Technical	Report	Documentation	Page

1. keprit No. 1. keprit Ne. 1. kep				Technical R	leport Documentation Page
IMPLEMENTING GPS INTO PAVE-IR October 2008 Published: March 2009 2. Author() 8. Performing Organization Route No. Stephen Sebesta, Wenting Liu, and Tom Scullion 8. Performing Organization Route No. Report 5-4577-03-1 3. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System 10. Work Unit No. (TRAIS) 12. Spensoring Agency Name and Address Texas Department of Transportation Research and Technology Implementation Office P. O. Dox 5080 13. Type of Report and Period Covered Technical Report: June 2007-September 2008 14. Spensoring Agency Name and Address Texas Department of Transportation Research and Technology Implementation Office P. O. Dox 5080 13. Type of Report and Period Covered Technical Report: June 2007-September 2008 14. Spensoring Agency Name Austin, Texas 78763-5080 14. Spensoring Agency Code 15. Supplementary Name Project Title: Pilol Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tit.tamu.edu/documents/5-4577-03-1.pdf 16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS Capability enhances operation by allowing easier identification of the limits of the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely ident	-	2. Government Accessio	n No.	3. Recipient's Catalog N	0.
1. Authot(s) 8. Performing Organization Report No. Stephen Sebesta, Wenting Liu, and Tom Scullion 8. Performing Organization Report No. Verforming Organization Name and Address 10. Work (link No. (IRANS) Texas Transportation Institute 11. Contract or Grean No. College Station, Texas 77843-3135 Project 5.4577-03-1 12. Sponsoring Agency Name and Address 13. Type of Report and Period Covered Technical Report: Texas Department of Transportation Office June 2007-September 2008 P. O. Box 5080 14. Sponsoring Agency Code Austin, Texas 78763-5080 14. Sponsoring Agency Code 15. Supplementary Naes Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tit.ianu.edu/documents/5-4577-03-1.pdf 16. Abunct To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile. The GPS capability enhances operation by allowing easier identification of the limits of the thermal profile. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile. This GPS capability enhances operation by allowing easier identification of		/E-IR			
1. Authot(s) 8. Performing Organization Report No. Stephen Sebesta, Wenting Liu, and Tom Scullion 8. Performing Organization Report No. Verforming Organization Name and Address 10. Work (link No. (IRANS) Texas Transportation Institute 11. Contract or Grean No. College Station, Texas 77843-3135 Project 5.4577-03-1 12. Sponsoring Agency Name and Address 13. Type of Report and Period Covered Technical Report: Texas Department of Transportation Office June 2007-September 2008 P. O. Box 5080 14. Sponsoring Agency Code Austin, Texas 78763-5080 14. Sponsoring Agency Code 15. Supplementary Naes Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tit.ianu.edu/documents/5-4577-03-1.pdf 16. Abunct To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile. The GPS capability enhances operation by allowing easier identification of the limits of the thermal profile. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile. This GPS capability enhances operation by allowing easier identification of				Published March	h 2009
Stephen Sebesta, Wenting Liu, and Tom Scullion Report 5-4577-03-1 9. Performing Organization Name and Address Texas Transportation Institute 10. Work Unit-No. (IRAB) The Texas A&M University System 11. Contrast or Grant No. College Station, Texas 77843-3135 Project 5-4577-03 12. Spannoting Agency Name and Address 13. Type of Report and Priod Covered Texas Department of Transportation Institute. Research and Technology Implementation Office P.O. Box 5080 14. Spannoting Agency Code 15. Supplementary Notes Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tti.tamu.edu/documents/5-4577-03-1.pdf 16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection in the thermal profile and by more easily and precisely identifying the location of anonalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Woods Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classified min report 20. Steening Classified min report 21. No. of Pages 21. Price					
Stephen Sebesta, Wenting Liu, and Tom Scullion Report 5-4577-03-1 9. Performing Organization Name and Address Texas Transportation Institute 10. Work Unit-No. (IRAB) The Texas A&M University System 11. Contrast or Grant No. College Station, Texas 77843-3135 Project 5-4577-03 12. Spannoting Agency Name and Address 13. Type of Report and Priod Covered Texas Department of Transportation Institute. Research and Technology Implementation Office P.O. Box 5080 14. Spannoting Agency Code 15. Supplementary Notes Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tti.tamu.edu/documents/5-4577-03-1.pdf 16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection in the thermal profile and by more easily and precisely identifying the location of anonalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Woods Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classified min report 20. Steening Classified min report 21. No. of Pages 21. Price	7 Arrel			9 Deufermine One miert	in Denert Ne
Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-313 5 In: Commat or Grant No. Project 5-4577-03 12. Symuoting Agency Name and Address Texas Department of Transportation Research and Technology Implementation Office P. O. Box 5080 Austin, Texas 78763-5080 13. Type of Report and Period Covered Technical Report: June 2007-September 2008 15. Supplementary Notes Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project Title: PiloI Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tit.tamu.edu/documents/5-4577-03-1.pdf 16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profile. Sins GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Woods 18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Clasif(of this report) 20. Security Clasif(of this page) 21. No. of Pages 22. Price	Stephen Sebesta, Wenting Liu, and	Tom Scullion			-
College Station, Texas 77843-3135 Project 5-4577-03 12. Separating Agency Name and Address Texas Department of Transportation Research and Technology Implementation Office P. O. Box 5080 Austin, Texas 78763-5080 13. Type Report and Period Covered Technical Report: June 2007-September 2008 15. Supplementary Nets Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project Title: Pilol Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tti.tamu.edu/documents/5-4577-03-1.pdf 16. Abstract 7 for ther enhance the capabilities of the Pave-IR thermal segregation detection system (GPS) data collection into the thermal profile. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Words Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classified 21. No. of Pages 22. Price				10. Work Unit No. (TRA	AIS)
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Implementation Office P. O. Box 5080 Austin, Texas 78763-5080 13. Type of Report and Period Covered Technical Report: June 2007-September 2008 15. Supplementary Notes Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tti.tamu.edu/documents/5-4577-03-1.pdf 16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profile. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. key Words Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classified 20. Security Classified this page/ Unclassified 21. No of Pages 21. No of Pages 22. Pice	The Texas A&M University System	1		11. Contract or Grant No).
Texas Department of Transportation Research and Technology Implementation Office P. O. Box 5080 Austin, Texas 78763-5080 Technical Report: June 2007-September 2008 1 ⁵ . Supplementary Notes Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tti.lamu.edu/documents/5-4577-03-1.pdf 16. Abstract 70 further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profile. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. [7. Key Words Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Closified 20. No of Pages 21. No of Pages 22. Price				Project 5-4577-0	3
Research and Technology Implementation Office P. O. Box 5080 June 2007-September 2008 Austin, Texas 78763-5080 14. Sponsoring Agency Code 15. Supplementary Notes Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://ti.tamu.edu/documents/5-4577-03-1.pdf 16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile. This GPS capability enhances operation by allowing easier identification of the limits of no long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Words Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virgina 22161 http://www.ntis.gov 19. Security Classified 20. Security Classified 21. No. of Pages 16 22. Price					
P. O. Box 5080 14. Sponsoring Agency Code Austin, Texas 78763-5080 14. Sponsoring Agency Code 15. Supplementary Notes Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project performed in cooperation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tit.atmu.edu/documents/5-4577-03-1.pdf 16. Abstract 16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Words 18. Distribution Statement Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement is available to the public through NTIS: National Technical Information Service Springfield, Virgina 22161 http://www.ntis.gov 19. Security Classified 20. Security Classified this page) 21. No. of Pages 22. Price				-	
Austin, Texas 78763-5080 11. Supplementary Notes Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tti.tamu.edu/documents/5-4577-03-1.pdf 16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Words 18. Distribution Statement Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classified 20. Security Classified 21. No. of Pages 22. Price		ntation Office		1	
15. Supplementary Notes Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tit.tamu.edu/documents/5-4577-03-1.pdf 16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Works 18. Distribution Statement Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classified 20. Security Classified 21. No. of Pages 19. Security Classified 21. No. of Pages 22. Price				14. Sponsoring Agency G	Code
Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration. Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities URL: http://tit.tamu.edu/documents/5-4577-03-1.pdf I6. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Words I8. Distribution Statement Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR I8. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.nits.gov 19. Security Classified time sequery 19. Security Classified 20. Security Classified time sequery 21. No. of Pages 10. 22. Price	Austin, Texas 78763-5080				
16. Abstract To further enhance the capabilities of the Pave-IR thermal segregation detection system developed at the Texas Transportation Institute, researchers incorporated global positioning system (GPS) data collection into the thermal profiles. This GPS capability enhances operation by allowing easier identification of the limits of the thermal profile and by more easily and precisely identifying the location of anomalous temperatures for long-term monitoring. Three existing Pave-IR test systems were retrofitted to include GPS capability. 17. Key Words I8. Distribution Statement Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR I8. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classif.(of this report) 20. Security Classif.(of this page) 21. No. of Pages 12. Price	Project performed in cooperation w Administration. Project Title: Pilot Implementation	of Thermal Segrega	-		
17. Key Words 18. Distribution Statement Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR 18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 19. Security Classif.(of this report) 20. Security Classif.(of this page) 19. Security Classif.ed 20. Security Classif.(of this page) 19. Security Classif.ed 20. Security Classif.(of this page) 11. Key Security Classif.(of this report) 20. Security Classif.(of this page) 12. No. of Pages 21. No. of Pages 13. No. of Pages 22. Price	-	1			
Segregation, Hot Mix Asphalt, Infrared Imaging, Quality Control, Pave-IR No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classif.(of this report) 20. Security Classif.(of this page) 21. No. of Pages 16 22. Price	Texas Transportation Institute, reset the thermal profiles. This GPS capa of the thermal profile and by more of for long-term monitoring. Three ex	archers incorporate ability enhances op easily and precisely	d global positionin eration by allowing identifying the loc	g system (GPS) da g easier identification ation of anomalou	ta collection into on of the limits s temperatures
Quality Control, Pave-IR public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classif.(of this report) 20. Security Classif.(of this page) 21. No. of Pages 16 22. Price	-	ared Imaging.			vailable to the
National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classif.(of this report) Unclassified 20. Security Classif.(of this page) Unclassified 21. No. of Pages 16 22. Price		-			
Springfield, Virginia 22161 http://www.ntis.gov 19. Security Classif.(of this report) Unclassified 20. Security Classif.(of this page) 21. No. of Pages 16 22. Price			1 0		vice
http://www.ntis.gov 19. Security Classif.(of this report) 20. Security Classif.(of this page) 21. No. of Pages 22. Price Unclassified 16 22. Price					
19. Security Classif.(of this report)20. Security Classif.(of this page)21. No. of Pages22. PriceUnclassified16					
Unclassified Unclassified 16	19. Security Classif.(of this report)	20. Security Classif (of the	1 0		22. Price
			P. 60)	-	
			Repr	-	ge authorized

IMPLEMENTING GPS INTO PAVE-IR

by

Stephen Sebesta Assistant Research Scientist Texas Transportation Institute

Wenting Liu, P.E. Associate Research Engineer Texas Transportation Institute

and

Tom Scullion, P.E. Senior Research Engineer Texas Transportation Institute

Report 5-4577-03-1 Project 5-4577-03 Project Title: Pilot Implementation of Thermal Segregation Detection Systems with GPS Capabilities

> Performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration

> > October 2008 Published: March 2009

TEXAS TRANSPORTATION INSTITUTE The Texas A&M University System College Station, Texas 77843-3135

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation (TxDOT) or the Federal Highway Administration (FHWA). This report does not constitute a standard, specification, or regulation. The engineer in charge was Tom Scullion, P.E. (Texas #62683).

ACKNOWLEDGMENTS

This project was made possible by the Texas Department of Transportation and the Federal Highway Administration. Special thanks must be extended to Magdy Mikhail, P.E., for serving as the project director, and Craig Clark, P.E., for serving as the program coordinator.

TABLE OF CONTENTS

List of Figures	. viii
Chapter 1. GPS Integration into Pave-IR	1
Summary	1
Objectives of GPS Capability	1
Hardware Selected for GPS	1
Example Data Collected with GPS	2
Chapter 2. Recommendations	5
References	7

LIST OF FIGURES

Figure	2	Page
1.	Trimble DSM232 System	2
2.	Paving CAM on US 90	2
3.	Pave-IR with GPS on Paver at US 90 Project	3
4.	Thermal Profile with GPS	4

CHAPTER 1

GPS INTEGRATION INTO PAVE-IR

SUMMARY

Through TxDOT Projects 0-4126, 0-4577, and 5-4577-01 (*1*, *2*, *3*), Texas Transportation Institute (TTI) researchers developed a paver-mounted thermal imaging system that collects thermal profiles of hot-mix-asphalt (HMA) construction. The system, called Pave-IR, collects a transverse scan of temperatures for every 2 inches of forward travel of the paver. Pave-IR displays the thermal profiles in real time; these profiles can further be reviewed and analyzed with post-processing functions.

To further the development of Pave-IR, TTI undertook the incorporation of global positioning system (GPS) capability into the system. The primary purpose of the GPS is to allow for easier documentation of thermal profile locations.

OBJECTIVES OF GPS CAPABILITY

Prior versions of Pave-IR simply used a distance wheel measurement to locate thermal profile locations. This method of collection required accurately recording a "zero" point at the start of the profile, and then the locations of thermal scans were defined by the distance from the zero point. While this method worked reasonably well, slight discrepancies among distance wheels could occasionally result in sizeable discrepancies in measured distance when paving runs traversed several thousand feet. With the availability of relatively low-cost, accurate GPS systems, TTI researchers desired to incorporate GPS into the collected thermal profiles for the following reasons:

- to more easily identify the limits of the thermal profile, and
- to more easily and precisely identify the location of anomalous temperatures in the thermal profile for long-term monitoring.

HARDWARE SELECTED FOR GPS

To enable accurate real-time GPS signal collection, TTI researchers selected the Trimble[®] DSM232 system, which provides sub-meter accuracy in real time. Figure 1 shows the GPS system. Currently, the Pave-IR system still requires the distance wheel to trigger data acquisition.



Figure 1. Trimble DSM232 System.

EXAMPLE DATA COLLECTED WITH GPS

To collect the thermal profiles with GPS, TTI updated the Pave-IR collection software to include GPS functionality. Each time a scan of temperatures is recorded, the GPS coordinates are also recorded. On September 23, 2008, TTI researchers collected thermal data on a crack-attenuating mix (CAM) paving project in the San Antonio District. The project site was on US 90 just west of Uvalde. A Barber Green[®] BG-260C paver was used to place the mix, which was produced in Uvalde approximately 15 miles away. End-dump trucks transported the mix and off-loaded the CAM directly into the paver hopper as Figure 2 illustrates.



Figure 2. Paving CAM on US 90.

A Pave-IR system retrofitted with GPS collected thermal plots during construction. Figure 3 shows the Pave-IR system with GPS installed on the paver. An antenna mount simply slips into holders on the infrared-bar mounts to secure the GPS antenna in place.



Figure 3. Pave-IR with GPS on Paver at US 90 Project.

Figure 4 illustrates thermal data collected on the project. In post-processing, moving the cursor across the mat will result in the GPS window displaying the coordinates of the location where the cursor is pointing.

ions Tools <u>H</u> elp Old T	Tools						
Check Field Ser Sensors Verifye	d mman	Bad Sensor			► ■ ►		Bar GPS hart Setting
GPSIR\Test\SANT\Tes	141 LC	0 TM 248		10. 290 e1. 987.2		301723 483151	
	- الحور اللية الرياد	- 17	[*] 276.3	الكلة كومه			525
	1.1.1	⁺ 290.0		1.0	[*] 290.0	239.8	245.5
0+0	0+20	0+40	0+60	0+80 0-	+100 0+	120 0-	+140
	and the second					A STREET	
101 - 401	ALC: N. 440			ALC: NO.	a second		100
0+160	0+180	0+200	0+220	0+240	0+260	0+280	0+300
0+160	0+180	0+200	0+220	0+240			0+300
0+160		0+200	234.8			281.1	0+300
1	[≁] 286.6		234.8	5. 3	[≁] 286	281.1 .5	
0+160		0+200 0+360	234.8			281.1	0+300
1	[≁] 286.6		234.8	5. 3	[≁] 286	281.1 .5	
1910	[≁] 286.6		234.8	5. 3	[≁] 286	281.1 .5	
0+320	286.6 0+340	0+360	234.8	5. 3	[≁] 286	281.1 .5	

Figure 4. Thermal Profile with GPS. *Note: GPS coordinates update according to location of cursor.*

CHAPTER 2

RECOMMENDATIONS

With GPS capabilities, Pave-IR now provides an even more powerful dataset for review and evaluation of HMA construction thermal profiles. GPS enables precise location of anomalous locations in the HMA mat so that these locations' long-term performance can be monitored. With GPS capabilities, the Pave-IR thermal profile is in an even better state of development to replace the manual thermal profiling required in Tex-244-F.

Currently, Pave-IR with GPS still requires the use of a distance wheel to trigger data acquisition. Work should be conducted to investigate if the distance wheel could be entirely eliminated.

REFERENCES

- 1. Sebesta, S., and T. Scullion. *Using Infrared Imaging and Ground-Penetrating Radar to Detect Segregation in Hot-Mix Overlays*, Report 0-4126-1, Texas Transportation Institute, May 2002.
- 2. Sebesta, S., F. Wang, T. Scullion, and W. Liu. *New Infrared and Radar Systems for Detecting Segregation in Hot-Mix Asphalt Construction*, Report 0-4577-2, Texas Transportation Institute, February 2005.
- 3. Sebesta, S., T. Scullion, W. Liu, and G. Harrison. *Pilot Implementation of PAVE-IR for Detecting Segregation in Hot-Mix Asphalt Construction*, Implementation Report 5-4577-01-1, Texas Transportation Institute, February 2006.