	27.50
6	28.7	728.98	30.48	5.08	1	5.08	47	30099	28.70
7	29.7	754.38	25.40	3.63	1	3.63	69	38308	29.70
6									

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
113	Average	8	34	24236	29.7
	Stdev.	3	12	5455	
	Max.	19	69	38308	
	Min.	4	11	11860	
	C. of V.	0.4	0.3	0.2	

Figure A 21. DCP Results for M-99 Southbound Station 40+50



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

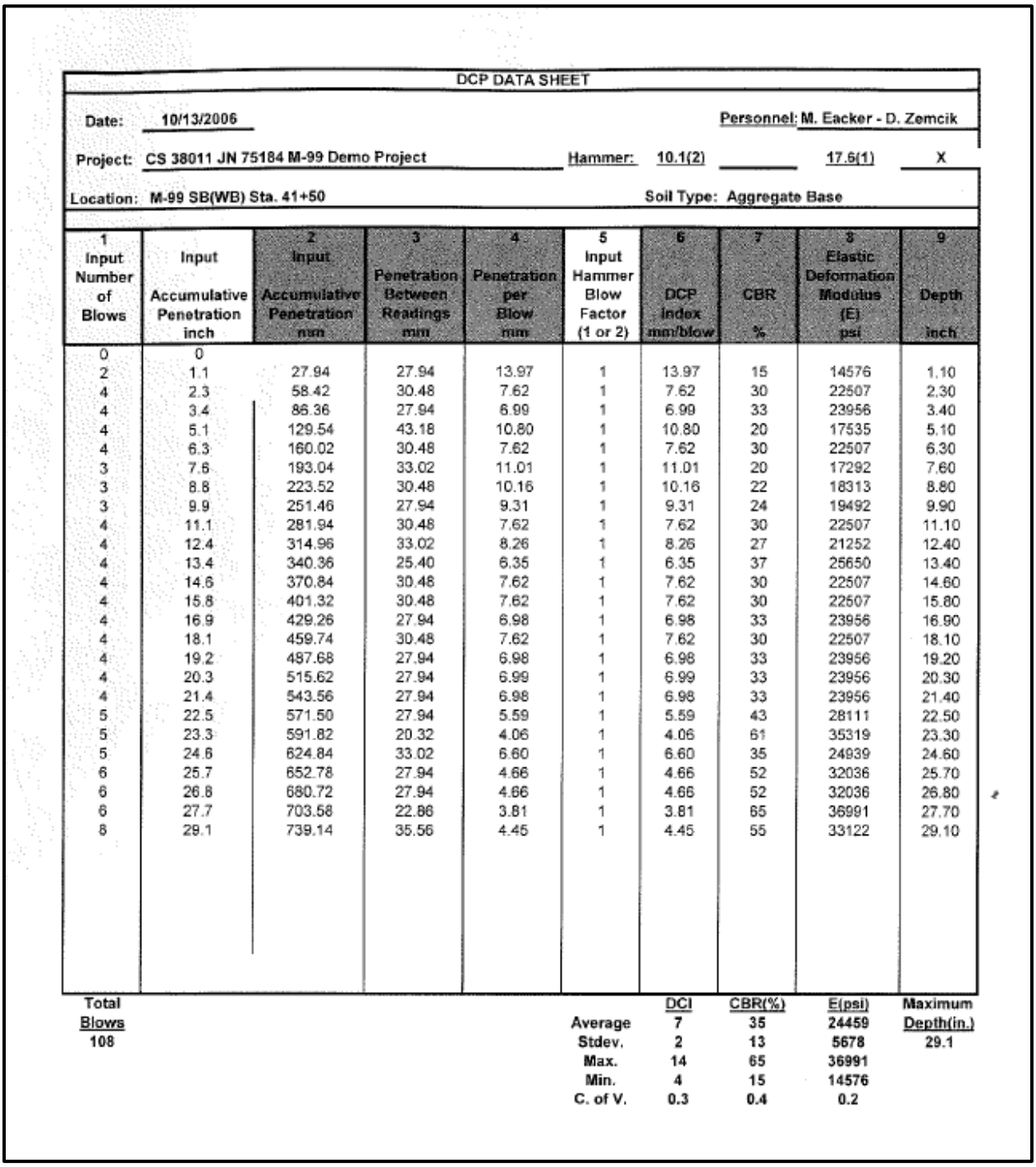
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 SB(WB) Sta. 41+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.1	27.94	27.94	13.97	1	13.97	15	14576	1.10
3	2.2	55.88	27.94	9.31	1	9.31	24	19492	2.20
3	3.2	81.28	25.40	8.47	1	8.47	27	20870	3.20
4	4.3	109.22	27.94	6.99	1	6.99	33	23956	4.30
3	5.4	137.16	27.94	9.31	1	9.31	24	19492	5.40
4	6.5	165.10	27.94	6.99	1	6.99	33	23956	6.50
3	7.7	195.58	30.48	10.16	1	10.16	22	18313	7.70
3	8.8	223.52	27.94	9.31	1	9.31	24	19492	8.80
3	10	254.00	30.48	10.16	1	10.16	22	18313	10.00
3	11	279.40	25.40	8.47	1	8.47	27	20870	11.00
4	12.3	312.42	33.02	8.26	1	8.26	27	21252	12.30
3	13.3	337.82	25.40	8.47	1	8.47	27	20870	13.30
3	14.3	363.22	25.40	8.47	1	8.47	27	20870	14.30
4	15.5	393.70	30.48	7.62	1	7.62	30	22507	15.50
4	16.6	421.64	27.94	6.99	1	6.99	33	23956	16.60
4	17.6	447.04	25.40	6.35	1	6.35	37	25650	17.60
7	18.7	474.98	27.94	3.99	1	3.99	62	35778	18.70
7	19.7	500.38	25.40	3.63	1	3.63	69	38308	19.70
7	20.8	528.32	27.94	3.99	1	3.99	62	35778	20.80
6	21.9	556.26	27.94	4.66	1	4.66	52	32036	21.90
7	23.1	586.74	30.48	4.35	1	4.35	56	33615	23.10
7	24.1	612.14	25.40	3.63	1	3.63	69	38308	24.10
7	25.2	640.08	27.94	3.99	1	3.99	62	35778	25.20
5	26.2	665.48	25.40	5.08	1	5.08	47	30099	26.20
4	27.2	690.88	25.40	6.35	1	6.35	37	25650	27.20
3	28.3	718.82	27.94	9.31	1	9.31	24	19492	28.30
4	29.6	751.84	33.02	8.26	1	8.26	27	21252	29.60

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
117	Average	7	37	25205	29.6
	Stdev.	3	16	7009	
	Max.	14	69	38308	
	Min.	4	15	14576	
	C. of V.	0.3	0.4	0.3	

Figure A 22. DCP Results for M-99 Southbound Station 41+00



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

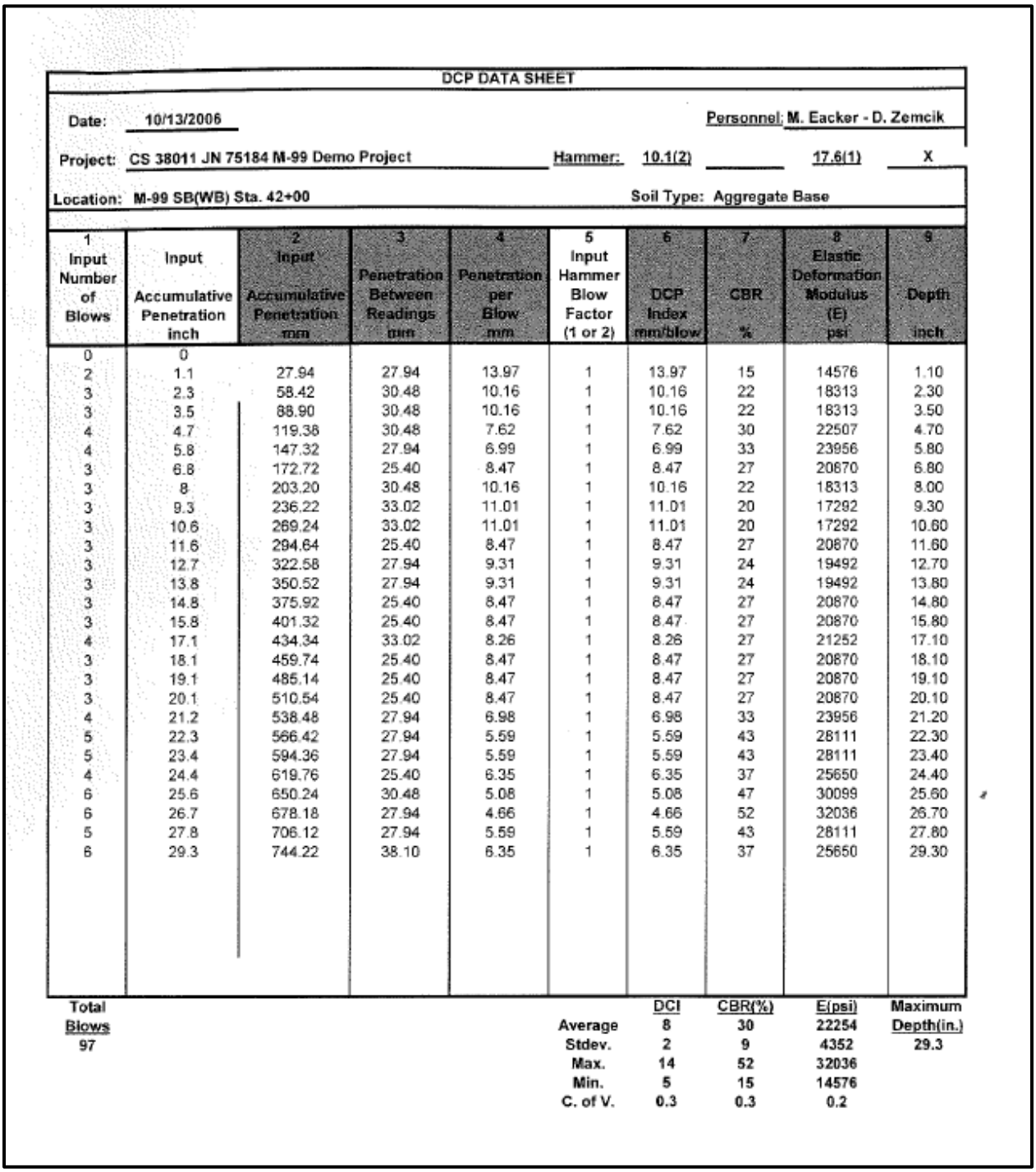
Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 SB(WB) Sta. 41+50 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.1	27.94	27.94	13.97	1	13.97	15	14576	1.10
4	2.3	58.42	30.48	7.62	1	7.62	30	22507	2.30
4	3.4	86.36	27.94	6.99	1	6.99	33	23956	3.40
4	5.1	129.54	43.18	10.80	1	10.80	20	17535	5.10
4	6.3	160.02	30.48	7.62	1	7.62	30	22507	6.30
3	7.6	193.04	33.02	11.01	1	11.01	20	17292	7.60
3	8.8	223.52	30.48	10.16	1	10.16	22	18313	8.80
3	9.9	251.46	27.94	9.31	1	9.31	24	19492	9.90
4	11.1	281.94	30.48	7.62	1	7.62	30	22507	11.10
4	12.4	314.96	33.02	8.26	1	8.26	27	21252	12.40
4	13.4	340.36	25.40	6.35	1	6.35	37	25650	13.40
4	14.6	370.84	30.48	7.62	1	7.62	30	22507	14.60
4	15.8	401.32	30.48	7.62	1	7.62	30	22507	15.80
4	16.9	429.26	27.94	6.98	1	6.98	33	23956	16.90
4	18.1	459.74	30.48	7.62	1	7.62	30	22507	18.10
4	19.2	487.68	27.94	6.98	1	6.98	33	23956	19.20
4	20.3	515.62	27.94	6.99	1	6.99	33	23956	20.30
4	21.4	543.56	27.94	6.98	1	6.98	33	23956	21.40
5	22.5	571.50	27.94	5.59	1	5.59	43	28111	22.50
5	23.3	591.82	20.32	4.06	1	4.06	61	35319	23.30
5	24.6	624.84	33.02	6.60	1	6.60	35	24939	24.60
6	25.7	652.78	27.94	4.66	1	4.66	52	32036	25.70
6	26.8	680.72	27.94	4.66	1	4.66	52	32036	26.80
6	27.7	703.58	22.86	3.81	1	3.81	65	36991	27.70
8	29.1	739.14	35.56	4.45	1	4.45	55	33122	29.10

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
108	Average	7	35	24459	29.1
	Stdev.	2	13	5678	
	Max.	14	65	36991	
	Min.	4	15	14576	
	C. of V.	0.3	0.4	0.2	

Figure A 23. DCP Results for M-99 Southbound Station 41+50



DCP DATA SHEET

Date: 10/13/2006 Personnel: M. Eacker - D. Zemcik

Project: CS 38011 JN 75184 M-99 Demo Project Hammer: 10.1(2) 17.6(1) X

Location: M-99 SB(WB) Sta. 42+00 Soil Type: Aggregate Base

1 Input Number of Blows	Input Accumulative Penetration inch	2 Input Accumulative Penetration mm	3 Penetration Between Readings mm	4 Penetration per Blow mm	5 Input Hammer Blow Factor (1 or 2)	6 DCP Index mm/blow	7 CBR %	8 Elastic Deformation Modulus (E) psi	9 Depth inch
0	0								
2	1.1	27.94	27.94	13.97	1	13.97	15	14576	1.10
3	2.3	58.42	30.48	10.16	1	10.16	22	18313	2.30
3	3.5	88.90	30.48	10.16	1	10.16	22	18313	3.50
4	4.7	119.38	30.48	7.62	1	7.62	30	22507	4.70
4	5.8	147.32	27.94	6.99	1	6.99	33	23956	5.80
3	6.8	172.72	25.40	8.47	1	8.47	27	20870	6.80
3	8	203.20	30.48	10.16	1	10.16	22	18313	8.00
3	9.3	236.22	33.02	11.01	1	11.01	20	17292	9.30
3	10.6	269.24	33.02	11.01	1	11.01	20	17292	10.60
3	11.6	294.64	25.40	8.47	1	8.47	27	20870	11.60
3	12.7	322.58	27.94	9.31	1	9.31	24	19492	12.70
3	13.8	350.52	27.94	9.31	1	9.31	24	19492	13.80
3	14.8	375.92	25.40	8.47	1	8.47	27	20870	14.80
3	15.8	401.32	25.40	8.47	1	8.47	27	20870	15.80
4	17.1	434.34	33.02	8.26	1	8.26	27	21252	17.10
3	18.1	459.74	25.40	8.47	1	8.47	27	20870	18.10
3	19.1	485.14	25.40	8.47	1	8.47	27	20870	19.10
3	20.1	510.54	25.40	8.47	1	8.47	27	20870	20.10
4	21.2	538.48	27.94	6.98	1	6.98	33	23956	21.20
5	22.3	566.42	27.94	5.59	1	5.59	43	28111	22.30
5	23.4	594.36	27.94	5.59	1	5.59	43	28111	23.40
4	24.4	619.76	25.40	6.35	1	6.35	37	25650	24.40
6	25.6	650.24	30.48	5.08	1	5.08	47	30099	25.60
6	26.7	678.18	27.94	4.66	1	4.66	52	32036	26.70
5	27.8	706.12	27.94	5.59	1	5.59	43	28111	27.80
6	29.3	744.22	38.10	6.35	1	6.35	37	25650	29.30

Total Blows		DCI	CBR(%)	E(psi)	Maximum Depth(in.)
97	Average	8	30	22254	29.3
	Stdev.	2	9	4352	
	Max.	14	52	32036	
	Min.	5	15	14576	
	C. of V.	0.3	0.3	0.2	

Figure A 24. DCP Results for M-99 Southbound Station 42+00

GEOGAUGE DATA SHEET

Date: 9/21/2006 Control Section 38011 Job Number 75184

Project Location: M-99 S. of Maple/Mechanic/W. Main Jct. to E. of Pearl St.

Site: Concrete

Soil Stiffness Range = 17 - 399 klbf/in
Young's Modulus Range = 3.8 - 89 kpsi

Test No.	Test Location			Layer Type	Soil Stiffness	Youngs Modulus	Nuclear Gauge Measurements	
	Station	Lane	Dist. from CL (ft.)		klbf/in	kpsi	Dry Density lbs/ft^3	Moisture %
1	37+50	NB(EB)	6	Subgrade	40.84	9.85		
2	37+50	NB(EB)	6	Subgrade	41	9.89		
Average	37+50			Subgrade	**40.92**	**9.87**	**113.8**	**4.0**
1	38+00	NB(EB)	6	Subgrade	43.42	10.47		
2	38+00	NB(EB)	6	Subgrade	44.17	10.66		
Average	38+00			Subgrade	**43.80**	**10.57**	**118.0**	**4.2**
1	38+50	NB(EB)	6	Subgrade	46.74	11.15		
2	38+50	NB(EB)	6	Subgrade	46.75	11.28		
Average	38+50			Subgrade	**46.75**	**11.22**	**116.9**	**4.4**
1	39+00	NB(EB)	6	Subgrade	35.81	8.64		
2	39+00	NB(EB)	6	Subgrade	35.87	8.65		
Average	39+00			Subgrade	**35.84**	**8.65**	**109.6**	**3.6**
1	39+50	NB(EB)	6	Subgrade	35.56	8.58		
2	39+50	NB(EB)	6	Subgrade	35.38	8.53		
Average	39+50			Subgrade	**35.47**	**8.56**	**112.2**	**3.7**
1	40+00	NB(EB)	6	Subgrade	39.44	9.51		
2	40+00	NB(EB)	6	Subgrade	40.24	9.71		
Average	40+00			Subgrade	**39.84**	**9.61**	**105.4**	**3.9**
1	40+50	NB(EB)	6	Subgrade	35.64	8.6		
2	40+50	NB(EB)	6	Subgrade	37.28	8.99		
Average	40+50			Subgrade	**36.46**	**8.80**	**111.8**	**5.2**
1	41+00	NB(EB)	6	Subgrade	43.07	10.39		
2	41+00	NB(EB)	6	Subgrade	43.95	10.6		
Average	41+00			Subgrade	**43.51**	**10.50**	**111.7**	**4.7**
1	41+50	NB(EB)	6	Subgrade	43.76	10.56		
2	41+50	NB(EB)	6	Subgrade	44.24	10.67		
Average	41+50			Subgrade	**44.00**	**10.62**	**107.5**	**4.9**
1	42+00	NB(EB)	6	Subgrade	39.15	9.44		
2	42+00	NB(EB)	6	Subgrade	40.91	9.87		
Average	42+00			Subgrade	**40.03**	**9.66**	**122.2**	**7.8**
1	42+50	NB(EB)	6	Subgrade	45.07	10.87		
2	42+50	NB(EB)	6	Subgrade	46.11	11.12		
Average	42+50				**45.59**	**11.00**	**119.6**	**7.1**

Figure A 25. Subgrade Density Results on M-99 Northbound

GEOGAUGE DATA SHEET

Date: 9/21/2006 Control Section 38011 Job Number 75184

Project Location: M-99 S. of Maple/Mechanic/W. Main Jct. to E. of Pearl St.

Site: Concrete

Soil Stiffness Range = 17 - 399 klbf/in
Young's Modulus Range = 3.8 - 89 kpsi

Test No.	Test Location			Layer Type	Soil Stiffness	Youngs Modulus	Nuclear Gauge Measurements	
	Station	Lane	Dist. from CL (ft.)		klbf/in	kpsi	Dry Density lbs/ft^3	Moisture %
1	37+50	SB(WB)	6	Subgrade	42.49	10.25		
2	37+50	SB(WB)	6	Subgrade	42.76	10.32		
Average	37+50	SB(WB)		Subgrade	**42.63**	**10.29**	**111.8**	**4.0**
1	38+00	SB(WB)	6	Subgrade	42.39	10.22		
2	38+00	SB(WB)	6	Subgrade	43.04	10.39		
Average	38+00	SB(WB)		Subgrade	**42.72**	**10.31**	**113.9**	**4.6**
1	38+50	SB(WB)	6	Subgrade	38.68	9.33		
2	38+50	SB(WB)	6	Subgrade	38.87	9.38		
Average	38+50	SB(WB)		Subgrade	**38.78**	**9.36**	**112.6**	**4.0**
1	39+00	SB(WB)	6	Subgrade	34.59	8.34		
2	39+00	SB(WB)	6	Subgrade	33.87	8.17		
Average	39+00	SB(WB)		Subgrade	**34.23**	**8.26**	**109.9**	**3.7**
1	39+50	SB(WB)	6	Subgrade	42.1	10.16		
2	39+50	SB(WB)	6	Subgrade	42.46	10.24		
Average	39+50	SB(WB)		Subgrade	**42.28**	**10.20**	**114.6**	**3.9**
1	40+00	SB(WB)	6	Subgrade	37.93	9.15		
2	40+00	SB(WB)	6	Subgrade	38.53	9.29		
Average	40+00	SB(WB)		Subgrade	**38.23**	**9.22**	**117.3**	**4.7**
1	40+50	SB(WB)	6	Subgrade	31.56	7.61		
2	40+50	SB(WB)	6	Subgrade	32.19	7.76		
Average	40+50	SB(WB)		Subgrade	**31.88**	**7.69**	**108.6**	**4.2**
1	41+00	SB(WB)	6	Subgrade	34.64	8.36		
2	41+00	SB(WB)	6	Subgrade	36.38	8.77		
Average	41+00	SB(WB)		Subgrade	**35.51**	**8.57**	**123.9**	**7.4**
1	41+50	SB(WB)	6	Subgrade	49.24	11.88		
2	41+50	SB(WB)	6	Subgrade	49.99	12.06		
Average	41+50	SB(WB)		Subgrade	**49.62**	**11.97**	**107.9**	**9.8**
1	42+00	SB(WB)	6	Subgrade	22.47	5.47		
2	42+00	SB(WB)	6	Subgrade	24.05	5.8		
Average	42+00	SB(WB)		Subgrade	**23.26**	**5.64**	**119.3**	**10.1**
1	42+50	SB(WB)	6	Subgrade				
2	42+50	SB(WB)	6	Subgrade				
Average	42+50*	SB(WB)			**NA**	**NA**	**NA**	**NA**
			*Contractor equipment obstruction.					

Figure A 26. Subgrade Density Results on M-99 Southbound

GEOGAUGE DATA SHEET

Date: 9/22/2006 Control Section 38011 Job Number 75184

Project Location: M-99 S. of Maple/Mechanic/W. Main Jct. to E. of Pearl St.

Site: Concrete

Soil Stiffness Range = 17 - 399 klbf/in
Young's Modulus Range = 3.8 - 89 kpsi

Test No.	Test Location			Layer Type	Soil Stiffness	Youngs Modulus	Nuclear Gauge Measurements	
	Station	Lane	Dist. from CL (ft.)		klbf/in	kpsi	Dry Density lbs/ft^3	Moisture %
1	37+50	NB(EB)	6	Sand Sub.	36.62	8.83		
2	37+50	NB(EB)	6	Sand Sub.	37.11	8.95		
Average	37+50	NB(EB)		Sand Sub.	36.87	8.89	113.7	4.6
1	38+00	NB(EB)	6	Sand Sub.	39.64	9.56		
2	38+00	NB(EB)	6	Sand Sub.	39.69	9.57		
Average	38+00	NB(EB)		Sand Sub.	39.67	9.57	116.5	5.3
1	38+50	NB(EB)	6	Sand Sub.	36.61	8.83		
2	38+50	NB(EB)	6	Sand Sub.	36.94	8.91		
Average	38+50	NB(EB)		Sand Sub.	36.78	8.87	144.0	4.9
1	39+00	NB(EB)	6	Sand Sub.	43.5	10.49		
2	39+00	NB(EB)	6	Sand Sub.	44	10.61		
Average	39+00	NB(EB)		Sand Sub.	43.75	10.55	114.3	4.2
1	39+50	NB(EB)	6	Sand Sub.	44.25	10.67		
2	39+50	NB(EB)	6	Sand Sub.	44.33	10.69		
Average	39+50	NB(EB)		Sand Sub.	44.29	10.68	114.8	4.1
1	40+00	NB(EB)	6	Sand Sub.	40.69	9.82		
2	40+00	NB(EB)	6	Sand Sub.	41.49	10.01		
Average	40+00	NB(EB)		Sand Sub.	41.09	9.92	111.1	4.9
1	40+50	NB(EB)	6	Sand Sub.	38.67	9.32		
2	40+50	NB(EB)	6	Sand Sub.	39.06	9.42		
Average	40+50	NB(EB)		Sand Sub.	38.87	9.37	106.1	4.0
1	41+00	NB(EB)	6	Sand Sub.	39.33	9.49		
2	41+00	NB(EB)	6	Sand Sub.	40	9.65		
Average	41+00	NB(EB)		Sand Sub.	39.67	9.57	117.3	4.6
1	41+50	NB(EB)	6	Sand Sub.	36.97	8.92		
2	41+50	NB(EB)	6	Sand Sub.	37.07	8.94		
Average	41+50	NB(EB)		Sand Sub.	37.02	8.93	115.6	5.0
1	42+00	NB(EB)	6	Sand Sub.	43.92	10.59		
2	42+00	NB(EB)	6	Sand Sub.	41.56	10.69		
Average	42+00	NB(EB)		Sand Sub.	42.74	10.64	117.0	5.3
1	42+50	NB(EB)	6	Sand Sub.	41.56	10.03		
2	42+50	NB(EB)	6	Sand Sub.	42	10.14		
Average	42+50	NB(EB)		Sand Sub.	41.78	10.09	108.5	6.5

Figure A 27. Subbase Density Results on M-99 Northbound

GEOGAUGE DATA SHEET

Date: 9/22/2006 Control Section 38011 Job Number 75184

Project Location: M-99 S. of Maple/Mechanic/W. Main Jct. to E. of Pearl St.

Site: Concrete

Soil Stiffness Range = 17 - 399 klbf/in
Young's Modulus Range = 3.8 - 89 kpsi

Test No.	Test Location			Layer Type	Soil Stiffness	Youngs Modulus	Nuclear Gauge Measurements	
	Station	Lane	Dist. from CL (ft.)		klbf/in	kpsi	Dry Density lbs/ft^3	Moisture %
1	37+50	SB(WB)	6	Sand Sub.	33.14	8.05		
2	37+50	SB(WB)	6	Sand Sub.	33.69	8.13		
Average	37+50	SB(WB)		Sand Sub.	**33.42**	**8.09**	**114.2**	**4.3**
1	38+00	SB(WB)	6	Sand Sub.	37.58	9.07		
2	38+00	SB(WB)	6	Sand Sub.	38.02	9.17		
Average	38+00	SB(WB)		Sand Sub.	**37.80**	**9.12**	**114.9**	**5.0**
1	38+50	SB(WB)	6	Sand Sub.	41.89	10.13		
2	38+50	SB(WB)	6	Sand Sub.	42.45	10.24		
Average	38+50	SB(WB)		Sand Sub.	**42.17**	**10.19**	**114.4**	**4.9**
1	39+00	SB(WB)	6	Sand Sub.	48.06	11.59		
2	39+00	SB(WB)	6	Sand Sub.	48.54	11.11		
Average	39+00	SB(WB)		Sand Sub.	**48.30**	**11.35**		
1	39+50	SB(WB)	6	Sand Sub.	41	9.89		
2	39+50	SB(WB)	6	Sand Sub.	41.1	9.91		
Average	39+50	SB(WB)		Sand Sub.	**41.05**	**9.90**	**115.8**	**4.4**
1	40+00	SB(WB)	6	Sand Sub.	38.42	9.27		
2	40+00	SB(WB)	6	Sand Sub.	38.8	9.36		
Average	40+00	SB(WB)		Sand Sub.	**38.61**	**9.32**	**109.0**	**5.3**
1	40+50	SB(WB)	6	Sand Sub.	38.65	9.32		
2	40+50	SB(WB)	6	Sand Sub.	38.83	9.37		
Average	40+50	SB(WB)		Sand Sub.	**38.74**	**9.35**	**107.8**	**4.4**
1	41+00	SB(WB)	6	Sand Sub.	40.89	9.86		
2	41+00	SB(WB)	6	Sand Sub.	41.67	10.05		
Average	41+00	SB(WB)		Sand Sub.	**41.28**	**9.96**	**108.2**	**7.0**
1	41+50	SB(WB)	6	Sand Sub.	47.83	11.54		
2	41+50	SB(WB)	6	Sand Sub.	48.08	11.6		
Average	41+50	SB(WB)		Sand Sub.	**47.96**	**11.57**	**115.7**	**5.4**
1	42+00	SB(WB)	6	Sand Sub.	46.81	11.29		
2	42+00	SB(WB)	6	Sand Sub.	47.5	11.46		
Average	42+00	SB(WB)		Sand Sub.	**47.16**	**11.38**	**110.2**	**6.4**
1	42+50	SB(WB)	6	Sand Sub.	39.15	9.44		
2	42+50	SB(WB)	6	Sand Sub.	39.47	9.52		
Average	42+50	SB(WB)		Sand Sub.	**39.31**	**9.48**	**110.1**	**9.3**

Figure A 28. Subbase Density Results on M-99 Southbound

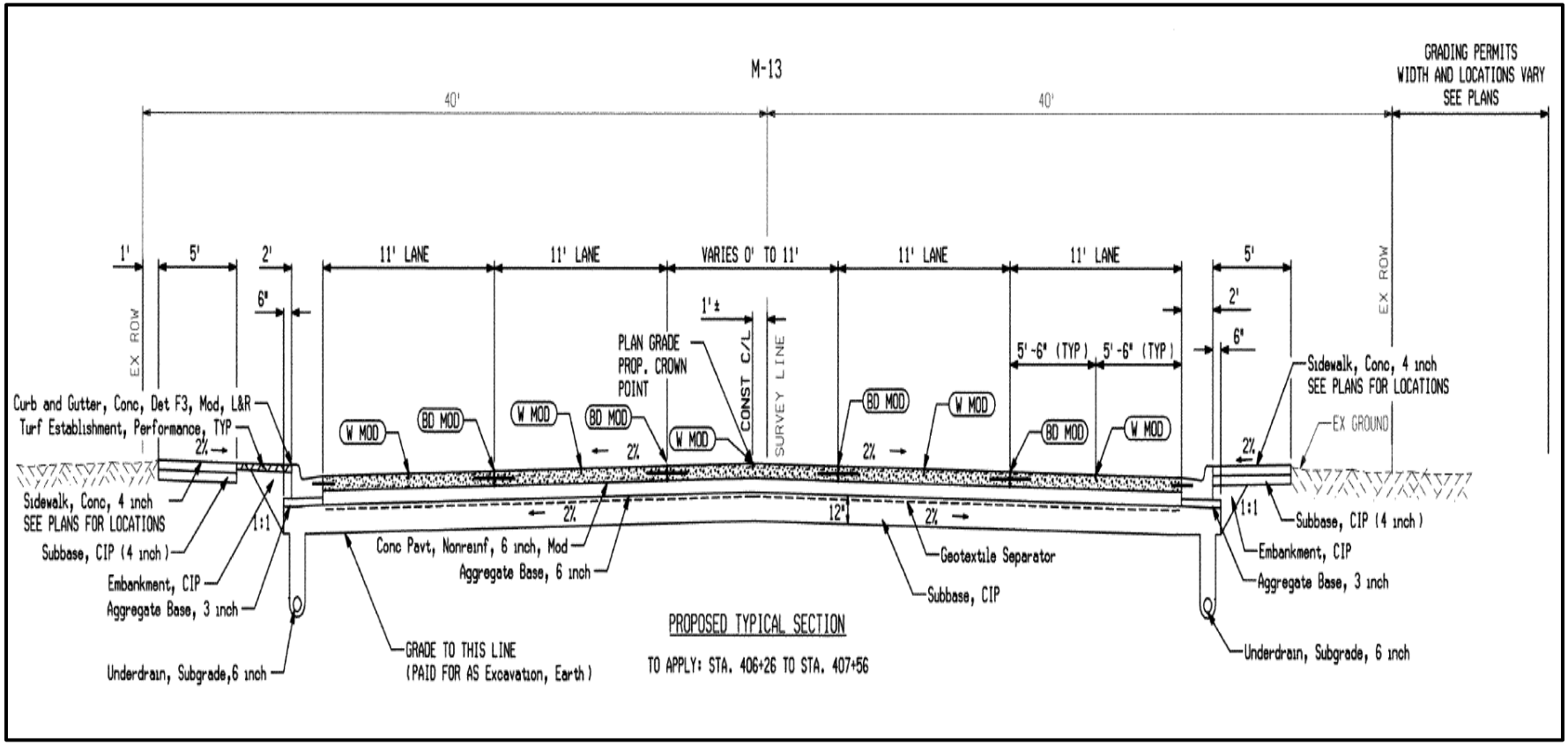


Figure A 29. Proposed Typical Section M-13 (4 lanes)

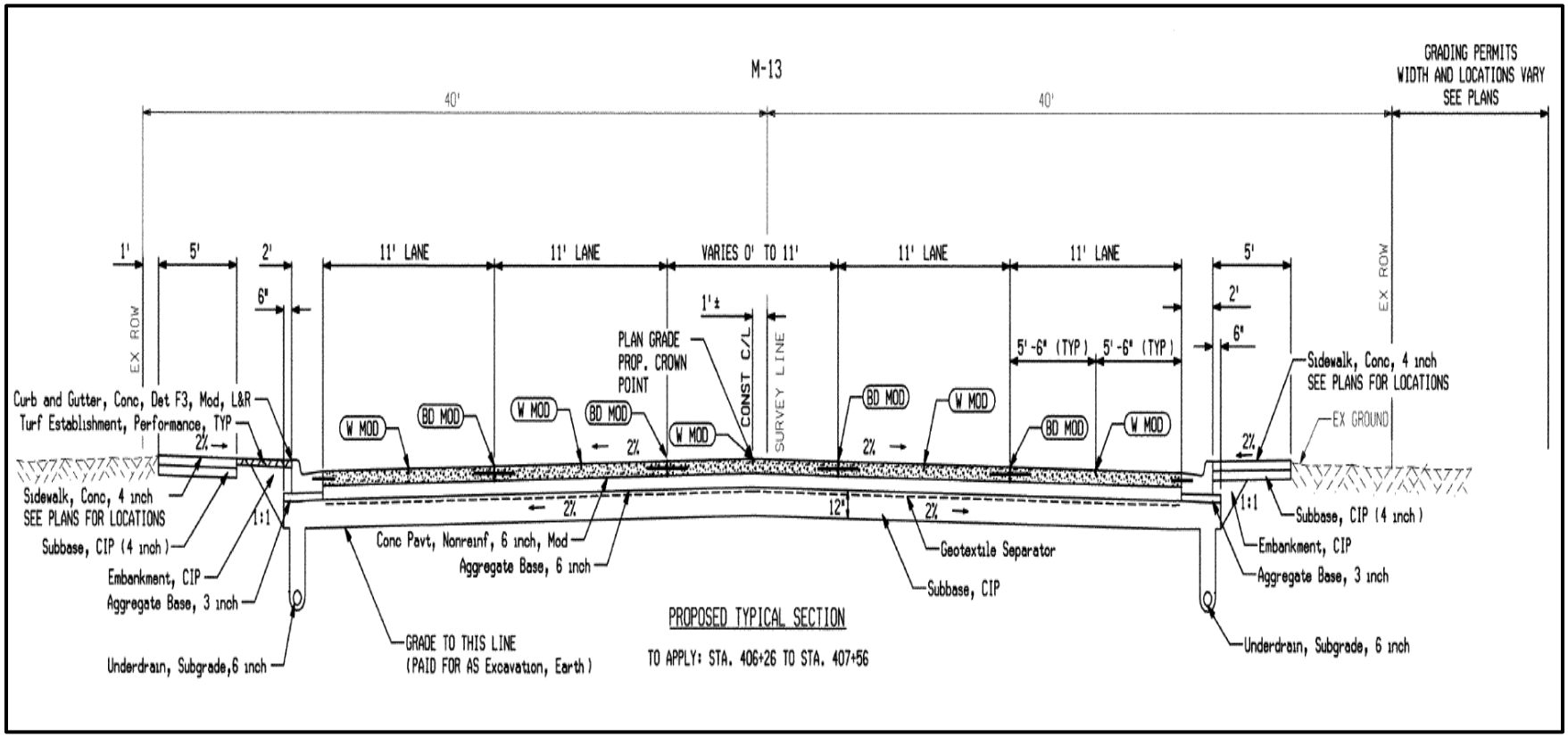


Figure A 30. Proposed Typical Section M-13 (5 lanes)

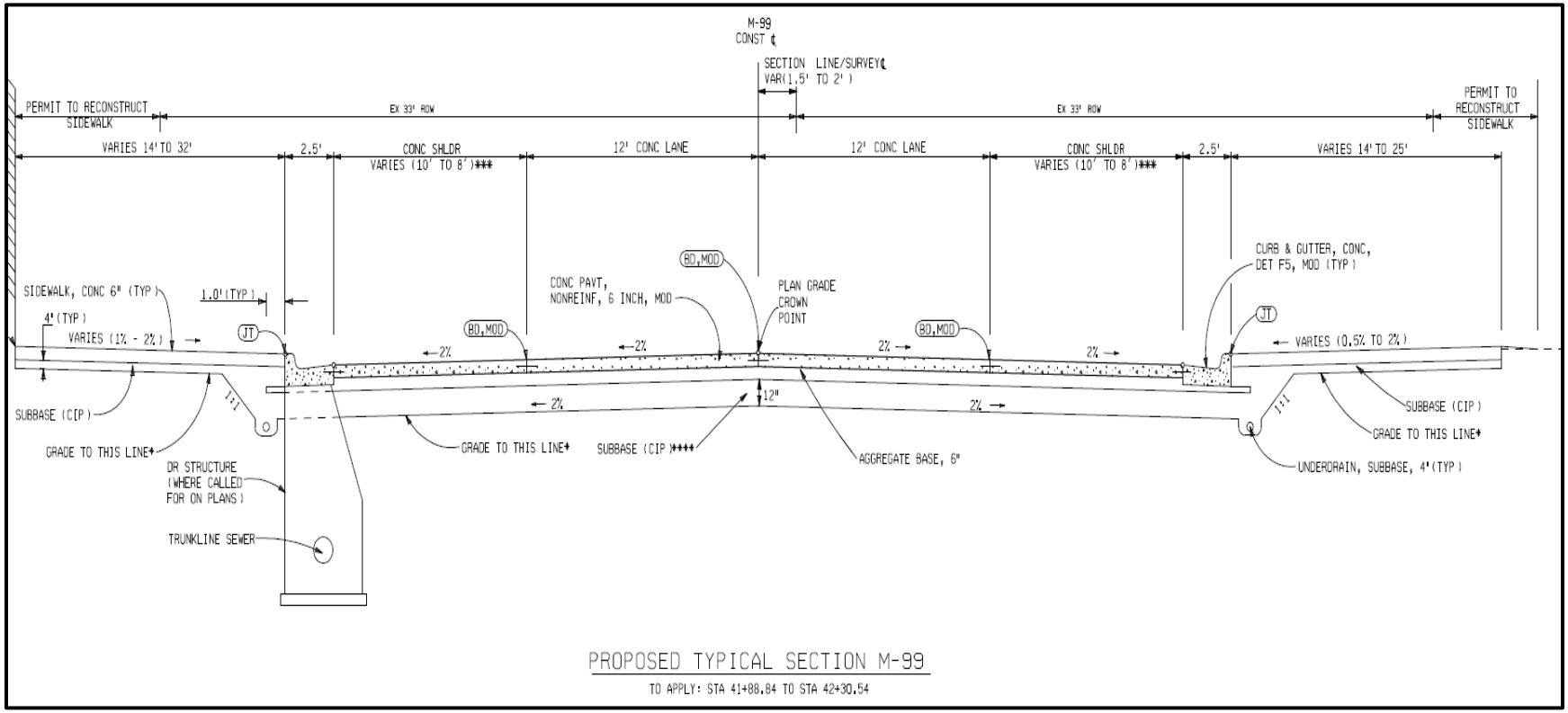


Figure A 31. Proposed Typical Section M-99 (4 lanes)

Field Evaluation Report

Michigan Department of Transportation
Construction Field Services Division
Pavement Management Section

Sheet 1 of 1

Research Proj.:	**Date:** 4/11/22	**Weather:** 60°F, clear & sunny	
Proj. Manager:	**Control Sec./Job No.:** 38011 / 75184		**Attendance:**
Item(s) Surveyed: Low-volume Concrete Demonstration Project			J. Schenkel E. Akerly F. Kaseer A. Hargrove
Location: M-99 in the Village of Springport			
Contractor(s):			
Objective: Yearly visual evaluation			

Observations:
Eastbound & Westbound (EB & WB) noted distresses:

- Only 4 new cracked concrete slabs were noted this year within the project limits. Only 3 additional slabs had noted spalling this year as compared to last year. Accordingly, the severity of existing distresses, including cracks, spalls, and corner breaks remained mostly unchanged from last year.

Conclusions: Like previous surveys, the progression of distress (number and severity of distresses) is mostly steady. Considering the pavement age (~17 years), pavement performance is satisfactory.

Future Work: Per past Pavement Demonstration Program Project Evaluation technical reporting, it was recommended that monitoring of this demonstration project end with final report because this project is performing as good or better than standard concrete reconstruction projects. Since their initial construction costs are generally lower than the standard 8-inch minimum design, and their performance is at least equivalent, it is concluded (based on qualitative and quantitative evaluation of available data) that they are a cost-effective alternative for low-volume roadways.

In the interim, monitoring of this project will continue until its final report is officially approved by MDOT.

Notes taken by: *Justin Schenkel*

Figure A 32. April 2022 Field Evaluation Report for M-99

Field Evaluation Report

Michigan Department of Transportation
Construction Field Services Division
Pavement Management Section

Sheet 1 of 2

Research Proj.:	**Date:** 4/27/22	**Weather:** 40°F, partially cloudy
Proj. Manager:	**Control Sec./Job No.:**	**Attendance:**
Item(s) Surveyed: Low-volume Concrete Demonstration Project		J. Schenkel F. Kaseer E. Akerly A. Hargrove
Location: M-13 in Pinconning		
Contractor(s):		
Objective: Yearly visual evaluation		

Observations:

- Started at south end, traveling in the northbound direction.

Northbound (NB) Direction:

- 50 cracked panels, 3 of which are at the south approach to the bridge for Pine River.
- 94 repaired slabs.
- The longitudinal joint in the middle of the right lane has intermittent areas of heavy scaling and spalling.
- From the south end POB north approximately 550', the 2 slabs making up the right lane have corner cracking/spalling between themselves.
  - Note that these corner spalls were not considered "cracked panels." This was noted in 2019, but these may have been considered "cracked panels" in 2018.
  - These corner spalls were repaired with mastic material, but this repair seems to be wearing out and segregating. The corner spalling may be growing, or slabs may be moving causing the repair to break down. About half of the repairs have failed.
  - Some of the corner spalls are showing signs of washout underneath the slab.

Southbound (SB) Direction:

- 7 cracked panels, 3 of which are at the south approach to the bridge for Pine River.
- 49 repaired slabs.
- Longitudinal joint in the middle of the right lane looks the same as NB.
- Slabs at north end (right before the pavement changes to asphalt), appear to have a small amount of faulting.

Conclusions:

This pavement continues to look good and appears relatively stable. Slight increase in distressed panels than last year, (~2.3% of slabs last year to ~2.4% of slabs this year). The number of previously noted damaged slabs (due to bridge construction) near the bridge for Pine River have remained unchanged, (with 4 few observed cracked slabs noted this year as compared to last year).

Figure A 33. April 2022 Field Evaluation Report for M-13, Page 1

Field Evaluation Report

Michigan Department of Transportation
Construction Field Services Division
Pavement Management Section

Sheet 2 of 2

Future Work:
Per past Pavement Demonstration Program Project Evaluation technical reporting, it was recommended that monitoring of this demonstration project end with final report because this project is performing as good or better than standard concrete reconstruction projects. Since their initial construction costs are generally lower than the standard 8-inch minimum design, and their performance is at least equivalent, it is concluded (based on qualitative and quantitative evaluation of available data) that they are a cost-effective alternative for low-volume roadways.

In the interim, monitoring of this project will continue until its final report is officially approved by MDOT.

Notes taken by: *Justin Schenkel*

Figure A 34. April 2022 Field Evaluation Report for M-13, Page 2

Figure A 35. April 2022 Field Evaluation Pictures for M-13

Figure A 36. April 2022 Field Evaluation Pictures for M-99

Alternative 2: Rigid Construction

Concrete Pavement Type	Thickness (in)		Total Cost
JPCP	6.0	$29.81	$209,880.00

No. of Mid-Panel Long. Joints	Transv. Joint Spacing (ft)	No. of Transv. Joints	Total Length of Joints (ft)	Price	Total Cost
1	6	880	15840	$2.23	$35,323.20

Conc Pavt, Ovly, Finishing and Curing	Price	Total Cost
	$2.03	N/A
		$245,203.20

Figure A 37. MDOT LCCA Cost Estimation for Thin Concrete Reconstruction

Alternative 2: Rigid Construction

Concrete Pavement Type	Thickness (in)	Price	Total Cost
JPCP	8.0	$39.75	$279,840.00

No. of Mid-Panel Long. Joints	Transv. Joint Spacing (ft)	No. of Transv. Joints	Total Length of Joints (ft)	Price	Total Cost
N/A	12	440	5280	$10.94	$57,763.20

Conc Pavt, Ovly, Finishing and Curing	Price	Total Cost
	$2.03	N/A
		$337,603.20

Figure A 38. MDOT LCCA Cost Estimation Spreadsheet for Standard PCC Reconstruction

Appendix B 1: Interim Warranty Inspection Report for M-99

The HNTB Companies
Engineers Architects Planners

119 S. Evans Street
Tecumseh, Michigan 49286

Telephone (517) 424-4682
Facsimile (517) 424-4680
www.hntb.com

April 27, 2009

Mr. Jeff Bigelow, PE
MDOT Jackson TSC
2750 N. Elm Road
Jackson, Mi. 49201

HNTB

Re: University Region Warranty Inspections

Dear Jeff,

A warranty inspection (Interim) was recently completed on the following projects, which were administered by the Jackson TSC:

- SWAD ID 2870 / The warranty location is on Main Street (M-99) in downtown Springport from Maple Street to East of Pearl Street: M&W Warranty for New/Reconstructed Jointed Plain Concrete Pavement. Contract ID 38011-75184 / The Contractor was Mead Bros. Excavating Inc.
- SWAD ID 2871 / The warranty location is on Main Street (M-99) in downtown Springport from Maple Street to East of Pearl Street: New/Reconstructed Hot Mix Asphalt Pavement. Contract ID 38011-75184 / The contractor was Mead Bros. Excavating Inc.

Attached to this correspondence you shall find MDOT Form 1884 (SWAD 2870) / JPCP / JRCP (First Cursory Inspection). As noted on the form, there was evidence of some distresses noted. It is probable that warranty work will be required in the future.

Form 1134 / Superpave and Hot Mix Asphalt (First Cursory Inspection) is also attached to the report pertaining to SWAD 2871. No evidence of any pavement distresses were noted in the HMA portion of this contract.

A PDF file of this inspection will also be e-mailed to you for your future use. Feel free to call at anytime should you have questions and/or concerns pertaining to this warranty report.

Sincerely,
HNTB, Michigan, Inc.

Tom Shultz

CC: Mike Irwin, MDOT
Joe VanPoppel, MDOT
Erin Chelotti, MDOT
File

Warranty Inspection
Materials and Workmanship Warranty for
New/Reconstructed Jointed Plain Concrete Pavement

Interim Inspection

SWAD ID: **2870**
Contract ID: **38011-75184**

Description: **Downtown Springport. Main Street (M-99) from Maple Street to East of Pearl Street. Village of Springport.**

SWAD 2870 Inspected 4-21-2009

M-99 Transverse Cracking near POE, NB-1

Additional cracking near POE NB-1

SWAD 2870 Inspected 4-21-2009

Corner Cracking 64' from POE NB-1

Transverse crack 90 from POE, NB-1

SWAD 2870 Inspected 4-21-2009

Spall 30' north of Pearl St. SB-1

Spall 80' north of Pearl St. SB-1

SWAD 2870 Inspected 4-21-2009

Corner Cracking 100' north of Pearl SB-1

Transverse Crack 100' north of Pearl NB-1

SWAD 2870 Inspected 4-21-2009

Transverse crack 130' north of Pearl across entire roadbed

Scaling around patch in CL near 136 Main Street

SWAD 2870 Inspected 4-21-2009

Transverse crack 180' north of Pearl St. NB-1

Transverse crack 225' north of Pearl St. across entire roadbed

SWAD 2870 Inspected 4-21-2009

Spall 75' south of Maple SB-1

Transverse crack 150' south of Maple

SWAD 2870 Inspected 4-21-2009

Transverse crack 200' south of Maple in SB-1

Corner crack 75' south of Maple St. in SB-1

SWAD 2870 Inspected 4-21-2009

Spall near springpoint of Maple/M-99 NE quad

Transverse Crack/Spall at Maple/M-99 intersection North leg

SWAD 2870 Inspected 4-21-2009

Joint sealant failure Maple/M-99 North leg

Transverse Crack North leg of M-99/Maple

SWAD 2870 Inspected 4-21-2009

Joint sealant failure Maple/M-99 North leg

South leg of M-99/Maple, Longitudinal crack

SWAD 2870 Inspected 4-21-2009

South Leg of M-99/Maple additional Long. crack

South leg of M-99/Maple, transverse crack

SWAD 2870 Inspected 4-21-2009

Corner crack/Transverse crack in SE radius of M-99 and Maple

Picture of slab that has faulted with out signs of distress. East spring point of SE quad of M-99 and Maple.

Michigan Department
of Transportation
1884 (07/07)

FOR: FUSP 602(I) & 602(D)

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (FIRST CURSORY INSPECTION)

CONTRACTOR: Mead Bros. Excavating	INSPECTION DATE: 04/21/09
CONTROL SECTION: 38011	INSPECTED BY: Shawn Tinkey/Dustin Black
JOB NUMBER: 75184 (SWAD 2870)	REVIEWED BY: Tom Shultz
ROUTE: M-99	RESIDENT ENGINEER: Jeffrey Bigelow

INSPECTION LIMITS: 2870, Station 36+02.23 to 43+52 along M-99, also on W. Main St., Mechanic St. and Pearl St. in village of Springport

DO ANY OF THE FOLLOWING DISTRESSES APPEAR?

DISTRESS TYPE	YES	NO	COMMENTS
TRANSVERSE CRACKING	✓		
LONGITUDINAL CRACKING	✓		
MAP CRACKING		✓	
SPALLING	✓		
SCALING	✓		One isolated area
CORNER CRACKING	✓		Minor corner cracking
JOINT SEAL FAILURE	✓		Predominately on Maple
SHATTERED SLABS		✓	

GENERAL COMMENTS ON LOCATION AND SEVERITY OF DISTRESSES:

Transverse Crack lanes 1 and 1A near POE: Corner Crack 64' from POE in lane 1: Transverse crack 90' from POE in across entire roadbed: Spalling 30' north of Pearl SB-1: Spalling 80' north of Pearl St. SB-1: Corner Cracking 100' North of Pearl St. SB-1: Transverse Crack 100' north of Pearl St. NB-1: Transverse crack 150' south of Maple in NB-1: Transverse crack 130' north of Pearl across entire roadbed: Scaling around patch on CL near 136 Main St. Transverse Crack 180' north of pearl across entire roadbed: Transverse crack 225' north of Pearl across entire roadbed: Spalling in NB-1 240' North of Pearl: Spalling 75' south of Maple SB-1: Spalling near springpoint in NE quad of Maple and M-99: Joint sealant failure in intersection of Maple and M-99 near north leg: Transverse Crack in intersection of Maple and M-99 North leg: Longitudinal crack in south leg of Maple/M-99 intersectionNB-1: Transverse Crack in NB-1 mid radius of the SE quad of Maple and M-99:

Also note that there was faulting occuring at one location near the east spring point of the SE quad of Maple and M-99 in a slab that did not show signs of distress.

It is our opinion that future warranty work will be necessary on this portion of the project.

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD

2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

Clear Form

Appendix B 2: Final Warranty Inspection Report for M-99

The HNTB Companies
Engineers Architects Planners

5495 Ann Arbor Road
Jackson, MI 49201

Telephone (517) 764-3345
Facsimile (517) 764-3477
www.hntb.com

June 7, 2011

Mr. Kelby Wallace, PE
MDOT Jackson TSC
2750 N. Elm Road
Jackson, Mi. 49201

HNTB

Re: University Region Warranty Inspections

Dear Kelby,

A warranty inspection **(Final)** was recently completed on the following project, which was administered by the Jackson TSC:

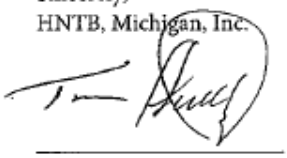
- SWAD ID 2870/ The warranty location is on M-99 (Downtown Springport/Main Street)from Maple Street to east of Pearl Street. / Contract ID: 38011-75184: The warranty is a M&W Warranty for new/Reconstructed Jointed Plain Concrete Pavement. The Warranty Contractor is mead Bros. Excavating, Inc.

Attached to this correspondence you shall find MDOT Forms 1831, JPCP/JRCP (Second Cursory Inspection-Worst Segments) and 1885, JPCP/JRCP (Detail Inspection – Questionable Segments). As noted on the forms, there is evidence of warranty parameters being exceeded. Therefore, **warranty work is required.** A PDF file of this inspection will also be e-mailed to you for your future use.

It should be mentioned that transverse cracking near the relief cuts was noted shortly after construction was completed. Additional cracking was also noted during the Interim Inspection of this contract. Because of the experimental nature of this contract representatives from C&T have been monitoring the condition of the pavement.

Feel free to call at anytime should you have questions and/or concerns pertaining to this warranty inspection. It should also be mentioned that all pictures taken during the field survey are identified by geo-tagging. Geo-tagging, with the use of Google Maps, pinpoints the exact location where the pictures were taken. If you desire, we will furnish you with the needed software and send you individual pictures of the field inspection, or just the ones that you want. The geo-tagging software does not work with the report in its current PDF format.

Sincerely,
HNTB, Michigan, Inc.



Tom Shultz

CC: Mike Irwin, MDOT
Joe VanPoppel, MDOT
Erin Chelotti, MDOT
File

Warranty Inspection
M & W Warranty for New/Reconstructed Jointed Plain Concrete Pavement

Final Inspection

SWAD ID: 2870
Contract ID: 38011-75184

Description: Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.

Picture #1: Spall and cracking around MH.

Picture #2: Corner spall near gutter pan.

Picture #3: Longitudinal cracking (two panels).

Picture #4: Transverse cracking to edge of panel.

Picture #5: Longitudinal cracking (three panels).

Picture #6: Cracking from curb joint through two panels.

Picture #7: Corner spall.

Picture #8: Transverse crack near joint.

Picture #9: Transverse crack near joint.

Picture #10: Transverse crack near joint.

Picture #11: Mid-panel transverse crack.

Picture #12: Transverse crack, parallel with joint.

Picture #13: Mid-panel transverse crack.

Picture #14: Corner crack.

Picture #15: Transverse crack (3 slabs).

Picture #16: Raveling/spalling joint.

Picture #17: Mid-panel transverse crack.

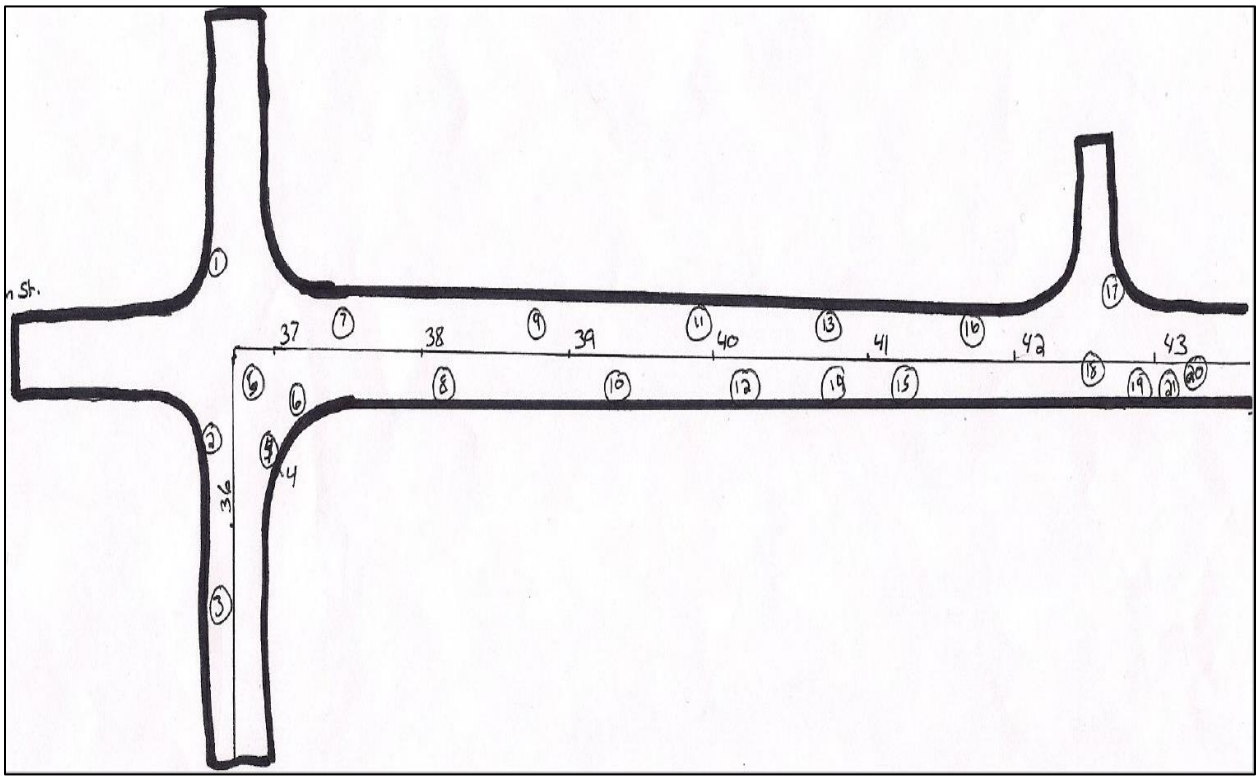
Picture #18: Longitudinal crack extending from previous patch.

Picture #19: Cracking/spalling near curb and gutter.

Picture #20: Longitudinal cracking, southbound only.

SWAD 2870 M-99 5-27-2011

Picture #21: Transverse crack near curb and gutter.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Michigan Department of Transportation 1831 (07/07)

FOR: FUSP 602(I) & 602(D)

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (SECOND CURSORY INSPECTION - WORST SEGMENTS)

CONTRACTOR	INSPECTION DATE
Mead Bros. Excavating Inc.	05/27/11
CONTROL SECTION	INSPECTED BY
38011	D. Black
JOB NUMBER	REVIEWED BY
75184 (SWAD 2870)	Tom Shultz
ROUTE	RESIDENT ENGINEER
M-99	Jeffrey Bigelow (Kelby Wallace)

INSPECTION LIMITS

Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.

TRANSVERSE CRACKING (> 5 FEET)

*(THRESHOLD LIMIT JPCP = 1, JRCP = 2)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF DISTRESSES	COMMENTS
TC-1	NB	0.0 (POB)	1	See picture #6.
TC-2	NB	0.0 (POB)	1	See picture #8.
TC-3	SB	0.0 (POB)	1	See picture #9.
TC-4	NB	0.0 (POB)	1	See picture #10.
TC-5	SB	0.0 (POB)	1	See picture #11.

LONGITUDINAL CRACKING (> 5 FEET)

*(THRESHOLD LIMIT = 5% OF SEGMENT LENGTH)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL % OF DISTRESS	COMMENTS
LC-1	SB	0.0 (POB)	2	See picture #3.
LC-2	NB	0.0 (POB)	1	See picture #5.
LC-3	NB	0.1	<1	See picture #18.
LC-4	SB	0.1	4	See picture #20.
LC-5				

MAP CRACKING

*(THRESHOLD LIMIT = 10% OF SEGMENT AREA)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL % OF DISTRESS	COMMENTS
MC-1				No deficiencies noted.
MC-2				
MC-3				
MC-4				
MC-5				

SPALLING

*(THRESHOLD LIMIT = ≤ 2 SLABS, 10% OF SLAB PERIMETER)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF SLABS	COMMENTS
SP-1	NE quad Mechanic	0.0 (POB)	1% of perimeter	See picture #1.
SP-2	NB	0.0 (POB)	1% of perimeter	See picture #7.
SP-3	SB	0.1	21% of perimeter	See picture #16.
SP-4	NB	0.1	3% of perimiter	See picture #19.
SP-5				

MDOT 1831 (07/07)

SCALING

*(THRESHOLD LIMIT = ≤ 1 SLAB, 15% OF SLAB AREA)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF SLABS	COMMENTS
SC-1				No deficiencies noted.
SC-2				
SC-3				
SC-4				
SC-5				

CORNER CRACKING

*(THRESHOLD LIMIT = 1)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF DISTRESSES	COMMENTS
CC-1	SE quad Mechanic	0.0 (POB)	1	See picture #2.
CC-2	NB	0.0 (POB)	1	See picture #14.
CC-3				
CC-4				
CC-5				

JOINT SEALANT FAILURE

*(THRESHOLD LIMIT = < 2 SLABS, 10% OF SLAB PERIMETER)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF SLABS	COMMENTS
JSF-1				No deficiencies noted.
JSF-2				
JSF-3				
JSF-4				
JSF-5				

SHATTERED SLABS

*(THRESHOLD LIMIT = NONE)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF SLABS	COMMENTS
SS-1				No deficiencies noted.
SS-2				
SS-3				
SS-4				
SS-5				

**WARRANTY WORK REQUIRED? ☑ YES ☐ NO

* ENTER THRESHOLD LIMIT HERE FROM MATERIALS AND WORKMANSHIP PAVEMENT WARRANTY APPENDIX

** FOR EACH CONDITION PARAMETER, SUBTRACT THE ALLOWED NUMBER OF DEFECTIVE SEGMENTS FOR THE PROJECT DRIVING LANES FROM THE RECORDED DEFECTIVE SEGMENTS. WARRANTY WORK IS REQUIRED IF THE RESULT IS POSITIVE.

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD

2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

Clear Form

Michigan Department
of Transportation
1885 (07/07)

FOR: FUSP 602(I) & 602(D)

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (DETAIL INSPECTION - QUESTIONABLE SEGMENTS)

CONTRACTOR: Mead Bros. Excavating Inc.	INSPECTION DATE: 05/27/11
CONTROL SECTION: 38011	INSPECTED BY: D. Black
JOB NUMBER: 75184 (SWAD 2870)	REVIEWED BY: Tom Shultz
ROUTE: M-99	RESIDENT ENGINEER: Jeffrey Bigelow (Kelby Wallace)

INSPECTION LIMITS (DRIVING LANES)
Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.

SCALING

(THRESHOLD LIMIT = ≤ 1 SLAB, 15% OF SLAB AREA)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF SLABS	COMMENTS
SC-1				No deficiencies noted.
SC-2				
SC-3				
SC-4				
SC-5				
SC-6				
SC-7				
SC-8				
SC-9				
SC-10				
SC-11				
SC-12				
SC-13				
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SC-19				
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SC-21				
SC-22				
SC-23				
SC-24				
SC-25				
SC-26				
SC-27				

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD

2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (DETAIL INSPECTION - QUESTIONABLE SEGMENTS)

CONTRACTOR: Mead Bros. Excavating Inc.	INSPECTION DATE: 05/27/11
CONTROL SECTION: 38011 (SWAD 2870)	INSPECTED BY: D. Black
JOB NUMBER: 75184	REVIEWED BY: Tom Shultz
ROUTE: M-99	RESIDENT ENGINEER: Jeffrey Bigelow (Kelby Wallace)

INSPECTION LIMITS (DRIVING LANES): Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.

SHATTERED SLABS

(THRESHOLD LIMIT = NONE)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF DEFECTIVE SLABS	COMMENTS
SS-1				No deficiencies noted.
SS-2				
SS-3				
SS-4				
SS-5				
SS-6				
SS-7				
SS-8				
SS-9				
SS-10				
SS-11				
SS-12				
SS-13				
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SS-18				
SS-19				
SS-20				
SS-21				
SS-22				
SS-23				
SS-24				
SS-25				
SS-26				
SS-27				

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD

2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (DETAIL INSPECTION - QUESTIONABLE SEGMENTS)

CONTRACTOR: Mead Bros. Excavating Inc.	INSPECTION DATE: 05/27/11
CONTROL SECTION: 38011	INSPECTED BY: D. Black
JOB NUMBER: 75184 (SWAD 2870)	REVIEWED BY: Tom Shultz
ROUTE: M-99	RESIDENT ENGINEER: Jeffrey Bigelow (Kelby Wallace)

INSPECTION LIMITS (DRIVING LANES): Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.

TRANSVERSE CRACKING (> 5 FEET)

(THRESHOLD LIMIT JPCP = 1, JRCP = 2)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF DISTRESSES	COMMENTS
TC-1	NB-1	0.0 (POB)	4	
TC-2	SB-1	0.0 (POB)	3	
TC-3	NB-1	0.1	0	
TC-4	SB-1	0.1	3	
TC-5				
TC-6				
TC-7				
TC-8				
TC-9				
TC-10				
TC-11				
TC-12				
TC-13				
TC-14				
TC-15				
TC-16				
TC-17				
TC-18				
TC-19				
TC-20				
TC-21				
TC-22				
TC-23				
TC-24				
TC-25				
TC-26				
TC-27				

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD

2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (DETAIL INSPECTION - QUESTIONABLE SEGMENTS)

CONTRACTOR Mead Bros. Excavating Inc.	INSPECTION DATE 05/27/11
CONTROL SECTION 38011	INSPECTED BY D. Black
JOB NUMBER 75184 (SWAD 2870)	REVIEWED BY Tom Shultz
ROUTE M-99	RESIDENT ENGINEER Jeffrey Bigelow (Kelby Wallace)
INSPECTION LIMITS (DRIVING LANES) Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.	

CORNER CRACKING

(THRESHOLD LIMIT = 1)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF DISTRESSES	COMMENTS
CC-1	NB-1	0.0 (POB)	1	
CC-2	SB-1	0.0 (POB)	1	
CC-3				
CC-4				
CC-5				
CC-6				
CC-7				
CC-8				
CC-9				
CC-10				
CC-11				
CC-12				
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CC-25				
CC-26				
CC-27				

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD

2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (DETAIL INSPECTION - QUESTIONABLE SEGMENTS)

CONTRACTOR	INSPECTION DATE
Mead Bros. Excavating Inc.	05/27/11
CONTROL SECTION	INSPECTED BY
38011	D. Black
JOB NUMBER	REVIEWED BY
75184 (SWAD 2870)	Tom Shultz
ROUTE	RESIDENT ENGINEER
M-99	Jeffrey Bigelow (Kelby Wallace)

INSPECTION LIMITS (DRIVING LANES)
Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.

JOINT SEALANT FAILURE

(THRESHOLD LIMIT = < 2 SLABS, 10% OF SLAB PERIMETER)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF DEFECTIVE SLABS	COMMENTS
JSF-1				No deficiencies noted.
JSF-2				
JSF-3				
JSF-4				
JSF-5				
JSF-6				
JSF-7				
JSF-8				
JSF-9				
JSF-10				
JSF-11				
JSF-12				
JSF-13				
JSF-14				
JSF-15				
JSF-16				
JSF-17				
JSF-18				
JSF-19				
JSF-20				
JSF-1				
JSF-1				
JSF-1				
JSF-1				
JSF-1				
JSF-1				

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD

2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (DETAIL INSPECTION - QUESTIONABLE SEGMENTS)

CONTRACTOR Mead Bros. Excavating Inc.	INSPECTION DATE 05/27/11
CONTROL SECTION 38011	INSPECTED BY D. Black
JOB NUMBER 75184 (SWAD 2870)	REVIEWED BY Tom Shultz
ROUTE M-99	RESIDENT ENGINEER Jeffrey Bigelow (Kelby Wallace)
INSPECTION LIMITS (DRIVING LANES) Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.	

LONGITUDINAL CRACKING (>5 FEET)

(THRESHOLD LIMIT = 5% OF SEGMENT LENGTH)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	TOTAL %OF DISTRESS	COMMENTS
LC-1	NB-1	0.0 (POB)	1	
LC-2	SB-1	0.0 (POB)	2	
LC-3	NB-1	0.1	0	
LC-4	SB-1	0.1	4	
LC-5				
LC-6				
LC-7				
LC-8				
LC-9				
LC-10				
LC-11				
LC-12				
LC-13				
LC-14				
LC-15				
LC-16				
LC-17				
LC-18				
LC-19				
LC-20				
LC-21				
LC-22				
LC-23				
LC-24				
LC-25				
LC-26				
LC-27				

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD

2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (DETAIL INSPECTION - QUESTIONABLE SEGMENTS)

CONTRACTOR Mead Bros. Excavating Inc.	INSPECTION DATE 05/27/11
CONTROL SECTION 38011	INSPECTED BY D. Black
JOB NUMBER 75184 (SWAD 2870)	REVIEWED BY Tom Shultz
ROUTE M-99	RESIDENT ENGINEER Jeffrey Bigelow (Kelby Wallace)
INSPECTION LIMITS (DRIVING LANES) Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.	

MAP CRACKING (THRESHOLD LIMIT = 10% OF SEGMENT AREA)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	TOTAL % OF DISTRESS	COMMENTS
MP-1				No deficiencies noted.
MP-2				
MP-3				
MP-4				
MP-5				
MP-6				
MP-7				
MP-8				
MP-9				
MP-10				
MP-11				
MP-12				
MP-13				
MP-14				
MP-15				
MP-16				
MP-17				
MP-18				
MP-19				
MP-20				
MP-21				
MP-22				
MP-23				
MP-24				
MP-25				
MP-26				
MP-27				

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD

2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

FIELD EVALUATION OF WARRANTY PERFORMANCE

JPCP / JRCP (DETAIL INSPECTION - QUESTIONABLE SEGMENTS)

CONTRACTOR: Mead Bros. Excavating Inc.	INSPECTION DATE: 05/27/11
CONTROL SECTION: 38011	INSPECTED BY: D. Black
JOB NUMBER: 75184 (SWAD 2870)	REVIEWED BY: Tom Shultz
ROUTE: M-99	RESIDENT ENGINEER: Jeffrey Bigelow (Kelby Wallace)

INSPECTION LIMITS (DRIVING LANES): Main Street (M-99) from Maple Street to east of Pearl Street, Village of Springport.

SPALLING (THRESHOLD LIMIT = ≤ 2 SLABS, 10% OF SLAB PERIMETER)

SEGMENT NO.	LANE DESCRIPTION	DISTANCE FROM POB TO START OF SEGMENT (miles)	ESTIMATED TOTAL NUMBER OF SLABS	COMMENTS
SP-1	NB-1	0.0 (POB)	1%	
SP-2	SB-1	0.0 (POB)	1%	
SP-3	NB-1	0.1	3%	
SP-4	SB-1	0.1	21%	
SP-5				
SP-6				
SP-7				
SP-8				
SP-9				
SP-10				
SP-11				
SP-12				
SP-13				
SP-14				
SP-15				
SP-16				
SP-17				
SP-18				
SP-19				
SP-20				
SP-21				
SP-22				
SP-23				
SP-24				
SP-25				
SP-26				
SP-27				

DISTRIBUTION: REGION OFFICE, TSC MANAGER, RESIDENT ENGINEER, WARRANTY CONTRACTOR, SURETY COMPANY[1,2]

1 - DISTRIBUTION AT THE END OF THE WARRANTY PERIOD
2 - DISTRIBUTION WHEN WARRANTY WORK IS REQUIRED

Clear Form

Appendix C: CESAL Computations

Table C 1. M-13 Actual CESAL Estimation Data from Mary Street to North Street

YEAR	CAADT	DD	LD	TF	CESALS
2025	448	0.57	0.9	0.78	65,434
2024	435	0.57	0.9	0.78	63,528
2023	422	0.57	0.9	0.78	61,677
2022	410	0.57	0.9	0.78	59,881
2021	418	0.57	0.9	0.78	61,049
2020	362	0.57	0.9	0.78	52,870
2019	440	0.57	0.9	0.78	64,262
2018	321	0.54	0.9	0.78	44,415
2017	341	0.54	0.9	0.78	47,182
2016	349	0.54	0.9	0.78	48,289
2015	405	0.54	0.9	0.78	56,038
2014	461	0.54	0.9	0.78	63,786
2013	450	0.54	0.9	0.78	62,264
2012	440	0.54	0.9	0.78	60,880
2011	434	0.54	0.9	0.78	60,050
2010	419	0.54	0.9	0.78	57,975
2009	404	0.59	0.9	0.78	61,075
2008	454	0.59	0.9	0.78	68,634
2007	440	0.59	0.9	0.78	66,575
2006	427	0.59	0.9	0.78	64,578
				Cumulative CESALS	1,190,441

Table C 2. M-99 Actual CESAL Estimation Data from Mechanic Street to Pearl Street

YEAR	CAADT	DD	LD	TF	CESALS
2026	93	0.51	1	0.78	13,564
2025	91	0.51	1	0.78	13,169
2024	88	0.51	1	0.78	12,785
2023	85	0.51	1	0.78	12,413
2022	83	0.51	1	0.78	12,051
2021	86	0.51	1	0.78	12,487
2020	76	0.51	1	0.78	11,035
2019	65	0.51	1	0.78	9,438
2018	65	0.51	1	0.78	9,438
2017	66	0.51	1	0.78	9,583
2016	75	0.51	1	0.78	10,890
2015	74	0.51	1	0.78	10,745
2014	73	0.51	1	0.78	10,599
2013	196	0.51	1	0.78	28,459
2012	192	0.51	1	0.78	27,878
2011	189	0.51	1	0.78	27,442
2010	183	0.51	1	0.78	26,619
2009	178	0.51	1	0.78	25,820
2008	172	0.51	1	0.78	25,046
2007	167	0.51	1	0.78	24,294
				Cumulative CESALS	333,755

Table C 3. M-99 Initial Design CESAL Estimation Data for M-13 and M-99

ROUTE	LOCATION	CAADT	DD	LD	TF	GF	CESALS
M-13	Mary Street to North Street	509	0.51	0.8	0.78	26.87	1,588,690
M-99	Mechanic Street to Pearl Street	103	0.51	1.0	0.78	20.33	303,397