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P O R T L A N D C E M E N T C O N C R E T E  
P A V E M E N T T E C H N O L O G Y

# Portland Cement Concrete Patching Techniques vs. Performance and Traffic Delay

Final Report  
January 2004

IOWA STATE UNIVERSITY

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

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<b>16. Abstract</b> Standards for the construction of full-depth patching in portland cement concrete pavement usually require replacement of all deteriorated based materials with crushed stone, up to the bottom of the existing pavement layer. In an effort to reduce the time of patch construction and costs, the Iowa Department of Transportation and the Department of Civil, Construction and Environmental Engineering at Iowa State University studied the use of extra concrete depth as an option for base construction. This report compares the impact of additional concrete patching material depth on rate of strength gain, potential for early opening to traffic, patching costs, and long-term patch performance. This report also compares those characteristics in terms of early setting and standard concrete mixes. The results have the potential to change the method of Portland cement concrete pavement patch construction in Iowa.					
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# **PORTLAND CEMENT CONCRETE PATCHING TECHNIQUES VS. PERFORMANCE AND TRAFFIC DELAY**

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The data collection and analysis for this project were the result of a combined effort by members of the Iowa DOT Office of Materials, the Iowa DOT Des Moines Construction Residency, the Department of Civil, Construction and Environmental Engineering (CCEE) at Iowa State University, and the ICPA. The research was completed and made available for the report through the work of Sara Somsy, Dr. Kejin Wang, and Jera Williams.

This project was made possible by the cooperation between the ACPA, ICPA, Iowa DOT, CTRE, PCC Center, and CCEE. The project originated with an idea from an ACPA representative and a concern from the Iowa DOT about traffic control within patching projects. The research in this report represents what can be done when all sectors of the concrete paving industry cooperate to solve problems.

## **INTRODUCTION**

Repair of concrete pavements includes both partial and full-depth patching of distressed areas of the slab. State departments of transportation are constantly looking for ways to reduce the traffic delay caused by patching operations, reduce construction costs, and improve the performance of patches.

Early experience in patching included early failures attributed to premature opening to heavy traffic and the environment. Patches developed various types of cracks and moved down into the subgrade at an early age. Transportation departments responded with the addition of special subgrade preparations, drainage, and load transfer methods and devices between the patch and the existing slabs. Departments also tested the addition of rapid setting agents in the patching mix and alternative times at which to patch during day and night hours. These ideas helped improve patch performance, but also added greatly to patching cost and delay time.

Concrete industry representatives and public owners in Iowa continued to look for optimal tradeoffs between construction methods, materials, and costs pertaining to traffic delay and improved performance of the patching materials. This study is one alternative being investigated to optimize this relationship.

## **BACKGROUND**

Each state and local government agency has adopted patching standards from surrounding agencies over time. Standards vary from area to area and often have little or no research background to support the methods used. At the state level, the American Association of State Highway and Transportation Officials (AASHTO) is working to standardize those methods and materials, but much remains to be done.

During the review of existing information for this project, two studies were identified that related directly to this standardization. The first was a study for the Iowa Department of Transportation (DOT) by Champak L. Narotam and John H. Vu, entitled “Evaluation of Concrete Patching Mixes and Opening Time Using the Maturity Concept” (MLR-93-01). The research was conducted in 1993. The second study was a “Statewide Summary of Accelerated Patching Quality Improvement Team Report” by H.M Wakefield of the Federal Highway Administration (FHWA) and Matthew Mueller of the Illinois Department of Transportation (IDOT).

The research for the Iowa DOT had three objectives:

- (1) Review the present patching specifications regarding the curing time and temperature requirements.
- (2) Estimate the resulting concrete strength based on the present patching specifications.
- (3) Evaluate the possibility of lowering the specification requirements.

The research included both laboratory and field testing of five mixes with various combinations of hot and cold water, along with water reducers and calcium chloride additives. Maturity and compressive strength testing procedures were used to compare the effects of water temperature and water reducer and calcium chloride additives on concrete performance.

Research results indicated that the current specifications for patching methods and curing times were adequate. The addition of water reducers to patching mixes resulted in lower strengths and the need for longer cure times. The concrete temperature of 75°F was retained as the control on 36-hour patches rather than specifications on water temperature. Based on the results, adequate compressive strength could be obtained in less than 24 hours of curing, without the addition of calcium chloride. A minimum cure time of six hours was identified vs. the current five-hour specification for use in cold weather.

Additional research was suggested to better understand maturity-concrete strength relationships, explore the impact of seasonal temperatures, and evaluate the influence of admixtures on concrete strength and maturity.

The Illinois study was undertaken to investigate methods for reducing time in the construction of pavement patches associated with the traveling public. The research team reviewed patching projects in four highway districts. Results and recommendations from the data analysis centered on the following areas:

- (1) Contract documents: Specifications should be tailored to meet the time requirements associated with the public need for the facility.
- (2) State of the practice: Ternary mix design could be used under specific conditions and the results shared among highway agency personnel.
- (3) Patching and rehabilitation: The type and use of accelerated concrete should be tailored to meet the project demands.
- (4) Calcium chloride: This admixture should be used only in deteriorated concrete or as part of overlay preparation, due to its detrimental impacts on the pavement and reinforcement.
- (5) Opening strength: Opening flexural strengths of 0 psi and compressive strengths 600 psi were achieved with an opening of 1.5 hours after construction. Strengths of 50 psi flexural or 1,500 psi compressive were recommended as opening criteria for two-lane roads using the calcium chloride-enhanced concrete, and 300 psi flexural and 2,000 psi compressive for continuously reinforced concrete or heavily trafficked roadways.
- (6) Class PP concrete practice: A special mix utilizing high-range water reducers, calcium chloride, and 735 lbs of cement has proven to be the best combination of materials in ambient air temperatures above 70°.
- (7) Technology new to IDOT: Materials research should be continued on the use of new patching materials.
- (8) Modification of patch designs: The DOT should continue the investigation of more rapid patching materials and methods.

## **RESEARCH OBJECTIVES**

The research in this report had the following objectives:

- (1) Investigate the relationship between pavement patch thickness and allowable opening time for concrete pavements.
- (2) Investigate the relationship between patch thickness and early traffic load capacity of concrete pavements.
- (3) Investigate whether maturity methods are suitable for determining concrete strength and pavement early opening to traffic timing.

## **PROJECT SITE DESCRIPTION**

An actual pavement patching construction project was chosen as the location for research testing. The site was located on U.S. Highway 6 in Polk County, Iowa, 0.2 miles west of I-35, easterly to Merle Hay Road, and is part of project MP-61 (707) 127, 76-77. The portion of the project used for research consisted of a four-lane divided roadway, 3.42 miles in length. Portions of the eastbound and westbound lanes that consisted of existing nine-inch-thick portland cement concrete pavement were used for the test locations. This portion of U.S. Highway 6 is located in an urban area and carries 22,000 vehicles per day. It serves as an intercity truck route across the Des Moines metropolitan area. This project was administered by the Des Moines Construction Residency of the Iowa DOT. The contractor for the project was E. K. Bridge Company of Hudson, Iowa.

## **EXPERIMENTAL DESIGN**

The experimental design for this work involved various combinations of concrete mix design, pavement patch thicknesses, and times of opening to traffic. The concrete mixes utilized in the experiment included the conventional C4 mix and the patching M4 mix. The common patch size on this project was selected as being 12 feet wide (the width of a lane) by 3 feet in length to allow for installation of dowels on each end of the patched areas. Dowels (1.5 inches in diameter) were to be inserted into the existing concrete and extended into the patch.

Two types of concrete mixes, C4 and M4, were used in the present project. C4 mix has a water-cement ratio (w/c) of approximately 0.43 and a cement factor of 624 lb/cy, while M4 mix has a w/c of approximately 0.33 and a cement factor of 825 lb/cy. C4 mix has only an air entraining agent as an admixture, while M4 mix has calcium chloride as an accelerator in addition to an air entraining agent. As a result, M4 mix is considered to have a higher early strength development than C4 mix.

The existing roadway on this project consisted of a two-lane, 24-foot-wide, 9-inch-thick pavement with doweled transverse joints. The 9-inch depth served as the default thickness. Additional patch depths of 11, 13, and 15 inches were tested to determine the effect of patch thickness on performance. The thickness also represents the impact of removing an unstable base and replacing it with concrete rather than special backfill with extra compaction effort.

Traffic opening criteria involved allowing traffic to begin driving over the patches at three, five, and seven hours. An additional set of patches was designed for opening at a maturity of 350 psi flexural strength.

The overall layout of the test patches resulted in 15 separate patches utilizing the M-4 mix and an additional 12 patches employing the C-4 mix.

## **TESTING PROCEDURES AND EQUIPMENT**

Four basic types of tests were conducted on this project during and after construction: (1) maturity testing of the plastic and hardened concrete during the first week after placement, (2) concrete strength estimation by use of the Schmidt Hammer, (3) load transfer and deflection of the patches and surrounding hardened concrete, and (4) visual distress surveys of the finished product. Photos of the completed patches were also taken.

### **Maturity Test Results**

The maturity test method determines a time-temperature factor (TTF) related to the flexural or compressive strength of the concrete. It represents the area under the time and temperature curve developed for a given concrete mix. In this case, a curve was developed for each of the M4 and C4 mixes. The required TTF factors for the various mixes to meet the target opening strength of 350 psi flexural strength were approximately 398 for M4 and approximately 596 for C4.

### **Load Transfer and Maximum Deflection**

Load transfer was accomplished on each side of the patch by adding smooth dowels at one-foot intervals across each of the transverse faces of the area to be patched. Testing was done by using the Iowa DOT falling weight deflectometer. All testing was done in the direction of travel. The first test on each patch was accomplished by placing the load on the existing concrete near the first patch joint and placing the second sensor on the patch. One 9,000-pound load level was applied at this point. Next, the load was moved to the second transverse joint of the patch and placed on the patch, with the second sensor on the existing concrete. Again, one drop at 9,000 pounds was made at this location. Maximum deflections were recorded under the load on the FWD at the center of the patch.

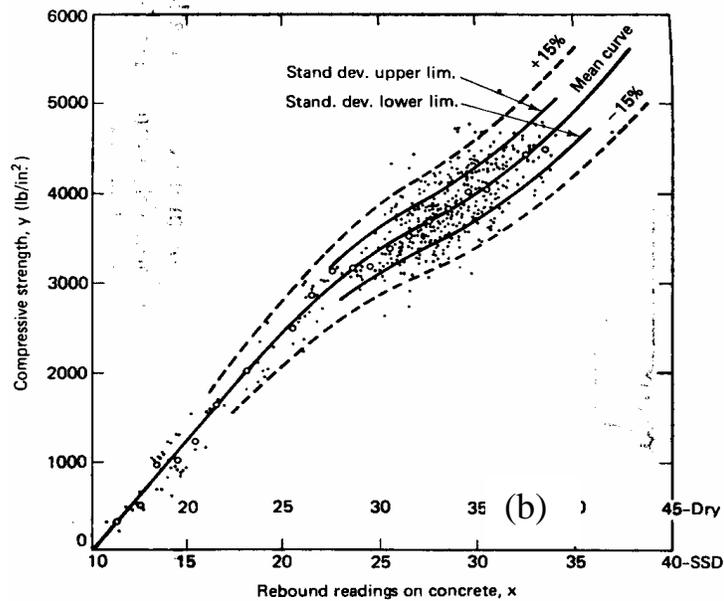
### **Schmidt Hammer**

A rebound test, often performed using the Schmidt rebound hammer, is a simple, quick, and inexpensive method for checking the uniformity of in-place hardened concrete. The Schmidt rebound hammer (Figure 1a) consists of a spring-controlled hammer that slides on a plunger. When the plunger is pressed against the concrete surface, it retracts against the force of the spring; when completely retracted, the spring is automatically released. The hammer impacts the concrete surface and the spring-controlled mass rebounds, taking a rider with it along a guide scale that is used to gauge the hammer rebound number.

From a theoretical point of view, a rebound test represents a complex problem of impact loading and stress wave propagation. The rebound distance depends on the kinetic energy in the hammer before impact with the shoulder of the plunger and the amount of that energy absorbed during the impact. Part of the energy is absorbed by mechanical friction in the instrument, and part of the energy is absorbed in the interaction between the plunger and the concrete. The energy absorbed by the concrete depends on the stress-strain relationship of the concrete; therefore, rebound numbers are related to the strength and the stiffness of the concrete. A low-strength, low-stiffness concrete absorbs more energy than a high-strength, high-stiffness concrete and thus produces a lower rebound number. Although there is no theoretical relationship, empirical correlations between rebound number and concrete strength have been discovered (Figure 1b).



**Figure 1a. Schmidt hammer**



**Figure 1b. Rebound number vs. compression strength**

Many factors affect the rebound number. In rebound hammer testing, only the concrete near the plunger significantly influences the rebound value. Therefore, the test is sensitive to the local conditions where the test is performed. Many factors other than concrete strength influence the rebound number, including concrete stiffness (amount and type of aggregate), surface smoothness, temperature and moisture conditions, degree of carbonation, and instrument orientation.

Since the rebound number depends on the concrete stress-strain relationship, two concretes with equal strengths may display different rebound numbers if the two mixtures have different stiffnesses. Conversely, two concretes with different strengths may produce the same rebound numbers if the stiffness of the low-strength concrete is greater than the stiffness of the high-strength concrete.

Because the amount and type of aggregate has a significant effect on concrete stiffness, it is necessary to establish the strength-rebound number relationship on concrete made with the same

materials. The location of the rebound hammer plunger also has a significant influence on rebound test results. If the plunger is located over a hard aggregate particle, an unusually high rebound number will result. On the other hand, if the plunger is located over a large air void or over a soft aggregate particle, a lower rebound number will occur.

The surface texture of a concrete structure may also influence the rebound number. When a rebound test is performed on rough concrete, local crushing occurs under the plunger and the indicated concrete strength will be lower than the true value. (Therefore, a rough surface should be ground before testing.) A hard, smooth surface, such as that produced by trowel finishing, can result in higher rebound numbers.

In addition, ambient temperature and relative humidity have important effects on rebound testing. If the near-surface concrete freezes, it displays a higher rebound number than thawed concrete. A dry surface may result in higher rebound numbers than a moist interior of the concrete. Similarly, curing conditions, which affect concrete surface strength more than the concrete strength several inches (hundreds of millimeters) from the surface, also affect the concrete rebound value.

Surface concrete carbonation can result in higher rebound numbers, which do not indicate the interior concrete conditions. However, the carbonation effect is not considered in the present research, since the rebound tests were performed on early age concrete (less than two weeks old).

Finally, rebound distance is affected by the orientation of the instrument. Therefore, the same instrument orientation should be maintained during the entire rebound test program. Otherwise, the strength-rebound number relationship must be developed for the same instrument orientation as that used for in-place testing.

## **Visual Distress**

Visual distress surveys were conducted on August 23 and October 8, 2002 by the research staff.

## **CONSTRUCTION METHODS**

The construction of the patches was carried out through a chain-type operation. One lane of the roadway was taken out of service and the patch areas to be removed were all sawed in one operation. At a second and separate time, the contractor broke and removed the broken concrete with a backhoe. In the same work train, one group cleaned out loose materials in the excavated area and installed dowels in each transverse side of the hole. To provide the results for the varying patch thicknesses, the depth of the final patch area was excavated to the design depths of 11, 13 and 15 inches. Later in the same day, when there was sufficient volume of excavation to warrant a truckload of concrete, patching material was ordered and placed in the excavated areas. The concrete was then finished, a thermocouple wire installed, white-pigmented curing compound was placed on the patch, and the patch was covered with insulation board for curing.

Patches were arranged so that the required seven-hour cure patches were placed first, the five-hour patches second, three-hour patches third, and the patches in the 350-psi group were placed fourth. Three patches of each combination were placed consecutively. In this way, all but the 350-psi patches could be opened at approximately the same time. Maturity was measured on each of the patches for seven days after placement or until the wires were lost due to vehicular traffic.

The first patches placed included the M4 mix design, and the second set included several patches in the westbound lane that included the C4 concrete mixture.

The original goal of the research team was the execution of the work with no extra effort by the contractor, and therefore no extra cost for this work. It was assumed that removing the need for special time and effort to stabilize the bottom of the patch area, and the lack of need for calcium chloride in a portion of the concrete patches, would more than offset the additional depth of removal in a portion of the test patches. The contractor on this project did not agree with this analysis and negotiated an extra work change order with the resident construction engineer. The order included an additional cost of \$2,091.60 for 74.7 sy of overdepth excavation and \$20,216.00 for 224 sy of test patches, for a total additional cost of \$22,307.60.

## **DATA ANALYSIS**

### **Load Transfer and Maximum Deflection**

The deflection data was collected as noted with the Iowa DOT's FWD, and the results are displayed in Appendix A. Testing was done in the direction of traffic flow, with the first load transfer test conducted at the approach side of the patch and the second test conducted at the leave side of the patch.

All load transfer values obtained were over 90%, indicating that over 90% of the load is transferred across the joint during the passage of the tire over the joint. The lowest value obtained was 90.3% and the highest value obtained was 99%. Values in excess of 75% are considered adequate for good performance of the joint. Due to the method of positioning the load sensor in each test, the values obtained from the leave side of the patch are always a small amount lower than those of the approach side of the patch.

### **Visual Distress**

The results of the visual distress surveys were very positive in terms of the performance of all patches. The results of the two surveys are shown Appendix B. Patch 2 in the eastbound lane exhibited a transverse crack that could be associated with lockup of the dowels. No further deterioration has been noted in this patch since that time. Patch 10 in the westbound lane showed small amounts of spalling and corner cracking in the surface only. This appears to be the only patch affected by the workmanship of the contractor forces and the time of opening. The surface spalling was sealed and no further deterioration has occurred in this patch.

## **Maturity Test Results**

The results of the maturity testing and a maturity graph for each of the patch areas are shown in Appendix C. The following is an analysis of the data.

Eastbound sites 1 through 4 were opened to traffic seven hours after the placement of the concrete. Regardless of the depth of the patch, each attained the required TTF of 398 in approximately seven hours. Sites 5 through 8 were opened to traffic five hours after placement at an attained TTF of approximately 300. Higher values were obtained for the patches of greater depth, where the mass of the concrete is working toward the larger heat production. Eastbound sites 9 through 12 were opened to traffic three hours after concrete placement. A TTF of approximately one-third the required number of 398 was achieved in three hours in each case. The results also indicate that the higher TTF factors were gained in the patches of greater depth for the given opening time. Sections 13 through 15 in the eastbound lane were placed with the target flexural strength value of 350 psi. As could be expected, this strength value required between seven and eight hours after concrete placement. The thicker sections achieved the desired strength earlier than the thinner sections.

In the case of the westbound patches, the C4 mix was employed and the maturity gages were installed one inch below the surface of the patch and near the midpoint in the patch depth. The intent of this placement was to compare the values for future use in determining opening times for patches.

Westbound patches 1 through 4 were opened to traffic seven hours after placement. The required TTF factor of 598 would be attained at approximately 15 hours after concrete placement, regardless of patch concrete depth. The TTF attained in the first seven hours after placement was approximately 300 at the midpoint gage depth, regardless of depth of patch. Patches 5 through 8 in the westbound direction were opened to traffic in five hours. In this time, a TTF factor of approximately 200 was attained at the mid point depth and the near surface gages. The values did not differ with regard to design depth of patch. The final group of patches in the westbound lane includes test sections 9 through 12. In this case, a TTF of approximately 115 was achieved in the three hours between placement of the concrete and the opening to traffic. There was no appreciable difference between the midpoint depth and surface gage values.

## **Schmidt Hammer Analysis**

Rebound tests were performed based on ASTM C805 requirements. Orientations of the rebound hammer were kept perpendicular to pavement surfaces for all measurements. To account for all possibilities caused by the various factors that influence rebound numbers, as discussed above, at least 10 rebound numbers were taken from each patch, according to ASTM C 805 requirements. The hammer plungers were located two feet from each other. Figure 2 illustrates the typical hammer plunger layouts for the tested patches.



The effects of concrete mix, patch thickness, and time patches were opened to traffic on rebound numbers are shown in Figures 3 and 4. The data points in the figures represent the average rebound values of tested patches. The rebound readings for all tested patches are presented in Appendix D. The average values were calculated based on the following rules: (1) if a reading differed by more than seven units from the average of all readings obtained from a tested patch, this reading was discarded and a new average was computed based on the remaining readings; and (2) if more than two out of ten readings differed from the average by seven units, the entire set of readings was discarded.

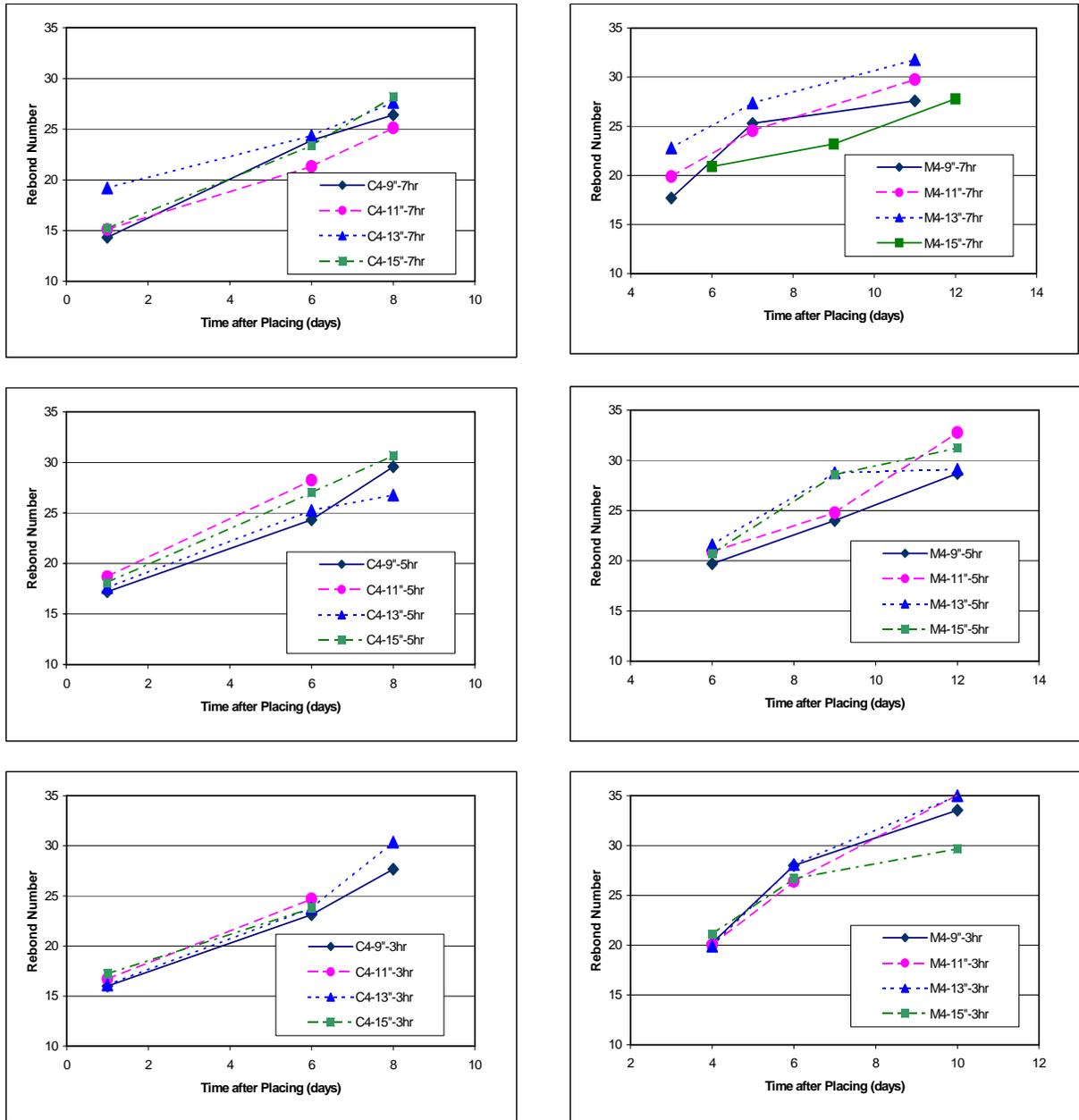


Figure 3. Effect of patch thickness on rebound numbers

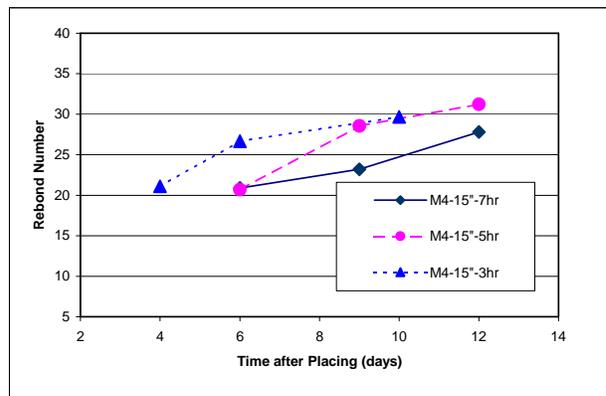
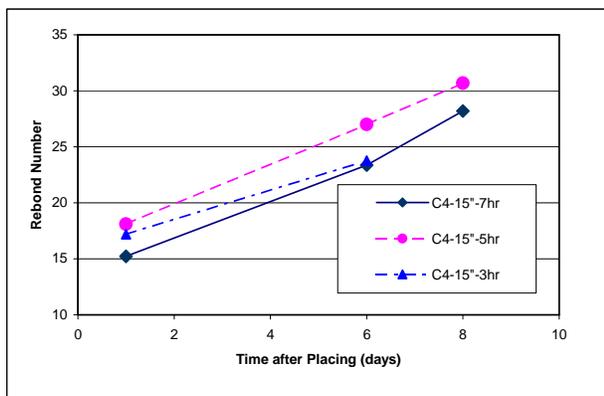
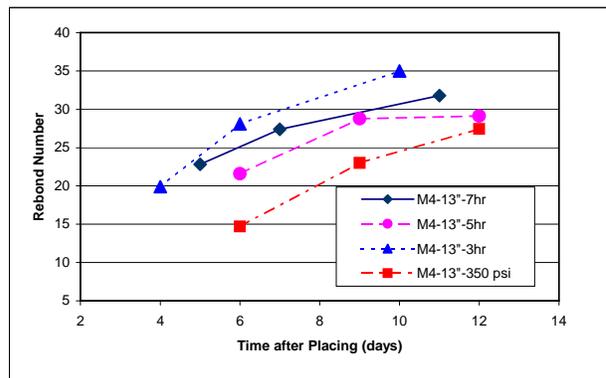
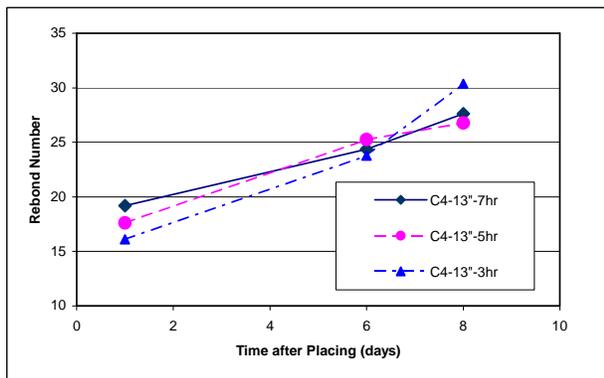
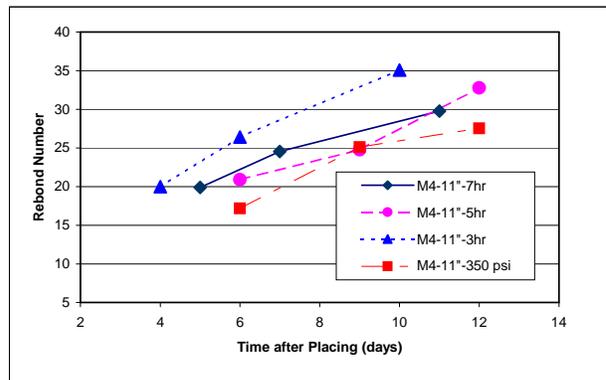
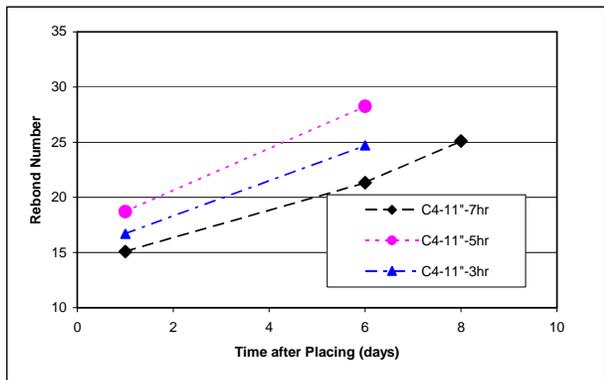
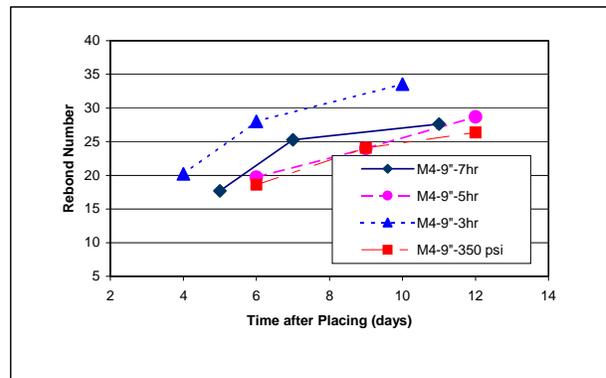
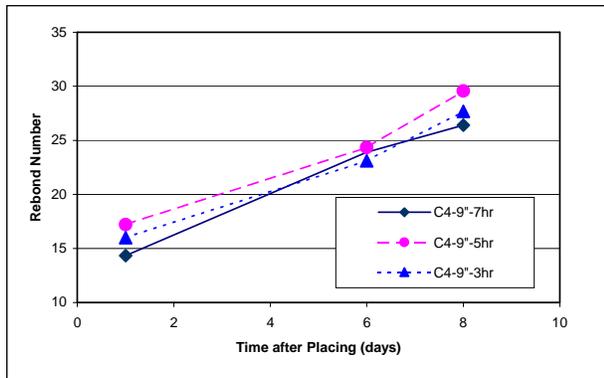


Figure 4. Effect of opening time on rebound numbers

Figure 3 plots the rebound numbers of the patches made with the same concrete mix and opened to traffic at the same time after placing, but having different patch thickness. The figure displays the effect of patch thickness on rebound numbers. The following is observed from the figure:

- (1) The rebound numbers of all patches increase with time after patching, indicating that rebound tests characterize strength development of the in-place concrete.
- (2) For a given patch thickness and opening time, patches made with M4 mix do not display significantly higher rebound numbers than patches made with C4 mix at the same age after placing. For example, at six days after placing, patches made with C4 mix and opened to traffic at seven hours display rebound numbers ranging from 21–24 (Figure 3a); these are similar to the patches made with M4 mix and opened to traffic at seven hours (Figure 3d).
- (3) These results may be attributed to three possibilities: (i) the rebound test is not sensitive enough to identify the difference in strength development between C4 and M4 mixes; (ii) as discussed before, it is possible that the two concretes have the same rebound numbers but different strengths if the stiffness of the low-strength concrete (C4 mix) is greater than the stiffness of the high-strength concrete (M4 mix); and (iii) some patches made with M4 mix were placed on different dates than the patches made with C4 mix (i.e., all C4 mix patches were placed on September 19, while M4 mix patches were placed on September 19, 20, and 21, 2001). The curing conditions for patches placed on different dates might vary, thus affecting rebound values.
- (4) No clear patterns in Figure 3 show how patch thickness influences concrete strength development. For example, among the patches made with C4 mix and opened to traffic at seven hours, the patch having a thickness of 13 inches displays the highest rebound number; while among the patches made with C4 mix but opened to traffic at five hours, the patch having a thickness of 13 inches has the second-to-lowest rebound number. This observation may indicate that patching thickness does not significantly influence near-surface concrete strength, though it may influence the internal concrete strength development. Therefore, maturity test results should be analyzed to determine whether patch thickness influences the internal concrete strength development.
- (5) Regardless of concrete mix, the patches having the same early opening time to traffic (such as three hours after placing) and different patch thickness display very close rebound numbers at an early age (one day or four days). This may indicate that the early strength of the near-surface concrete in pavements may be predominantly influenced by the compression of the concrete mixture resulting from early traffic loads. Contribution of cement hydration to near-surface concrete strength might become more significant at a later age.

To illustrate the effect of pavement opening time on rebound number, all rebound test data are re-plotted into an alternative form in Figure 4. Closely examining Figure 4, one can find some patterns that may reveal optimal opening times for patches made with different concrete mixes:

- (1) Regardless of patch thickness, all patches made with C4 mix and having an opening time of five hours display the highest rebound numbers, the patches having an opening time of three hours display medium rebound numbers, and the patches with an opening time of seven hours display the lowest rebound numbers, expected for the 13-inch-thick patches.
- (2) Regardless of patch thickness, all patches made with M4 mix and having an opening time of three hours display the highest rebound numbers, the patches having an opening time of seven hours display medium rebound numbers, the patches having an opening time of five hours display low rebound numbers, and the patches opening at 300 psi display the lowest rebound numbers, expected for the 15-inch-thick patches.

As mentioned above, near-surface concrete strength development may benefit from both the compression effect of early traffic loading and cement hydration. Before concrete starts to harden, proper compression from appropriate traffic loads may facilitate concrete early strength development by improving concrete density. However, if the load applied is too large and/or too early, it will damage the concrete. On the other hand, after the concrete hardens, applying traffic loads not only fails to make the concrete denser, but also requires the concrete to have sufficient strength to carry the load. As a result, there is an optimal time for pavement made with a given concrete mix to open to traffic. The present rebound test results indicate that the optimal opening time is five hours after placing for the patches made with C4 mix, and three hours for the patches made with M4 mix.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **Project Conclusions**

- (1) Increased patch depth enhanced the concrete strength gain associated with the heat of hydration and maturity testing.
- (2) Measured performance, in terms of deflection testing for load transfer and visual distress measurements, indicated no differences due to concrete mix, opening times for traffic, or concrete patch depths.
- (3) Due to the limited amount of patches, the research team was not able to determine the amount of time saved in each patch by reducing the amount of time spent in subgrade preparation.
- (4) Maturity test methods proved to be consistent in terms of the resulting TTF factors for each concrete mix used. The reliable test method determines opening times to traffic vs. achieved flexural or compressive concrete strength.
- (5) The Schmidt hammer is capable of monitoring strength gain over time in concrete pavement patches or pavement construction. Further development is needed of the strength relationship between hammer rebound and concrete.

## **Recommendations**

- (1) Conduct an expanded test of the patching techniques on multiple pavements in Iowa. Pavements of different existing depths can be used to verify that patches with additional depth can save time and money in patching operations.
- (2) Investigate the tolerable lower limits of TTF in terms of concrete patch performance (resistance to cracking and tracking in the surface).
- (3) Continue to develop the Schmidt hammer or a similar device as an additional nondestructive testing method that can determine patch opening time to traffic.
- (4) Develop a performance specification to provide incentives to the contractors who utilize this method to develop patching.

## **REFERENCE**

Narotam, C.L. and J.H. Vu. 1993. *Evaluation of Concrete Patching Mixes and Opening Time Using the Maturity Concept (MLR-93-01) for the Iowa DOT*. Ames, Iowa: Iowa Department of Transportation, Iowa Highway Research Board.

## APPENDIX A. LOAD TRANSFER

**Table 1. Eastbound lane load transfer data**

EBL	Load	Sensor 1	Sensor 2	Sensor 3	Sensor 4	Sensor 5	Sensor 6	Sensor 7	Sensor 8	Sensor 9	Load transfer	
1	9.28	7.13	6.88	6.67	6.31	5.93	4.94	4.03	3.24	6.5	98.9	94.6%
1	9.51	7.88	7.53	7.11	6.58	6.05	5.04	4.14	3.34	6.99	102.2	92.5%
2	9.01	5.52	5.43	5.25	5.07	4.85	4.38	3.56	2.89	5.1	98.5	96.6%
2	8.44	7.6	6.83	6.73	6.1	5.59	4.6	3.71	2.91	5.46	101.8	90.6%
3	8.75	4.39	4.12	3.97	3.8	3.6	3.25	2.8	2.34	4.2	103.3	95.7%
3	8.8	5.87	5.8	5.54	5.21	4.86	4.19	3.51	2.85	4.81	101.4	94.0%
4	8.87	3.05	2.94	2.9	2.87	2.82	2.67	2.36	2.01	2.93	102.5	99.0%
4	9.26	3.2	4.58	4.34	4.07	3.79	3.29	2.83	2.39	3.88	102.9	93.8%
5	9.23	4.69	4.47	4.26	4.02	3.72	3.18	2.63	2.16	4.32	104.4	94.4%
5	8.84	5.55	5.43	5.14	4.8	4.43	3.83	3.25	2.76	4.6	102.5	93.4%
6	9.11	4.91	4.71	4.54	4.29	4.07	3.63	3.04	2.49	4.49	104	94.5%
6	9.24	5.97	6.24	6.16	5.56	5.15	4.37	3.66	3	4.98	102.5	90.3%
7	8.5	3.48	3.44	3.34	3.25	3.18	3.02	2.55	2.12	3.26	108.4	97.3%
7	8.97	4.76	5.14	5.09	4.68	4.31	3.61	2.96	2.38	3.96	102.9	91.9%
8	8.42	3	2.83	2.73	2.62	2.54	2.36	2.1	2.04	2.87	104.7	96.0%
8	9.26	4.08	4.18	4.29	3.94	3.61	3	2.45	1.96	3.39	104	91.8%
9	9.25	5.54	5.2	4.97	4.59	4.18	3.43	2.76	2.18	5.27	101.8	92.4%
9	9.02	6.24	6.54	6.17	5.69	5.25	4.41	3.65	2.99	5.21	103.3	92.2%
10	8.62	4.27	4.08	3.93	3.74	3.55	3.15	2.66	2.21	4	105.5	95.2%
10	8.77	6.18	6.25	5.92	5.52	5.17	4.43	3.73	3.1	5.03	104	93.2%
11	9.18	4.15	3.93	3.83	3.67	3.53	3.25	2.88	2.37	4.12	105.5	95.8%
11	8.15	6.45	5.62	5.49	5.06	4.67	3.89	3.15	2.48	4.27	105.1	92.2%
12	8.01	3.09	2.93	2.83	2.67	2.58	2.33	2.27	2.02	3.04	105.5	94.3%
12	9.2	4.25	4.52	4.45	4.14	3.8	3.21	2.66	2.13	3.61	106.6	93.0%
13	8.73	5.56	5.26	5.06	4.71	4.34	3.58	2.92	2.32	5.37	101.8	93.1%
13	8.82	7.28	7.62	7.06	6.53	6.06	5.15	4.29	3.53	6.07	105.8	92.5%
14	8.26	5.38	5.05	4.83	4.48	4.16	3.43	2.76	2.2	5.16	101.4	92.8%
14	8.25	5.35	5.34	5.02	4.57	4.18	3.4	2.73	2.13	4.68	103.3	91.0%
15	8.65	4.49	4.19	4.03	3.81	3.61	3.2	2.72	2.25	4.35	103.6	94.5%
15	8.79	4.94	5.25	4.89	4.54	4.2	3.52	2.9	2.32	4.19	104.7	92.8%

**Table 2. Westbound lane load transfer data**

<b>WBL</b>	<b>Load</b>	<b>Sensor 1</b>	<b>Sensor 2</b>	<b>Sensor 3</b>	<b>Sensor 4</b>	<b>Sensor 5</b>	<b>Sensor 6</b>	<b>Sensor 7</b>	<b>Sensor 8</b>	<b>Sensor 9</b>	<b>Load transfer</b>	
1	8.06	5.59	5.27	5.07	4.72	4.38	3.69	3.01	2.36	5.37	83.5	93.1%
1	8.44	6.95	7.48	7.02	6.45	5.88	4.8	3.84	2.95	5.78	83.1	91.9%
2	8.36	4.56	4.42	4.3	4.16	4.03	3.71	3.12	2.62	4.26	101.4	96.7%
2	8.68	5.52	5.46	5.16	4.81	4.5	3.85	3.21	2.66	4.92	103.3	93.2%
3	9.03	4.26	3.99	3.85	3.68	3.51	3.16	2.82	2.45	4.24	101.4	95.6%
3	7.71	4.4	4.6	4.55	4.39	4.21	3.75	3.2	2.65	3.84	103.6	96.5%
4	9.3	3.99	3.74	3.6	3.45	3.31	3.04	2.77	2.35	3.98	103.3	95.8%
4	8.75	4.61	4.64	4.5	4.29	4.05	3.48	2.9	2.23	3.99	105.8	95.3%
5	8.14	4.99	4.78	4.6	4.34	4.08	3.51	2.97	2.46	4.6	101.1	94.3%
5	8.81	6.42	5.78	5.59	5.31	5.02	4.4	3.78	3.15	5.52	103.3	95.0%
6	8.05	4.6	4.26	4.06	3.81	3.59	3.15	2.7	2.62	4.68	102.5	93.8%
6	8.09	5.78	5.9	5.61	5.27	4.97	4.3	3.69	3.12	4.91	103.6	93.9%
7	8.69	4.14	4.04	3.96	3.87	3.78	3.55	3.16	2.67	3.92	102.9	97.7%
7	8.17	4.86	5.03	4.8	4.52	4.23	3.6	2.93	2.36	4.24	101.1	94.2%
8	8.82	4.01	3.7	3.56	3.37	3.18	2.8	2.46	2.19	4.05	100.3	94.7%
8	8.62	4.39	4.5	4.33	4.11	3.85	3.33	2.78	2.27	3.74	102.2	94.9%
9	8.17	4.69	4.52	4.35	4.08	3.83	3.29	2.75	2.25	4.31	102.2	93.8%
9	8.41	5.29	5.23	4.98	4.66	4.35	3.67	3.04	2.49	4.57	104.4	93.6%
10	7.83	4.79	4.69	4.62	4.51	4.44	4.14	3.53	2.95	4.48	100.7	97.6%
10	8.62	6.8	6.83	6.47	6.07	5.64	4.8	3.98	3.19	5.86	101.4	93.8%
11	8.76	3.63	3.46	3.36	3.23	3.08	2.74	2.28	1.81	3.54	104.7	96.1%
11	7.81	4.38	4.47	4.23	3.94	3.65	3.07	2.51	2.59	3.73	103.3	93.1%
12	8.53	3.89	3.75	3.68	3.59	3.48	3.29	2.87	2.47	3.85	100	97.6%
12	8.35	4.7	4.94	4.92	4.66	4.4	3.79	3.21	2.65	4.13	101.1	94.7%

## APPENDIX B. VISUAL DISTRESS SURVEYS

**Table 3. Visual distress survey results for 8/23/02**

Date	Lane	Patch	Comment
8/23/02	EBL	1	no deterioration
8/23/02	EBL	2	no deterioration
8/23/02	EBL	3	transverse crack, full width, 4" E of edge, sealed
8/23/02	EBL	4	no deterioration
8/23/02	EBL	5	no deterioration
8/23/02	EBL	6	no deterioration
8/23/02	EBL	7	no deterioration
8/23/02	EBL	8	spall at edge, construction related
8/23/02	EBL	9	no deterioration
8/23/02	EBL	10	no deterioration
8/23/02	EBL	11	no deterioration
8/23/02	EBL	12	no deterioration
8/23/02	EBL	13	no deterioration
8/23/02	EBL	14	no deterioration, location of rejected concrete
8/23/02	WBL	1	no deterioration
8/23/02	WBL	2	no deterioration
8/23/02	WBL	3	no deterioration
8/23/02	WBL	4	no deterioration
8/23/02	WBL	5	no deterioration
8/23/02	WBL	6	no deterioration
8/23/02	WBL	7	no deterioration
8/23/02	WBL	8	double panel, no deterioration
8/23/02	WBL	9	no deterioration
8/23/02	WBL	10	18"x3" spall W edge; 6"x3" crack NE corner; 12"x4" NW corner lost; all sealed
8/23/02	WBL	11	no deterioration

**Table 4. Visual distress survey results for 10/8/02**

<b>Date</b>	<b>Lane</b>	<b>Patch</b>	<b>Comment</b>
10/8/02	EBL	1	no deterioration
10/8/02	EBL	2	no deterioration
10/8/02	EBL	3	minor spalling E edge; longitudinal crack 3" E of W edge, full width
10/8/02	EBL	4	no deterioration
10/8/02	EBL	5	no deterioration
10/8/02	EBL	6	no deterioration
10/8/02	EBL	7	no deterioration
10/8/02	EBL	8	no deterioration
10/8/02	EBL	9	no deterioration
10/8/02	EBL	10	no deterioration
10/8/02	EBL	11	no deterioration
10/8/02	EBL	12	no deterioration
10/8/02	EBL	13	no deterioration
10/8/02	EBL	14	no deterioration
10/8/02	WBL	1	no deterioration
10/8/02	WBL	2	no deterioration
10/8/02	WBL	3	no deterioration
10/8/02	WBL	4	no deterioration
10/8/02	WBL	5	no deterioration
10/8/02	WBL	6	no deterioration
10/8/02	WBL	7	spall E edge, 8"x2"
10/8/02	WBL	8	spall E edge, 8"x2"
10/8/02	WBL	9	no deterioration
10/8/02	WBL	10	spall W side, 10"x2"; spall E side, 5"x1"
10/8/02	WBL	11	spall W edge, 20"x3"; spall NW corner, 16"x4"; spall E side, 5"x2"; crack NE corner, 3"x5"
10/8/02	WBL	12	spall SE corner, 2"x6"

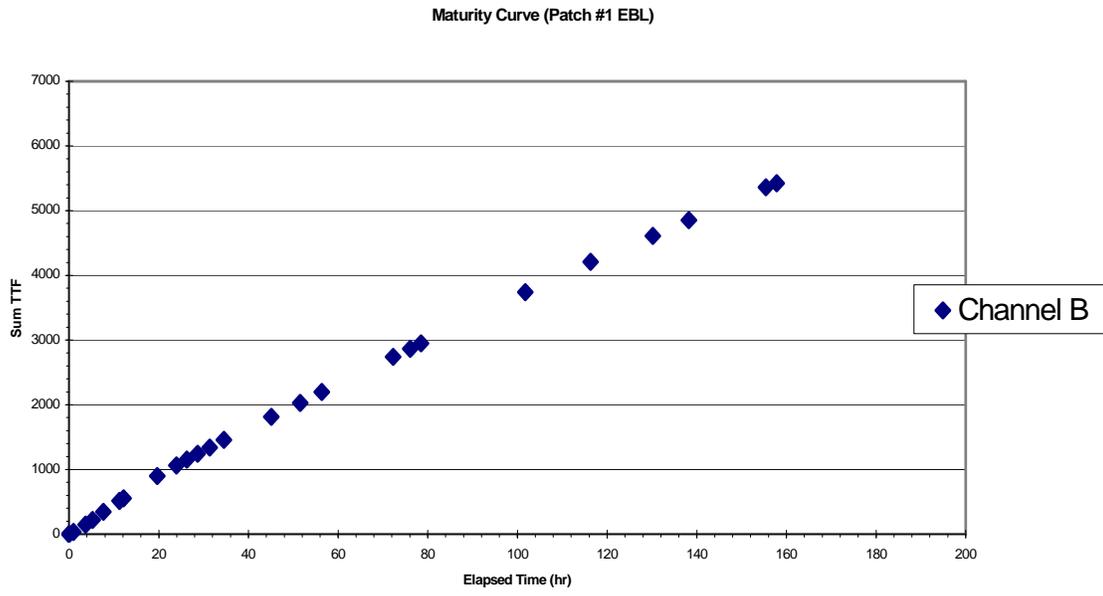
## APPENDIX C. MATURITY DATA TABLES AND GRAPHS

**Table 5. Maturity data for Patch 1, eastbound lane**

Patch #1 EBL

Time concrete place 10:00                      Air temp 46                      Depth 9  
 Maturity start time 10:20 AM                      Slump 4                      Pave temp 62

Date	Time	Elapsed (hr)	Temp F	Temp C	TTF @ Age	Sum TTF
9/19/2001	10:20	0.00	76.2	24.56		0.00
	11:20	1.00	82	27.78	36.17	36.17
	14:00	3.67	96.2	35.67	111.26	147.43
	15:35	5.25	102.7	39.28	75.16	222.59
	18:00	7.67	105	40.56	120.63	343.22
	21:36	11.27	94	34.44	171.00	514.22
	22:50	12.17	99.2	37.33	41.30	555.52
9/20/2001	6:20	19.67	92.1	33.39	340.36	895.88
	10:35	23.92	78.8	26.00	168.70	1064.58
	12:56	26.27	80.7	27.06	85.84	1150.42
	15:22	28.70	80.5	26.94	90.03	1240.46
	18:04	31.40	82.4	28.00	101.18	1341.63
	21:10	34.50	80.2	26.78	115.91	1457.54
9/21/2001	7:45	45.09	69.3	20.72	357.19	1814.72
	14:15	51.59	76.9	24.94	213.42	2028.14
	19:00	56.34	80.9	27.17	171.26	2199.41
9/22/2001	11:55	72.25	69.5	20.83	541.17	2740.57
	15:45	76.09	75.9	24.39	125.01	2865.58
	18:10	78.50	78.1	25.61	84.58	2950.16
9/24/2001	17:27	101.79	72	22.22	789.69	3739.86
	20:00	116.34	71.4	21.89	466.41	4206.27
9/25/2001	9:50	130.17	62.4	16.89	406.55	4612.81
	17:55	138.25	72.7	22.61	240.48	4853.29
9/26/2001	11:05	155.42	61.5	16.39	506.42	5359.71
	13:30	157.84	63.4	17.44	65.05	5424.76



**Figure 5. Maturity curve for Patch 1, eastbound lane**

**Table 6. Maturity data for Patch 2, eastbound lane**

Patch #2 EBL

Time concrete place 10:20                      Air temp 46                      Depth 11  
Maturity start time 10:28 AM                      Slump 4                      Pave temp 62

<b>Date</b>	<b>Time</b>	<b>Elapsed (hr)</b>	<b>Temp F</b>	<b>Temp C</b>	<b>TTF @ Age</b>	<b>Sum TTF</b>
9/19/2001	10:28	0.00	75.5	24.17		0.00
	12:28	1.00	86.2	30.11	37.14	37.14
	14:00	2.53	102.3	39.06	68.36	105.50
	15:36	4.13	108.6	42.56	81.12	186.62
	18:05	5.71	108.3	42.39	83.08	269.70
	21:40	9.29	100.6	38.11	179.90	449.60
	22:52	10.49	92.3	33.50	54.81	504.41
9/20/2001	6:22	17.99	86.7	30.39	314.58	818.99
	10:36	22.22	83.7	28.72	167.45	986.44
	12:57	45.22	84.7	29.28	897.00	1883.44
	15:23	47.66	84	28.89	95.10	1978.55
	18:06	50.37	84.7	29.28	106.18	2084.72
	21:10	53.44	82.5	28.06	118.58	2203.30
9/21/2001	7:47	64.06	71.6	22.00	371.88	2575.18
	14:15	70.52	77	25.00	216.63	2791.81
	19:01	75.27	82.6	28.11	173.64	2965.45
9/22/2001	11:55	92.17	69.3	20.72	581.64	3547.09
	15:45	96.01	75.2	24.00	124.05	3671.14
	18:12	98.46	78	25.56	85.21	3756.35
9/24/2001	17:30	121.76	71.5	21.94	786.38	4542.73
	20:02	136.29	71.7	22.06	465.07	5007.79
9/25/2001	9:53	150.14	62	16.67	406.65	5414.44
	17:55	158.17	72	22.22	236.54	5650.98
9/26/2001	11:05	175.34	60.5	15.83	498.31	6149.29
	23:30	187.76	65.9	18.83	339.39	6488.68

Maturity Curve (Patch #2 EBL)

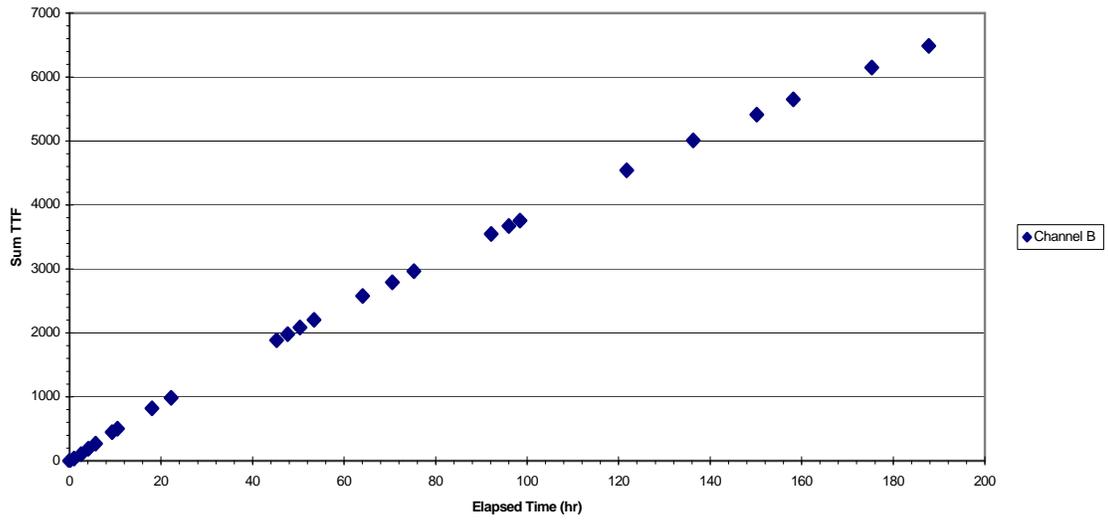


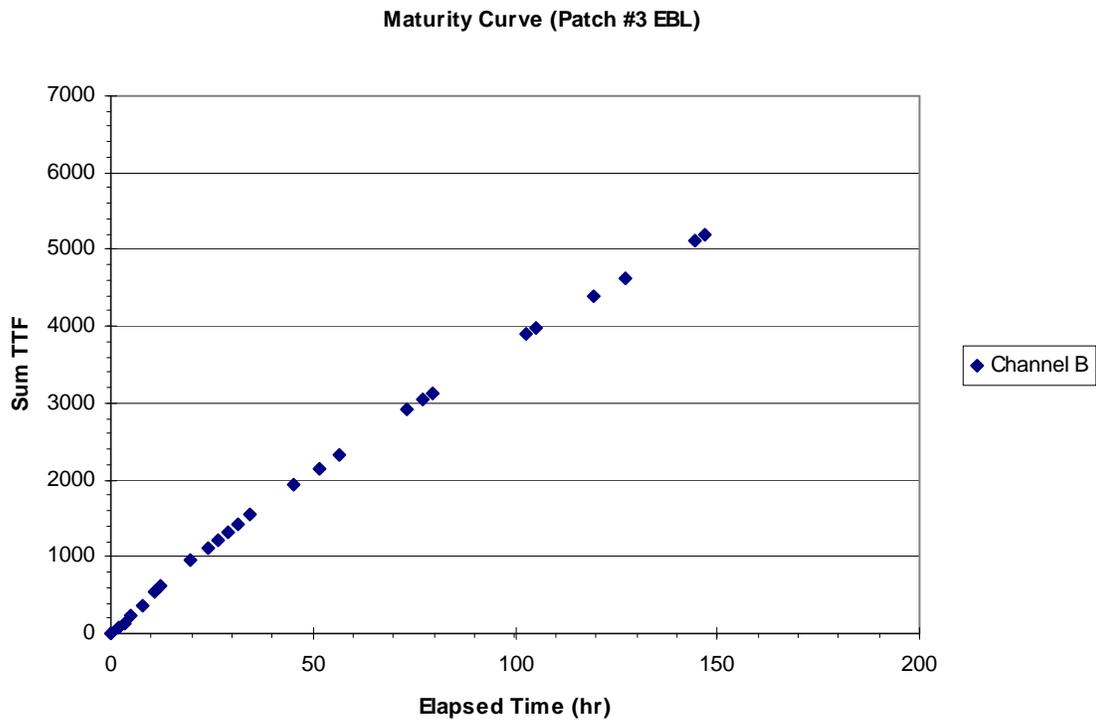
Figure 6. Maturity curve for Patch 2, eastbound lane

**Table 7. Maturity data for Patch 3, eastbound lane**

Patch #3 EBL

Time concrete place 10:27                      Air temp                      Depth 13  
Maturity start time 10:40 AM                      Slump 4                      Pave temp 65

<b>Date</b>	<b>Time</b>	<b>Elapsed (hr)</b>	<b>Temp F</b>	<b>Temp C</b>	<b>TTF @ Age</b>	<b>Sum TTF</b>
9/19/2001	10:40	0.00	75.9	24.39		0.00
	12:35	1.92	87.8	31.00	72.25	72.25
	14:02	3.37	105.3	40.72	66.65	138.90
	15:42	5.04	111.6	44.22	87.45	226.35
	18:17	7.62	114.9	46.06	142.63	368.98
	21:40	11.00	104.6	40.33	179.80	548.78
	22:55	12.25	102	38.89	61.85	610.62
9/20/2001	6:23	19.72	89.1	31.72	338.28	948.91
	10:39	23.99	86	30.00	174.48	1123.38
	12:59	26.32	86.6	30.33	93.72	1217.11
	15:25	28.75	86.3	30.17	97.94	1315.05
	18:07	31.45	86.8	30.44	108.83	1423.87
	21:15	34.59	84.3	29.06	124.55	1548.42
9/21/2001	7:50	45.17	73.5	23.06	381.59	1930.01
	14:16	51.60	78.6	25.89	221.77	2151.78
	19:03	56.39	83.4	28.56	178.05	2329.83
9/22/2001	11:56	73.27	69.4	20.78	585.29	2915.12
	15:46	77.10	75.1	23.94	124.05	3039.17
	18:13	79.55	77.9	25.50	85.07	3124.24
9/24/2001	17:30	102.84	71.4	21.89	784.52	3908.76
	20:03	105.39	71.9	22.17	81.67	3990.43
9/25/2001	9:54	119.24	60.1	15.61	400.11	4390.54
	17:55	127.25	71.6	22.00	230.92	4621.46
9/26/2001	11:10	144.50	60.2	15.67	497.38	5118.84
	13:35	146.92	66	18.89	65.92	5184.76



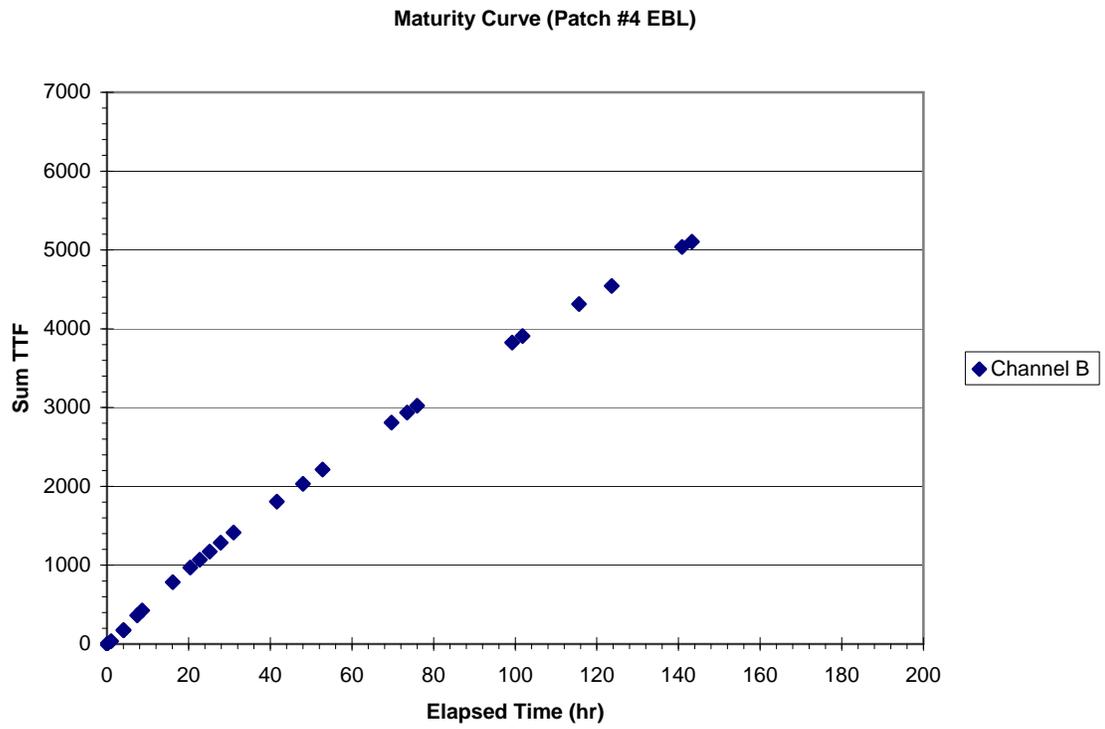
**Figure 7. Maturity curve for Patch 3, eastbound lane**

**Table 8. Maturity data for Patch 4, eastbound lane**

Patch #4 EBL

Time concrete place 11:15 AM                      Air temp XX                      Depth 15  
Maturity start time 11:35 AM                      Slump X                      Pave temp XX

<b>Date</b>	<b>Time</b>	<b>Elapsed (hr)</b>	<b>Temp F</b>	<b>Temp C</b>	<b>TTF @ Age</b>	<b>Sum TTF</b>
9/19/2001	11:35	0.00	75.5	24.17		0.00
	12:35	1.00	81.4	27.44	35.81	35.81
	15:38	4.05	111.5	44.17	139.71	175.51
	18:20	4.05	118.7	48.17	0.00	175.51
	21:42	7.42	109.4	43.00	187.13	362.64
	22:55	8.63	106.7	41.50	63.57	426.21
9/20/2001	6:24	16.12	94.1	34.50	359.20	785.41
	10:40	20.38	90.6	32.56	185.72	971.13
	13:00	22.72	90.6	32.56	99.30	1070.43
	15:25	25.13	89.3	31.83	101.97	1172.40
	18:08	27.85	89.1	31.72	113.50	1285.89
	21:16	30.98	85.9	29.94	127.94	1413.84
9/21/2001	7:53	41.60	75	23.89	391.93	1805.77
	14:17	48.00	79.9	26.61	225.60	2031.37
	19:05	52.80	84.5	29.17	181.87	2213.24
9/22/2001	11:57	69.67	70.7	21.50	595.96	2809.19
	15:47	73.50	76.2	24.56	126.61	2935.80
	18:14	75.95	79.3	26.28	86.77	3022.57
9/24/2001	17:32	99.25	72.7	22.61	802.56	3825.13
	20:04	101.78	73.3	22.94	83.04	3908.16
9/25/2001	9:55	115.63	60	15.56	405.11	4313.28
	17:55	123.63	71.6	22.00	230.22	4543.50
9/26/2001	11:10	140.88	59.7	15.39	494.98	5038.48
	13:35	143.30	67.9	19.94	66.86	5105.34



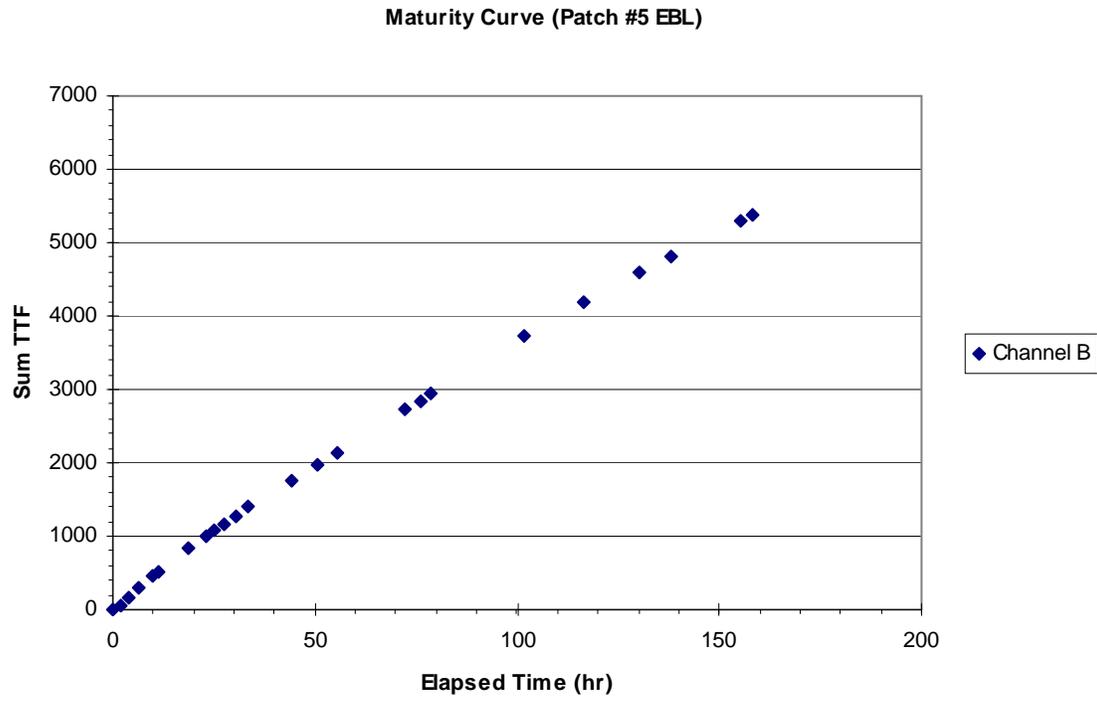
**Figure 8. Maturity curve for Patch 4, eastbound lane**

**Table 9. Maturity data for Patch 5, eastbound lane**

Patch#5 EBL

Time concrete place 11:30 AM                      Air temp XX                      Depth 9  
Maturity start time 11:45 AM                      Slump X                      Pave temp 69

<b>Date</b>	<b>Time</b>	<b>Elapsed (hr)</b>	<b>Temp F</b>	<b>Temp C</b>	<b>TTF @ Age</b>	<b>Sum TTF</b>
9/19/2001	11:45	0.00	75.8	24.33		0.00
	13:37	1.87	80.5	26.94	66.53	66.53
	15:40	3.92	103.2	39.56	88.66	155.19
	18:22	6.62	108.9	42.72	138.08	293.26
	21:42	9.95	98.6	37.00	166.20	459.47
	22:58	11.22	95.8	35.44	58.55	518.02
9/20/2001	6:25	18.67	83.3	28.50	312.69	830.71
	10:42	22.95	81.1	27.28	162.29	993.00
	13:02	25.28	81.9	27.72	87.50	1080.50
	15:27	27.70	82.6	28.11	91.63	1172.13
	18:09	30.40	83.6	28.67	103.65	1275.78
	21:17	33.53	80.8	27.11	118.72	1394.50
9/21/2001	7:54	44.15	70.3	21.28	363.03	1757.53
	14:23	50.63	77.2	25.11	215.21	1972.74
	19:07	55.37	84	28.89	175.13	2147.87
9/22/2001	11:59	72.23	68.1	20.06	581.43	2729.31
	15:45	76.00	74.9	23.83	120.32	2849.63
	18:15	78.50	78.1	25.61	86.81	2936.44
9/24/2001	17:33	101.80	72.4	22.44	792.85	3729.28
	20:06	116.35	72.7	22.61	473.28	4202.56
9/25/2001	9:57	130.20	56.4	13.56	388.95	4591.52
	18:00	138.25	71.2	21.78	222.72	4814.23
9/26/2001	11:10	155.42	59.3	15.17	488.77	5303.01
	14:00	158.25	59.7	15.39	71.62	5374.63



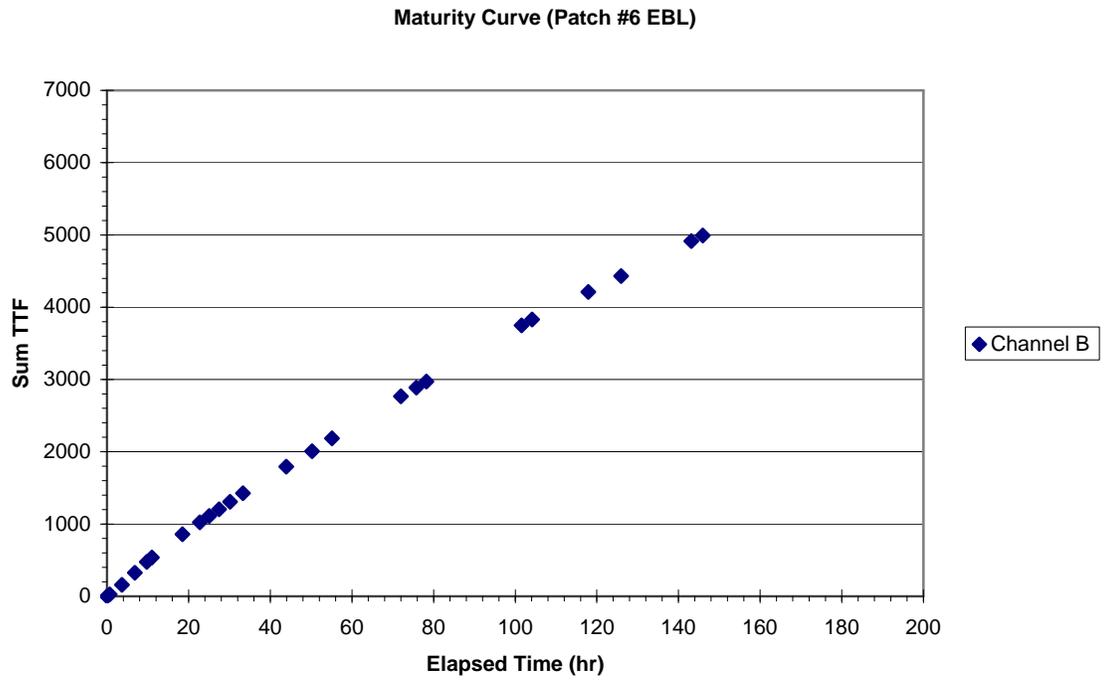
**Figure 9. Maturity curve for Patch 5, eastbound lane**

**Table 10. Maturity data for Patch 6, eastbound lane**

Patch #6 EBL

Time concrete place 11:47 AM Air temp XX Depth 11  
 Maturity start time 12:00 PM Slump X Pave temp 72

Date	Time	Elapsed (hr)	Temp F	Temp C	TTF @ Age	Sum TTF
9/19/2001	12:00	0.00	83.1	28.39		0.00
	12:40	0.67	81.6	27.56	25.31	25.31
	15:40	3.67	105.9	41.06	132.92	158.23
	18:50	6.83	111.8	44.33	166.87	325.10
	21:44	9.73	102.4	39.11	149.99	475.09
	23:00	11.00	98.7	37.06	60.91	536.00
9/20/2001	6:28	18.47	84.7	29.28	322.31	858.31
	10:45	22.75	82.3	27.94	165.38	1023.69
	13:03	25.05	82.8	28.22	87.59	1111.28
	15:28	27.47	83	28.33	92.50	1203.79
	18:09	30.15	83.6	28.67	103.31	1307.10
	21:18	33.30	81	27.22	119.53	1426.62
9/21/2001	7:56	43.90	71.7	22.06	367.17	1793.79
	14:15	50.22	77.2	25.11	212.13	2005.93
	19:07	55.08	83.6	28.67	179.53	2185.46
9/22/2001	12:00	71.97	68.1	20.06	580.13	2765.59
	15:48	75.77	74.4	23.56	120.86	2886.45
	18:16	78.23	77.9	25.50	85.17	2971.61
9/24/2001	17:35	101.55	70.3	21.28	778.52	3750.13
	20:08	104.10	70.7	21.50	80.04	3830.17
9/25/2001	9:58	117.93	56.4	13.56	380.80	4210.98
	18:00	125.97	70.9	21.61	221.59	4432.56
9/26/2001	11:10	143.13	58.7	14.83	484.48	4917.04
	14:00	145.97	65.1	18.39	75.40	4992.44



**Figure 10. Maturity curve for Patch 6, eastbound lane**

**Table 11. Maturity data for Patch 7, eastbound lane**

Patch #7 EBL

Time concrete place 1:15 PM                      Air temp XX                      Depth 13  
 Maturity start time 1:25 PM                      Slump 3                      Pave temp 78

<b>Date</b>	<b>Time</b>	<b>Elapsed (hr)</b>	<b>Temp F</b>	<b>Temp C</b>	<b>TTF @ Age</b>	<b>Sum TTF</b>
9/19/2001	13:25	0.00	80.5	26.94		0.00
	15:42	2.28	101.7	38.72	97.80	97.80
	18:50	5.42	121.5	49.72	169.90	267.70
	21:45	8.33	112.7	44.83	167.06	434.76
	23:02	9.62	109.3	42.94	69.16	503.92
9/20/2001	6:29	17.07	94.6	34.78	364.02	867.93
	10:46	21.35	91.1	32.83	187.63	1055.57
	13:04	23.65	91	32.78	98.45	1154.02
	15:30	26.08	90.1	32.28	103.48	1257.50
	18:10	28.75	90	32.22	112.67	1370.17
	21:17	31.87	86.6	30.33	128.65	1498.82
9/21/2001	7:57	42.53	75.2	24.00	396.44	1895.26
	14:25	49.00	79.5	26.39	227.59	2122.85
	19:10	53.75	84.8	29.33	179.84	2302.69
9/22/2001	12:01	70.60	70.4	21.33	595.37	2898.06
	15:50	74.42	75.5	24.17	125.00	3023.06
	18:17	76.87	79	26.11	86.09	3109.15
9/24/2001	17:36	100.18	71.1	21.72	790.82	3899.97
	20:10	102.75	71.6	22.00	81.78	3981.75
9/25/2001	10:00	116.58	56.6	13.67	385.03	4366.78
	18:00	124.58	70.6	21.44	220.44	4587.22
9/26/2001	11:14	141.82	58.3	14.61	483.01	5070.23
	14:05	144.67	67.4	19.67	77.35	5147.58

Maturity Curve (Patch #7 EBL)

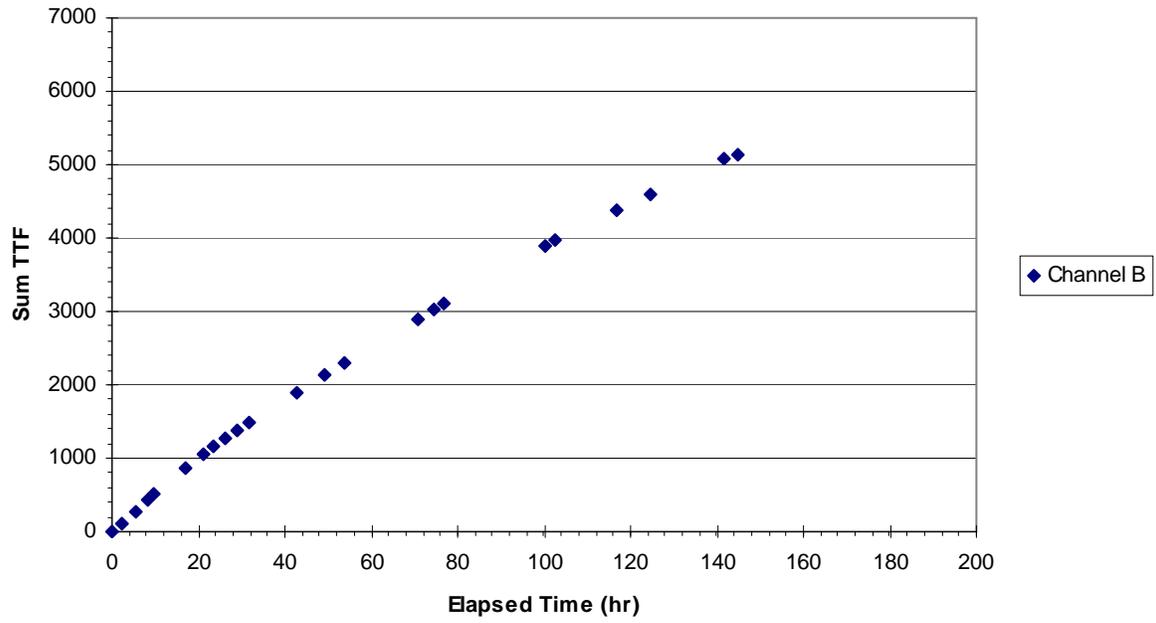


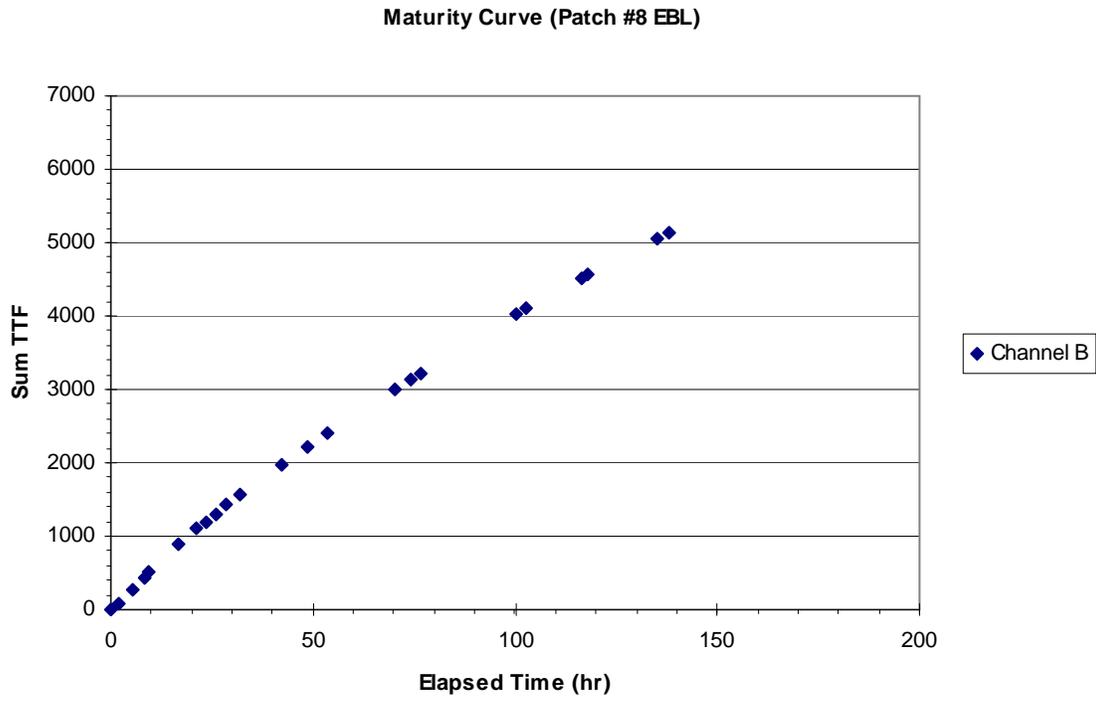
Figure 11. Maturity curve for Patch 7, eastbound lane

**Table 12. Maturity data for Patch 8, eastbound lane**

Patch #8 EBL

Time concrete place 1:25 PM                      Air temp XX                      Depth 15  
Maturity start time 1:36 PM                      Slump 3                      Pave temp 85

Date	Time	Elapsed (hr)	Temp F	Temp C	TTF @ Age	Sum TTF
9/19/2001	13:36	0.00	81.8	27.67		0.00
	15:43	2.12	103.8	39.89	92.66	92.66
	19:00	5.40	125.8	52.11	183.87	276.53
	21:46	8.17	118.2	47.89	166.00	442.53
	23:03	9.45	114.2	45.67	72.86	515.39
9/20/2001	6:31	16.92	99	37.22	384.12	899.51
	10:46	21.17	95.4	35.22	196.44	1095.96
	13:05	23.48	94.8	34.89	104.38	1200.34
	15:30	25.90	92.8	33.78	107.14	1307.48
	18:11	28.58	93.7	34.28	118.14	1425.62
	21:20	31.73	89.8	32.11	136.06	1561.68
9/21/2001	7:58	42.37	77.4	25.22	411.16	1972.83
	14:26	48.83	82.1	27.83	236.21	2209.05
	19:11	53.58	86.9	30.50	186.04	2395.09
9/22/2001	12:02	70.43	71.4	21.89	609.88	3004.97
	15:50	74.23	77.3	25.17	127.41	3132.37
	18:18	76.70	80.9	27.17	89.21	3221.58
9/24/2001	17:36	100.00	72.8	22.67	813.56	4035.14
	20:10	102.57	73	22.78	83.99	4119.13
9/25/2001	10:00	116.40	58.4	14.67	397.32	4516.45
	18:05	118.00	73	22.78	45.96	4562.41
9/26/2001	11:15	135.17	59.4	15.22	497.83	5060.24
	14:05	138.00	70.8	21.56	80.44	5140.68



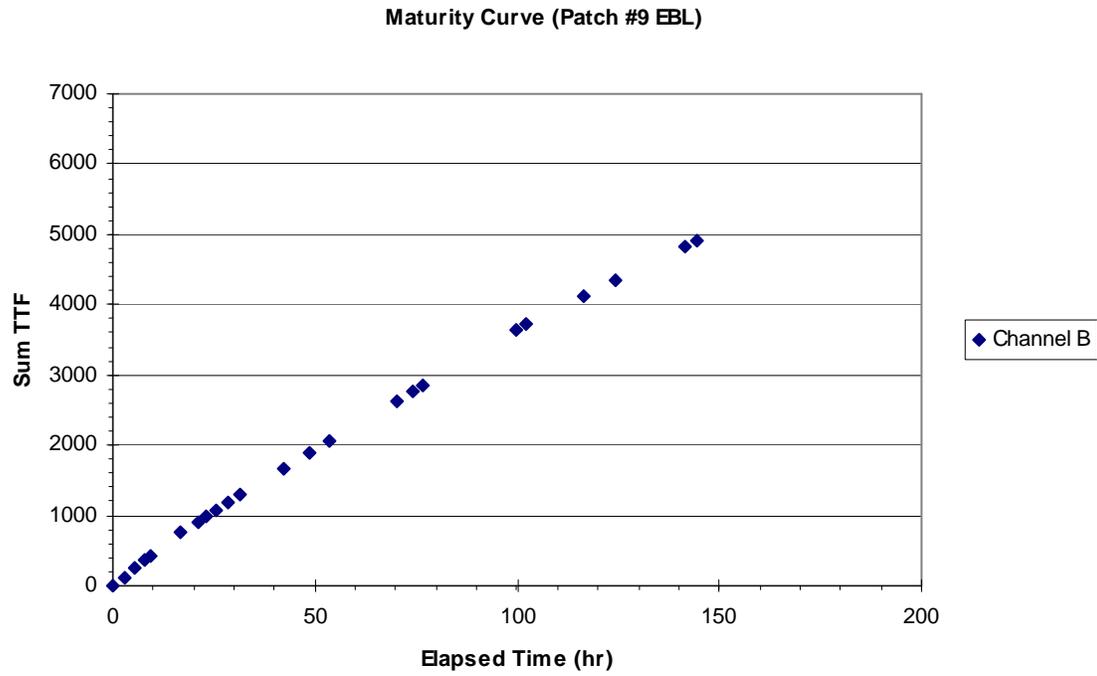
**Figure 12. Maturity curve for Patch 8, eastbound lane**

**Table 13. Maturity data for Patch 9, eastbound lane**

Patch #9 EBL

Time concrete place 1:45 PM                      Air temp XX                      Depth 9  
 Maturity start time 1:50 PM                      Slump X                      Pave temp 86

<b>Date</b>	<b>Time</b>	<b>Elapsed (hr)</b>	<b>Temp F</b>	<b>Temp C</b>	<b>TTF @ Age</b>	<b>Sum TTF</b>
9/19/2001	13:50	0.00	83.3	28.50		0.00
	16:47	2.95	98.4	36.89	125.95	125.95
	19:22	5.53	108.5	42.50	128.38	254.33
	21:50	8.00	100.4	38.00	123.95	378.28
	23:05	9.25	96.2	35.67	58.54	436.82
9/20/2001	6:32	16.70	82.3	27.94	311.45	748.27
	10:50	21.00	80.5	26.94	161.01	909.28
	13:06	23.27	81.4	27.44	84.31	993.59
	15:32	25.70	82.1	27.83	91.59	1085.18
	18:12	28.37	83.1	28.39	101.63	1186.81
	21:23	31.55	80.3	26.83	119.73	1306.53
9/21/2001	8:05	42.25	70.4	21.33	364.69	1671.23
	14:27	48.62	77.8	25.44	212.58	1883.80
	19:13	53.38	82.6	28.11	175.31	2059.11
9/22/2001	12:04	70.23	68.6	20.33	576.64	2635.75
	15:53	74.05	74.6	23.67	122.13	2757.89
	18:20	76.50	78.4	25.78	85.07	2842.96
9/24/2001	17:38	99.80	72.4	22.44	794.79	3637.74
	20:12	102.37	73.1	22.83	83.77	3721.52
9/25/2001	21:12	116.22	56.2	13.44	389.72	4111.24
	22:12	124.25	72.6	22.56	224.93	4336.18
9/26/2001	23:12	141.43	59.2	15.11	495.45	4831.63
	0:12	144.50	70	21.11	86.21	4917.84



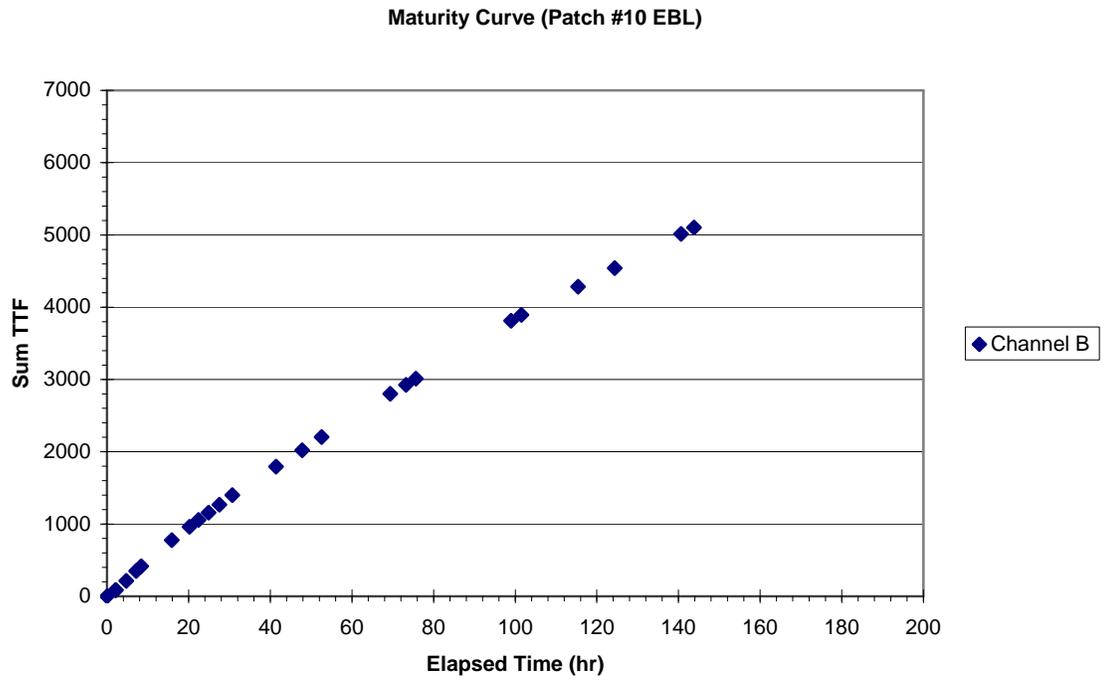
**Figure 13. Maturity curve for Patch 9, eastbound lane**

**Table 14. Maturity data for Patch 10, eastbound lane**

Patch #10 EBL

Time concrete place	2:30 PM	Air temp	XX	Depth	11
Maturity start time	2:42 PM	Slump	X	Pave temp	77

Date	Time	Elapsed (hr)	Temp F	Temp C	TTF @ Age	Sum TTF
9/19/2001	14:42	0.00	82.5	28.06		0.00
	16:48	2.10	88.6	31.44	83.48	83.48
	16:54	2.20	90.4	32.44	4.19	87.67
	19:25	4.72	117.9	47.72	126.04	213.71
	21:50	7.13	112.8	44.89	136.07	349.78
	23:05	8.38	108.3	42.39	67.05	416.83
9/20/2001	6:34	15.87	92.8	33.78	359.82	776.66
	10:53	20.18	89.5	31.94	185.02	961.67
	13:08	22.43	89.3	31.83	94.25	1055.92
	15:34	24.87	89.2	31.78	101.73	1157.65
	18:13	27.52	89.3	31.83	110.78	1268.44
	21:24	30.70	86	30.00	130.25	1398.69
9/21/2001	8:07	41.42	74.7	23.72	395.03	1793.71
	14:30	47.80	80.4	26.89	225.37	2019.08
	19:15	52.55	86.1	30.06	182.74	2201.83
9/22/2001	12:05	69.38	70	21.11	598.99	2800.81
	15:55	73.22	74.8	23.78	124.37	2925.18
	18:21	75.65	79.7	26.50	85.50	3010.69
9/24/2001	17:40	98.97	72.1	22.28	801.83	3812.52
	20:13	101.52	72	22.22	82.24	3894.76
9/25/2001	10:05	115.38	57.3	14.06	390.19	4284.95
	19:05	124.38	73.6	23.11	257.25	4542.20
9/26/2001	11:20	140.63	59	15.00	472.15	5014.35
	14:30	143.80	68.8	20.44	87.79	5102.14



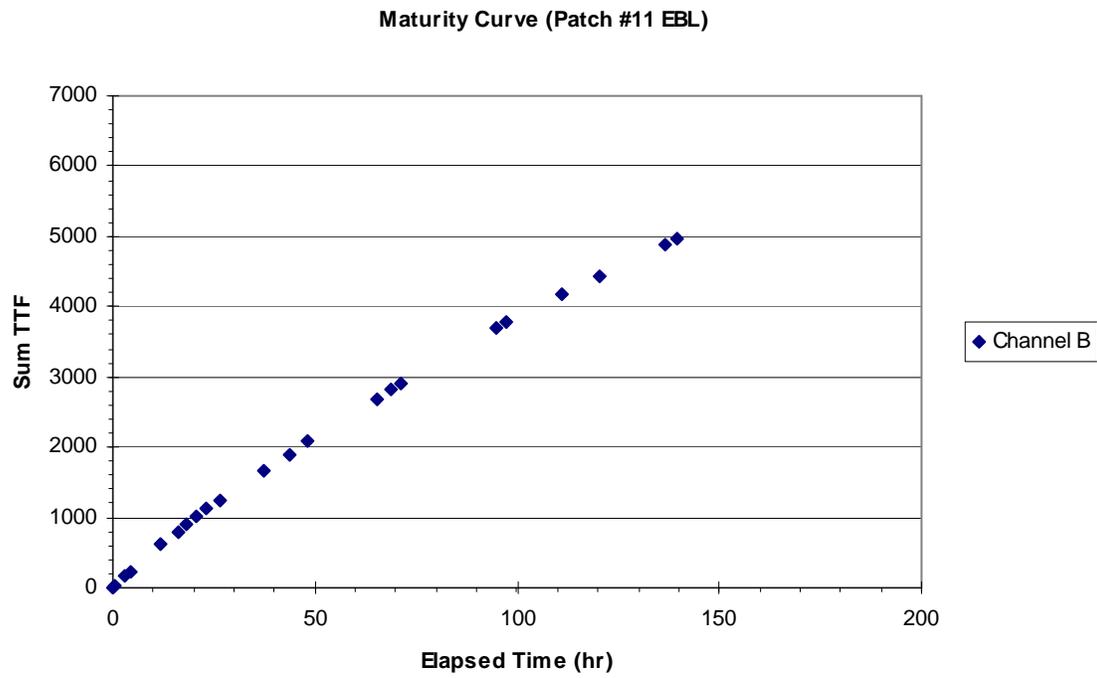
**Figure 14. Maturity curve for Patch 10, eastbound lane**

**Table 15. Maturity data for Patch 11, eastbound lane**

Patch #11 EBL

Time concrete place 2:42 PM Air temp XX Depth 13  
 Maturity start time 2:55 PM Slump X Pave temp 79

Date	Time	Elapsed (hr)	Temp F	Temp C	TTF @ Age	Sum TTF
9/19/2001	14:55	0.00	82.5	28.06		0.00
	19:30	0.58	120.8	49.33	28.41	28.41
	21:52	2.95	116.1	46.72	137.33	165.74
	23:08	4.22	111.8	44.33	70.34	236.07
9/20/2001	6:36	11.68	96.5	35.83	373.96	610.03
	10:54	15.98	92.9	33.83	192.78	802.81
	13:09	18.23	92.6	33.67	98.44	901.25
	15:35	20.67	91.7	33.17	105.65	1006.90
	18:14	23.32	91.3	32.94	114.10	1120.99
	21:25	26.50	87.8	31.00	133.61	1254.61
9/21/2001	8:08	37.22	76.6	24.78	406.04	1660.65
	14:33	43.63	80.6	27.00	230.29	1890.93
	19:17	48.37	87.1	30.61	183.68	2074.61
9/22/2001	12:06	65.18	71.2	21.78	608.67	2683.28
	15:56	69.02	75.4	24.11	126.29	2809.57
	18:22	71.45	79.6	26.44	85.84	2895.41
9/24/2001	17:41	94.77	72.3	22.39	802.48	3697.90
	20:15	97.33	71.8	22.11	82.77	3780.67
9/25/2001	10:06	111.18	57.2	14.00	388.57	4169.24
	19:05	120.17	73.1	22.83	255.28	4424.52
9/26/2001	11:20	136.42	58.9	14.94	469.44	4893.96
	14:25	139.50	69.2	20.67	85.73	4979.69



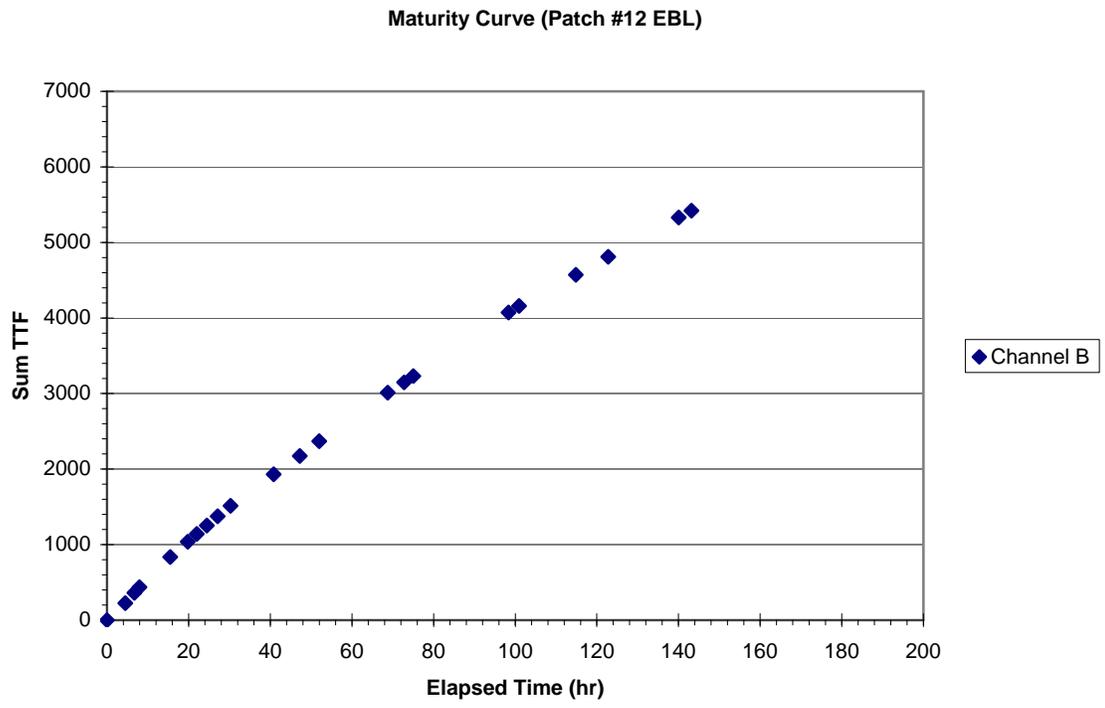
**Figure 15. Maturity curve for Patch 11, eastbound lane**

**Table 16. Maturity data for Patch 12, eastbound lane**

Patch #12 EBL

Time concrete place 2:55 PM Air temp XX Depth 15  
 Maturity start time 3:12 PM Slump X Pave temp 83

Date	Time	Elapsed (hr)	Temp F	Temp C	TTF @ Age	Sum TTF
9/19/2001	15:12	0.00	84.7	29.28		0.00
	19:40	4.47	125.2	51.78	225.69	225.69
	21:55	6.72	120.5	49.17	136.06	361.75
	23:10	7.97	118	47.78	73.09	434.84
9/20/2001	6:42	15.50	101.1	38.39	399.89	834.74
	10:58	19.77	98.4	36.89	203.26	1038.00
	13:11	21.98	97.1	36.17	103.14	1141.13
	15:38	24.43	96	35.56	112.36	1253.49
	18:17	27.08	95.4	35.22	120.28	1373.77
	21:27	30.25	90.9	32.72	139.25	1513.02
9/21/2001	8:12	40.83	79.2	26.22	417.75	1930.77
	14:35	47.22	85.3	29.61	242.03	2172.80
	19:20	51.97	91.7	33.17	196.60	2369.40
9/22/2001	12:07	68.75	73.6	23.11	640.10	3009.50
	16:08	72.77	77.6	25.33	137.46	3146.96
	18:24	75.03	83.4	28.56	83.74	3230.70
9/24/2001	17:43	98.35	74.7	23.72	842.64	4073.34
	20:17	100.92	74.6	23.67	86.48	4159.82
9/25/2001	10:12	114.83	60.2	15.67	412.86	4572.68
	18:10	122.80	75.6	24.22	238.56	4811.24
9/26/2001	11:25	140.05	60.7	15.94	518.94	5330.17
	14:32	143.17	71.8	22.11	90.47	5420.64



**Figure 16. Maturity curve for Patch 12, eastbound lane**

**Table 17. Maturity data for Patch 13, eastbound lane**

Patch #13 EBL - 8.5'x12' Patch

Time concrete place 4:15 PM

Air temp XX

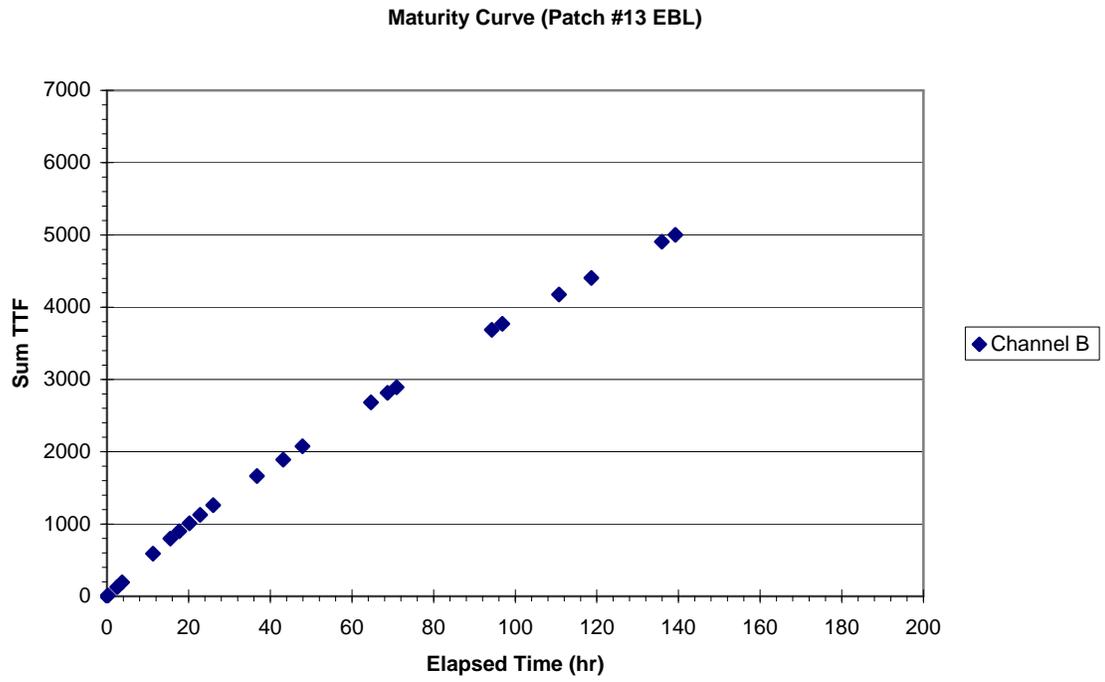
Depth 9

Maturity start time 4:30 PM

Slump X

Pave temp 77

Date	Time	Elapsed (hr)	Temp F	Temp C	TTF @ Age	Sum TTF
9/19/2001	16:30	0.00	81.9	27.72		0.00
	19:45	0.25	104.5	40.28	11.00	11.00
	22:00	2.50	111.4	44.11	117.44	128.44
	23:12	3.70	112.3	44.61	65.23	193.67
9/20/2001	6:45	11.25	104.5	40.28	395.96	589.63
	11:02	15.53	99.1	37.28	208.93	798.56
	13:13	17.72	96.1	35.61	101.40	899.96
	15:41	20.18	93.8	34.33	110.93	1010.89
	18:19	22.82	92.2	33.44	115.57	1126.47
	21:30	26.00	87.8	31.00	134.41	1260.87
9/21/2001	8:14	36.73	75	23.89	401.90	1662.78
	14:40	43.17	80.6	27.00	228.03	1890.80
	19:22	47.87	88	31.11	183.56	2074.37
9/22/2001	12:10	64.67	70.3	21.28	608.07	2682.43
	16:12	68.70	74.7	23.72	131.08	2813.52
	18:26	70.93	79.2	26.22	78.10	2891.62
9/24/2001	17:45	94.25	71.7	22.06	796.01	3687.63
	20:20	96.83	72.9	22.72	83.67	3771.30
9/25/2001	10:13	110.72	60	15.56	404.54	4175.84
	18:10	118.67	72.5	22.50	230.77	4406.61
9/26/2001	11:25	135.92	60.1	15.61	501.21	4907.82
	14:45	139.25	70	21.11	94.54	5002.36



**Figure 17. Maturity curve for Patch 13, eastbound lane**

**Table 18. Maturity data for Patch 14, eastbound lane**

Patch #14 EBL

Time concrete place	4:35 PM	Air temp	XX	Depth	11
Maturity start time	4:50 PM	Slump	X	Pave temp	80

Date	Time	Elapsed (hr)	Temp F	Temp C	TTF @ Age	Sum TTF
9/19/2001	16:50	0.00	84.8	29.33		0.00
	19:45	2.92	103.3	39.61	129.71	129.71
	22:02	5.20	108.2	42.33	116.39	246.10
	23:15	6.42	109.3	42.94	64.04	310.14
9/20/2001	6:47	13.95	101	38.33	381.48	691.62
	11:04	18.23	95.4	35.22	200.36	891.99
	13:14	20.40	92.9	33.83	96.48	988.46
	15:43	22.88	91.1	32.83	107.61	1096.07
	18:20	37.50	90.1	32.28	622.02	1718.09
	21:30	40.67	87.4	30.78	131.50	1849.60
9/21/2001	8:18	51.47	74.7	23.72	402.30	2251.90
	14:42	57.87	79.8	26.56	224.89	2476.79
	19:23	62.55	85.6	29.78	178.75	2655.53
9/22/2001	12:11	79.35	70.2	21.22	596.40	3251.93
	16:13	83.38	74.3	23.50	130.52	3382.46
	18:27	85.62	79	26.11	77.73	3460.19
9/24/2001	17:47	108.95	71.6	22.00	794.63	4254.82
	20:22	111.53	72.2	22.33	83.10	4337.92
9/25/2001	10:15	127.42	59.6	15.33	457.97	4795.89
	18:15	135.42	72.2	22.33	230.67	5026.55
9/26/2001	11:30	152.67	60.2	15.67	500.25	5526.80
	14:46	155.93	69.4	20.78	92.19	5619.00

Maturity Curve (Patch #14 EBL)

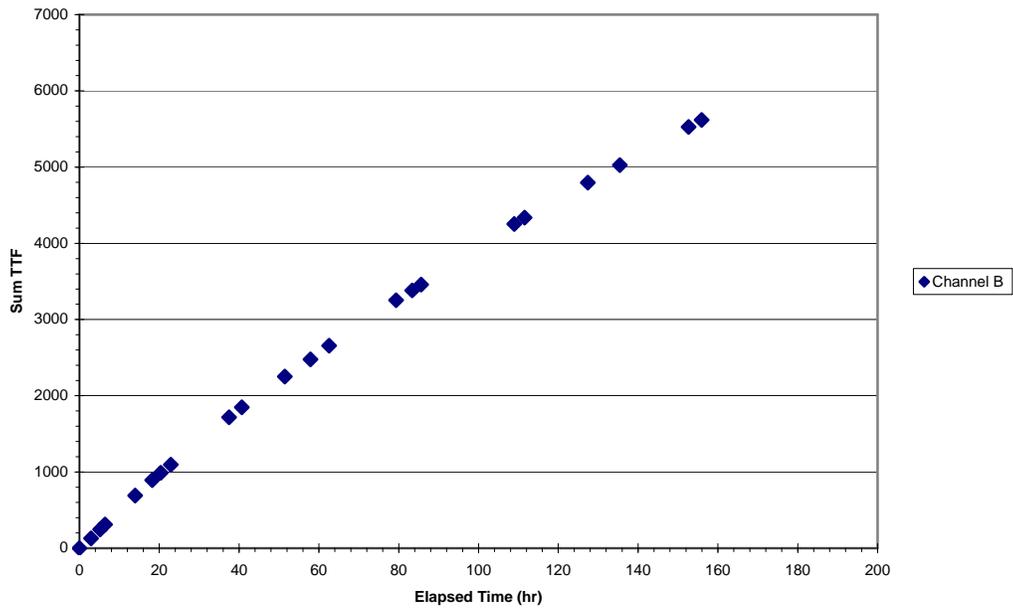


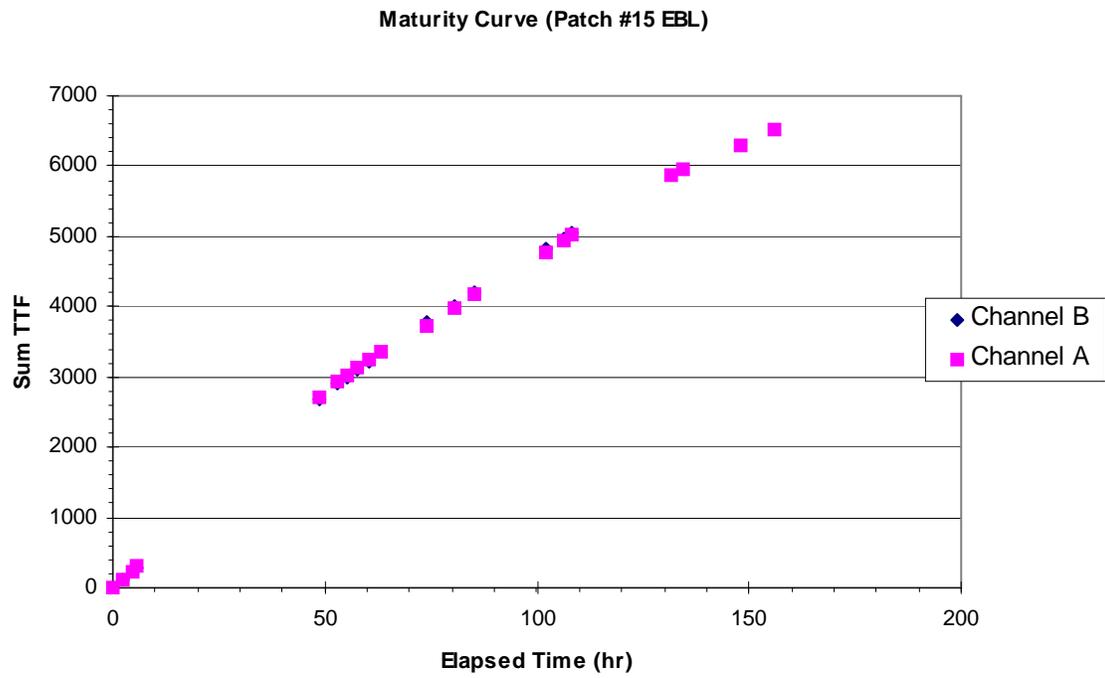
Figure 18. Maturity curve for Patch 14, eastbound lane

**Table 19. Maturity data for Patch 15, eastbound lane**

Patch #15 EBL

Time concrete place 4:30 PM                      Air temp XX                      Depth 13  
 Maturity start time 5:35 PM                      Slump X                      Pave temp 76

Date	Time	Elapsed (hr)	Channel B - lower				Channel A - upper			
			Temp F	Temp C	TTF @ Age	Sum TTF	Temp F	Temp C	TTF @ Age	Sum TTF
9/19/2001	17:35	0.00	86.5	30.28		0.00	90.3	32.39		0.00
	19:50	2.25	106.5	41.39	103.13	103.13	108.5	42.50	106.75	106.75
	22:05	4.50	113.6	45.33	120.06	223.19	119.1	48.39	124.75	231.50
	23:16	5.68	115.3	46.28	66.04	289.22	120.9	49.39	69.69	301.19
9/20/2001	6:52	48.68	112.4	44.67	2385.31	2674.53	109.6	43.11	2418.75	2719.94
	11:07	52.93	101.3	38.50	219.23	2893.76	95.5	35.28	209.08	2929.01
	13:17	55.10	97.1	36.17	102.56	2996.31	87.6	30.89	93.35	3022.36
	15:45	57.57	95.5	35.28	112.78	3109.10	95.6	35.33	106.34	3128.70
	18:23	60.20	94.4	34.67	118.43	3227.52	90.7	32.61	115.79	3244.49
	21:35	63.40	90.3	32.39	139.29	3366.81	81.3	27.39	128.00	3372.49
9/21/2001	8:24	74.22	76.3	24.61	416.44	3783.25	68.2	20.11	365.06	3737.56
	14:50	80.65	83.4	28.56	235.35	4018.61	93.4	34.11	238.75	3976.30
	19:26	85.25	87.2	30.67	182.21	4200.82	85.8	29.89	193.20	4169.50
9/22/2001	12:13	102.03	72.8	22.67	615.39	4816.21	72.7	22.61	608.40	4777.90
	16:17	106.10	80.2	26.78	141.20	4957.41	87.8	31.00	149.68	4927.58
	18:33	108.37	82.1	27.83	84.56	5041.97	82.4	28.00	89.53	5017.11
9/24/2001	17:55	131.73	Wires removed by traffic				76.5	24.72	849.64	5866.75
	20:25	134.23					66	18.89	79.51	5946.26
9/25/2001	10:22	148.18					52.5	11.39	350.69	6296.95
	18:15	156.07					75.1	23.94	218.11	6515.05
9/26/2001	11:35	173.40					65.8	18.78	543.59	7058.65
	14:55	176.73					84.8	29.33	113.52	7172.16



**Figure 19. Maturity curve for Patch 15, eastbound lane**

**Table 20. Maturity data for Patch 1, westbound lane**

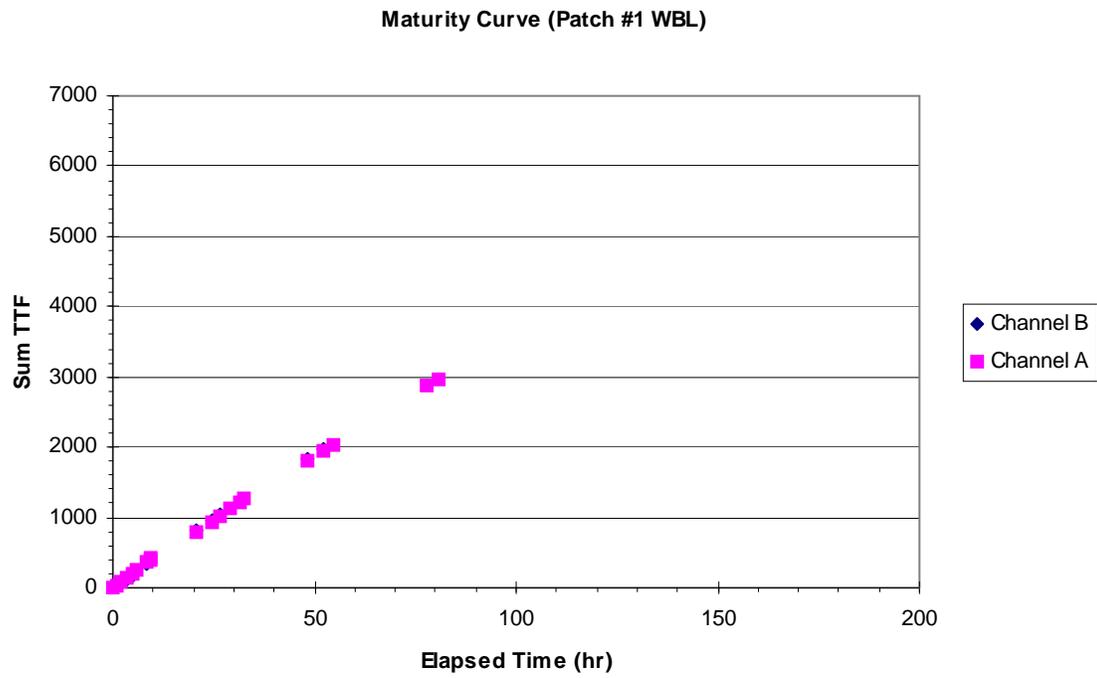
Patch #1 WBL

Time concrete

place 11:00 AM Air temp XX Depth 15

Maturity start time 11:15 AM Slump 4 Pavement temp 73

Channel B - lower							Channel A - upper			
Date	Time	Elapsed (hr)	Temp		TTF @ Age	Sum TTF	Temp		TTF @ Age	Sum TTF
			F	C			F	C		
9/20/2001	11:15	0.00	78.9	26.06		0.00	78.3	25.72		0.00
	12:11	0.93	79.2	26.22	33.73	33.73	80.2	26.78	33.83	33.83
	13:27	2.20	82.2	27.89	46.94	80.67	83.3	28.50	47.68	81.51
	14:38	3.38	86.6	30.33	46.28	126.95	89.8	32.11	47.69	129.20
	15:59	4.73	92.1	33.39	56.51	183.46	96.4	35.78	59.33	188.53
	17:22	6.12	95.9	35.50	61.48	244.94	105.2	40.67	66.71	255.24
	19:35	8.33	98.3	36.83	102.34	347.28	94.2	34.56	105.54	360.77
	20:35	9.33	95	35.00	45.92	393.19	90.1	32.28	43.42	404.19
	21:40	9.58	92	33.33	11.04	404.24	84.8	29.33	10.20	414.39
9/21/2001	8:35	20.50	73.6	23.11	417.26	821.50	68.6	20.33	380.26	794.66
	12:47	24.70	78.6	25.89	144.90	966.40	83.6	28.67	144.90	939.56
	14:55	26.83	80.5	26.94	77.69	1044.08	88.7	31.50	85.51	1025.07
	17:07	29.03	85.3	29.61	84.21	1128.30	90.2	32.33	92.22	1117.28
	19:35	31.50	84.6	29.22	97.23	1225.52	83.1	28.39	99.56	1216.84
		20:40	32.58	83	28.33	42.01	1267.53	80	26.67	40.66
9/22/2001	12:20	48.25	72.4	22.44	554.43	1821.96	72	22.22	539.63	1797.13
	16:30	52.42	79.7	26.50	143.63	1965.59	86.2	30.11	150.69	1947.82
	18:40	54.58	81.1	27.28	79.93	2045.52	81.8	27.67	84.26	2032.08
9/24/2001	18:07	78.03	73.6	23.11	825.31	2870.83	75.8	24.33	844.20	2876.28
	20:42	80.62	70.7	21.50	83.46	2954.28	66.2	19.00	81.81	2958.09
9/25/2001	10:00	93.92	Wires removed by traffic				Wires removed by traffic			



**Figure 20. Maturity curve for Patch 1, westbound lane**

**Table 21. Maturity data for Patch 2, westbound lane**

Patch #2 WBL

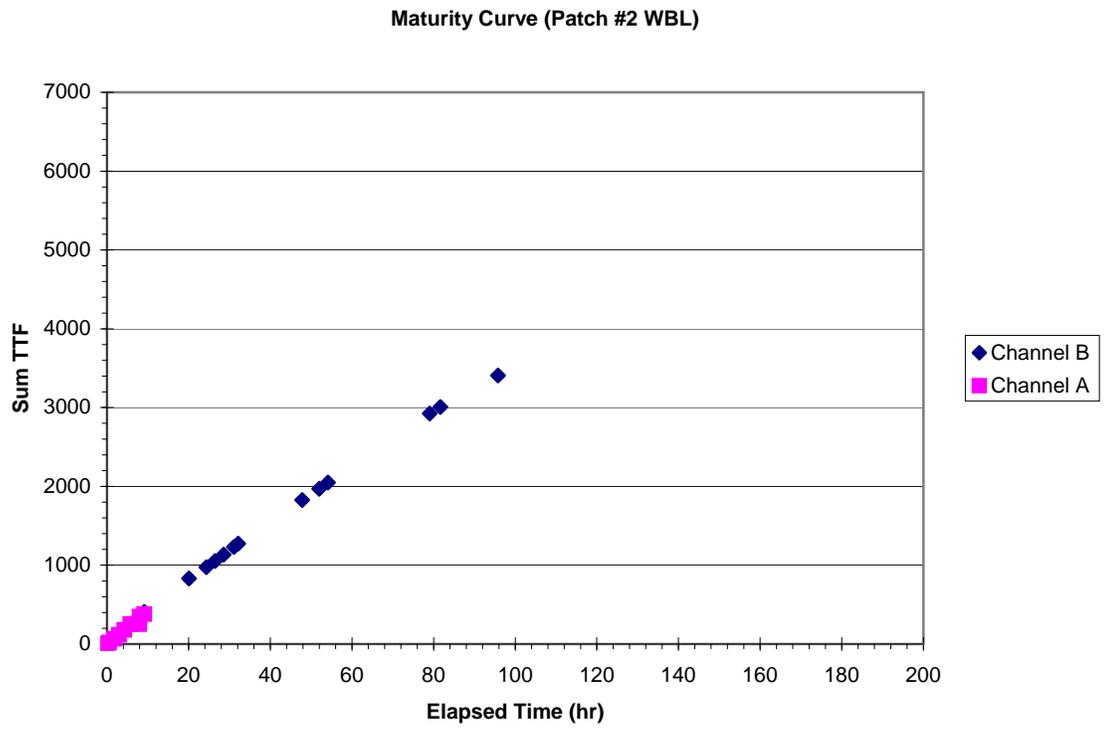
Time concrete

place 11:30 AM Air temp XX Depth 11

Maturity start time 11:45 AM Slump 4 Pave

temp 77

Date	Time	Elapsed (hr)	Channel B - lower				Channel A - upper			
			Temp F	Temp C	TTF @ Age	Sum TTF	Temp F	Temp C	TTF @ Age	Sum TTF
9/20/2001	11:45	0.00	79.6	26.44		0.00	80.8	27.11		0.00
	12:15	0.50	81.8	27.67	18.53	18.53	80.4	26.89	18.50	18.50
	13:30	1.75	84.2	29.00	47.92	66.44	86	30.00	48.06	66.56
	14:42	2.95	90.5	32.50	48.90	115.34	94.5	34.72	50.83	117.39
	16:01	4.27	97	36.11	58.34	173.68	102.1	38.94	61.66	179.05
	17:28	5.72	102.9	39.39	69.24	242.92	109.4	43.00	73.91	252.96
	19:40	7.92	103.6	39.78	109.08	352.00	No reading		0.00	252.96
	20:36	8.00	98.9	37.17	4.04	356.04	67.3	19.61	94.31	347.28
	21:43	9.12	94.2	34.56	51.21	407.25	65.5	18.61	32.51	379.78
	9/21/2001	8:40	20.07	73.4	23.00	424.62	831.87	Wires Removed by Traffic		
12:55		24.32	76.3	24.61	143.67	975.54				
15:05		26.48	80.7	27.06	77.64	1053.18				
17:12		28.60	85.3	29.61	81.14	1134.32				
19:40		31.07	84.7	29.28	97.30	1231.62				
20:45		32.15	82.6	28.11	41.92	1273.54				
9/22/2001	12:25	47.82	72.2	22.33	551.81	1825.35				
	16:34	51.97	80.5	26.94	143.75	1969.10				
	18:43	54.12	81.2	27.33	79.85	2048.95				
9/24/2001	18:12	79.03	73.1	22.83	874.16	2923.11				
	20:50	81.67	69.7	20.94	83.97	3007.08				
9/25/2001	10:55	95.75	60.7	15.94	400.59	3407.68				
	16:55	101.75	Wires Removed by Traffic							



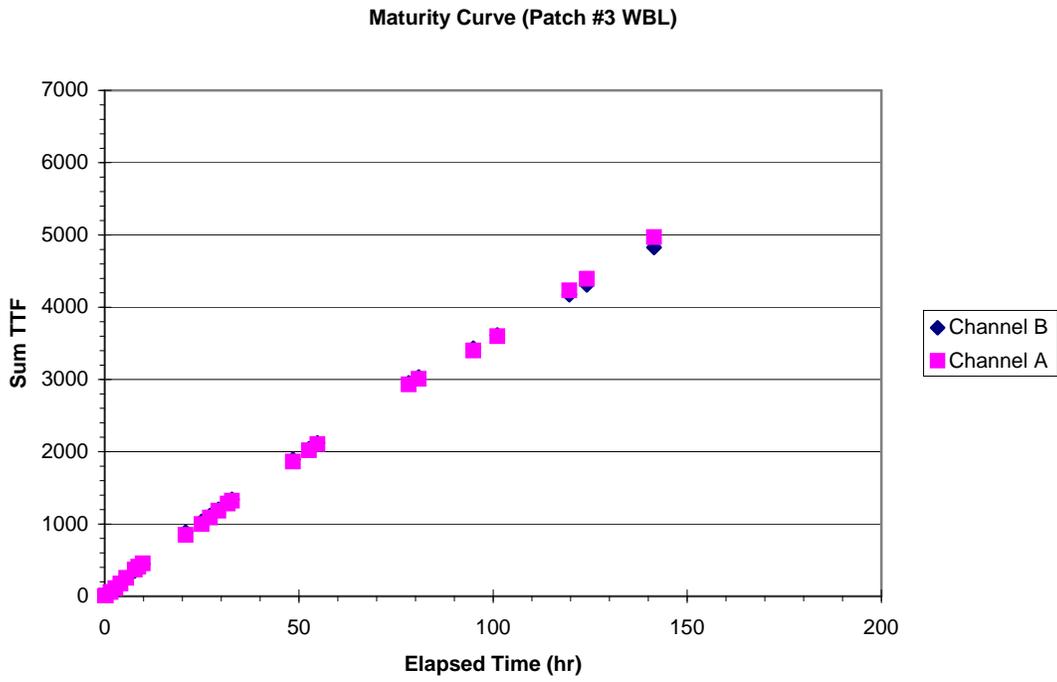
**Figure 21. Maturity curve for Patch 2, westbound lane**

**Table 22. Maturity data for Patch 3, westbound lane**

Patch #3 WBL

Time concrete place 11:45 AM      Air temp XX      Depth 13  
 Maturity start time 12:00 PM      Slump 4      Pave temp 69

Date	Time	Elapsed (hr)	Channel B - lower				Channel A - upper			
			Temp F	Temp C	TTF @ Age	Sum TTF	Temp F	Temp C	TTF @ Age	Sum TTF
9/20/2001	12:00	0.00	78.8	26.00		0.00	81.2	27.33		0.00
	12:18	0.30	79.8	26.56	10.88	10.88	82.3	27.94	11.29	11.29
	13:32	1.53	86.7	30.39	47.45	58.33	86.4	30.22	48.20	59.49
	14:45	2.75	92.7	33.72	51.17	109.50	97.5	36.39	52.69	112.18
	16:04	4.07	99	37.22	59.87	169.37	107.5	41.94	64.74	176.92
	17:31	5.52	103.5	39.72	70.28	239.66	116.2	46.78	78.82	255.74
	19:45	7.75	104.4	40.22	111.60	351.26	95.1	35.06	113.71	369.46
	20:40	8.67	100.2	37.89	44.97	396.23	89.8	32.11	39.95	409.41
	21:47	9.78	96	35.56	52.17	448.40	85.8	29.89	45.78	455.19
9/21/2001	8:50	20.83	75.8	24.33	441.39	889.79	70.6	21.44	394.12	849.31
	12:57	24.95	79.8	26.56	145.91	1035.70	87.8	31.00	149.11	998.42
	15:05	27.08	83.2	28.44	80.00	1115.70	94.2	34.56	91.26	1089.68
	17:15	29.25	86	30.00	84.98	1200.68	91.3	32.94	94.79	1184.47
	19:40	31.67	84.8	29.33	95.86	1296.54	82	27.78	97.54	1282.01
	20:46	32.77	82.8	28.22	42.66	1339.20	79	26.11	40.64	1322.65
9/22/2001	12:26	48.43	72.9	22.72	555.73	1894.93	73.6	23.11	542.24	1864.89
	16:36	52.60	81.1	27.28	145.83	2040.76	88.4	31.33	155.09	2019.99
	18:45	54.75	81.8	27.67	80.57	2121.33	82.1	27.83	85.10	2105.09
9/24/2001	18:15	78.25	73.2	22.89	829.03	2950.36	72.4	22.44	825.76	2930.85
	20:50	80.83	69.5	20.83	82.31	3032.66	63.4	17.44	77.36	3008.21
9/25/2001	10:55	94.92	60.80	16.00	400.20	3432.87	65.1	18.39	393.16	3401.37
	17:05	101.08	73.5	23.06	182.09	3614.95	78.6	25.89	198.19	3599.56
9/26/2001	11:40	119.67	62.9	17.17	559.56	4174.52	72.3	22.39	634.41	4233.97
	16:10	124.17	74.4	23.56	136.63	4311.14	84.7	29.28	161.25	4395.22
9/27/2001	9:28	141.47	61.1	16.17	516.60	4827.74	63.3	17.39	576.67	4971.89



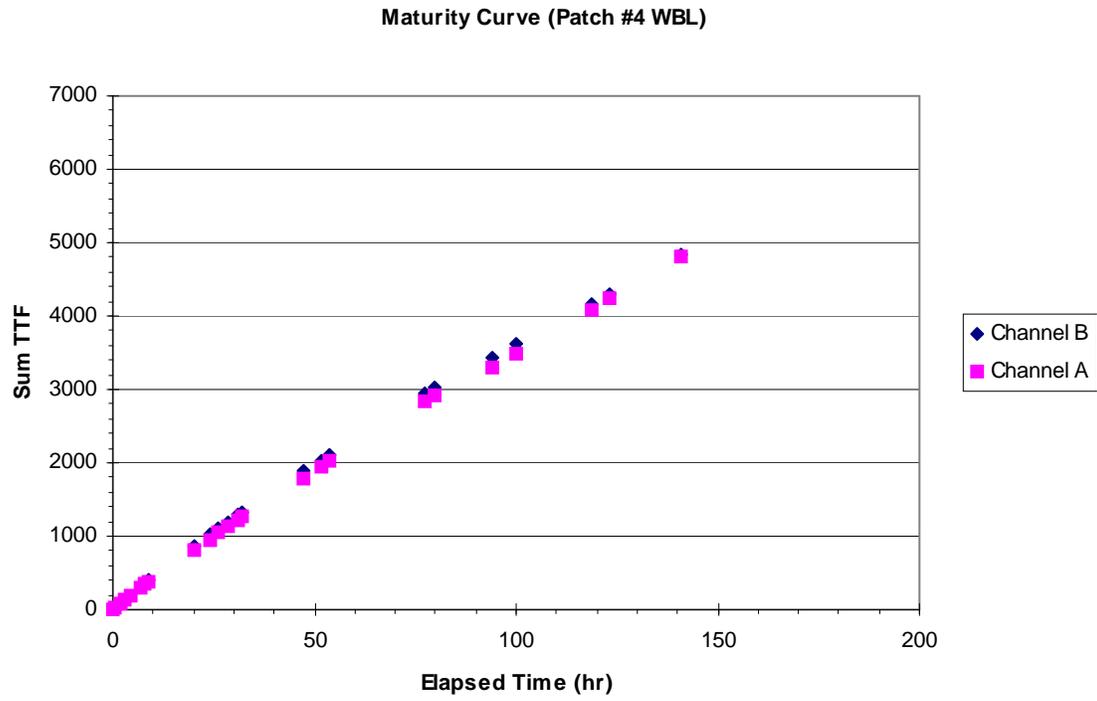
**Figure 22. Maturity curve for Patch 3, westbound lane**

**Table 23. Maturity data for Patch 4, westbound lane**

Patch #4 WBL

Time concrete place 12:40 PM      Air temp XX      Depth 15  
 Maturity start time 12:57 PM      Slump 3.5      Pave temp 66

Date	Time	Elapsed (hr)	Channel B - lower				Channel A - upper			
			Temp F	Temp C	TTF @ Age	Sum TTF	Temp F	Temp C	TTF @ Age	Sum TTF
9/20/2001	12:57	0.00	77.9	25.50		0.00	77.3	25.17		0.00
	13:35	0.63	78.8	26.00	22.64	22.64	77.9	25.50	22.38	22.38
	14:48	1.85	83	28.33	45.22	67.86	84.9	29.39	45.56	67.94
	16:07	3.17	90.9	32.72	53.36	121.22	92	33.33	54.46	122.39
	17:33	4.60	99.3	37.39	64.58	185.80	100.7	38.17	65.58	187.97
	19:49	6.87	106.7	41.50	112.07	297.88	101.9	38.83	109.93	297.90
	20:42	7.75	105.5	40.83	45.20	343.07	98.2	36.78	42.23	340.13
	21:50	8.88	102.5	39.17	56.67	399.74	94.2	34.56	51.76	391.89
9/21/2001	9:00	20.05	79.5	26.39	477.69	877.43	71	21.67	425.57	817.46
	13:00	24.05	80.8	27.11	147.00	1024.43	82.9	28.28	139.89	957.35
	15:09	26.20	83.9	28.83	81.64	1106.07	89.1	31.72	86.00	1043.35
	17:19	28.37	86.7	30.39	85.82	1191.89	88.3	31.28	89.92	1133.27
	19:45	30.80	85	29.44	97.13	1289.02	82	27.78	96.18	1229.45
	20:50	31.88	83.9	28.83	42.40	1331.42	79.2	26.22	40.08	1269.53
9/22/2001	12:27	47.50	72.7	22.61	557.86	1889.28	69.7	20.94	524.46	1793.99
	16:40	51.72	79.4	26.33	145.36	2034.64	84.6	29.22	147.93	1941.93
	18:45	53.80	80.7	27.06	76.45	2111.09	80.7	27.06	79.46	2021.38
9/24/2001	18:20	77.38	73.7	23.17	828.04	2939.12	72.7	22.61	821.49	2842.87
	20:53	79.93	69.7	20.94	81.74	3020.87	65.2	18.44	77.85	2920.72
9/25/2001	10:50	93.88	61.6	16.44	400.29	3421.15	63	17.22	388.28	3308.99
	17:08	100.18	73.60	23.11	187.60	3608.75	73.2	22.89	189.35	3498.34
9/26/2001	11:45	118.80	63.3	17.39	563.15	4171.91	68.8	20.44	589.53	4087.87
	16:15	123.30	73.2	22.89	135.63	4307.53	81.3	27.39	152.63	4240.49
9/27/2001	9:53	140.93	61.8	16.56	524.10	4831.63	61.8	16.56	563.78	4804.27



**Figure 23. Maturity curve for Patch 4, westbound lane**

**Table 24. Maturity data for Patch 5, westbound lane**

Patch #5 WBL

Time concrete place 1:05 PM                      Air temp XX                      Depth 9  
 Maturity start time 1:25 PM                      Slump X                      Pave temp 76

Date	Time	Elapsed (hr)	Channel B - lower			Channel A - upper				
			Temp F	Temp C	TTF @ Age	Sum TTF	Temp F	Temp C	TTF @ Age	Sum TTF
9/20/2001	14:55	0.00	82.7	28.17		0.00	78.9	26.06		0.00
	15:02	1.57	Error Reading				85.6	29.78	59.40	59.40
	16:25	2.78	Error Reading				92.4	33.56	50.69	110.10
	17:39	4.18	Error Reading				101	38.33	64.32	174.42
	20:00	6.45	Error Reading				97.5	36.39	107.35	281.77
	20:50	7.33	Error Reading				93.3	34.06	39.95	321.72
	21:56	8.50	Error Reading				89.2	31.78	50.07	371.79
9/21/2001	9:12	19.70	Error Reading				68.6	20.33	403.82	775.61
	13:26	23.68	Error Reading				83.7	28.72	137.54	913.14
	15:15	25.83	Error Reading				89.4	31.89	86.66	999.80
	17:27	27.95	Error Reading				88.6	31.44	88.19	1088.00
	19:52	30.42	Error Reading				81.2	27.33	97.16	1185.16
	20:57	31.50	Wires Removed				79.9	26.61	40.05	1225.21
9/22/2001	12:31	47.12					72	22.22	537.47	1762.68
	16:52	51.33					85.9	29.94	152.15	1914.83
	18:55	53.42					81.2	27.33	80.50	1995.33
9/24/2001	18:30	77.00					74.1	23.39	833.93	2829.26
	21:00	79.50					64.4	18.00	76.74	2906.00
9/25/2001	10:42	93.33					63.3	17.39	383.11	3289.11
	17:21	99.83					79	26.11	206.38	3495.48
9/26/2001	11:50	118.37					69.00	20.56	617.78	4113.26
	16:20	122.83					83.3	28.50	154.22	4267.48
9/27/2001	9:59	140.52					61.6	16.44	574.22	4841.70

Maturity Curve (Patch #5 WBL)

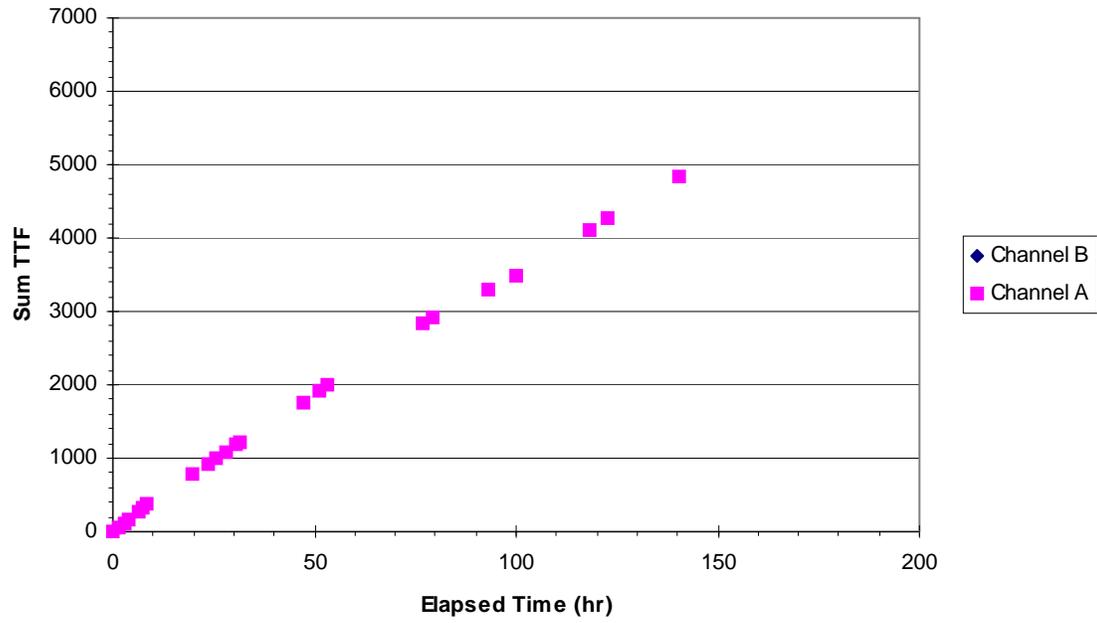
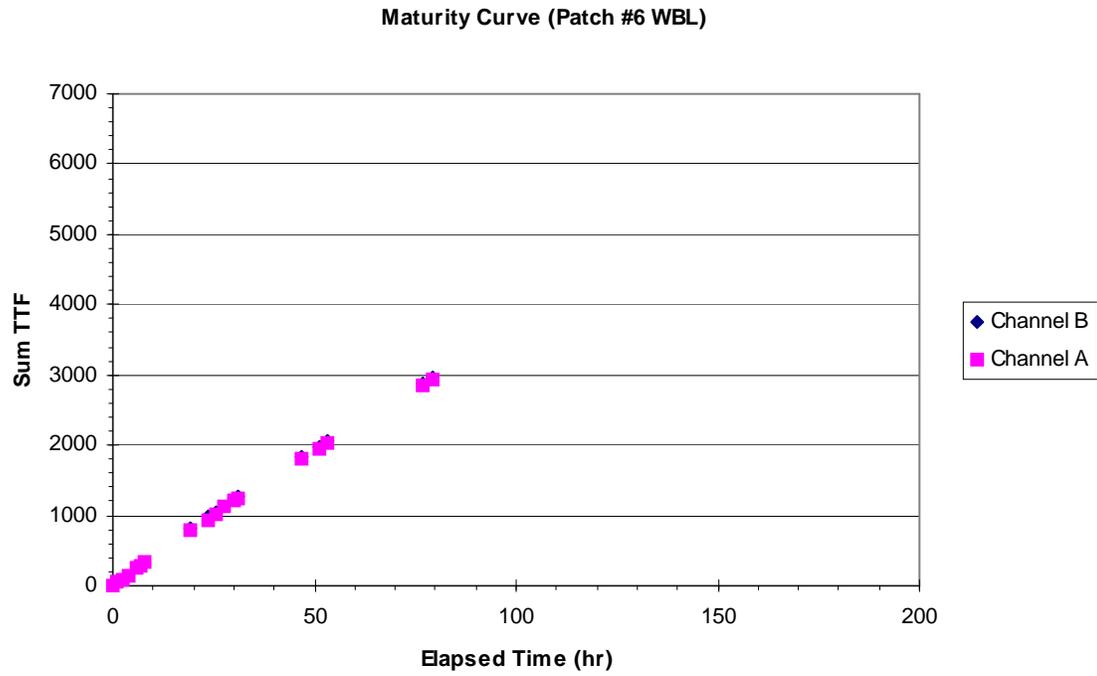


Figure 24. Maturity curve for Patch 5, westbound lane





**Figure 25. Maturity curve for Patch 6, westbound lane**

**Table 26. Maturity data for Patch 7, westbound lane**

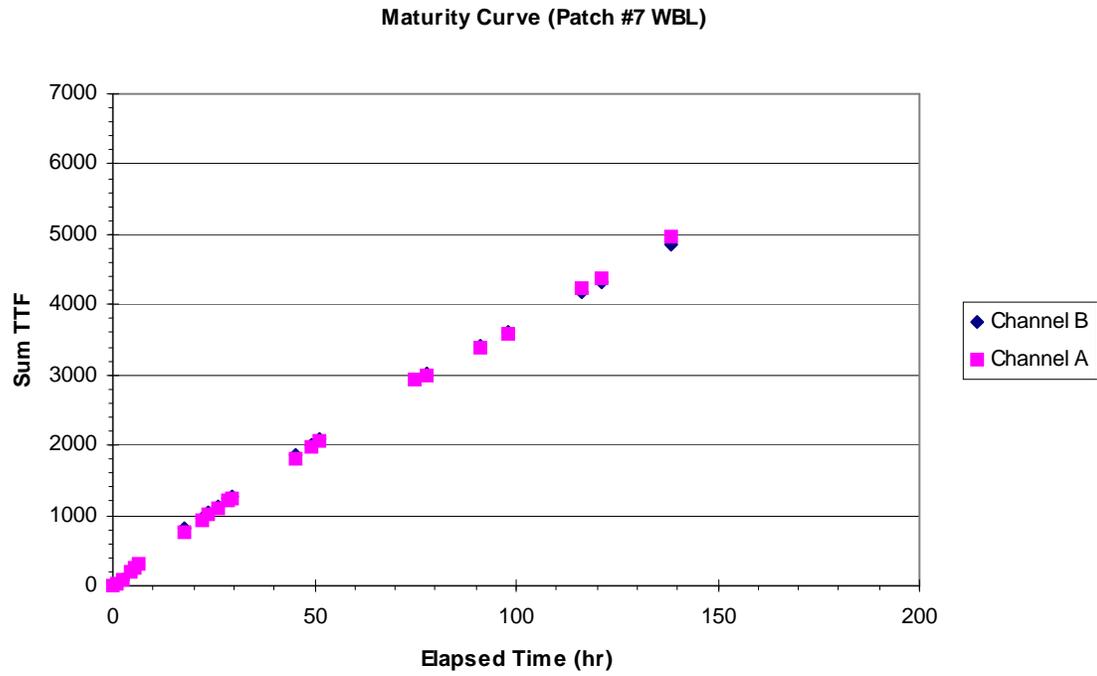
Patch #7 WBL

Time concrete

place 3:00 PM Air temp XX Depth 13

Maturity start time 3:27 PM Slump 1.5 Pave temp 85

Date	Time	Elapsed (hr)	Channel B - lower				Channel A - upper			
			Temp F	Temp C	TTF @ Age	Sum TTF	Temp F	Temp C	TTF @ Age	Sum TTF
9/20/2001	15:27	0.00	82.1	27.83		0.00	80.5	26.94		0.00
	16:28	1.02	88.4	31.33	40.24	40.24	88.7	31.50	39.88	39.88
	17:42	2.25	96	35.56	53.58	93.82	98.4	36.89	54.51	94.38
	20:03	4.60	109.3	42.94	115.74	209.56	103.7	39.83	113.65	208.03
	20:55	5.47	108.5	42.50	45.69	255.25	100.4	38.00	42.39	250.43
	22:00	6.55	106	41.11	56.12	311.38	97.1	36.17	51.01	301.43
9/21/2001	9:25	17.97	80	26.67	501.06	812.44	76.5	24.72	461.74	763.17
	13:30	22.05	84.4	29.11	154.71	967.16	91.7	33.17	159.02	922.20
	15:20	23.88	87.8	31.00	73.44	1040.59	96.6	35.89	81.63	1003.83
	17:30	26.05	90.4	32.44	90.40	1130.99	94.8	34.89	98.34	1102.17
	19:55	28.47	88.2	31.22	101.10	1232.09	85.9	29.94	102.51	1204.68
	21:03	29.60	86.2	30.11	46.09	1278.17	82.7	28.17	44.26	1248.94
9/22/2001	12:36	45.15	74.4	23.56	572.76	1850.93	75.3	24.06	561.53	1810.47
	16:55	49.47	82.5	28.06	154.56	2005.49	88.7	31.50	163.07	1973.54
	18:55	51.47	83	28.33	76.39	2081.88	84.2	29.00	80.50	2054.04
9/24/2001	18:34	75.12	76.4	24.67	863.23	2945.11	76.3	24.61	870.45	2924.50
	21:05	77.63	71.4	21.89	83.75	3028.86	66.6	19.22	80.32	3004.82
9/25/2001	10:37	91.17	60.6	15.89	390.96	3419.82	61.7	16.50	377.05	3381.87
	17:25	97.97	74.2	23.44	201.73	3621.55	78.7	25.94	212.31	3594.18
9/26/2001	11:55	116.47	64.5	18.06	568.88	4190.43	71.4	21.89	627.46	4221.64
	16:25	120.97	75.60	24.22	140.13	4330.55	83.7	28.72	158.88	4380.52
9/27/2001	10:02	138.58	62.1	16.72	536.82	4867.37	62.1	16.72	576.46	4956.97



**Figure 26. Maturity curve for Patch 7, westbound lane**

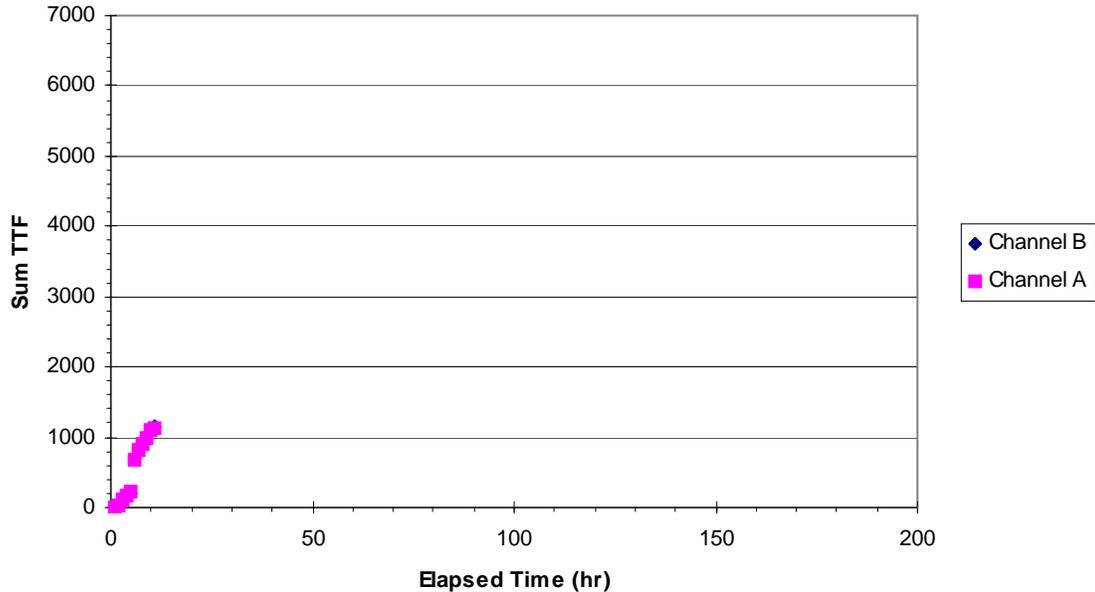
**Table 27. Maturity data for Patch 8, westbound lane**

Patch #8 WBL

Time concrete place 4:45 PM                      Air temp XX                      Depth 15  
 Maturity start time 5:04 PM                      Slump 3.5                      Pave temp 74

Date	Time	Elapsed (hr)	Channel B - lower				Channel A - upper			
			Temp F	Temp C	TTF @ Age	Sum TTF	Temp F C	TTF @ Age	Sum TTF	
9/20/2001	17:04	0.00	79.5	26.39		0.00	81	27.22		0.00
	17:45	0.68	81.6	27.56	25.26	25.26	79.4	26.33	25.13	25.13
	20:07	3.05	89.4	31.89	94.01	119.27	90.4	32.44	93.22	118.35
	21:02	3.97	94	34.44	39.57	158.84	96.1	35.61	40.36	158.71
	22:10	5.10	99.7	37.61	52.16	211.01	102.8	39.33	53.80	212.51
9/21/2001	9:40	16.60	81.9	27.72	490.67	701.67	73.9	23.28	475.01	687.53
	13:36	20.53	83.4	28.56	150.01	851.69	85.9	29.94	144.00	831.53
	15:26	22.37	85.7	29.83	71.86	923.54	89.9	32.17	75.27	906.80
	17:35	24.52	87.4	30.78	86.66	1010.20	88.6	31.44	89.88	996.68
	20:02	26.97	84.6	29.22	98.00	1108.20	80.9	27.17	96.30	1092.98
	21:07	28.05	83.7	28.72	42.22	1150.42	78.9	26.06	39.66	1132.64
9/22/2001	12:40	Wires Removed by Traffic				Wires Removed by Traffic				

**Maturity Curve (Patch #8 WBL)**



**Figure 27. Maturity curve for Patch 8, westbound lane**

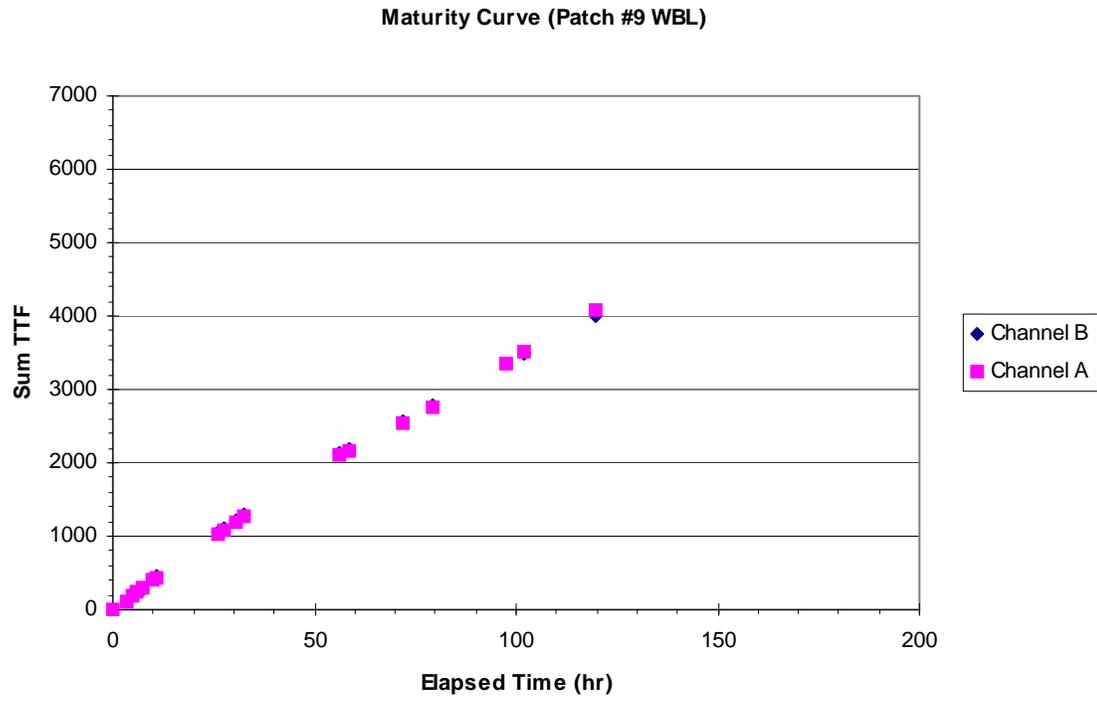
**Table 28. Maturity data for Patch 9, westbound lane**

Patch #9 WBL

Time concrete

place 10:15 AM Air temp XX Depth 9  
 Maturity start time 10:27 AM Slump 2.5 Pave temp 82

Date	Time	Elapsed (hr)	Channel B - lower				Channel A - upper			
			Temp F	Temp C	TTF @ Age	Sum TTF	Temp F C	TTF @ Age	Sum TTF	
9/21/2001	10:27	0.00	74	23.33		0.00	74.2	23.44		0.00
	13:40	3.22	82.6	28.11	114.91	114.91	85.4	29.67	117.59	117.59
	15:30	5.05	90.9	32.72	74.10	189.00	90.8	32.67	75.47	193.06
	16:22	5.92	93.7	34.28	37.70	226.70	99.6	37.56	39.10	232.16
	17:36	7.15	99.6	37.56	56.63	283.33	97	36.11	57.76	289.92
	20:05	9.63	96.4	35.78	115.89	399.22	90.7	32.61	110.16	400.08
	21:10	10.72	94	34.44	48.87	448.09	87.4	30.78	45.17	445.25
9/22/2001	12:42	26.25	74.9	23.83	607.96	1056.05	74.6	23.67	578.19	1023.43
	14:15	27.80	77.9	25.50	53.73	1109.78	82.5	28.06	55.58	1079.02
	17:00	30.55	81.8	27.67	100.60	1210.39	86	30.00	107.33	1186.35
	19:05	32.63	82.2	27.89	78.70	1289.09	82.2	27.89	81.13	1267.48
9/24/2001	18:45	56.30	72.8	22.67	834.91	2124.00	71.8	22.11	828.33	2095.81
	21:13	58.77	69.9	21.06	78.59	2202.59	64.7	18.17	74.34	2170.16
9/25/2001	10:32	72.08	58.5	14.72	371.39	2573.98	60.7	15.94	360.29	2530.45
	17:35	79.13	73	22.78	202.69	2776.66	76.6	24.78	214.05	2744.49
9/26/2001	12:06	97.65	64.5	18.06	563.22	3339.88	71.7	22.06	618.77	3363.26
	16:35	102.13	74.2	23.44	137.86	3477.74	81.5	27.50	155.92	3519.18
9/27/2001	10:08	119.68	62.6	17.00	530.30	4008.04	64.2	17.89	573.68	4092.86



**Figure 28. Maturity curve for Patch 9, westbound lane**

**Table 29. Maturity data for Patch 10, westbound lane**

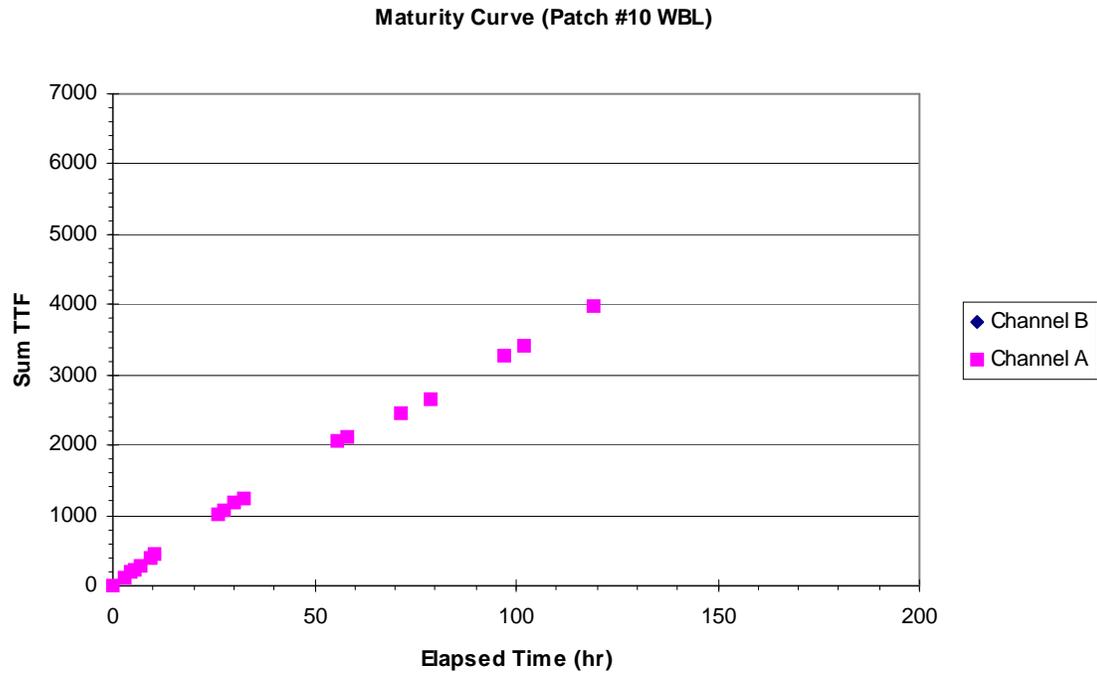
Patch #10 WBL

Time concrete

place 10:35 AM Air temp XX Depth 11

Maturity start time 10:53 AM Slump 2.5 Pave temp 72

Date	Time	Elapsed (hr)	Channel B - lower			Channel A - upper		
			Temp F	Temp C	TTF @ Age	Temp F C	TTF @ Age	Sum TTF
9/21/2001	10:53	0.00	Error Reading			77	25.00	0.00
	13:47	2.90	Error Reading			89	31.67	111.17
	15:30	4.62	Error Reading			100.6	38.11	77.06
	16:27	5.57	Error Reading			102.9	39.39	46.31
	17:40	6.78	Error Reading			98.4	36.89	58.57
	20:10	9.28	Error Reading			88.1	31.17	110.07
	21:15	10.37	Error Reading			84.6	29.22	43.54
9/22/2001	12:46	25.88	Error Reading			74.6	23.67	565.50
	14:17	27.40	Error Reading			81.2	27.33	53.84
	17:07	30.23	Error Reading			84.3	29.06	108.22
	19:10	32.28	Wires Removed			80.7	27.06	78.01
9/24/2001	18:47	55.90				68.7	20.39	796.41
	21:15	58.37				61.5	16.39	70.03
9/25/2001	10:27	71.57				58.5	14.72	337.33
	17:37	78.73				72.8	22.67	205.64
9/26/2001	12:10	97.28				71.6	22.00	599.78
	16:40	101.78				83	28.33	158.25
9/27/2001	10:11	119.30				62.6	17.00	572.21



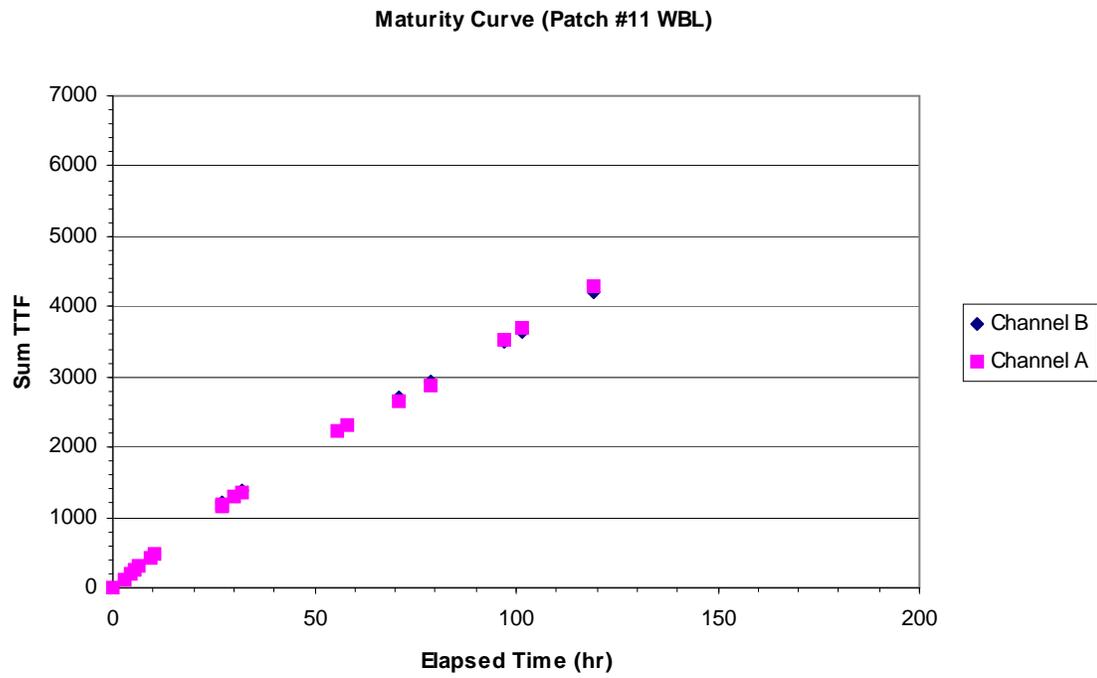
**Figure 29. Maturity curve for Patch 10, westbound lane**

**Table 30. Maturity data for Patch 11, westbound lane**

Patch #11 WBL

Time concrete place 11:00 AM      Air temp XX      Depth 13  
 Maturity start time 11:10 AM      Slump 2.5      Pave temp 83

Date	Time	Elapsed (hr)	Channel B - lower				Channel A - upper			
			Temp F	Temp C	TTF @ Age	Sum TTF	Temp F	Temp C	TTF @ Age	Sum TTF
9/21/2001	11:10	0.00	79	26.11		0.00	77.7	25.39		0.00
	14:00	2.83	93.7	34.28	113.88	113.88	97.1	36.17	115.54	115.54
	15:40	4.50	103.2	39.56	78.19	192.08	109.2	42.89	82.55	198.08
	16:40	5.50	108	42.22	50.89	242.97	112.8	44.89	53.89	251.97
	17:47	6.62	109.2	42.89	58.69	301.65	108.3	42.39	59.90	311.87
	20:20	9.17	103.2	39.56	130.62	432.27	93.6	34.22	123.18	435.05
	21:20	10.17	100	37.78	48.67	480.94	89.4	31.89	43.06	478.10
9/22/2001	14:05	26.92	80.2	26.78	708.15	1189.09	84.5	29.17	678.84	1156.94
	14:30	27.33	79.1	26.17	15.20	1204.29	85.5	29.72	16.44	1173.38
	17:15	30.08	85.1	29.50	104.04	1308.33	89.2	31.78	112.06	1285.44
	19:17	32.12	82.9	28.28	79.07	1387.40	85.1	29.50	82.63	1368.07
9/24/2001	18:52	55.70	75.3	24.06	852.93	2240.33	74	23.33	858.83	2226.90
	21:20	58.17	71.4	21.89	81.33	2321.67	64.7	18.17	75.85	2302.75
9/25/2001	10:20	71.17	61.1	16.17	377.36	2699.03	60.5	15.83	351.00	2653.75
	17:45	78.58	76.1	24.50	224.97	2924.00	79.7	26.50	231.15	2884.90
9/26/2001	12:20	97.17	66	18.89	588.99	3512.99	75.2	24.00	655.06	3539.97
	16:42	101.53	77.2	25.11	139.73	3652.72	85.3	29.61	160.72	3700.68
9/27/2001	10:14	119.07	63.2	17.33	547.43	4200.15	65	18.33	595.65	4296.33



**Figure 30. Maturity curve for Patch 11, westbound lane**

**Table 31. Maturity data for Patch 12, westbound lane**

Patch #12 WBL

Time concrete place 11:20 AM      Air temp XX      Depth 15  
 Maturity start time 11:45 AM      Slump 2      Pave temp 71

Date	Time	Elapsed (hr)	Channel B - lower			Channel A - upper			
			Temp F	Temp C	TTF @ Age	Temp F	Temp C	TTF @ Age	Sum TTF
9/21/2001	11:45	0.00	Error Reading			79.4	26.33		0.00
	14:05	2.33	Error Reading			95.4	35.22	95.15	95.15
	15:42	3.95	Error Reading			111.5	44.17	80.34	175.49
	16:50	5.08	Error Reading			118.6	48.11	63.62	239.11
	17:50	6.08	Error Reading			120.8	49.33	58.72	297.83
	20:22	8.62	Error Reading			119.8	48.78	149.61	447.44
	21:22	9.62	Error Reading			117.9	47.72	58.25	505.69
9/22/2001	14:00	26.25	Error Reading			94.7	34.83	852.92	1358.61
	14:30	26.75	Error Reading			95.6	35.33	22.54	1381.15
	17:20	29.58	Wires Removed			96.4	35.78	129.07	1510.23
	18:30	30.75				92.7	33.72	52.21	1562.44
9/24/2001	17:50	54.08				77.3	25.17	920.37	2482.81
	20:25	56.67				68	20.00	84.17	2566.98
9/25/2001	10:16	70.52				60.7	15.94	387.42	2954.39
	17:45	78.00				76.4	24.67	226.79	3181.18
9/26/2001	11:33	95.80				66.4	19.11	567.62	3748.80
	14:50	99.08				80.6	27.00	108.53	3857.34
9/27/2001	10:19	118.57				64	17.78	631.04	4488.38

Maturity Curve (Patch #12 WBL)

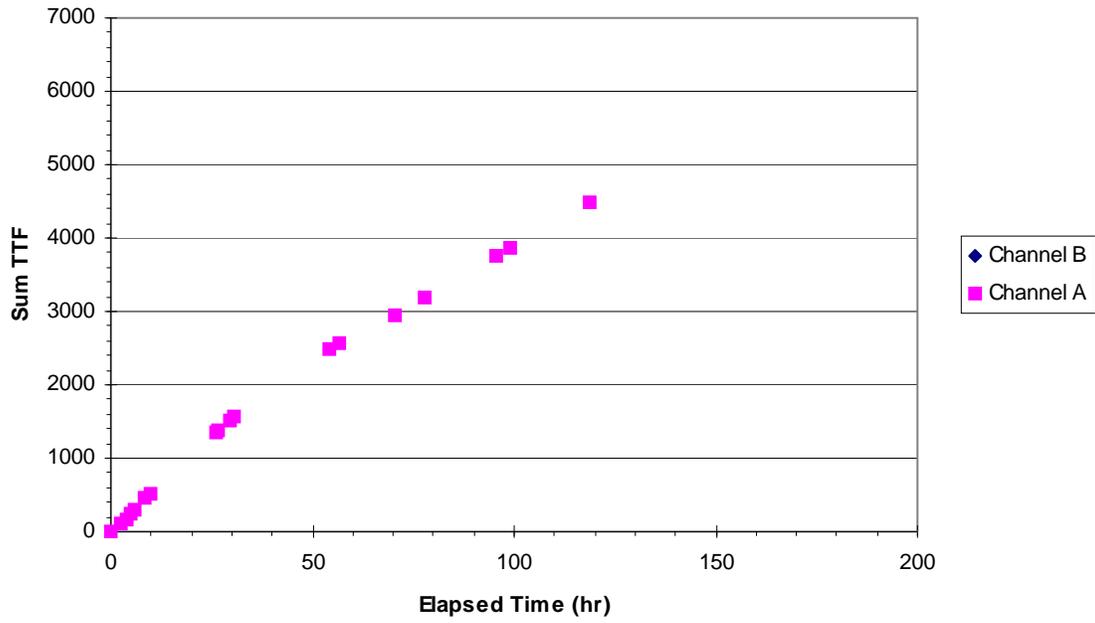


Figure 31. Maturity curve for Patch 12, westbound lane

## APPENDIX D. SCHMIDT HAMMER REBOUND TEST RESULTS

**Table 32. Schmidt rebound hammer data for all patches**

Eastbound lane			
EBL Patch: 1		Placed: 9/19/2001	
C4-9"-7hr	1	6	8
	9/20	9/25	9/27
1	14	28	30
2	15	36*	28
3	11	18	26
4	17	24	22
5	24*	20	26
6	18	29	22
7	14	22	26
8	14	24	27
9	12	31	31
10	14	19	26
Ave.	14.3	23.9	26.4

Westbound lane			
WBL Patch: 1		Placed: 9/20/2001	
M4-9"-7hr	5	7	11
	9/25	9/27	10/1
1	15	21	30
2	18	25	31
3	21	28	29
4	19	21	20
5	18	28	18*
6	19	29	32
7	17	24	23
8	17	22	32
9	16	30	24
10	17	25	36*
Ave.	17.7	25.3	27.6

EBL Patch: 2		Placed: 9/19/2001	
C4-11"-7hr	1	6	8
	9/20	9/25	9/27
1	13	28	22
2	15	22	26
3	11	23	22
4	16	23	26
5	19	19	22
6	12	31*	34*
7	15	20	24
8	19	19	27
9	16	20	25
10	15	18	32
Ave.	15.1	21.3	25.1

WBL Patch: 2		Placed: 9/20/2001	
M4-11"-7hr	5	7	11
	9/25	9/27	10/1
1	20	28	37
2	22	22	31
3	20	24	30
4	17	22	37
5	17	24	28
6	22	24	31
7	20	24	27
8	18	26	22
9	23	27	25
10	38*	44*	42*
Ave.	19.9	24.6	29.8

EBL Patch: 3 Placed: 9/19/2001  
 C4-13"-7hr 1 6 8

	9/20	9/25	9/27
1	15	20	24
2	18	23	29
3	19	20	30
4	14	22	19*
5	18	16*	28
6	21	28	33
7	25	30	42*
8	26	22	25
9	18	38*	26
10	18	30	26

Ave. 19.2 24.4 27.6

WBL Patch: 3 Placed: 9/20/2001  
 M4-13"-7hr 5 7 11

	9/25	9/27	10/1
1	41*	25	44*
2	26	44*	35
3	19	28	32
4	21	30	29
5	31	32	30
6	22	24	26
7	22	19*	28
8	22	25	38
9	22	26	31
10	20	29	37

Ave. 22.8 27.4 31.8

EBL Patch: 4 Placed: 9/19/2001  
 C4-15"-7hr 1 6 8

	9/20	9/25	9/27
1	15	22	33
2	16	21	22
3	14	18	30
4	19	23	22
5	25*	26	32
6	16	26	26
7	14	25	33
8	15	26	26
9	14	38*	30
10	14	36*	28

Ave. 15.2 23.4 28.2

WBL Patch: 4 Placed: 9/19/2001  
 M4-15"-7hr 6 9 12

	9/25	9/27	10/1
1	19	23	34
2	22	28	32
3	20	24	25
4	22	24	27
5	20	22	29
6	22	26	27
7	22	18	23
8	20	19	30
9	24	26	28
10	18	22	23

Ave. 20.9 23.2 27.8

EBL Patch: 5 Placed: 9/19/2001  
 C4-9"-5hr 1 6 8

	9/20	9/25	9/27
1	14	28	24
2	17	25	36
3	23	20	25
4	18	24	38*
5	16	25	36
6	14	20	24
7	18	24	24
8	18	28	32
9	14	25	33
10	20	39*	32

Ave. 17.2 24.3 29.6

WBL Patch: 5 Placed: 9/19/2001  
 M4-9"-5hr 6 9 12

	9/25	9/27	10/1
1	20	18	32
2	17	22	19
3	20	24	26
4	18	22	33
5	16	21	28
6	17	24	32
7	18	24	27
8	25	31	30
9	24	32*	30
10	22	30	30

Ave. 19.7 24.0 28.7

EBL Patch: 6 Placed: 9/19/2001  
C4-11"-5hr 1 6 8

	9/20	9/25	9/27
1	18	22	30
2	18	31	22*
3	19	28	36
4	20	30	32
5	18	29	42*
6	20	40*	26
7	18	40*	20*
8	18	24	36
9	20	26	34
10	18	36	24

Ave. 18.7 28.3 discard

WBL Patch: 6 Placed: 9/19/2001  
M4-11"-5hr 6 9 12

	9/25	9/27	10/1
1	22	35*	32
2	22	19	34
3	18	28	34
4	22	28	32
5	16	28	29
6	23	22	24*
7	21	24	38
8	22	29	32
9	18	21	32
10	25	24	32

Ave. 20.9 24.8 32.8

EBL Patch: 7 Placed: 9/19/2001  
C4-13"-5hr 1 6 8

	9/20	9/25	9/27
1	20	31	34
2	15	22	22
3	18	30	29
4	19	40*	24
5	19	20	32
6	15	22	24
7	15	25	20
8	18	39*	37*
9	16	20	24
10	21	32	32

Ave. 17.6 25.3 26.8

WBL Patch: 7 Placed: 9/19/2001  
M4-13"-5hr 6 9 12

	9/25	9/27	10/1
1	21	30	28
2	22	34	26
3	21	32	34
4	20	31	28
5	24	30	30
6	20	20*	32
7	20	25	22
8	22	28	40*
9	22	24	30
10	24	25	32

Ave. 21.6 28.8 29.1

EBL Patch: 8 Placed: 9/19/2001  
C4-15"-5hr 1 6 8

	9/20	9/25	9/27
1	16	33	30
2	18	21	28
3	19	24	32
4	19	32	34
5	17	26	25
6	18	22	30
7	23	26	36
8	27*	34	32
9	17	23	26
10	16	29	34

Ave. 18.1 27 30.7

WBL Patch: 8 Placed: 9/19/2001  
M4-15"-5hr 6 9 12

	9/25	9/27	10/1
1	21	32	24
2	22	22	36
3	21	30	34
4	21	30	42*
5	20	30	31
6	20	25	33
7	22	28	32
8	18	20*	33
9	20	29	28
10	22	31	30

Ave. 20.7 28.6 31.2

EBL Patch: 9 Placed: 9/19/2001  
C4-9"-3hr

	9/20	9/25	9/27
1	15	23	26
2	15	21	27
3	18	32	31
4	15	19	28
5	16	20	22
6	16	30	39*
7	16	38*	34
8	16	21	29
9	17	22	24
10	16	20	28
Ave.	16	23.1	27.7

WBL Patch: 9 Placed: 9/21/2001  
M4-9"-3hr

	9/25	9/27	10/1
1	21	30	32
2	19	30	32
3	16	27	24*
4	19	29	28
5	20	30	34
6	22	27	37
7	16	20	32
8	22	29	24*
9	19	24	36
10	22	23	31
11	22	27	33
12	20	34	35
13	20	29	39
14	25	33	46*
Ave.	20.2	28.0	33.5

EBL Patch: 10 Placed: 9/19/2001  
C4-11"-3hr

	9/20	9/25	9/27
1	14	18	32
2	18	16	28
3	17	26	20*
4	15	25	32
5	15	25	32
6	16	26	29
7	17	24	26
8	19	26	27
9	17	29	41*
10	19	32	46*
Ave.	16.7	24.7	discard

WBL Patch: 10 Placed: 9/21/2001  
M4-11"-3hr

	9/25	9/27	10/1
1	22	30	34
2	26	21	30
3	35*	22	36
4	20	24	37
5	19	21	28
6	20	29	42
7	18	26	35
8	20	31	37
9	15	28	38
10	20	32	34
Ave.	20	26.4	35.1

EBL Patch: 11 Placed: 9/19/2001  
C4-13"-3hr

	9/20	9/25	9/27
1	19	24	32
2	16	20	25
3	18	24	40*
4	14	30	36
5	14	22	29
6	16	31	33
7	16	22	30
8	17	33*	40*
9	15	19	28
10	16	22	30

Ave. 16.1 23.8 30.4

WBL Patch: 11 Placed: 9/21/2001  
M4-13"-3hr

	9/25	9/27	10/1
1	19	24	25*
2	22	21	32
3	18	30	33
4	18	24	29
5	23	36	41
6	22	34	32
7	18	30	41
8	20	29	43*
9	18	24	34
10	21	29	38

Ave. 19.9 28.1 35.0

EBL Patch: 12 Placed: 9/19/2001  
C4-15"-3hr

	9/20	9/25	9/27
1	21	27	23
2	16	22	26
3	16	21	32
4	17	22	36*
5	15	20	28
6	16	28	36*
7	20	34	24
8	16	18	20*
9	17	22	28
10	18	36*	38*

Ave. 17.2 23.8 discard

WBL Patch: 12 Placed: 9/21/2001  
M4-15"-3hr

	9/25	9/27	10/1
1	20	24	33
2	22	36*	25
3	20	26	35
4	24	24	27
5	24	28	31
6	23	24	40*
7	20	30	28
8	20	30	24
9	21	24	31
10	17	30	33

Ave. 21.1 26.7 29.7

EBL Patch: 13                      Placed: 9/19/2001

M4-9"-350 psi	9/20	9/25	9/27
1	19	20	26
2	17	21	23
3	19	31	30
4	17	20	24
5	19	31	25
6	18	24	24
7	16	23	26
8	20	44*	25
9	21	38*	33
10	20	30	24
11	18	28	36*
12	18	23	24
13	18	20	26
14	19	22	27
15	20	20	32

Ave.                      18.6                      24.1                      26.4

EBL Patch: 14                      Placed: 9/19/2001

M4-11"-350 psi	9/20	9/25	9/27
1	18	23	24
2	17	29	32
3	19	20	24
4	15	21	24
5	14	20	23
6	21	28	36*
7	16	30	30
8	17	33	34
9	18	22	23
10	17	35*	34

Ave.                      17.2                      25.1                      27.6

EBL Patch: 15                      Placed: 9/19/2001

M4-13"-350 psi	9/20	9/25	9/27
1	16	19	28
2	14	27	22
3	14	20	26
4	14	25	35
5	15	18	18
6	15	24	35
7	13	18	30
8	12	36*	40*
9	18	24	30
10	16	32	23

Ave.                      14.7                      23                      27.4