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16. Abstract

This project conducted work to complement implementation of Pave-IR into the Texas Department of Transportation's hot-mix-asphalt quality control/quality assurance specification. Pave-IR provides real-time thermal profiling of paving operations to detect thermal segregation. To facilitate this implementation, a webinar was first conducted to introduce industry and agency personnel to the background of thermal profiling and how thermal segregation relates to mixture properties and performance. More than 80 attendees comprising both contractor and agency personnel attended the webinar. The webinar materials are available separate of this report as Product 5-4577-05-P1. Next, Pave-IR thermal profiling was demonstrated on eight construction projects. This report presents the results from these demonstrations, which were made of varying mixture types around the state. The thermal profiles collected ranged from projects with little thermal segregation to projects with frequent severe thermal segregation. In all cases, the demonstrations revealed contractor and agency staff eager to learn more about the technology and how the results can be used to place higher quality asphalt mixtures.

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STATEWIDE IMPLEMENTATION OF PAVE-IR IN THE TEXAS DEPARTMENT OF TRANSPORTATION

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DISCLAIMER

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ACKNOWLEDGMENTS

This project was made possible by the Texas Department of Transportation and the Federal Highway Administration. Special thanks must be extended to Richard Izzo, P.E., for serving as the project director. This project also would not have been possible without the support and involvement of the many districts and contractors that participated in field demonstrations.

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EXECUTIVE SUMMARY

The Texas Department of Transportation (TxDOT) initiated work beginning in 2000 studying the utility of thermal imaging during hot-mix-asphalt paving for detecting thermal segregation of the asphalt mixture. Based upon promising results, temperature differential thresholds and a thermal profiling test procedure in Tex-244-F were developed. Subsequent research project work developed an automatic method of thermal profiling using a series of infrared sensors attached to the paver and a computer to collect, process, and display the results. Named Pave-IR, this thermal profiling system became commercially available in 2009.

With existing thresholds to define thermal segregation, and commercial availability of Pave-IR for full-coverage real-time thermal profiling, TxDOT initiated activities to implement Pave-IR into Test Method Tex-244-F and into their hot-mix-asphalt quality control/quality assurance specification. To complement these TxDOT activities, this implementation project developed and conducted webinar training to introduce industry and TxDOT to Pave-IR, then worked with contractors and TxDOT offices to conducted Pave-IR demonstrations on eight construction projects throughout the state.

The webinar was conducted on December 1, 2010, and included more than 80 attendees comprised of contractor and agency personnel. The webinar included an introduction to thermal profiling and how thermal segregation relates to mixture properties and performance, a summary of how to use Pave-IR for data collection and reporting according to Test Method Tex-244-F, and a summary of how to manually review Pave-IR thermal profiles in post-processing software. These webinar materials are available separately from this report as Product 5-4577-05-P1.

Pave-IR demonstration projects for informational purposes were conducted in TxDOT's Austin, Bryan, Odessa, Atlanta, El Paso, Laredo, Houston, and Waco Districts. These projects represented a spectrum of hot mix asphalt including Type C, D, stone-matrix asphalt (SMA), permeable friction course (PFC), course-matrix high-binder (CMHB), and crack-attenuating mix (CAM) mixture types. The collected thermal profiles included examples of a minimal amount of thermal segregation and examples of frequent severe thermal segregation. The body of this report presents the results from each demonstration project. The demonstrations revealed contractors were most interested in discovering how compliant their operations are with the current thermal profile specification, while TxDOT personnel were primarily interested in the format of the output and how to interpret the results. In general, both contractor and agency staff were eager to learn more about the technology to improve placement operations to produce more uniform, higher quality overlays.

CHAPTER 1.
PAVE-IR DEMONSTRATION WITH CMHB-F MIX IN THE AUSTIN DISTRICT

Summary

On October 25, 2010, the Texas Transportation Institute (TTI) performed a Pave-IR demonstration on CMHB-F placed on IH 35. TTI used a Moba Pave-IR system to collect thermal profiles on the southbound inside lane (SBIL) of mix placed from Station 325+47 to 514+80. This mix was produced with PG 76-22 binder. The data showed good thermal uniformity, with 84 percent of profiles having no thermal segregation, 80 percent of measured placement temperatures falling between 300 and 320°F, and nearly 100 percent of placement temperatures between 280 and 320°F. The following summarizes the results from the 127 thermal profiles collected and processed with Pave-IR in accordance with Test Method Tex-244-F:

- Eighteen profiles, or 14 percent, had moderate thermal segregation. Of these profiles with moderate thermal segregation, 11 profiles had temperature differentials exceeding 25°F but less than 30°F.
- Two profiles, or about 2 percent, had severe thermal segregation. These were the very first and the very last profiles of the paving run.

Based on experience, the results collected on this CMHB-F project show good thermal uniformity, especially considering the 1 in. lift thickness placed, and the cooler, windy conditions experienced the night of this survey.

Summary of Paving Operations

The contractor used belly dump trucks to transport the mix from their north plant to the job site. This resulted in a haul distance of approximately 7 miles. A Roadtec SB2500D transferred the mix to a Barber Green paver. Figure 1 shows the paving operation with Pave-IR data collection taking place.

Figure 1. Paving CMHB-F on IH 35 SBIL.

Thermal Profile Results

Appendix A contains the automated thermal profile results per Tex-244-F. This section presents example screen captures of thermal profiles observed:

- Figure 2 presents a typical thermal profile, with no thermal segregation and a temperature differential less than 25°F. Approximately 84 percent of the section surveyed was in this category.
- Figure 3 presents a typical thermal profile with moderate temperature segregation; this figure shows a profile where the temperature differential exceeded 25 but was less than 30°F. In this case the temperature differential appears due to random variation in the operation.
- Figure 4 shows two more profiles with moderate temperature segregation; in this case the mean mixture temperature increases from the first to the second profile; this increase in the average mixture temperature is what resulted in the moderate thermal segregation.
- Figure 5 shows the severe thermal segregation in the first profile; the last profile also exhibited severe thermal segregation. The thermal segregation in these two profiles is likely caused by the variations of beginning and stopping a paving train's pull.
- Figure 6 shows an interesting case where water spilled from the cooler on the paver resulted in an isolated artificial cold spot. In this case, the automated processing approach used in Pave-IR was insensitive to this artificial cold spot, and the calculated temperature differential for the profile was 23°F.

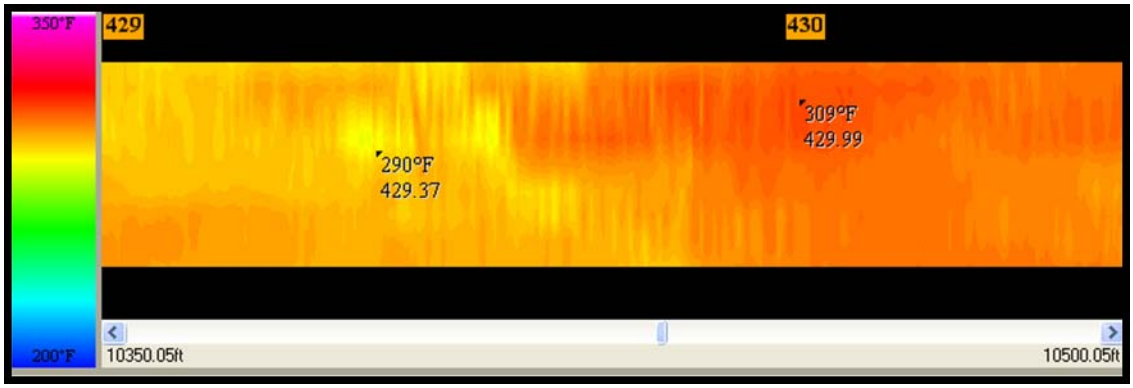


Figure 2. Typical Profile without Thermal Segregation on IH 35 SBIL.
Note: Profile 70 shown.

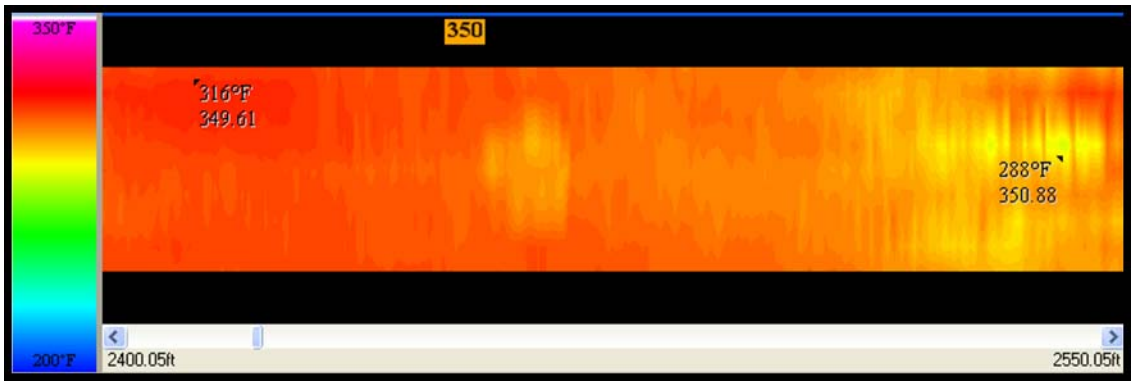


Figure 3. Moderate Thermal Segregation from CMHB-F.
Note: Profile 17 shown.

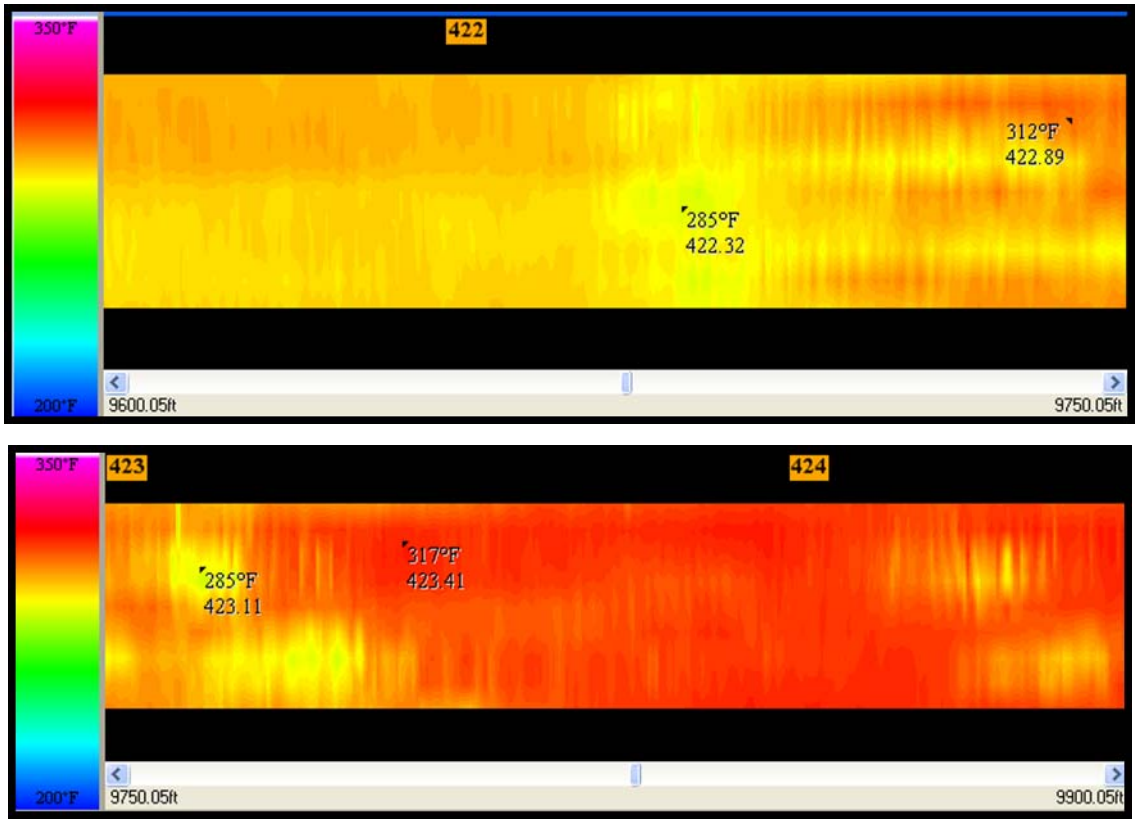


Figure 4. Moderate Thermal Segregation due to Increase in Average Mixture Temperature.
Note: Profiles 65 and 66 shown.

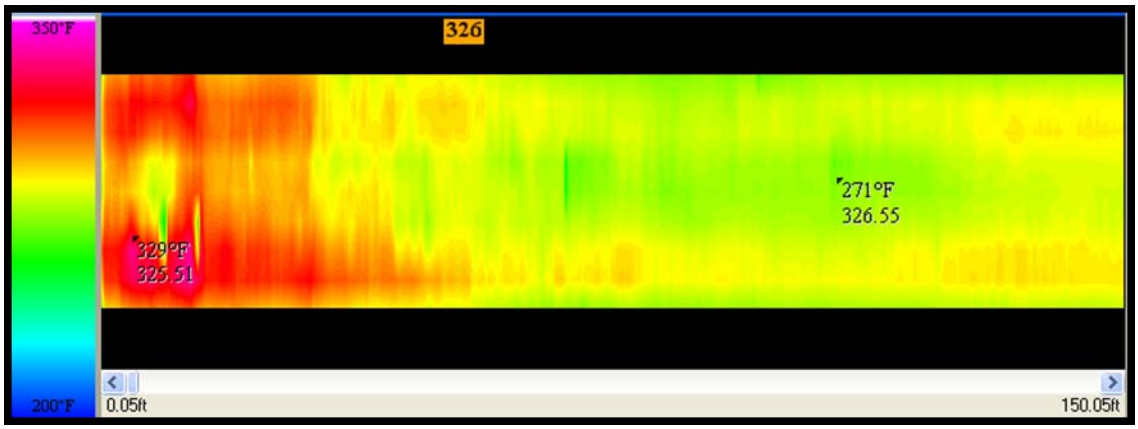


Figure 5. Severe Thermal Segregation in First Profile from CMHB-F.

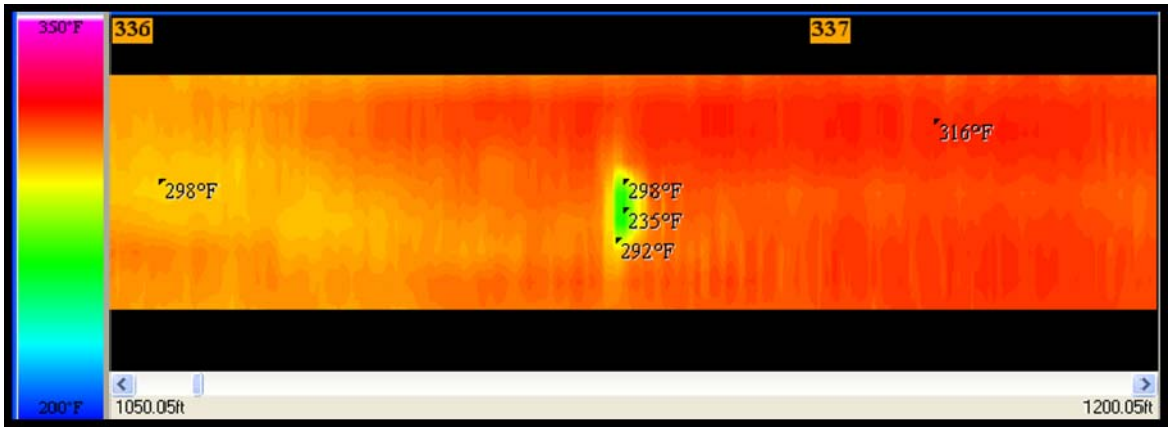


Figure 6. Artificial Cold Spot from Water Cooler Detected by Pave-IR Automated Processing.

Note: profile 8 shown. Calculated temperature differential in Pave-IR was 23°F.

CHAPTER 2.
PAVE-IR DEMONSTRATION WITH CAM MIX IN THE BRYAN DISTRICT

Summary

On December 10 and 15, 2010, TTI performed a Pave-IR demonstration on the westbound lane of 1-in. thick CAM placed on FM 158 in Bryan, Texas. On December 10, the contractor initially employed a windrow operation; however, problems with the material transfer device resulted in the suspension of the windrow operation. Of the profiles collected during the placement utilizing windrows, all profiles had thermal segregation. Due to the equipment problems encountered, most of the results collected December 10 likely do not represent the actual operation. The few profiles collected that day that likely would represent the normal paving operation had moderate thermal segregation.

On December 15, 2010, the contractor used end-dump trucks into the material transfer device. On this date, 15 profiles were collected, and 80 percent of those had moderate thermal segregation. The remaining profiles had severe thermal segregation.

Generally, with the haul distance, equipment, and processes used on FM 158, one would expect more uniformity than what the data provides. However, little experience exists in thermal profiling such thin overlays. As TxDOT continues to construct more projects with thin overlays, thermal profile data should continue to be collected to establish a better baseline of the temperature differentials on those types of projects.

Summary of Paving Operations

The contractor used belly dump trucks when placing the mix profiled on December 10, 2010. On that day, the contractor placed an 18 ft wide mat to include the westbound inside lane and half of the center turn lane; the Pave-IR system was set up to profile the inside lane and ignore the turn lane. Due to problems with the material transfer device, the next day of placement profiled on December 15 used end dump trucks. On December 15, the placement width was approximately 14 ft. In all cases, a Roadtec SB 2500 transferred the mix into a Cat AP 1000D paver. The CAM mix was produced locally and hauled approximately 6 miles to the job site. Figure 7 shows the paving operation, Figure 8 shows the limits of data collection on December 10, and Figure 9 shows the limits of data collection on December 15.

December 10, 2010 *December 15, 2010*

Figure 7. Paving Operation on FM 158.

Figure 8. Limits of Data Collected December 10, 2010, on FM 158.

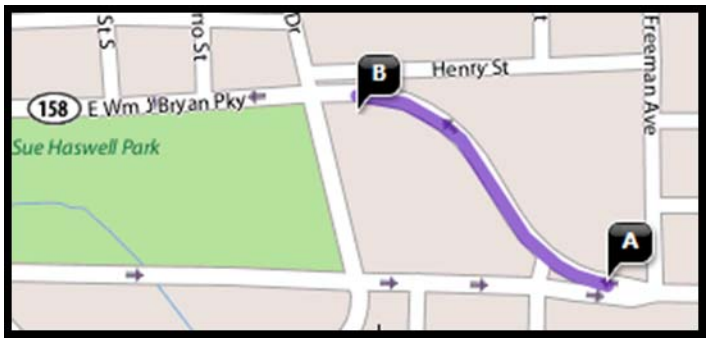


Figure 9. Limits of Data Collected December 15, 2010, on FM 158.

Thermal Profile Results

The automated thermal profile results per Tex-244-F from December 10 and 15 are in Appendices B and C, respectively. This section presents example screen captures of thermal profiles observed:

- Figure 10 presents a typical thermal profile from December 10. Moderate temperature segregation exists, with temperature differentials approximately 35°F.
- Figure 11 presents a non-typical thermal profile from December 10. Profiles 1, 2, 6, and 7 on December 10 do not represent the normal operation of the paving train, because

these profiles contain significant anomalies due to the crew trying to address problems with the material transfer device. In Figure 5, the first paver stop (annotated with an arrow) lasted 43 minutes, while the second paver stop (also annotated) lasted 18 minutes.

- In Figure 11, after the first paver stop, the pattern of the paver screed remained visible in the finished mat upon the paving train resuming progress. Figure 12 shows this phenomenon. Personnel observing this pattern on other projects have suggested making a joint may be a better alternative to keeping the paver idle for so long on the uncompacted mat.
- Figure 13 shows a typical profile, which had moderate thermal segregation, from December 15. On December 15, 80 percent of profiles exhibited moderate thermal segregation, with the typical temperature differential between 35 and 45°F.
- The severe thermal segregation in profile 3 clearly resulted from a shift in mean mixture temperature as Figure 14 shows.
- Figure 15 shows profile 10 from December 15. This profile contained two paver stops as annotated. Since TxDOT specifications handle paver stops separately, the limits of the paver stop are excluded from the thermal profile analysis in Test Method Tex-244-F. Figure 15 also highlights that, in general, the thermal irregularities observed on this project could be classified as random.

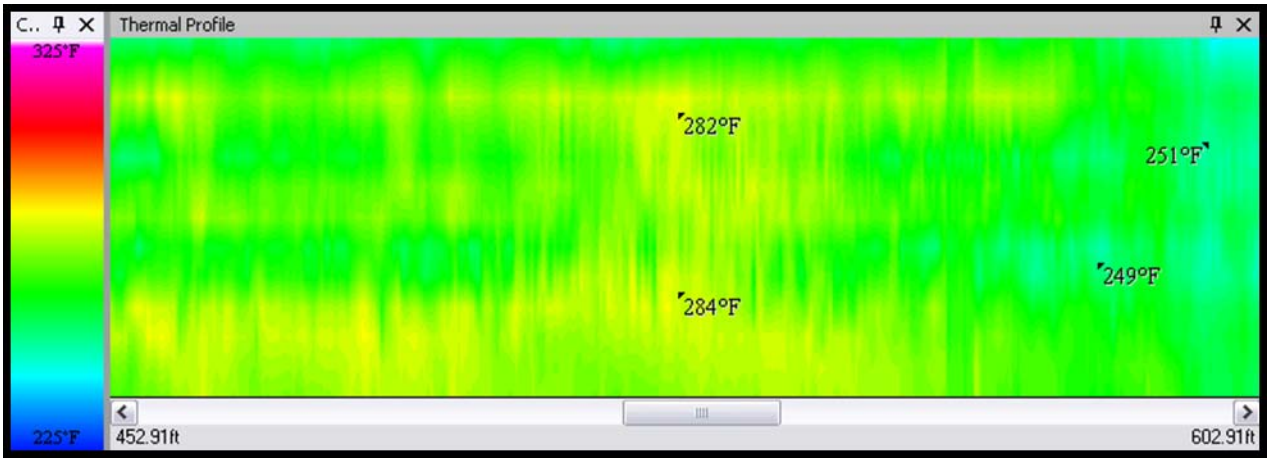


Figure 10. Typical Thermal Profile from December 10 on FM 158.
Note: profile 4 shown.

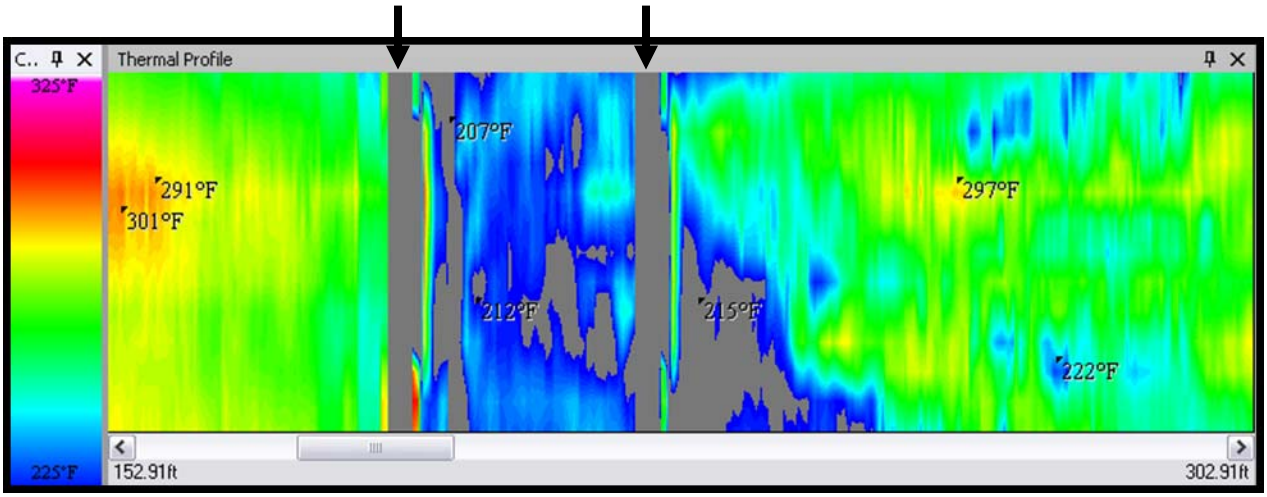


Figure 11. Non-Representative Profile from December 10 on FM 158.
Note: profile 2 shown. Long delays in paving train occurred while crew worked on material transfer device.

Figure 12. Pattern of Screed Left in Completed Mat due to Long Paver Stop.

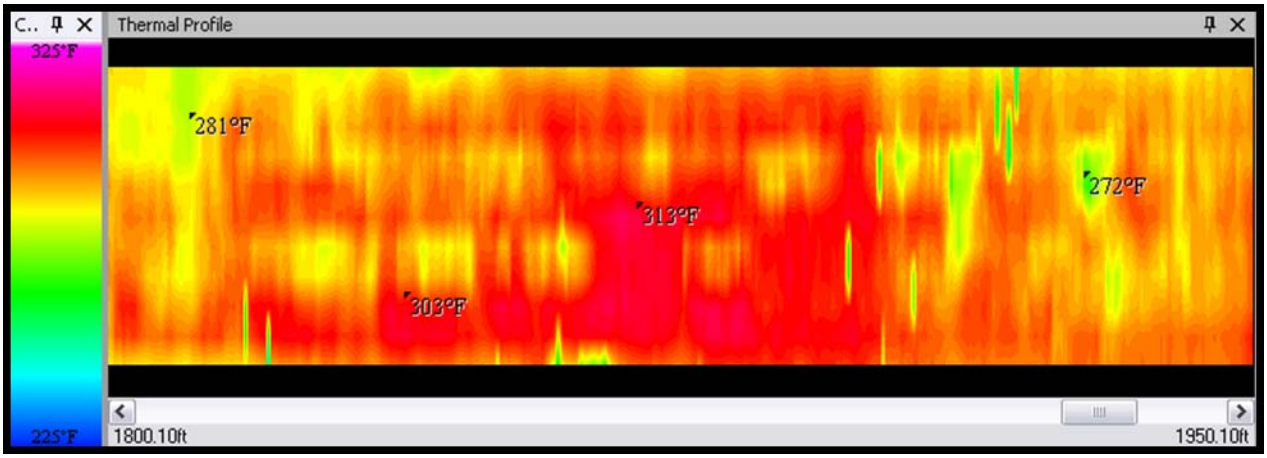


Figure 13. Example Thermal Profile from FM 158 on December 15, 2010.
Note: profile 13 shown.

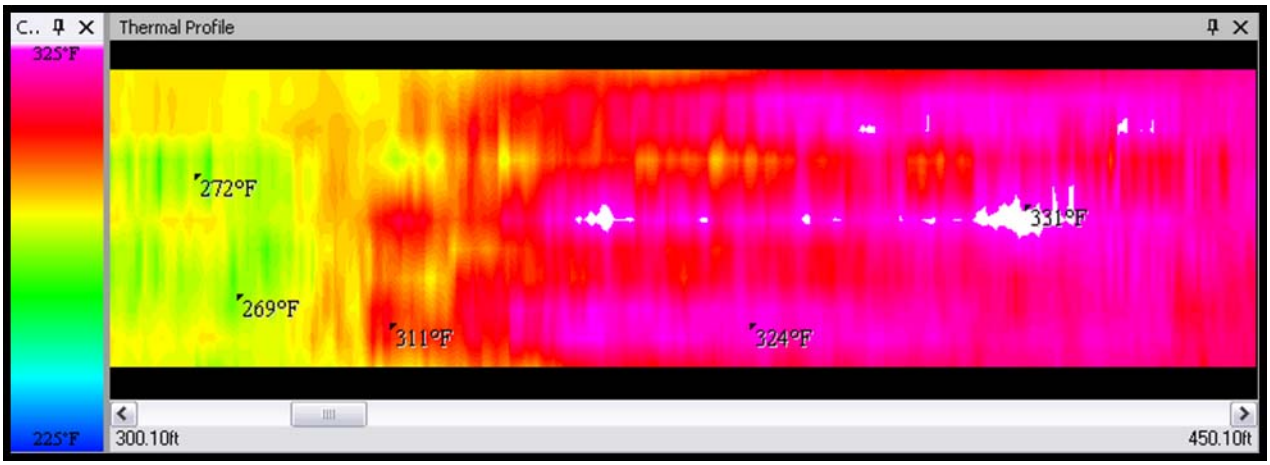


Figure 14. Thermal Segregation due to Increase in Mean Mixture Temperature on FM 158.

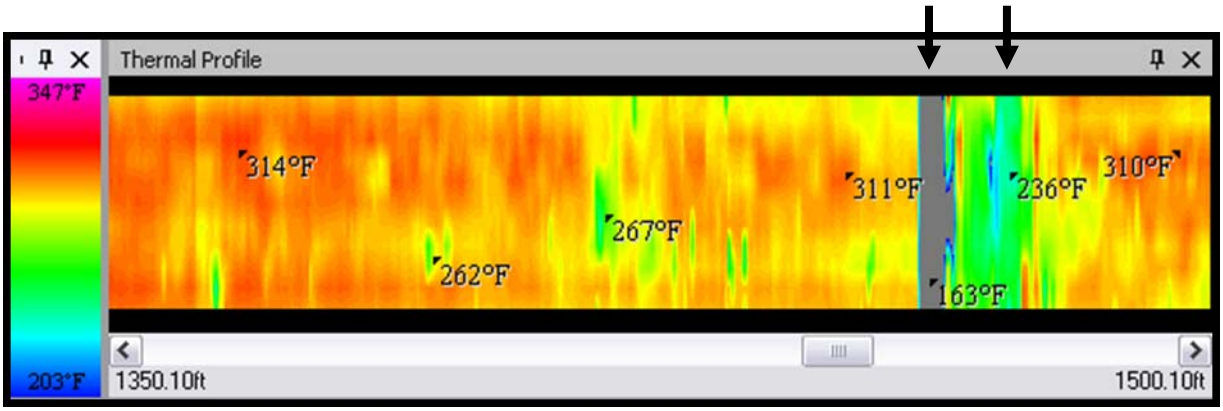


Figure 15. Paver Stops and Random Thermal Segregation on FM 158.
Note: profile 10 shown.

CHAPTER 3.
PAVE-IR DEMONSTRATION WITH SMA AND PFC MIXTURES IN THE ODESSA DISTRICT

Summary

On April 26 and 27, 2011, TTI performed a Pave-IR demonstration on experimental mixes placed at the entrance to the Pecos Research and Testing Center. The sections tested included 1-in. thick SMA and PFC mixtures. The results showed generally good uniformity, with moderate thermal segregation sometimes present in both the SMA and PFC mixes. With the SMA mixes, when thermal segregation was present, the 25°F temperature differential threshold was typically only exceeded by a few degrees, which is not cause for major concern. The temperature differentials observed with the PFC were typically slightly higher than those observed with the SMA.

Summary of Paving Operations

The contractor used tarped belly dump trucks to haul the mix from Midland to the job site, resulting in a haul distance of approximately 100 miles. At the job site, a Roadtec Shuttle Buggy SB 2500D transferred the windrows to a Vogele Vision 5203 paver. Figure 16 shows the paving operation.

Figure 16. Paving Operation on Pecos Test Sites.

SMA Thermal Profile Results

Appendices D and E contain the automated thermal profile results per Tex-244-F for the SMA mixes. The mix designs were the same, with the exception of the aggregate source. The results show good thermal uniformity. Although the percent of profiles with moderate thermal segregation is high, a review of those profiles reveals temperature differentials rarely exceeding the 25°F threshold by more than just a few degrees. With both mixes, the highest temperature differential is from the first profile, which based on experience is a common occurrence.

Figure 17 shows a representative profile from the SMA with Hoban aggregate where the temperature differential barely exceeds the 25°F threshold. Figure 18 presents an example profile from the SMA with Eastland aggregate, which typically did not exhibit any thermal segregation. In both of these figures, the black horizontal line surrounded by red feathering near the center of the plots is due to sensor 7; that sensor received damage in transit to the job site and was providing bad data; sensor 7 was therefore ignored from the profile analyses.

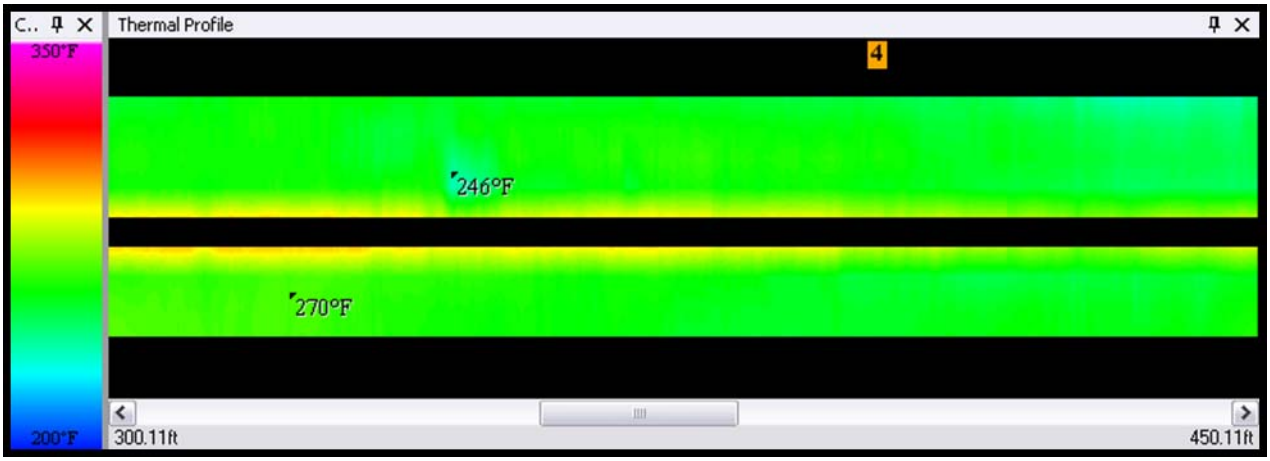


Figure 17. Example Thermal Profile from SMA with Hoban Aggregate.
Note: profile 3 shown.

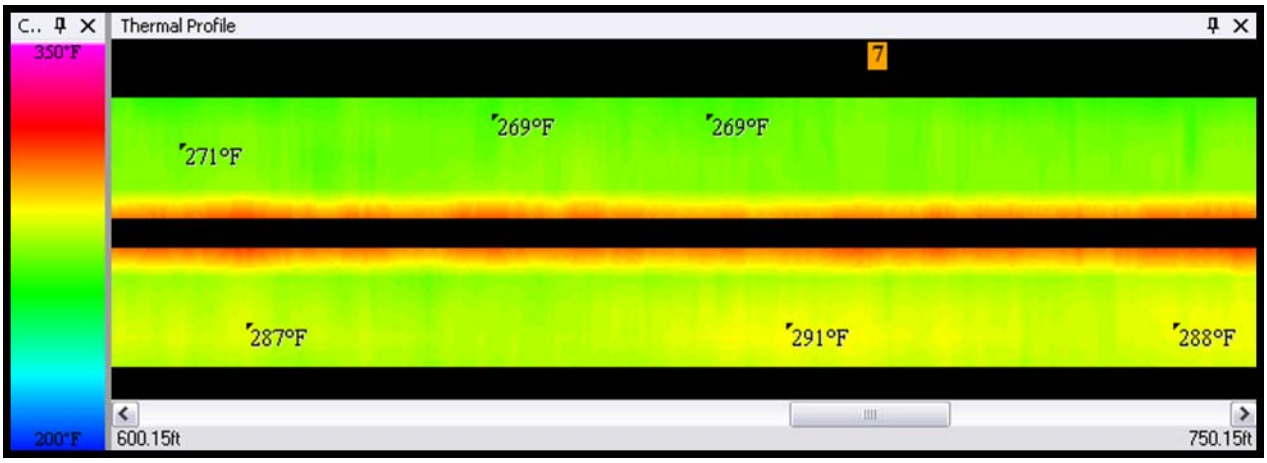


Figure 18. Example Thermal Profile from SMA with Eastland Aggregate.
Note: profile 5 shown.

PFC Thermal Profile Results

Appendices F and G contain the automated thermal profile results per Tex-244-F for the PFC mixes. The mix designs were the same, with the exception of the aggregate source. For both PFC mixes, the results show the majority of profiles exhibiting moderate thermal segregation. Figure 19 shows a representative profile from the PFC with Hoban aggregate, while Figure 20 presents a representative profile from the PFC with Eastland aggregate.

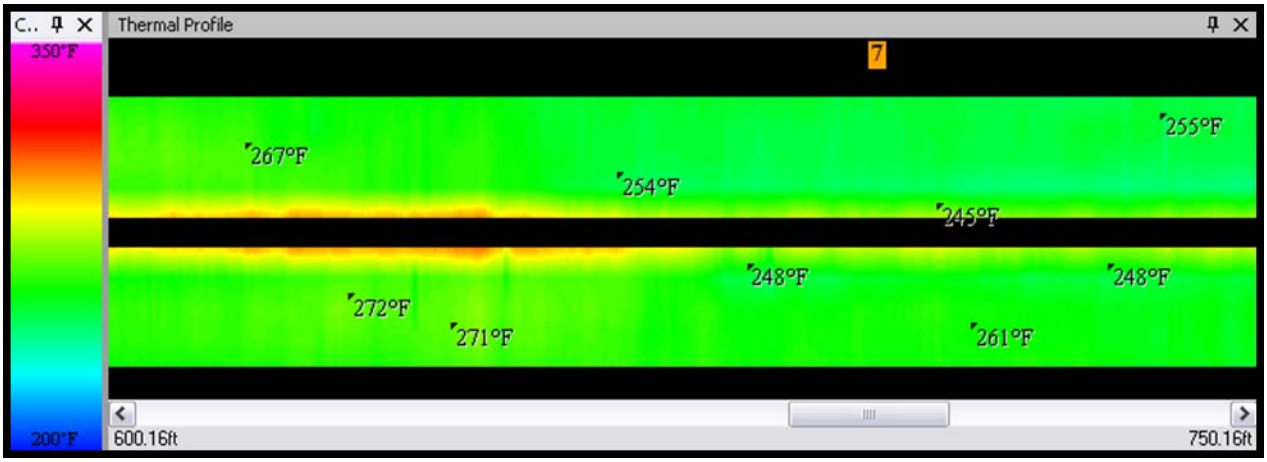


Figure 19. Example Thermal Profile from PFC with Hoban Aggregate.
Note: profile 5 shown.

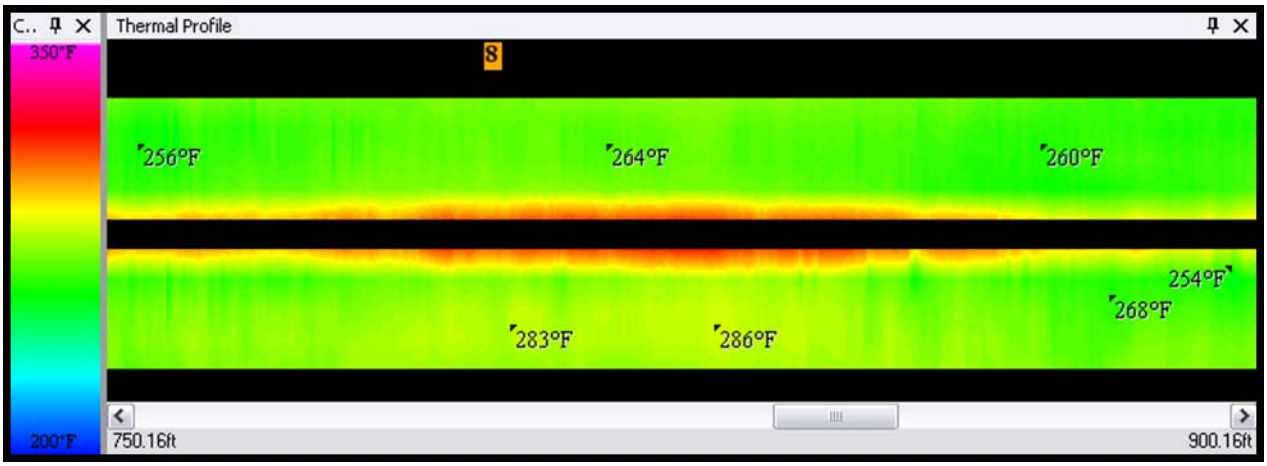


Figure 20. Example Thermal Profile from PFC with Eastland Aggregate.
Note: profile 6 shown.

CHAPTER 4.
PAVE-IR DEMONSTRATION WITH TYPE D MIX IN THE ATLANTA DISTRICT

Summary

On May 5, 2011, TTI performed a Pave-IR demonstration in TxDOT's Atlanta District on SH 8 near New Boston, Texas. Thermal profiles were collected on the southbound lane of Type D mix placed from Station 743+00 to 760+98. The results from the thermal profiles collected show no thermal segregation present.

After collection of these data, TTI returned to TxDOT's New Boston Maintenance Office and reviewed the thermal profile results from both May 5 and the prior day's placement with TxDOT staff. The thermal profile results show:

- Data collected May 5, no thermal segregation was present.
- On May 4, 38 profiles (or 78 percent) had moderate thermal segregation. Of these profiles with moderate thermal segregation, 24 of them had temperature differentials less than 30°F. Considering that observation, the job on May 4 had reasonably good thermal uniformity, although as evidenced by the data from May 5, improvements could be made.
- The moderate thermal segregation observed on May 4 appears to be primarily from truck exchanges; in a few instances changes in mean mixture temperature resulted in the moderate thermal segregation.
- Discussions with project personnel indicate heavy rains were experienced in the area on May 2 and 3. It is possible that bringing the mix production to equilibrium with the wet stockpiles contributed to the moderate thermal segregation observed on May 4. Alternatively, other operational factors such as the operation of the material transfer device (keeping the MTD at capacity for the most thorough remixing) may have contributed to the moderate thermal segregation observed.

Summary of Paving Operations

The contractor used end dump and flow boy trucks to transport the mix from the plant in Texarkana to the job site, resulting in a haul distance of approximately 25 miles. The mix was Type D HMA with PG 64-22 binder; recycled asphalt shingles (RAS) and reclaimed asphalt pavement (RAP) was also included in the mix design. The trucks offloaded into a Roadtec SB 2500D, which then transferred the mix into a Roadtec paver. The mat width was 12 ft. Figure 21 shows the paving operation, and Figure 22 shows Pave-IR data collection taking place.

Figure 21. Paving Operation on SH 8.

Figure 22. Pave-IR Collecting Project Data on SH 8.

Thermal Profile Results

The automated thermal profile results per Tex-244-F from May 5 and May 4 are in Appendices H and I, respectively. This section presents example screen captures of thermal profiles observed:

- Figure 23 presents a typical thermal profile from May 5. No thermal segregation was observed on that day.
- Figure 24 presents a typical thermal profile from May 4. While a large percentage (78 percent) of profiles collected May 4 had moderate thermal segregation, the majority of the profiles with moderate thermal segregation observed on that day had temperature differentials below 30°F. Only 28 percent of the project on May 4 had temperature differentials exceeding 30°F. This statistic could be improved, but based on experience is probably not cause for great concern.
- Figure 25 shows 1,000 ft of paving from May 4 and illustrates that truck exchanges, spaced on average about 150 ft apart, primarily resulted in the moderate thermal segregation observed. Figure 5 also shows a clear transition in mean mixture placement

temperature between stations 707 and 708; in some instances the moderate thermal segregation was the result of shifts in mean mix temperature.

- Figure 26 shows a different 1,000 ft of paving from May 4 illustrating the cyclical nature of the truck exchanges in the thermal profile.
- Figure 27 illustrates a paver stop on May 4, 2011. The distinct green rectangle in the color plot between stations 737 and 738 is the location of the paver stop; since TxDOT specifications separately address paver stops, the anomalous thermal signature at the location of the paver stop is excluded from the thermal profile analysis in Test Method Tex-244-F. On May 4, with a paving duration of approximately 5 hours and 7 minutes, the total accumulated paver stop time was only 6 minutes. During the course of data collection on May 5, 2011, the paver was never idle.

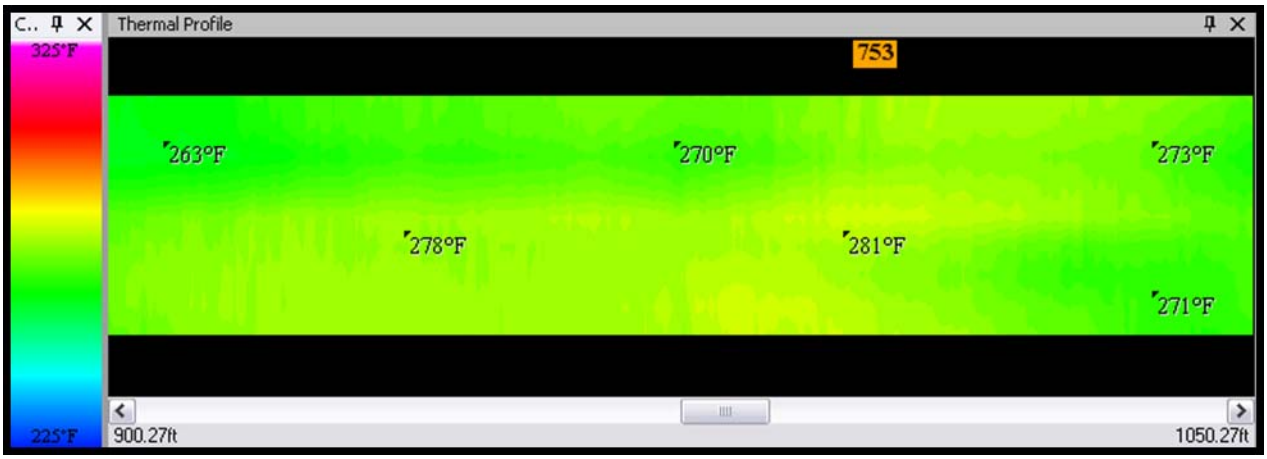


Figure 23. Typical Thermal Profile from May 5 on SH 8.
Note: profile 7 shown.

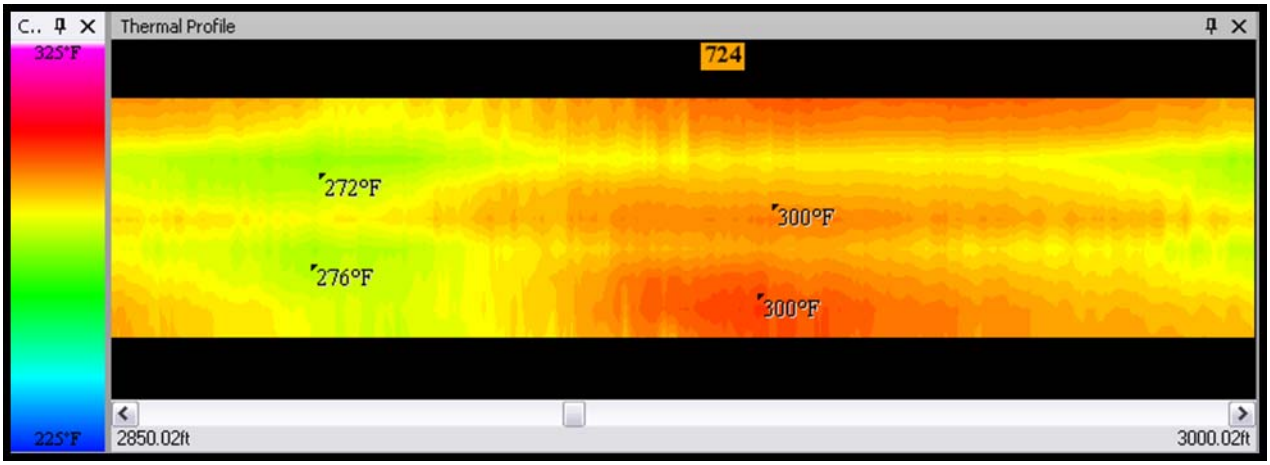


Figure 24. Typical Thermal Profile from May 4 on SH 8.
Note: profile 20 shown.

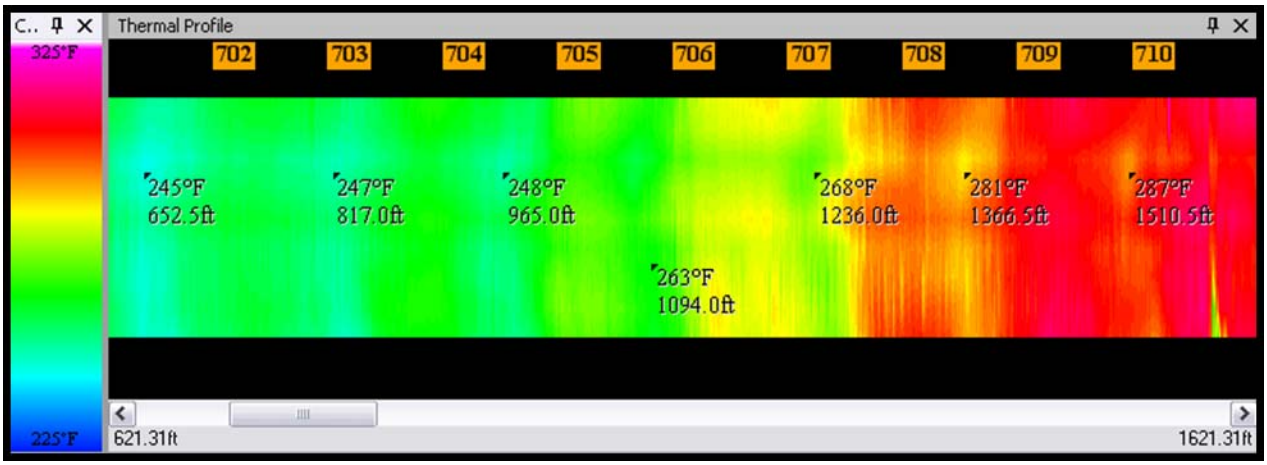


Figure 25. Example Truck Exchanges and Shift in Mean Mixture Temperature from SH 8 on May 4, 2011.

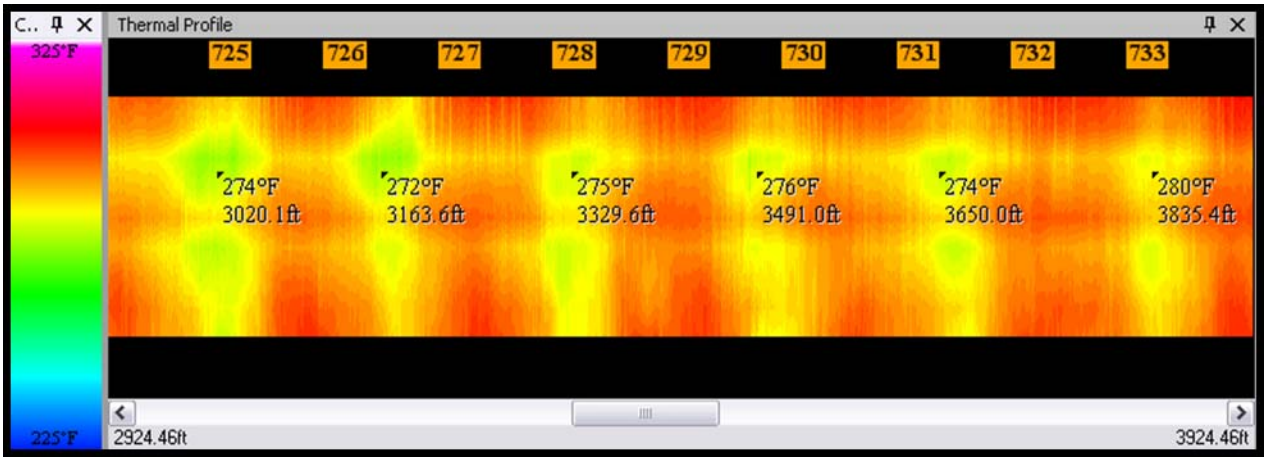


Figure 26. Cyclical Pattern of Truck Exchanges from SH 8 on May 4, 2011.

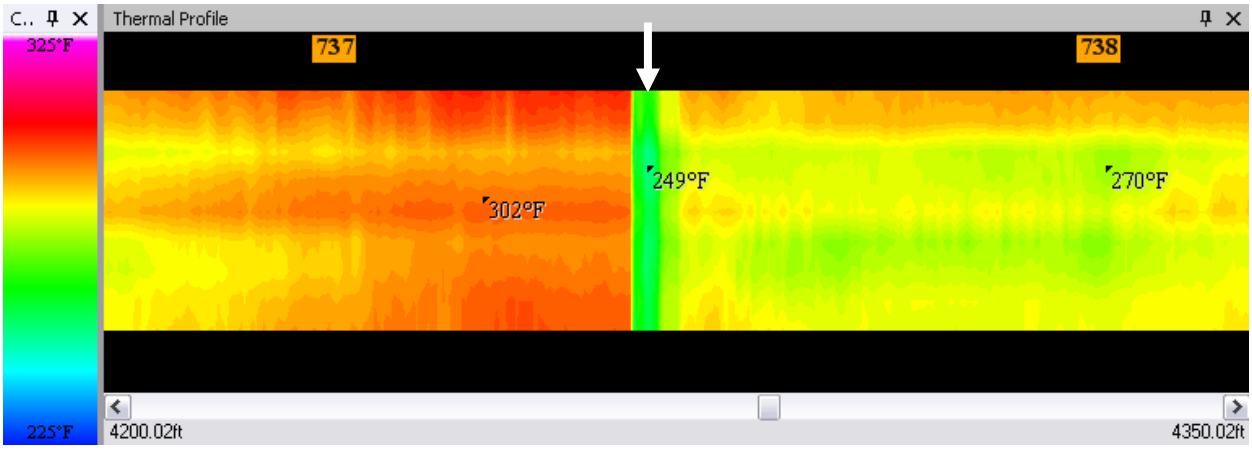


Figure 27. Paver Stop from SH 8 on May 4, 2011.
Note: profile 29 shown.

CHAPTER 5.
PAVE-IR DEMONSTRATION WITH TYPE C MIX IN THE EL PASO DISTRICT

Summary

On May 11, 2011, TTI performed a Pave-IR demonstration in cooperation with TxDOT's El Paso District on Dyer St. (BU-54A) in El Paso, Texas. The demonstration was conducted on the southbound outside lane of Type C mix placed from Station 64+95 to 19+32. This mix was produced with PG 64-22 binder. RAP and RAS were not used. The results from the thermal profiles collected and processed with Pave-IR per Test Method Tex-244-F show:

- Eighty-three percent of profiles had severe thermal segregation, with temperature differentials exceeding 50°F.
- The remaining 17 percent of profiles had moderate thermal segregation.
- The severe thermal segregation is from truck-ends, with cyclical cold spots recurring at an average spacing of 200 ft apart.

Based on experience, minimizing thermal segregation is difficult with the end-dump operation observed on the day of testing. Project personnel indicated that the majority of the project employed belly dump trucks and a windrow elevator to place the mix, so the results observed on the day of the thermal profile demonstration may not represent the remainder of the project.

Summary of Paving Operations

The producer used end dump trucks to transport the mix from the plant to the job site, resulting in a haul distance of approximately 15 miles. The planned compacted thickness was 2 in., and the mat width was approximately 10.5 ft. The air temperature was 57°F when placement began. The trucks offloaded into a Barber Green BG-260C paver to place the mix. Figure 28 shows the paving operation with Pave-IR data collection taking place.


Figure 28. Paving TY C Mix on Dyer Street.

Thermal Profile Results

Appendix J contains the automated thermal profile results per Tex-244-F. This section presents example screen captures of thermal profiles observed:

- Figure 29 presents a typical thermal profile, which had severe thermal segregation. Profiles with temperature differentials exceeding 50°F are classified as having severe thermal segregation. Approximately 83 percent of the mat area surveyed was in this category.
- The remainder of the project had moderate thermal segregation. Figure 30 shows a typical profile where the temperature differential exceeded 25 but was less than 50°F. On this project random thermal irregularities seemed to be the cause of the moderate thermal segregation observed.
- Figure 31 shows 1,000 ft of paving and illustrates that truck-end thermal segregation dominated the pattern observed from the paving operation. Cyclical cold spots appeared at intervals approximately 200 ft apart throughout the paving operation. Additionally, the cyclical decline in paving speed (illustrated in the speed diagram portion of Figure 32) shows how the paver slowed down to accommodate each truck exchange.
- During the course of the demonstration, which lasted approximately 3 hours and 40 minutes, the paver was idle for approximately 1 hour and 7 minutes. Figure 5 shows two example locations of paver stops; one lasting approximately 15 minutes and the other lasting approximately 4 minutes. The cooling of the mat behind the screed and the heating of the surface of the mat under the paver burners are evident in both examples, and more dramatic the longer the duration of the paver stop. Since paver stops are addressed separately in TxDOT specifications, the thermal profile analysis excludes the paver stop locations from the calculation of the temperature differential.

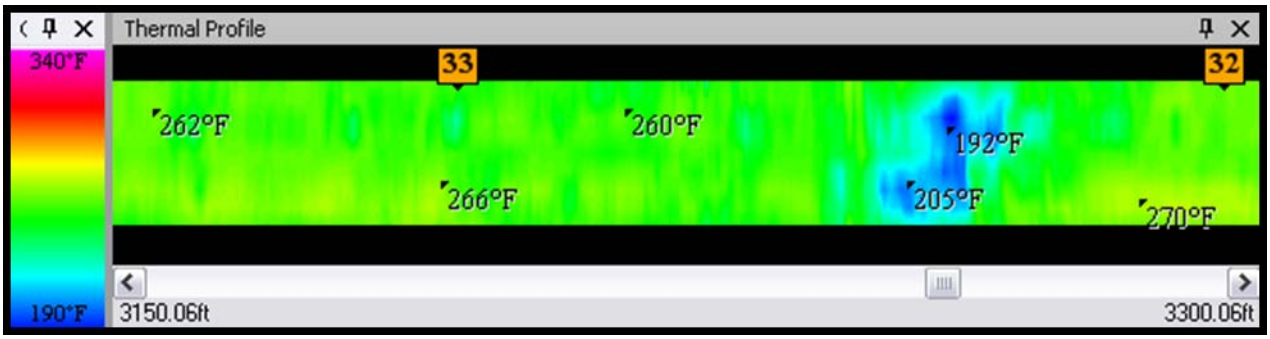


Figure 29. Typical Thermal Profile on Dyer Street.
Note: profile 22 shown.

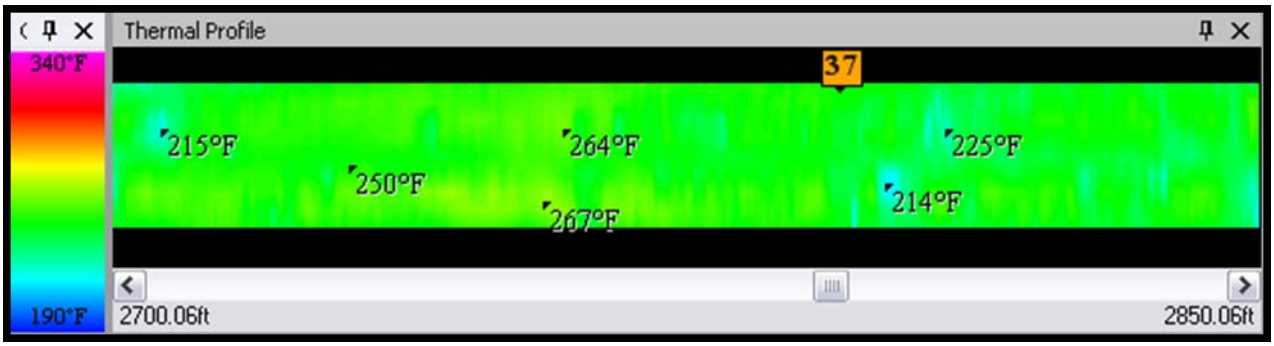


Figure 30. Moderate Thermal Segregation on Dyer Street.
Note: profile 19 shown.

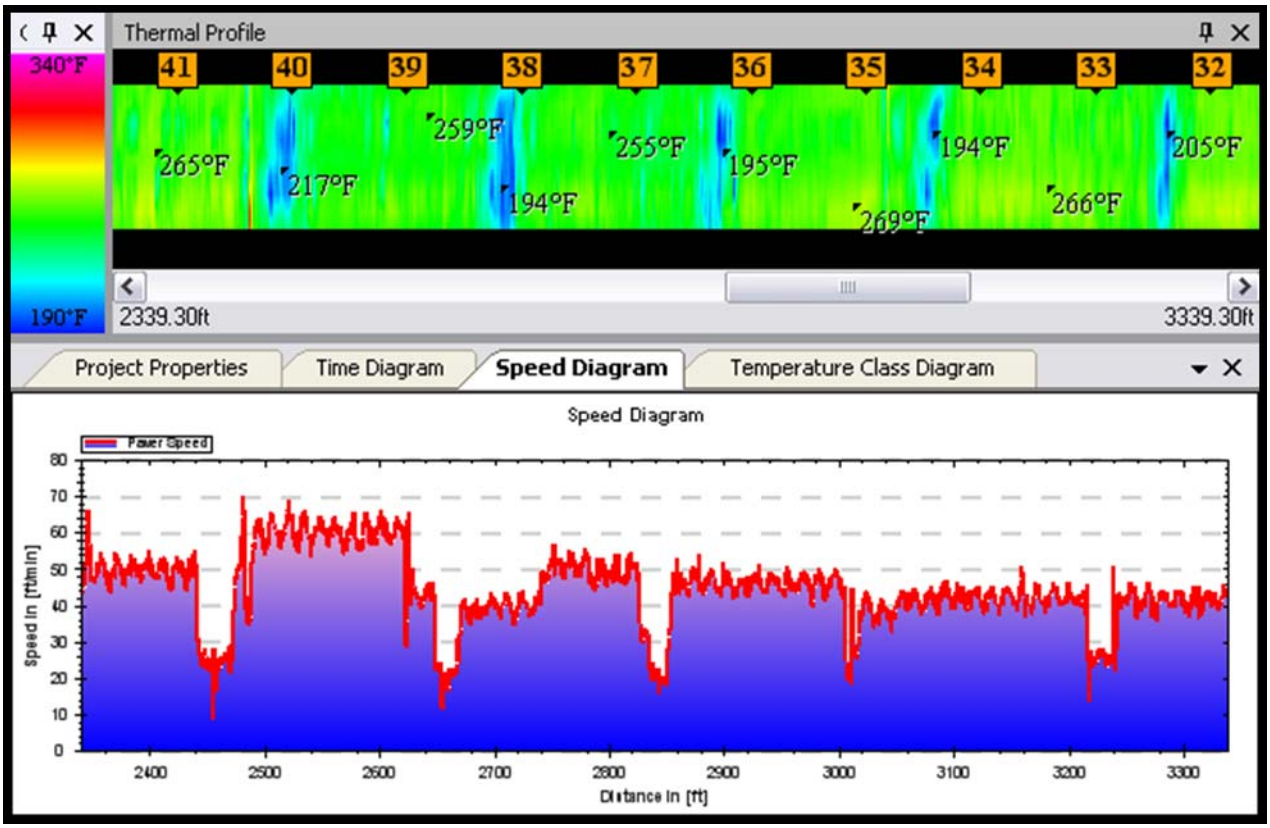
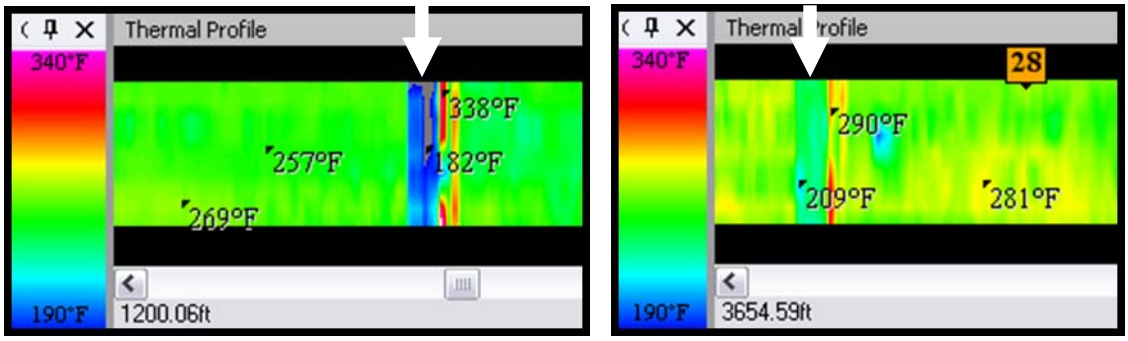


Figure 31. Cyclical Truck-End Thermal Segregation on Dyer Street.
Note cyclical drop in paver speed indicative of charging the paver hopper.



Stop Duration (h:m:s): 0:15:42 Stop Duration: 0:03:56

Figure 32. Example Locations of Paver Stops on Dyer Street.

CHAPTER 6.
PAVE-IR DEMONSTRATION WITH TYPE C MIX IN THE LAREDO DISTRICT

Summary

On June 1, 2011, TTI performed a Pave-IR demonstration in cooperation with TxDOT's Laredo District on SL 20 in Laredo, Texas. Thermal profiles on the two pulls of Type C mix placed that day were collected. This mix was produced with PG 64-22 binder and contained 20 percent RAP. The results from the thermal profiles collected and processed with Pave-IR per Test Method Tex-244-F show:

- All profiles in the first pull (northbound outside lane from STA 122.20 to 150.45) contained moderate thermal segregation.
- In the second pull (northbound inside lane from STA 121.90 to 201.58), 33 percent of profiles had severe thermal segregation. The remainder of profiles exhibited moderate thermal segregation.
- In both pulls, the thermal segregation is from truck-ends, with cyclical cold spots recurring at an average spacing of 140 ft apart.

Based on experience, it should be feasible to place belly-dump operations with a windrow elevator without any severe thermal segregation. It is suggested the contractor experiment with different overlap lengths of the windrows and try to minimize exposed windrow ends.

Summary of Paving Operations

Belly dump trucks transported the mix from the plant to the job site, resulting in a haul distance of approximately 20 miles. A Lincoln 660 AXL windrow elevator transferred the mix into a Cat AP 1000D paving machine. The planned compacted thickness was 2 in., and the mat width was approximately 15 ft. Figure 33 shows the paving operation with Pave-IR data collection taking place.


Figure 33. Paving TY C Mix on SL 20.

Thermal Profile Results

The automated thermal profile results per Tex-244-F from the first and second pull are in Appendices K and L, respectively. The first pull covered the northbound outside lane from Station 122.20 to 150.45. The second pull covered the northbound inside lane from Station 121.90 to 201.58. This section presents example screen captures of thermal profiles observed:

- Figure 34 presents a typical thermal profile from the first pull, which had moderate thermal segregation. Profiles with temperature differentials exceeding 25°F but not exceeding 50°F are classified as having moderate thermal segregation.
- The apparent severe thermal segregation of profiles 12 and 13 in the first pull are actually due to the GPS cable dangling underneath one infrared sensor and interfering with that sensor's readings. Figure 35 presents the pattern observed in these two profiles; the true temperature differential should be in the moderate thermal segregation category.
- In the second pull, 67 percent of profiles had moderate thermal segregation. Figure 36 presents a typical profile from the second pull.
- The remaining 33 percent of profiles in the second pull had severe thermal segregation. Temperature differentials exceeding 50°F are classified as severe thermal segregation. Figure 37 presents an example of one of these profiles.
- In some, but not all, cases of thermal segregation, the mat appeared visibly more open at the cold spot. Figure 38 illustrates one such instance of seeing visible evidence of the thermal segregation.
- Figure 39 shows 1,000 ft of paving from the first pull and illustrates that truck-end thermal segregation dominated the pattern observed from the paving operation. Cyclical cold spots appeared at intervals approximately 140 ft apart throughout the paving operation.
- An increase in the mean mixture temperature occurred in the second pull at approximately Station 151. Figure 40 presents 1,000 ft of paving in that pull, illustrating the shift in mean mixture temperature. This increase in mix temperature did seem to help thermal uniformity. Partitioning the second pull into sections before and after the

temperature increase shows that, prior to the increase in mix temperature, approximately 53 percent of thermal profiles had severe thermal segregation. After increasing the mean mixture placement temperature, the percentage of profiles with severe thermal segregation dropped to 21 percent.

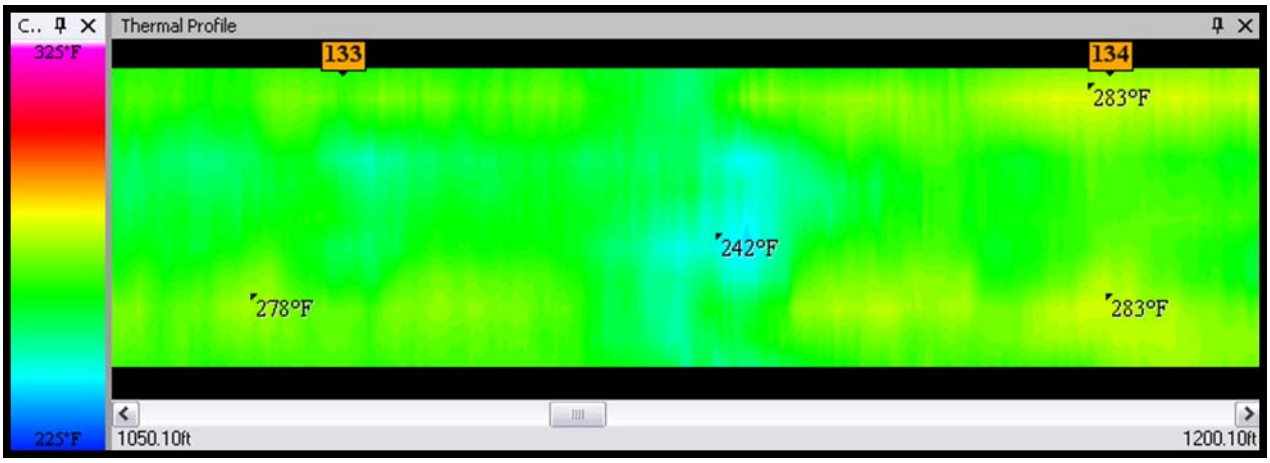


Figure 34. Typical Thermal Profile from First Pull on SL 20.
Note: profile 8 shown.

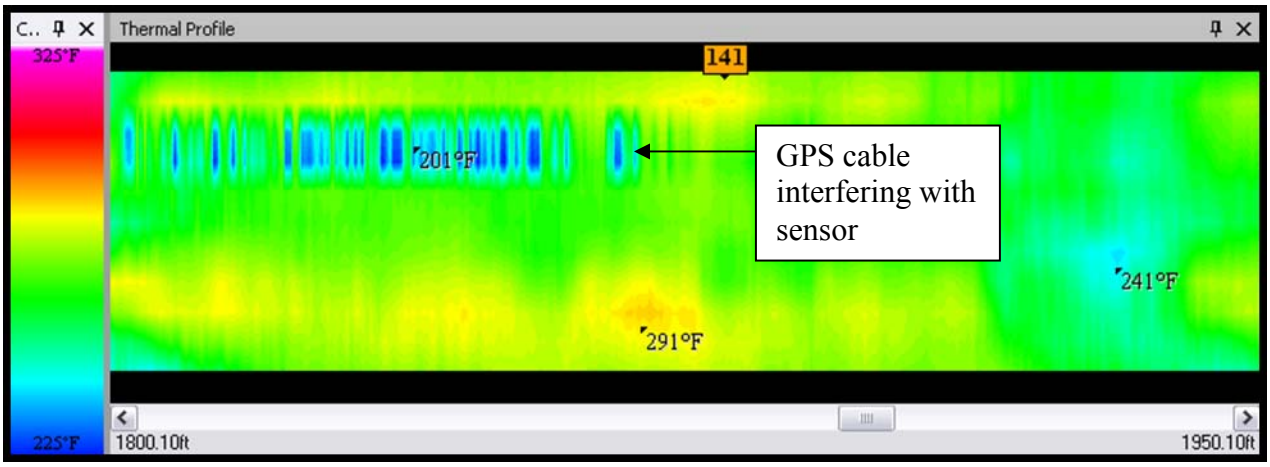


Figure 35. GPS Cable under Sensor Interfering with Reading in Profiles 12 and 13.

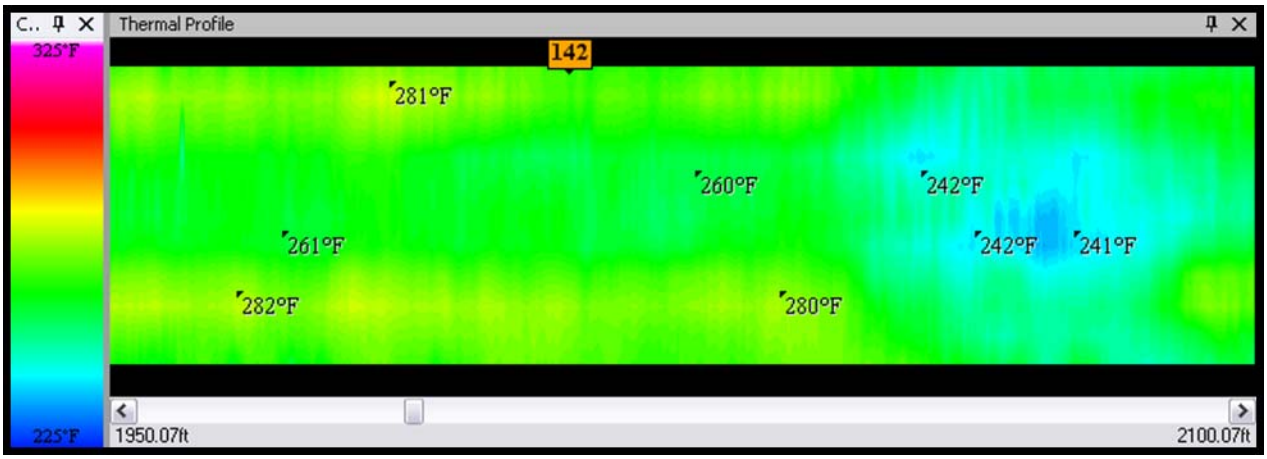


Figure 36. Typical Thermal Profile from Second Pull on SL 20.
Note: profile 14 shown.

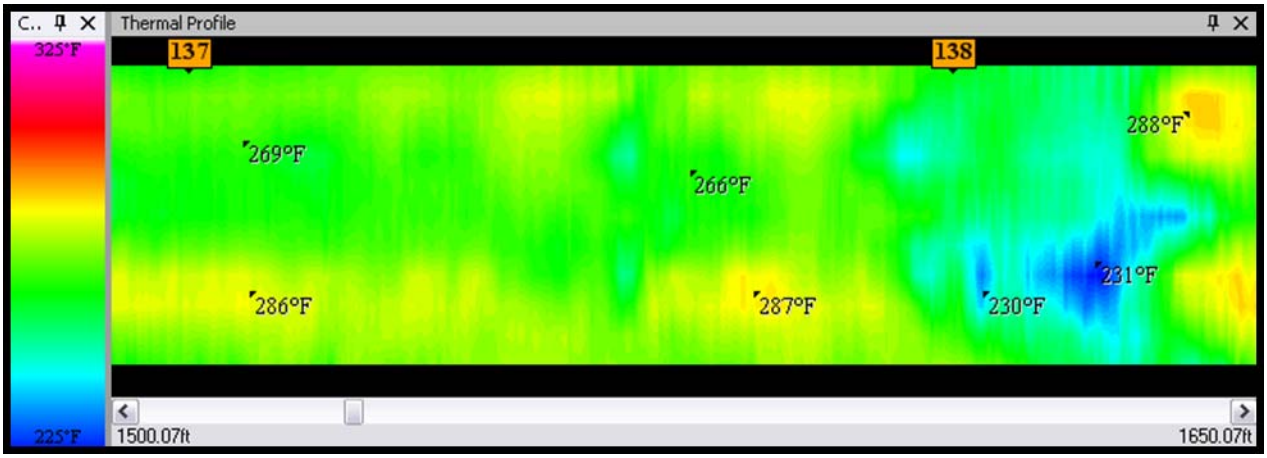


Figure 37. Severe Thermal Segregation in Second Pull on SL 20.
Note: profile 11 shown.

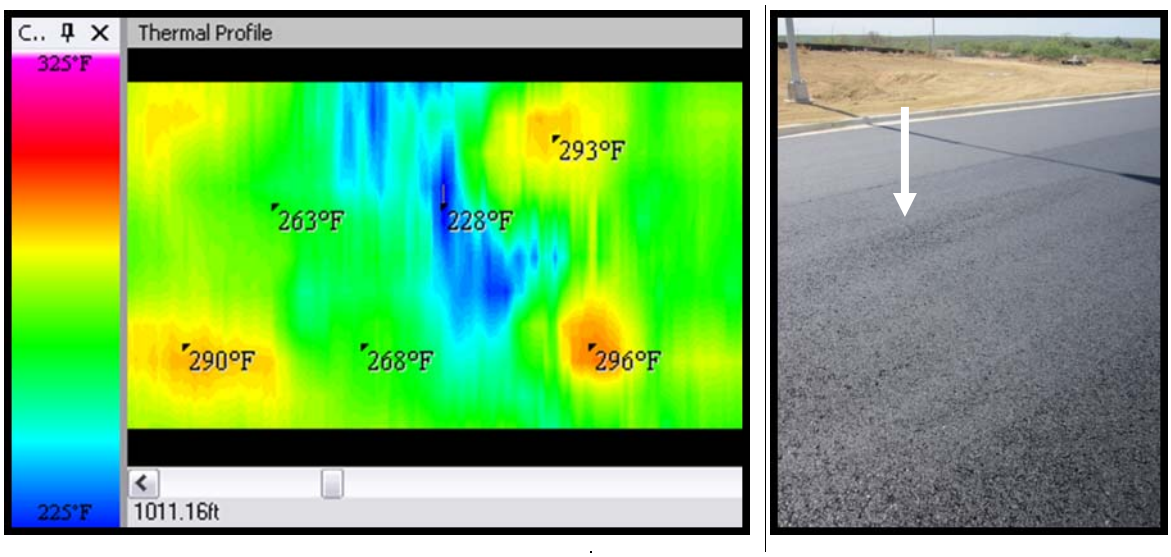


Figure 38. Visually Different Surface Texture at Thermally Segregated Location.

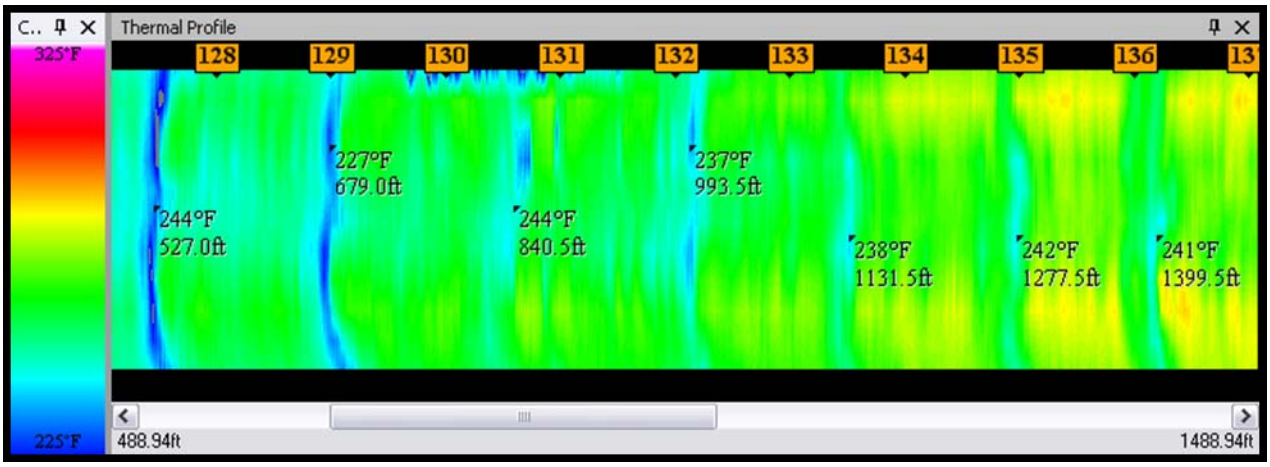


Figure 39. Cyclical Nature of Thermal Segregation on SL 20.

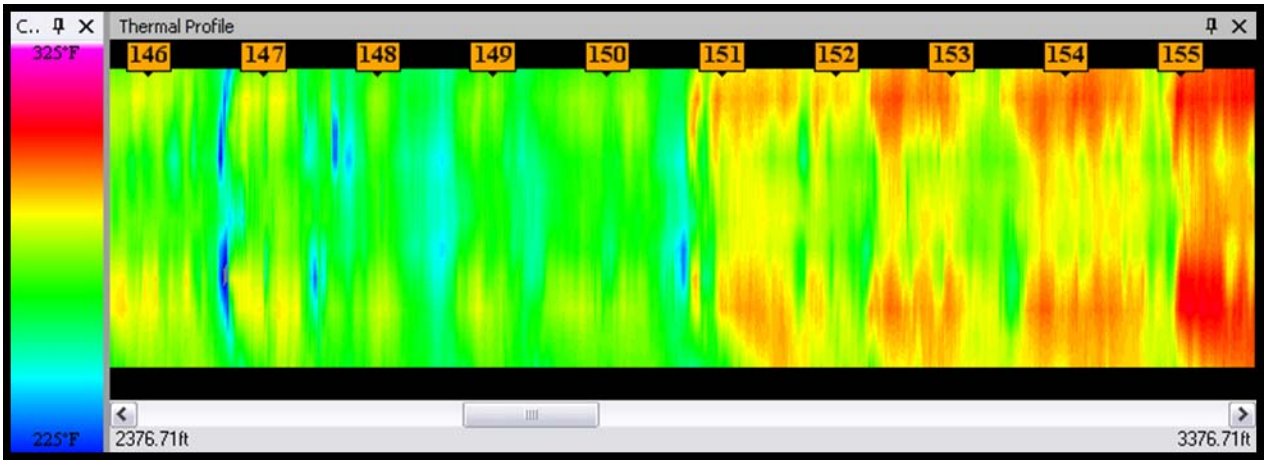


Figure 40. Shift in Mean Placement Temperature on SL 20 Second Pull.

CHAPTER 7.
PAVE-IR DEMONSTRATION WITH TYPE D MIX IN THE HOUSTON DISTRICT

Summary

On June 16, 2011, TTI performed a Pave-IR demonstration in TxDOT's Houston District on Type D mix placed on FM 2854. The results from the thermal profiles collected and processed with Pave-IR per Test Method Tex-244-F show most of the profiles exhibited moderate thermal segregation. Of those profiles, about half had temperature differentials exceeding the 25°F threshold by only a few degrees. The remaining profiles with moderate thermal segregation had temperature differentials between 33 and 35°F.

Based on experience, the equipment used on the job site should be able to place mix with 20 percent or less moderate thermal segregation. It is possible the transfer device may not have been run at full capacity, which can hinder its effectiveness at thorough remixing.

Summary of Paving Operations

The mix was produced with PG 64-22 binder and transported approximately 12 miles from the plant to the project site. No RAP and RAS was used. At the job site, a Roadtec SB-2500C transferred the mix to a Cedarapids 452 paver. The planned compacted thickness was 2 inches. Figure 41 shows the paving operation with Pave-IR data collection taking place.

Figure 41. Paving on FM 2854 with Pave-IR Data Being Collected.

Thermal Profile Results

Appendix M contains the automated thermal profile results per Tex-244-F. The results show most of the profiles exhibit moderate thermal segregation, where the temperature differential exceeds 25°F but does not exceed 50°F. Within these profiles, approximately half had temperature differentials barely exceeding the 25°F threshold. Figures 42 and 43 present example profiles with moderate thermal segregation.

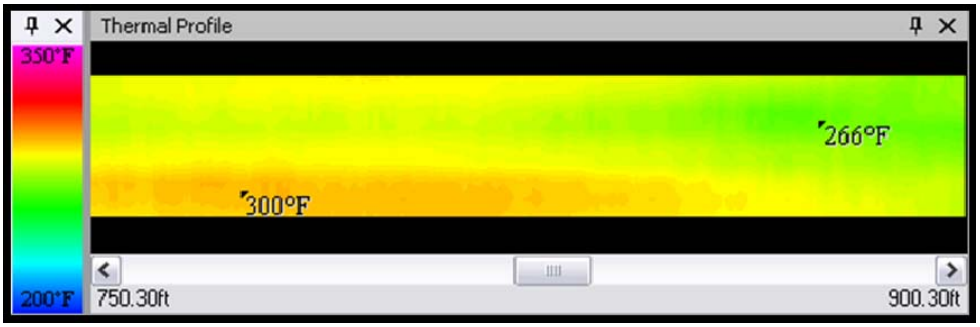


Figure 42. Moderate Thermal Segregation on FM 2854.
Note: profile 6 shown.

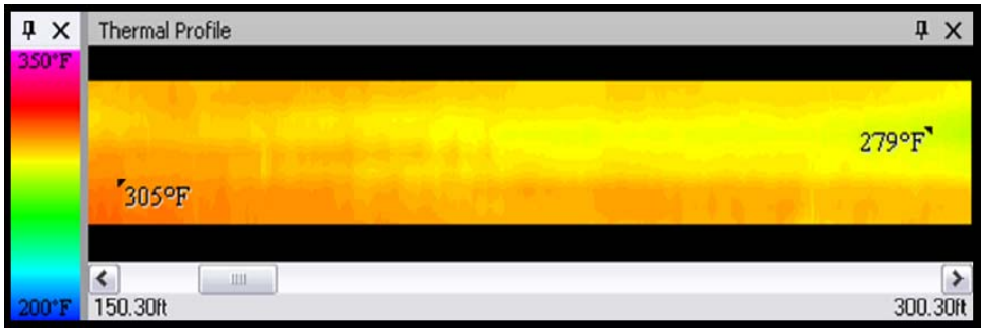


Figure 43. Moderate Thermal Segregation Barely Exceeding 25°F Threshold on FM 2854.
Note: profile 2 Shown.

During the course of the demonstration, two paver stops occurred for a combined duration of 55 seconds. Figure 44 shows these locations; the limits of these paver stops are omitted from the automated temperature differential analysis per Tex-244-F.

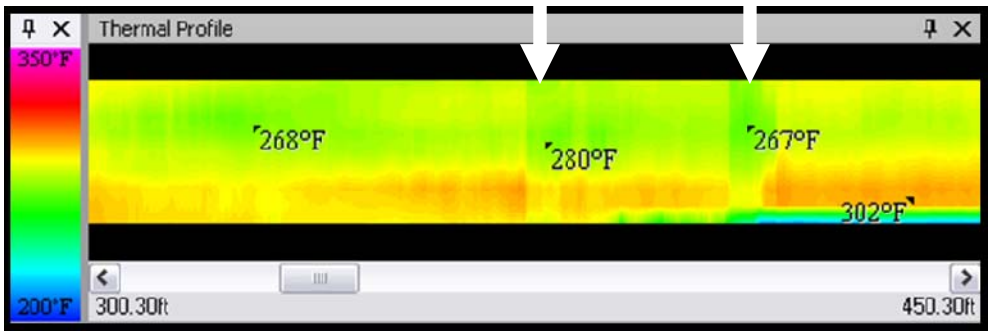


Figure 44. Paver Stop Locations on FM 2854.

CHAPTER 8.
PAVE-IR DEMONSTRATION WITH TYPE C MIX IN THE WACO DISTRICT

Summary

On June 29, 2011, TTI performed a Pave-IR demonstration on Type C mix placed on Loop 340 in TxDOT's Waco District. The results from the thermal profiles collected and processed with Pave-IR per Test Method Tex-244-F show only the first profile had significant thermal segregation. This occurrence of thermal segregation in the first profile is not uncommon and not cause for great concern. The data suggest that, once the paving train was in normal production, thermal segregation concerns did not exist.

Summary of Paving Operations

The mix was produced with PG 64-22 binder and transported approximately 6 miles with belly-dump trucks from the plant to the project site. RAP and RAS was not used. At the job site, a Roadtec SB-2500D transferred the mix to a Cat AP1000 paver. The planned compacted thickness was 2 inches. Figure 45 shows the paving operation with Pave-IR data collection taking place.

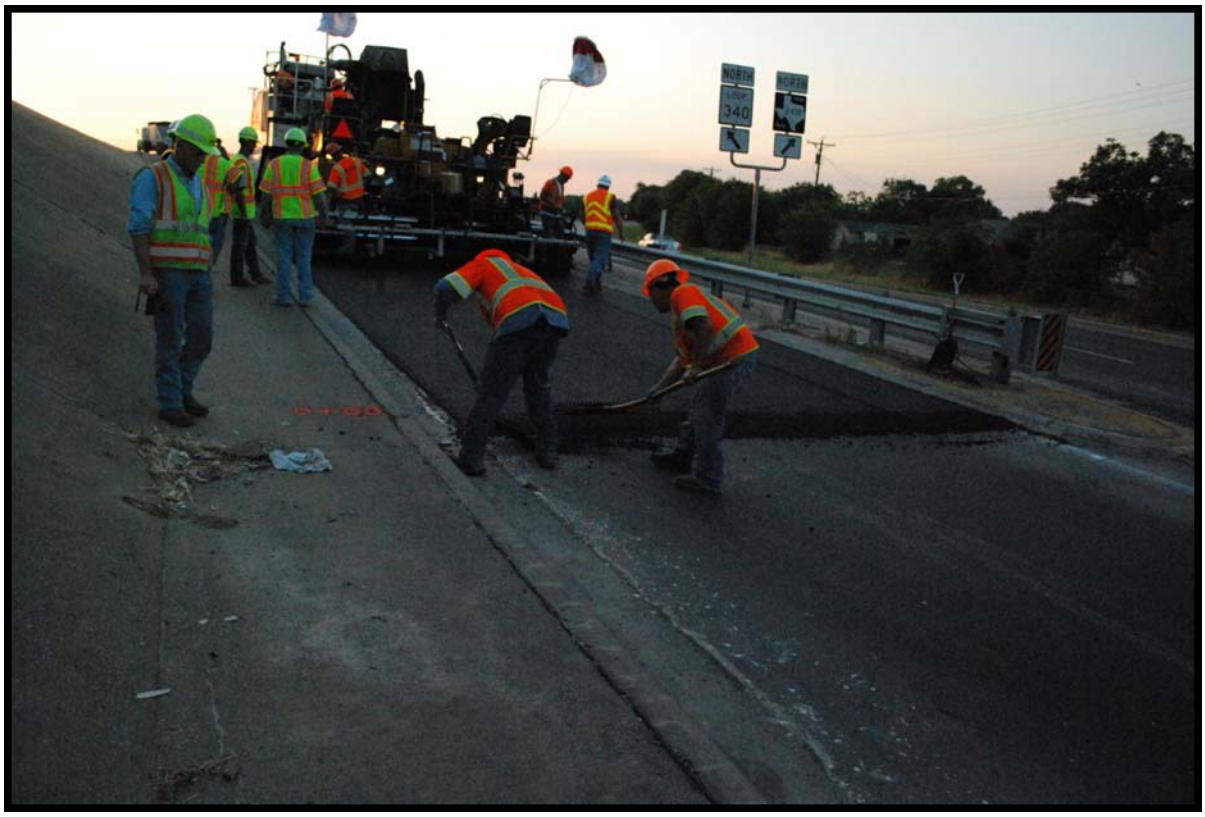


Figure 45. Paving on Loop 340 with Pave-IR Data Being Collected.

Thermal Profile Results

Appendix N contains the automated thermal profile results per Tex-244-F. The results show the first profile has severe thermal segregation, which is defined as a temperature differential exceeding 50°F. Occurrence of this thermal segregation in the first profile is not uncommon when paving trains first begin placement and is not cause for great concern. Figure 46 shows this profile. Figure 46 also contains a paver stop of approximately 6 minute duration; the limits of paver stops are omitted from the automated temperature differential analysis per Tex-244-F.

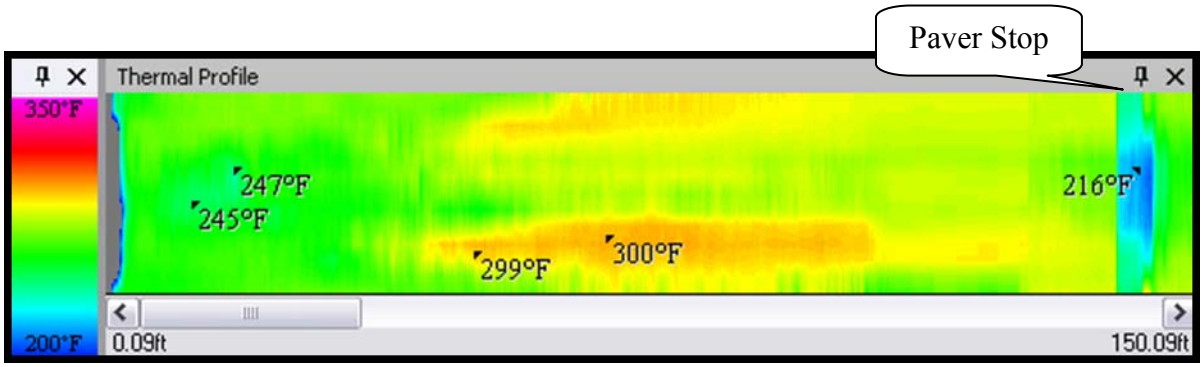


Figure 46. Thermal Segregation in First Profile on Loop 340.

Figure 47 shows the second thermal profile exhibiting moderate thermal segregation, which is defined as temperature differentials exceeding 25°F but not exceeding 50°F. However, in Figure 47 the temperature differential barely exceeds the 25°F threshold. This also is not cause for great concern.

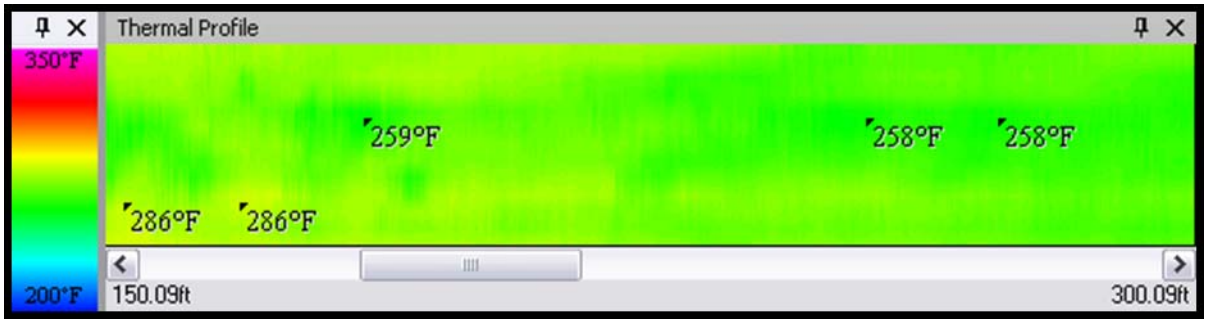


Figure 47. Moderate Thermal Segregation Barely Exceeding 25°F Threshold on Loop 340.
Note: profile 2 shown.

The remaining profiles were free of thermal segregation. Figure 48 shows an example profile. The data suggest that, once the paving train was in normal production, thermal segregation concerns did not exist.

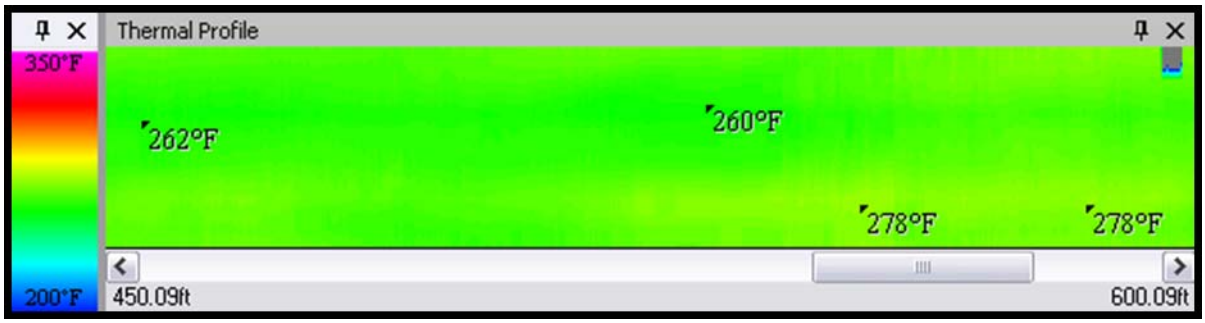


Figure 48. Representative Thermal Profile on Loop 340.
Note: profile 4 shown.

CHAPTER 9.
CONCLUSIONS AND RECOMMENDATIONS

With the inclusion of Pave-IR into Test Method Tex-244-F and Special Provision 341-024, TxDOT has implemented this technology into their QC/QA specification for dense-graded asphalt mixtures. The webinar and demonstration projects conducted in this implementation project showed industry and agency interest in learning more about the technology, how it can be used to improve their operations, and how to interpret the results. The webinar conducted to disseminate information about Pave-IR and thermal profiling saw good attendance, with over 80 unique attendees logged on for participation.

The demonstration projects encompassed various mixture types and placement operations around the state. Table 1 presents a comparison of the thermal profile results from the demonstration projects.

Table 1. Summary of Thermal Profile Results from Demonstration Projects.

Mixture	Haul Distance (mi.)	Thickness (in.)	Placement	Thermal Profile Summary
TY D with RAP and RAS	25	2	Transfer device	None present
CMHB-F	7	1	Transfer device	14% moderate, with most moderate barely exceeding 25°F
TY C	6	2	Transfer device	20% moderate, with moderate barely exceeding 25°F
SMA	100	1	Transfer device	54% moderate, with most moderate barely exceeding 25°F
PFC	100	1	Transfer device	75% moderate, with temperature differentials slightly higher than 1 in. SMA
TY D	12	2	Transfer device	91% moderate, with some moderate barely exceeding 25°F
CAM	5	1	Transfer device	80% moderate
TY C with RAP	20	2	Windrow elevator	73% moderate, 27% severe
TY C	15	2	End dump	83% severe

The results suggest that:

- The current maximum differential of 25 °F is achievable. Many projects, however, will exhibit moderate thermal segregation. In these cases, applying the intent of the specification becomes paramount to successful implementation. From projects tested, ideally moderate segregation should not exist on more than 20 percent of the thermal profiles. However, since moderate thermal segregation encompasses a broad range of

temperature differentials from 25.1 to 50.0 °F, up to approximately 50 to 75 percent moderate thermal segregation could probably be allowed as long as the majority of those profiles with moderate thermal segregation do not exceed the 25 °F threshold by more than 5 °F.

- Ideally, no severe thermal segregation should exist. However, to allow for the starting and stopping of the paving train at the beginning and ending of each pull (which oftentimes produces severe thermal segregation), 2 percent severe thermal segregation should be allowed.
- One of the most uniform projects was placed at night near the end of the paving season in the fall. The thermal profile criteria should not be changed for night paving. For informational purposes, an input of the ambient air temperature at the start of the pull for inclusion in the automated report should be considered.
- The data collected do not suggest any special considerations are needed for thermal uniformity criteria when reclaimed asphalt pavement (RAP) or recycled asphalt shingles (RAS) are used in the mixture. The mix design on the most uniform project tested included both RAP and RAS and was placed with a material transfer device. In contrast, one of the projects with significant thermal segregation (the 2 in. Type C with 20 mi. haul distance) included RAP in the mix design and was placed with a windrow elevator. The thermal uniformity largely depends on the placement operation rather than the presence or lack of recycled materials in the mixture.
- From the projects tested, no strong evidence exists to suggest mix type, lift thickness, or haul distance substantially impacted the ability to achieve thermal placement uniformity.
- The type of paving operation impacts the thermal uniformity most. In all cases projects with transfer devices exhibited better placement uniformity than windrow elevator or end dump operations. The end dump operation, by far, produced the most severe cases of thermal segregation.
- In addition to the type of placement operation, properly operating and maintained equipment, along with a well-trained paving crew with prior exposure to full-coverage thermal profiling, also seemed to help achieve better placement uniformity.

TxDOT should continue to promote full-coverage testing such as demonstrated in this project. Such testing provides rapid information feedback to contractors to enable decision making to produce a better product, and such testing enables TxDOT to inspect a larger portion of construction with minimal impacts on manpower requirements.

APPENDIX A.
TEX-244-F RESULT FROM CMHB-F

Tex-244-F Part II

Thermal Profile Summary Report

Profile ID:	IH 35 SB IL	Profile Date:	10/26/2010 5:31:19 AM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:	sds	Spec Item:	
Test Location:	sb il	Special Provision:	
Material Code:	CMHB-F	Mix Type:	CMHB-F
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	T. Blackmore

Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 2, 11, 12

Thermal Profile Results Summary				
Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
127	Number	Percent	Number	Percent
	18	14	2	2

Summary of Locations with Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	325.47	97.62704 W, 30.77293 N	326.97	97.62713 W, 30.77251 N	327.4	273.7	53.6
2	326.97	97.62713 W, 30.77251 N	328.47	97.62727 W, 30.77212 N	311.2	269.1	42.1
3	328.47	97.62727 W, 30.77212 N	329.97	97.62737 W, 30.77172 N	312.3	286.2	26.1
4	329.97	97.62737 W, 30.77172 N	331.47	97.62751 W, 30.77133 N	314.1	288.0	26.1
9	337.47	97.62801 W, 30.76970 N	338.97	97.62813 W, 30.76929 N	315.3	290.3	25.0
17	349.47	97.62901 W, 30.76648 N	350.97	97.62914 W, 30.76607 N	316.0	288.9	27.2
26	362.97	97.6304 W, 30.76291 N	364.47	97.63057 W, 30.76251 N	315.5	289.8	25.7
39	382.47	97.63254 W, 30.75786 N	383.97	97.6327 W, 30.75747 N	316.2	285.3	31.0
41	385.48	97.63286 W, 30.75708 N	386.97	97.63303 W, 30.75669 N	315.9	283.6	32.2
51	400.47	97.63441 W, 30.75314 N	401.97	97.63454 W, 30.75275 N	311.4	276.8	34.6
59	412.48	97.63541 W, 30.74992 N	413.97	97.63553 W, 30.74952 N	301.5	276.1	25.4
65	421.47	97.63616 W, 30.74749 N	422.97	97.6363 W, 30.74709 N	310.6	283.6	27.0
66	422.97	97.6363 W, 30.74709 N	424.47	97.63643 W, 30.74668 N	317.5	283.6	33.8
90	458.97	97.63945 W, 30.73741 N	460.47	97.6396 W, 30.73701 N	309.2	282.2	27.0
100	473.98	97.64082 W, 30.73340 N	475.47	97.64097 W, 30.73300 N	310.8	280.4	30.4
101	475.47	97.64097 W, 30.73300 N	476.97	97.64111 W, 30.73262 N	311.5	286.5	25.0

Summary of Locations with Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
103	478.47	97.64124 W, 30.73221 N	479.97	97.64137 W, 30.73181 N	313.7	285.4	28.3
124	509.97	97.64411 W, 30.72384 N	511.47	97.64424 W, 30.72345 N	312.6	281.3	31.3
126	512.97	97.64437 W, 30.72305 N	514.47	97.64452 W, 30.72264 N	312.4	286.0	26.5
127	514.47	97.64452 W, 30.72264 N	514.87	97.64456 W, 30.72253 N	311.9	247.3	64.6

Summary of Locations Without Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
5	331.47	97.62751 W, 30.77133 N	332.97	97.62764 W, 30.77092 N	315.5	298.8	16.7
6	332.97	97.62764 W, 30.77092 N	334.47	97.62775 W, 30.77051 N	318.0	296.4	21.6
7	334.47	97.62777 W, 30.77051 N	335.97	97.62788 W, 30.77011 N	315.9	298.4	17.5
8	335.98	97.62788 W, 30.77011 N	337.47	97.62801 W, 30.76970 N	316.9	293.9	23.0
10	338.97	97.62813 W, 30.76929 N	340.47	97.62826 W, 30.76889 N	313.7	289.6	24.1
11	340.47	97.62826 W, 30.76888 N	341.97	97.62837 W, 30.76848 N	312.3	297.0	15.3
12	341.98	97.62837 W, 30.76848 N	343.47	97.6285 W, 30.76808 N	317.3	294.8	22.5

Summary of Locations Without Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
13	343.47	97.6285 W, 30.76807 N	344.97	97.62862 W, 30.76767 N	314.1	293.5	20.5
14	344.97	97.62863 W, 30.76767 N	346.47	97.62875 W, 30.76727 N	317.5	295.3	22.1
15	346.47	97.62875 W, 30.76727 N	347.97	97.62888 W, 30.76687 N	312.4	295.2	17.3
16	347.97	97.62888 W, 30.76687 N	349.47	97.62901 W, 30.76648 N	315.9	295.0	20.9
18	350.97	97.62915 W, 30.76607 N	352.47	97.62928 W, 30.76567 N	317.7	293.4	24.3
19	352.47	97.62928 W, 30.76567 N	353.97	97.62944 W, 30.76527 N	314.8	301.8	13.0
20	353.97	97.62944 W, 30.76527 N	355.47	97.62959 W, 30.76488 N	314.1	302.5	11.5
21	355.47	97.62959 W, 30.76488 N	356.97	97.62977 W, 30.76452 N	310.6	295.0	15.7
22	356.97	97.62977 W, 30.76451 N	358.47	97.62991 W, 30.76412 N	315.9	296.1	19.8
23	358.48	97.62991 W, 30.76411 N	359.97	97.63008 W, 30.76370 N	315.5	297.7	17.8
24	359.97	97.63008 W, 30.76370 N	361.47	97.63024 W, 30.76331 N	315.0	300.6	14.4
25	361.47	97.63024 W, 30.76331 N	362.97	97.6304 W, 30.76291 N	310.1	292.5	17.6
27	364.47	97.63057 W, 30.76250 N	365.97	97.63073 W, 30.76211 N	316.2	298.8	17.5
28	365.97	97.63073 W, 30.76211 N	367.47	97.63089 W, 30.76174 N	321.6	298.9	22.7
29	367.47	97.63089 W, 30.76173 N	368.97	97.63106 W, 30.76136 N	317.5	302.7	14.8
30	368.97	97.63106 W, 30.76136 N	370.47	97.63122 W, 30.76098 N	317.8	304.7	13.1

Summary of Locations Without Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
31	370.47	97.63122 W, 30.76098 N	371.97	97.63139 W, 30.76060 N	317.1	308.1	9.0
32	371.97	97.63139 W, 30.76060 N	373.47	97.63155 W, 30.76017 N	320.9	301.5	19.4
33	373.47	97.63155 W, 30.76017 N	374.97	97.63171 W, 30.75978 N	320.5	307.9	12.6
34	374.97	97.63171 W, 30.75978 N	376.47	97.63187 W, 30.75939 N	315.5	302.0	13.5
35	376.47	97.63187 W, 30.75939 N	377.97	97.63203 W, 30.75902 N	319.3	310.6	8.6
36	377.97	97.63203 W, 30.75902 N	379.47	97.63221 W, 30.75863 N	313.2	295.2	18.0
37	379.47	97.63221 W, 30.75863 N	380.97	97.63237 W, 30.75824 N	317.5	300.4	17.1
38	380.97	97.63237 W, 30.75824 N	382.47	97.63254 W, 30.75786 N	314.8	300.0	14.8
40	383.97	97.6327 W, 30.75747 N	385.47	97.63286 W, 30.75708 N	312.1	291.2	20.9
42	386.97	97.63303 W, 30.75669 N	388.47	97.63319 W, 30.75630 N	313.3	302.5	10.8
43	388.47	97.63319 W, 30.75630 N	389.97	97.63335 W, 30.75591 N	312.1	293.5	18.5
44	389.97	97.63335 W, 30.75591 N	391.47	97.63351 W, 30.75552 N	313.3	305.4	7.9
45	391.47	97.63351 W, 30.75552 N	392.97	97.63367 W, 30.75513 N	311.5	295.5	16.0
46	392.97	97.63367 W, 30.75513 N	394.47	97.63383 W, 30.75474 N	313.7	294.4	19.3
47	394.47	97.63383 W, 30.75474 N	395.97	97.63399 W, 30.75433 N	304.3	282.2	22.1
48	395.97	97.63399 W, 30.75433 N	397.47	97.63413 W, 30.75394 N	304.9	288.1	16.7

Summary of Locations Without Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
49	397.47	97.63413 W, 30.75394 N	398.97	97.63428 W, 30.75354 N	304.3	280.8	23.6
50	398.97	97.63428 W, 30.75354 N	400.47	97.63441 W, 30.75314 N	308.5	293.0	15.5
52	401.97	97.63454 W, 30.75275 N	403.47	97.63467 W, 30.75235 N	312.1	302.2	9.9
53	403.47	97.63467 W, 30.75235 N	404.97	97.6348 W, 30.75195 N	309.4	290.8	18.5
54	404.97	97.6348 W, 30.75194 N	406.47	97.63491 W, 30.75153 N	318.7	299.7	19.1
55	406.47	97.63491 W, 30.75153 N	407.97	97.63503 W, 30.75112 N	315.9	304.5	11.3
56	407.97	97.63503 W, 30.75112 N	409.47	97.63515 W, 30.75070 N	316.8	302.5	14.2
57	409.47	97.63515 W, 30.75070 N	410.97	97.63528 W, 30.75031 N	311.0	294.4	16.6
58	410.97	97.63528 W, 30.75031 N	412.47	97.63541 W, 30.74992 N	307.6	292.1	15.5
60	413.97	97.63553 W, 30.74951 N	415.47	97.63566 W, 30.74912 N	303.4	281.5	22.0
61	415.47	97.63566 W, 30.74912 N	416.97	97.63579 W, 30.74874 N	302.0	282.7	19.3
62	416.97	97.63579 W, 30.74874 N	418.47	97.63592 W, 30.74829 N	302.5	283.6	18.9
63	418.47	97.63592 W, 30.74829 N	419.97	97.63603 W, 30.74789 N	300.4	278.8	21.6
64	419.97	97.63603 W, 30.74789 N	421.47	97.63616 W, 30.74749 N	305.2	284.5	20.7
67	424.47	97.63643 W, 30.74668 N	425.97	97.63654 W, 30.74627 N	319.5	304.3	15.1
68	425.97	97.63654 W, 30.74626 N	427.47	97.63665 W, 30.74586 N	317.8	305.1	12.8

Summary of Locations Without Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
69	427.47	97.63665 W, 30.74586 N	428.97	97.63679 W, 30.74545 N	312.1	296.1	16.0
70	428.97	97.63679 W, 30.74545 N	430.47	97.63689 W, 30.74504 N	311.7	289.2	22.5
71	430.47	97.63689 W, 30.74504 N	431.97	97.63703 W, 30.74462 N	308.5	294.1	14.4
72	431.97	97.63703 W, 30.74462 N	433.47	97.63714 W, 30.74421 N	310.1	291.4	18.7
73	433.47	97.63714 W, 30.74421 N	434.97	97.63725 W, 30.74380 N	306.1	290.1	16.0
74	434.97	97.63725 W, 30.74380 N	436.47	97.63738 W, 30.74341 N	301.3	286.7	14.6
75	436.47	97.63738 W, 30.74341 N	437.97	97.63752 W, 30.74301 N	299.3	278.4	20.9
76	437.97	97.63752 W, 30.74301 N	439.47	97.63766 W, 30.74261 N	305.4	285.3	20.2
77	439.48	97.63766 W, 30.74261 N	440.97	97.63779 W, 30.74221 N	305.4	291.4	14.0
78	440.97	97.63779 W, 30.74221 N	442.47	97.63794 W, 30.74181 N	303.3	281.8	21.4
79	442.47	97.63794 W, 30.74181 N	443.97	97.63808 W, 30.74140 N	302.7	290.3	12.4
80	443.97	97.63808 W, 30.74140 N	445.47	97.63821 W, 30.74101 N	302.7	280.9	21.8
81	445.47	97.63821 W, 30.74101 N	446.97	97.63836 W, 30.74060 N	303.3	287.8	15.5
82	446.98	97.63836 W, 30.74060 N	448.47	97.6385 W, 30.74021 N	303.6	283.8	19.8
83	448.47	97.6385 W, 30.74021 N	449.97	97.63864 W, 30.73980 N	304.5	291.2	13.3
84	449.97	97.63864 W, 30.73980 N	451.47	97.63876 W, 30.73940 N	302.5	282.4	20.2

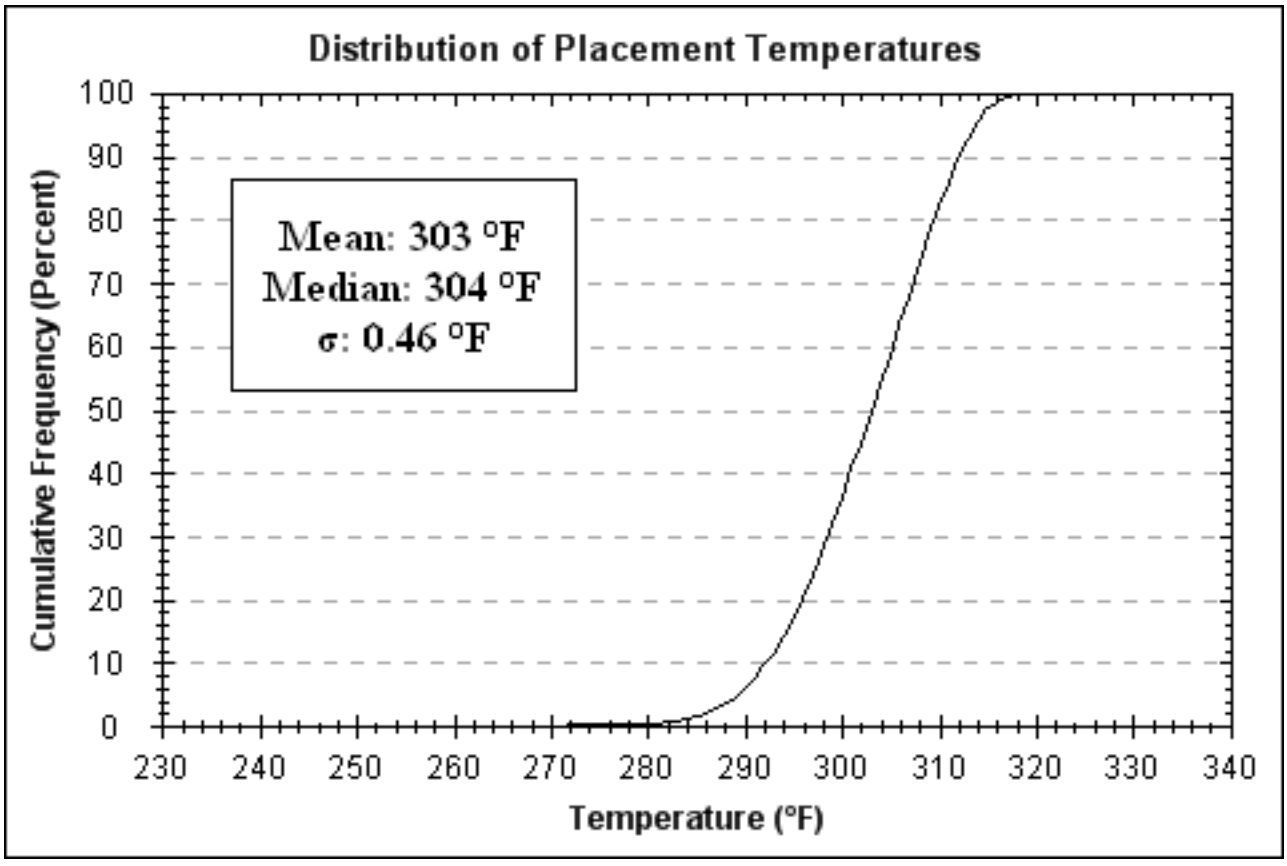
Summary of Locations Without Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
85	451.47	97.63876 W, 30.73940 N	452.97	97.6389 W, 30.73901 N	304.0	291.0	13.0
86	452.97	97.6389 W, 30.73901 N	454.47	97.63905 W, 30.73862 N	308.8	289.9	18.9
87	454.47	97.63905 W, 30.73861 N	455.97	97.63918 W, 30.73821 N	309.9	293.5	16.4
88	455.97	97.63918 W, 30.73821 N	457.47	97.63931 W, 30.73781 N	307.0	293.0	14.0
89	457.47	97.63931 W, 30.73781 N	458.97	97.63945 W, 30.73741 N	309.7	296.8	13.0
91	460.47	97.6396 W, 30.73701 N	461.97	97.63973 W, 30.73661 N	309.9	286.0	23.9
92	461.97	97.63973 W, 30.73661 N	463.47	97.63988 W, 30.73620 N	307.9	294.4	13.5
93	463.47	97.63988 W, 30.73620 N	464.97	97.64001 W, 30.73580 N	307.0	293.7	13.3
94	464.97	97.64001 W, 30.73580 N	466.47	97.64014 W, 30.73541 N	303.8	288.3	15.5
95	466.47	97.64014 W, 30.73541 N	467.97	97.64028 W, 30.73501 N	306.0	290.1	15.8
96	467.97	97.64028 W, 30.73501 N	469.47	97.64041 W, 30.73462 N	304.7	294.3	10.4
97	469.47	97.64041 W, 30.73462 N	470.97	97.64054 W, 30.73420 N	307.0	289.2	17.8
98	470.97	97.64056 W, 30.73420 N	472.47	97.64069 W, 30.73379 N	297.1	282.4	14.8
99	472.47	97.64069 W, 30.73379 N	473.97	97.64082 W, 30.73341 N	296.1	278.4	17.6
102	476.97	97.64111 W, 30.73262 N	478.47	97.64124 W, 30.73221 N	312.1	293.4	18.7
104	479.97	97.64137 W, 30.73181 N	481.47	97.6415 W, 30.73141 N	311.5	293.9	17.6

Summary of Locations Without Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
105	481.47	97.6415 W, 30.73141 N	482.97	97.64165 W, 30.73101 N	314.2	300.0	14.2
106	482.97	97.64165 W, 30.73101 N	484.47	97.64178 W, 30.73059 N	307.8	293.5	14.2
107	484.47	97.64178 W, 30.73059 N	485.97	97.64193 W, 30.73022 N	310.6	296.6	14.0
108	485.97	97.64193 W, 30.73022 N	487.47	97.64207 W, 30.72982 N	311.2	292.6	18.5
109	487.47	97.64207 W, 30.72982 N	488.97	97.64222 W, 30.72944 N	313.2	299.8	13.3
110	488.97	97.64222 W, 30.72944 N	490.47	97.64236 W, 30.72905 N	308.8	296.4	12.4
111	490.47	97.64236 W, 30.72905 N	491.97	97.64249 W, 30.72863 N	309.6	295.2	14.4
112	491.97	97.64249 W, 30.72863 N	493.47	97.64261 W, 30.72822 N	304.9	288.3	16.6
113	493.47	97.64261 W, 30.72822 N	494.97	97.64274 W, 30.72781 N	304.7	292.3	12.4
114	494.97	97.64274 W, 30.72781 N	496.47	97.64291 W, 30.72742 N	301.1	291.4	9.7
115	496.47	97.64291 W, 30.72742 N	497.97	97.64302 W, 30.72702 N	303.6	287.8	15.8
116	497.97	97.64302 W, 30.72702 N	499.47	97.64317 W, 30.72662 N	304.5	289.9	14.6
117	499.47	97.64317 W, 30.72662 N	500.97	97.6433 W, 30.72623 N	307.6	284.4	23.2
118	500.98	97.6433 W, 30.72623 N	502.47	97.64342 W, 30.72583 N	308.3	295.2	13.1
119	502.47	97.64342 W, 30.72583 N	503.97	97.64357 W, 30.72543 N	313.3	290.8	22.5
120	503.97	97.64357 W, 30.72543 N	505.47	97.64371 W, 30.72504 N	311.5	298.6	13.0

Summary of Locations Without Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
121	505.47	97.64371 W, 30.72503 N	506.97	97.64384 W, 30.72464 N	312.1	294.8	17.3
122	506.97	97.64384 W, 30.72464 N	508.47	97.64397 W, 30.72425 N	311.9	299.1	12.8
123	508.47	97.64397 W, 30.72425 N	509.97	97.64411 W, 30.72385 N	311.4	293.5	17.8
125	511.47	97.64424 W, 30.72345 N	512.97	97.64437 W, 30.72305 N	305.2	290.1	15.1



Location of Paver Stops greater than One Minute	
Location (stations)	Duration (h:min:sec)
411.72	0:2:19
511.01	0:3:6

APPENDIX B.
TEX-244-F RESULT FROM CAM PLACED 12-10-2010

Tex-244-F Part II

Thermal Profile Summary Report

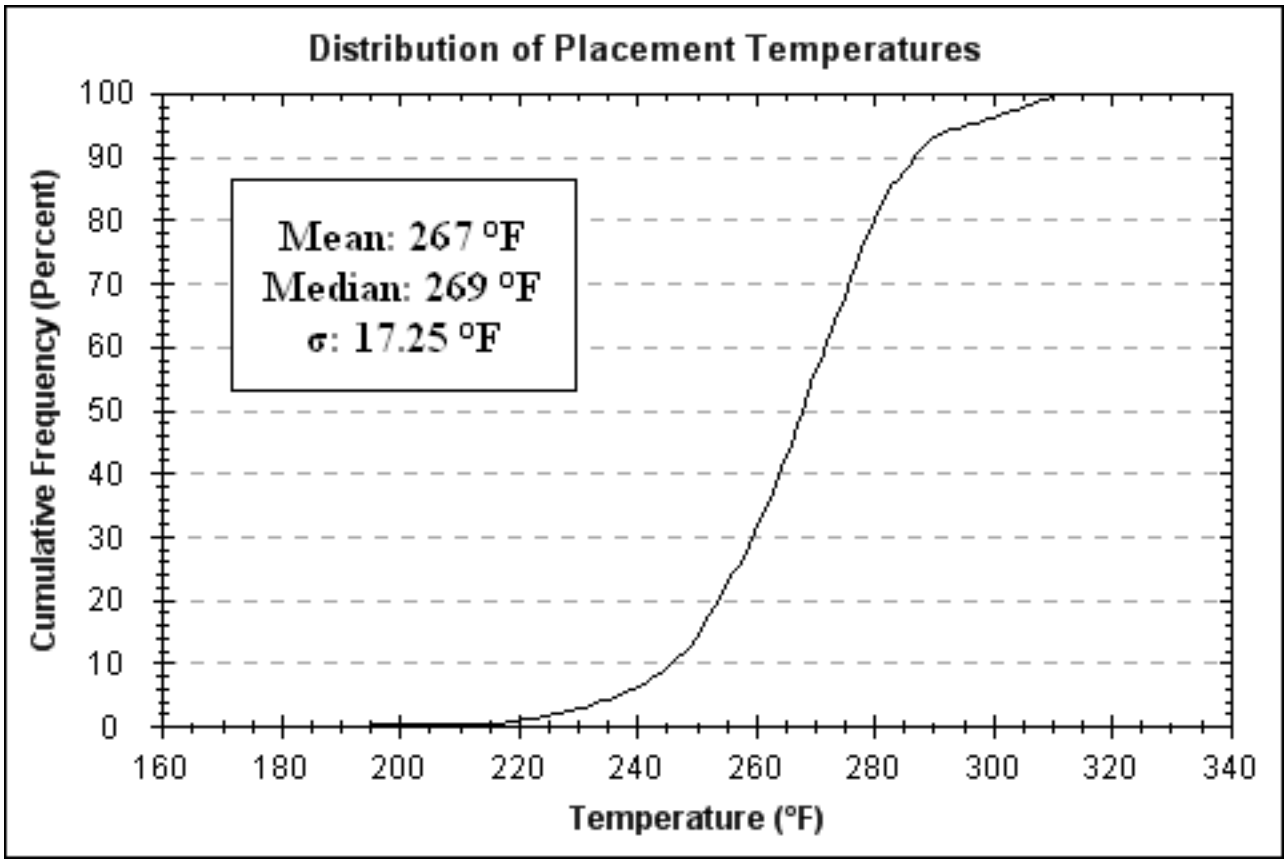
Profile ID:	fm158	Profile Date:	12/10/2010 5:39:18 PM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	sh6	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	-

Thermal Profile Results Summary

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
7	Number	Percent	Number	Percent
	4	57	3	43

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	93.66	96.34119 W, 30.67203 N	92.16	96.3418 W, 30.67197 N	313.7	237.0	76.7
2	92.16	96.3418 W, 30.67197 N	90.66	96.3424 W, 30.67191 N	290.8	213.6	77.2
3	90.66	96.3424 W, 30.67191 N	89.16	96.343 W, 30.67184 N	288.1	244.4	43.7
4	89.16	96.343 W, 30.67184 N	87.66	96.34359 W, 30.67180 N	283.8	250.2	33.7
5	87.65	96.34361 W, 30.67180 N	86.16	96.34419 W, 30.67175 N	279.9	245.7	34.2
6	86.15	96.34419 W, 30.67175 N	84.66	96.34481 W, 30.67170 N	271.9	224.4	47.5
7	84.65	96.34481 W, 30.67170 N	83.45	96.3453 W, 30.67165 N	271.0	186.6	84.4



Location of Paver Stops greater than One Minute	
Location (stations)	Duration (h:min:sec)
92.94	0:9:9
91.80	0:1:6
91.76	0:43:14
91.43	0:18:58
84.10	0:18:43

APPENDIX C.
TEX-244-F RESULT FROM CAM PLACED 12-15-2010

Tex-244-F Part II

Thermal Profile Summary Report

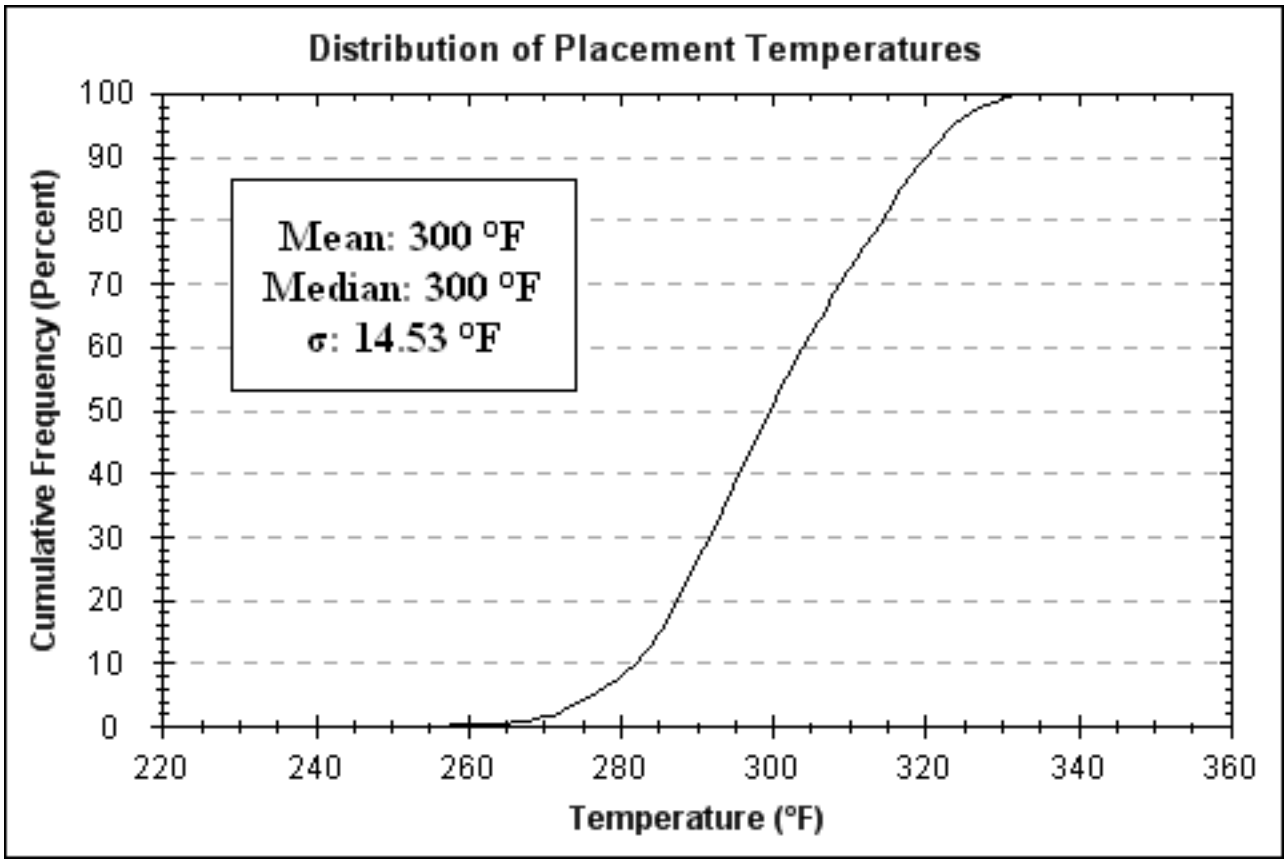
Profile ID:	FM.158	Profile Date:	12/15/2010 9:21:25 AM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	WB.TRVL.LN.A	Special Provision:	
Material Code:		Mix Type:	CAM
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 12

Thermal Profile Results Summary

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
15	Number	Percent	Number	Percent
	12	80	3	20

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	65.50	96.35323 W, 30.67191 N	64.00	96.35368 W, 30.67205 N	304.2	256.1	48.1
2	64.00	96.35368 W, 30.67205 N	62.50	96.35407 W, 30.67234 N	300.9	265.1	35.8
3	62.50	96.35409 W, 30.67234 N	61.00	96.35439 W, 30.67267 N	330.6	271.6	59.0
4	61.00	96.35439 W, 30.67267 N	59.50	96.35464 W, 30.67304 N	326.7	280.6	46.1
5	59.49	96.35464 W, 30.67304 N	58.00	96.35493 W, 30.67340 N	316.8	285.6	31.1
6	57.99	96.35493 W, 30.67341 N	56.50	96.35537 W, 30.67361 N	328.6	293.4	35.3
7	56.49	96.35537 W, 30.67361 N	55.00	96.35586 W, 30.67368 N	333.7	297.1	36.5
8	54.99	96.35586 W, 30.67368 N	53.50	96.35635 W, 30.67368 N	331.7	295.0	36.7
9	53.49	96.35635 W, 30.67368 N	52.00	96.35686 W, 30.67365 N	319.6	267.3	52.4
10	51.99	96.35686 W, 30.67364 N	50.50	96.35738 W, 30.67363 N	311.9	262.2	49.7
11	50.49	96.35738 W, 30.67363 N	49.00	96.35789 W, 30.67360 N	313.0	270.7	42.3
12	48.99	96.35789 W, 30.67360 N	47.50	96.3584 W, 30.67358 N	298.0	269.2	28.8
13	47.49	96.35841 W, 30.67358 N	46.00	96.35892 W, 30.67356 N	311.9	273.7	38.2
14	45.99	96.35893 W, 30.67356 N	44.50	96.35944 W, 30.67353 N	306.5	259.9	46.6
15	44.49	96.35946 W, 30.67353 N	44.33	96.35952 W, 30.67353 N	295.2	241.7	53.5



Location of Paver Stops greater than One Minute	
Location (stations)	Duration (h:min:sec)
53.30	0:1:38
52.80	0:5:57
50.89	0:16:47
50.78	0:1:56
44.47	0:2:40

APPENDIX D.
TEX-244-F RESULT FROM SMA-HOBAN

Tex-244-F Part II

Thermal Profile Summary Report

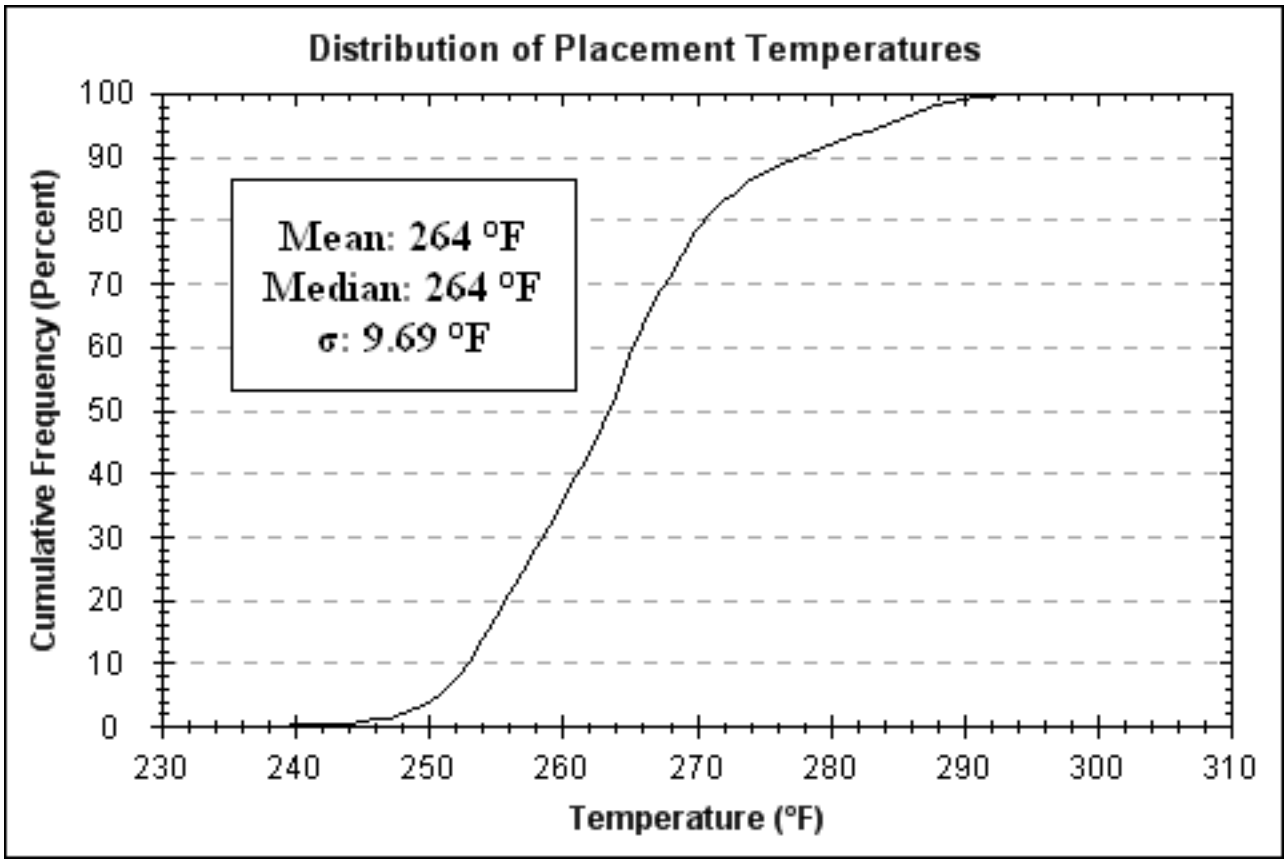
Profile ID:	pecos sma-Hoban-track	Profile Date:	4/26/2011 9:35:56 PM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	track	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 2, 7, 11, 12

Thermal Profile Results Summary				
Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
6	Number	Percent	Number	Percent
	4	67	0	0

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	0.00	103.23499 W, 31.28457 N	1.50	103.23544 W, 31.28471 N	295.2	254.8	40.3
3	3.00	103.23586 W, 31.28493 N	4.50	103.23624 W, 31.28510 N	269.8	244.0	25.7
5	6.01	103.2367 W, 31.28522 N	7.50	103.23717 W, 31.28540 N	274.1	246.2	27.9
6	7.51	103.23717 W, 31.28540 N	8.08	103.23734 W, 31.28547 N	263.3	237.9	25.4

Summary of Locations Without Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
2	1.50	103.23544 W, 31.28471 N	3.00	103.23586 W, 31.28493 N	277.7	254.7	23.0
4	4.50	103.23624 W, 31.28510 N	6.00	103.2367 W, 31.28522 N	271.6	247.5	24.1



Location of Paver Stops greater than One Minute	
Location (stations)	Duration (h:min:sec)
1.01	0:1:32

APPENDIX E.
TEX-244-F RESULT FROM SMA-EASTLAND

Tex-244-F Part II

Thermal Profile Summary Report

Profile ID:	pecos sma-Eastland-entrance	Profile Date:	4/27/2011 1:03:52 AM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	entrance	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

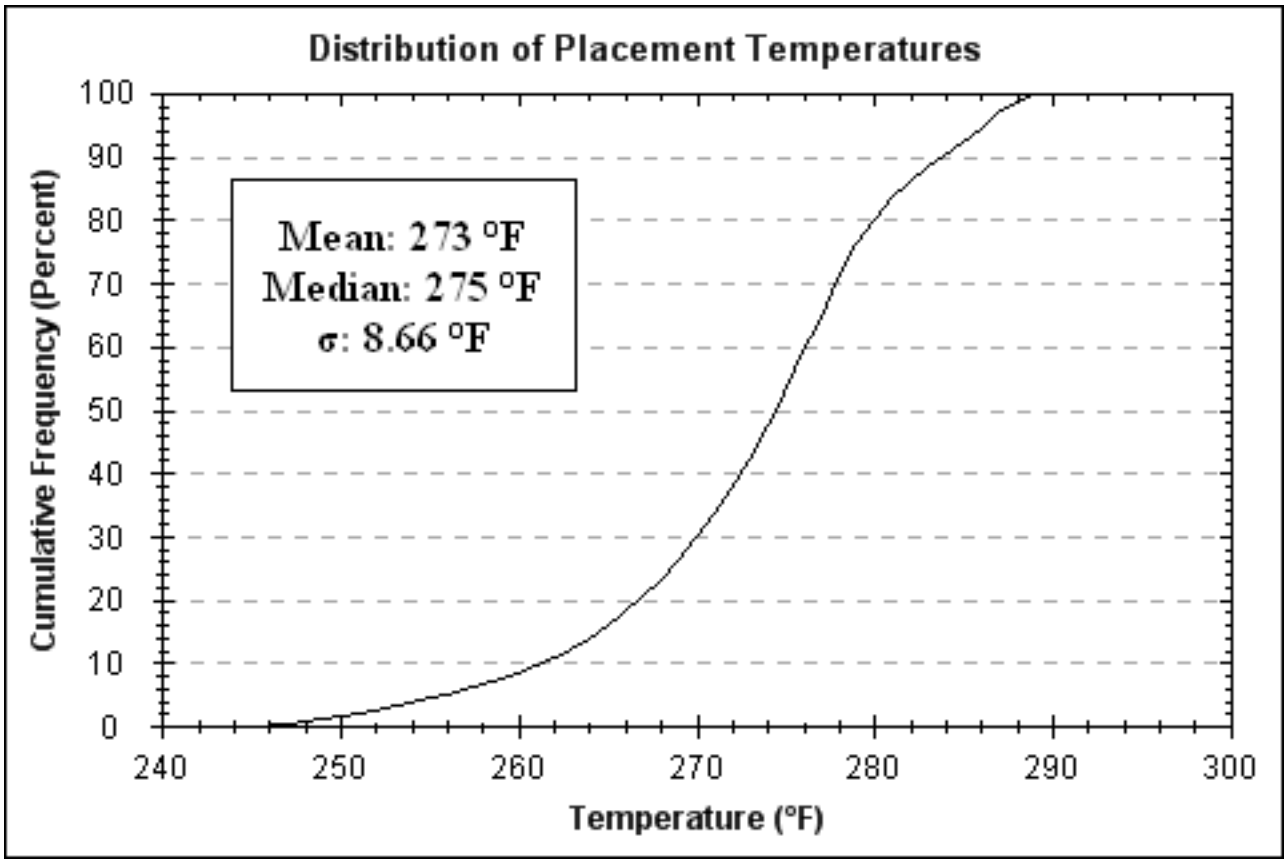
Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 2, 7, 12

Thermal Profile Results Summary

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
7	Number	Percent	Number	Percent
	3	43	0	0

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	0.00	103.22241 W, 31.28660 N	1.50	103.22282 W, 31.28638 N	289.2	254.3	34.9
2	1.51	103.22282 W, 31.28638 N	3.00	103.22321 W, 31.28617 N	275.5	246.2	29.3
3	3.01	103.22321 W, 31.28617 N	4.50	103.2236 W, 31.28595 N	281.5	253.9	27.5

Summary of Locations Without Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
4	4.51	103.2236 W, 31.28595 N	6.00	103.22401 W, 31.28574 N	287.8	266.7	21.1
5	6.01	103.22401 W, 31.28574 N	7.50	103.2244 W, 31.28552 N	289.9	269.1	20.9
6	7.51	103.2244 W, 31.28552 N	9.00	103.22482 W, 31.28529 N	289.6	266.5	23.0
7	9.00	103.22482 W, 31.28529 N	10.00	103.2251 W, 31.28514 N	289.6	273.0	16.6


Distribution of Placement Temperatures
Mean: 273 °F
Median: 275 °F
σ: 8.66 °F
Cumulative Frequency (Percent)
100
90
80
70
60
50
40
30
20
10
0
240
250
260
270
280
290
300
Temperature (°F)

APPENDIX F.
TEX-244-F RESULT FROM PFC-HOBAN

Tex-244-F Part II

Thermal Profile Summary Report

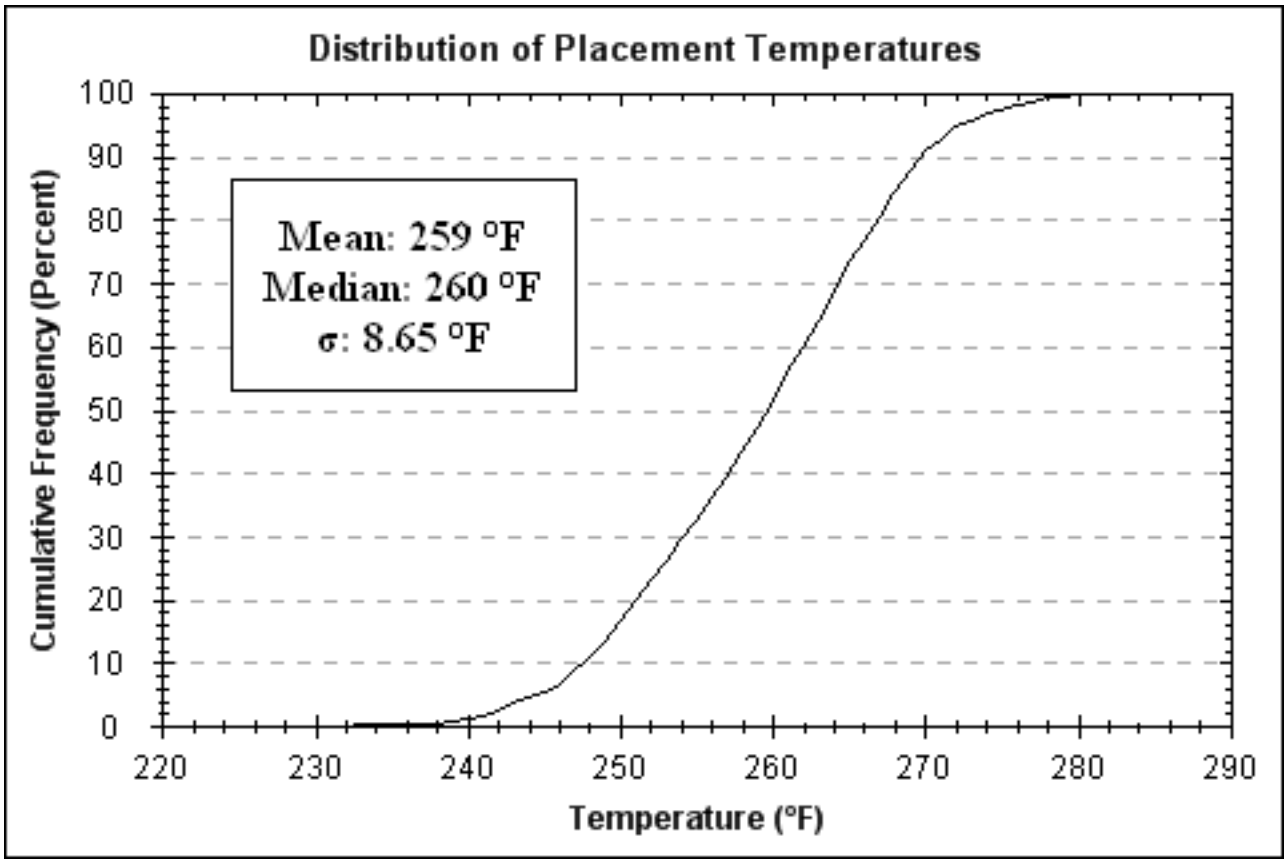
Profile ID:	pecos PFC-Hoban-entrance	Profile Date:	4/27/2011 4:41:21 PM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	entrance	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 2, 7, 12

Thermal Profile Results Summary				
Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
7	Number	Percent	Number	Percent
	5	71	1	14

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	0.00	103.22505 W, 31.28512 N	1.50	103.22544 W, 31.28493 N	282.0	230.0	52.0
3	3.00	103.22585 W, 31.28469 N	4.50	103.22623 W, 31.28448 N	278.6	247.5	31.1
4	4.50	103.22623 W, 31.28447 N	6.00	103.22665 W, 31.28425 N	271.4	246.0	25.4
5	6.00	103.22665 W, 31.28425 N	7.50	103.22704 W, 31.28400 N	272.8	242.2	30.6
6	7.51	103.22704 W, 31.28400 N	9.00	103.22741 W, 31.28373 N	264.6	238.3	26.3
7	9.01	103.22741 W, 31.28373 N	10.00	103.22764 W, 31.28354 N	267.1	235.8	31.3

Summary of Locations Without Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
2	1.50	103.22544 W, 31.28493 N	3.00	103.22585 W, 31.28469 N	275.7	253.0	22.7


Distribution of Placement Temperatures
Mean: 259 °F
Median: 260 °F
σ: 8.65 °F
Cumulative Frequency (Percent)
Temperature (°F)
0
10
20
30
40
50
60
70
80
90
100
220
230
240
250
260
270
280
290

APPENDIX G.
TEX-244-F RESULT FROM PFC-EASTLAND

Tex-244-F Part II

Thermal Profile Summary Report

Profile ID:	pecos pfc-Eastland-Entrance	Profile Date:	4/27/2011 10:01:06 PM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	entrance	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

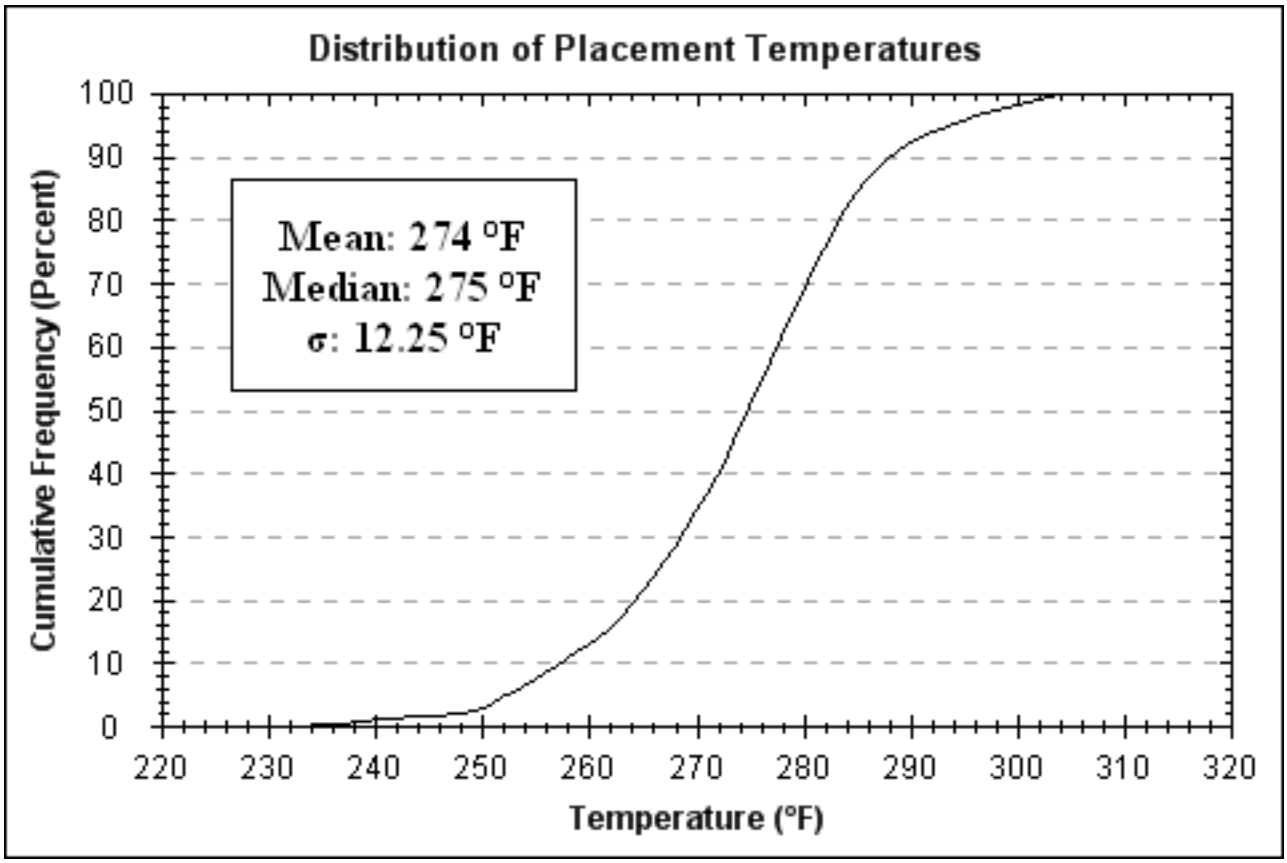
Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 2, 7, 12

Thermal Profile Results Summary

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
9	Number	Percent	Number	Percent
	7	78	1	11

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	0.00	103.22503 W, 31.28512 N	1.50	103.22544 W, 31.28492 N	306.5	256.3	50.2
2	1.50	103.22544 W, 31.28492 N	3.00	103.22585 W, 31.28467 N	290.5	253.2	37.3
3	3.00	103.22585 W, 31.28467 N	4.50	103.22623 W, 31.28446 N	282.9	257.9	25.0
4	4.50	103.22623 W, 31.28446 N	6.00	103.22665 W, 31.28423 N	274.3	234.0	40.3
5	6.01	103.22665 W, 31.28423 N	7.50	103.22702 W, 31.28399 N	280.9	250.5	30.4
6	7.51	103.22702 W, 31.28399 N	9.00	103.22739 W, 31.28370 N	284.9	254.7	30.2
7	9.01	103.22739 W, 31.28370 N	10.50	103.22774 W, 31.28341 N	292.1	261.7	30.4
9	12.01	103.22806 W, 31.28312 N	12.81	103.22826 W, 31.28294 N	295.3	268.5	26.8

Summary of Locations Without Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
8	10.51	103.22775 W, 31.28341 N	12.00	103.22806 W, 31.28312 N	290.8	268.2	22.7



Location of Paver Stops greater than One Minute	
Location (stations)	Duration (h:min:sec)
7.27	0:19:27

APPENDIX H.
TEX-244-F RESULT FROM TYPE D MIX PLACED 5-5-2011 IN THE ATLANTA DISTRICT

Tex-244-F Part II

Thermal Profile Summary Report

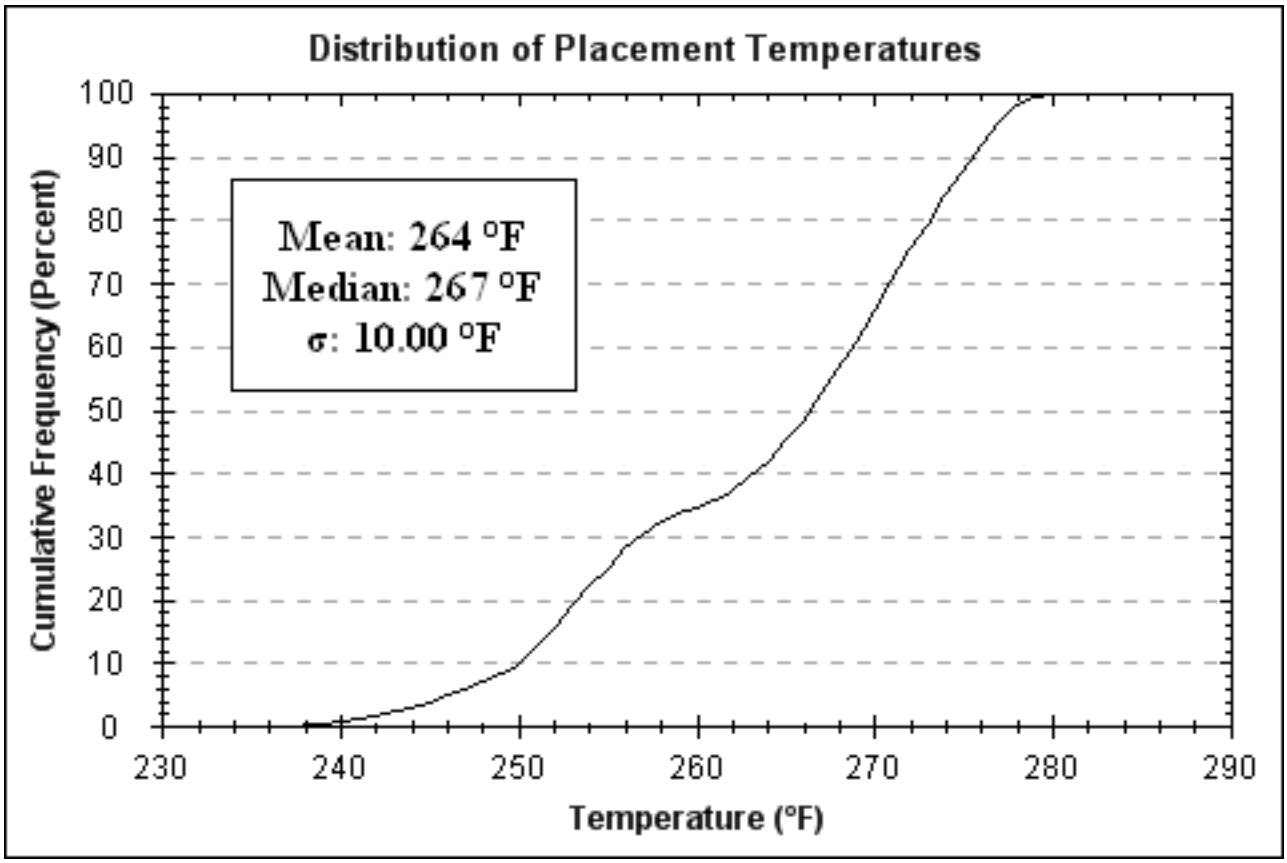
Profile ID:	new boston hwy eight	Profile Date:	5/5/2011 8:34:50 AM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	sbml	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 2, 11, 12

Thermal Profile Results Summary				
Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
12	Number	Percent	Number	Percent
	0	0	0	0

Summary of Locations Without Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	743.00	94.41807 W, 33.42474 N	744.50	94.41817 W, 33.42434 N	259.5	244.0	15.5
2	744.50	94.41817 W, 33.42434 N	746.00	94.41826 W, 33.42393 N	258.3	242.2	16.0
3	746.00	94.41826 W, 33.42393 N	747.50	94.41834 W, 33.42353 N	260.1	237.6	22.5
4	747.50	94.41834 W, 33.42353 N	749.00	94.41843 W, 33.42312 N	268.9	250.2	18.7
5	749.01	94.41843 W, 33.42311 N	750.50	94.41849 W, 33.42271 N	271.8	252.5	19.3
6	750.51	94.41849 W, 33.42271 N	752.00	94.41854 W, 33.42230 N	278.2	258.3	20.0
7	752.01	94.41854 W, 33.42229 N	753.50	94.41859 W, 33.42189 N	281.8	263.1	18.7
8	753.51	94.41859 W, 33.42189 N	755.00	94.41862 W, 33.42146 N	279.7	261.3	18.4
9	755.01	94.41862 W, 33.42146 N	756.50	94.41863 W, 33.42105 N	278.1	262.8	15.3
10	756.51	94.41863 W, 33.42105 N	758.00	94.41862 W, 33.42064 N	276.6	262.2	14.4
11	758.01	94.41862 W, 33.42064 N	759.50	94.41863 W, 33.42021 N	275.9	259.7	16.2
12	759.51	94.41863 W, 33.42021 N	760.98	94.41863 W, 33.41979 N	280.4	259.7	20.7


Distribution of Placement Temperatures
Mean: 264 °F
Median: 267 °F
σ: 10.00 °F
Cumulative Frequency (Percent)
100
90
80
70
60
50
40
30
20
10
0
230
240
250
260
270
280
290
Temperature (°F)

APPENDIX I.
TEX-244-F RESULT FROM TYPE D MIX PLACED 5-4-2011 IN THE ATLANTA DISTRICT

Tex-244-F Part II

Thermal Profile Summary Report

Profile ID:	new boston hwy eight	Profile Date:	5/4/2011 9:36:14 AM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	nbml	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 2, 11, 12

Thermal Profile Results Summary

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
49	Number	Percent	Number	Percent
	38	78	0	0

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	694.70	94.41476 W, 33.43750 N	696.20	94.41491 W, 33.43710 N	293.4	246.0	47.3
2	696.20	94.41491 W, 33.43710 N	697.70	94.41502 W, 33.43670 N	294.3	268.7	25.6
3	697.70	94.41502 W, 33.43670 N	699.20	94.41515 W, 33.43629 N	286.7	258.6	28.1
7	703.71	94.4155 W, 33.43510 N	705.20	94.4156 W, 33.43469 N	276.1	249.1	27.0
8	705.21	94.4156 W, 33.43469 N	706.70	94.4157 W, 33.43428 N	288.3	258.3	30.1
9	706.71	94.4157 W, 33.43428 N	708.20	94.41579 W, 33.43387 N	303.3	267.8	35.5
10	708.20	94.41579 W, 33.43386 N	709.70	94.4159 W, 33.43347 N	314.2	284.2	30.1
11	709.70	94.4159 W, 33.43347 N	711.20	94.416 W, 33.43306 N	317.8	289.8	28.1
13	712.70	94.41611 W, 33.43267 N	714.20	94.41619 W, 33.43228 N	315.1	289.8	25.4
14	714.20	94.41619 W, 33.43227 N	715.70	94.41631 W, 33.43184 N	311.7	282.0	29.7
16	717.20	94.41639 W, 33.43143 N	718.70	94.41649 W, 33.43101 N	295.9	263.8	32.0
18	720.20	94.41659 W, 33.43060 N	721.70	94.41668 W, 33.43019 N	287.1	262.0	25.0
19	721.70	94.41668 W, 33.43019 N	723.20	94.41678 W, 33.42979 N	295.0	260.1	34.9
20	723.20	94.41678 W, 33.42979 N	724.70	94.41689 W, 33.42937 N	300.4	272.3	28.1
21	724.70	94.41688 W, 33.42936 N	726.20	94.41699 W, 33.42897 N	300.9	271.8	29.2
22	726.20	94.41699 W, 33.42897 N	727.70	94.41709 W, 33.42855 N	302.2	272.3	29.9

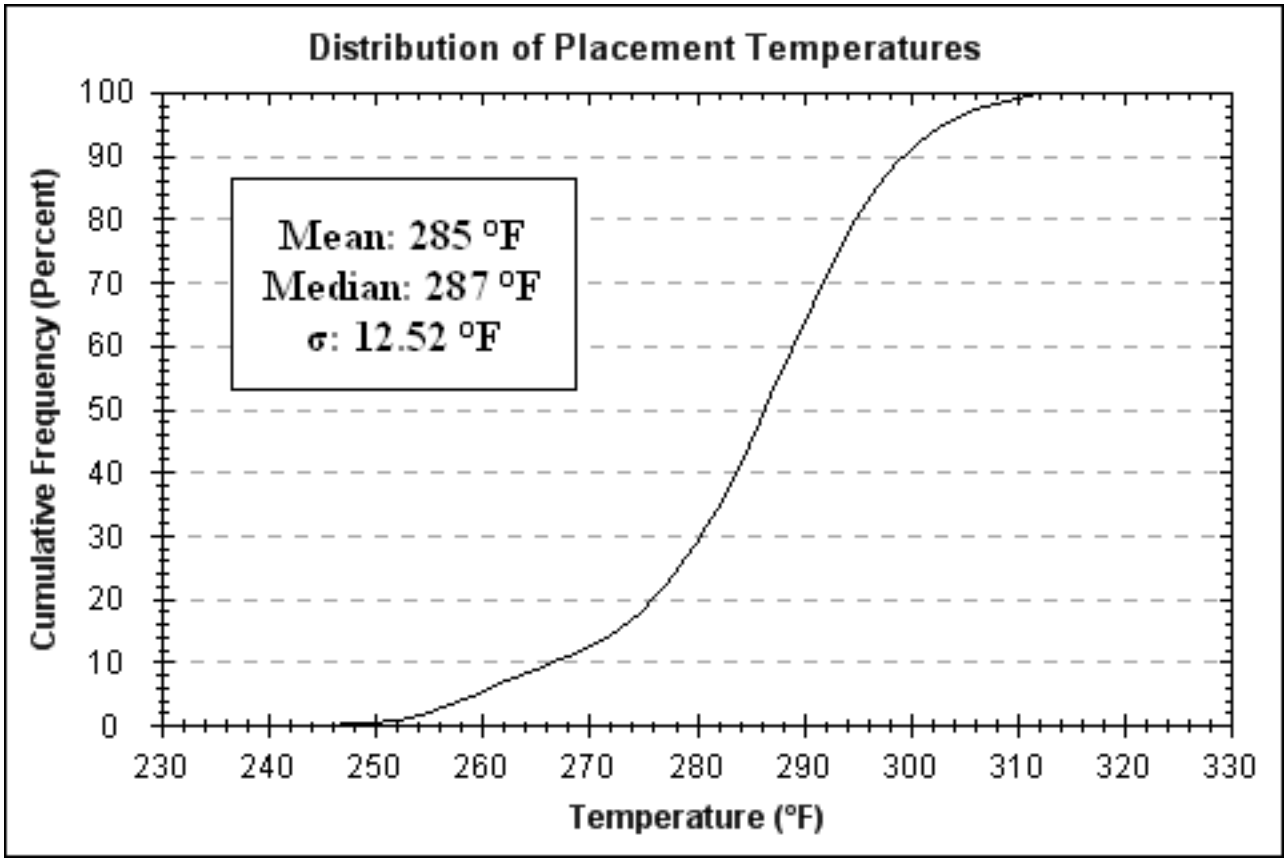
Summary of Locations with Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
23	727.70	94.41709 W, 33.42854 N	729.20	94.41719 W, 33.42814 N	303.1	275.4	27.7
24	729.20	94.41719 W, 33.42814 N	730.70	94.41728 W, 33.42775 N	302.2	275.5	26.6
25	730.70	94.41728 W, 33.42775 N	732.20	94.41738 W, 33.42734 N	302.5	273.7	28.8
27	733.70	94.41748 W, 33.42693 N	735.20	94.41758 W, 33.42652 N	304.3	278.6	25.7
28	735.20	94.41758 W, 33.42652 N	736.70	94.41768 W, 33.42611 N	302.2	276.1	26.1
29	736.70	94.41768 W, 33.42611 N	738.20	94.41777 W, 33.42572 N	302.2	271.4	30.8
30	738.20	94.41777 W, 33.42571 N	739.70	94.41787 W, 33.42532 N	302.5	272.1	30.4
31	739.70	94.41787 W, 33.42532 N	741.20	94.41795 W, 33.42490 N	306.7	275.5	31.1
32	741.20	94.41795 W, 33.42490 N	742.70	94.41807 W, 33.42450 N	303.6	278.2	25.4
33	742.70	94.41807 W, 33.42449 N	744.20	94.41817 W, 33.42408 N	300.7	274.8	25.9
34	744.21	94.41817 W, 33.42408 N	745.70	94.41826 W, 33.42367 N	295.0	268.7	26.3
36	747.20	94.41836 W, 33.42326 N	748.70	94.41844 W, 33.42284 N	297.1	271.4	25.7
38	750.20	94.41849 W, 33.42243 N	751.70	94.41854 W, 33.42202 N	293.0	267.3	25.7
40	753.20	94.41859 W, 33.42161 N	754.70	94.41859 W, 33.42120 N	297.3	259.7	37.6
41	754.70	94.41859 W, 33.42120 N	756.20	94.4186 W, 33.42078 N	300.0	269.6	30.4
42	756.20	94.4186 W, 33.42078 N	757.70	94.41859 W, 33.42036 N	299.7	266.5	33.1

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
43	757.71	94.41859 W, 33.42036 N	759.20	94.41859 W, 33.41994 N	302.4	275.0	27.4
44	759.20	94.41859 W, 33.41994 N	760.70	94.41859 W, 33.41953 N	302.0	273.0	29.0
45	760.70	94.41859 W, 33.41953 N	762.20	94.41859 W, 33.41912 N	300.7	268.5	32.2
46	762.20	94.41859 W, 33.41912 N	763.70	94.41859 W, 33.41870 N	298.8	267.4	31.3
48	765.20	94.41859 W, 33.41829 N	766.70	94.41859 W, 33.41787 N	294.4	268.3	26.1
49	766.70	94.41859 W, 33.41787 N	767.90	94.41859 W, 33.41755 N	294.8	268.0	26.8

Summary of Locations Without Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
4	699.20	94.41515 W, 33.43629 N	700.70	94.41527 W, 33.43591 N	267.8	252.0	15.8
5	700.71	94.41527 W, 33.43591 N	702.20	94.41538 W, 33.43551 N	263.5	245.5	18.0
6	702.21	94.41538 W, 33.43550 N	703.70	94.4155 W, 33.43510 N	268.5	248.9	19.6
12	711.20	94.416 W, 33.43306 N	712.70	94.41611 W, 33.43267 N	312.6	289.4	23.2
15	715.70	94.41631 W, 33.43184 N	717.20	94.41639 W, 33.43143 N	299.5	276.8	22.7

Summary of Locations Without Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
17	718.70	94.41649 W, 33.43100 N	720.20	94.41659 W, 33.43060 N	284.0	260.6	23.4
26	732.20	94.41738 W, 33.42734 N	733.70	94.41748 W, 33.42693 N	302.7	278.4	24.3
35	745.70	94.41826 W, 33.42367 N	747.20	94.41836 W, 33.42326 N	295.0	273.2	21.8
37	748.70	94.41844 W, 33.42284 N	750.20	94.41849 W, 33.42244 N	295.9	275.0	20.9
39	751.70	94.41854 W, 33.42202 N	753.20	94.41859 W, 33.42161 N	294.1	270.7	23.4
47	763.70	94.41859 W, 33.41870 N	765.20	94.41859 W, 33.41829 N	292.5	268.9	23.6



Location of Paver Stops greater than One Minute	
Location (stations)	Duration (h:min:sec)
737.40	0:5:19

APPENDIX J.
TEX-244-F RESULT FROM TYPE C MIX IN THE EL PASO DISTRICT

Tex-244-F Part II

Thermal Profile Summary Report

Profile ID:	Dyer	Profile Date:	5/11/2011 7:17:37 PM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:	SDS	Spec Item:	
Test Location:	sb ol	Special Provision:	
Material Code:		Mix Type:	TY C (WMA) PG 64-22
Material Name:			
Producer:	Jobe		
Area Engeneer:		Project Manager:	

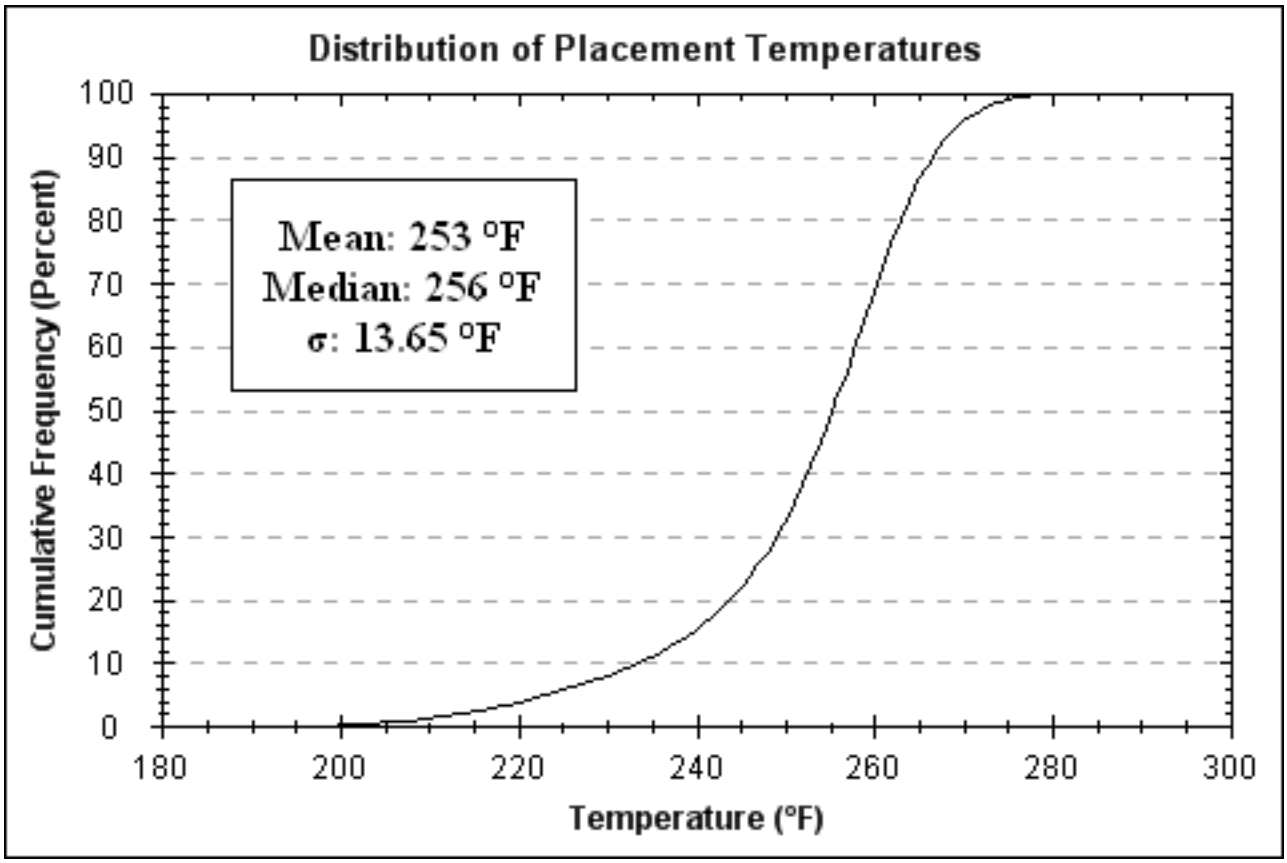
Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 2, 11, 12

Thermal Profile Results Summary

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
30	Number	Percent	Number	Percent
	5	17	25	83

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	64.95	106.4312 W, 31.86544 N	63.45	106.43143 W, 31.86510 N	276.1	204.4	71.6
2	63.45	106.43143 W, 31.86510 N	61.95	106.43167 W, 31.86474 N	273.6	234.5	39.1
3	61.95	106.43167 W, 31.86474 N	60.45	106.43192 W, 31.86436 N	275.4	209.3	66.1
4	60.45	106.43192 W, 31.86436 N	58.95	106.43217 W, 31.86399 N	274.1	225.7	48.4
5	58.95	106.43217 W, 31.86399 N	57.45	106.43242 W, 31.86364 N	273.2	215.8	57.4
6	57.45	106.43242 W, 31.86364 N	55.95	106.43265 W, 31.86328 N	272.3	214.7	57.6
7	55.95	106.43265 W, 31.86328 N	54.45	106.43289 W, 31.86289 N	273.6	193.8	79.7
8	54.45	106.43289 W, 31.86289 N	52.95	106.43315 W, 31.86252 N	270.3	211.3	59.0
9	52.95	106.43315 W, 31.86252 N	51.45	106.4334 W, 31.86213 N	268.3	234.1	34.2
10	51.45	106.4334 W, 31.86213 N	49.95	106.43364 W, 31.86176 N	272.3	210.0	62.3
11	49.95	106.43364 W, 31.86176 N	48.45	106.43388 W, 31.86139 N	276.8	204.4	72.4
12	48.44	106.43388 W, 31.86139 N	46.95	106.43413 W, 31.86102 N	269.4	203.5	65.9
13	46.95	106.43413 W, 31.86102 N	45.45	106.43436 W, 31.86067 N	271.6	219.6	52.0
14	45.44	106.43436 W, 31.86067 N	43.95	106.4346 W, 31.86029 N	272.1	201.0	71.1
15	43.95	106.4346 W, 31.86028 N	42.45	106.43486 W, 31.85991 N	271.4	216.1	55.3
16	42.45	106.43486 W, 31.85991 N	40.95	106.4351 W, 31.85955 N	275.0	205.0	70.0

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
17	40.95	106.4351 W, 31.85955 N	39.45	106.43535 W, 31.85917 N	270.9	200.7	70.2
18	39.45	106.43535 W, 31.85917 N	37.95	106.43559 W, 31.85881 N	265.5	196.3	69.1
19	37.95	106.43559 W, 31.85880 N	36.45	106.43584 W, 31.85843 N	266.5	226.0	40.5
20	36.45	106.43584 W, 31.85843 N	34.95	106.4361 W, 31.85806 N	271.2	198.9	72.4
21	34.95	106.4361 W, 31.85806 N	33.45	106.43635 W, 31.85768 N	271.6	207.5	64.1
22	33.45	106.43635 W, 31.85768 N	31.95	106.43657 W, 31.85732 N	272.5	200.5	72.0
23	31.95	106.43657 W, 31.85732 N	30.45	106.43684 W, 31.85693 N	274.5	215.2	59.2
24	30.45	106.43684 W, 31.85693 N	28.95	106.4371 W, 31.85654 N	281.7	202.5	79.2
25	28.94	106.4371 W, 31.85654 N	27.45	106.43732 W, 31.85619 N	281.3	211.3	70.0
26	27.45	106.43732 W, 31.85619 N	25.95	106.43755 W, 31.85581 N	276.8	239.7	37.1
27	25.95	106.43755 W, 31.85581 N	24.45	106.43777 W, 31.85545 N	267.4	213.6	53.8
28	24.44	106.43777 W, 31.85545 N	22.95	106.43803 W, 31.85506 N	265.8	200.8	65.0
29	22.95	106.43803 W, 31.85506 N	21.45	106.4383 W, 31.85469 N	282.4	202.8	79.6
30	21.45	106.4383 W, 31.85469 N	21.22	106.43833 W, 31.85463 N	275.9	221.9	54.0



Location of Paver Stops greater than One Minute	
Location (stations)	Duration (h:min:sec)
62.72	0:1:40
61.77	0:6:45
60.36	0:6:32
54.59	0:3:47
52.56	0:15:42
45.92	0:1:57
43.38	0:1:9
42.65	0:5:37
40.40	0:1:30
34.84	0:1:27

Location of Paver Stops greater than One Minute	
Location (stations)	Duration (h:min:sec)
29.47	0:8:49
28.29	0:3:56
27.43	0:1:10
25.64	0:1:5

APPENDIX K.
TEX-244-F RESULT FROM TYPE C OUTSIDE LANE IN THE LAREDO DISTRICT

Tex-244-F Part II

Thermal Profile Summary Report

Profile ID:	SL 20 NB OL	Profile Date:	6/1/2011 3:22:28 PM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	0086-16-001
County:		Spec Year:	
Tested By:	sds	Spec Item:	
Test Location:	by cielito lindo	Special Provision:	
Material Code:		Mix Type:	TY C HMA 20% RAP
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

Course/Lift:	2	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 12

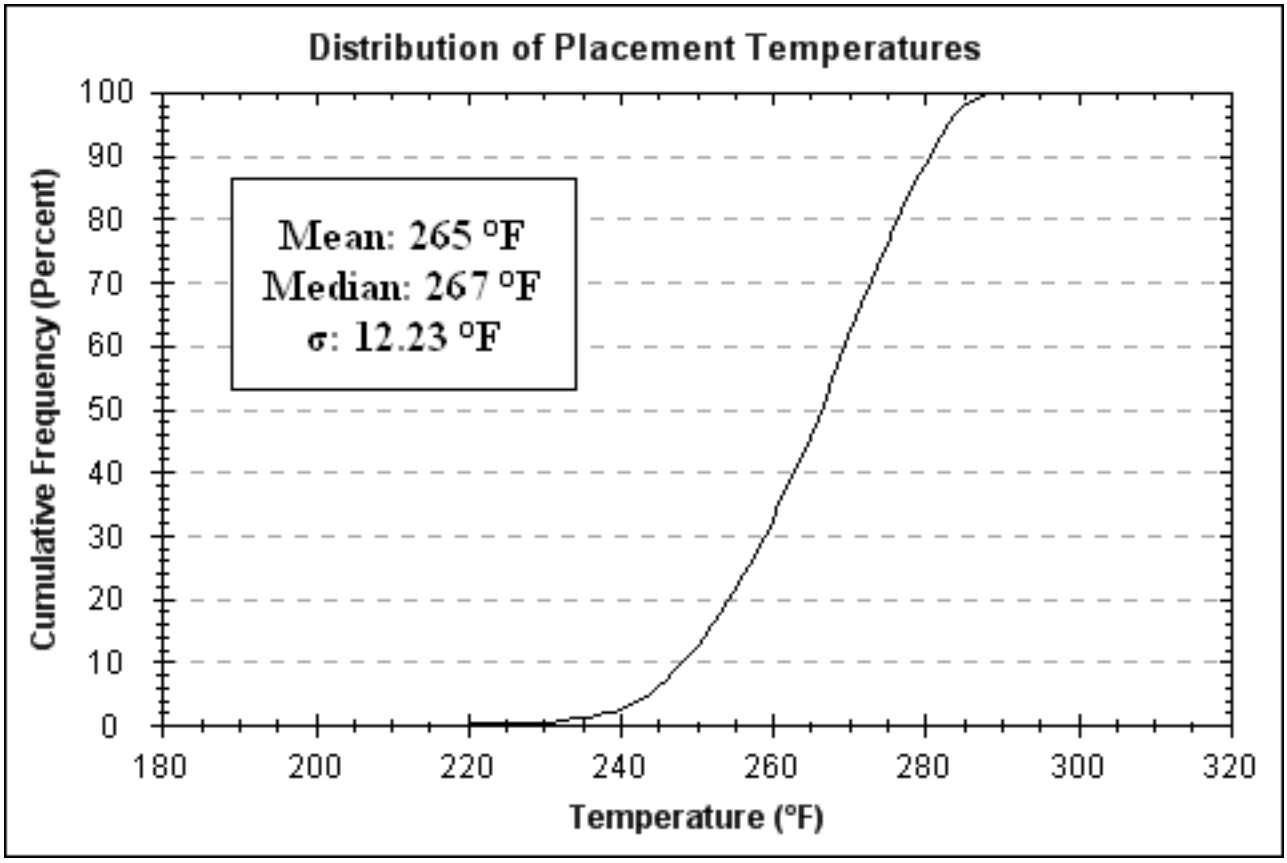
Thermal Profile Results Summary

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
19	Number	Percent	Number	Percent
	17	89	2	11

Summary of Locations with Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	122.20	99.45212 W, 27.43062 N	123.70	99.45213 W, 27.43103 N	289.0	246.9	42.1
2	123.70	99.45213 W, 27.43103 N	125.20	99.45213 W, 27.43144 N	270.9	233.8	37.1
3	125.20	99.45213 W, 27.43144 N	126.70	99.45213 W, 27.43185 N	256.5	227.8	28.6
4	126.70	99.45213 W, 27.43185 N	128.20	99.45213 W, 27.43224 N	267.1	221.2	45.9
5	128.21	99.45213 W, 27.43225 N	129.70	99.45213 W, 27.43265 N	270.1	231.3	38.9
6	129.71	99.45213 W, 27.43265 N	131.20	99.45215 W, 27.43308 N	275.9	239.9	36.0
7	131.21	99.45215 W, 27.43308 N	132.70	99.45213 W, 27.43351 N	275.0	239.9	35.1
8	132.71	99.45213 W, 27.43351 N	134.20	99.45215 W, 27.43394 N	282.6	244.8	37.8
9	134.21	99.45215 W, 27.43394 N	135.70	99.45216 W, 27.43435 N	287.1	245.8	41.2
10	135.71	99.45216 W, 27.43435 N	137.20	99.45215 W, 27.43475 N	288.3	243.7	44.6
11	137.21	99.45215 W, 27.43475 N	138.70	99.45215 W, 27.43518 N	286.0	249.8	36.2
12	138.71	99.45215 W, 27.43518 N	140.20	99.45216 W, 27.43558 N	291.2	237.0	54.2
13	140.21	99.45216 W, 27.43558 N	141.70	99.45216 W, 27.43598 N	287.2	201.2	86.0
14	141.71	99.45216 W, 27.43599 N	143.20	99.45218 W, 27.43640 N	284.4	237.0	47.3
15	143.21	99.45218 W, 27.43640 N	144.70	99.45218 W, 27.43682 N	283.8	241.3	42.5
16	144.71	99.45218 W, 27.43682 N	146.20	99.45218 W, 27.43723 N	278.2	240.8	37.4

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
17	146.21	99.45218 W, 27.43723 N	147.70	99.45219 W, 27.43765 N	286.0	250.9	35.1
18	147.71	99.45219 W, 27.43765 N	149.20	99.45218 W, 27.43806 N	288.5	240.8	47.7
19	149.21	99.45218 W, 27.43806 N	150.29	99.45219 W, 27.43832 N	291.6	248.5	43.0



APPENDIX L.
TEX-244-F RESULT FROM TYPE C INSIDE LANE IN THE LAREDO DISTRICT

Tex-244-F Part II

Thermal Profile Summary Report

Profile ID:	SL 20 NB IL	Profile Date:	6/1/2011 6:30:21 PM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	by cielito lindo	Special Provision:	
Material Code:		Mix Type:	TY C HMA 20% RAP
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

Course/Lift:	2	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 12

Thermal Profile Results Summary				
Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
54	Number	Percent	Number	Percent
	36	67	18	33

Summary of Locations with Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	121.90	99.45215 W, 27.43051 N	123.40	99.45216 W, 27.43090 N	288.3	240.6	47.7
2	123.40	99.45216 W, 27.43091 N	124.90	99.45218 W, 27.43131 N	291.4	230.7	60.7
3	124.90	99.45218 W, 27.43131 N	126.40	99.45218 W, 27.43173 N	290.7	226.6	64.1
4	126.40	99.45218 W, 27.43173 N	127.90	99.45218 W, 27.43214 N	288.3	250.2	38.2
5	127.91	99.45218 W, 27.43214 N	129.40	99.45218 W, 27.43255 N	294.1	241.5	52.6
6	129.41	99.45218 W, 27.43255 N	130.90	99.45218 W, 27.43296 N	294.1	242.6	51.5
7	130.91	99.45218 W, 27.43296 N	132.40	99.45218 W, 27.43337 N	295.0	236.5	58.5
8	132.41	99.45218 W, 27.43337 N	133.90	99.45218 W, 27.43372 N	289.0	231.1	58.0
9	133.91	99.45218 W, 27.43373 N	135.40	99.45218 W, 27.43416 N	284.5	241.7	42.8
10	135.41	99.45218 W, 27.43416 N	136.90	99.45218 W, 27.43454 N	286.0	239.2	46.8
11	136.91	99.45218 W, 27.43454 N	138.40	99.45219 W, 27.43497 N	286.9	232.9	54.0
12	138.41	99.45219 W, 27.43497 N	139.90	99.45222 W, 27.43537 N	288.9	246.6	42.3
13	139.91	99.45222 W, 27.43537 N	141.40	99.45219 W, 27.43577 N	288.7	228.6	60.1
14	141.41	99.45219 W, 27.43577 N	142.90	99.45219 W, 27.43617 N	280.4	242.1	38.3
15	142.91	99.45219 W, 27.43617 N	144.40	99.45222 W, 27.43662 N	283.6	216.5	67.1
16	144.41	99.45222 W, 27.43662 N	145.90	99.45222 W, 27.43701 N	287.2	243.7	43.6

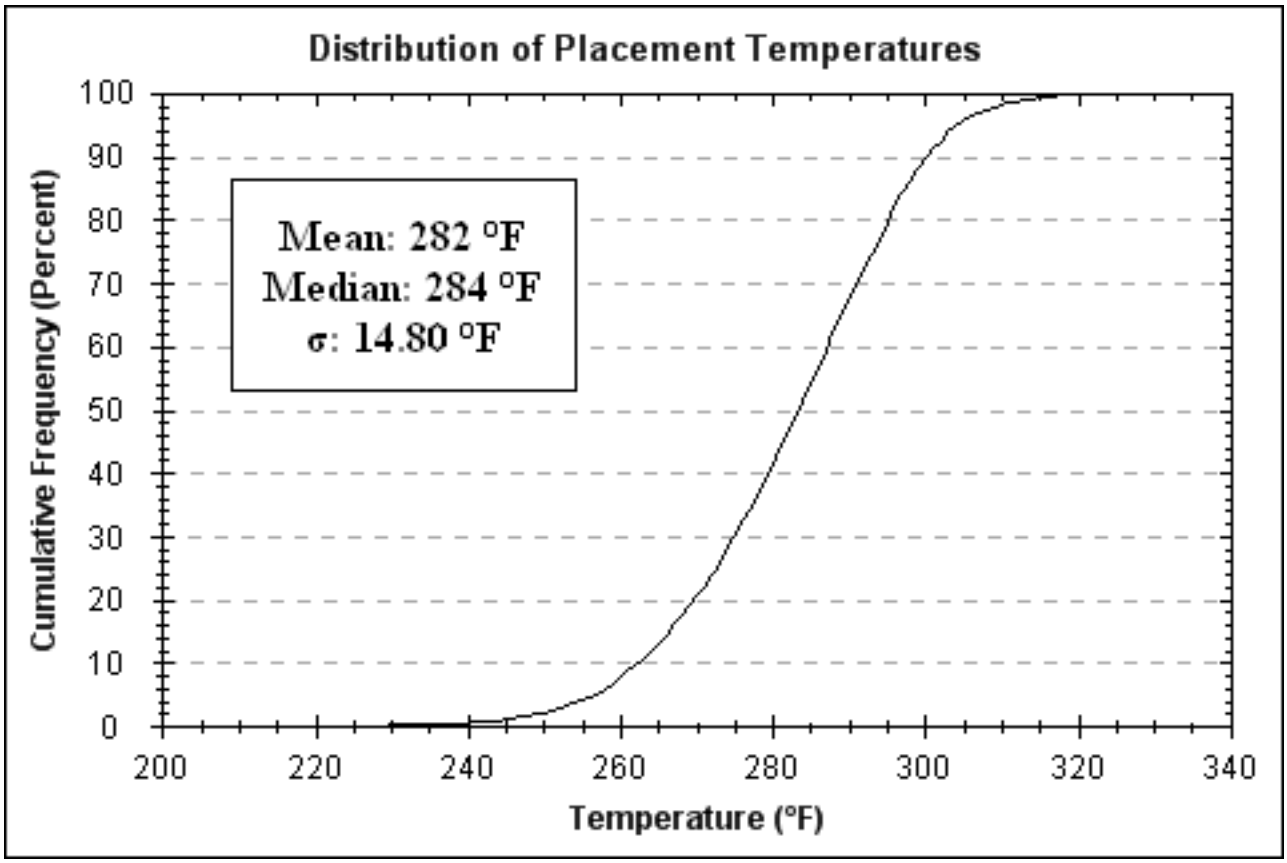
Summary of Locations with Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
17	145.91	99.45222 W, 27.43701 N	147.40	99.45222 W, 27.43743 N	287.1	227.3	59.8
18	147.41	99.45222 W, 27.43743 N	148.90	99.45222 W, 27.43785 N	280.6	234.5	46.1
19	148.90	99.45222 W, 27.43785 N	150.40	99.45225 W, 27.43827 N	281.3	250.9	30.4
20	150.40	99.45225 W, 27.43827 N	151.90	99.45222 W, 27.43868 N	293.9	242.8	51.1
21	151.90	99.45222 W, 27.43868 N	153.40	99.45225 W, 27.43911 N	299.1	258.6	40.5
22	153.40	99.45225 W, 27.43911 N	154.90	99.45223 W, 27.43953 N	300.2	257.9	42.3
23	154.90	99.45223 W, 27.43953 N	156.40	99.45225 W, 27.43993 N	307.8	265.5	42.3
24	156.41	99.45225 W, 27.43994 N	157.90	99.45223 W, 27.44034 N	304.0	265.1	38.9
25	157.90	99.45223 W, 27.44034 N	159.40	99.45223 W, 27.44076 N	304.0	253.4	50.6
26	159.40	99.45223 W, 27.44076 N	160.90	99.45226 W, 27.44114 N	298.2	255.2	43.0
27	160.90	99.45226 W, 27.44115 N	162.40	99.45226 W, 27.44155 N	301.1	256.1	45.0
28	162.40	99.45226 W, 27.44155 N	163.90	99.45225 W, 27.44197 N	302.5	262.9	39.6
29	163.90	99.45225 W, 27.44197 N	165.40	99.45225 W, 27.44237 N	305.2	264.2	41.0
30	165.40	99.45225 W, 27.44237 N	166.90	99.45226 W, 27.44277 N	305.4	259.0	46.4
31	166.90	99.45226 W, 27.44277 N	168.40	99.45228 W, 27.44320 N	304.7	265.6	39.1
32	168.40	99.45228 W, 27.44320 N	169.90	99.45229 W, 27.44361 N	305.4	269.1	36.4

Summary of Locations with Thermal Segregation

Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
33	169.91	99.45229 W, 27.44361 N	171.40	99.45228 W, 27.44401 N	312.4	267.3	45.2
34	171.41	99.45228 W, 27.44401 N	172.90	99.45229 W, 27.44444 N	311.9	248.4	63.5
35	172.90	99.45229 W, 27.44445 N	174.40	99.45228 W, 27.44486 N	303.4	261.9	41.6
36	174.40	99.45228 W, 27.44486 N	175.90	99.45228 W, 27.44527 N	309.9	265.5	44.5
37	175.90	99.45228 W, 27.44527 N	177.40	99.45229 W, 27.44569 N	309.0	260.8	48.2
38	177.40	99.45229 W, 27.44569 N	178.90	99.45231 W, 27.44609 N	309.0	255.9	53.1
39	178.90	99.45231 W, 27.44609 N	180.40	99.45232 W, 27.44651 N	305.8	274.6	31.1
40	180.40	99.45232 W, 27.44651 N	181.90	99.45235 W, 27.44691 N	300.0	259.9	40.1
41	181.90	99.45235 W, 27.44691 N	183.40	99.45239 W, 27.44732 N	304.9	271.9	32.9
42	183.41	99.45239 W, 27.44732 N	184.90	99.45241 W, 27.44774 N	300.4	256.6	43.7
43	184.91	99.45241 W, 27.44774 N	186.40	99.45244 W, 27.44816 N	297.7	261.7	36.0
44	186.40	99.45244 W, 27.44816 N	187.90	99.45248 W, 27.44859 N	297.7	259.9	37.8
45	187.90	99.45248 W, 27.44859 N	189.40	99.45249 W, 27.44900 N	301.1	257.5	43.6
46	189.40	99.45249 W, 27.44901 N	190.90	99.45254 W, 27.44943 N	303.3	248.7	54.5
47	190.90	99.45254 W, 27.44943 N	192.40	99.45259 W, 27.44985 N	304.2	275.0	29.2
48	192.40	99.45259 W, 27.44985 N	193.90	99.45261 W, 27.45026 N	308.1	264.0	44.1

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
49	193.90	99.45261 W, 27.45026 N	195.40	99.45261 W, 27.45069 N	309.9	248.5	61.4
50	195.40	99.45261 W, 27.45069 N	196.90	99.45261 W, 27.45111 N	314.1	240.4	73.6
51	196.91	99.45261 W, 27.45111 N	198.40	99.45262 W, 27.45153 N	317.8	273.0	44.8
52	198.41	99.45262 W, 27.45153 N	199.90	99.45262 W, 27.45193 N	322.5	284.9	37.6
53	199.90	99.45262 W, 27.45193 N	201.40	99.45264 W, 27.45238 N	325.0	266.2	58.9
54	201.40	99.45264 W, 27.45238 N	201.69	99.45262 W, 27.45244 N	307.0	275.0	32.0


Distribution of Placement Temperatures
Mean: 282 °F
Median: 284 °F
σ: 14.80 °F
Cumulative Frequency (Percent)
100
90
80
70
60
50
40
30
20
10
0
200
220
240
260
280
300
320
340
Temperature (°F)

APPENDIX M.
TEX-244-F RESULT FROM TYPE D MIX IN THE HOUSTON DISTRICT

Tex-244-F Part II

Thermal Profile Summary Report

Profile ID:	FM 2854	Profile Date:	6/16/2011 9:37:57 AM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	sta157 test strip	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

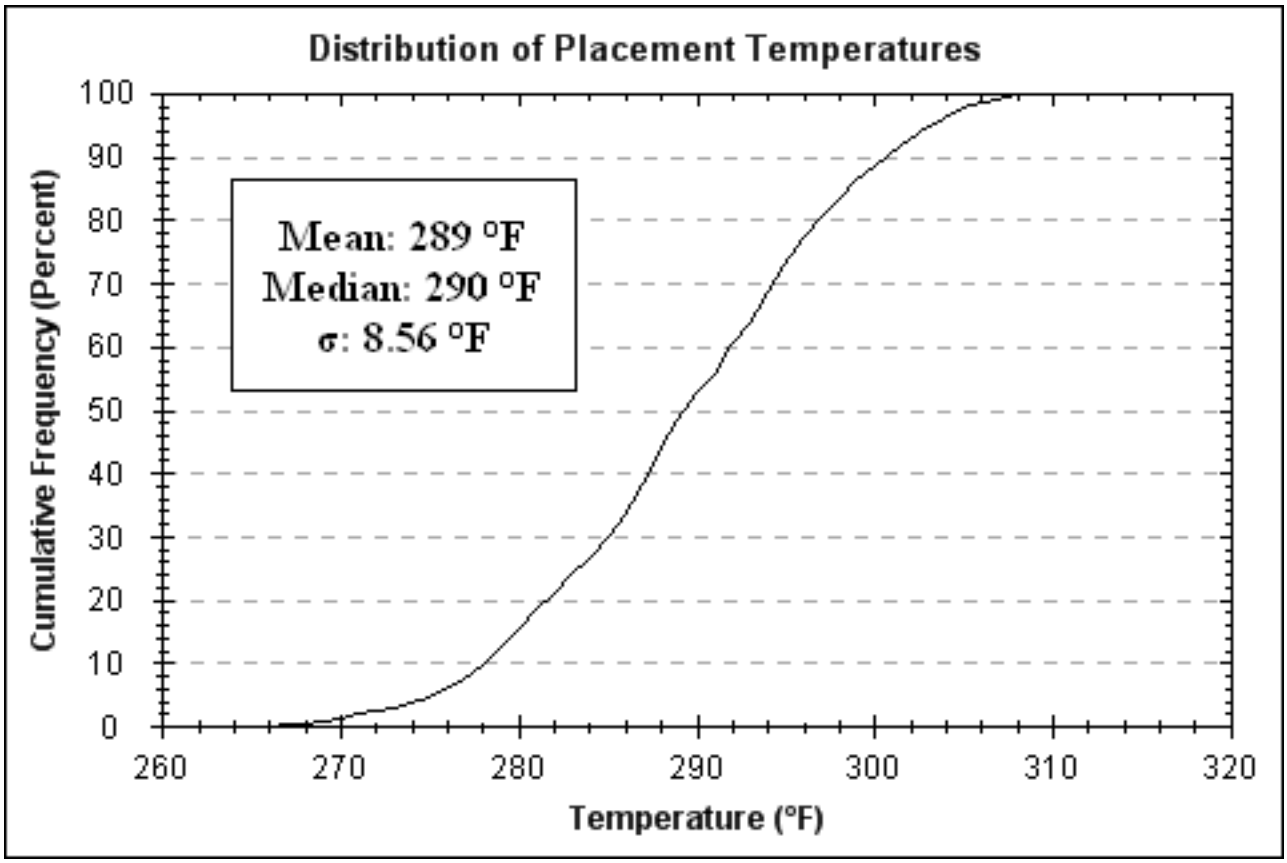
Course/Lift:	1	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	1, 2, 11, 12

Thermal Profile Results Summary

Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
11	Number	Percent	Number	Percent
	10	91	0	0

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	157.00	95.56224 W, 30.31863 N	155.50	95.56253 W, 30.31865 N	309.2	283.3	25.9
2	155.50	95.56253 W, 30.31865 N	154.00	95.56284 W, 30.31865 N	306.3	279.1	27.2
3	154.00	95.56284 W, 30.31865 N	152.50	95.56315 W, 30.31871 N	302.0	268.3	33.7
4	152.50	95.56315 W, 30.31871 N	151.00	95.56346 W, 30.31873 N	301.1	267.8	33.3
6	149.49	95.56377 W, 30.31877 N	148.00	95.56406 W, 30.31878 N	300.0	266.0	34.0
7	147.99	95.56406 W, 30.31878 N	146.50	95.56437 W, 30.31882 N	294.8	268.3	26.5
8	146.49	95.56437 W, 30.31882 N	145.00	95.56468 W, 30.31883 N	305.6	272.3	33.3
9	144.99	95.56468 W, 30.31883 N	143.50	95.56499 W, 30.31886 N	306.1	275.4	30.8
10	143.49	95.56499 W, 30.31886 N	142.00	95.56532 W, 30.31890 N	306.7	271.4	35.3
11	141.99	95.56532 W, 30.31890 N	141.51	95.5654 W, 30.31890 N	302.9	274.8	28.1

Summary of Locations Without Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
5	150.99	95.56346 W, 30.31873 N	149.50	95.56377 W, 30.31878 N	297.1	273.2	23.9


Distribution of Placement Temperatures
Mean: 289 °F
Median: 290 °F
σ: 8.56 °F
Cumulative Frequency (Percent)
100
90
80
70
60
50
40
30
20
10
0
260
270
280
290
300
310
320
Temperature (°F)

APPENDIX N.
TEX-244-F RESULT FROM TYPE C MIX IN THE WACO DISTRICT

Tex-244-F Part II

Thermal Profile Summary Report

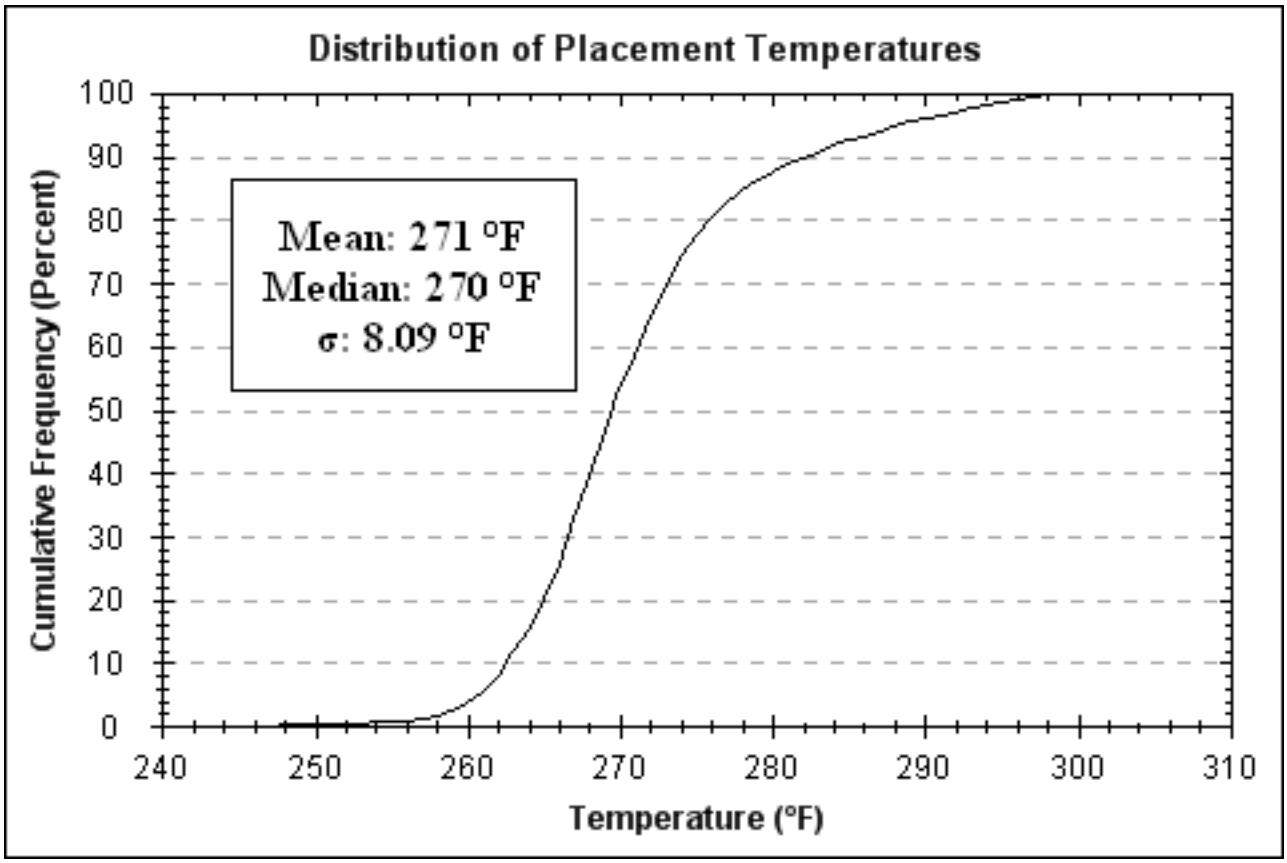
Profile ID:	ramp loop 340	Profile Date:	6/30/2011 4:22:13 AM
Profile Number:		Letting Date:	
Status:		Controlling CSJ:	
County:		Spec Year:	
Tested By:		Spec Item:	
Test Location:	entrance ramp	Special Provision:	
Material Code:		Mix Type:	
Material Name:			
Producer:			
Area Engeneer:		Project Manager:	

Course/Lift:	2	Temperature Differential Threshold:	25.0
Segment Length (ft):	150	Sensors Ignored:	-

Thermal Profile Results Summary				
Number of Profiles	Moderate 25.0°F < differential <= 50.0°F		Severe differential > 50.0°F	
5	Number	Percent	Number	Percent
	1	20	1	20

Summary of Locations with Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
1	0.00	97.09066 W, 31.60026 N	1.50	97.09102 W, 31.60047 N	299.8	246.7	53.1
2	1.50	97.09102 W, 31.60047 N	3.00	97.09142 W, 31.60067 N	284.7	258.4	26.3

Summary of Locations Without Thermal Segregation							
Profile Nr	Beginning Location		Ending Location		Max Temp	Min Temp	Temperature Differential
	Station	GPS in °	Station	GPS in °			
3	3.00	97.09142 W, 31.60067 N	4.50	97.0919 W, 31.60090 N	278.2	258.6	19.6
4	4.50	97.0919 W, 31.60090 N	6.00	97.09235 W, 31.60111 N	278.6	260.1	18.5
5	6.00	97.09235 W, 31.60111 N	6.80	97.09256 W, 31.60120 N	275.0	257.2	17.8



Location of Paver Stops greater than One Minute	
Location (stations)	Duration (h:min:sec)
1.40	0:3:47
1.40	0:2:35
4.09	0:1:18
5.59	0:1:5