Bridge Deck Thermography Verification and Policy

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WisDOT recently coordinated a statewide infrared program organized by WisDOT's Bureau of Structures (BOS) for all WisDOT responsible bridges. However, interpreting the procedures between different inspection methods, such as vehicle and fixed-wing aerial IRT inspection, is difficult. The accuracy of infrared thermography inspection can vary based on different infrared equipment, environmental parameters, and data collection procedures. This research project aims to develop infrared-based inspection and analysis protocols to assist with WisDOT's bridge asset management program.
Determining what IRT collection method is best suited depends on the end use of the data and the level of IRT survey that is required. IRT data can be collected with handheld, drone, fixed-wing aerial, or vehicle-mounted cameras. The optimal time of day and weather conditions for collecting the IRT data depends on the bridge's wearing surface.
Routine IRT bridge inspections at set intervals are important for monitoring the bridge lifecycle and providing additional information for rehabilitation decisions. IRT defects compared to rehabilitation results can vary depending on the wearing surface and the number of years the IRT data was collected before the rehabilitation project.</td></tr>
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EXECUTIVE SUMMARY

As a part of the Wisconsin Department of Transportation's (WisDOT) overall bridge asset management program, different non-destructive evaluation techniques have been utilized on bridge decks to determine bridge condition. Since the early 1980s, WisDOT has used Infrared Thermography (IRT) to assess defect quantities and locations on bridge decks. These results aid WisDOT’s bridge asset management program, routine bridge inspections and help determine rehabilitation strategies.

WisDOT recently coordinated a statewide infrared program organized by WisDOT's Bureau of Structures (BOS) for all WisDOT responsible bridges. However, interpreting the procedures between different inspection methods, such as vehicle and aerial IRT inspection, is difficult. The accuracy of infrared thermography inspection can vary based on different infrared equipment, environmental parameters, and data collection procedures. This research project aims to develop infrared-based inspection and analysis protocols to assist with WisDOT’s bridge asset management program.

Determining what IRT collection method is best suited depends on the end use of the data and what type of IRT survey is required. Program level IRT surveys are recommended to be collected with handheld, drone, fixed-wing aerial, or vehicle-mounted IRT cameras. Providing a baseline and monitoring the asset condition is important for the bridge asset management program's future maintenance and rehabilitation planning. Project level IRT surveys require more detailed mapping of the bridge defects and sometimes in-field confirmation sounding. This can be provided with the drone and vehicle-mounted IRT systems. The recommended IRT system minimum specifications vary depending on the data collection method. It is important to have a cooled IRT camera for fixed-wing with an IRT Ground Sample Distance (GSD) of 1.5 inches per pixel or high-speed vehicle data collection with an IRT GSD of 0.25 inches per pixel. Handheld and drone IRT cameras can vary depending on the application but the recommended minimum resolution for handheld cameras is 640x480 pixels and 320x256 pixels and GSD of 1.5 inches per pixel for drone IRT cameras.

The bridge's wearing surface and weather conditions are important factors in determining each bridge's optimal collection time-period. It is recommended to follow the ASTM D4788-03 IRT collection standard for environmental factors except for recommending reducing the wind speed to 15 miles per hour during data collection. The time needed for the sun to emit enough thermal load to heat the defect depends on the wearing surface. The recommended optimal IRT

inspection time for all studied wearing surfaces is 6 to 10 hours after sunrise. Data can be collected outside of this time but should follow the recommended timeframe for each wearing surface.

The Project Oversight Committee considers a defect quantity of 2% of the wearing surface to be significant to start the planning process on bridges. The year when less than 90% of bridges have defect quantities less than 2% of the wearing surface area was the initial guideline to determine the optimal start IRT inspection year. The analysis of IRT data provided by WisDOT determined that the first IRT inspection for a bare concrete deck should occur 18 years from the time it was constructed. When a new overlay is placed, the inspection cycle should reset. PCC and PMA overlays should be inspected 5 years after being placed, while HMA overlays and TPOs should be inspected 2 years after being placed.

The interval of scheduling IRT inspections is important for monitoring bridge deck conditions and preparing for rehabilitation activities. It is recommended that bare decks be inspected at 7-year intervals after the initial IRT inspection. For overlay-wearing surfaces, IRT inspections are completed at 5-year intervals after the initial IRT inspection. If an overlay is scheduled, it is recommended that a project-level IRT inspection is completed prior to the new overlay placement.

IRT inspection accuracy and how long an IRT inspection is valid are important for project-level rehabilitation planning. It was determined that the accuracy of the IRT results depended on when the IRT survey was conducted in relation to when the rehabilitation took place. IRT inspections are recommended to be completed within 2 years of the planned rehabilitation project.

An additional spatial comparison was made between IRT defect locations and deck rehabilitation locations within select overlay projects. The IRT defect plan view was overlayed and compared with the type 1 deck preparation plan view for each bridge. The average percent of deck correlation was 86.5% for this study. Variations in the IRT defect accuracies between the different wearing surfaces were seen in this project. A limited number of project-specific rehabilitation plan views were available for analysis; therefore, it is recommended that more project comparison data is collected and analyzed.

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List of Abbreviations

AC = Asphalt Concrete
ASTM = American Society for Testing Materials
DOT = Department of Transportation
FAA = Federal Aviation Administration
FHWA = Federal Highway Administration
FPS = Frames Per Second
GPR = Ground Penetrating Radar
GSD = Ground Sample Distance
HMA = Hot Mix Asphalt
HR = Hour
HSI = Highway Structures Information
IRT = Infrared Thermography
MPH = Miles Per Hour
NDE = Non-Destructive Evaluation
PCC = Portland Cement Concrete
PMA = Polymer Modified Asphalt
PPC = Polyester Polymer Concrete
RGB = Red, Green, Blue
TPO = Thin Polymer Overlay
UAV = Unmanned Aerial Vehicle
WHRP = Wisconsin Highway Research Program
WisDOT = Wisconsin Department of Transportation
WS = Wearing Surface

1. Introduction

1.1 Background and Problem Statement

The Wisconsin Department of Transportation (WisDOT) has been using infrared thermography (IRT) as a non-destructive evaluation tool in its bridge asset management program for over 40 years. Recently, WisDOT has implemented IRT usage across the entire statewide bridge asset management program.

The IRT results have been valuable for WisDOT, but there have been challenges in interpreting the IRT reports to aid in maintenance or rehabilitation decisions. The limited IRT collection and analysis protocols have led to inconsistency across different wearing surface types and collection methods.

This research project aims to develop infrared-based inspection and analysis protocols to assist WisDOT's asset management program. A statewide infrared inspection program can provide information to be used during routine bridge inspections and aid in decision-making for future maintenance or rehabilitation decisions. Ultimately, having a uniform IRT policy can result in reduced cost and effort in managing the statewide bridge assets.

1.2 Objectives

The goal of this research project is to develop research-driven recommendations for the development of:

- Specifications related to the equipment type, sensor platform, and environmental parameters for IRT data collection.
- Statewide policies on the bridge deck life-cycle condition to begin and stop using IRT, along with optimal IRT data collection practices and frequencies.
- Guidelines on the IRT's accuracy compared to the actual condition found in bridges during overlay construction projects.
- Statewide policy on data collection within the WisDOT Structure Inspection Manual.

1.3 Scope

The scope of the research project was outlined by the Wisconsin Highway Research Program Structures Technical Oversight Committee and WisDOT to have five different Tasks as summarized below:

- IRT literature review
- DOT/Vendor IRT usage review
- Review WisDOT IRT Policy – Compare existing IRT results to actual rehabilitation quantities
- Field testing equipment, conditions, and analysis
- Provide IRT recommendations for inspection and implementation protocols

Twelve bridge decks were selected to help determine the recommended IRT policies. The selected bridges were comprised of different wearing surfaces, such as bare deck, Portland cement concrete overlay, polymer modified asphalt overlay, hot mixed asphalt overlay, and thin polymer overlay.

1.4 Outline of Report

The report breaks down into the following sections regarding infrared thermography:

- Inspection Methods
- Data Collection Systems
- Data Reports
- Collection Parameters
- Bridge Deck Collection Lifecycle
- Rehabilitation
- Recommendations

The *Infrared Thermography Inspection Methods* section details the different IRT inspection methods and recommended uses. The *Infrared Thermography Data Collections Systems* section lists the equipment specifications that were used during the research project and provides recommended system requirements for the different IRT inspection methods. The *Infrared Thermography Data Reports* section details the different types of reports IRT can provide and the different uses. Section *Infrared Thermography Collection Parameters* covers the environmental conditions and the time-of-day recommendations IRT should be collected. The *Infrared Thermography Bridge Deck Collection Lifecycle* details when the first IRT inspection should be collected for different wearing surfaces. The *Infrared Thermography Rehabilitation* section compares the IRT defect quantities to actual rehabilitation quantities and how long the IRT results are valid before another IRT inspection occurs. Lastly, the *Infrared Thermography Recommendations* section summarizes this research project's findings.

2. Inspection Methods

2.1 Overview

The traditional bridge deck inspection methods included hammer sounding, chain dragging and visual inspection. These methods can be labor-intensive and often require lane closures. Since the 1980s, Infrared Thermography has been studied as a Non-Destructive Evaluation (NDE) and used to aid in evaluating bridge deck defects. It has proven to be a valuable tool for reducing time in the inspection process, creating less traffic disruption and in turn, a safer inspection environment. IRT can image the temperature differential that exists between delaminated and solid concrete under certain environmental conditions. Additionally, it provides a visual image of delaminations that can be used for confirmation and provides suitable location accuracy (Maser, 2008). Even though IRT has proven to be a useful tool in delamination detection, many studies have shown varying levels of accuracy when using this NDE method. This is most likely because there are many factors that need to be considered to obtain a successful IRT survey. These factors can be both environmental (time of year or day, cloud cover, ambient temperature, etc.) and physical (age of deck, type of wearing surface, etc.). Often, past research projects only focus on one or two factors at a time.

The twelve bridges selected for this research project are listed in Table 1. The bridges varied in age and wearing surfaces. They were in the Southeast Region of Wisconsin to allow the researchers better access and more data collection opportunities.

Table 1 - WHRP Selected Bridges

Bridge ID	Feature On	Feature Under	Wearing Surface Type	Year Wearing Surface Placed
B400519	W GRANGE AVE	ROOT RIVER	Bare	1979
B660030	CTH Q COUNTY LINE RD	IH 41-USH 45	Bare	1996
B660053	MILEVIEW RD	USH 45	Bare	1984
B660037	USH 45 SB	IH 41	HMA Overlay	1997
B300048	STH 50 EB-STH 83 SB	SOO LINE	PMA Overlay	2006
B300058	STH 50 WB-STH 83 NB	SOO LINE RR	PMA Overlay	2006
B660031	MAPLE RD	IH 41-USH 45	Concrete Overlay	1996
B670122	CENTER DRIVE	IH 43	Concrete Overlay	2001
B670152	STH 59 EB	FOX RIVER	Concrete Overlay	2004
B300073	STH 165 WB	C & N.W. RR	TPO	2017
B300074	STH 165 EB	C & N.W. RR	TPO	2017
B400330	H DAVIDSON ACCESS RD	STH 190	TPO	2004

The four selected IRT bridge deck collection methods were handheld, drone or unmanned aerial vehicles (UAV), fixed-wing aerial, and vehicle-mounted. Each method was used to collect IRT images across the deck, and specific delamination locations were chosen to compare each method's Ground Sample Distance (GSD). Then, each method was assessed to determine its pros and cons. Table 2 shows the IRT inspection methods used during the research project on each selected bridge. B660030 was only collected with fixed-wing aerial as the rehabilitation project was completed before additional deck collection methods could be scheduled.

Table 2 - WHRP Selected Bridges Inspection Method

Bridge ID	Handheld	Drone	Fixed Wing Aerial	Vehicle
B400519	Y	Y		Y
B660030			Y	
B660053	Y		Y	Y
B660037			Y	Y
B300048	Y	Y	Y	Y
B300058	Y	Y	Y	Y
B660031			Y	
B670122	Y	Y	Y	Y
B670152	Y	Y	Y	Y
B300073	Y	Y	Y	Y
B300074	Y	Y	Y	Y
B400330	Y		Y	Y

Table 3 shows the weather conditions for each day the different IRT method data was collected. All the aerial IRT data was collected on September 28, 2022, except B660053 which was collected on September 29, 2022. The drone IRT data was collected on October 17-18, 2023. The handheld IRT data was collected on December 14-15, 2023. The vehicle data collection is discussed in more detail in a later section.

Table 3 - IRT Bridge Collection Conditions

Date	Method of Scanning	Min Temp	Max Temp	Average Wind Speed
9/28/2022	Aerial IRT	44°F	57°F	10 mph
9/29/2022	Aerial IRT	42°F	60°F	10 mph
10/17/2023	Drone IRT	39°F	61°F	9 mph
10/18/2023	Drone IRT	45°F	68°F	10 mph
12/14/2023	Handheld IRT	33°F	53°F	10 mph
12/15/2023	Handheld IRT	37°F	54°F	9 mph

2.2 DOT Use of Infrared Thermography

In a Federal Highway Administration (FHWA) article, California, Colorado, Indiana, Iowa, Louisiana, Nebraska, New Mexico, Oregon, Pennsylvania, and Virginia were listed for evaluating or using IRT bridge inspections in varying capacities (Azari, 2023). WisDOT has used IRT for bridge deck inspections since 1981. A firm acquired by AECOM was the first firm in 1981 to complete an IRT inspection for WisDOT. Since 1980, AECOM has performed IRT inspections throughout the United States and worldwide for different DOTs and private companies. In a separate technical report, an evaluation of IRT field techniques was done with several state DOTs to determine if specific IRT bridge deck training is viable for employees. The IRT bridge deck training proved successful in training users to identify delamination using IRT (Washer, 2013). Past and current research projects can help guide WisDOT and other DOTs toward statewide IRT policies and programs.

As part of this project, the research team contacted other Departments of Transportation to inquire about their experiences with IRT technologies and whether they have any current IRT practices in place. The Michigan Department of Transportation (MDOT) responded, and the following paragraph is their response.

MDOT owns a FLIR handheld IRT camera that inspectors can use during routine bridge inspections. They are also aware of different IRT inspection methods and have been involved in past research projects related to IRT on bridge decks. They also use other NDE methods like Ground-Penetrating Radar (GPR) on bridge decks, but their conventional method of evaluating bridge decks is chain drag or sounding. Currently, MDOT does not implement guidelines for IRT bridge inspections.

IRT usage within an annual bridge asset management program is limited for many DOTs across the United States. Many DOTs have limited experience using IRT on bridges, but they have no standard IRT inspection policy in place.

2.3 Vendor Use of Infrared Thermography

There are many different vendors of infrared cameras (such as Teledyne FLIR, Fluke, and InfraTec Infrared) that can be used during an IRT inspection. Infrared cameras are not designed solely for bridge inspections but are a useful tool for detecting the thermal difference between the delaminated concrete temperature and the surrounding solid concrete. When determining what infrared camera should be used, other factors, such as what the bridge deck wearing surface consists of and what IRT results will be used for, need to be considered. This project used IRT cameras manufactured by Teledyne FLIR and InfraTec.

2.4 Handheld Data Collection

Handheld collection requires the least amount of IRT equipment training for operation but often requires traffic control to access the entire bridge deck. Handheld cameras can be helpful during routine bridge inspections or for planning level IRT topside inspections. The angle of view from the handheld cameras is lower to the deck's surface when compared to other IRT inspection methods. This low angle can distort the defects if viewing a larger area of a bridge deck, causing improper scaling of defects. When collecting IRT data with a handheld camera, it is important to view a smaller section of the bridge to reduce the defect distortion. Handheld cameras can be a good tool allowing the IRT field inspector to pinpoint the delamination location for confirmation sounding.

2.5 Drone Data Collection

Drone/UAVs can be used for bridge deck IRT collection and for hard-to-reach areas. Drone operators are required to be certified by the Federal Aviation Administration (FAA) part 107 requirement and follow careful consideration of airspace regulations. Currently, drones cannot fly directly over traffic without lane closures. Setup and limited flight times also need to be considered (Omar & Nehdi, 2019). When comparing drone IRT inspections to other IRT methods, the setup time for the inspection is longer, as you must identify a safe take-off and landing zone and verify there are no overhead obstructions.

A wide range of drones with varying capacities are available for IRT inspection. When selecting a drone, it is important to determine the carrying capacity and how the infrared camera mounts to the drone. Some infrared cameras are mounted on the drone's underside, allowing for a full view of the top side of the bridge deck. If scanning the underside of a bridge deck, finding a drone with a top-mounted infrared camera may be important. Flight times are usually less than 30 to 40 minutes, so preplanning the drone's flight path is important. The ability to adjust the temperature range within the thermal image is not always an option for drone-mounted IRT cameras (Ahearn, Seston, Zhou, & Brockman, 2023).

2.6 Fixed-wing Aerial Data Collection

Fixed-wing aerial collection allows for the highest data collection quantities in a single day. Often a single pass can cover the entire bridge deck. Aerial data collection requires a high-resolution cooled camera for the best data but still may have the lowest resolution of all methods because of the altitude of the flight path. The lower resolution of the IRT and RGB imagery can cause the misidentification or non-imaging of smaller defects. The advantage of fixed-wing aerial IRT is the number of IRT bridge inspections that can be collected in one day. There is also no disruption of traffic during the IRT inspection process. A drawback of fixed-wing aerial IRT is that the operator cannot confirm the presence of delamination through traditional sounding during the IRT inspection.

2.7 Vehicle-mounted Data Collection

Vehicle-mounted data collection allows the operator to drive over a bridge deck at posted speed limits with minimum traffic disruption. This method can achieve the best resolution when using a high-speed cooled IRT camera. The higher resolution images can aid during the data analysis process in determining if an infrared anomaly is a defect or material distortion on the deck surface. Still, this method may need multiple passes for each lane to cover a deck (Hiasa, Catbas, Matsumoto, & Mitani, 2016). Vehicle-mounted systems allow operators to locate delamination while still in the field for confirmation sounding if needed, which may require traffic control.

2.8 Visual Comparison of Methods

This section compares the general image quality that is possible when collecting IRT with each of the four IRT collection methods. In general, fixed-wing aerial has the highest allowable GSD because of the minimum height allowed for flight, typically 1,000 feet. Drones have the largest range in GSD because they can fly anywhere from 1 foot to as high as 400 feet off the ground, depending on the model. This allows a drone to match aerial and vehicle GSD depending on the flight height and camera resolution. FAA regulations restrict uncontrolled airspace to 400 feet above ground level, which does not require prior authorization (Ahearn, Seston, Zhou, & Brockman, 2023).

Vehicle and handheld methods can have similar GSD depending on the camera resolutions. Although handheld and drone cameras can have similar GSD to fixed-wing aerial and vehicle cameras, the cameras recommended for fixed-wing aerial and vehicle systems typically have better image quality at the same GSD due to their cooled sensors' higher sensitivity and faster integration times. Images collected by all four methods on bridge B670122 can be compared below. The comparisons of the other bridges in the project can be found in Appendix A.

Below are two IRT overview images of B670122, a PCC overlay deck. Figure 1 was captured with an aerial-mounted IRT camera at 1,000 feet above the deck. Figure 2 was captured by a drone at 400 feet above the deck. Given the flight elevation and the difference in camera resolution, the GSD is approximately 1.5 inches per pixel for both images. With the GSD being equal, the aerial image has a higher quality image because of its cooled sensor.

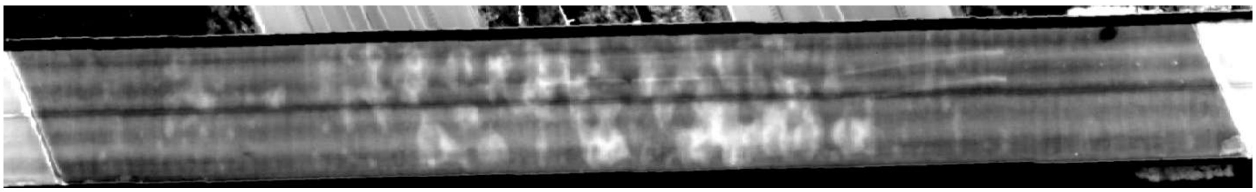

Figure 1 - B670122 - Aerial Full Deck - 1,000 Feet Above Deck

Figure 2 - B670122 - Drone Full Deck - 400 Feet Above Deck

For this project, we also compared a specific delamination area for each bridge to compare how the area looks using each method in more detail. Examples from B670122 can be seen further in this section.

A cooled vehicle-mounted system can provide the smallest GSD and best image quality when compared to the other systems, as seen in Figure 3. The GSD of the vehicle camera tested was approximately 0.25 inches per pixel.

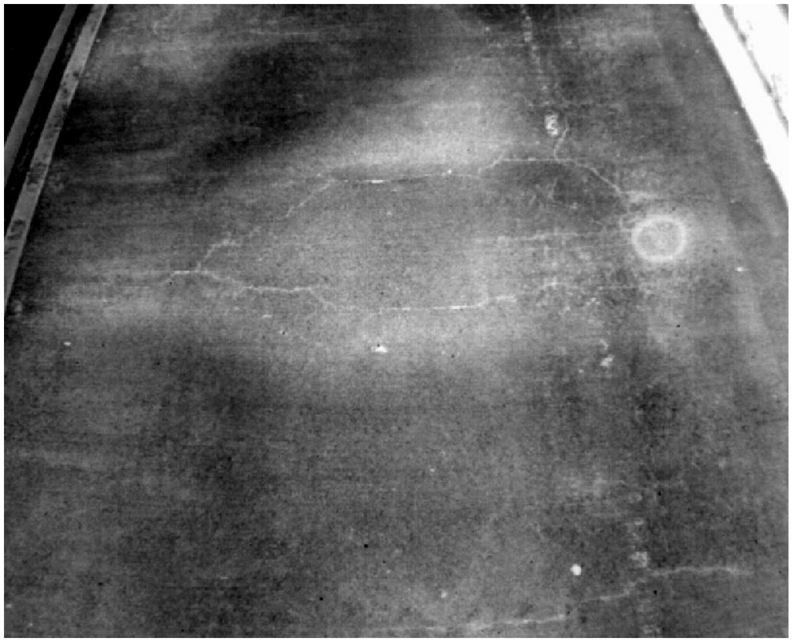

Figure 3 - B670122 - Vehicle Delamination - Defect #2

Though the handheld camera used for this project has the same resolution as the vehicle camera, the image quality in Figure 4 suffers slightly from the sensor differences. The handheld camera is still able to see the same delaminated area, but the clarity and the angle of the image can make analysis more difficult.

Figure 4 - B670122 - Handheld Delamination - Defect #2

The drone image in Figure 5 was collected at 30 feet above the deck and has a GSD of approximately 0.5 inches per pixel. Compared to the vehicle system, there is a clear difference in image quality, but the drone camera can still identify the delaminated area.

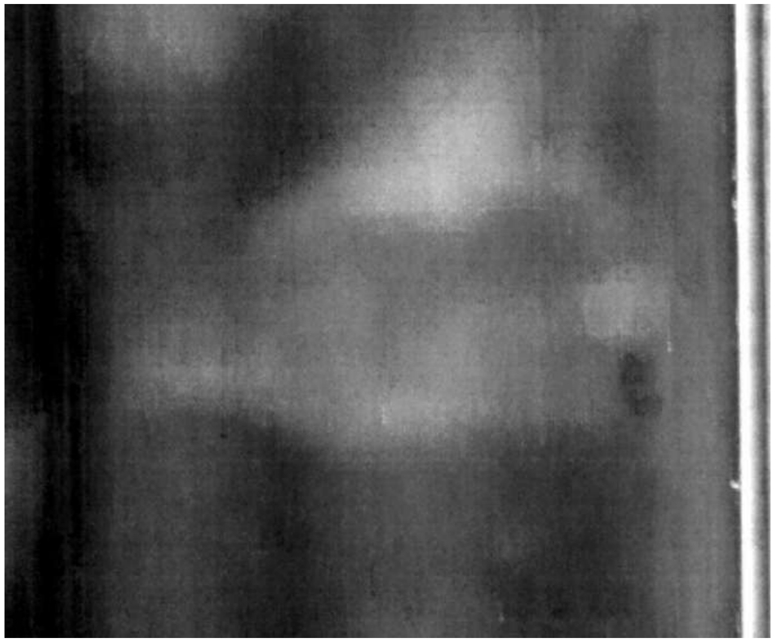

Figure 5 - B670122 - Drone Delamination - Defect #2 - 30 Feet Above Deck

The drone image in Figure 6 was collected at 400 feet above the deck and has a GSD of approximately 1.5 inches per pixel. There is a clear difference in image quality compared to the vehicle system. The drone camera at 400 feet is still able to identify the delaminated area, but the edges of the delamination start to feather and are more challenging to define when analyzing.

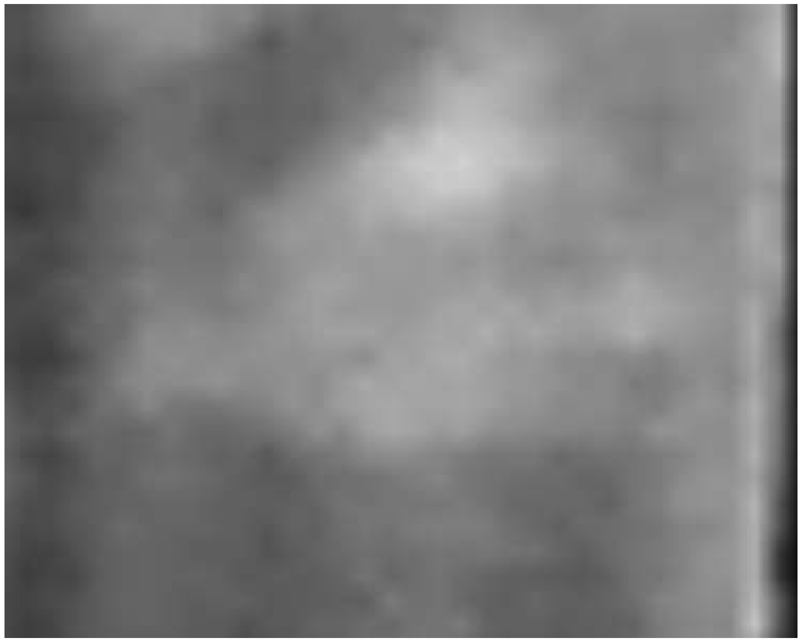

Figure 6 - B670122 - Drone Delamination - Defect #2 - 400 Feet Above Deck

The aerial image in Figure 7 was collected at 1,000 feet above the deck and has a GSD of approximately 1.5 inches per pixel. There is a clear difference in image quality compared to the vehicle system. The aerial camera at 1,000 feet can still identify the delaminated area. Smaller areas of delamination (typically less than 1 square foot) may be missed when using aerial or drone imagery with a GSD of 1.5 inches per pixel, as seen on B660053. Comparison images of smaller delamination can be seen in the B660053 section of Appendix A. Compared to the drone image at 400 feet with the same GSD, the aerial camera has a notably higher image quality due to the cooled sensor.

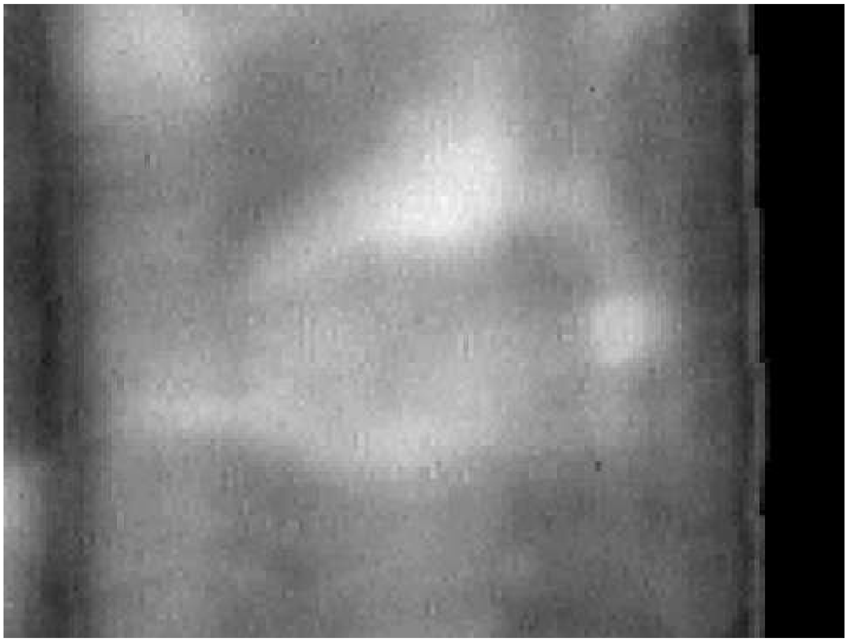

Figure 7 - B670122 - Aerial Delamination - Defect #2 - 1,000 Feet Above Deck

Analysis of the images shows that when IRT is collected under proper conditions, all methods can detect delamination. The primary limitations of each method are the achievable GSD, ease of collection, and the ability to confirm the presence of defects through traditional sounding. In general, the higher the IRT camera resolution, the smaller the GSD. The smaller the IRT GSD and the higher the sensor sensitivity, the more likely the analyst can distinguish delamination from false positives on the surface, such as tinning or oil marks. There are limitations on the achievable GSD depending on the cameras available on the market for each collection method and the distance from the bridge that each method can be collected at.

2.9 Method Recommendations

Each method has pros and cons for data collection and analysis, but all can identify defects on a bridge deck. Choosing the correct method is situational and must be determined based on specific project needs. Handheld cameras are recommended for spot-checking topside IRT data during inspections or areas where a vehicle or drone cannot be utilized. Drone IRT inspections are recommended when there are a limited number of bridges to inspect or if access is restricted by a vehicle or a handheld IRT camera. Fixed-wing aerial IRT systems are recommended when there is a large number of decks requiring IRT. Vehicle-mounted IRT systems are recommended for higher resolution requirements and on bridge decks with higher surface anomalies such as tinning or staining.

3. Systems Requirements

3.1 Overview

Two main types of thermal cameras are used for bridge deck analysis, cooled and uncooled. Cooled cameras are significantly more expensive to purchase and maintain but have much higher integration times, allowing for more image clarity and faster data collection speeds. Uncooled cameras are cheaper, more readily available, and smaller than cooled cameras, but they sacrifice image quality and integration time speeds. When comparing the two types of cameras, it has been determined that an uncooled camera's integration time is insufficient for high/posted-speed data collection, causing blurry images and poor thermal data. Uncooled cameras, which can be mounted to a vehicle or drone or be handheld, should be used for stationary or low-speed data collection, such as handheld or drone applications. Cooled cameras produce higher image resolution at driving speed and should be used for high-speed collection (Hiasa, Catbas, Matsumoto, & Mitani, 2016). Cooled cameras are typically larger and are usually mounted to a vehicle or fixed-wing aircraft. In addition to a thermal camera, a visual camera (RGB) of comparable resolution and speed needs to be used to help aid the analysis process and eliminate false positive defect detection from surface anomalies.

3.2 Handheld Specifications

The FLIR E96 camera was tested for this project. The specification for the camera is listed below:

FLIR E96:

- Resolution: 640x480 pixels
- Frame Rate: 30 FPS
- Accuracy: <40 mK at 30°C (86°F), ±2°C (±3.6°F) or ±2% of the reading
- Detector: Uncooled microbolometer
- Spectral Range: 7.5-14 μm

Handheld IR cameras typically utilize uncooled detectors to cut down on the cost and size of the cameras. This is acceptable for handheld inspections where the camera is not moving at a high rate of speed. Testing showed that the E96 was suitable for handheld survey-level data collection. The E96 can also be used with various lenses to get the optimum coverage and GSD at varying distances from the target (Ahearn, Seston, Zhou, & Brockman, 2023). Outside of this project, cameras such as the FLIR C5 (160x120 resolution) did not prove suitable for IRT on bridges due to low image quality. Other manufacturers, such as FLUKE, have similar camera specifications for handheld cameras. The recommended specifications are typical for handheld cameras with interchangeable lenses that allow for varied GSD. Below are the recommended minimum specifications for a handheld IRT camera.

Minimum Specifications for Handheld IRT Camera:

- Resolution: 640x480 Pixels
- Frame Rate: 30 FPS
- Accuracy: <40 mK at 30°C (86°F), ±2°C (±3.6°F) or ±2% of the reading
- Detector: Uncooled microbolometer
- Spectral Range: 7.5-14 μm

The accuracy, detector type, and spectral range may vary slightly from the recommendation based on different camera models and manufacturers.

3.3 UAV Specifications

Drones are one of the more difficult data collection processes to set a minimum specification. There is no one-size-fits-all for drone specifications (Ahearn, Seston, Zhou, & Brockman, 2023). For this project, a DJI Matrice 210 with Zenmuse XT2 Sensor was tested.

DJI Matrice 210 Drone Specifications:

- Commercial UAV
- Max Take Off Weight: 13.5 pounds
- Max Flight Time: 38 Minutes
- Wind Resistance: 32.8 feet/second
- Obstacle Detection

Zenmuse XT2 IRT Camera Specifications:

- Resolution: 640x512 Pixels
- Frame Rate: 30 FPS
- Accuracy: <50 mK at f/1.0
- Detector: Uncooled microbolometer
- Spectral Range: 7.5-13.5 μm

Drones often have integrated IRT cameras with IRT images that cannot be adjusted in the field. The most common drone IRT camera resolution is 320x256 pixels, which is suitable for inspections. A drone with a 320x256 IR camera can fly at a height of 100 feet above the deck and can achieve 1.5 inches per pixel GSD. Depending on the inspection level, 1.5 inches per pixel GSD is the recommended minimum. The drone can also fly at a lower elevation to achieve higher GSD if desired for other inspection levels. There are many drones on the market with varying specifications such as flight time, max wind speed, carrying capacity, obstacle avoidance, launch capabilities, camera tilt functions, etc. These specifications must be assessed case-by-case. The minimum specifications were based on the in-depth UAV study by the New England Transportation Consortium research project NETC 20-3 (Ahearn, Seston, Zhou, & Brockman, 2023). Below are the recommended minimum requirements for a drone IRT camera.

Minimum Specifications for Drone-mounted IRT Camera:

- Resolution: 320x256 Pixels
- Frame Rate: 30 FPS
- Accuracy: <50 mK
- Detector: Uncooled microbolometer
- Spectral Range: 7.5-13.5 μm
- Ground Sample Distance: 1.5 inches per pixel
- Ability to adjust span and level of IR image in the field.

The accuracy, detector type and spectral range may vary slightly from the recommendation based on different camera models and manufacturers.

3.4 Fixed-wing Aerial Specifications

The fixed-wing aerial IRT camera used for this project was a FLIR x8501SC SLS and the RGB camera was a Phase One PAS RGB camera. The flight path had an elevation of approximately 1,000 feet above the decks, providing a GSD of less than 1.5 inches per pixel. The specifications for the IRT camera used during the aerial data collection are listed below. The RGB camera resolution and GSD were the same as the IRT camera.

FLIR x8501SC SLS Specifications:

- Resolution: 1280x1024 Pixels
- Frame Rate: 10 FPS
- Accuracy: <40 mK, ≤100°C: ±2°C (±1°C typical), >100°C: ±2% of reading (±1% typical)
- Detector: Strained Layer Superlattice, Linear Sterling Cooler

- Integration Time: 270 ns
- Spectral Range: 7.5µm (lower), 11.5-12.5 µm (upper)
- Ground Sample Distance: 1.5 inches per pixel

The recommended minimum specifications are based on providing an IRT GSD of 1.5 inches per pixel, which is currently the standard requirement for WisDOT IRT aerial data collection. Collecting a GSD of 1.5 inches per pixel requires an IRT camera resolution of 1280x1024 pixels and a flying height of 1,000 feet. There are FAA flying restrictions that may not allow flying at 1,000 feet to achieve the 1.5 inches per pixel GSD in all areas of the state. Other projects have been completed with higher flying heights and a reduced GSD, and the results have been successful. Additional research should be completed to investigate the differences in defect detection at higher flight paths and increased GSD.

Minimum Specifications for Aerial IRT Camera:

- Resolution: 1280x1024 Pixels
- Frame Rate: 10 FPS
- Accuracy: <40 mK, ≤100°C: ±2°C (±1°C typical), >100°C: ±2% of reading (±1% typical)
- Detector: Strained Super Lattice, Linear Sterling Cooler
- Integration Time: 270 ns
- Spectral Range: 7.5µm (lower), 11.5-12.5 µm (upper)
- Ground Sample Distance: 1.5 inches per pixel

The accuracy, detector type, and spectral range may vary slightly from the recommendation based on different camera models. The aerial RGB camera specifications should, at minimum, match the IRT camera's resolution, frame rate, and GSD.

3.5 Vehicle-mounted Specifications

For this project, the vehicle-mounted data collection method used an InfraTec Image IR8800 IRT camera and a FLIR Blackfly RGB camera. The RGB camera had a resolution of 1280x720. Vehicle-mounted camera specifications may vary depending on the speed at which the data is collected. Posted speed data collection requires a cooled IRT camera with high integration speeds to avoid blurring of the IRT image. Uncooled cameras may be used without image blurring at lower collection speeds.

InfraTec Image IR8800 Specifications:

- Resolution: 640x512 Pixels
- Frame Rate: 50 FPS
- Accuracy: Better than 0.025 K at 30°C, ± 1 °C or ± 1 %
- Detector: Mercury Cadmium Telluride (MCT), Sterling Cooler
- Integration Time: (10 … 20,000) μs
- Spectral Range: 7.7-10.2 μm
- Ground Sample Distance: 0.25 inch per pixel

The recommended minimum specifications are based on collecting IRT data at posted speed limits. The current WisDOT IRT resolution requirement for vehicle-mounted IRT data collection is 640x480.

Minimum Specifications for Vehicle-mounted IRT Camera:

- Resolution: 640x512 Pixels
- Frame Rate: 30 FPS for up to 15 MPH, 50 FPS for up to 70MPH
- Accuracy: Better than 0.025 K at 30°C, ± 1 °C or ± 1 %
- Detector: Mercury Cadmium Telluride (MCT), Sterling Cooler
- Detector: Cooled if traveling at posted speeds over 15 MPH
- Integration Time: (10 … 20,000) μs
- Spectral Range: 7.7-10.2 μm
- Ground Sample Distance: 0.25 inch per pixel

The accuracy, detector type, integration time, and spectral range may vary slightly from the recommendation based on different camera models.

The recommended vehicle's minimum RGB camera specifications should have a minimum resolution of 1280x720 per current WisDOT data collection standards. The frame rate and GSD should, at a minimum, match the IR camera specifications.

4. Data Reports

4.1 Overview

IRT and other NDE methods can be used to monitor bridge deck conditions and aid in rehabilitation decisions. Depending on the condition of a bridge deck or upcoming projects, different types of IRT surveys and equipment can be utilized. Different IRT surveys may aid in cost savings in an IRT program and provide better results for decision-making. The IRT surveys can be used for either program or project level analysis. Program level analysis is meant to collect a vast amount of data to help monitor the condition of all the bridge assets under your responsibility. The project-level analysis is intended to collect more detailed information on a select number of bridges where additional data is desired for an upcoming project or more detailed investigation. Depending on the desired analysis, different equipment setups are better suited.

4.2 Defect Mapping for Bridge Monitoring

The first type of survey provides a plan view with the defects mapped on a scaled drawing and a table quantifying the total defects. The plan view offers a reference point for inspectors in the field or a visual depiction of where defects are located. This type of survey can be helpful in program analysis and monitoring of how defects change over time and can become an inspection aid during the required bridge inspection process. The data collection methods can include drones, vehicles, and aerial-mounted IRT cameras. Handheld IRT cameras are not recommended for defect mapping surveys as the IRT image scaling can become an issue for mapping purposes. WisDOT classifies this type of report as a Level 0 IRT survey.

4.3 Defect Values/Estimates

The second IRT survey is when the defect values and percentages of bridge deck defects are totaled in a basic report without defect mapping. These types of surveys are good for monitoring large bridge programs where the majority of the bridge decks are in good condition with minimal defects. This type of survey is also helpful for establishing a baseline for a bridge program and monitoring bridge deck conditions. The IRT data can be collected with most IRT systems, such as handheld, drone, aerial, or vehicle-mounted IRT cameras. WisDOT classifies this type of report as a Level 1 IRT survey.

4.4 Defect Mapping for Bridge Rehabilitation Projects

The third type of IRT survey provides a plan view with a table quantifying the total defects identified on a computer-aided design of the bridge deck, usually drafted from an as-built plan. This type of survey is commonly performed for project scoping or already-planned rehabilitation projects. Additional details are sometimes required to validate the IRT results during the IRT survey. This additional detail requires higher data resolution and, where possible, field confirmation during the data collection process. Therefore, it is recommended that a drone or vehicle-based system perform the data collected for this type of survey. WisDOT classifies this type of report as a Level 2 IRT survey.

The last type of IRT survey provides a level 2 IRT survey along with a rehabilitation plan view. The rehabilitation plan view provides estimated repair quantities by drafting proposed rehabilitation areas and quantifying the estimated repair areas. In cases with a high potential for defects and a planned rehabilitation project, additional NDE methods may be added to aid in the rehabilitation determination process. Adding a visual survey to view the current condition of the bridge deck's top and bottom is typical. IRT can also be used on the underside of the deck to identify defects that are not visible during the visual survey. Ground Penetrating Radar (GPR) may be added to determine areas of potential deterioration and depth of cover over the top reinforcement. Concrete cores can be tested for compressive strength or chloride ion concentration of the concrete bridge deck. Together with the IRT results, a comprehensive report on the condition of the bridge deck can be created. WisDOT classifies this type of rehabilitation report as a Level 3 IRT survey.

5. Collection Parameters

5.1 Overview

Environmental and physical factors affect the effectiveness of thermal bridge deck data. Many studies have been conducted but can only focus on one or two parameters at a time. This has led to variations in IRT data collection and accuracy. Changing environmental conditions make it challenging to assign rule-based practices for IRT data (Kee, Oh, Popvics, Arndt, & Zhu, 2012). Different environmental and physical factors are discussed in the following sections.

5.2 Environmental Detection Parameters

One environmental factor that can affect defect detection is wind. The *ASTM Standard D4788-03 – Standard Test Method for Detecting Delaminations in Bridge Decks Using Infrared Thermography* states that IRT data collection should not be conducted with a wind speed above 30 MPH, decreasing to 15 MPH during the winter months (ASTM, 2022). A study on ambient weather conditions found that wind speeds of 15 MPH can reduce thermal load two-fold compared to no wind. Wind has the most significant reduction on thermal load during the cooling cycles compared to the heating phases. This may have a greater effect on nighttime IRT inspections. Also, deeper delaminations have a higher thermal load reduction than shallow delaminations at the same wind speed (Raja, et al., 2020). Based on this previous research, it is recommended that IRT data should not be collected with wind speeds above 15 mph year-round to reduce potential data deterioration.

Ambient air temperature does not have as much of an effect on IRT accuracy during the summer as other factors. During winter, the ASTM Standard D4788-03 lists that IRT data can be collected, but the thermal contrast will be lower. Also, data collection should not be conducted under 32°F as it may cause inaccurate readings because of potential ice in delaminations. Rising ambient air temperature of 20 degrees Fahrenheit is also recommended (ASTM, 2022). It is recommended that IRT data should be collected at temperatures above 32°F.

Water on the deck's surface can also affect the accuracy of IRT data. The ASTM Standard D4788-03 states the bridge deck should be dry for at least 24 hours before inspection (ASTM, 2022). Water can potentially cool delaminations and cause false readings. It is recommended that IRT data be collected only when the bridge deck has been dry for at least 24 hours.

The current ASTM Standard D4788-03 was originally approved in 1988, and subsequent editions were approved, with the most recent edition in 2022. It is recommended that the ASTM Standard D4788-03 be updated with the current IRT collection methods and available technologies.

5.3 Data Collection Times – Past Research

Delamination up to 1 inch in depth can typically be detected at any time during the day, outside of the morning and evening equilibrium times (when delaminated and solid concrete are at the same temperature). Delaminations deeper than 2 inches in depth can be imaged if the correct environmental conditions are met or the delamination is large in size (Hiasa, Catbas, Matsumoto, & Mitani, 2016). Another study showed that the highest thermal contrast occurs around 4 hours after sunrise for 2-inch deep delaminations and 7 hours after sunrise for 3-inch deep delaminations (Omar & Nehdi, 2019). Overlaid decks require more solar load than decks with no overlays and need more time to create a detectable temperature differential (Nehdi & Omar, 2016). Delamination typically occurs at the top of the steel mat, which is typically at a greater depth with overlaid decks. Past IRT studies have shown that the ideal time for collection is affected by the depth and size of delaminations and the type of overlay that is present at the time of the inspection.

IRT data can be collected during the day (heating cycle) or at night (cooling cycle). Studies have found that nighttime data collection has been effective after sunset during the cooling phase of the bridge (Kee, Oh, Popvics, Arndt, & Zhu, 2012) (Hiasa, Catbas, Matsumoto, & Mitani, 2016). During the night, delaminations cool quicker than the surrounding solid concrete. One study tested day and night IRT data collection and found that both are effective depending on the appropriate weather conditions and collection times during the day/night heating and cooling cycles. Also, night collections can sometimes be more effective on shallow and deep delaminations. Nighttime data collection removes solar reflection or glare from the sun on the bridge deck (Kee, Oh, Popvics, Arndt, & Zhu, 2012). However, it should be noted that the nighttime data collection window is smaller and not as well-defined compared to data collected during the day. Depending on ambient temperature conditions, nighttime data collection may not be as effective on all decks. During the day, the ideal collection times are from approximately 3 hours after sunrise for delaminations up to 2 inches deep, increasing to about 6 hours after sunrise for overlaid decks (ASTM, 2022).

5.4 Data Collection Times – Current Research

For this project, a total of 12 decks with different wearing surfaces were inspected using different IRT methods. The decks are listed in Table 1. Vehicle-mounted IRT Data was collected over several sunny days to collect the hourly conditions of the deck. Table 4 lists the bridges that received 12-hour IRT data collection and the weather conditions during the survey. Bridges B660030 and B660031 were already under construction in 2023, so a 12-hour scan could not be performed. The remaining bridges were scanned on 9/14/2023. The low temperature for the day was 53°F with a max temperature of 69°F and an average wind speed of 8 mph.

Table 4 - 12-Hour IRT Bridges

Bridge ID	Wearing Surface	Date
B400519	Bare	9/14/2023
B660030	Bare	NA
B300048	PMA Overlay	9/14/2023
B300058	PMA Overlay	9/14/2023
B660031	Concrete Overlay	NA
B670122	Concrete Overlay	9/14/2023
B670152	Concrete Overlay	9/14/2023
B300073	TPO	9/14/2023
B300074	TPO	9/14/2023

Three bridges, each with a different wearing surface, had a 24-hour time-lapse scan and are listed in Table 5. The 24-hour scan was collected over a 3-day period under similar environmental conditions. Table 6 lists the different dates of collection and the environmental conditions.

Table 5 - 24-Hour IRT Bridges

Bridge ID	Wearing Surface
B660053	Bare
B660037	HMA Overlay
B400330	TPO

Table 6 - 24-Hour IRT Conditions

Date	Time of Scanning	Min Temp	Max Temp	Wind Speed
8/10/2023	8am to 4pm	66°F	84°F	9 mph
8/28/2023	4pm to 12am	59°F	79°F	9 mph
8/31/2023	12am to 8am	57°F	70°F	8 mph

The analysis focuses on the daylight collection window as the main time for data collection, even though night collection is possible. The daytime collection is preferred for the higher thermal differential that can be achieved due to thermal loading from the sun. Three delaminations of low-, medium-, and high-temperature differentials were chosen on each deck and were monitored every few hours throughout each time-lapse. The temperature differential was calculated by subtracting the delaminated average temperature from the average temperature of a nearby solid area and comparing it over time. The data was originally graphed using a third-order polynomial. Then a sinusoidal fit equation and graphs, provided by UW-Madison Technical Support, were used to normalize the trendline at zero and twenty-four hours. The sinusoidal fit equation is as follows: (Temp(t) = A + B sin(2*pi/24 hours * t - phase)), where "t" is the time of day, "A" is the average temperature during the day, "B" is the amplitude of the cyclic temperature, and "phase" aligns the measurements' peaks with the sinusoidal function's peak. A 1°F minimum temperature differential was used to determine the start and stop time for data collection on each wearing surface along the trendline. The AC decks collected for this project had lower temperature differentials for delaminations in the low and medium temperature ranges compared to other wearing surfaces. The resulting trend line did not meet the 1°F threshold even though all delaminations were detectable by IRT, a temperature differential of 0.5°F was used for the calibration of the start and stop times. All other wearing surfaces used a temperature differential of 1°F.

The following sections are the time plots for each wearing surface, including all decks with the same wearing surface. The time-lapse data table and images are provided in Appendix B.

5.4.1 Time Lapse – Bare Decks

This study inspected two bare decks, B660053 and B400519. B660053 was scanned for 24 hours and B400519 was scanned for 12 hours. Both sets of data were used in the 24-hour temperature differential plots seen in Figure 8. Based on the data collected for this project, bare decks had a minimum 1°F temperature differential from 1 to 9 hours after sunrise.

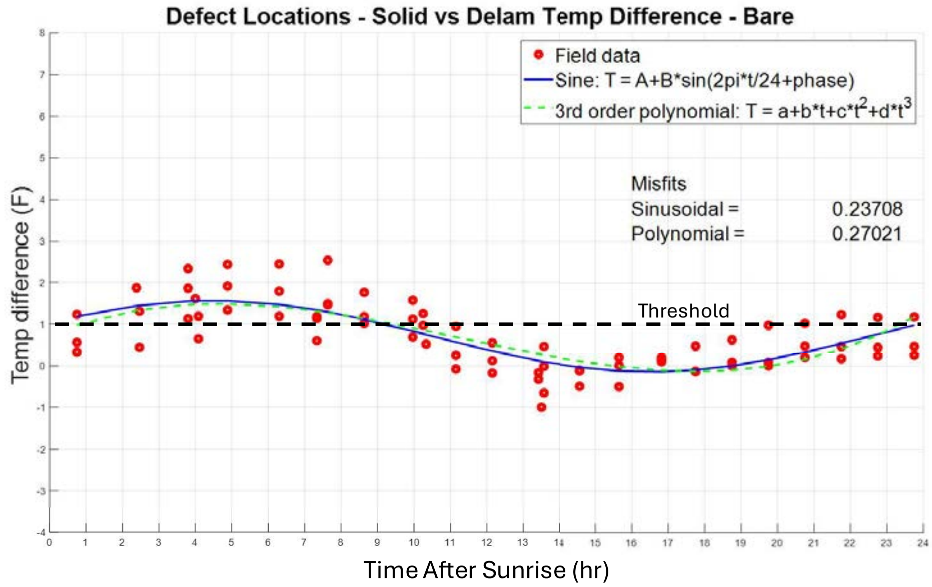

Figure 8 - Time Lapse - Bare Decks

5.4.2 Time Lapse – Concrete Overlay Decks

This study inspected three PCC overlaid decks. B670122 and B670152 were scanned for 12 hours. B400330 was scanned for 24 hours and had a double overlay of TPO over a PCC overlay. The data from B400330 was used for the 24-hour plot as delaminations selected for monitoring would have been beneath the existing concrete overlay and not debonding of the TPO. All three sets of data were used in the 24-hour plots in Figure 9. Based on the data collected for this project, PCC overlaid decks had a minimum 1°F temperature differential from 3.5 to 12.5 hours after sunrise.

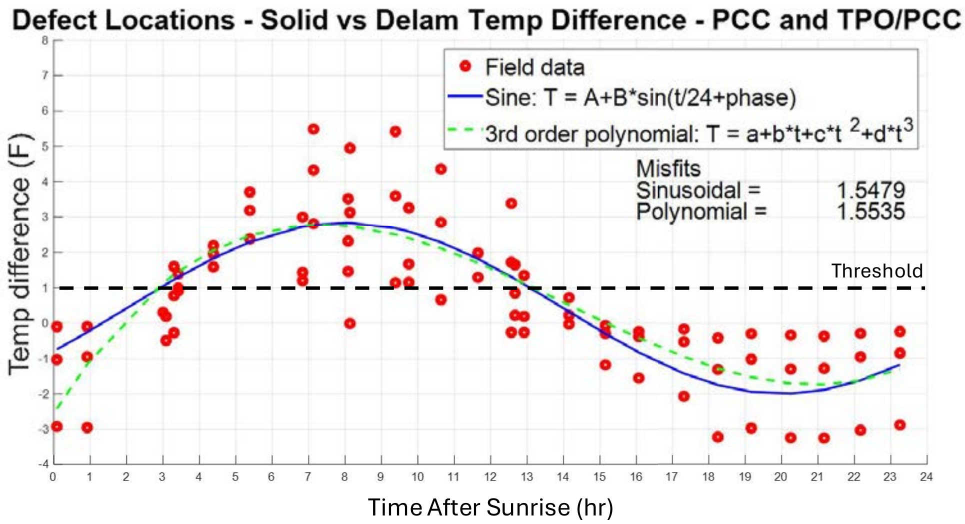

Figure 9 - Time Lapse - Concrete Overlay Decks

5.4.3 Time Lapse – Asphalt Overlay Decks

This study inspected three asphalt-overlaid decks. B660037 was scanned for 24 hours. B300048 and B300058 were scanned for 12 hours. All three sets of data were used in the 24-hour plots in Figure 10. The asphalt overlay decks collected for this project had lower overall temperature differentials than all other wearing surfaces, so a temperature differential of 0.5°F was used for the calibration of the start and stop times. This is potentially due to the different thermal properties of asphalt overlays. Based on the data collected for this project, asphalt overlaid decks had a minimum 0.5°F temperature differential from 3 to 10 hours after sunrise.

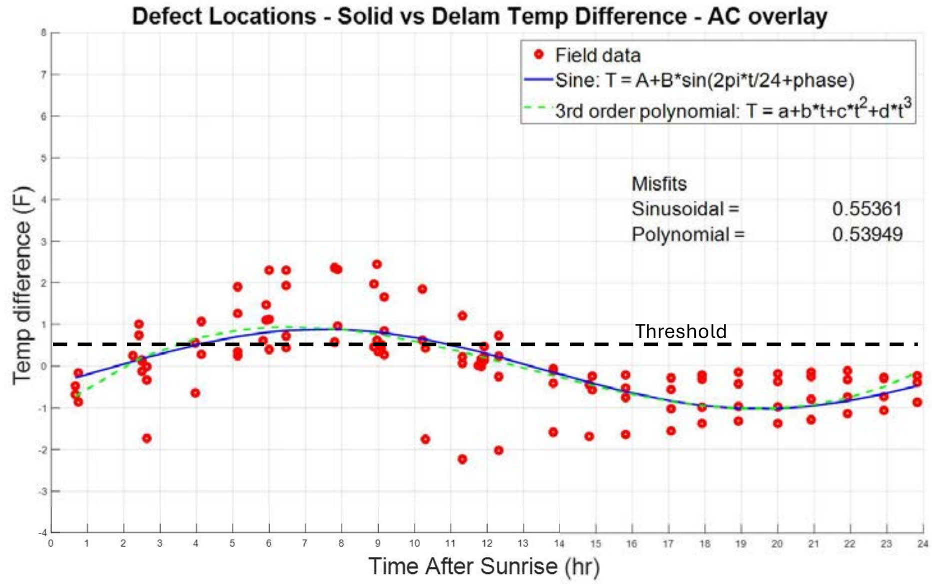

Figure 10 - Time Lapse - Asphalt Overlay Decks

5.4.4 Time Lapse – Thin Polymer Overlay Decks

This study inspected three TPO decks. B300073 and B300074 were scanned for 12 hours. B400330 was scanned for 24 hours and had a PCC overlay present under the TPO. All three data sets were used in the 24-hour plots in Figure 11. Based on the data collected for this project TPO decks had a minimum 1°F temperature differential from 3 to 13 hours after sunrise.

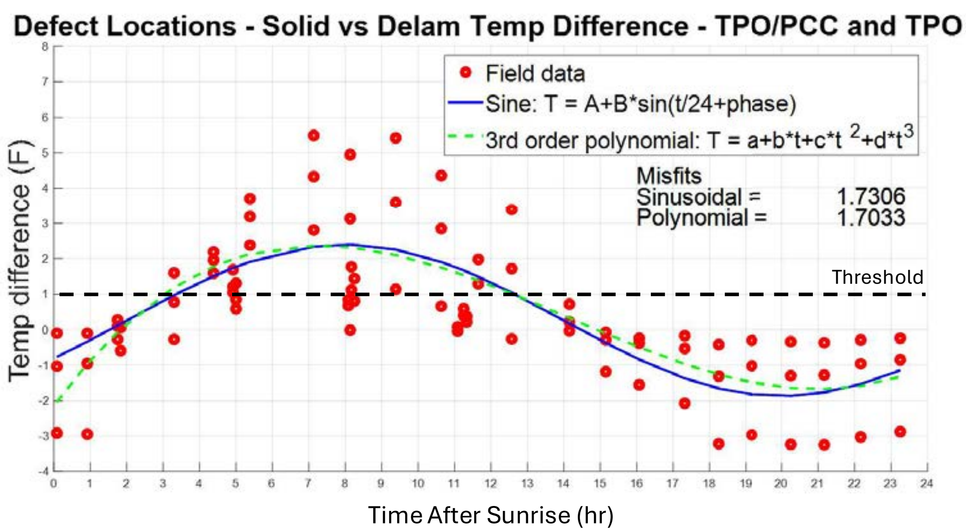

Figure 11 - Time Lapse - TPO Overlay Decks

5.4.5 Data Collection Time Recommendations

Two collection timetables were created. The first, Table 7 lists the hours after sunrise when an IRT inspection should start based on the data collected during this project. The general data collection time is the most restricted time frame for collecting all studied overlay types.

Table 7 - IRT Collection Time Hours After Sunrise Based on Collected Data

Overlay Type	Start	End
General	4 HR	9 HR
Bare	1 HR	9 HR
PCC	3 HR	13 HR
AC	4 HR	11 HR
TPO	2.5 HR	13.5 HR

The collected data start time for the different overlay types was earlier than expected. This is potentially due to using the 24-hour trendline to determine the start time, the depth of the delamination, or the size of the delamination, which could also affect the data. A previous study found that delamination up to 1 inch in depth can typically be detected at any time during the day, outside of the morning and evening equilibrium times (when delaminated and solid concrete are at the same temperature). Delamination deeper than 2 inches in depth can be imaged if the correct environmental conditions are met or if the delamination is large in size (Hiasa, Catbas, Matsumoto, & Mitani, 2016).

Table 8 start times after sunrise are based on the project data and recommendations from the ASTM D4788-03 standard. The selected decks for this research project had high percentages of defects and were visible for extended periods, which is not typical compared to past research and IRT knowledge. It is recommended that all IRT inspections occur during the period listed in Table 8. The general collection time encompasses all the studied overlay types and should be the base collection time. The individual overlay time should be followed if data is collected outside of the general start and end period. When collecting data in the winter months (November to March), start times after sunrise shall be the same to allow decks to reach optimum thermal loading, end times for winter months should be shorter due to the sun setting earlier. Based on experience, stopping data collection a minimum of 1 hour before sunset is recommended. Further research is recommended on data collection times for the winter months.

Table 8 - Recommended IRT Collection Time Hours After Sunrise

Overlay Type	Start	End
General	6 HR	10 HR
Bare	3 HR	10 HR
PCC	6 HR	12 HR
AC	5 HR	11 HR
TPO	4 HR	11 HR

Table 9 shows the sunrise, sunset, and day length times for Portage County, WI, throughout the year as a sunrise reference. Portage County was chosen as it is centrally located in Wisconsin.

Table 9 - Sunrise, Sunset and Daylength Times - Portage County

Date	Sunrise	Sunset	Daylength
1/1/2024	7:34 AM	4:29 PM	8h 55m
2/1/2024	7:15 AM	5:07 PM	9h 51m
3/1/2024	6:32 AM	5:47 PM	11h 15m
4/1/2024	6:35 AM	7:26 PM	12h 50m
5/1/2024	5:46 AM	8:03 PM	14h 17m
6/1/2024	5:15 AM	8:36 PM	15h 21m
7/1/2024	5:17 AM	8:46 PM	15h 28m
8/1/2024	5:46 AM	8:21 PM	14h 35m
9/1/2024	6:22 AM	7:32 PM	13h 10m
10/1/2024	6:57 AM	6:36 PM	11h 39m
11/1/2024	7:37 AM	5:45 PM	10h 8m
12/1/2024	7:15 AM	4:19 PM	9h 3m

Sunrise, sunset and day length data is from https://sunrise.maplogs.com/portage_county_wi_usa.27946.html.

6. Bridge Deck Collection Lifecycle

6.1 Overview

Part of the research project aims to establish the optimal year to start IRT inspections after a new wearing surface is placed. The Project Oversight Committee, based on existing WisDOT policies and practice, considers a defect quantity of 2% of the wearing surface to be significant for planning purposes. Since the early IRT inspections are for planning purposes, it is acceptable to allow some structures to exceed this limit before the first IRT inspection. The defect quantity at the first IRT inspection will not likely require an immediate project to correct the defects. The year when less than 90% of bridges have defect quantities less than 2% of the wearing surface area was the initial guideline to determine the optimal start IRT inspection year. The deck defects include asphalt patching, debonding, delamination, concrete patching, and spalling. The optimum start inspection year and interval of IRT inspections for each wearing cycle were calculated from previous IRT inspection data stored in WisDOT's HSI System.

6.2 Background

Repeated IRT deck inspections need to be looked at over time to help determine the effectiveness of IRT, the interval of inspections, and for how long an inspection is valid. WisDOT has conducted IRT scans for over 30 years. A total of 8,213 WisDOT IRT inspections were used for analysis. They were divided by wearing surface to better calculate each wearing surface lifecycle. The inspections were processed to remove outliers and help understand data interpretation problems. The past IRT data may not conform to the current WisDOT IRT standards, which may cause additional outliers.

6.3 Data Processing Steps.

The IRT inspection data was queried from WisDOT's online HSI System, which stores past bridge maintenance and inspection information. The IRT results were then processed by the following steps:

1. Inspections were divided by the wearing surface at the time of the IRT inspection.
2. Data for each wearing surface was reviewed and found that TPO over a concrete overlay and PPC overlays did not have enough data to analyze lifecycle data.
3. Year zero inspections were removed from all wearing surfaces due to entry timing errors after a replacement.

4. For bare and concrete overlay decks, year-one outliers that were suspected as incorrect inspection entries from a 2009 data import were removed. These entries may have been a previous inspection before the new wearing surface was placed.
5. Older inspections that fell outside the normal wearing surface service life age range were also removed.

The initial review of the data indicated that inspections before 2020 were originally recorded as having 0-5% defects on IRT inspections. When the inspections were entered HSI, an average value for the selected range was entered; in this case, an average of 2.5% was entered for 0-5% defects. This affected the data because the threshold for this research project was 2%. The data was analyzed in two additional ways to normalize it. The first method used a <2.6% threshold to account for inspections that may have been overestimated and still retain most of the inspections. The second method was to analyze only 2020 and later inspections with a threshold less than or equal to 2.0%. Starting in 2020, IRT inspections were entered into HSI as actual defect percentages and not ranges. Table 10 provides a comparison of the count for each wearing surface before and after outliers were removed, along with the count for 2020 and newer inspections.

Table 10 - IRT Inspections per Wearing Surface

WS Type	Count All	W/O Outliers	Post 2020
Bare	4,455	4,361	1,952
PCC	2,101	2,066	748
PMA/HMA	879	847	164
PPC	4	4	4
TPO	760	663	505
TPO/PCC	14	14	14
Total	8,213	7,955	3,387

Best fit trend lines were used to find the optimal year to start inspection for each wearing surface. Appendix C contains the data tables for this section.

6.4 Bare Deck – Defect vs Age Comparison

Box and whisker plots were used to compare the percent range of defects identified during each IRT inspection, grouped by the wearing surface age. The bare deck wearing surface comparison is seen in Figure 12.

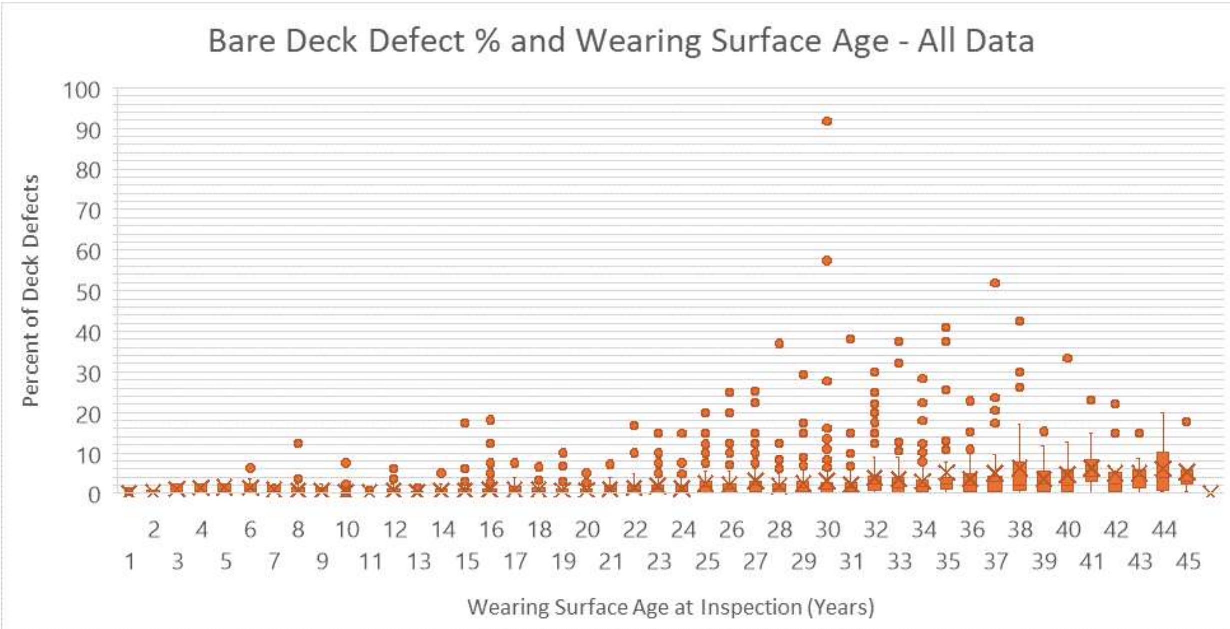

Figure 12 - Bare Deck Defect % and Wearing Surface Age

The total number of bare deck inspections with less than or equal to 2% of deck defects at each wearing surface age was calculated. The percentage of bare decks with a defect threshold of 2% was graphed against the wearing surface age at inspection. To determine the initial IRT inspection year, the year when less than 90% of decks have less than or equal to 2% of deck defects was calculated based on the data trend line. Within the original bare deck data, there were conflicts in how the IRT data was recorded in HSI as a defect range average, which affected the data shown in Figure 13. With 90% of decks as a goal, the IRT inspection start year for bare wearing surfaces, using the calculated trend line, is between years 11 and 12.

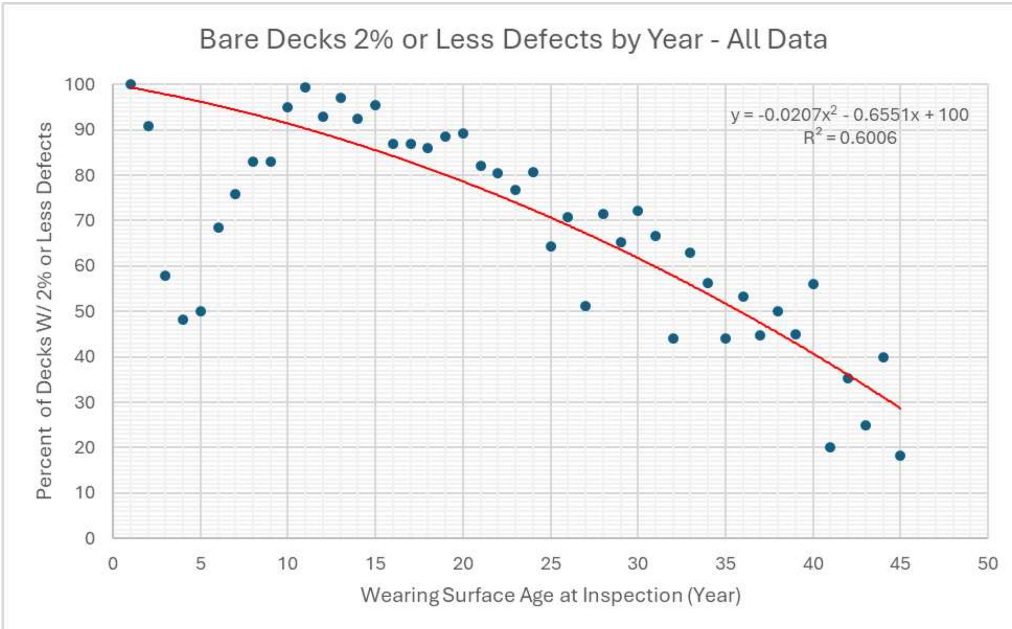

Figure 13 - Bare Decks 2% or Less Defects by Year

6.4.1 Bare Deck – Defect vs Age – 2.6% Defect Threshold

Figure 14 was created by using the calculated percentage of decks with a defect threshold of 2.6% and their respective wearing surface age. This method calculated the 90% majority and the start inspection year for bare decks to be between years 18 and 19.

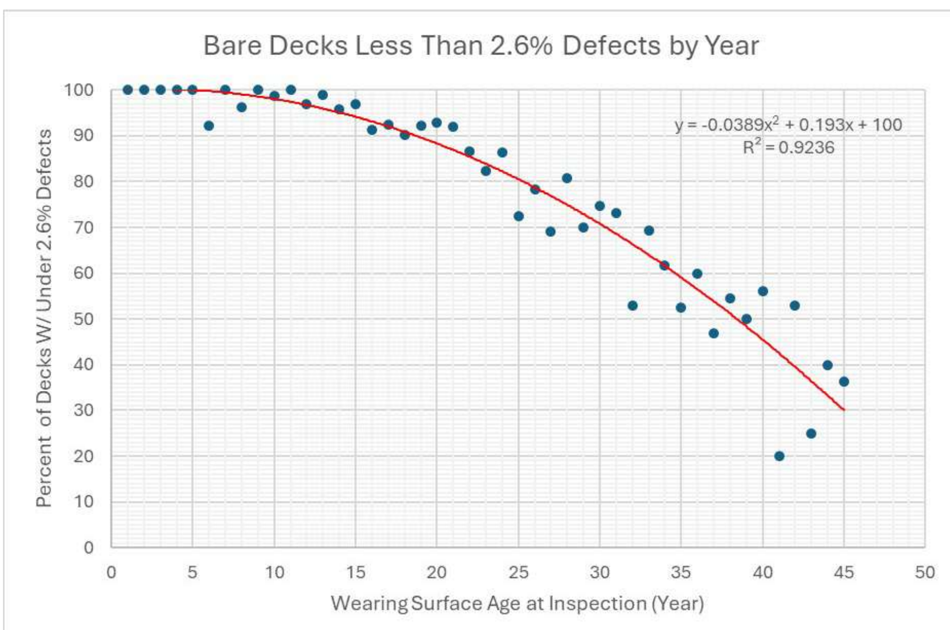

Figure 14 - Bare Decks Less Than 2.6% Defects by Year

6.4.2 Bare Deck – Defect vs Age – Post 2020

Figure 15 was created by using only inspections from 2020 on and a less than or equal to 2% threshold. While the number of available inspections was smaller, they provided higher detail of defect percentages. This method calculated a start inspection year for bare decks between years 18 and 19 of wearing surface age.

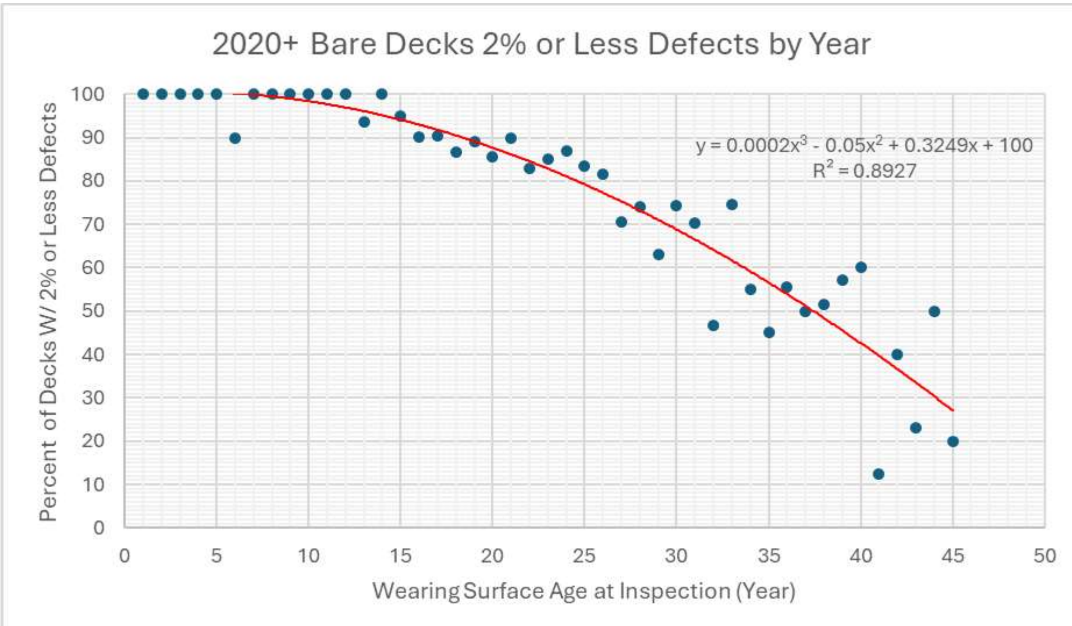

Figure 15 - 2020+ Bare Decks 2% or Less Defects by Year

6.5 Concrete Overlay Deck – Defect vs Age Comparison

Box and whisker plots were used to compare the percent range of defects identified during each IRT inspection, grouped by the wearing surface age. The concrete overlay deck wearing surface comparison is seen in Figure 16. Higher variation was observed in the concrete overlay decks compared to bare decks.

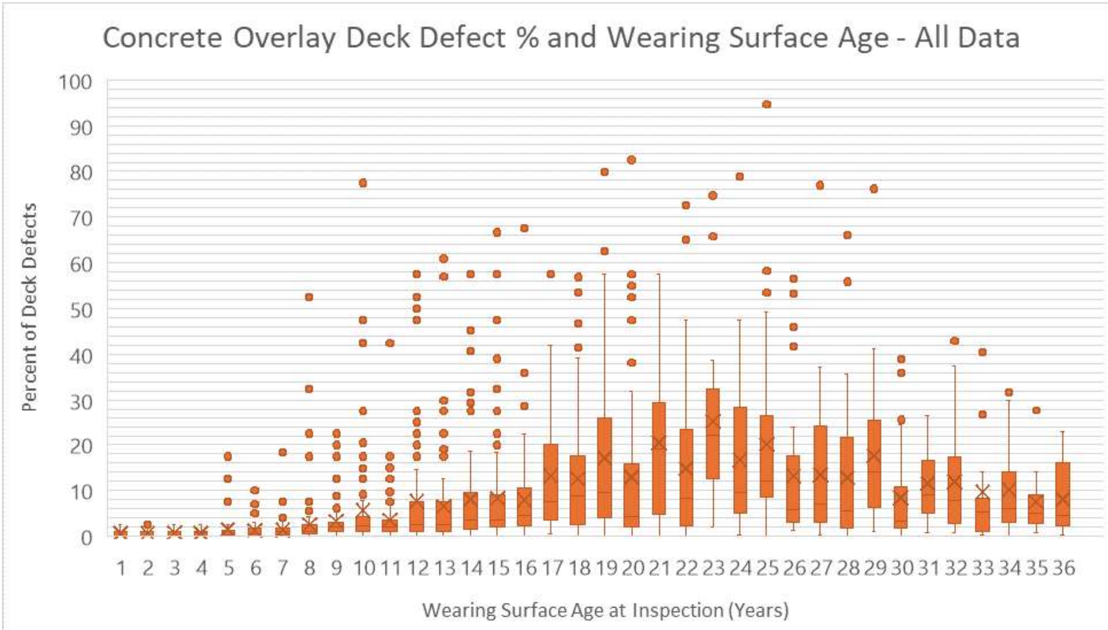

Figure 16 - Concrete Overlay Deck Defect % and Wearing Surface Age

The total number of concrete overlay deck inspections with less than or equal to 2% of deck defects at each wearing surface age was calculated. The percentage of concrete overlay decks with a defect threshold of 2% was graphed against the wearing surface age at inspection. To determine the start of the IRT inspection year, the year when less than 90% of decks have less than or equal to 2% of deck defects was calculated based on the data trend line. Same as bare decks, the concrete overlay had conflicts with how the IRT data was recorded in HSI as a defect range average, which affected the data shown in Figure 17. With 90% of decks as a goal, the IRT inspection start year for concrete overlay wearing surfaces, using the calculated trend line, is at year 2 of wearing surface age.

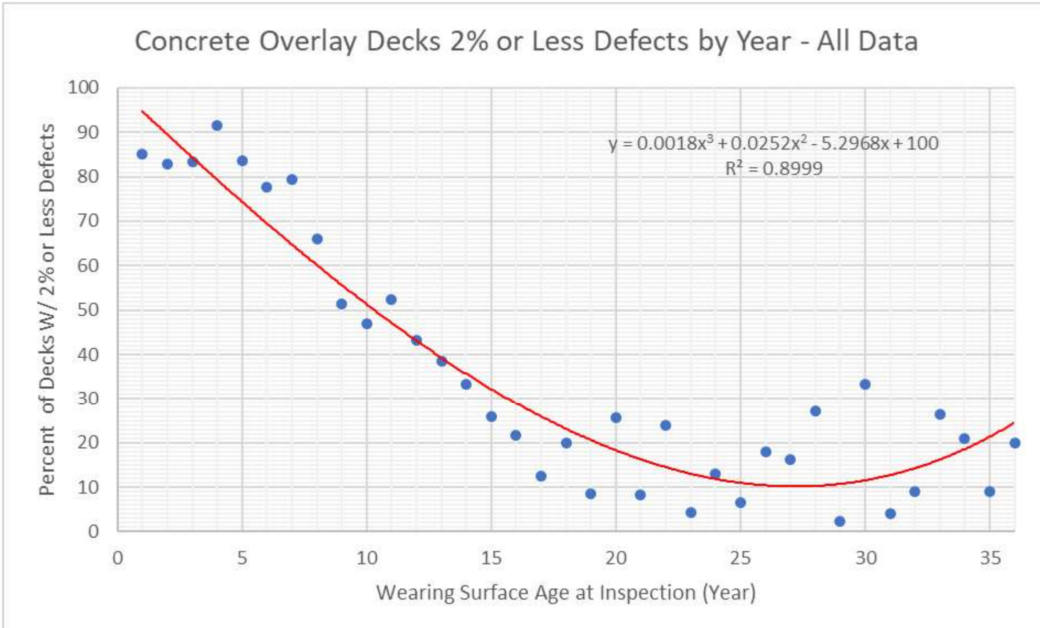

Figure 17 - Concrete Overlay Decks 2% or Less Defects by Year

6.5.1 Concrete Overlay – Defect vs Age – 2.6% Defect Threshold

Figure 18 was created by using a calculated percentage of concrete overlay decks with a defect threshold of 2.6% and their respective wearing surface age. The age range was limited to 25 years to remove the upward data trend for atypical decks that have retained lower defects past the typical lifecycle and have not required rehabilitation during the typical life span. This method calculated the 90% majority and the start inspection year for concrete overlay decks between years 5 and 6 of wearing surface age.

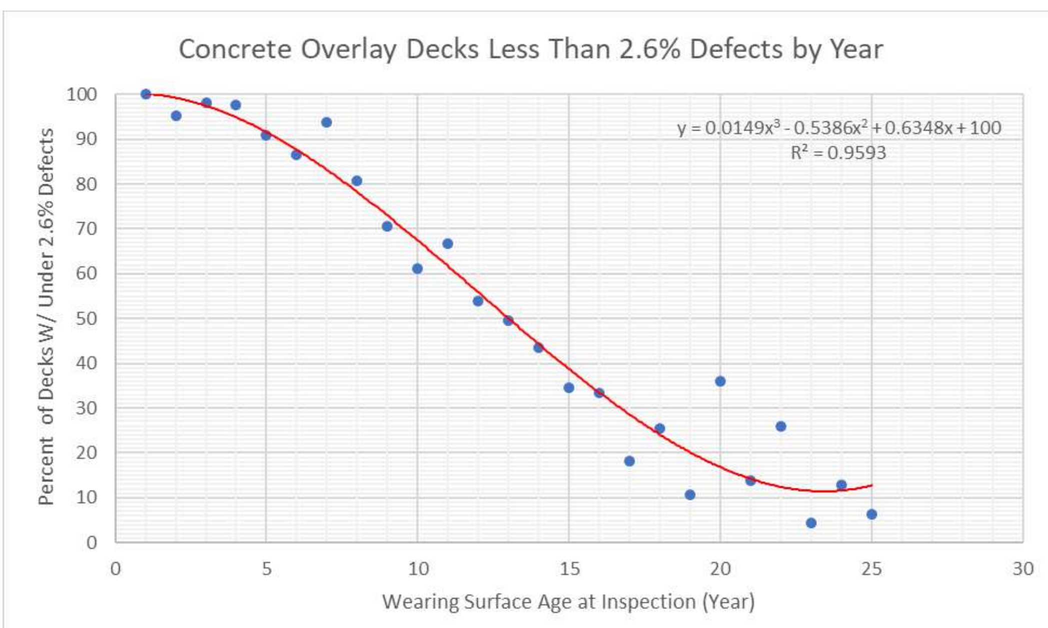

Figure 18 - Concrete Overlay Decks Less Than 2.6% Defects by Year

6.5.2 Concrete Overlay – Defect vs Age – Post 2020

Figure 19 was created using only inspections from 2020 onward and a defect threshold of 2%. The age range was again limited to 25 years to remove the upward data trend for atypical decks that have retained lower defects past the typical lifecycle and have not required rehabilitation during the typical life span. Though the number of available inspections was smaller, they provided greater detail of defect percentages. This method calculated a start inspection year for concrete overlay decks between years 5 and 6 of wearing surface age.

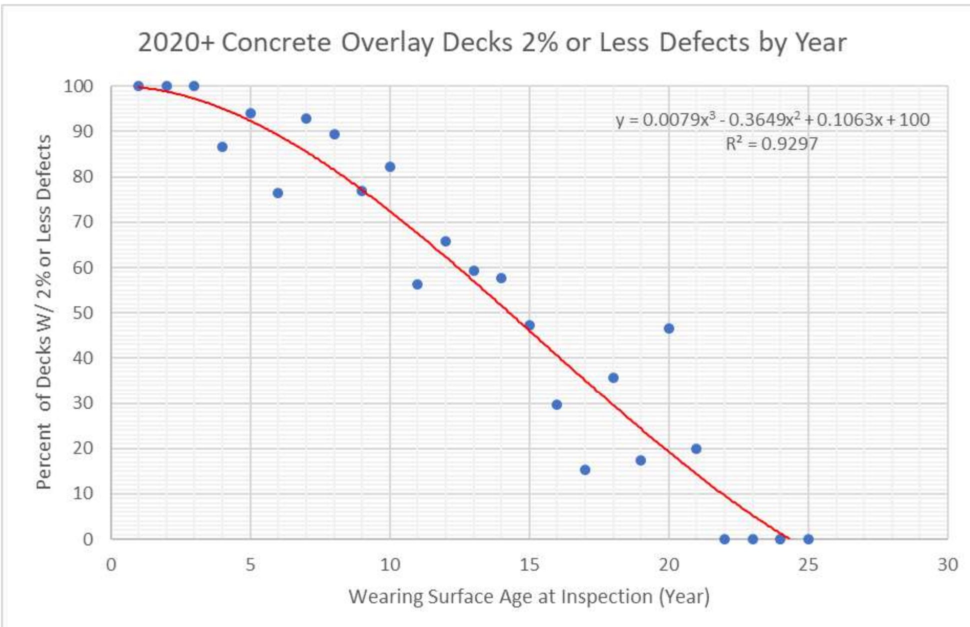

Figure 19 - 2020+ Concrete Overlay Decks 2% or Less Defects by Year

6.6 PMA/HMA Overlay Deck – Defect vs Age Comparison

Box and whisker plots were used to compare the percent range of defects identified during each IRT inspection, grouped by the wearing surface age. A comparison of the asphalt wearing surface is seen in Figure 20. The asphalt wearing surface comparison includes both Polymer Modified Asphalt (PMA) and Hot Mix Asphalt (HMA) overlays. Higher variation was observed when compared to bare decks.

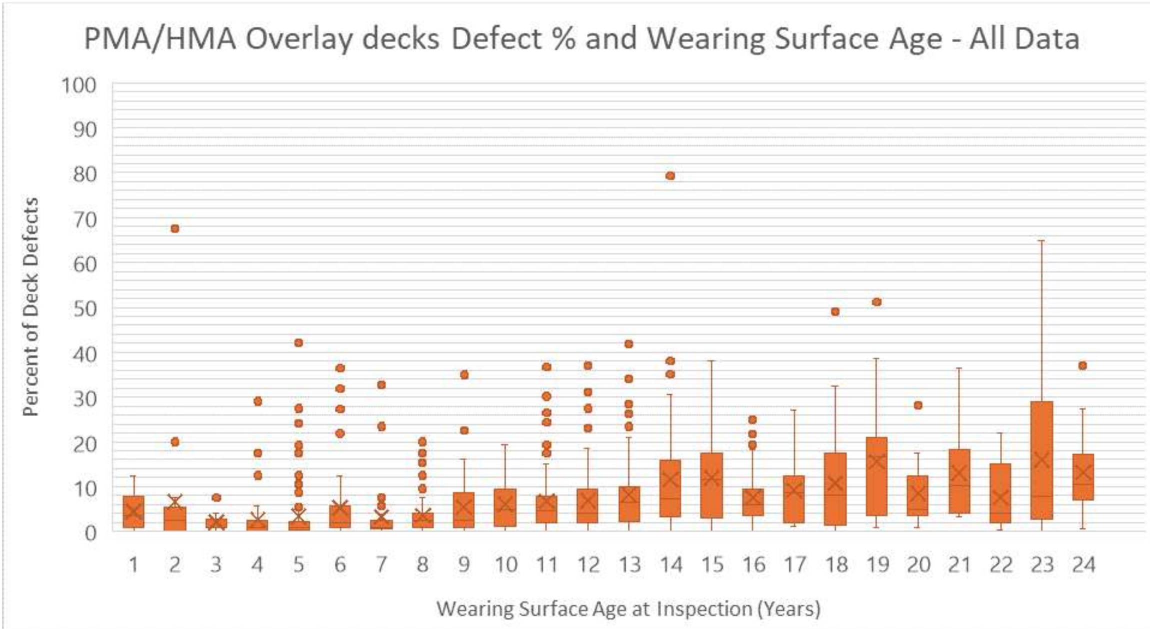

Figure 20 - PMA/HMA Overlay Deck Defect % and Wearing Surface Age

The total number of PMA/HMA overlay wearing surface inspections with less than or equal to 2% of deck defects at each wearing surface age was calculated. The percentage of PMA/HMA overlay wearing surfaces with a defect threshold of 2% was graphed against the wearing surface age at inspection. To determine the start of the IRT inspection year, the year when less than 90% of decks have less than or equal to 2% of deck defects was calculated based on the data trend line. With the original HMA/PMA overlay data, there were again conflicts in how the IRT data was recorded in HSI as a defect range average, which affected the data shown in Figure 21. With 90% of decks as a goal, the IRT inspection start year for PMA/HMA overlay wearing surfaces, using the calculated trend line, is between years 1 and 2 of wearing surface age.

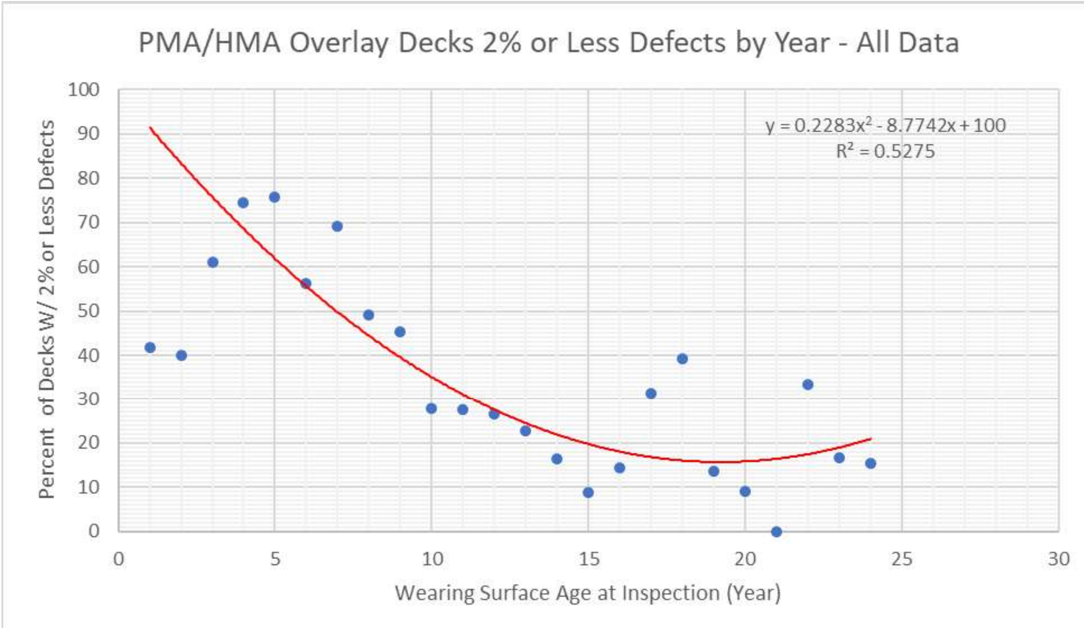

Figure 21 - PMA/HMA Overlay Decks 2% or Less Defects by Year

6.6.1 PMA/HMA Overlay – Defect vs Age – 2.6% Defect Threshold

PMA and HMA have different purposes when placed as an overlay. Therefore, PMA and HMA overlay wearing surfaces were analyzed separately. PMA overlays are typically placed with membranes and are designed to protect the deck concrete from chlorides and provide a more long-term fix. HMA overlays are used more for a short-term fix until a larger rehabilitation project can be completed. Therefore, PMA and HMA overlays were analyzed separately.

Figure 22 was created using a calculated percentage of PMA overlay decks with a defect threshold of 2.6% and their respective wearing surface age. The age range was limited to 19 years due to the low number of inspections after year 19. This method calculated the 90% majority and the start inspection year for PMA overlays at year 4 of wearing surface age.

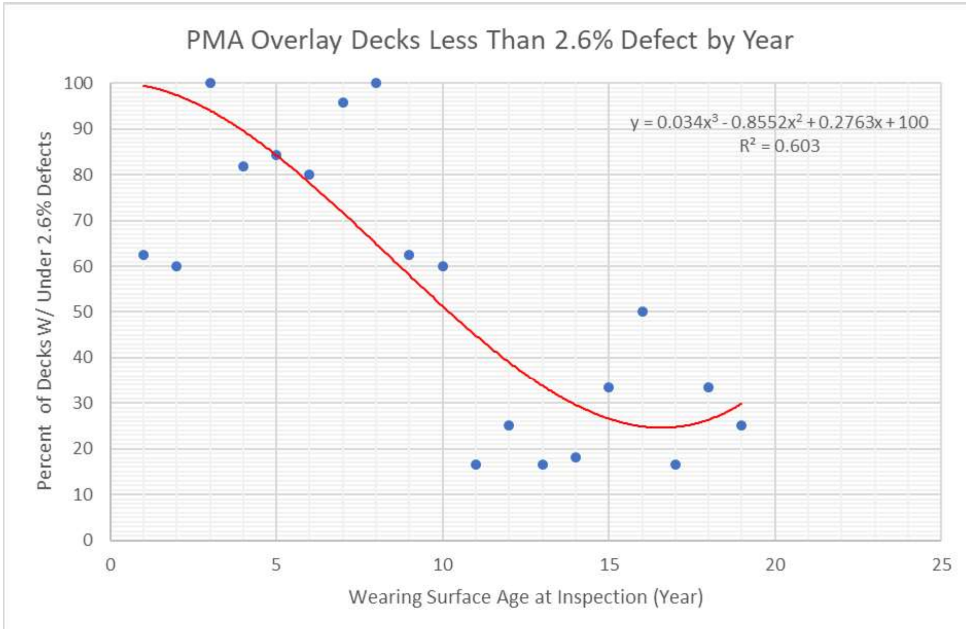

Figure 22 - PMA Overlay Decks Less than 2.6% Defects by Year

Figure 23 was created using a calculated percentage of HMA overlay decks with a defect threshold of 2.6% and their respective wearing surface age. This method calculated the 90% majority and the start inspection year for HMA overlays between years 1 and 2 of wearing surface age.

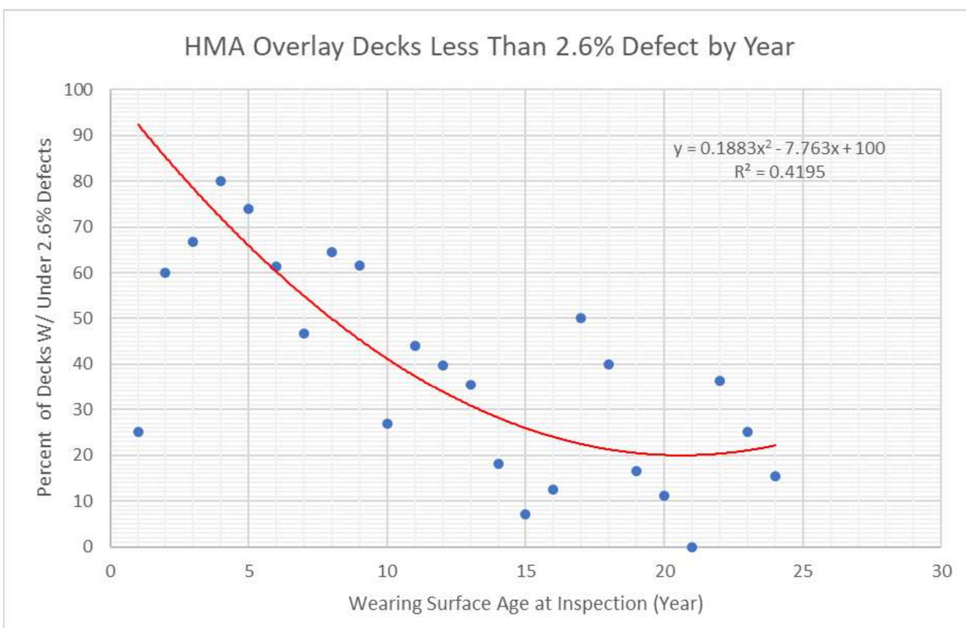

Figure 23 - HMA Overlay Decks Less Than 2.6% Defects by Year

6.6.2 PMA/HMA Overlay – Defect vs Age – Post 2020

Figure 24 and Figure 25 were created using only PMA and HMA overlay inspections from 2020 on and a less than or equal to 2% threshold. PMA age range was limited to 19 years due to the low number of inspections after year 19. This method provided inconsistent results by year, this may be due to a low number of PMA or HMA inspections from 2020 on. This method calculated the 90% majority and the start inspection year for PMA overlays between years 5 and 6 and HMA overlays between years 1 and 2 of wearing surface age.

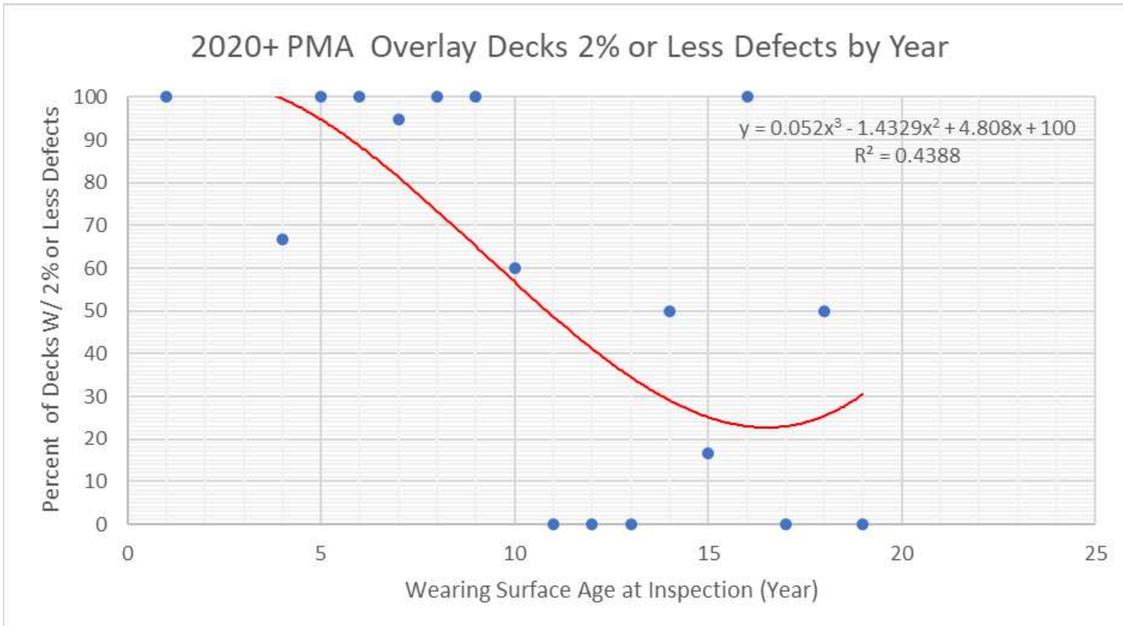

Figure 24 - 2020+ PMA Overlay Decks 2% or Less Defects by Year

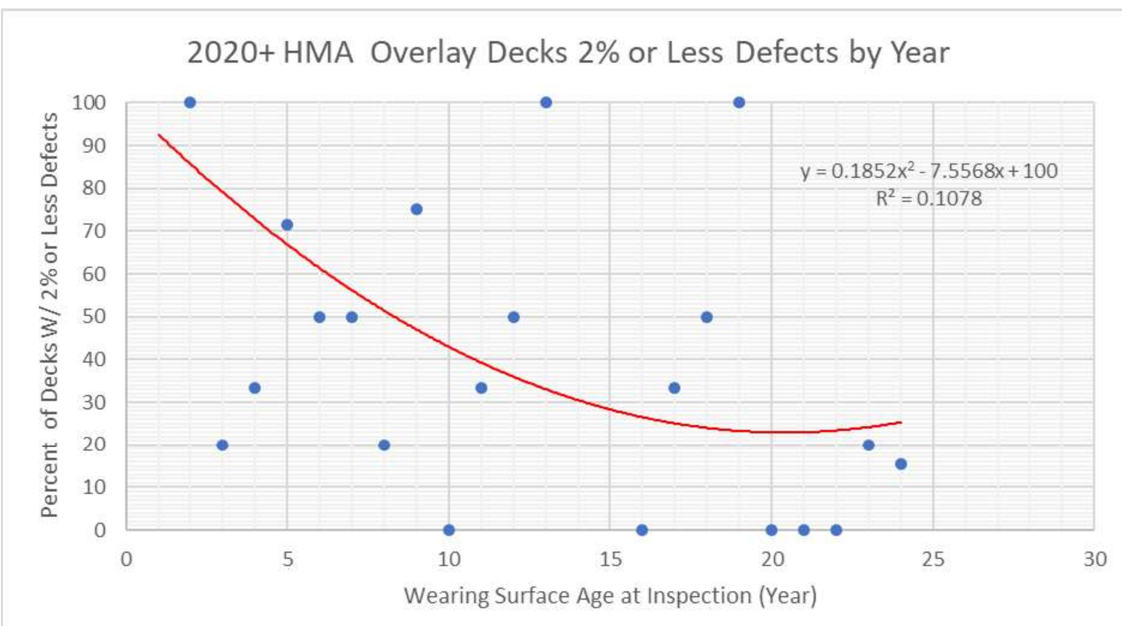

Figure 25 - 2020+ HMA Overlay Decks 2% or Less Defects by Year

6.7 Thin Polymer Overlay Deck – Defect vs Age Comparison

Box and whisker plots were used to compare the percent range of defects identified during each IRT inspection, grouped by the wearing surface age. TPO deck wearing surface comparison is seen in Figure 26.

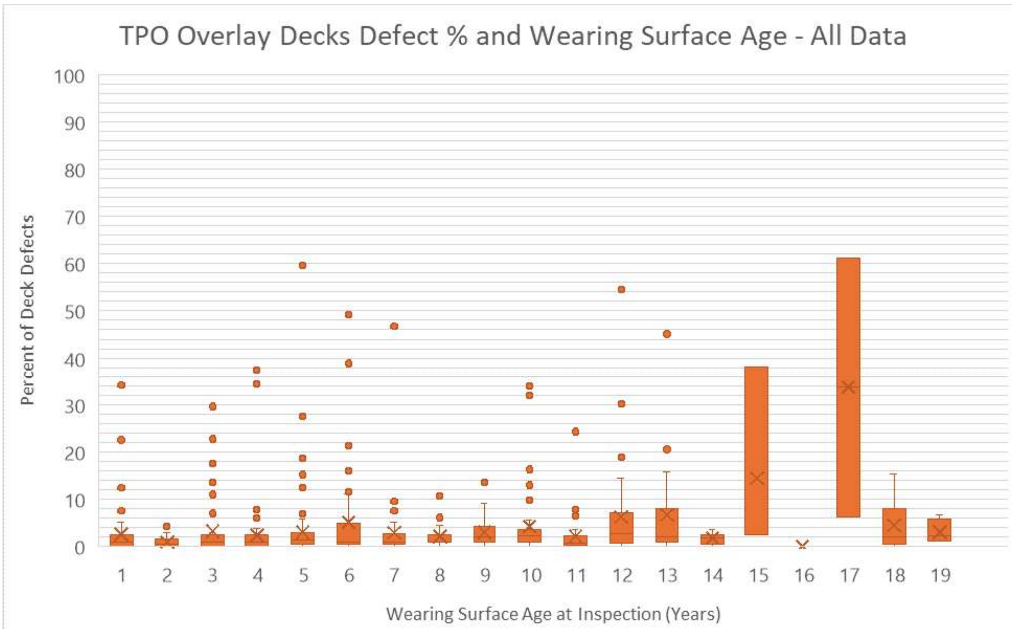

Figure 26 - TPO Decks Defect % and Wearing Surface Age

The total number of TPO deck inspections with less than or equal to 2% of deck defects at each wearing surface age was calculated. The percentage of TPO decks with a defect threshold of 2% was graphed against the wearing surface age at inspection. To determine the start of the IRT inspection year, the year when less than 90% of decks have less than or equal to 2% of deck defects was calculated based on the data trend line. With the original TPO deck data, there were conflicts in how the IRT data was recorded in HSI as a defect range average, which affected the data shown in Figure 27. With 90% of decks as a goal, the IRT inspection start year for TPO wearing surfaces, using the calculated trend line, is year 1 of the wearing surface age.

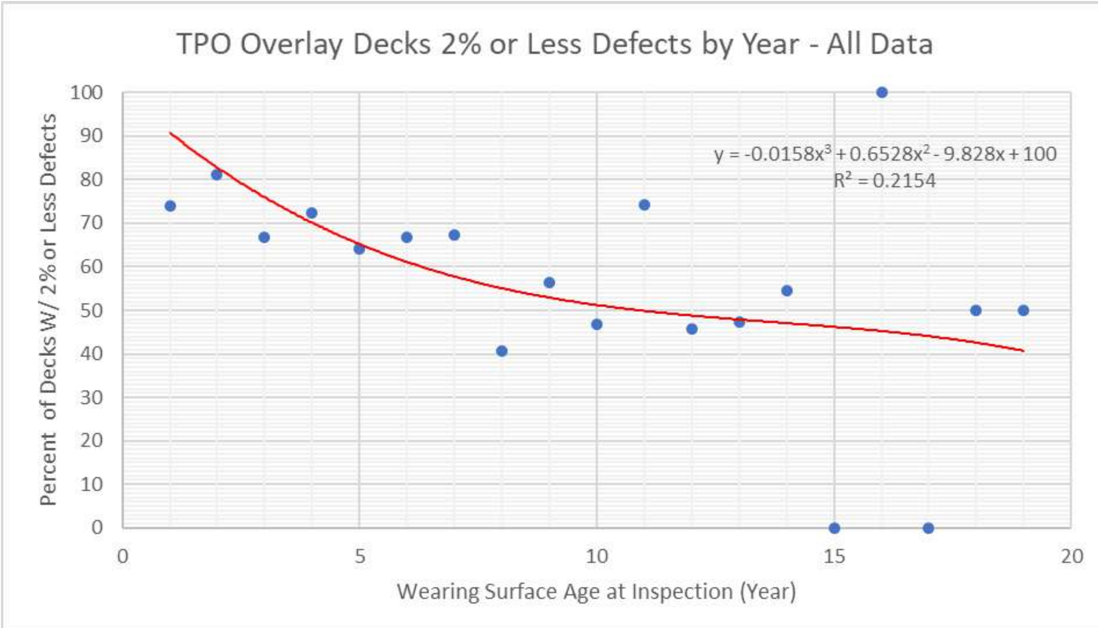

Figure 27 - TPO Decks 2% or Less Defects by Year

6.7.1 Thin Polymer Overlay – Defect vs Age – 2.6% Defect Threshold

Figure 28 was created using TPO inspections and a defect threshold of less than 2.6% to calculate the percentage of decks at or below 2.6% defects for each wearing surface age. This method calculated the 90% majority and the start inspection year for TPO decks between years 1 and 2 of wearing surface age.

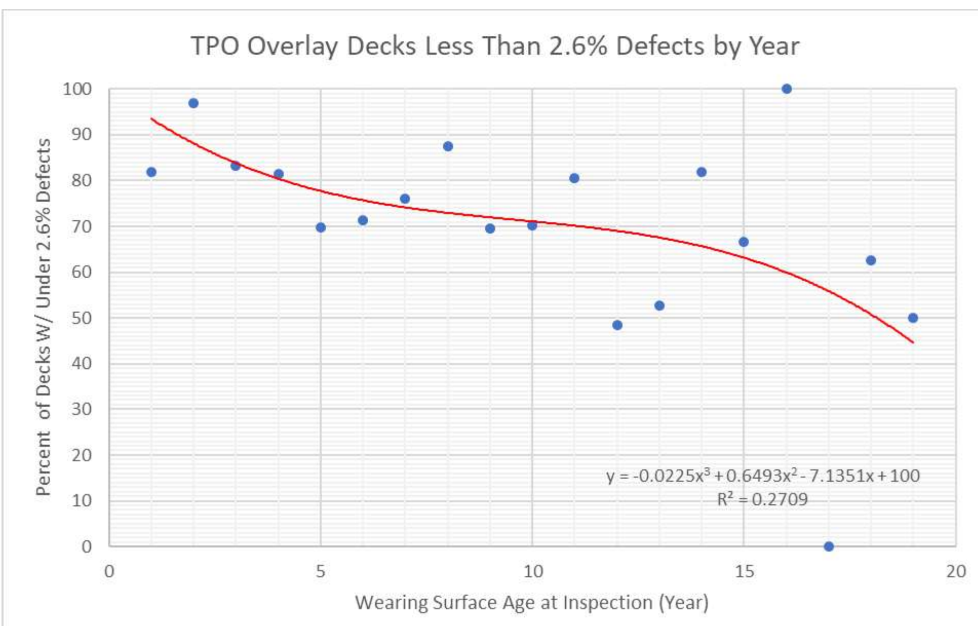

Figure 28 - TPO Decks Less Than 2.6% Defects by Year

6.7.2 Thin Polymer Overlay – Defect vs Age – Post 2020

Figure 29 was created using only inspections from 2020 on and a less than or equal to 2% threshold. Though the number of available inspections was smaller, they provided higher detail of defect percentages. This method calculated a start inspection year for bare decks between years 1 and 2 of wearing surface age.

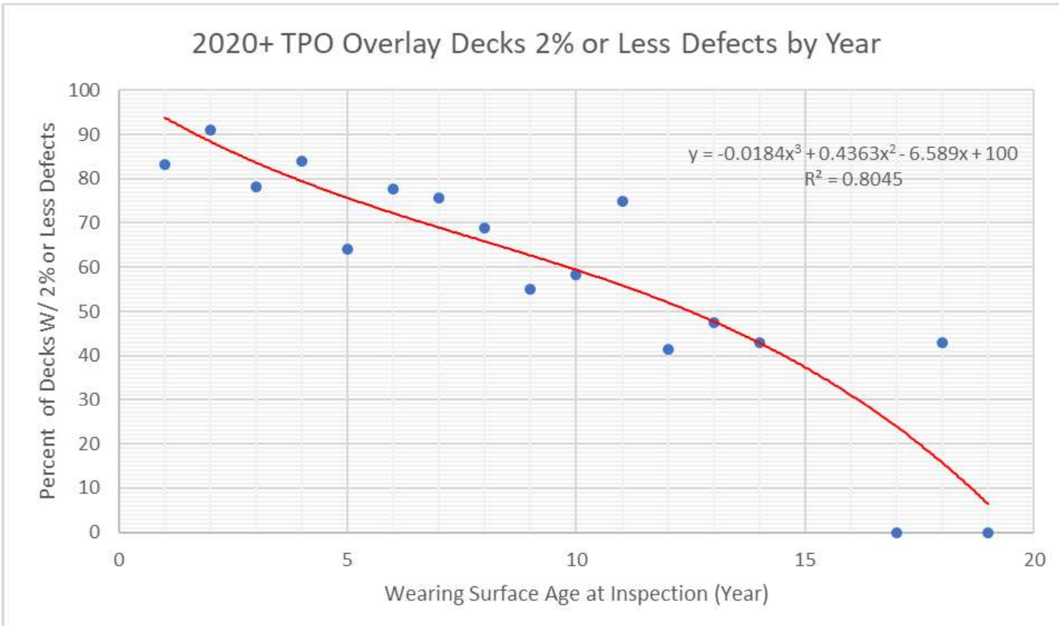

Figure 29 - 2020+ TPO Decks 2% or Less Defects by Year

6.8 Wearing Surface Inspection Start Cycle Summary

The recommended start year of IRT inspections for each wearing surface after its construction is summarized in Table 11. There was not enough data for PPC overlay recommendations, so until more data is collected, it is recommended to follow PCC recommendations as they have similar design life spans.

Table 11 - Recommended First IRT Inspection Year

Wearing Surface	Start Year
Bare	18
PCC	5
PMA	5
HMA	2
TPO	2

7. Inspection Intervals

7.1 Overview

After determining the initial IRT inspection for each wearing surface, the interval of IRT inspections was evaluated by considering the rate of defect change, the wearing surface's life span, the percentage defect threshold for rehabilitation, and the time needed to plan an end-of-life rehabilitation.

7.2 Background

To determine the rate of defect change over time, the average percent of defects by deck area for each wearing surface age was calculated and then plotted. The same data set was also graphed with two standard deviations to examine the worst-case rate of change.

Once graphed, WisDOT's design life span of each wearing surface and the rehabilitation threshold from WisDOT's bridge manual, shown in Table 12, was compared to the defects rate of change. The rate of change was calculated between the recommended initial inspection year and the estimated end-of-life span year. The average percent defects at the end-of-life was subtracted from the average percent defects at the initial inspection year and then divided by the number of years between. This was calculated for the average and for two standard deviations data. A 5% increase in defect quantity by deck area was used to determine the inspection interval on the wearing surfaces, except for bare decks since the rate of defect increase was less than overlayed decks. Further explanations are provided in the following wearing surface sections.

Table 12 - WisDOT Bridge Design

Wearing Surface	Design Life Span (years)	Rehabilitation Threshold
Bare	40	15%
PCC	15-20	20%
PMA	10-15	20%
HMA	3-15	20%
TPO	7-15	20%

7.3 Bare Decks

WisDOT's design life span of a bare deck is 40 years and the threshold for planning a rehabilitation is 15% of the deck area containing defects. Figure 30 shows that at year 40, bare decks have an average of 5% defects. Using the trend line and extrapolating the data until the 15% defect threshold, the average end-of-span year would be 73, which is later than what is expected and is beyond design estimates. With the two standard deviations graph shown in

Figure 31 at year 40, the defect percentage is 18, which is slightly over the 15% threshold for rehabilitation. Using the 15% threshold at two standard deviations, the end-of-life span would be year 36, which is closer to expected.

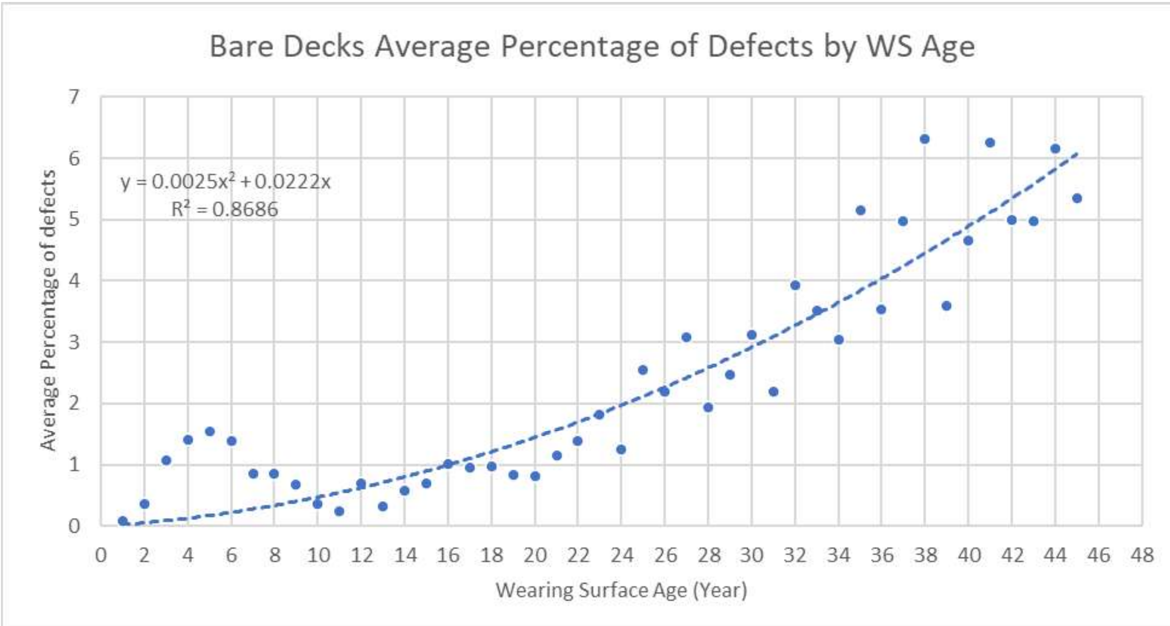

Figure 30 - Bare Decks Average Percentage of Defects by WS Age

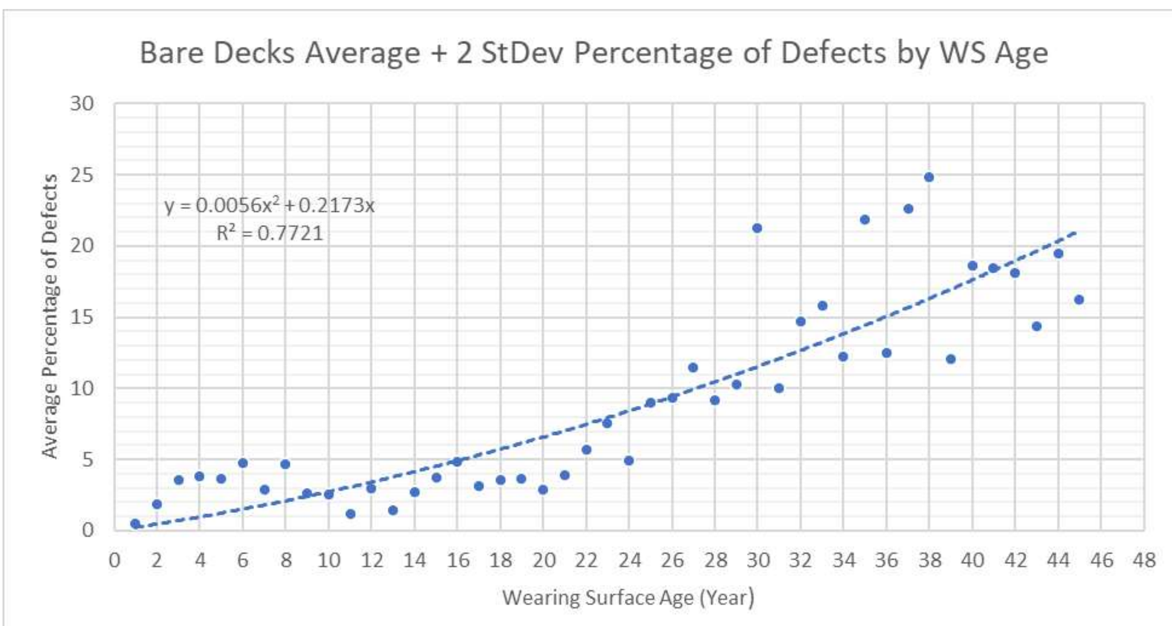

Figure 31 - Bare Decks Average + 2 StDev Percentage of Defects by WS Age

The recommended initial inspection for a bare deck is year 18. The average rate of change from year 18 to 40 was approximately 0.2% per year. The rate of change from year 18 to 36 (15%

threshold) was approximately 0.5% per year at two standard deviations. Due to the low rate of defects change on bare decks, using a 5% increase in defects to determine inspection interval does not put the inspections at an ideal interval for end-of-life planning. To follow WisDOT's design standard of having a rehabilitation project scheduled by year 40, an inspection would have to take place 7 years before or in year 33 to account for planning and DOT design time. It is recommended that an inspection be conducted around year 33. This leaves a 15-year gap between the first inspection at year 18 and around year 33. A 15-year inspection gap is too long of a period of no inspection as a 5% increase of defect change at two standard deviations would call for an inspection 10 years after the initial inspection. Therefore, an additional inspection at year 25 is recommended to create a 7-year inspection interval for bare decks from the initial inspection. This would allow for proper timing of inspections before the design life span. Around year 33, WisDOT can evaluate the condition of the deck and determine if a rehabilitation plan is needed or if the scheduled 7-year inspection interval should be continued.

7.4 Overlayed Wearing Surfaces

For overlayed wearing surfaces, the average and two standard deviation graphs of the average percentage of defects were plotted. These graphs were used to calculate the percentage of defects at WisDOT's design life span year and compared to the calculated year of rehabilitation using the 20% defect percentage threshold for overlayed wearing surfaces. Using the average defect percentage, the different overlays exceeded the design life span compared to the 20% defect threshold for rehabilitation. Using a 20% defect threshold on the two standard deviations graphs, PCC overlays reached the threshold at year 10, while PMA and HMA reached year 11 and TPO reached year 10, which is within their respective overlay life span ranges.

The rate of change per year was calculated by the average and two standard deviations between the recommended start year for IRT inspections and the year when each wearing surface reached the 20% defect threshold. The rate of defect change by year was at least double for all overlay types compared to bare decks. A 5% threshold for defect change and the design life span was used to set the inspection interval. PCC and PMA overlays reach a 5% change at 5 years. HMA and TPO overlays reach 5% at 8 and 10 years, but due to their shorter design life span, it is recommended that they are inspected more frequently. Appendix D has the average and two standard deviation graphs and a wearing surface comparison table.

7.5 Inspection Interval Summary

Based on the rates of deterioration for each wearing surface, it is recommended that bare decks be inspected at 7-year intervals and overlayed wearing surfaces be inspected at 5-year intervals to account for higher rates of deterioration. It should be noted that higher deterioration rates in overlayed decks may also be due to the age of the deck below the wearing surface. If an overlay is scheduled, it is recommended that a project-level IRT inspection is completed prior to the new overlay placement. This allows WisDOT to identify areas of repair before the overlay is placed. Based on extrapolating the average data trends found in this study, it is possible for wearing surfaces to outlive their life expectancy, though the data may be skewed since there are fewer inspections available near the end of a wearing surface life because of rehabilitation projects. WisDOT's use of the recommended IRT inspection interval can help to monitor and maintain decks past their expected design life span.

8. Bridge Deck Rehabilitation Comparison

8.1 Overview

As a part of this study, previous IRT inspections were compared to actual bridge deck rehabilitation quantities to evaluate the accuracy of IRT compared to rehabilitation quantities. This comparison was also used to determine how long IRT inspection is valid for use in rehabilitation plans. An initial 152 IRT inspections and their corresponding rehabilitation projects were reviewed, with the IRT inspections ranging from one year to eleven years before the rehabilitation project was completed. The initial review determined insufficient data for IRT inspections conducted more than three years before the rehabilitation project. Therefore, only inspections within three years of rehabilitation were used for the data analysis. Type 1 deck preparation paid quantities from rehabilitation projects were compared to IRT inspection defect quantities as a percentage of the deck area. Per the WisDOT 2024 Standard Specifications, Type 1 deck preparation is defined as, *"remove existing asphaltic patching and unsound bridge deck concrete only to a depth that exposes 1/2 of the peripheral area of the top or bottom bar steel in the top mat of reinforcement."* Appendix E contains the data table for this section.

8.2 Background

Studies have found that IRT delamination detection accuracy has varied compared to actual rehabilitation. Anywhere from 40% up to 100% accuracy in detection has been found (Vaghefi, Harris, & Ahlborn, 2011). Studies have also shown that reported IRT delamination quantities may be higher or lower than actual. False positives or solar reflection can lead to higher IRT quantities being reported. Lower quantities may be reported due to any of the factors discussed in previous sections that negatively impact defect detection. Furthermore, poor accuracy of IRT and rehabilitation relationships may occur when too much time has elapsed between the time the data was collected and the rehabilitation time. Under favorable data collection conditions, IRT images can show accurate delamination quantities (Kee, Oh, Popvics, Arndt, & Zhu, 2012).

8.3 Rehabilitation Results – Year of inspection

Data in Figure 32 shows that rehabilitation projects completed three years after the IRT inspection had a significantly higher difference between the rehabilitation and IRT quantities compared to inspections one and two years before rehabilitation. A positive percent difference is defined as the rehabilitation quantity that was higher than the IRT inspection quantity, whereas a negative percent means that the IRT inspection quantities were higher. In general, the rehabilitation difference would be expected to be slightly higher (positive percent) than an IRT inspection due to rehabilitation areas extending out slightly beyond the actual defect into solid concrete or combing of the defect areas during rehabilitation.

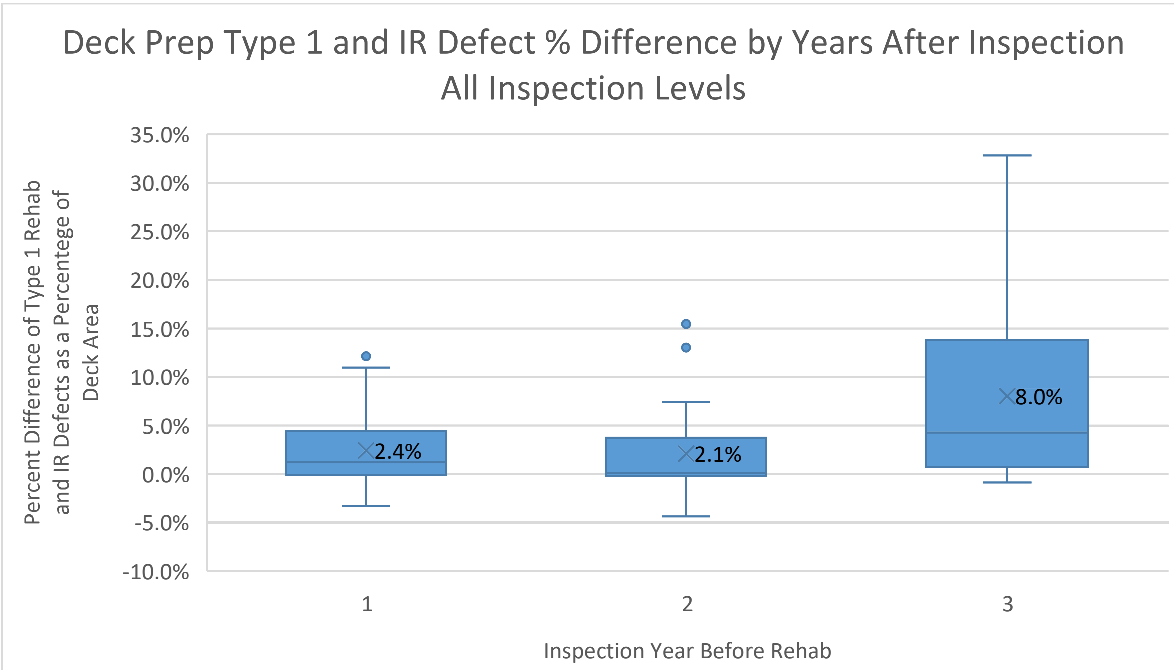

Figure 32 - Deck Prep Type 1 and IR Defect % Difference by Years After Inspection – All Inspection Levels

The rehabilitation data included all IRT inspection levels. Typically, only levels 2 and 3 are used for rehabilitation planning so those rehabs were also analyzed separately for comparison to all the data. When only comparing levels 2 and 3 results, Figure 33, a similar trend is seen where rehabilitations completed three years after inspection had higher differences than rehabilitation projects completed closer to the IRT inspection. The differences between all inspections and only levels 2 and 3 may be due to the reduced data set.

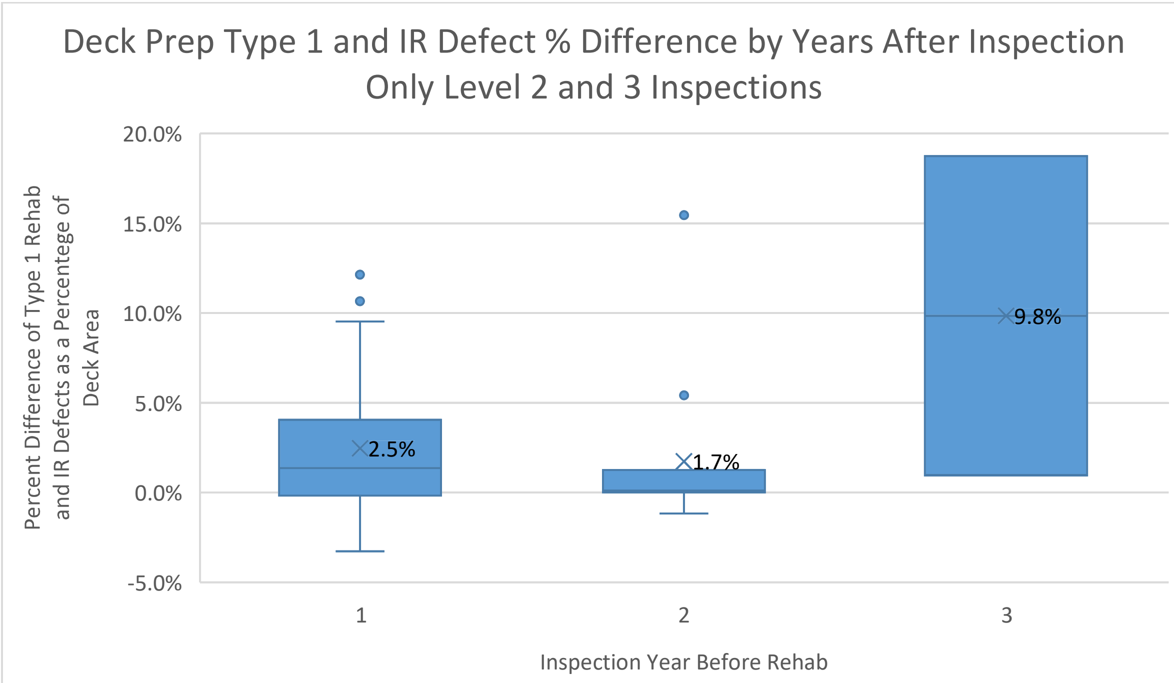

Figure 33 - Deck Prep Type 1 and IR Defect % Difference by Years After Inspection – Only Level 2 and 3 Inspections

8.4 Rehabilitation Results – Quantities

The quantity of IRT defects was also compared to determine if there was a correlation between the number of defects found in an IRT survey and the percent difference between IRT and rehabilitation quantities. Data from years 1 to 3 were used for the comparison. The data shown in Figure 34 indicates that there was a positive correlation. This means the higher the number of defects found by IRT, the higher the chance of variation compared to the rehabilitation area.

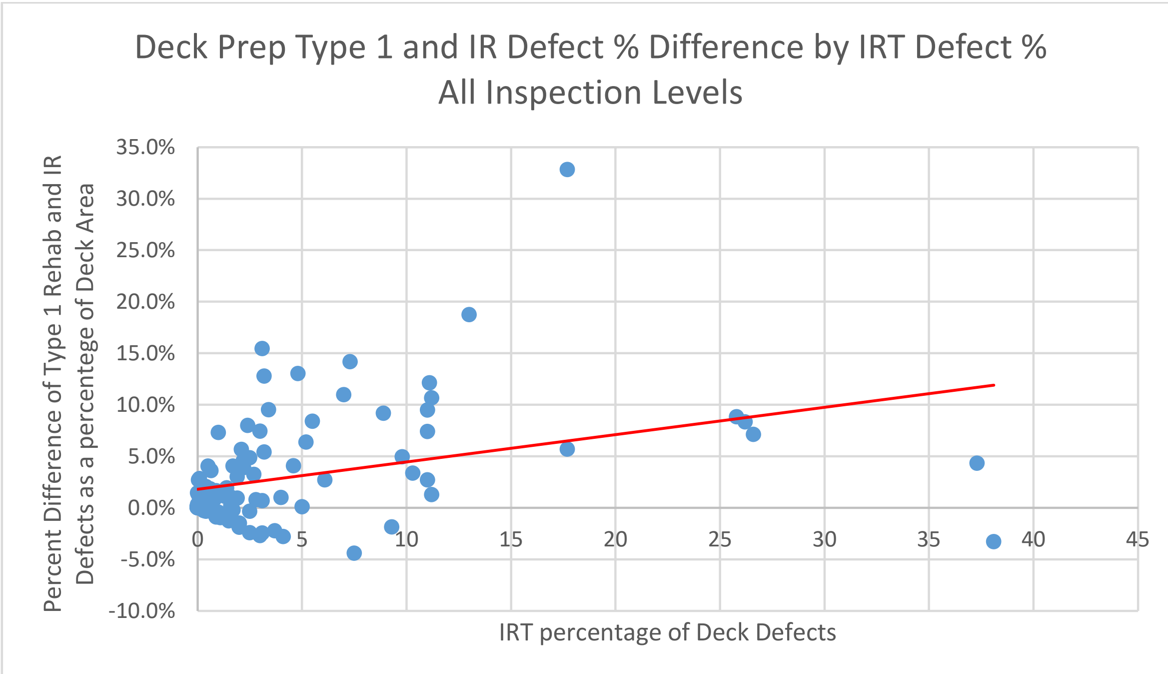

Figure 34 - Deck Prep Type 1 and IR Defect % Difference by IRT Defect % – All Inspection Levels

8.5 Rehabilitation Results – Wearing Surface Type

The different wearing surfaces were also analyzed to determine if there was a variation between the rehabilitation and IRT quantities relative to the wearing surface. Data from years 1 to 3 were used for the comparison. Figure 35 details the variation found by wearing surface type. TPO overlay data may not be sufficient because there are only two inspections. Generally, bare decks had less variance in rehabilitation and IRT quantities compared to other wearing surfaces.

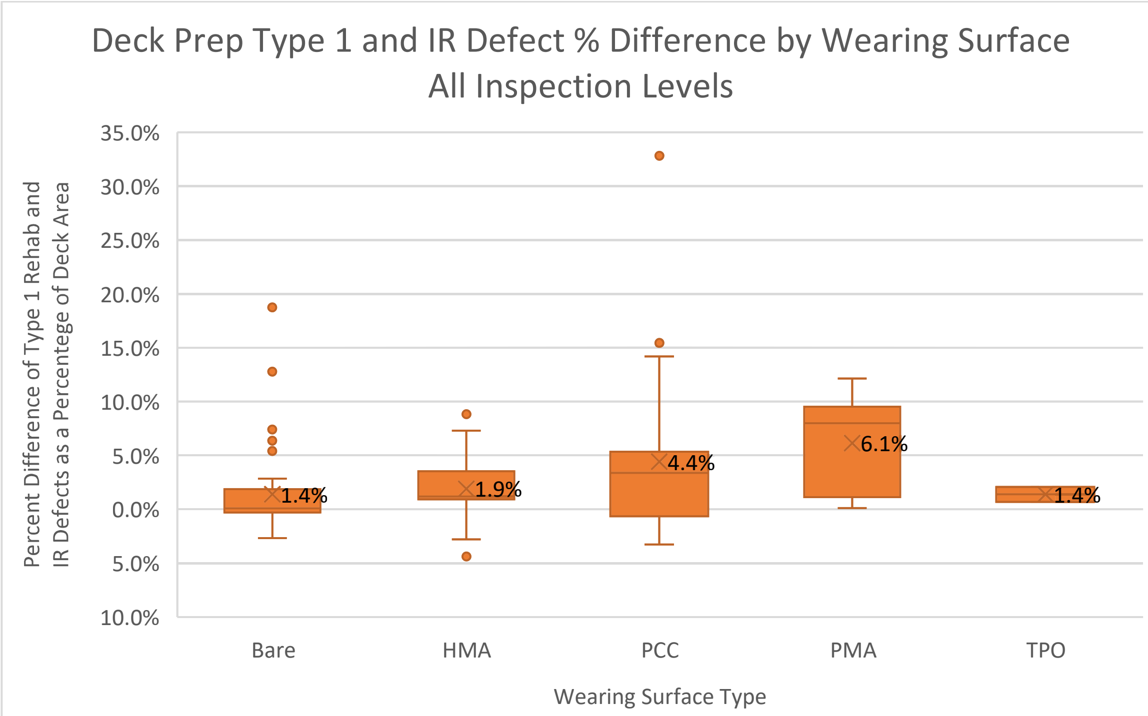

Figure 35 - Deck Prep Type 1 and IR Defect % Difference by Wearing Surface – All Inspection Levels

8.6 Rehabilitation Results – Summary

The validity of IRT inspection for use in rehabilitation planning depends on several factors: the accuracy of the inspection, how close the inspection is to the rehabilitation date, the quantity of defects found by an IRT inspection, and the wearing surface type. Most outliers found in the data set were overlaid and/or had a high quantity of defects identified in the IRT inspection. Additionally, there may be outliers because past IRT inspection procedures did not follow current WisDOT IRT standards. It may be possible to anticipate the difference in IRT inspections and rehabilitation quantities when looking at different wearing surfaces or the quantity of defects on an IRT inspection. However, further data collection and analysis may be necessary to understand the relationships better.

The data indicates that an IRT inspection is valid for a rehabilitation project two years after the inspection. Therefore, it is recommended that IRT inspections be completed within two years of the planned rehabilitation. This allows for the required time for the design process and project delays after the inspection. The quantity of defects may increase slightly when the IRT inspection is completed two years before the rehabilitation project compared to the year before.

9. Rehabilitation Project Comparison

9.1 Overview

Additional comparison was completed by comparing the IRT defect locations and the location of rehabilitation completed during rehabilitation projects. WisDOT provided rehabilitation plan views from recent projects with the Type 1 preparation areas identified. The IRT defect plan view was overlayed with the Type 1 deck preparation plan view. Areas where there were both IRT defects and Type 1 preparation, were considered to be data overlap areas. Areas of IRT defects that were not within the rehabilitation areas were considered IRT false positives. Lastly, areas of rehabilitation with no IRT defects were identified as rehabilitation that was not detected by IRT.

9.2 Bridge Projects

A total of 20 bridge rehabilitation projects were compared to IRT inspections and are listed in Table 12. Of the 20 bridges, 13 had PMA overlays, 5 had HMA overlays, and 2 had bare decks. The distribution of different overlays and the number of bridges with plan views of the rehabilitation areas are limited. The IRT results were from level 2 IRT inspections. The IRT defect areas were overlapped with the Type 1 rehabilitation area and then compared. The IRT area was calculated as square feet and a percentage of the deck area. The defect comparison included rehabilitation areas where the IRT and Rehabilitation concurred, areas where IRT did not detect a defect, and areas where IRT called a false positive defect. To calculate the correlation of IRT and rehabilitation within the bridge deck, IRT false positives and the rehabilitation areas not identified by IRT were subtracted from the total deck area. The resulting deck area is the amount of correlated IRT defect and non-defect areas confirmed by the rehabilitation project. The data table and plan views of the overlapped data are in Appendix F.

Table 13 - Rehabilitation Bridges

Bridge ID	Wearing Surface	Deck Area	Total IRT Defects (SF)	Total Rehab (SF)	Overlap (SF)
B-5-202	PMA	7,188	2	104	0
B-5-203	PMA	7,188	61	113	7
B-5-208	PMA	7,454	1,684	3,318	1,377
B-5-209	PMA	6,188	214	800	132
B-5-210	PMA	4,303	236	598	158
B-5-211	PMA	5,530	30	252	13
B-5-212	PMA	7,578	531	1,359	292
B-5-213	PMA	10,364	3,470	4,850	2,732

B-5-214	PMA	5,137	459	929	378
B-5-215	PMA	9,826	2,783	5,688	2,271
B-5-216	PMA	8,445	2,208	2,846	1,608
B-5-219	PMA	5,152	144	185	47
B-5-220	PMA	6,022	149	617	95
B-5-221	HMA	7,259	805	1,586	661
B-5-222	HMA	4,872	92	239	47
B-5-223	HMA	4,904	541	1005	423
B-20-23	HMA	5,883	1,517	1,949	1,335
B-31-18	HMA	7,000	782	882	608
B-31-23	Bare	22,417	301	768	155
B-5-284	Bare	2,228	539	474	323

Overall, many of the areas found in the IRT were confirmed by the rehabilitation. The average percentage of decks that correlated was 86.5%. These distributions were also compared by wearing surfaces, as seen in Figure 36. PMA overlays showed the highest difference in IRT and rehabilitation areas. In our experience, PMAs have caused issues with missed delamination in IRT inspections, and this trend has been confirmed throughout this study.

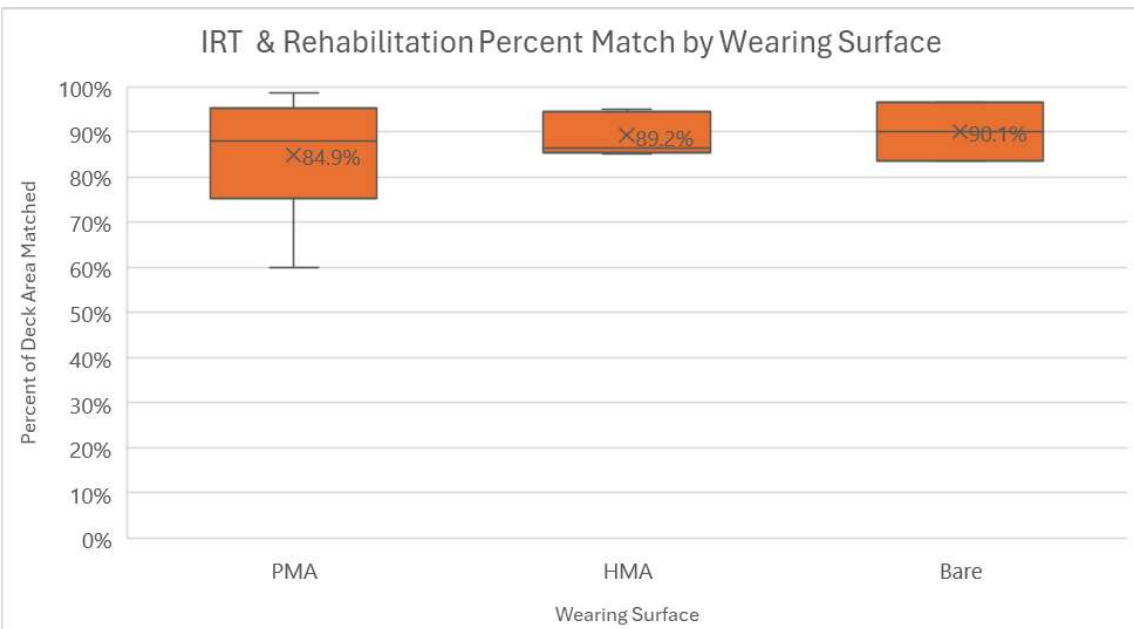

Figure 36 - IRT & Rehabilitation Percent Match by Wearing Surface

Comparing the areas misidentified by IRT inspections, the number of false positives was relatively low, averaging 2.8% of the deck area. Rehabilitation areas not detected by IRT averaged 10.6% of the deck area as shown in Figure 37.

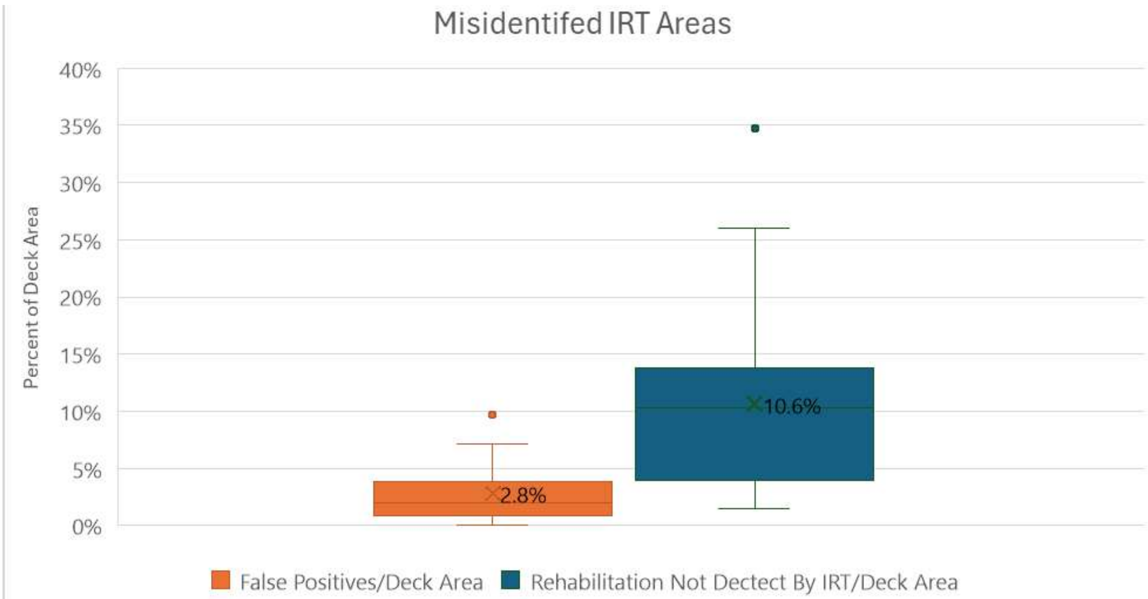

Figure 37 - Misidentified IRT Areas

PMAs had the highest variation in rehabilitation areas missed by the IRT, as seen in Figure 38. The comparisons show that rehabilitation areas are often larger than IRT areas. This could be due to the rehabilitation beyond the IRT-identified defect area or the combining of large defect areas during the rehabilitation process. Also, most of the comparisons were of PMA overlays, which have been shown to have slightly lower IRT accuracy. In general, the IRT inspections match well with the rehabilitation areas. Overall, more deck rehabilitation comparisons are needed to determine the accuracies of IRT and rehabilitation areas and the differences between wearing surfaces.

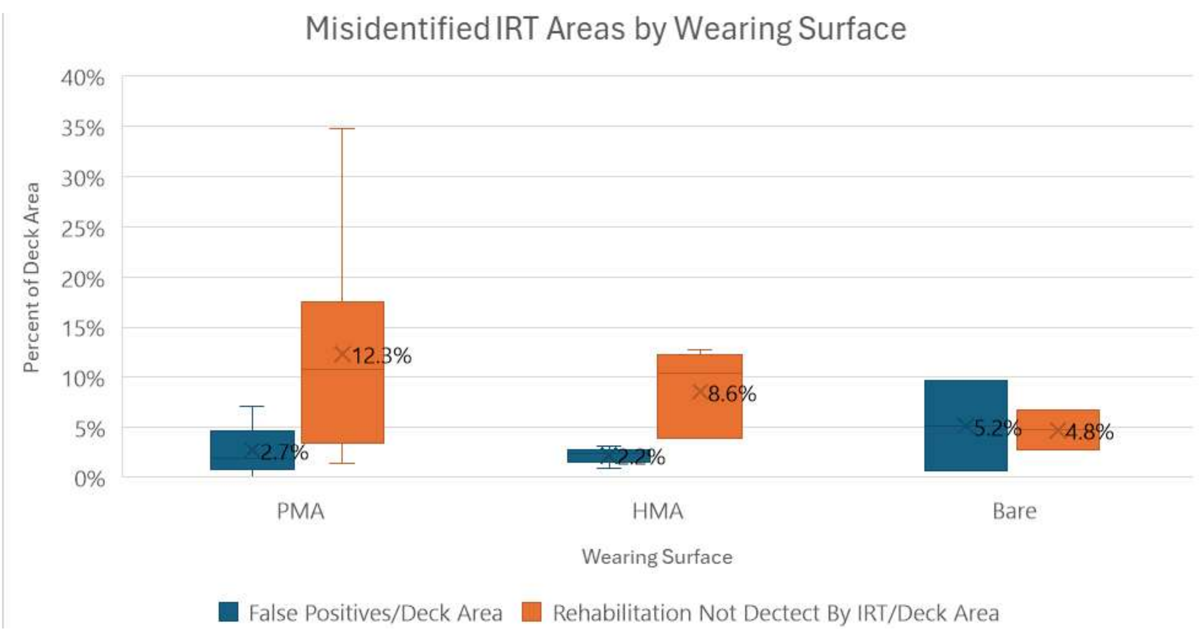

Figure 38 - Misidentified IRT Areas by Wearing Surface

10. Recommendations

10.1 Recommend Infrared Thermography Methods

Program level IRT surveys are recommended to be collected with handheld, drone, fixed-wing aerial, or vehicle-mounted IRT cameras. Monitoring a bridge's condition is important for future maintenance and rehabilitation planning. Project level IRT surveys require more detailed mapping of the bridge defects and sometimes in-field confirmation sounding, which can be provided with the drone and vehicle-mounted IRT systems. The recommended IRT system minimum specifications vary depending on the data collection method. Handheld and drone IRT camera specifications can vary depending on the application. For handled IRT cameras, the recommended minimum resolution is 640x480 pixels with an uncooled detector. A drone-mounted IRT camera's recommended minimum is an uncooled detector with 320x256 pixels and a minimum GSD of 1.5 inches per pixel. A cooled IRT camera with a minimum GSD of 1.5 inches per pixel is recommended for a fixed-wing aerial. For high-speed vehicle data collection, it is recommended to have a cooled IRT camera with a minimum resolution of 640x512 pixels and a GSD of 0.25 inches per pixel. Additional research is recommended for fixed-wing aerial to determine the effect of higher GSD for areas of flight restrictions and data efficiency.

10.2 Collection Parameters

It is important to monitor the environmental conditions when collecting IRT data. It is recommended that IRT is collected when temperatures are above 32°F and the deck is dry for at least 24 hours prior, which follows the ASTM D4788-03 IRT collection standard. An exception from the ASTM standard would be reducing the recommended wind speeds to under 15 mph to reduce the effect of the wind on the thermal load.

The time needed after sunrise for the sun to emit enough thermal load to identify the bridge deck defects depends on the wearing surface. The recommended optimal IRT inspection time for all studied wearing surfaces is 6 to 10 hours after sunrise. Data can be collected outside of the optimal IRT time period but should follow the recommended period for each wearing surface in Table 8 and field-verify that the defects are visible to the infrared camera. It is also important to field-verify defects when possible to verify that the data collection window and conditions are valid for the wearing surface being inspected.

10.3 Initial Inspection

The Project Oversight Committee considers a defect quantity of 2% of the wearing surface to be significant for planning purposes. The year when less than 90% of bridges have defect quantities less than 2% of the wearing surface area was the initial guideline to determine the optimal start IRT inspection year. The IRT results were calculated from previous IRT inspection data stored in WisDOT's HSI System. Data was separated by wearing surface type and processed to remove outliers. The threshold was adjusted and analyzed using two methods for each wearing surface. The first method used all inspections and the year when less than 90% of bridges have defect quantities less than 2.6% of the wearing surface. The second method used post-2020 inspections and the year when 90% of bridges have defect quantities less than or equal to 2% of the wearing surface to calculate the initial inspection year. Based on the two methods, it is recommended that once a new deck is placed, the first IRT inspection is to occur at year 18 for bare decks. When a new overlay wearing surface is placed, the initial inspection should reset and follow the recommended initial inspection year for each wearing surface overlay type. PCC and PMA overlays should be inspected at year 5, while HMA overlays and TPOs should be inspected at year 2.

10.4 Inspection Cycle Interval

The interval of scheduling IRT inspections is important for monitoring bridge deck conditions and preparing for maintenance activities. For this study, the IRT inspection cycle interval was calculated by comparing the rate of defect change, the wearing surface's life span, the percentage defect threshold for rehabilitation for each wearing surface type, and the time needed to plan an end-of-life rehabilitation. Each wearing surface type was analyzed separately. A 5% increase in defect quantity by deck area was used as a guide for calculating the inspection interval between the initial inspection and the end of the design life span. Using these comparisons, it is recommended that bare decks are inspected at 7-year intervals after the initial IRT inspection. For overlay wearing surfaces, it is recommended that IRT inspections are completed at 5-year intervals after the initial IRT inspection. If an overlay is scheduled, it is recommended that a project-level IRT inspection is completed prior to the new overlay placement.

10.5 Inspection Validity Before Rehabilitation

IRT inspection accuracy and how long an IRT inspection is valid are important for project-level rehabilitation planning. Past IRT survey results were compared to rehabilitation paid quantities.

The age of the IRT inspection at the time of the rehabilitation project was calculated. It was determined that the accuracy of the IRT results depended on when the IRT survey was conducted in relation to when the rehabilitation took place. The optimal correlation between IRT survey results and rehabilitation quantities was when the IRT survey was conducted one to two years before the rehabilitation project for all inspection levels. This resulted in an average difference of 2.4% one year before and 2.1% two years before the rehabilitation project. The average difference of additional rehabilitation quantities increased to 8% if the rehabilitation project was completed three years after the IRT inspection. IRT inspections are recommended to be completed within two years of the planned rehabilitation. This allows for the required time for the design process and project delays after the inspection. It can be expected that the quantity of defects may increase slightly when the rehabilitation project is completed two years after the IRT inspection.

10.6 Rehabilitation Project Comparison

Additional comparison was completed by comparing the IRT defect locations and the location of rehabilitation completed during rehabilitation projects. WisDOT provided rehabilitation plan views from recent projects with the Type 1 preparation areas identified. The IRT defect plan view was overlayed with the Type 1 deck preparation plan view for each bridge. IRT data from the bare decks had the best average of 90.1% of the deck area, matching the rehabilitation findings. Across all projects, the IRT data indicated, on average, 2.8% of the deck area as false positives and 10.6% of the deck area was rehabilitated but was not identified by the IRT survey. It can be expected that some rehabilitation areas are larger than IRT defect areas, as separate defects can be combined during the rehabilitation process. Variations in the IRT defect accuracies between the different wearing surfaces were seen in this project. PMA overlays had higher variation in accuracy compared to bare decks and PCC overlays, but this may be due to the low number of bare decks and PCC inspections available. It is recommended that more project comparison data is collected and analyzed to determine the accuracies of IRT area and rehabilitation areas and understand the relationship between different wearing surfaces.

References

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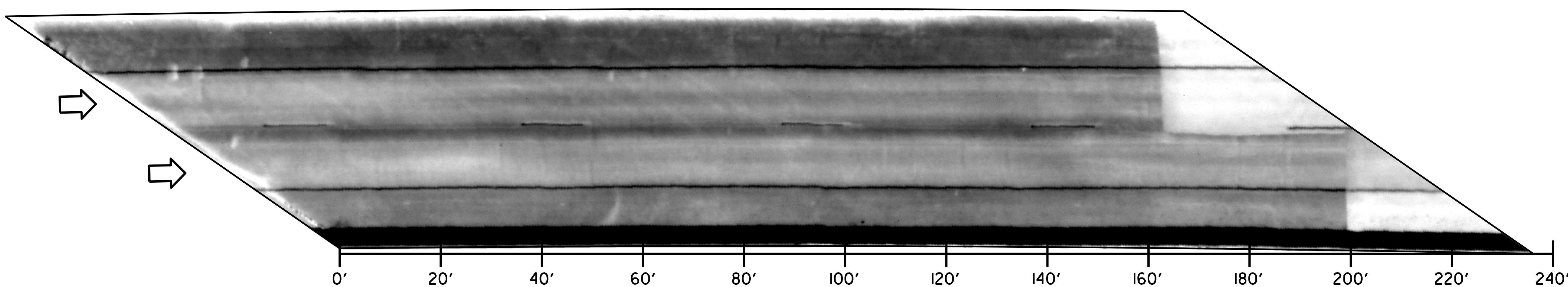
11. Washer, G. (2013). *Field Evaluation of Thermographic Bridge Concrete Inspection Techniques.* Retrieved from https://rosap.ntl.bts.gov/view/dot/27939

Appendix A – Infrared Thermography Method Comparison Images



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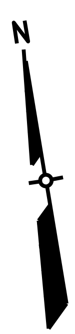
AERIAL INFRARED THERMOGRAPHIC OVERVIEW



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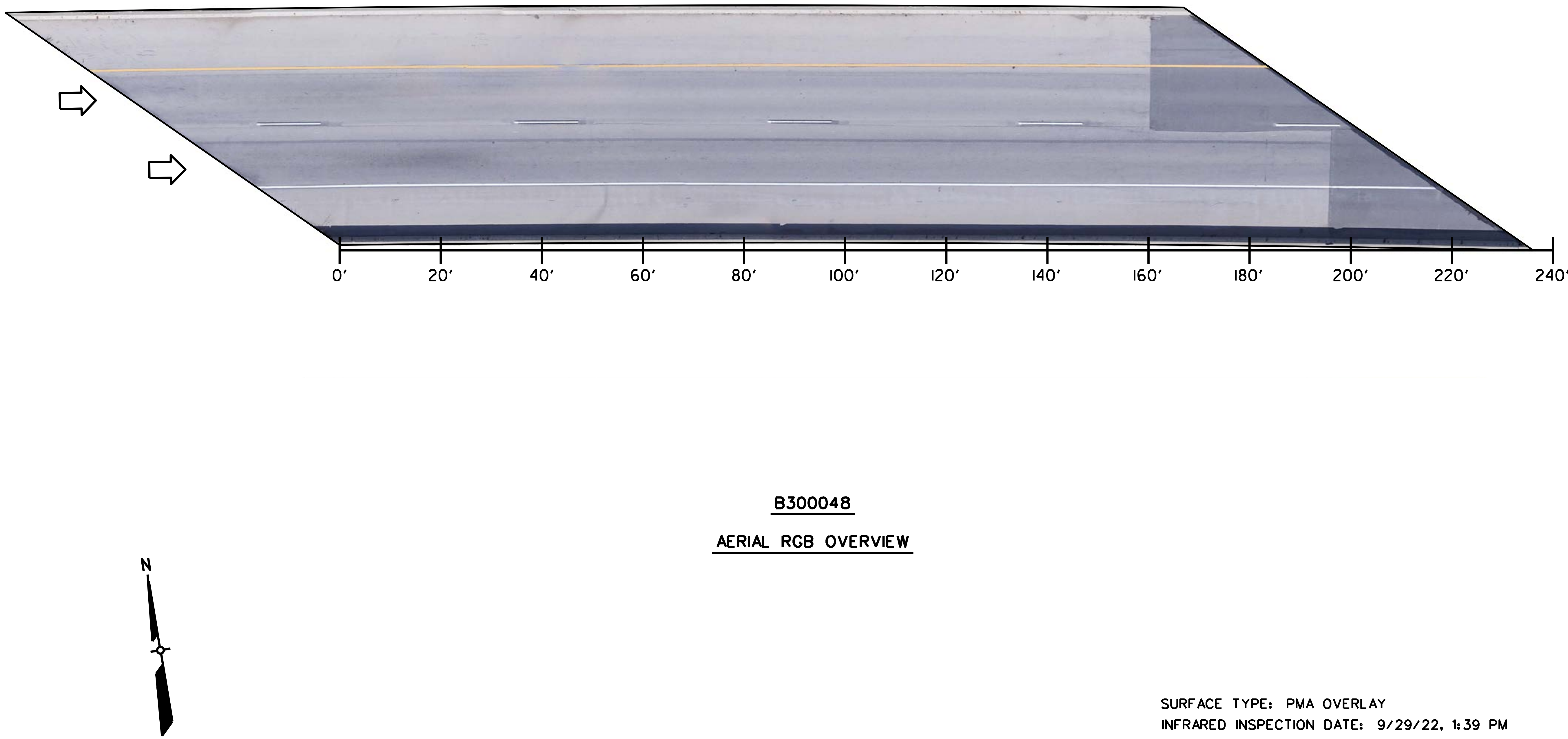

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AERIAL RGB OVERVIEW

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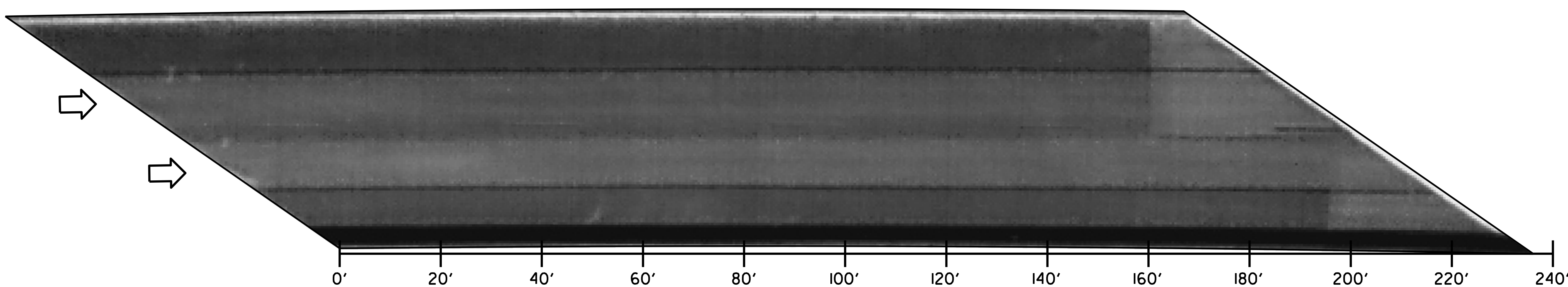
INFRARED INSPECTION DATE: 9/29/22, 1:39 PM



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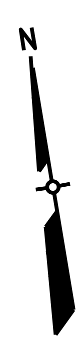
DRONE INFRARED THERMOGRAPHIC OVERVIEW



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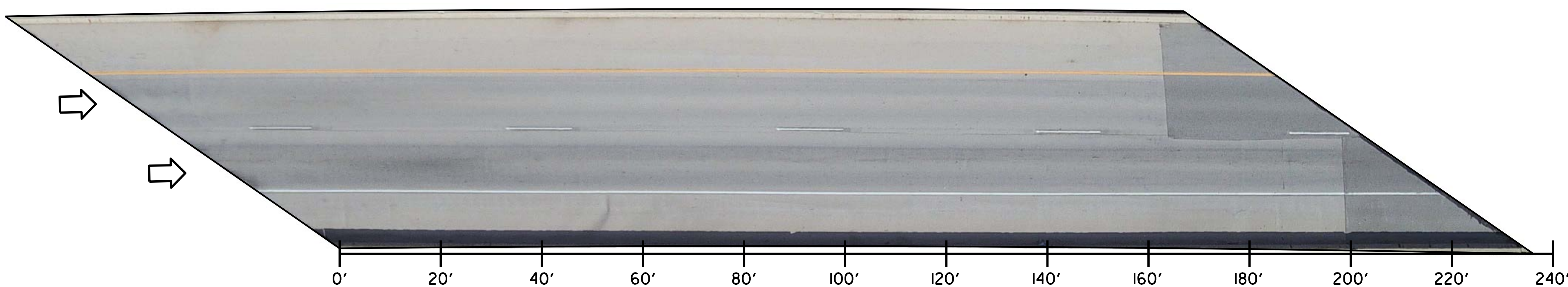

N

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DRONE RGB OVERVIEW

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 10/17/23, 12:45 PM

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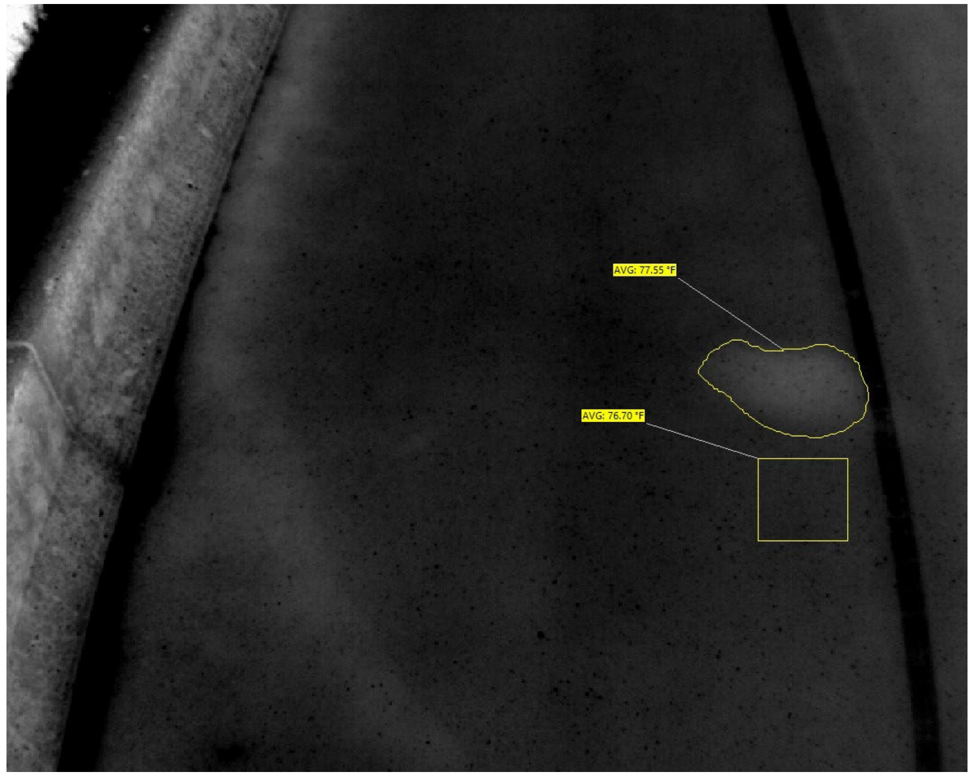
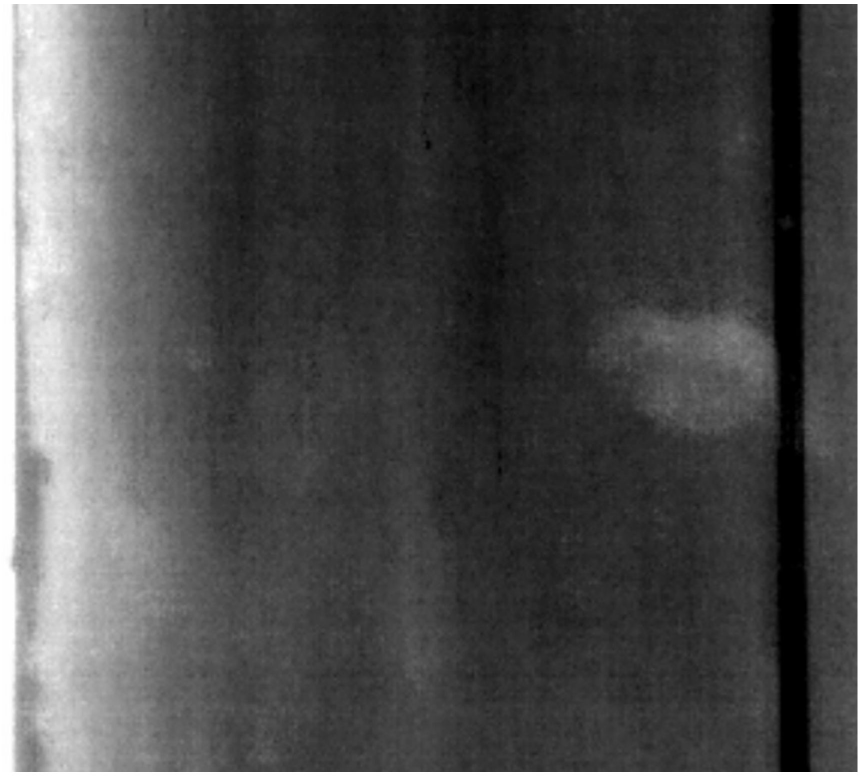
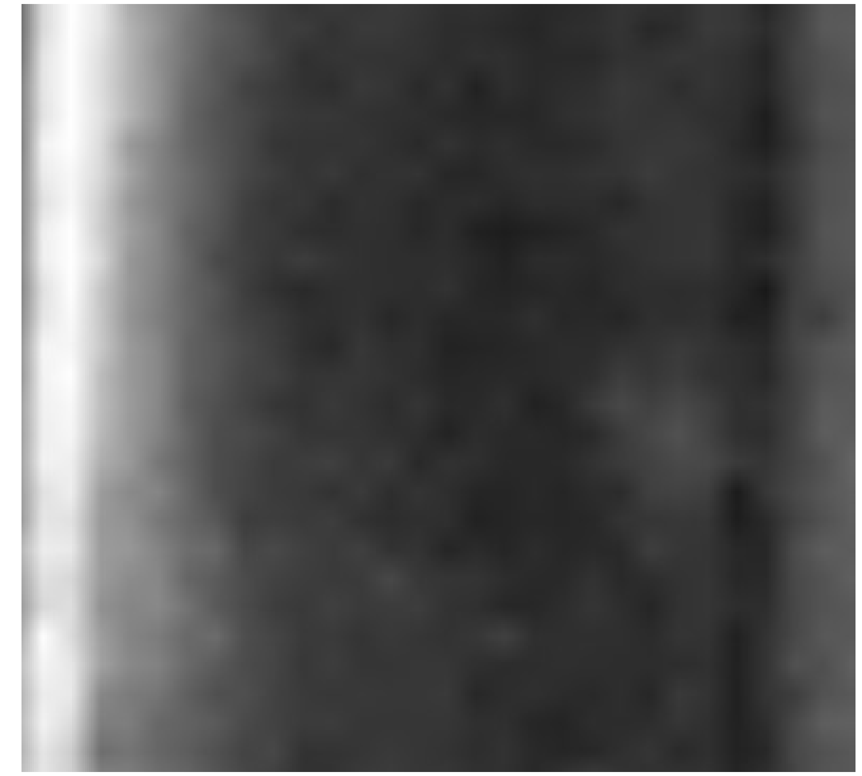
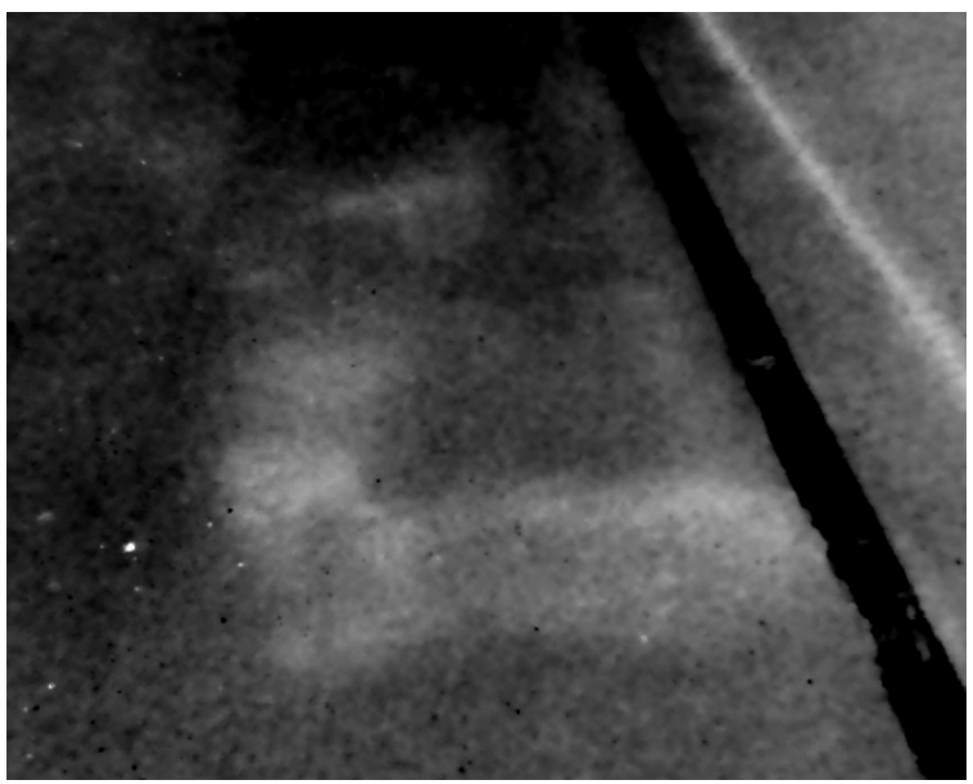
Infrared Thermography Method Comparison Images – Defect 2

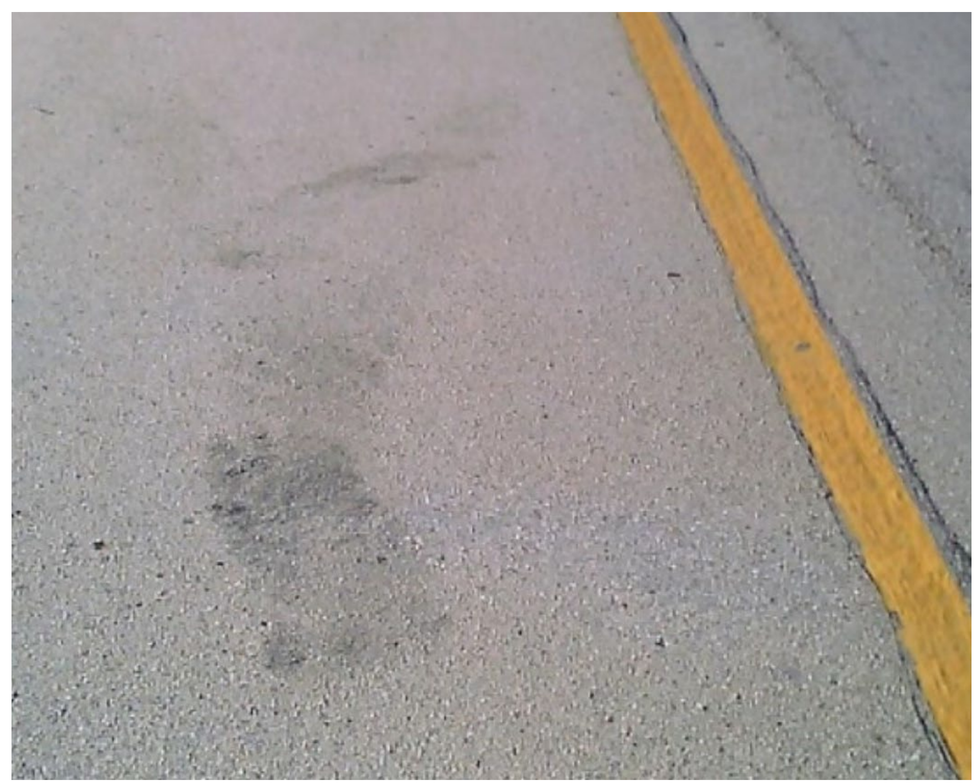


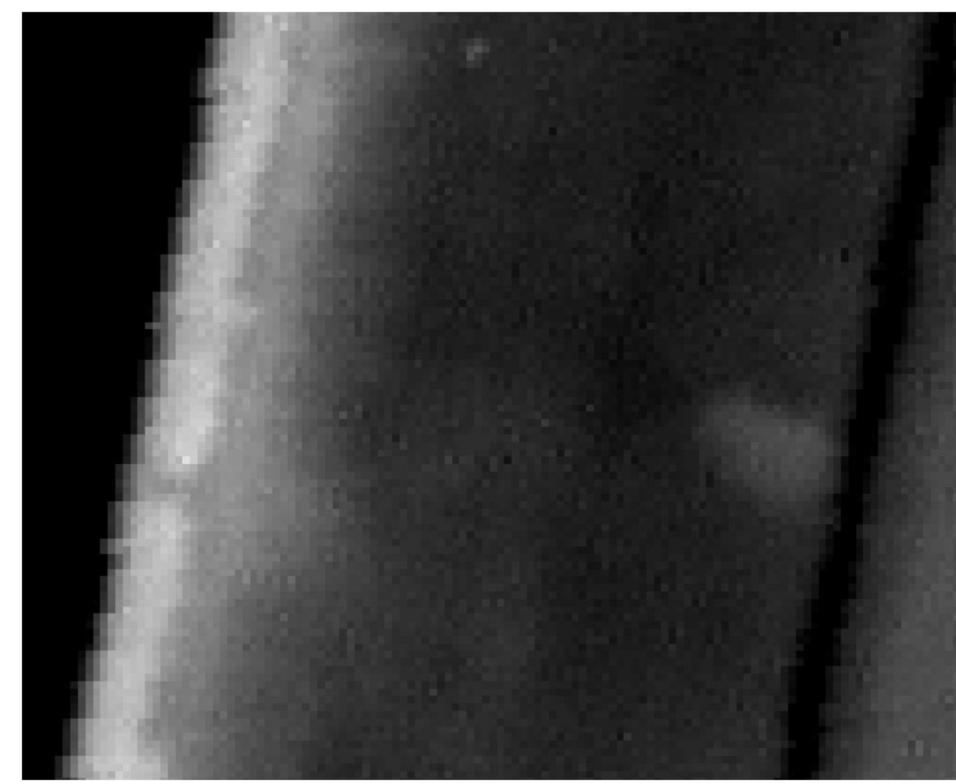
Vehicle Mounted IR Camera

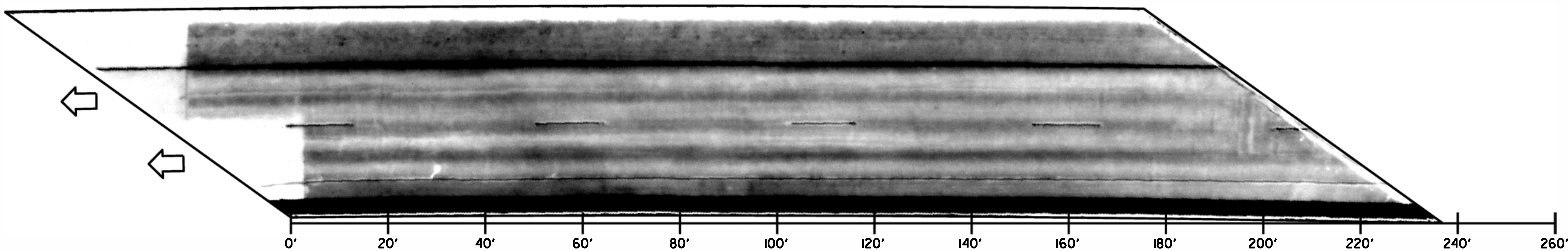

Drone IR Camera (collection height: 30 ft)


Drone IR Camera (collection height: 350 ft)


Handheld IR Camera (tire marks and the defect appear bright – see RGB view)


Handheld IR Camera (RGB view)


Fixed Wing – Aerial IR Camera (collection altitude: 1000 ft)



B300058

AERIAL INFRARED THERMOGRAPHIC OVERVIEW

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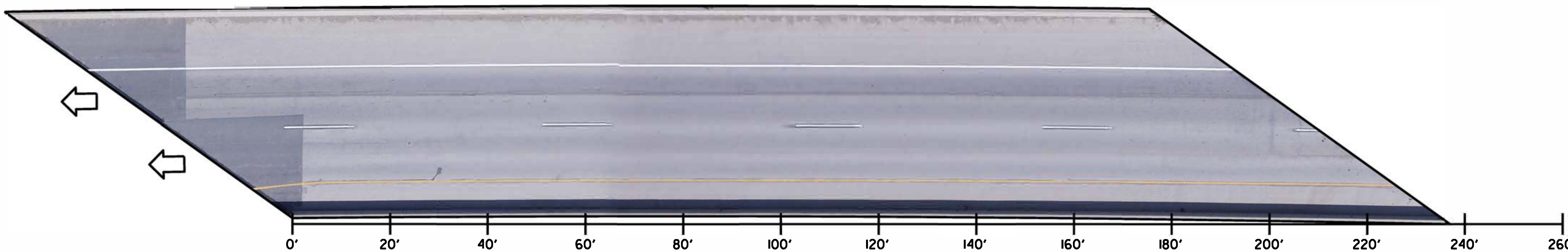

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AERIAL RGB OVERVIEW

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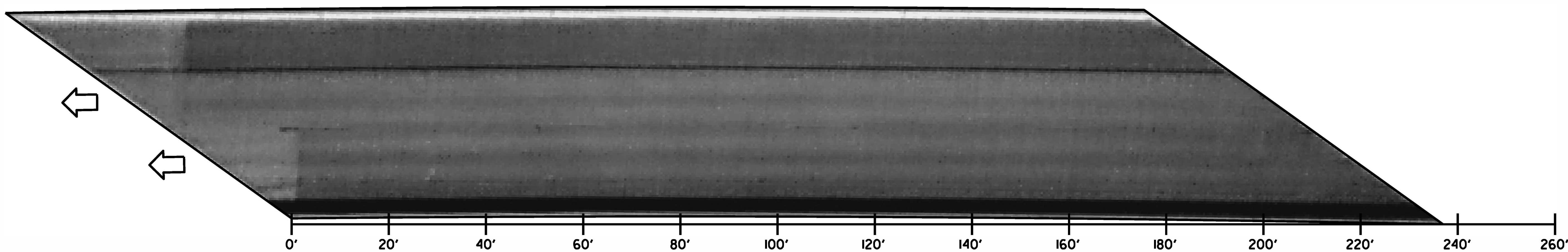

B300058

DRONE INFRARED THERMOGRAPHIC OVERVIEW

SURFACE TYPE: PMA OVERLAY
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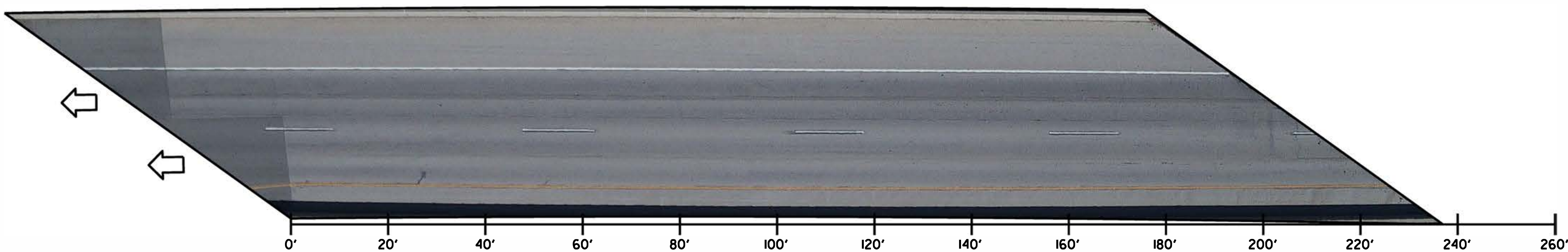

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DRONE RGB OVERVIEW

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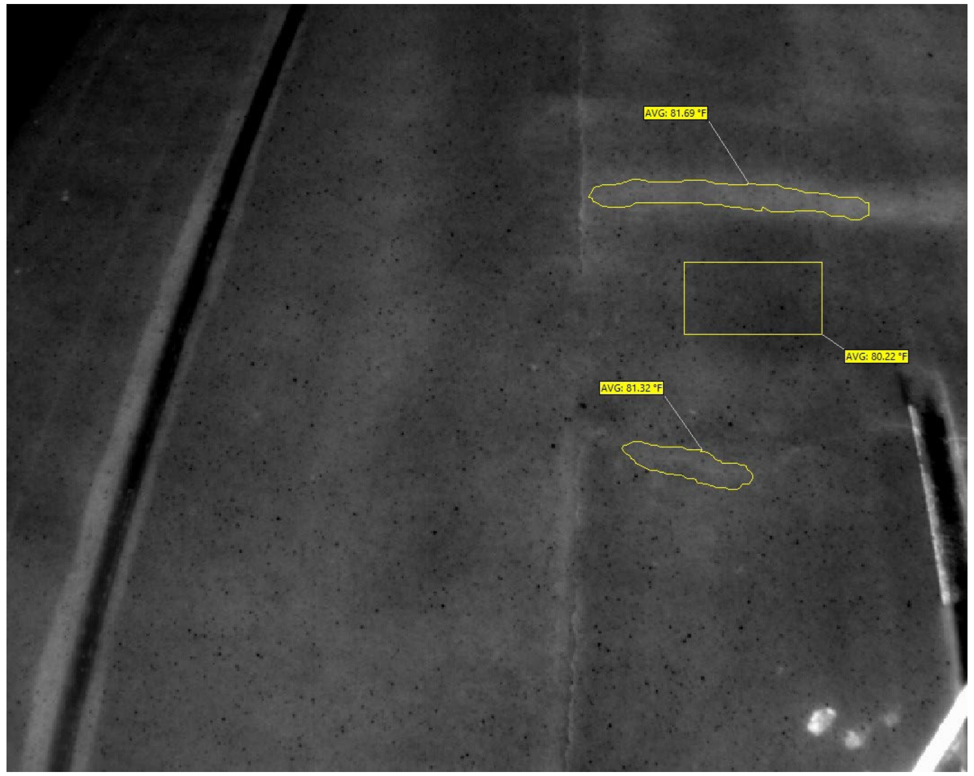
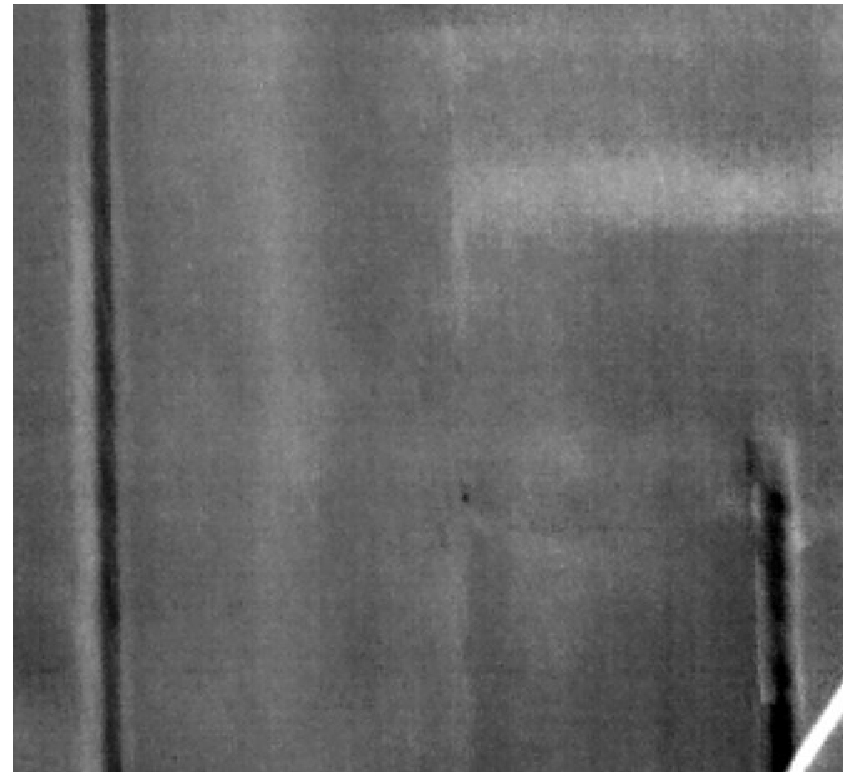
Infrared Thermography Method Comparison Images – Defects 1 and 2

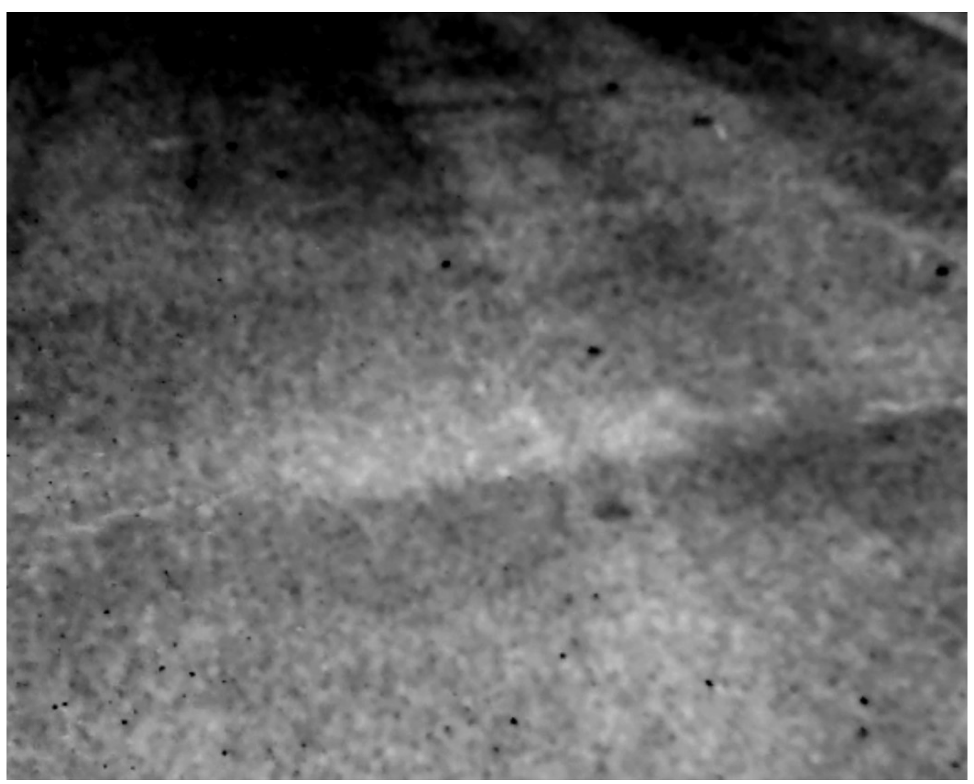


Vehicle Mounted IR Camera



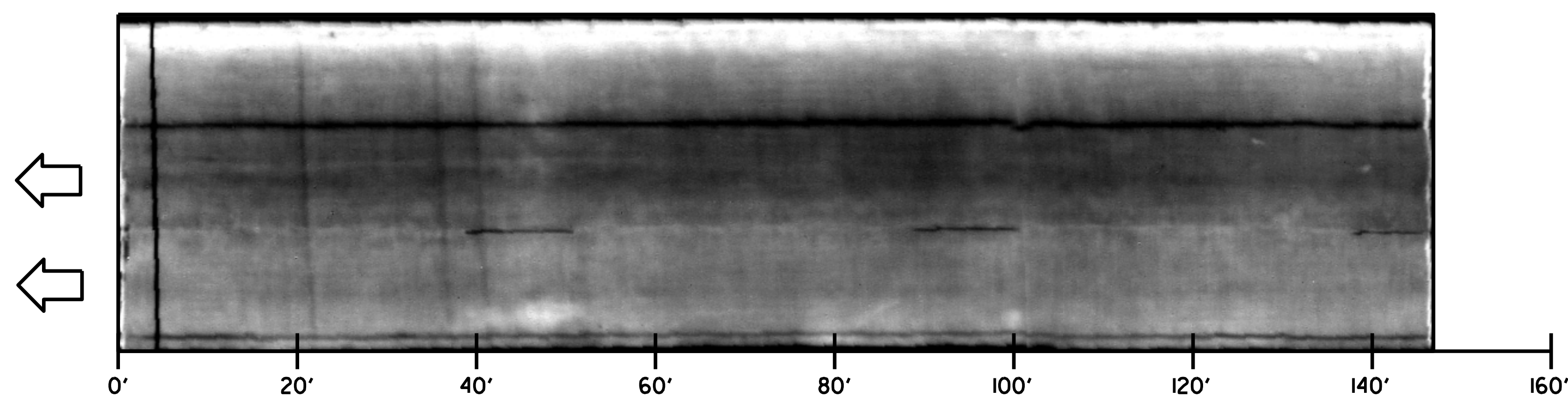
Drone IR Camera (collection height: 30 ft)

Drone IR Camera (collection height: 350 ft)



Handheld IR Camera

Fixed Wing – Aerial IR Camera (collection altitude: 1000 ft)



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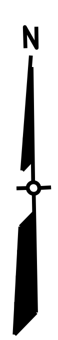

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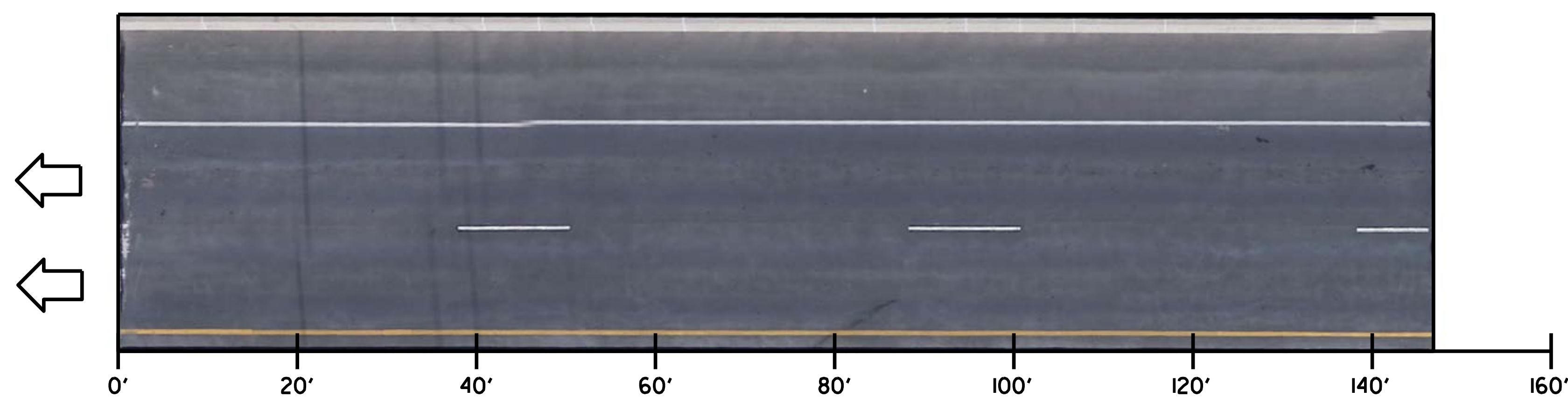

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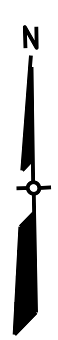

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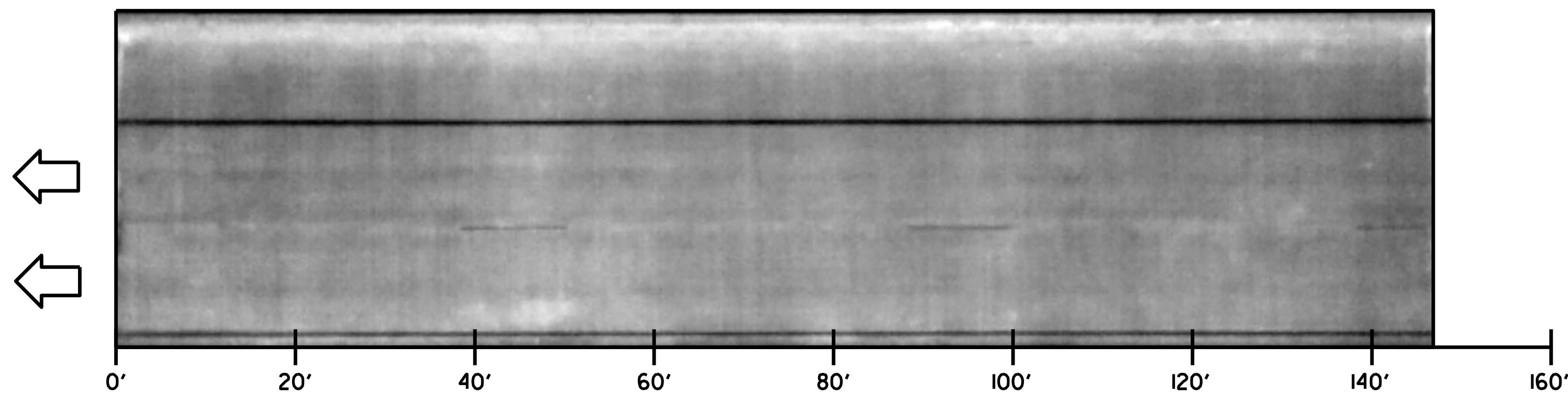

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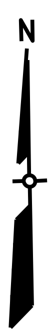

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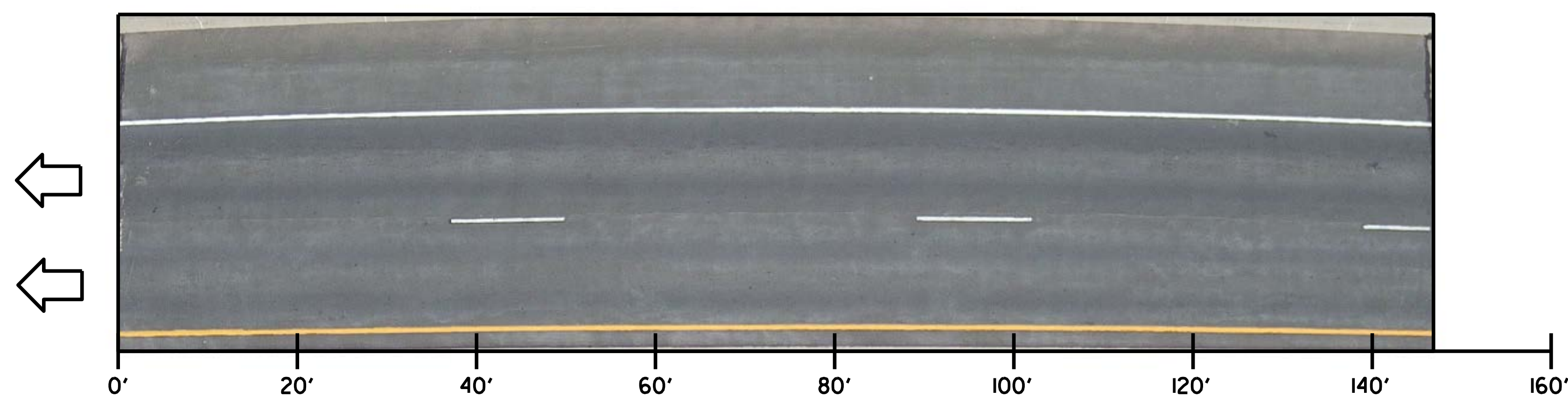

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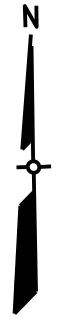

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INFRARED INSPECTION DATE: 10/17/23, 11:05 AM

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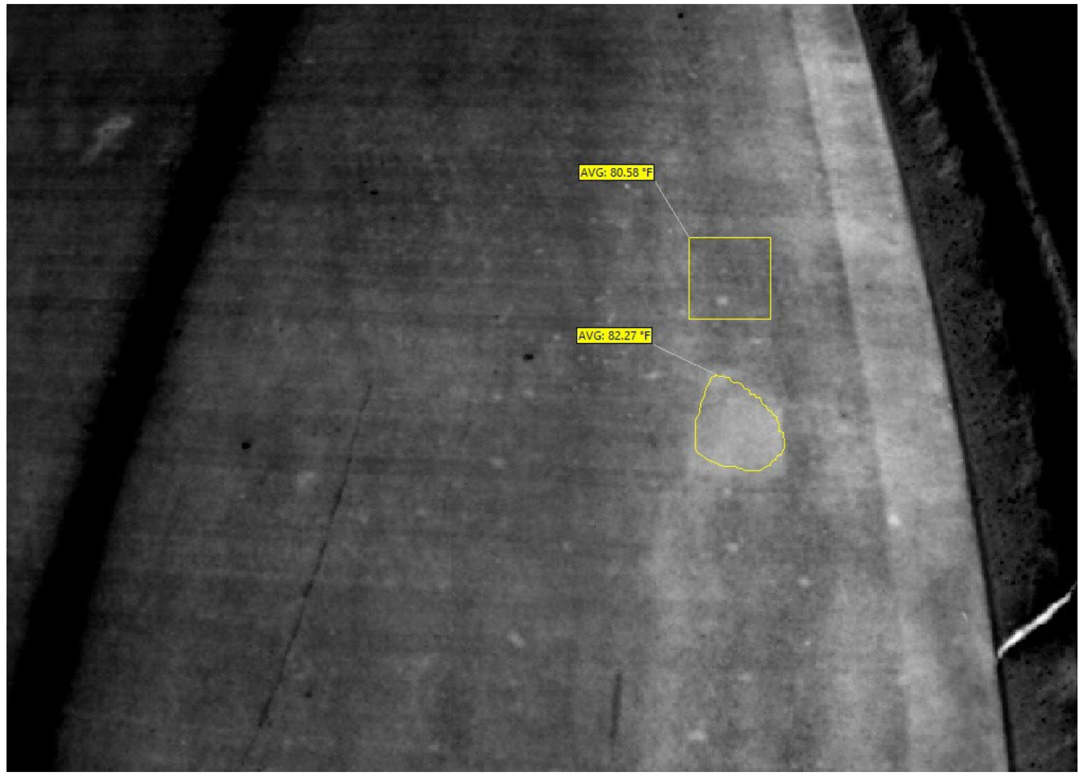
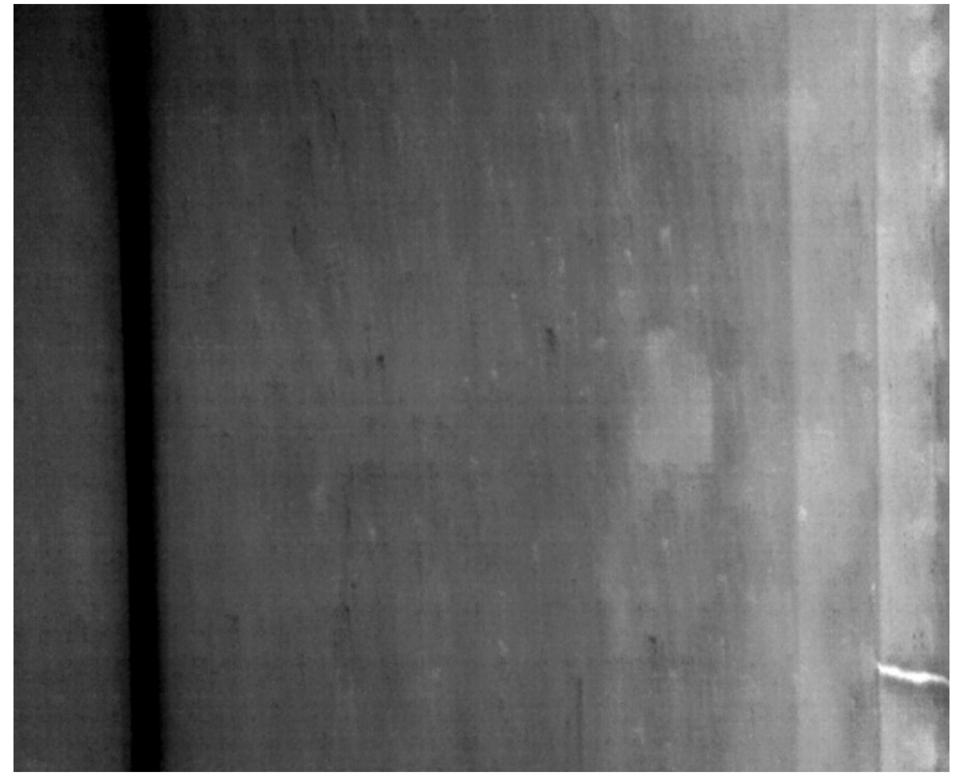
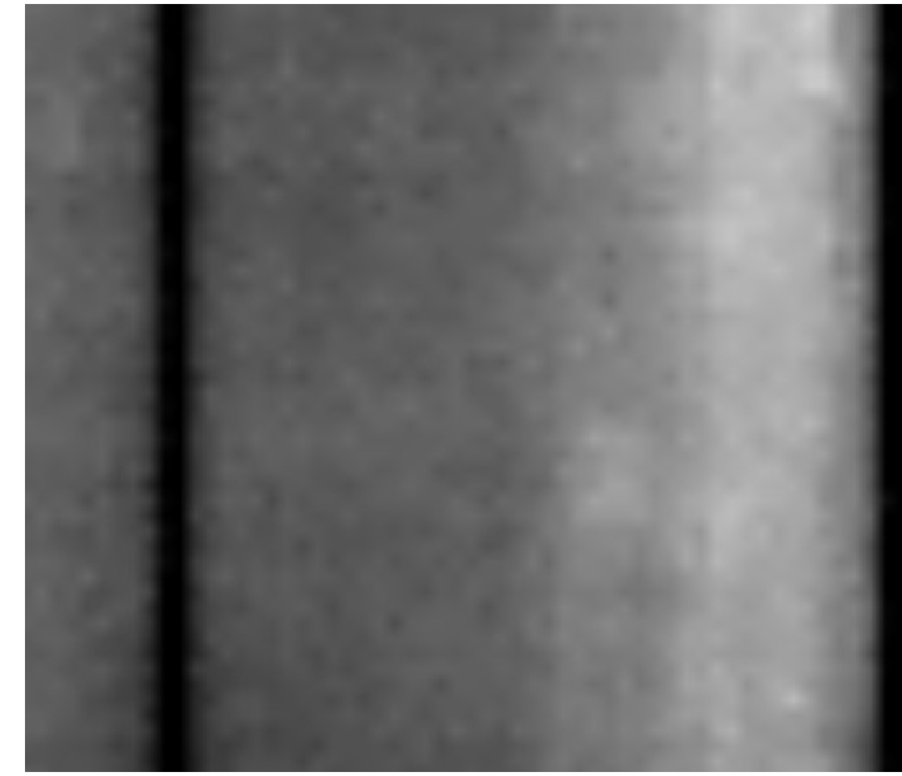
Infrared Thermography Method Comparison Images – Defect 3



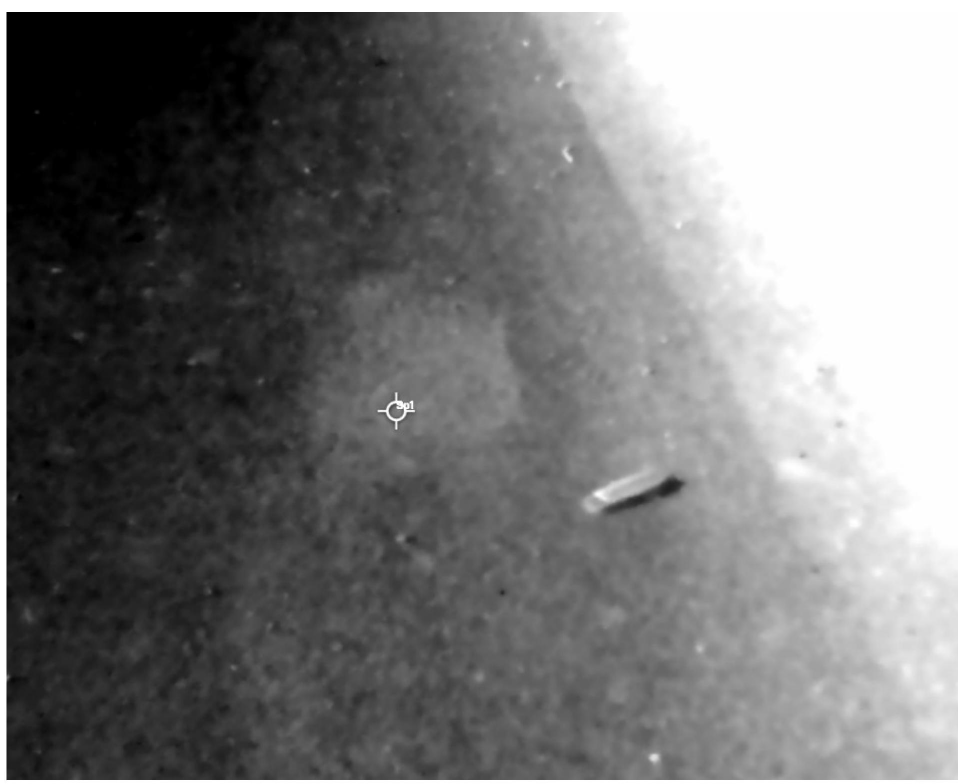
Vehicle Mounted IR Camera



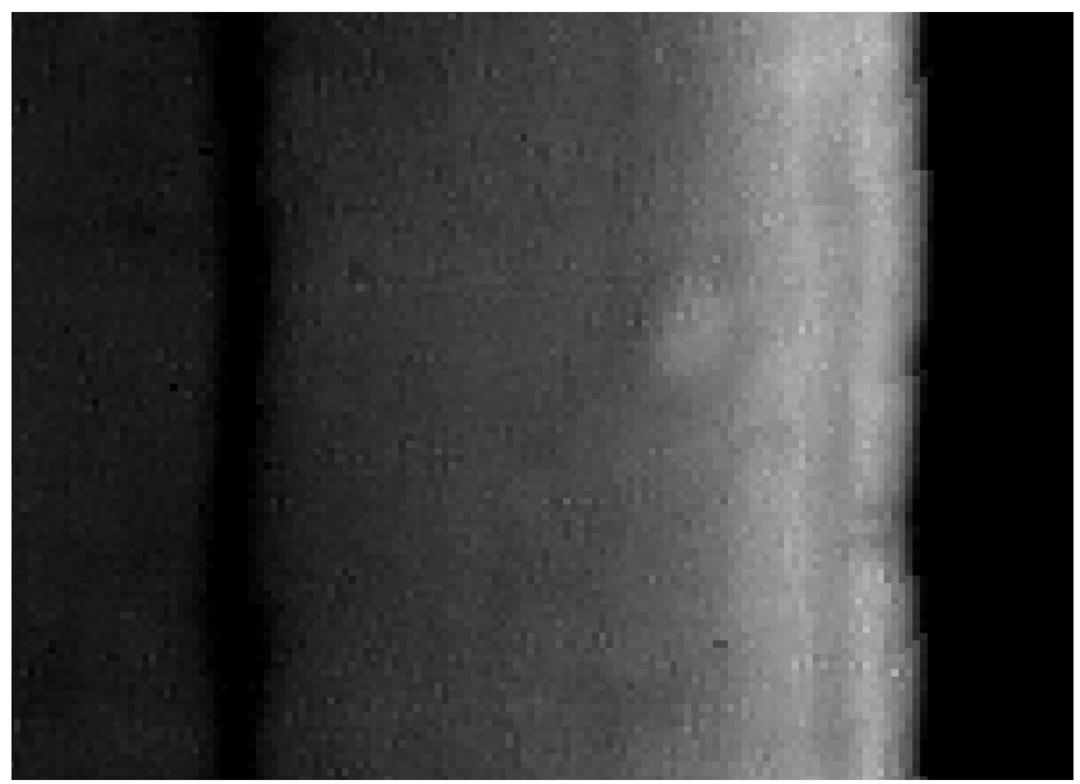
Drone IR Camera (collection height: 25 ft)



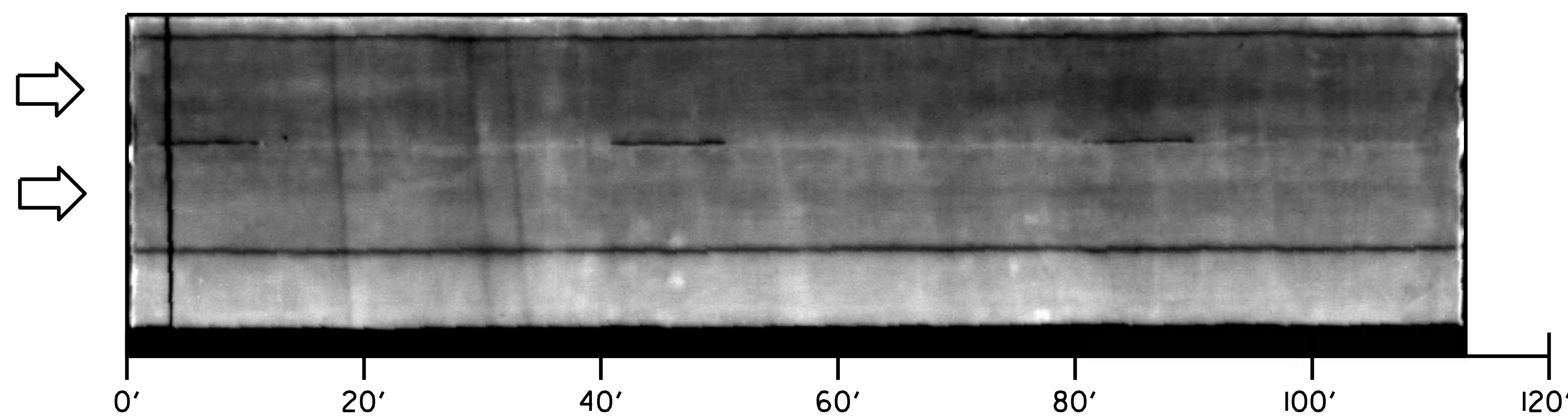
Drone IR Camera (collection height: 200 ft)



Handheld IR Camera



Fixed Wing – Aerial IR Camera (collection altitude: 1000 ft)



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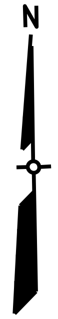
AERIAL INFRARED THERMOGRAPHIC OVERVIEW



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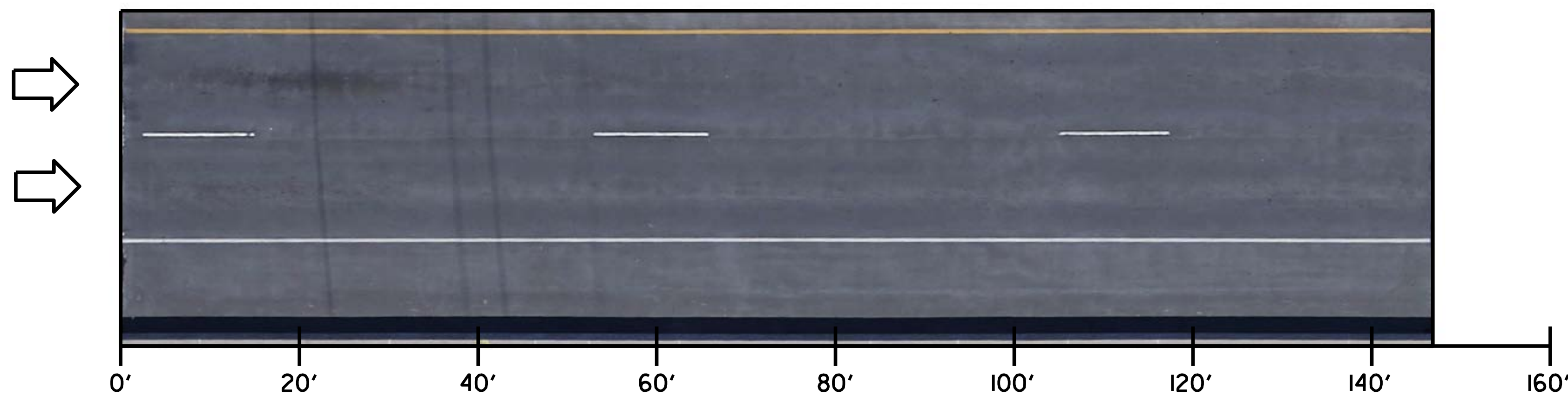

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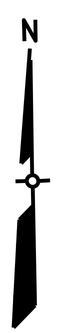
AERIAL RGB OVERVIEW



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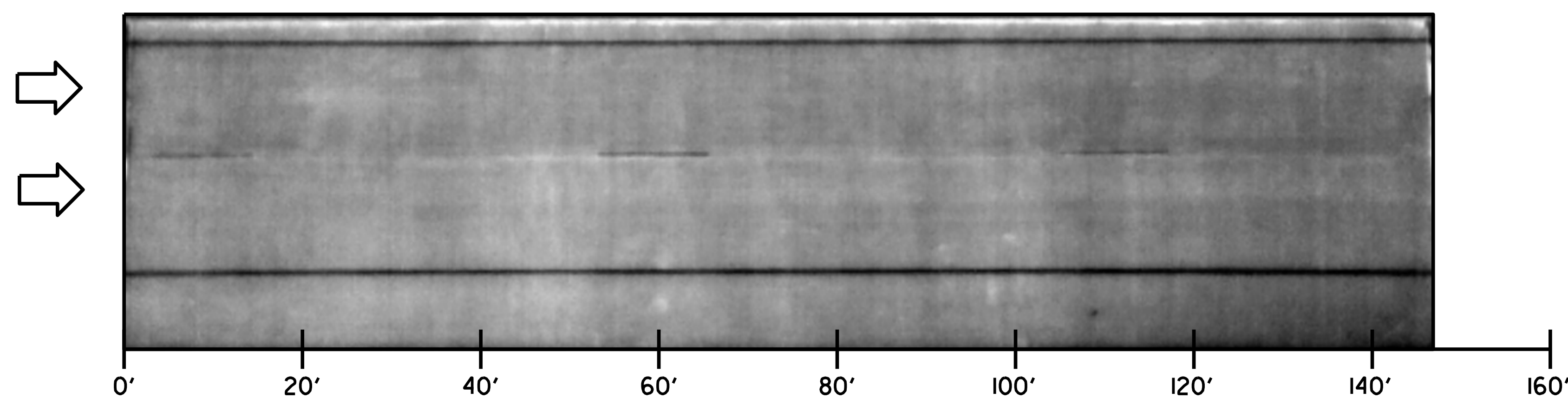

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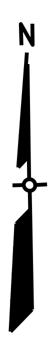
DRONE INFRARED THERMOGRAPHIC OVERVIEW



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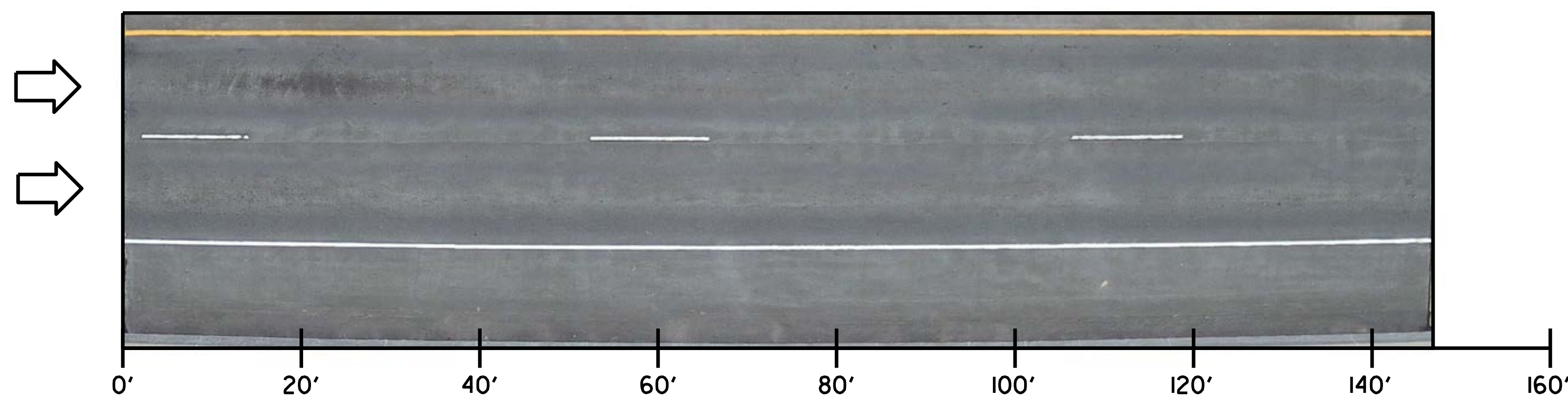
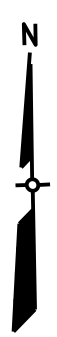


B300074

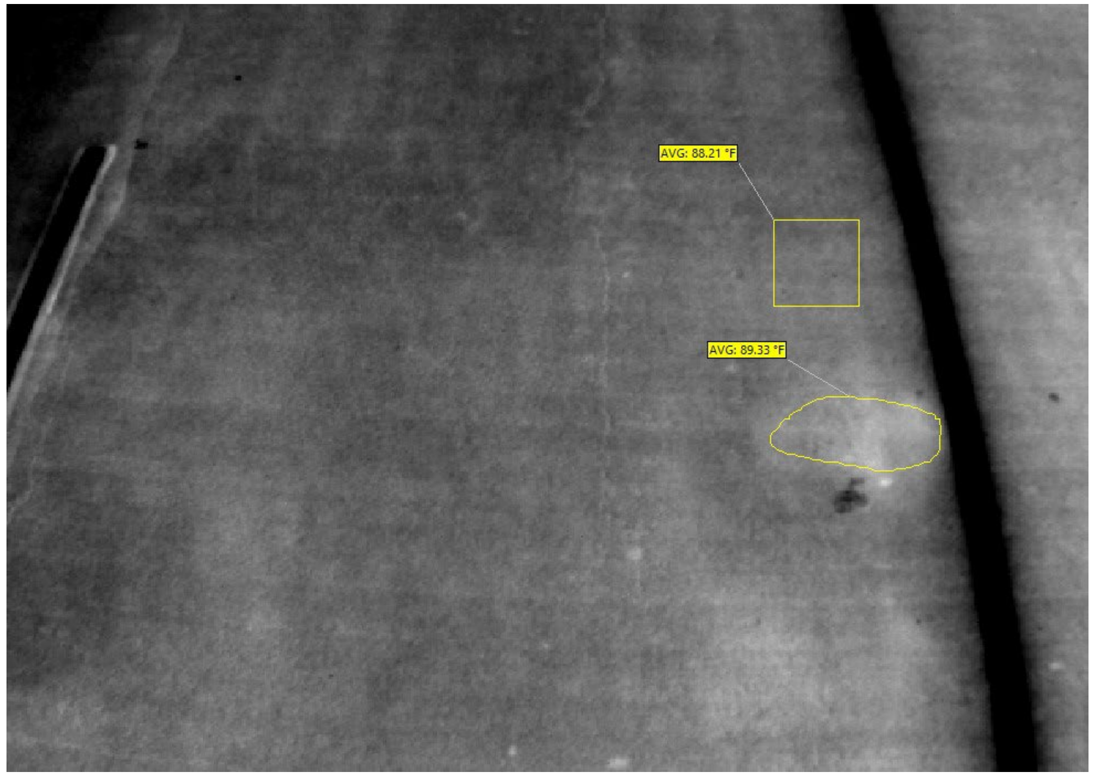
DRONE RGB OVERVIEW



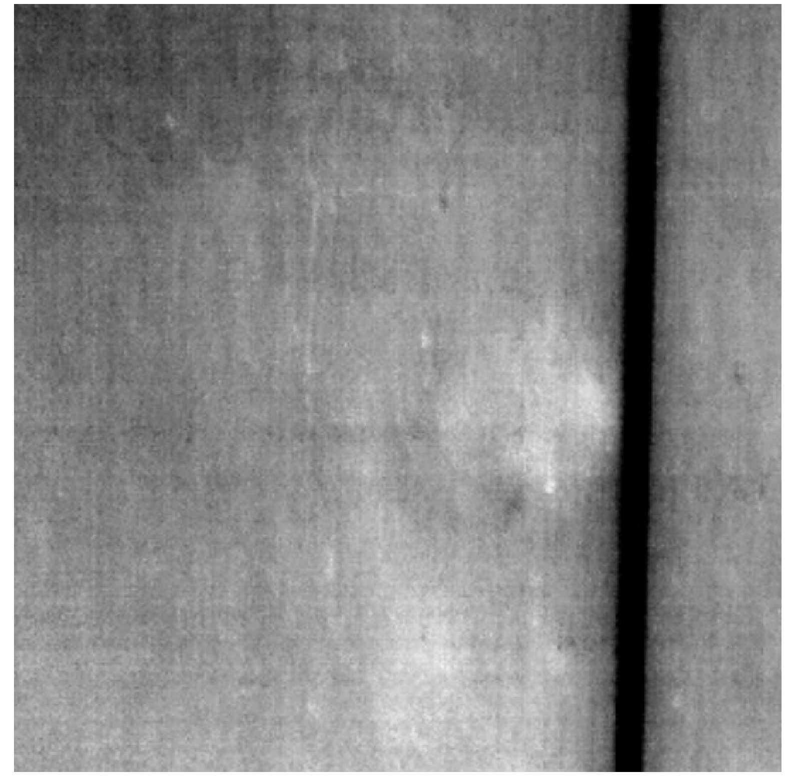
SURFACE TYPE: THIN POLYMER OVERLAY
INFRARED INSPECTION DATE: 10/17/23, 11:05 AM

B300074

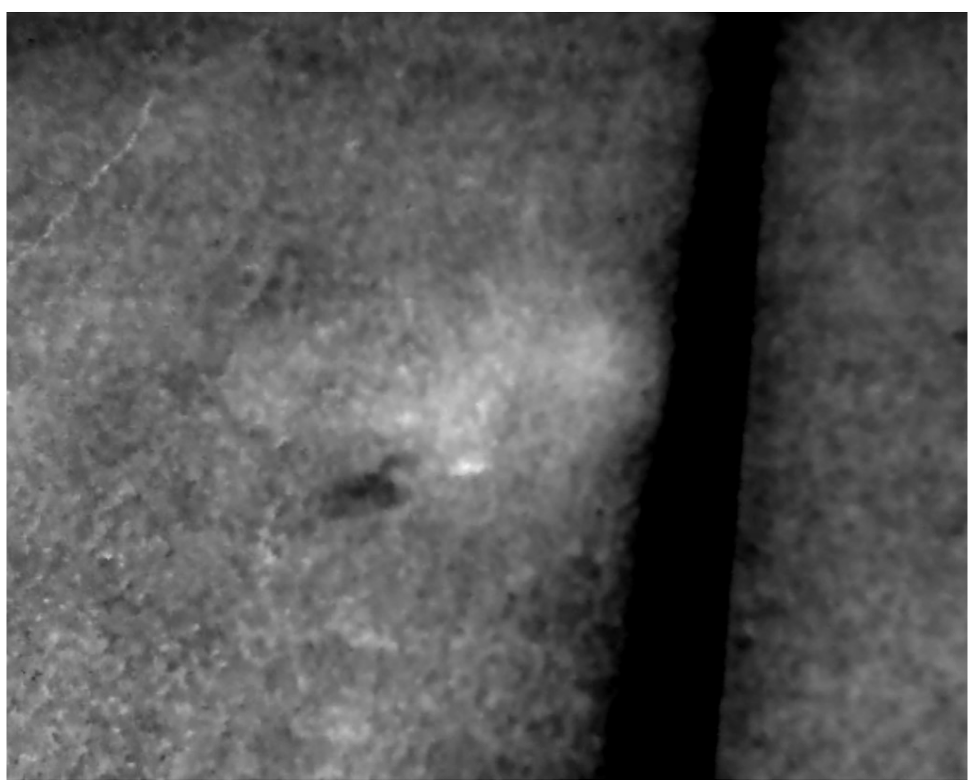
Infrared Thermography Method Comparison Images – Defect 1

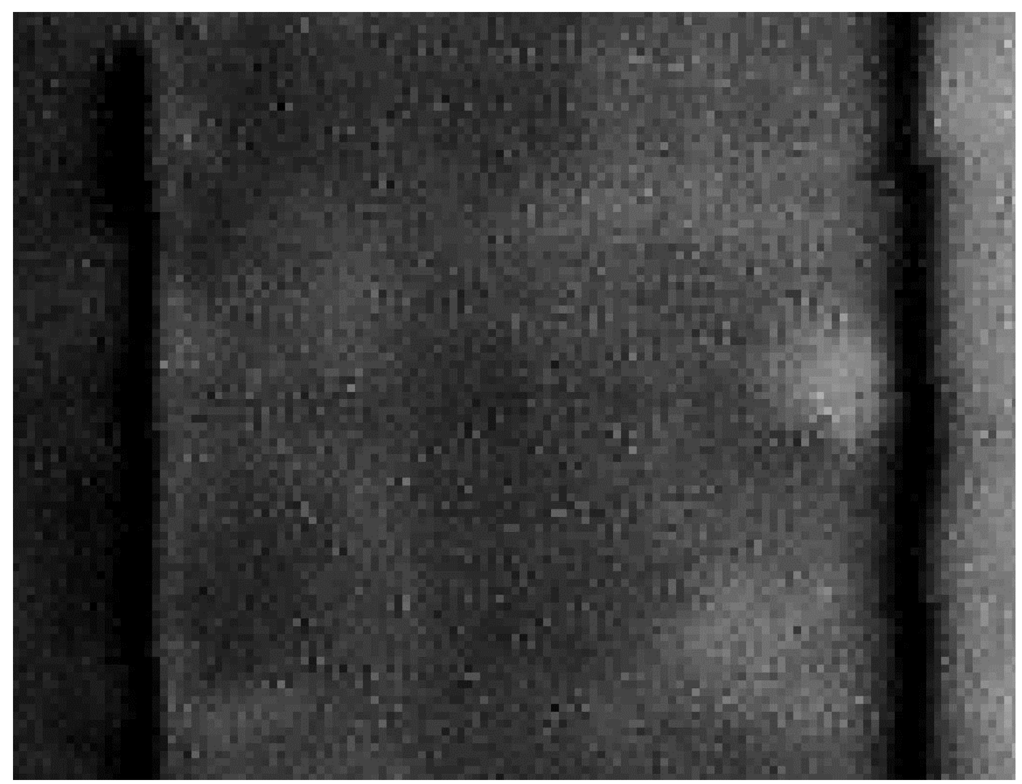


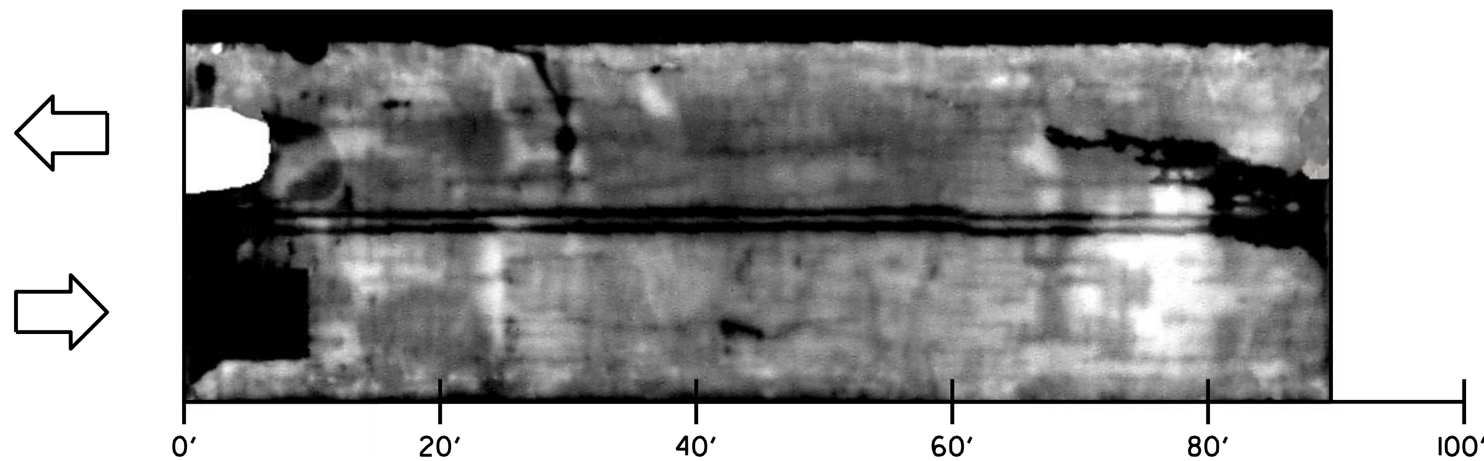
Vehicle Mounted IR Camera

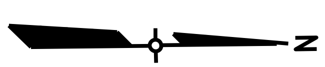

Drone IR Camera (collection height: 25 ft)


Drone IR Camera (collection height: 200 ft)


Handheld IR Camera


Fixed Wing – Aerial IR Camera (collection altitude: 1000 ft)



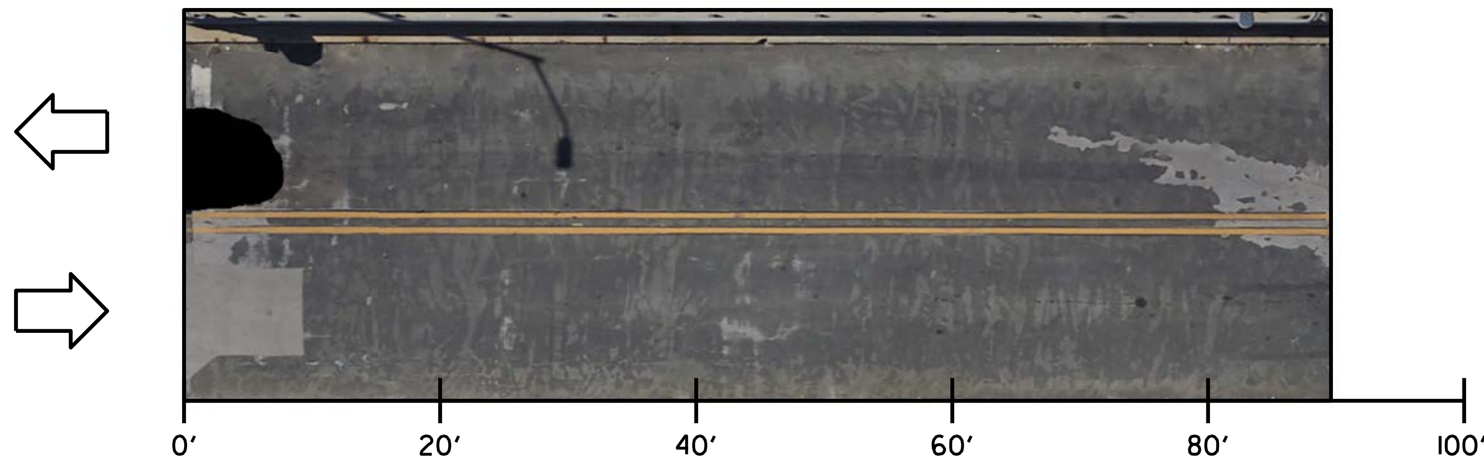


B400330

AERIAL INFRARED THERMOGRAPHIC OVERVIEW

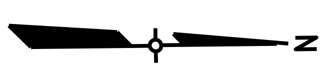
SURFACE TYPE: THIN POLYMER OVERLAY/
CONCRETE OVERLAY

INFRARED INSPECTION DATE: 9/29/22, 12:35 PM



<u>B400330</u>

<u>AERIAL RGB OVERVIEW</u>

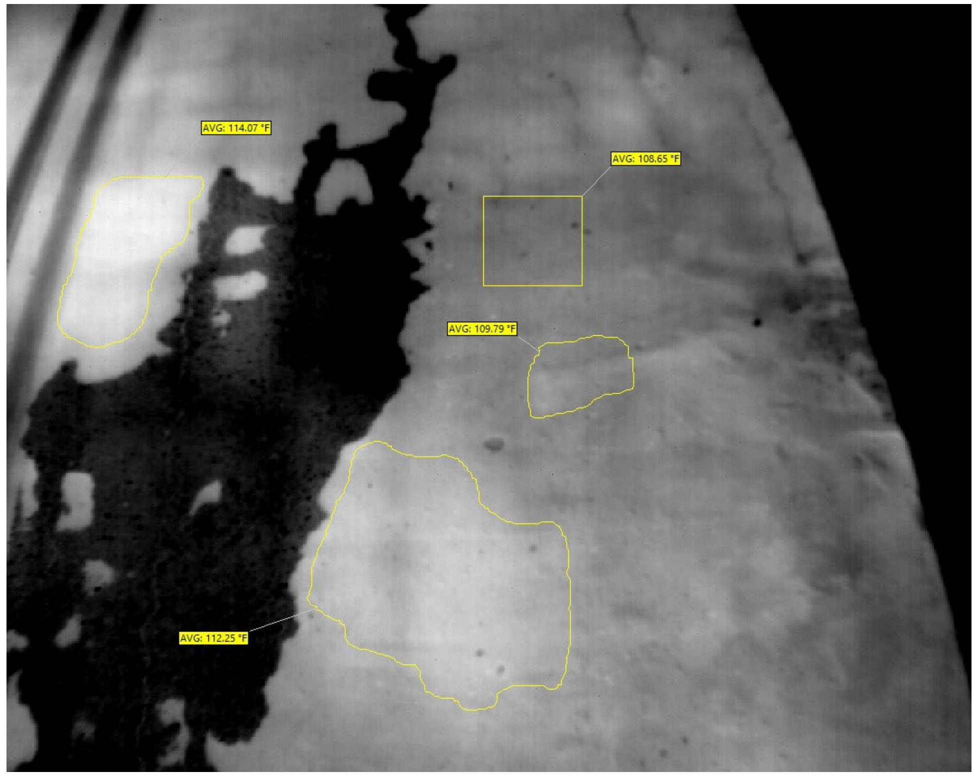


SURFACE TYPE: THIN POLYMER OVERLAY/
CONCRETE OVERLAY

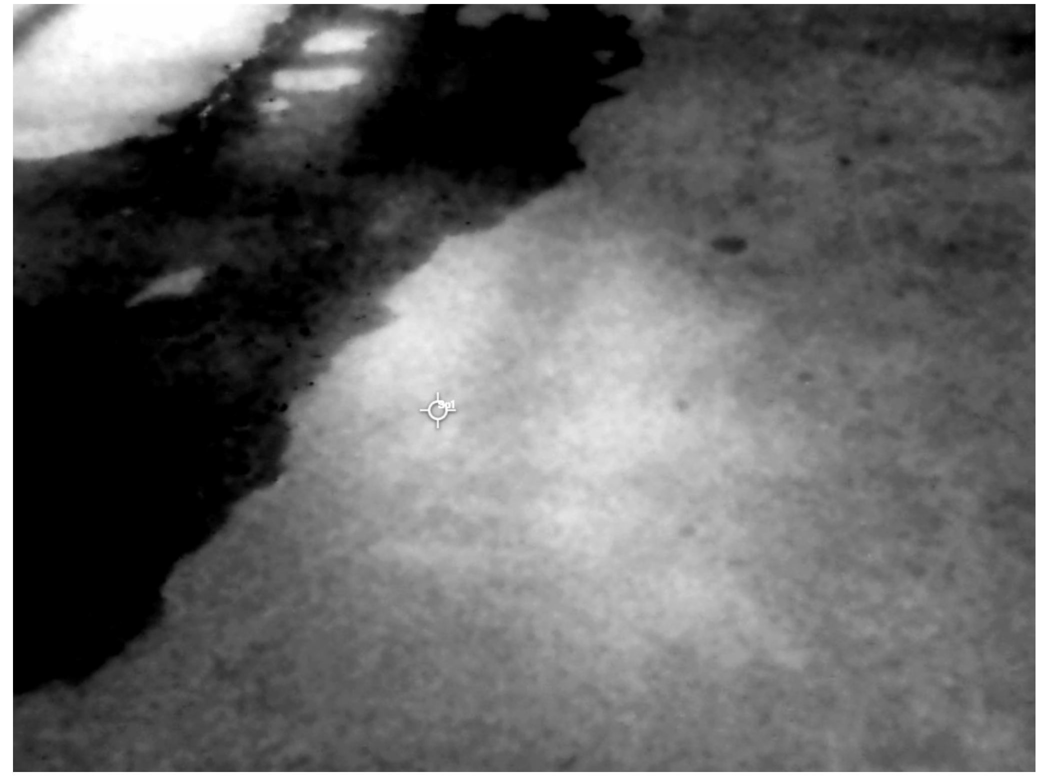
INFRARED INSPECTION DATE: 9/29/22, 12:35 PM

B400330

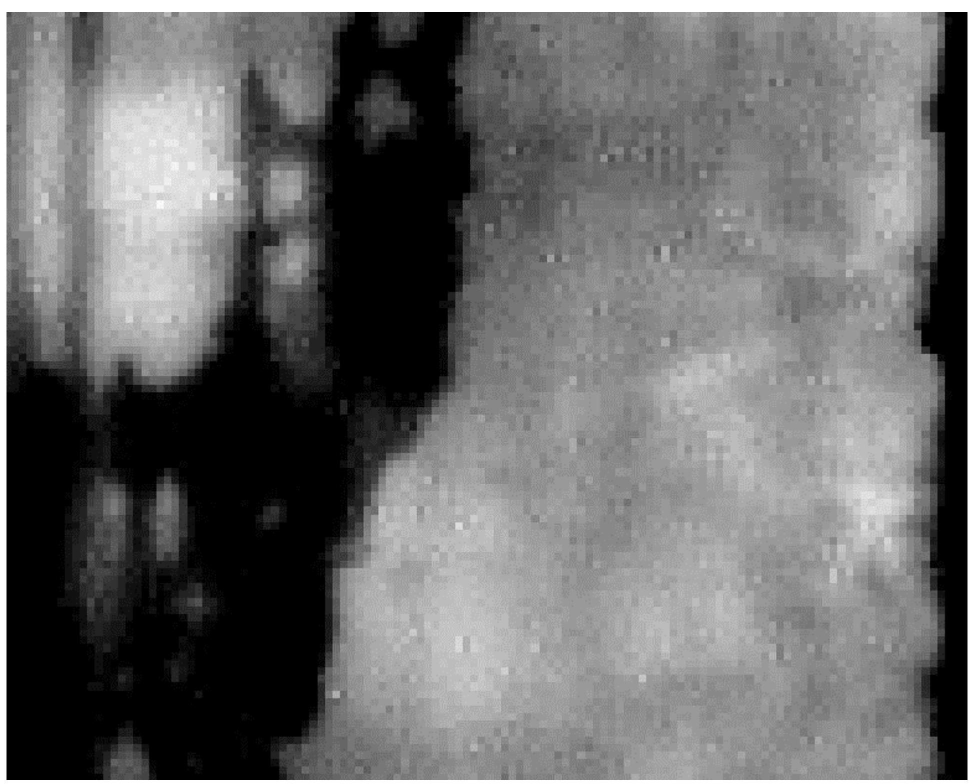
Infrared Thermography Method Comparison Images – Defect 1, 2 and 3



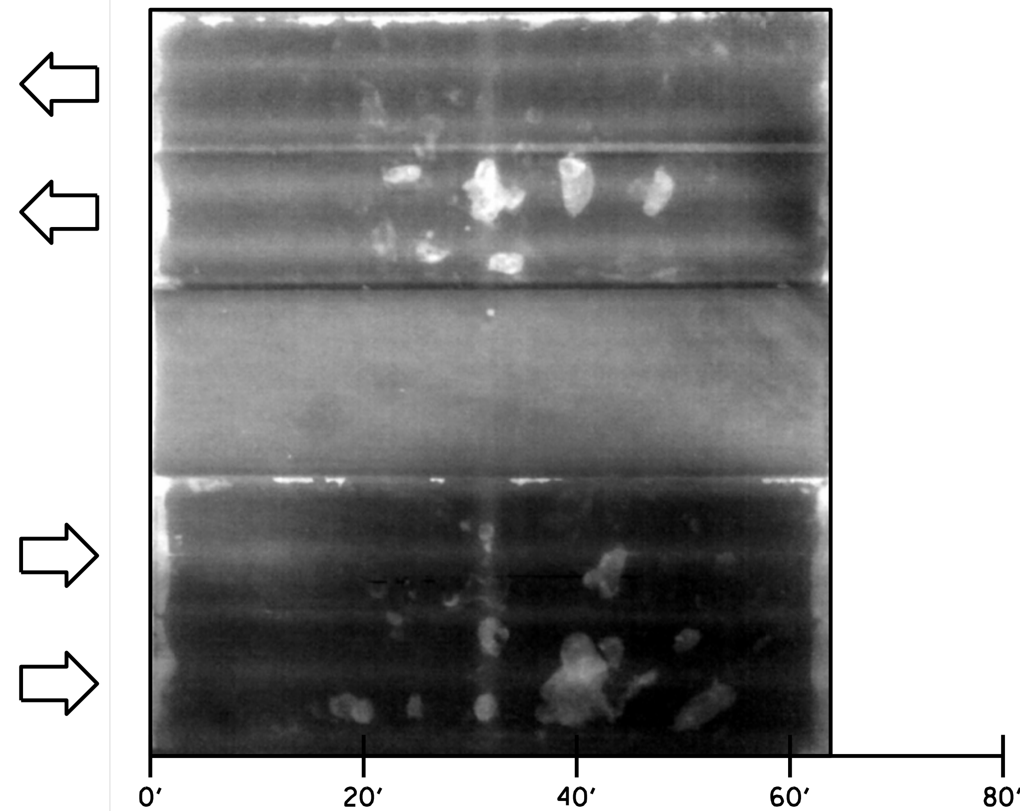
Vehicle Mounted IR Camera



Handheld IR Camera

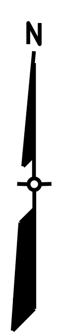


Fixed Wing – Aerial IR Camera (collection altitude: 1000 ft)

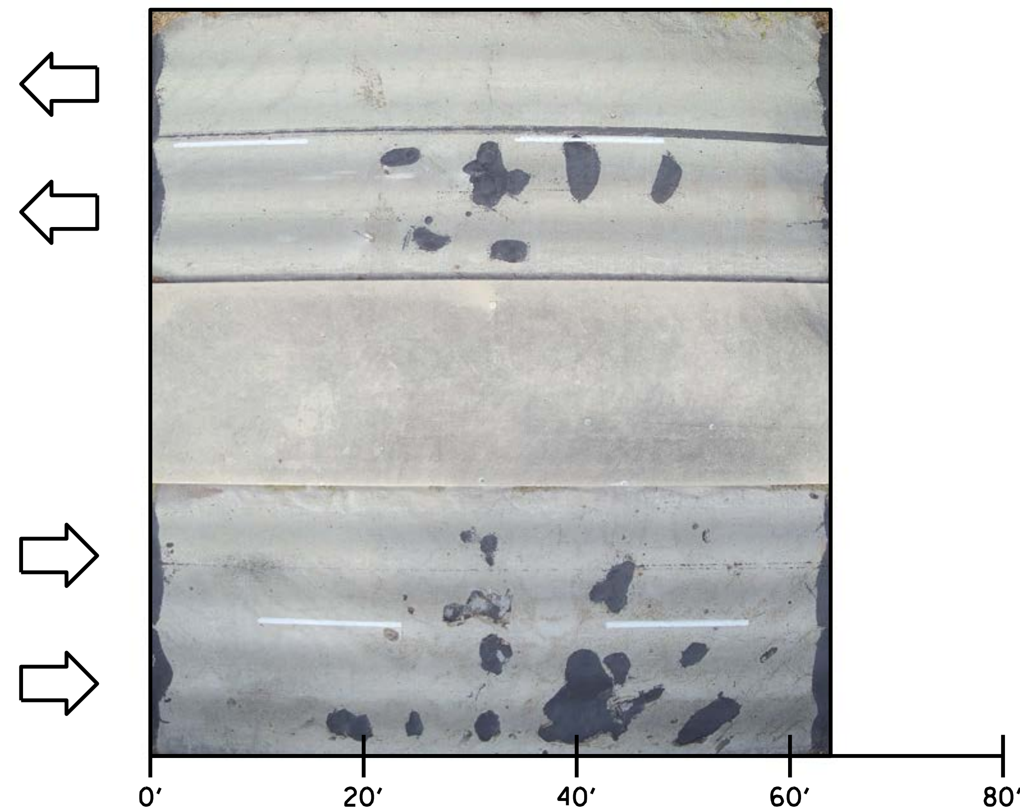


B400519

DRONE INFRARED THERMOGRAPHIC OVERVIEW

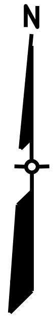


SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 10/17/23, 2:50 PM



B400519

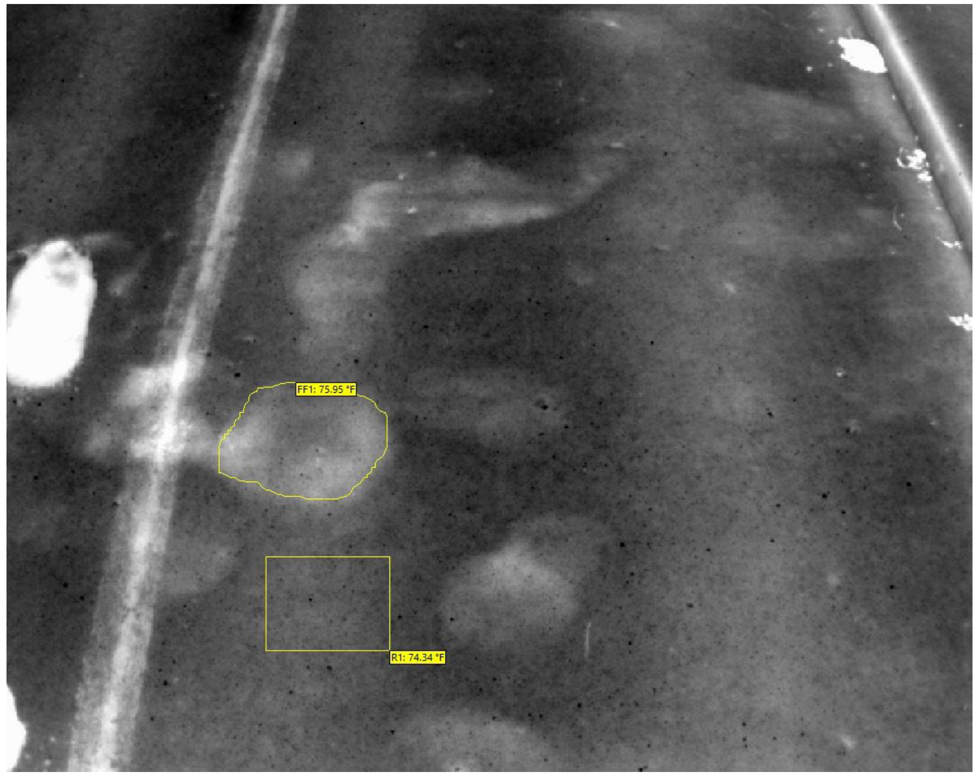
DRONE RGB OVERVIEW



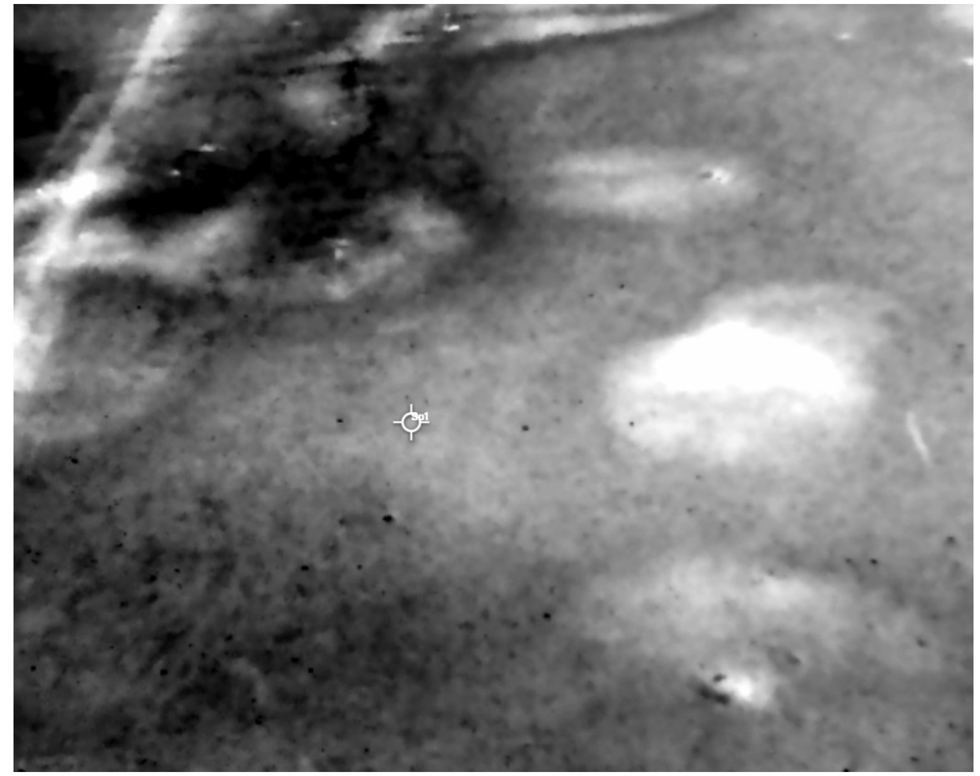
SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 10/17/23, 9:40 AM

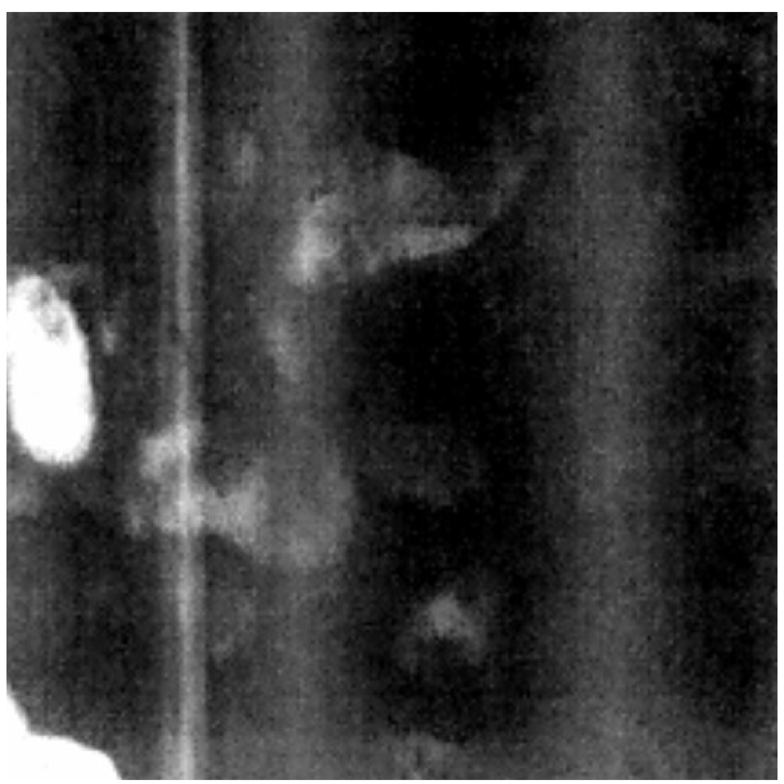
B400519

Infrared Thermography Method Comparison Images – Defect 1

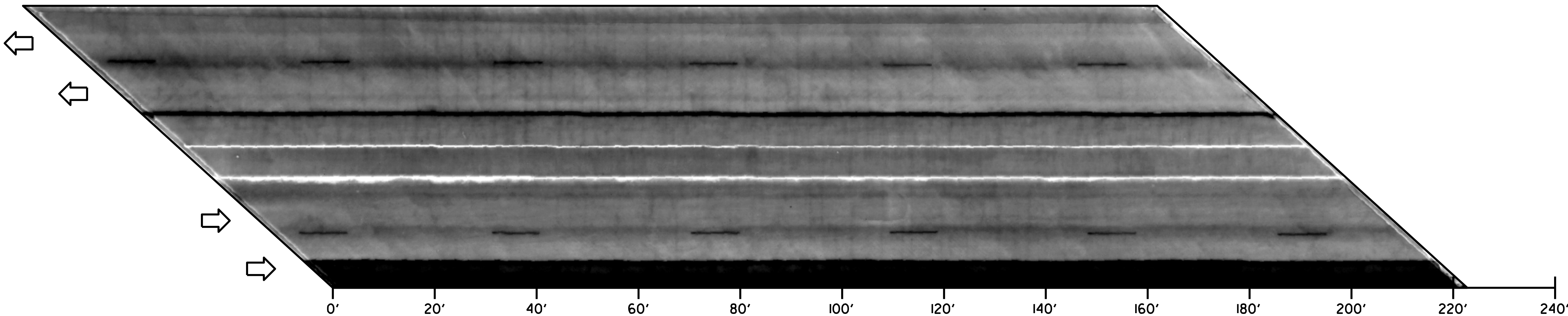


Vehicle Mounted IR Camera


Handheld IR Camera

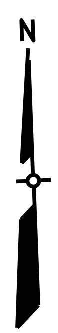

Drone IR Camera (collection height: 50 ft)


Drone IR Camera (collection height: 110 ft)

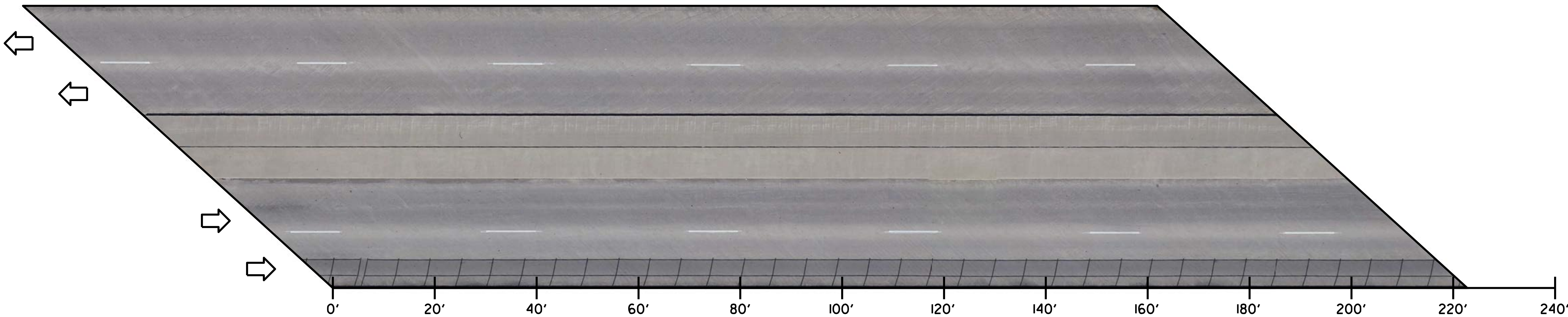


B660030

AERIAL INFRARED THERMOGRAPHIC OVERVIEW

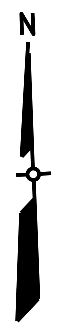


SURFACE TYPE: CONCRETE - NO OVERLAY
INFRARED INSPECTION DATE: 9/29/22, 12:21 PM

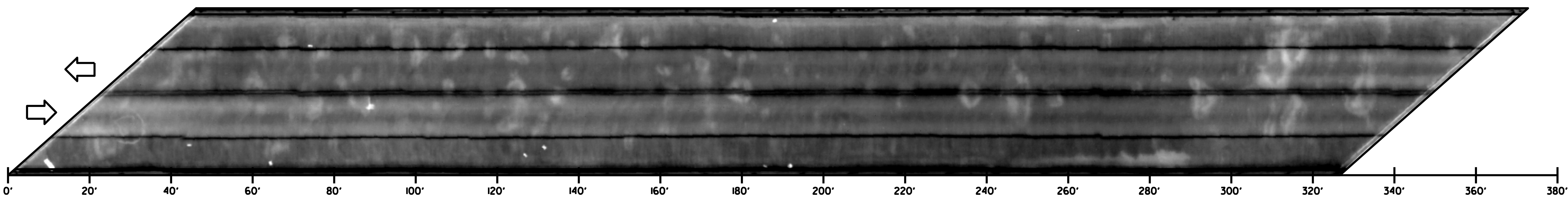


B660030

AERIAL RGB OVERVIEW



SURFACE TYPE: CONCRETE - NO OVERLAY
INFRARED INSPECTION DATE: 9/29/22, 12:21 PM

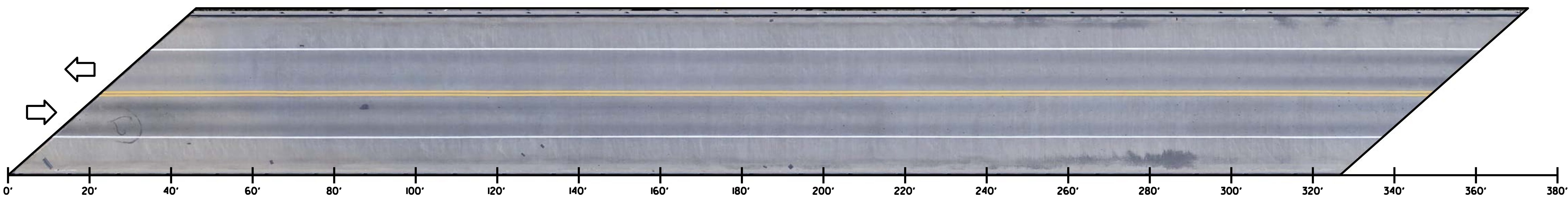


N

B660031

AERIAL INFRARED THERMOGRAPHIC OVERVIEW

SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 9/29/22, 12:16 PM

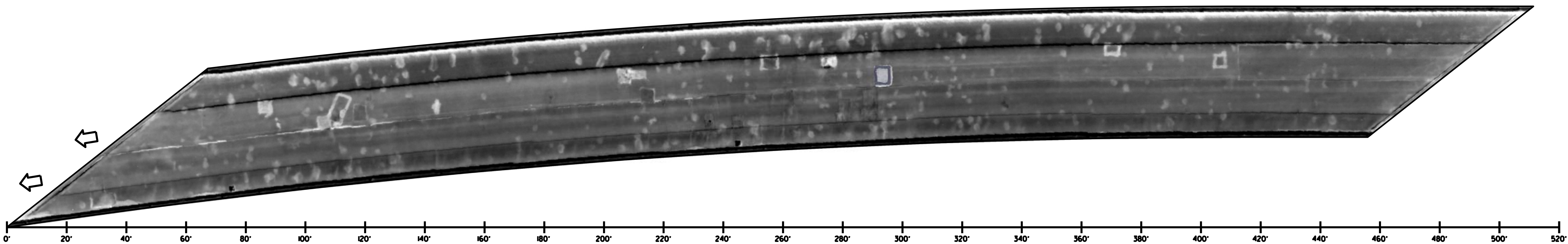


B660031

AERIAL RGB OVERVIEW

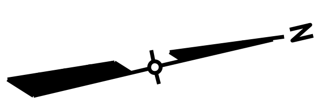
SURFACE TYPE: CONCRETE OVERLAY

INFRARED INSPECTION DATE: 9/29/22, 12:16 PM

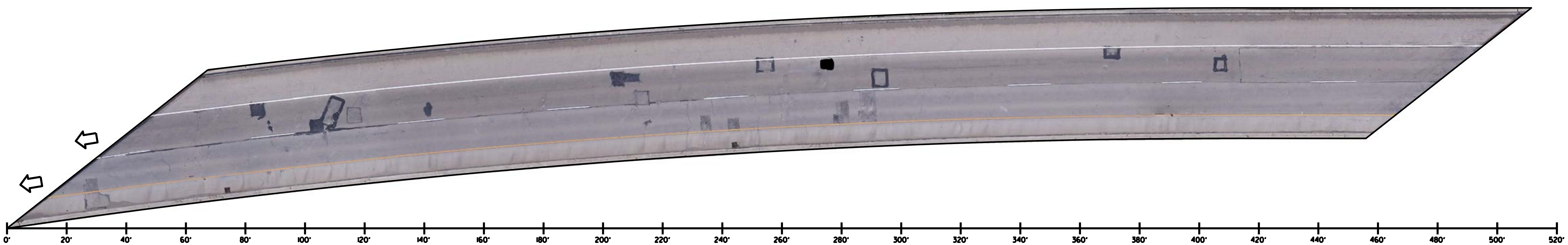


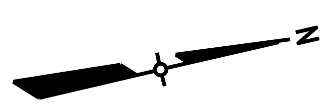
B660037

AERIAL INFRARED THERMOGRAPHIC OVERVIEW



SURFACE TYPE: BITUMINOUS OVERLAY
INFRARED INSPECTION DATE: 9/29/22, 12:14 PM





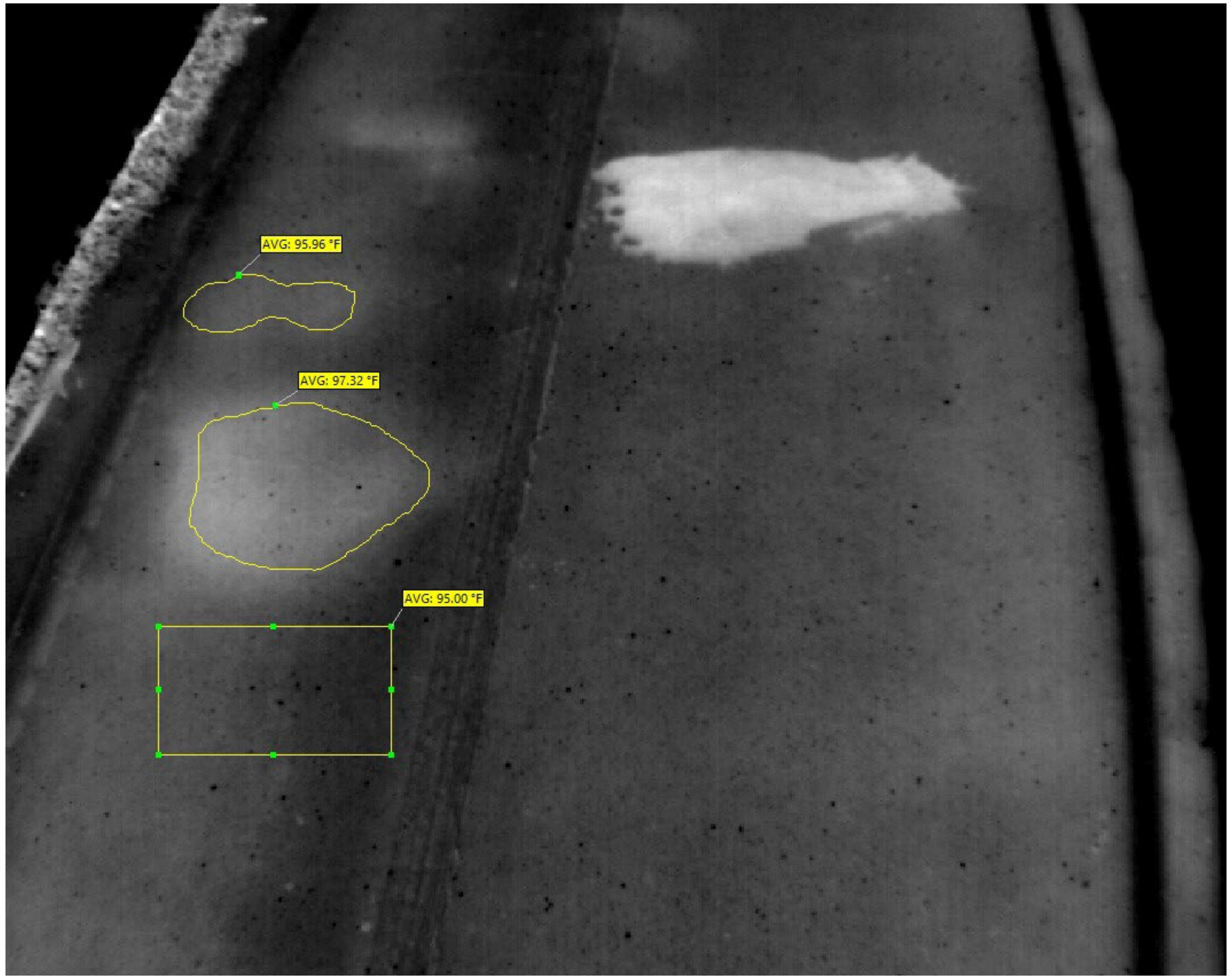
B660037

AERIAL RGB OVERVIEW

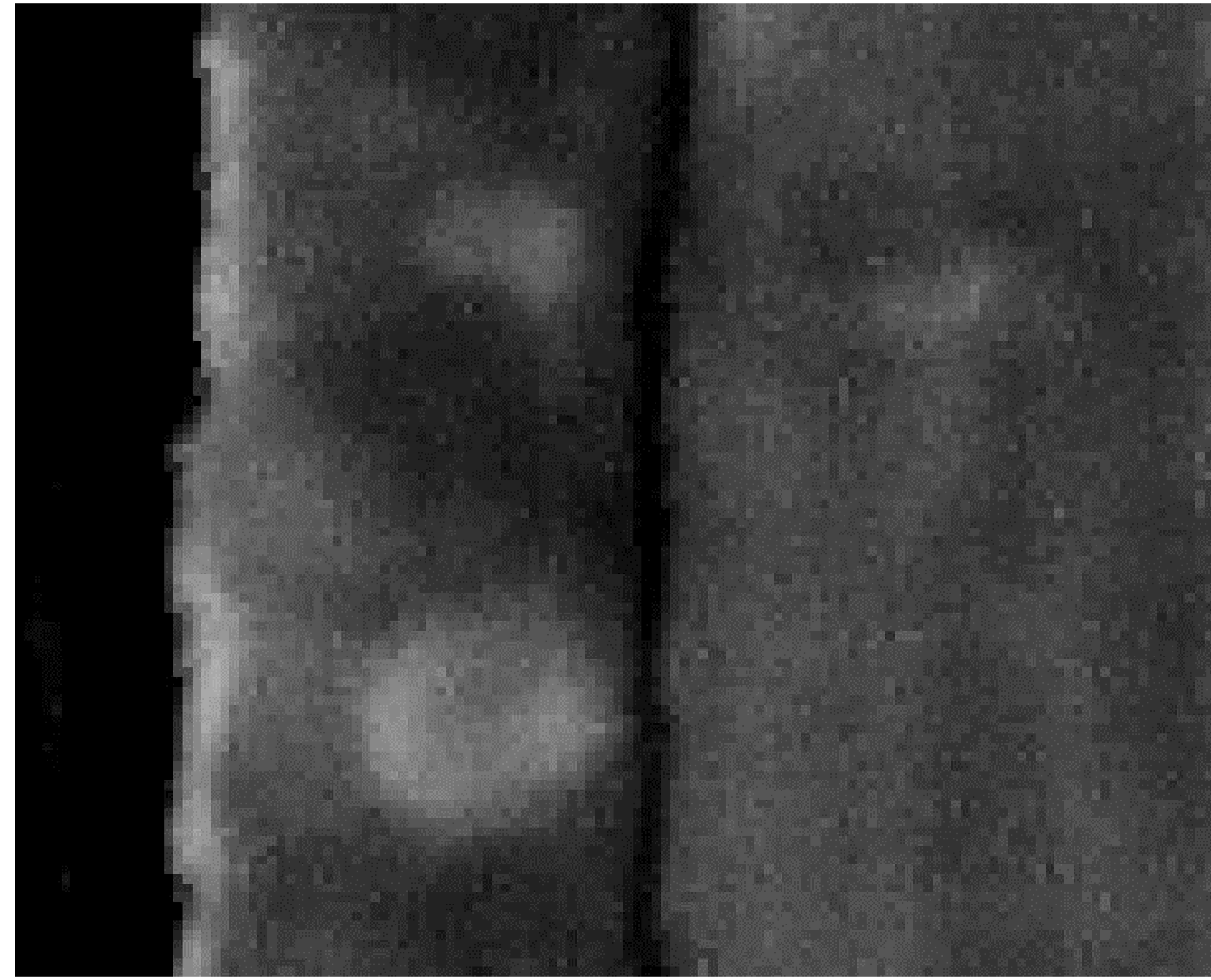
SURFACE TYPE: BITUMINOUS OVERLAY
INFRARED INSPECTION DATE: 9/29/22, 12:14 PM

B660037

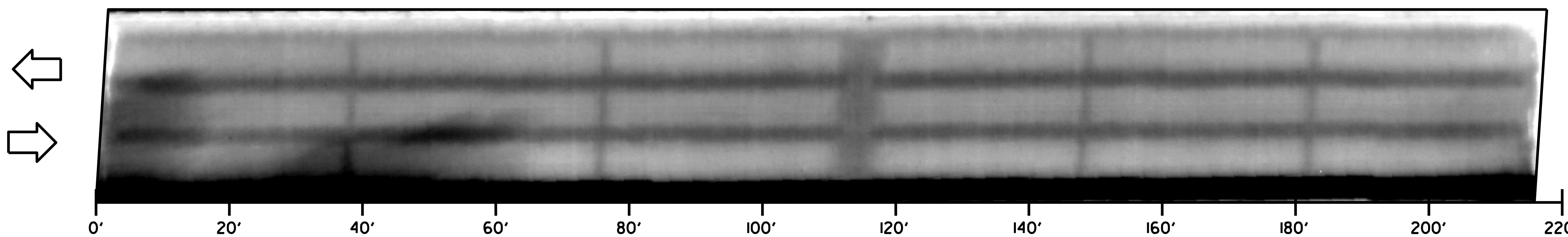
Infrared Thermography Method Comparison Images – Defects 1 and 2



Vehicle Mounted IR Camera



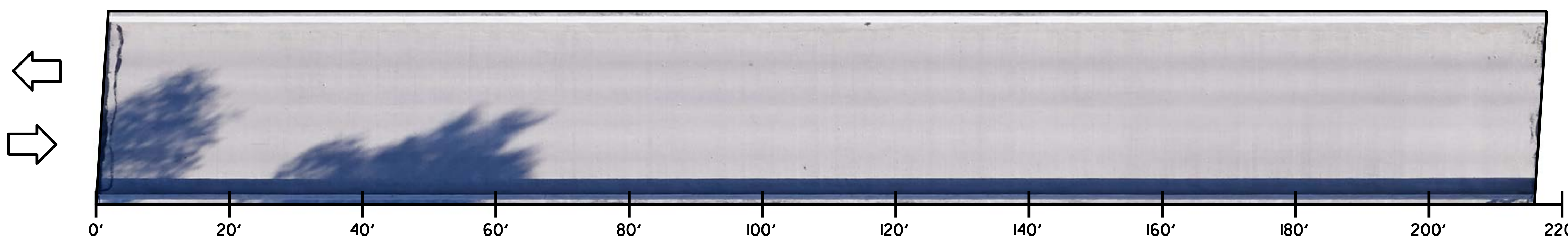
Fixed Wing – Aerial IR Camera (collection altitude: 1000 ft)



B660053

AERIAL INFRARED THERMOGRAPHIC OVERVIEW

SURFACE TYPE: CONCRETE - NO OVERLAY
INFRARED INSPECTION DATE: 9/28/22. 3:34 PM



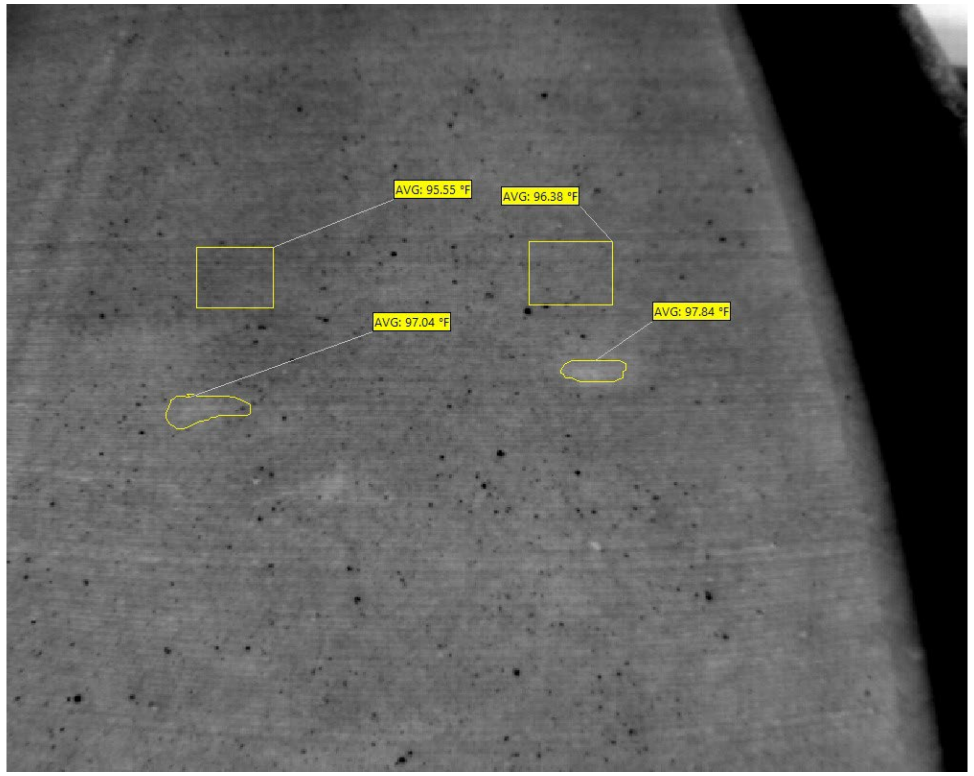
B660053

AERIAL RGB OVERVIEW

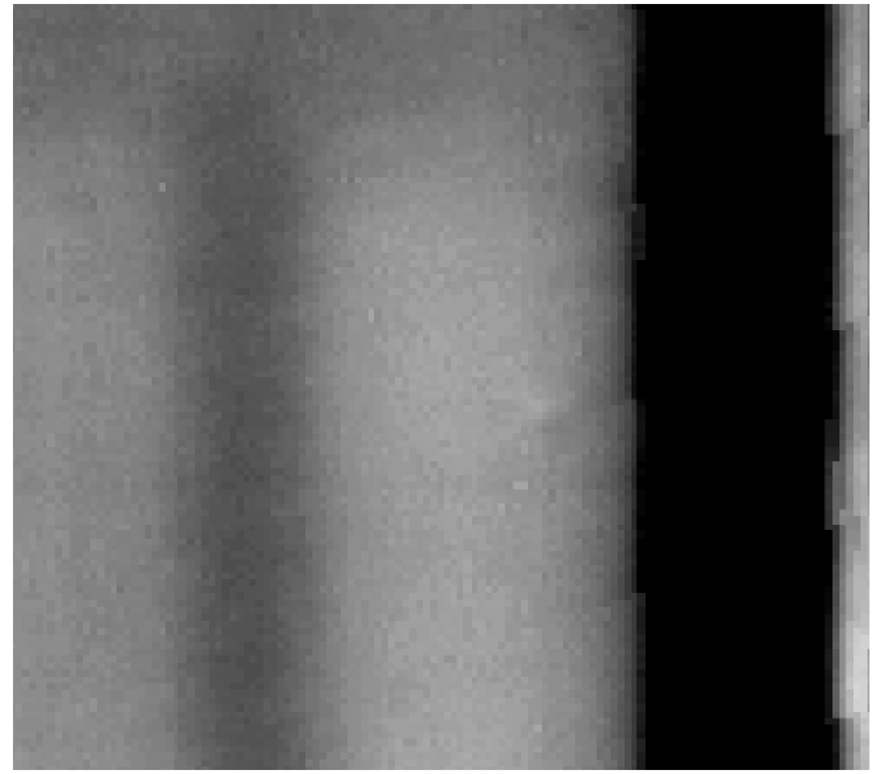
SURFACE TYPE: CONCRETE - NO OVERLAY
INFRARED INSPECTION DATE: 9/28/22. 3:34 PM

B660053

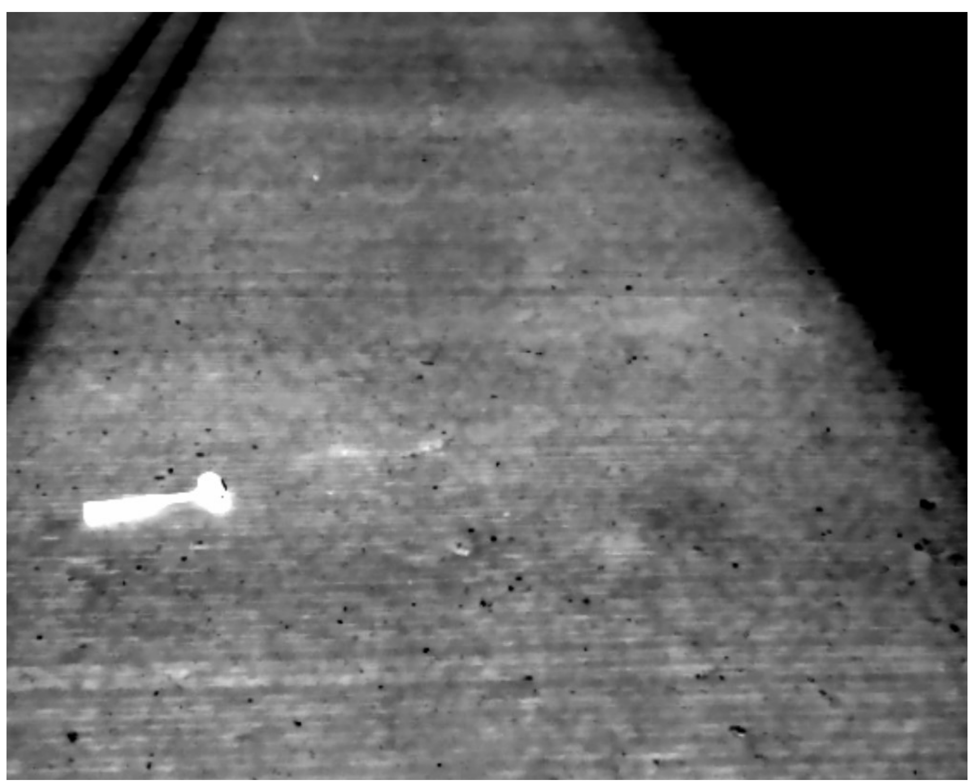
Infrared Thermography Method Comparison Images – Defects 2 and 3



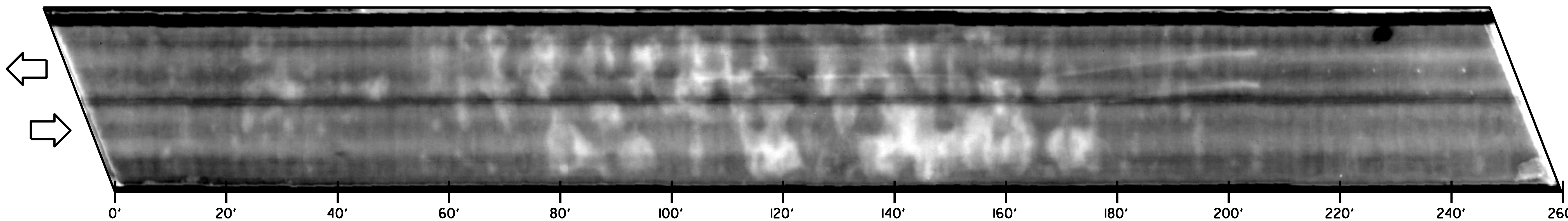
Vehicle Mounted IR Camera

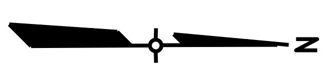


Fixed Wing – Aerial IR Camera (collection altitude: 1000 ft)



Handheld IR Camera (hammer indicating one of the defects)



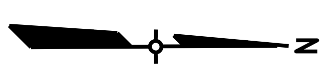


B670122

AERIAL INFRARED THERMOGRAPHIC OVERVIEW

SURFACE TYPE: CONCRETE OVERLAY

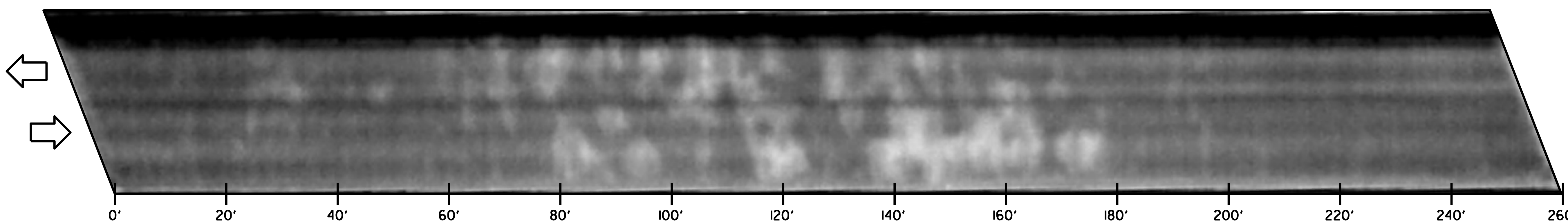
INFRARED INSPECTION DATE: 9/29/22, 1:16 PM



B670122

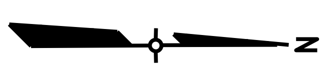
AERIAL RGB OVERVIEW

SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 9/29/22, 1:16 PM

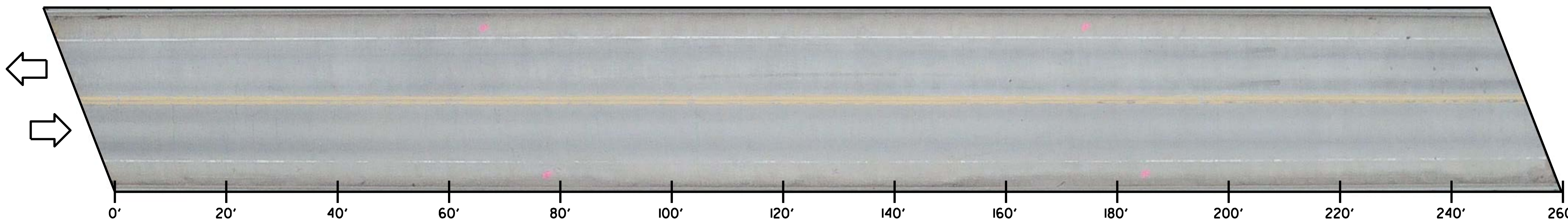


B670122

DRONE INFRARED THERMOGRAPHIC OVERVIEW



SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 10/18/23, 2:35 PM



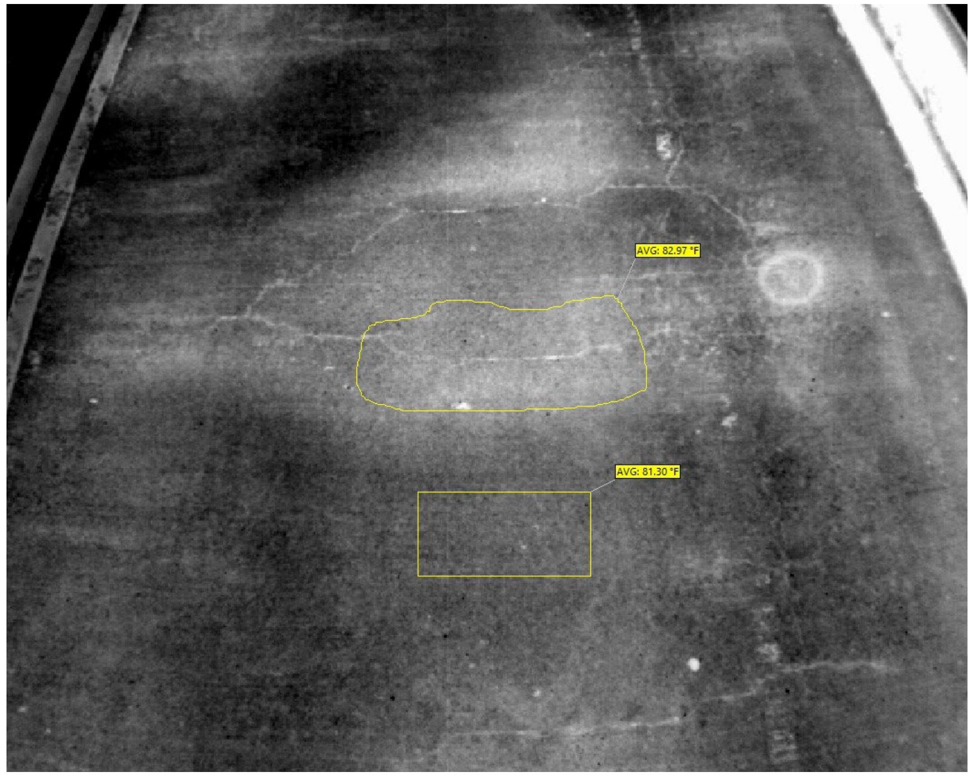
B670122

DRONE RGB OVERVIEW

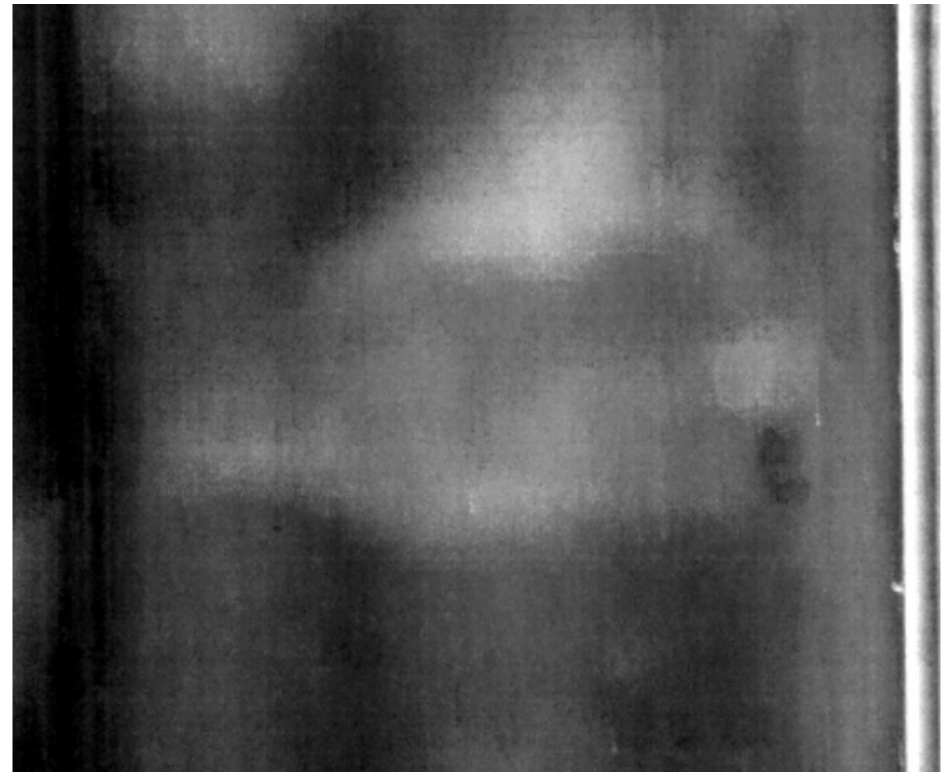
SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 10/18/23, 2:35 PM

B670122

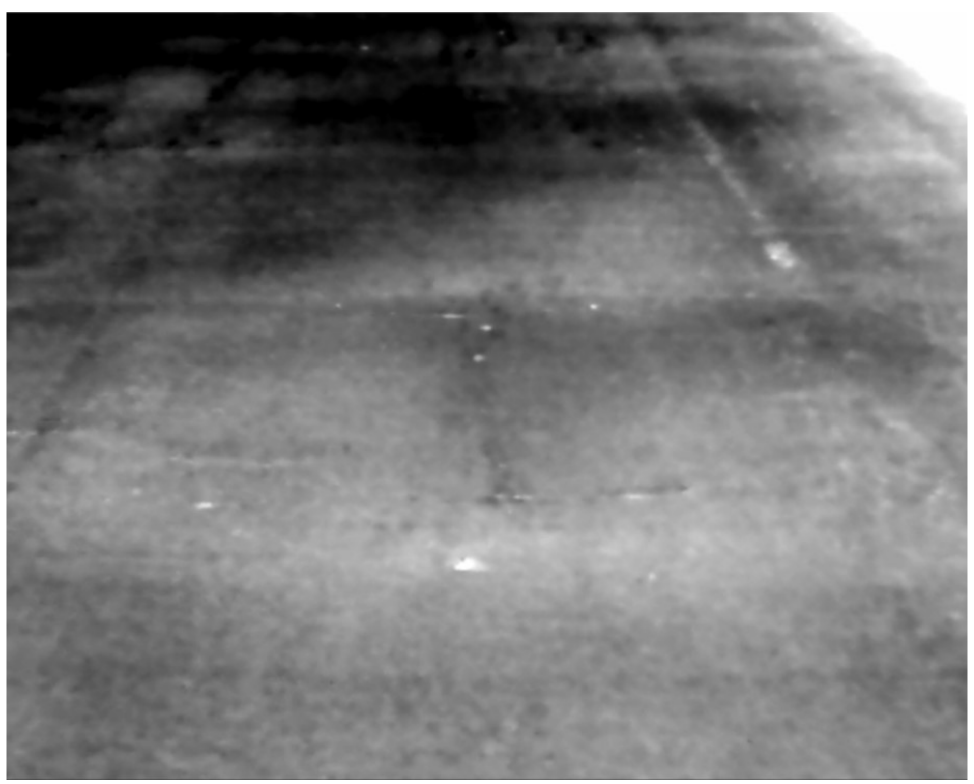
Infrared Thermography Method Comparison Images – Defect 2

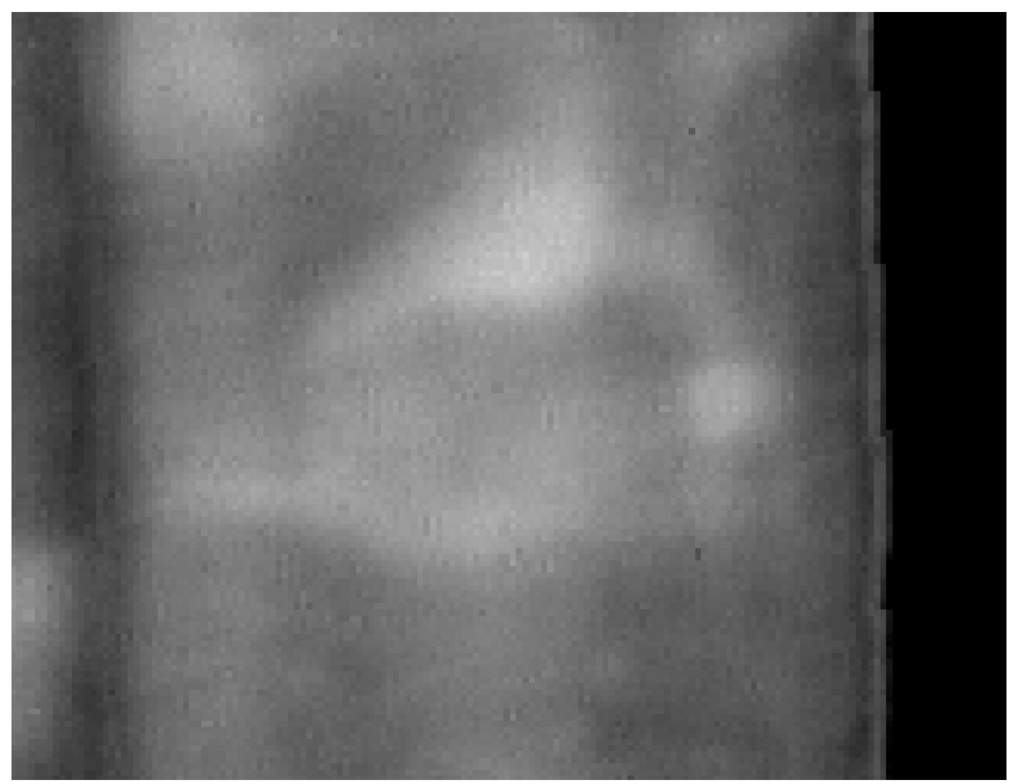


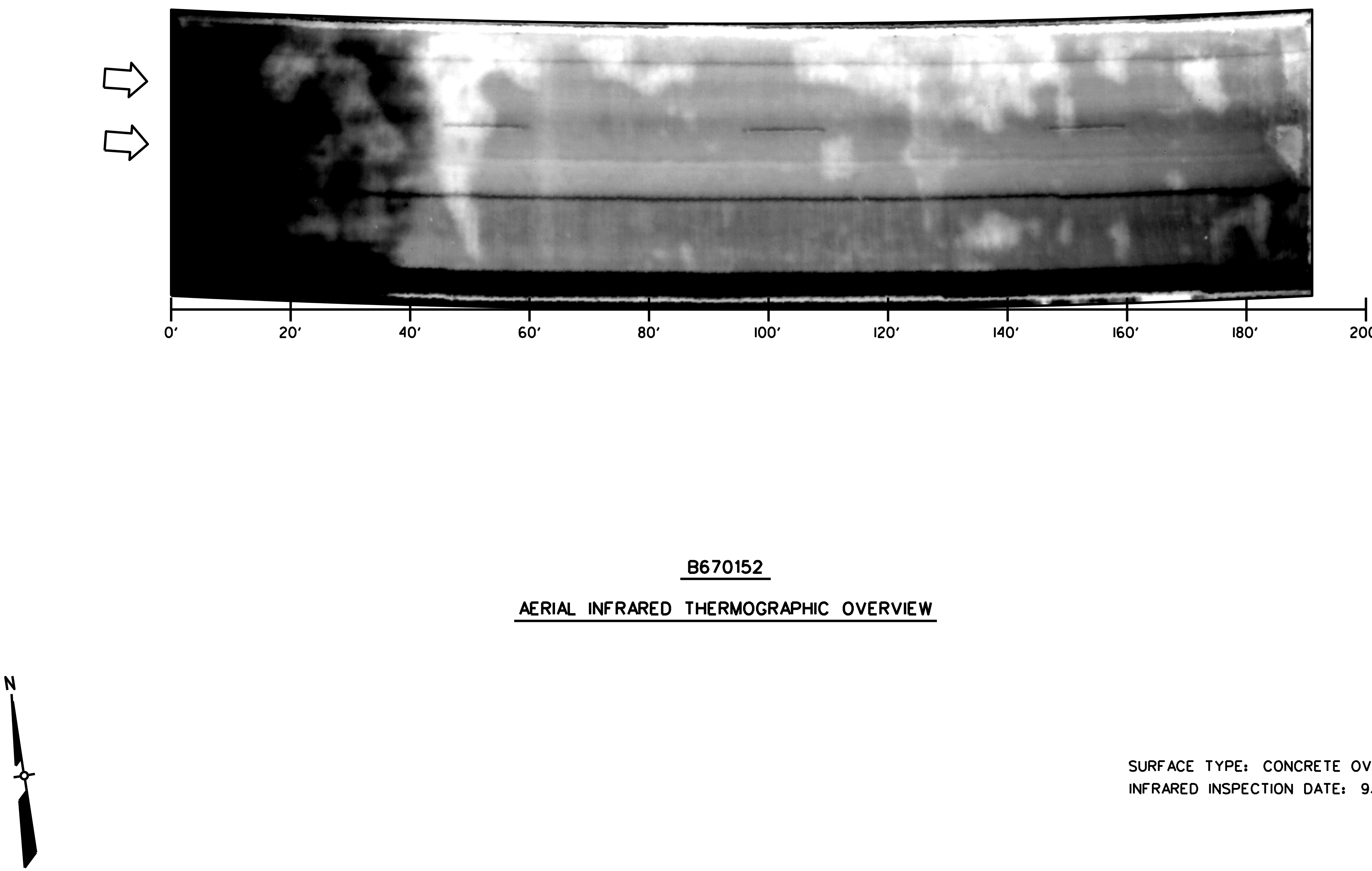
Vehicle Mounted IR Camera


Drone IR Camera (collection height: 30 ft)


Drone IR Camera (collection height: 400 ft)


Handheld IR Camera

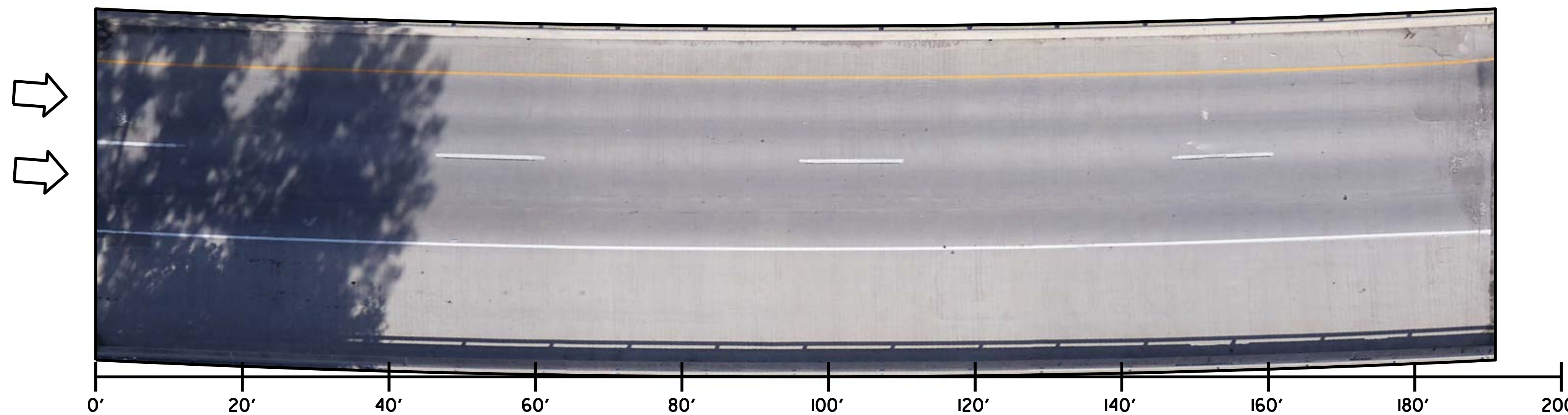

Fixed Wing – Aerial IR Camera (collection altitude: 1000 ft)



B670152

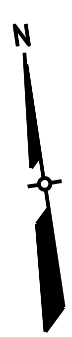
AERIAL INFRARED THERMOGRAPHIC OVERVIEW

SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 9/29/22, 1:11 PM

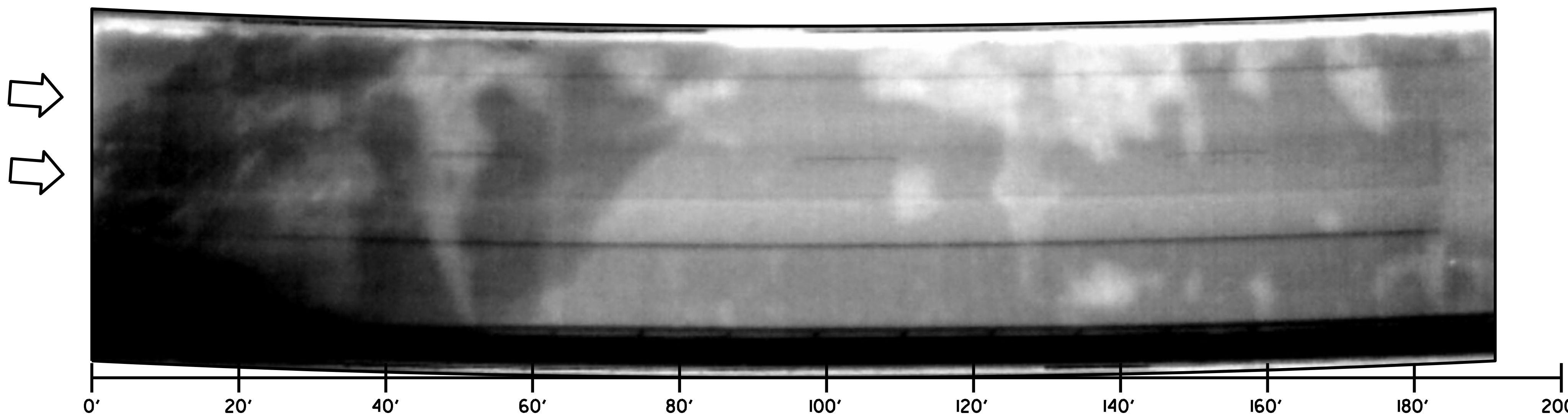


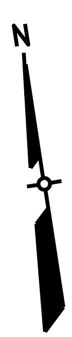
B670152

AERIAL RGB OVERVIEW



SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 9/29/22, 1:11 PM

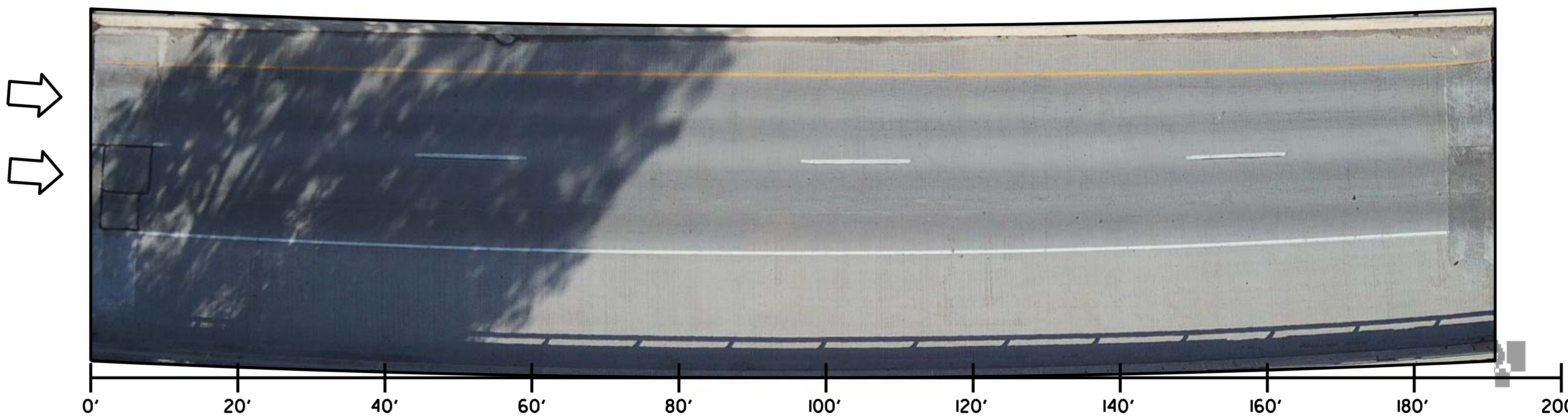




B670152

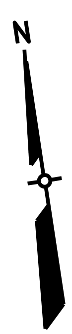
DRONE INFRARED THERMOGRAPHIC OVERVIEW

SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 10/17/23, 2:50 PM



B670152

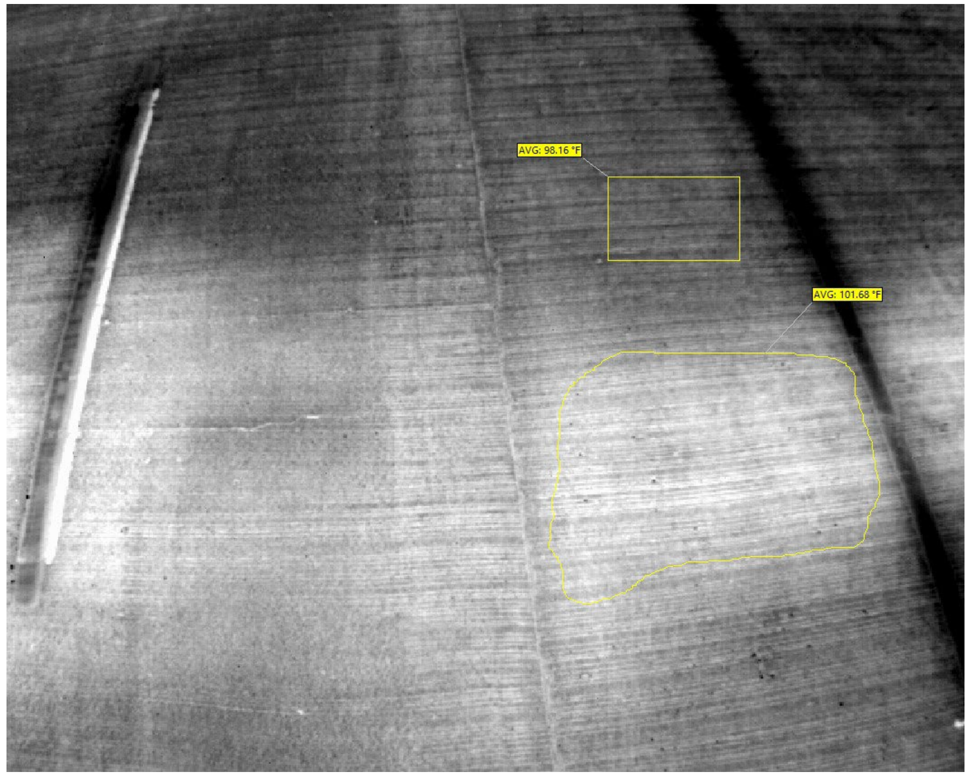
DRONE RGB OVERVIEW



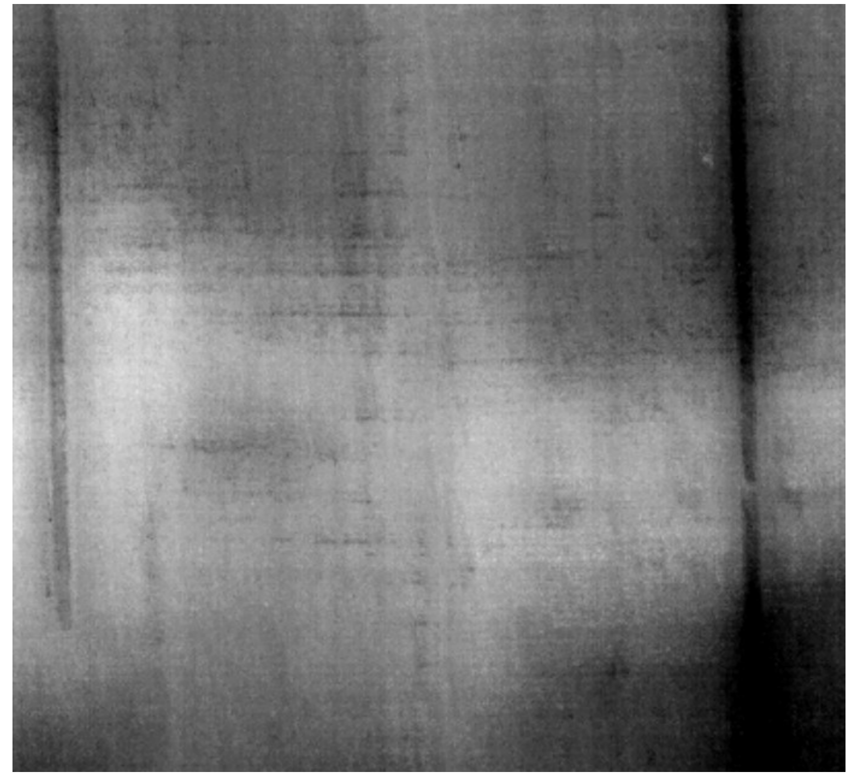
SURFACE TYPE: CONCRETE OVERLAY
INFRARED INSPECTION DATE: 10/17/23, 2:50 PM

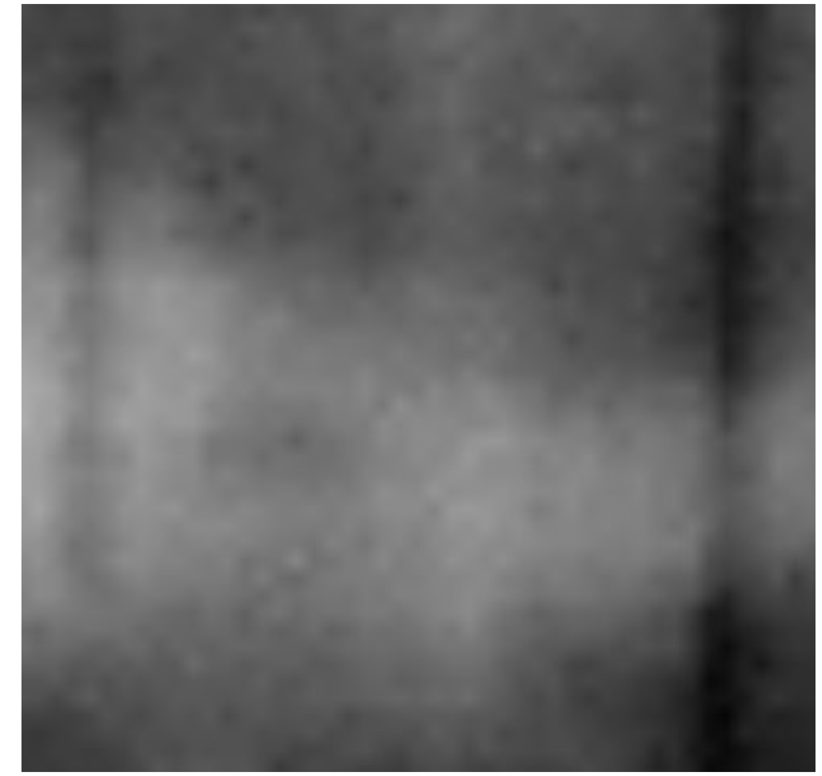
B670152

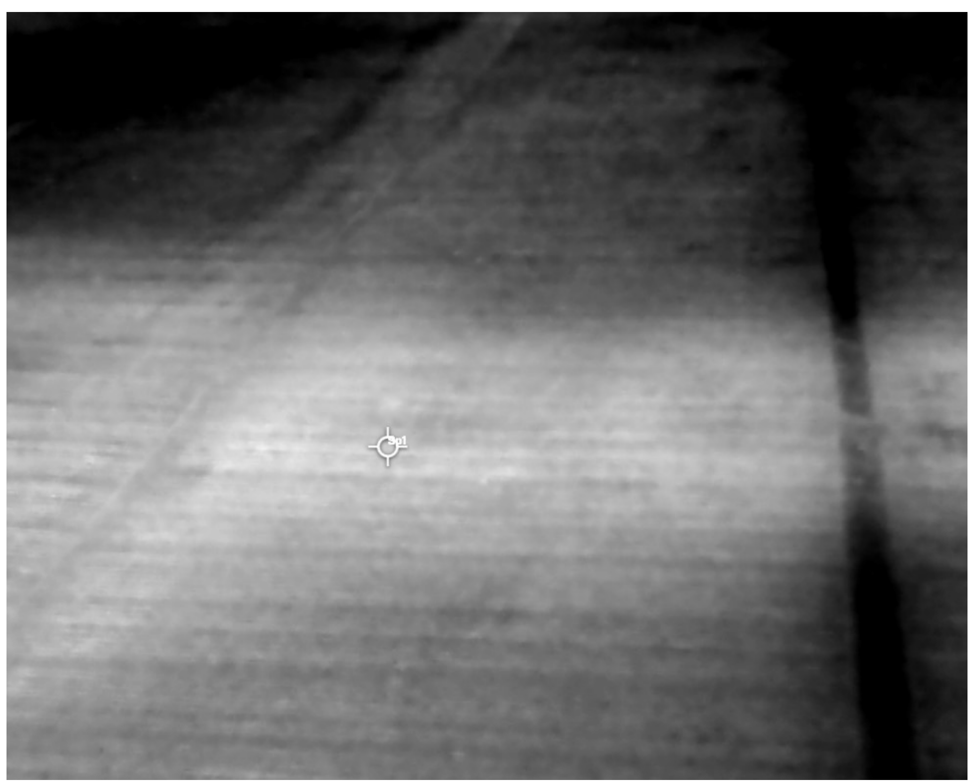
Infrared Thermography Method Comparison Images – Defect 1

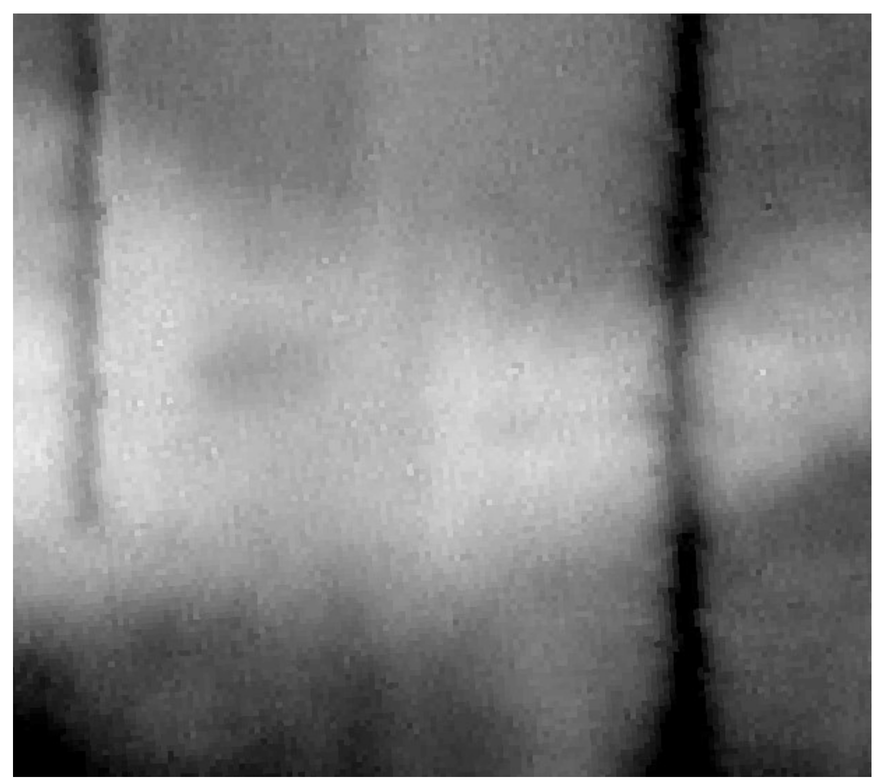


Vehicle Mounted IR Camera


Drone IR Camera (collection height: 30 ft)

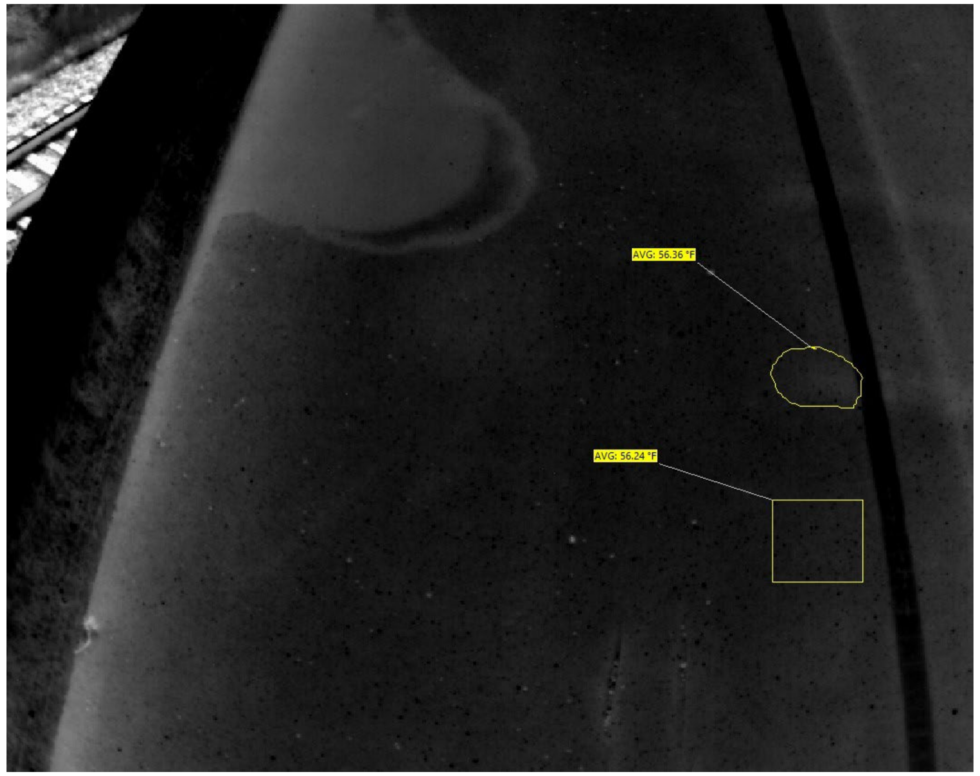

Drone IR Camera (collection height: 250 ft)


Handheld IR Camera

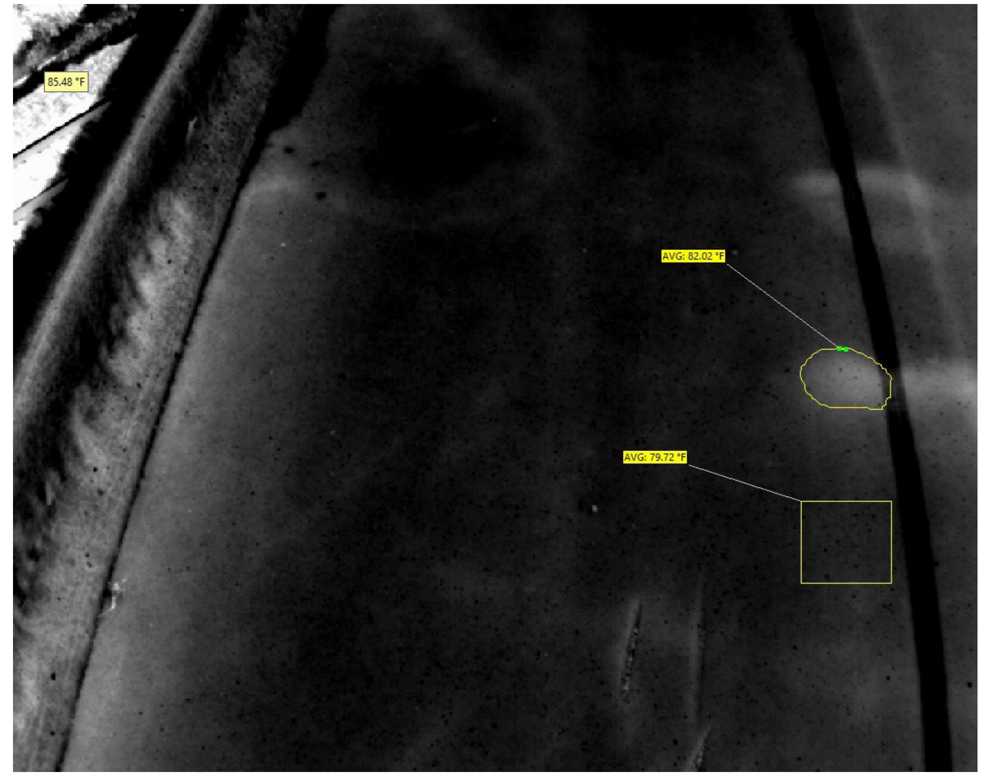

Fixed Wing – Aerial IR Camera (collection altitude: 1000 ft)

Appendix B – Defect Time Lapse Images and Table

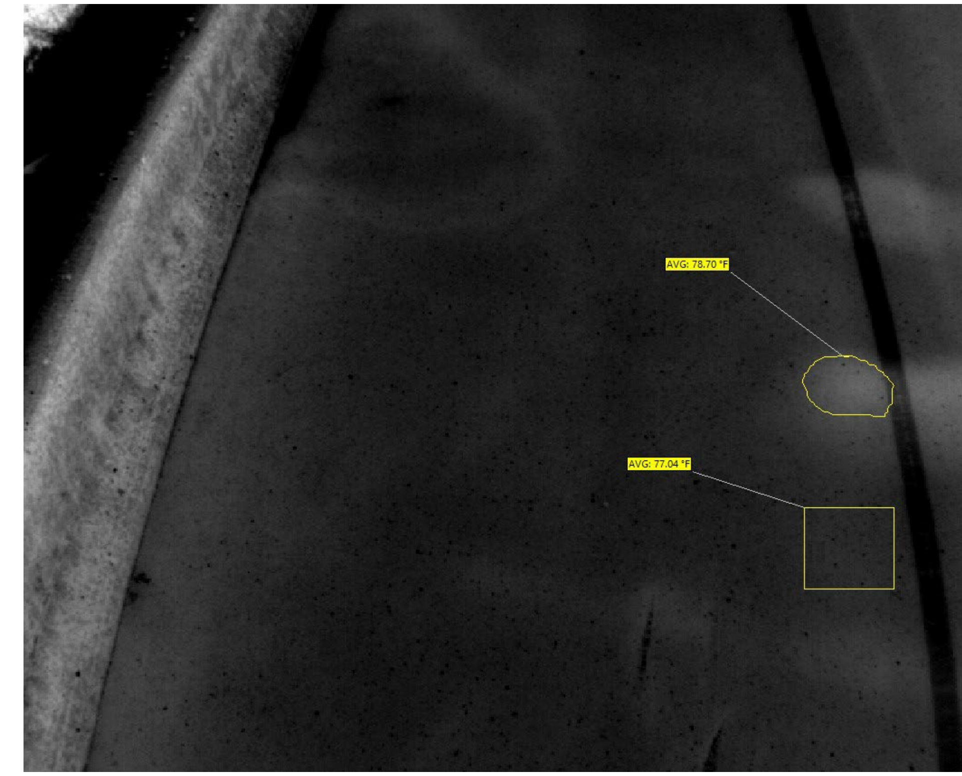
B300048 EB Left Shoulder defect 1



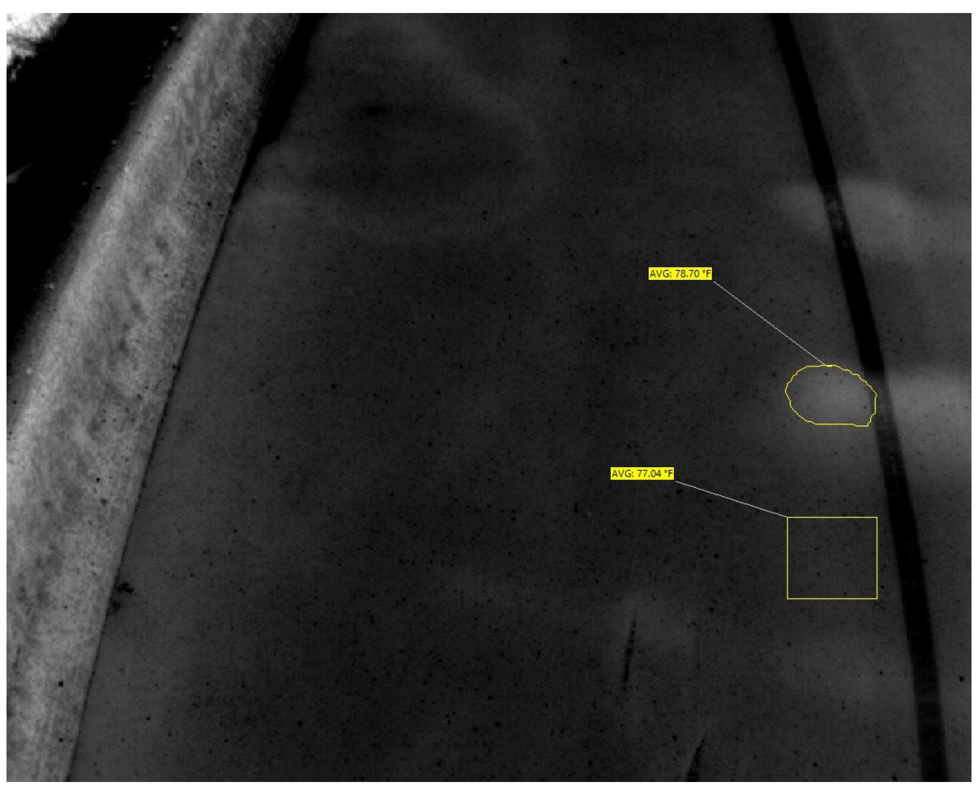
9/14/2023 9:00



9/14/2023 12:30



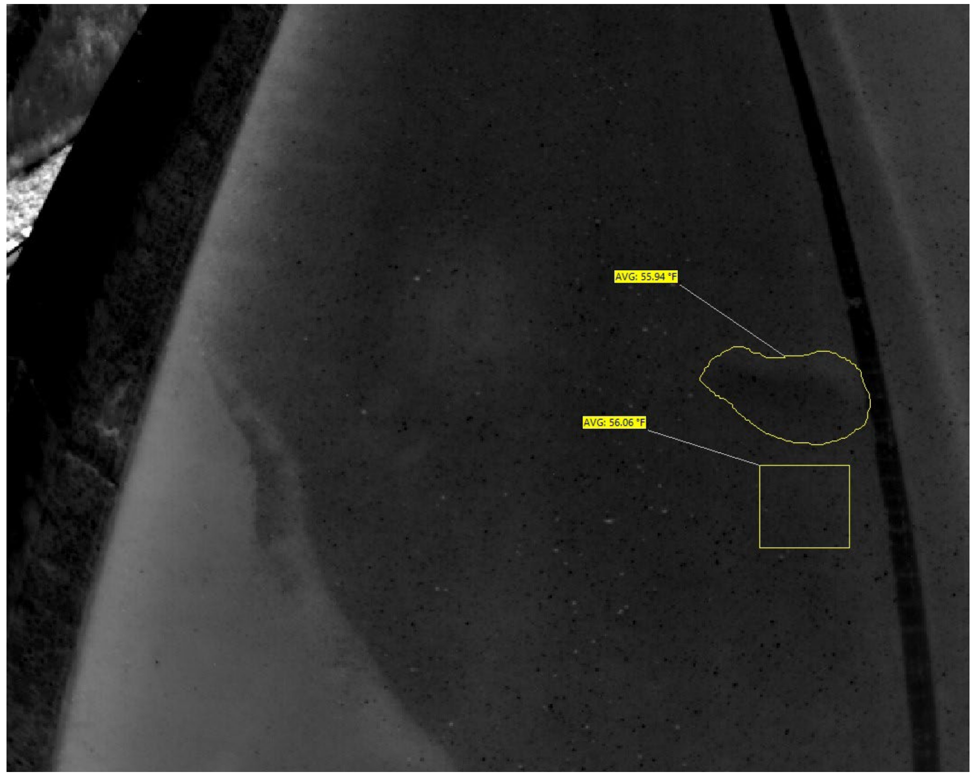
9/14/2023 15:40



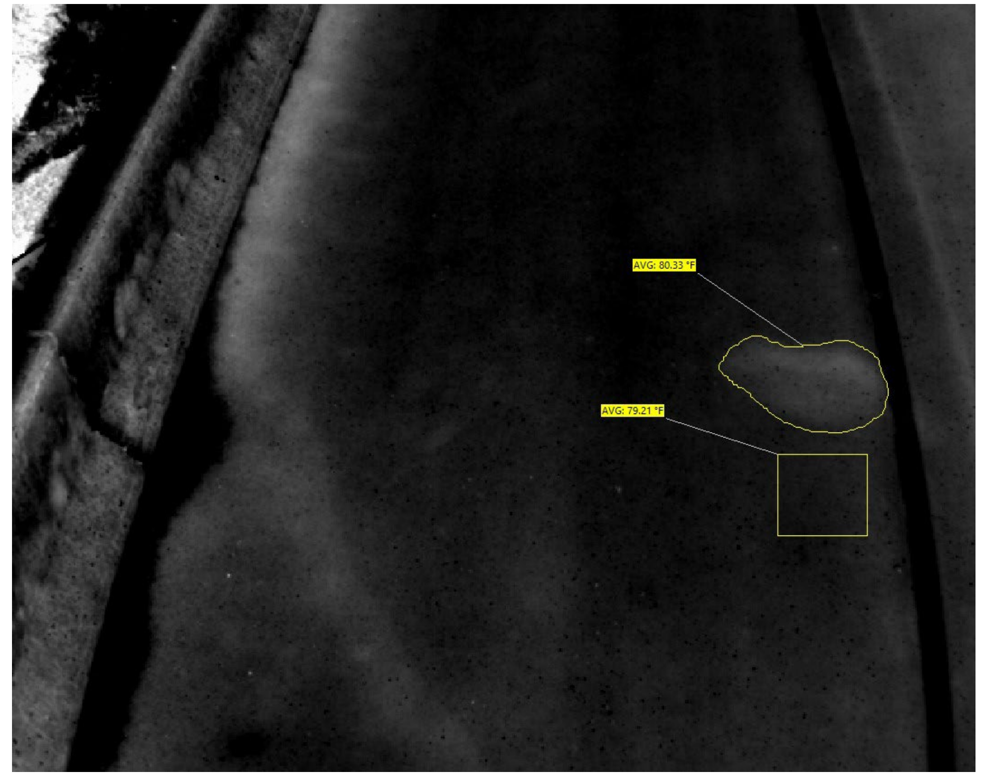
9/14/2023 18:25

Live Image

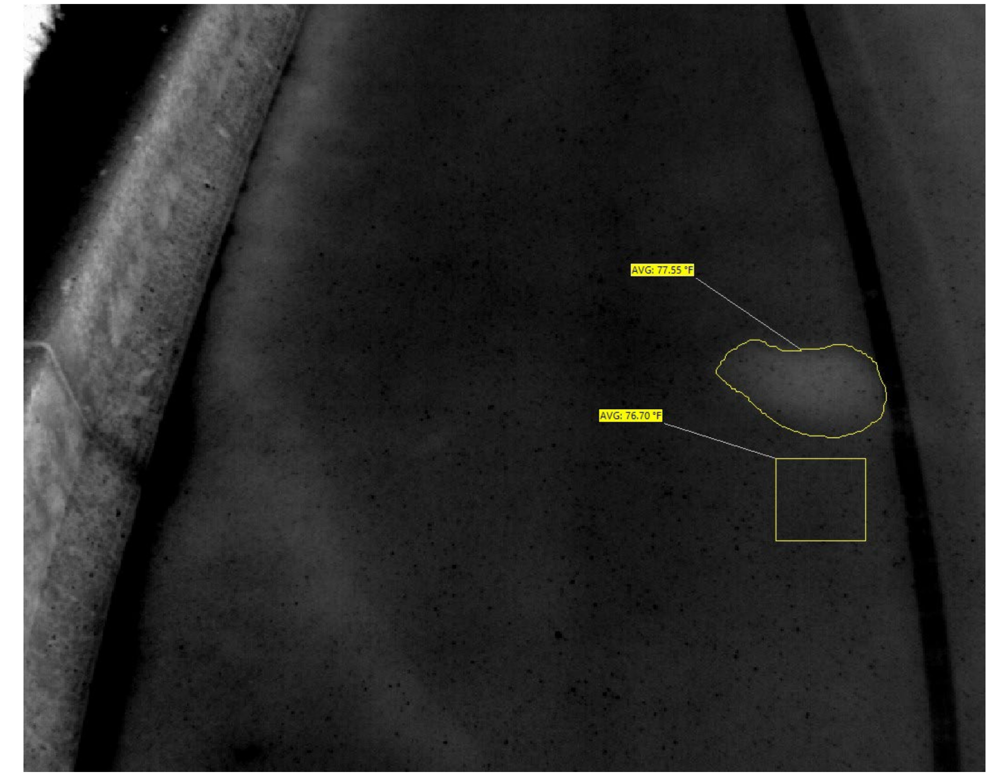
B300048 EB Left Shoulder defect 2



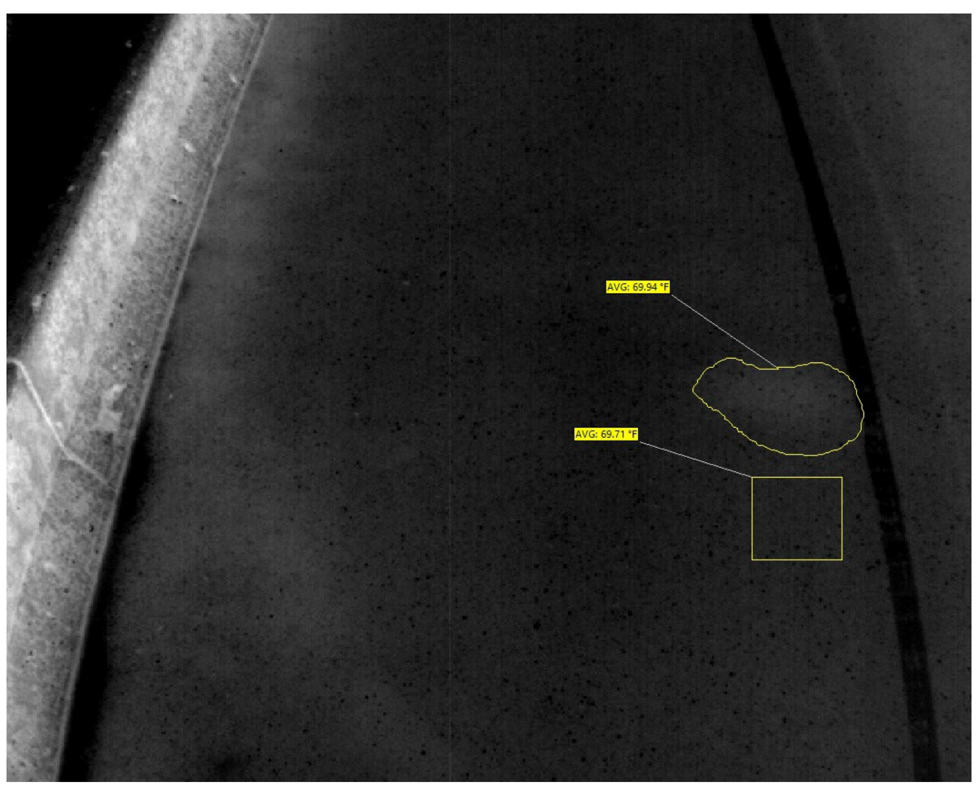
9/14/2023 9:00



9/14/2023 12:30



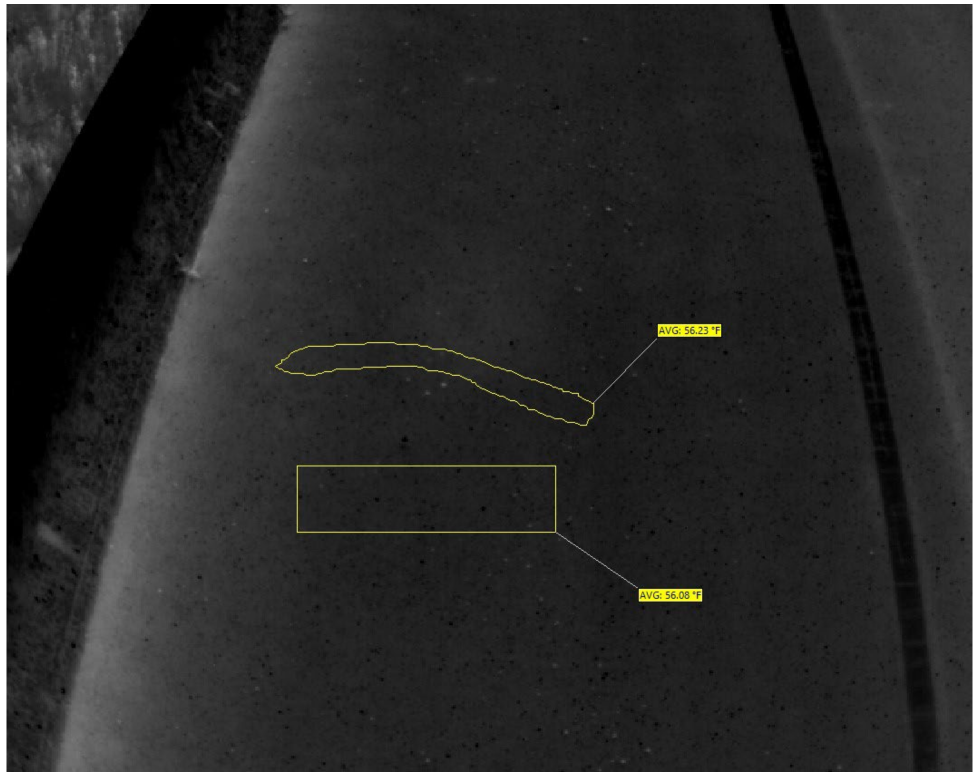
9/14/2023 15:40



9/14/2023 18:25

Live Image

B300048 EB Left Shoulder defect 3



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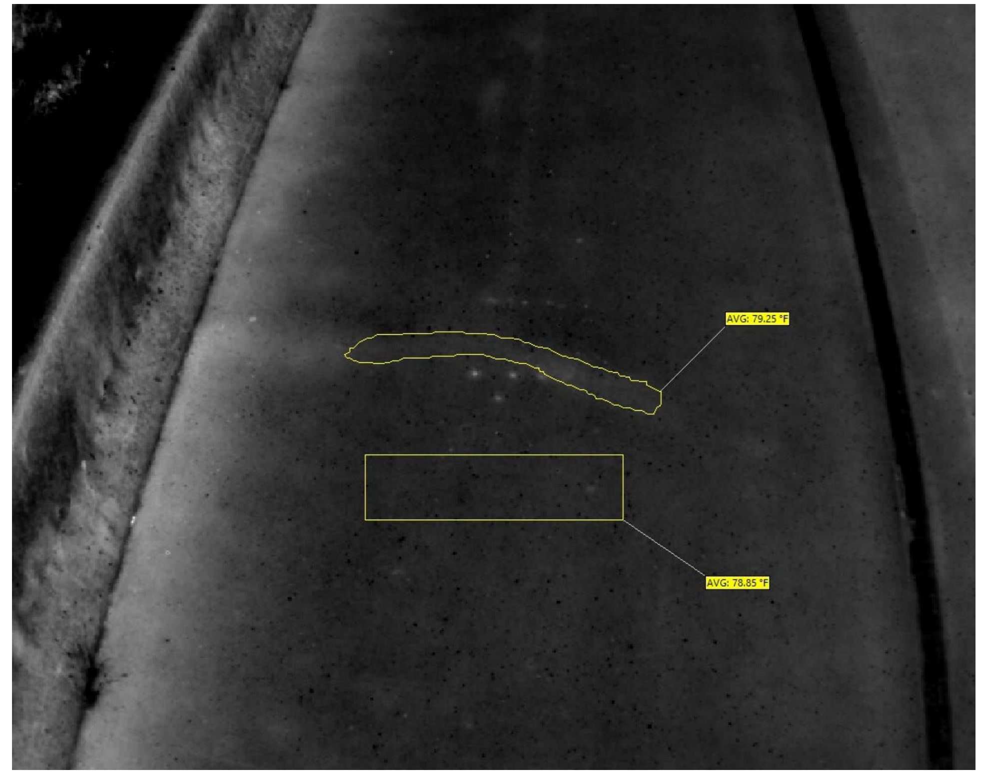
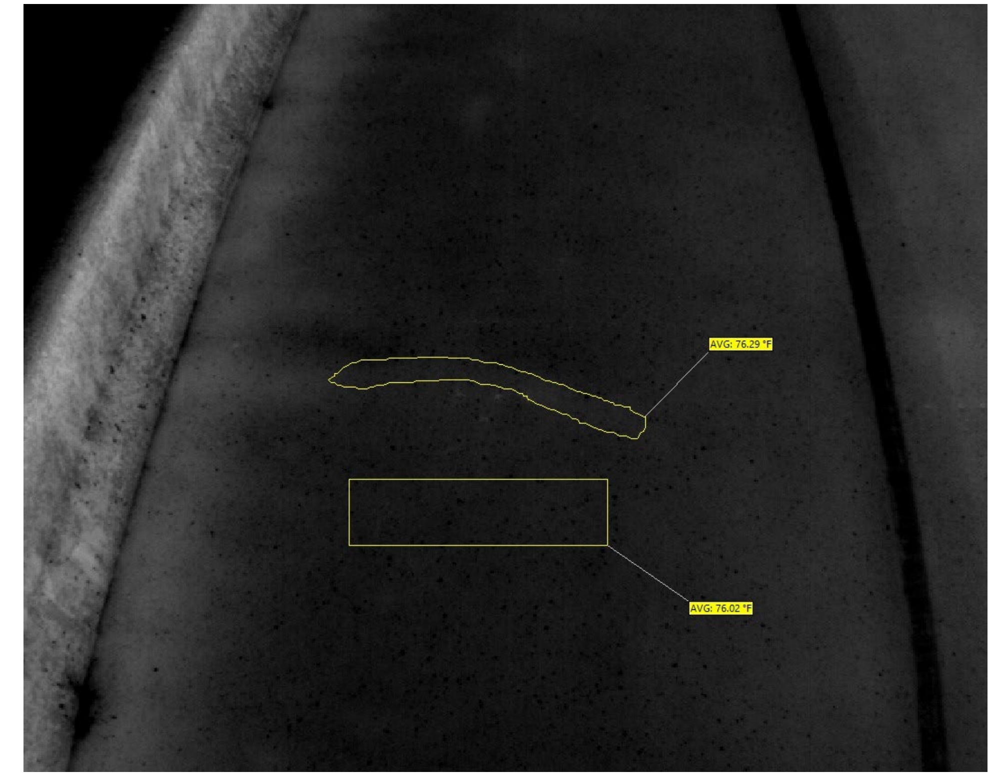


9/14/2023 12:30



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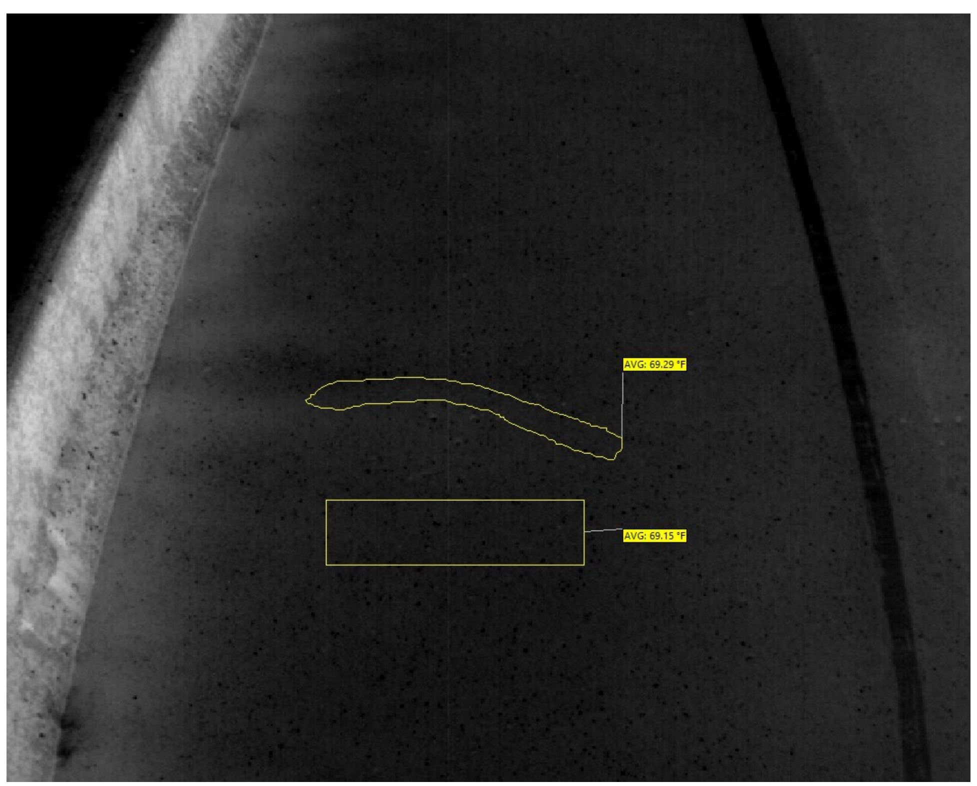
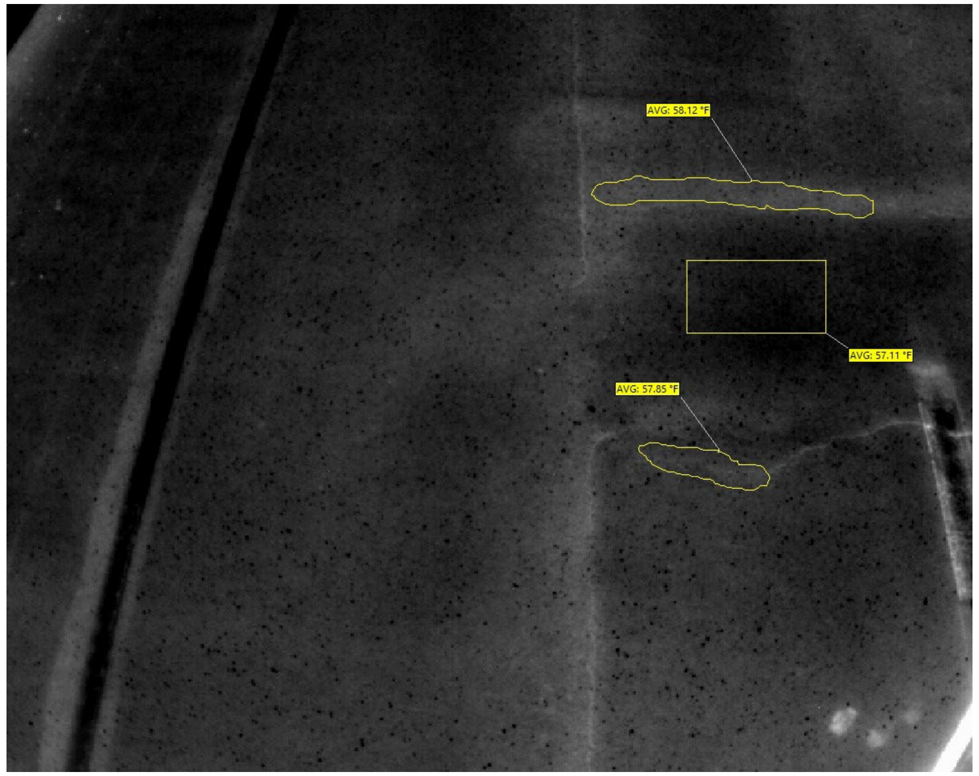


9/14/2023 18:25

Live Image

B300058 WB Left Lane defects 1 and 2



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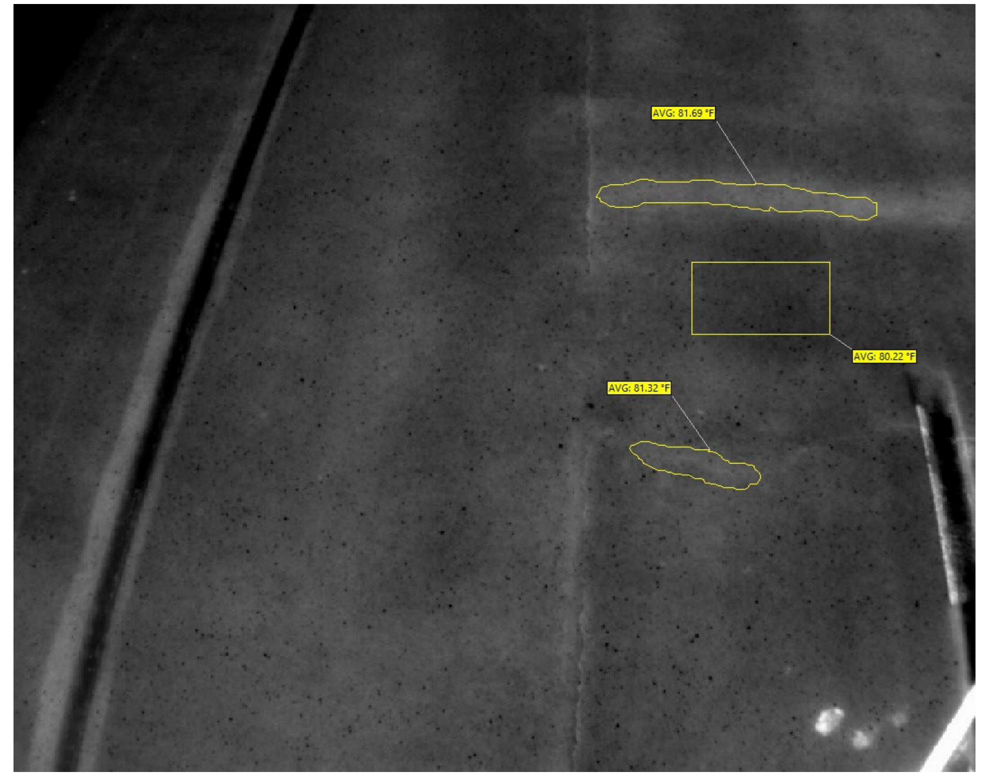

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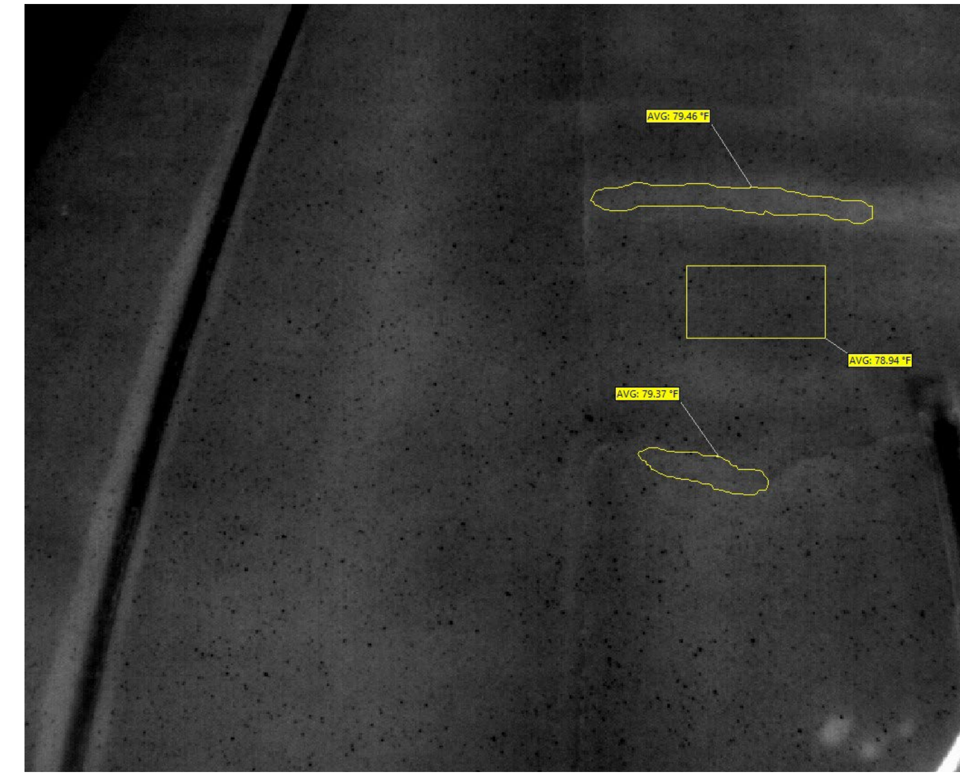

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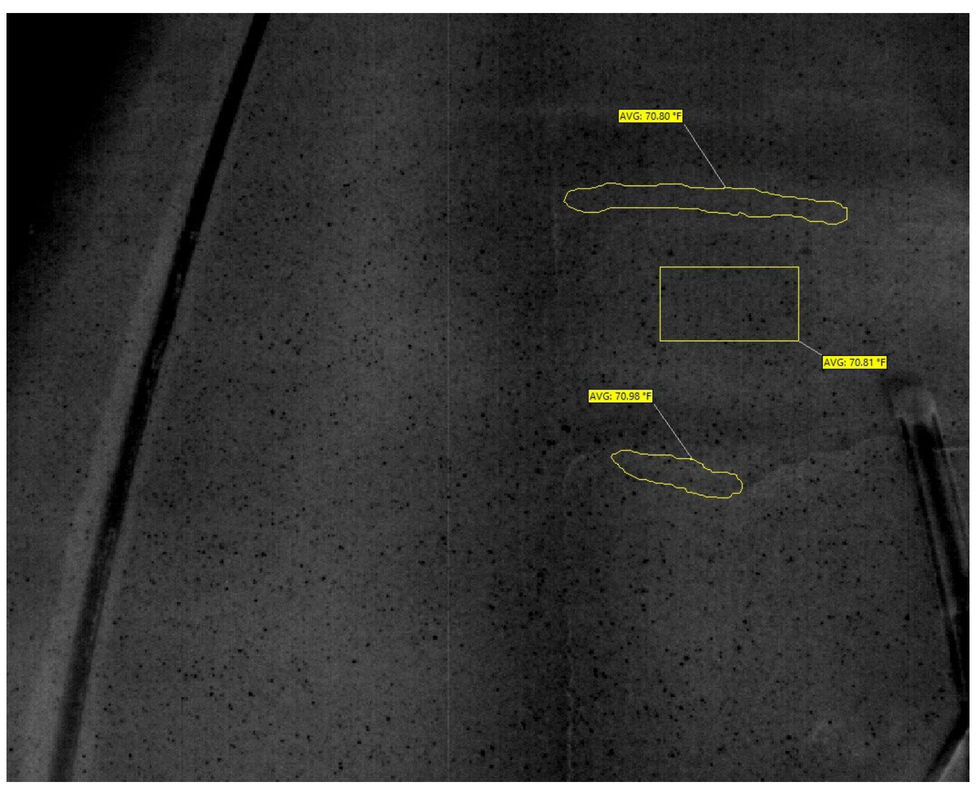

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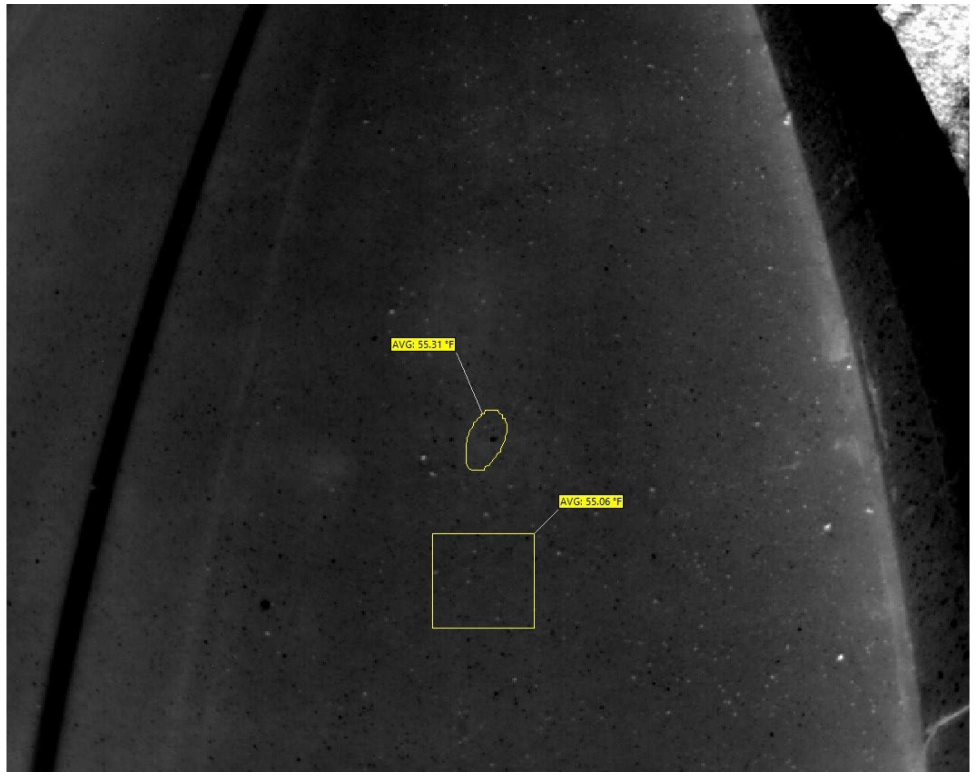
Live Image

B300058 WB Left Lane defect 3



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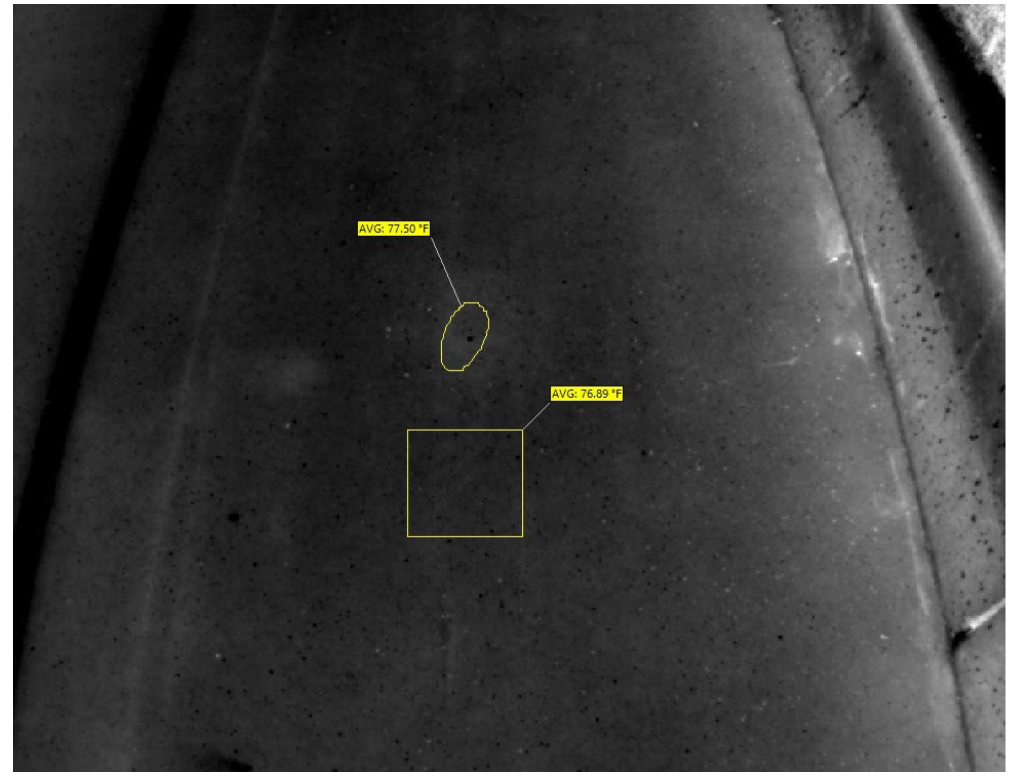

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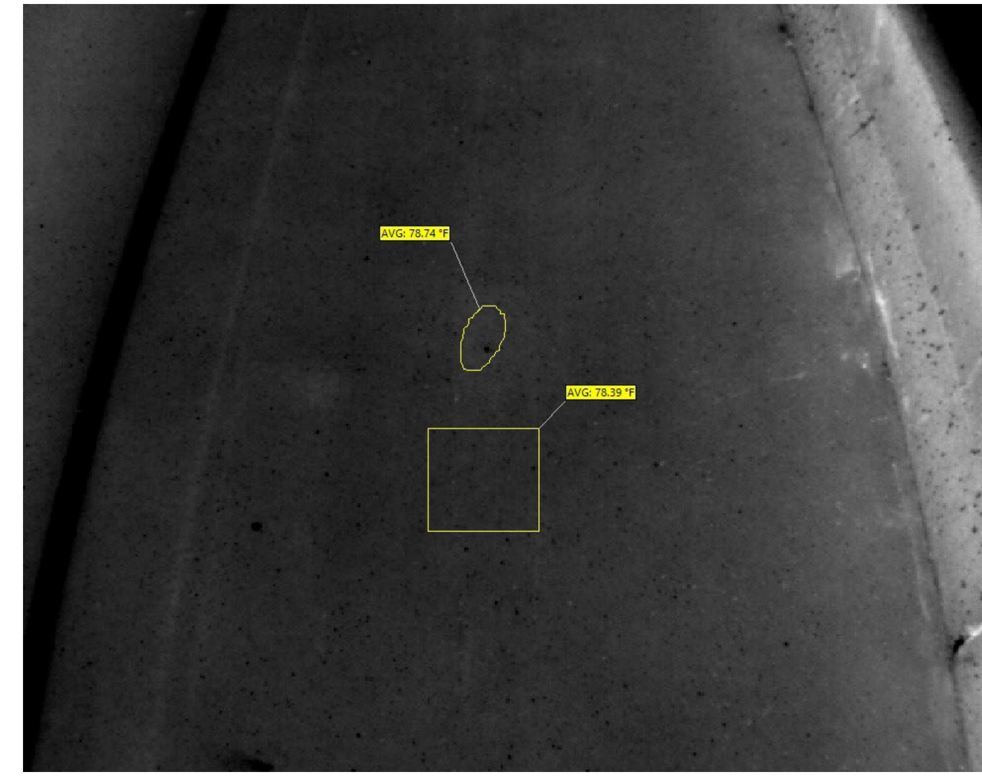

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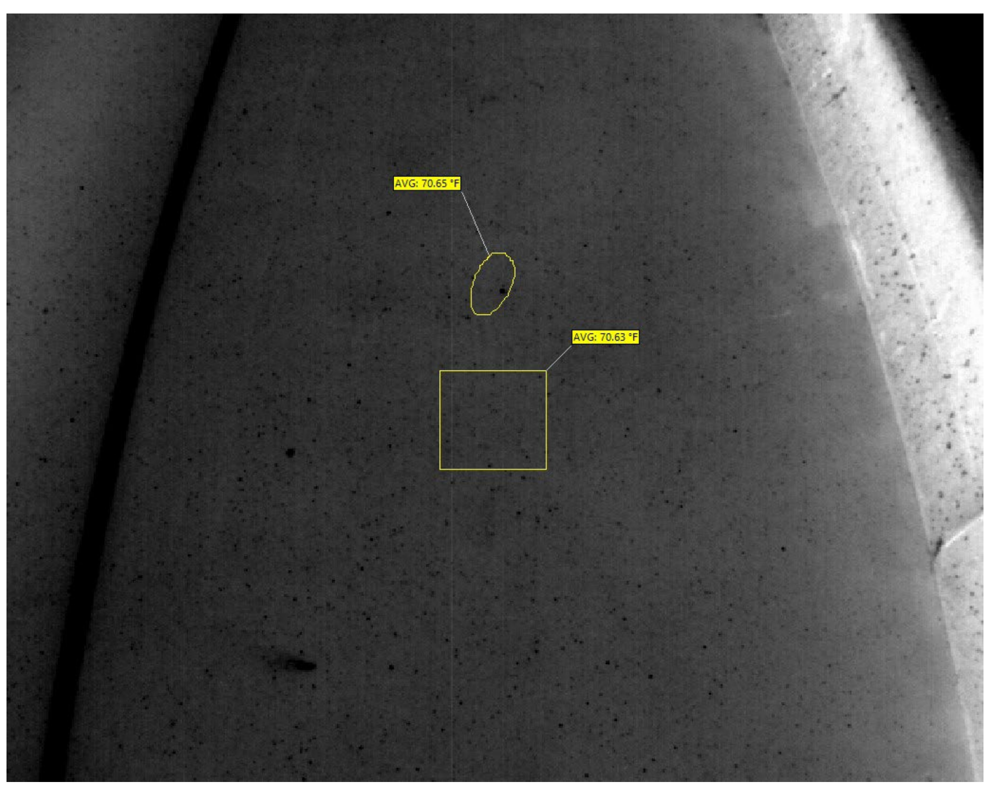

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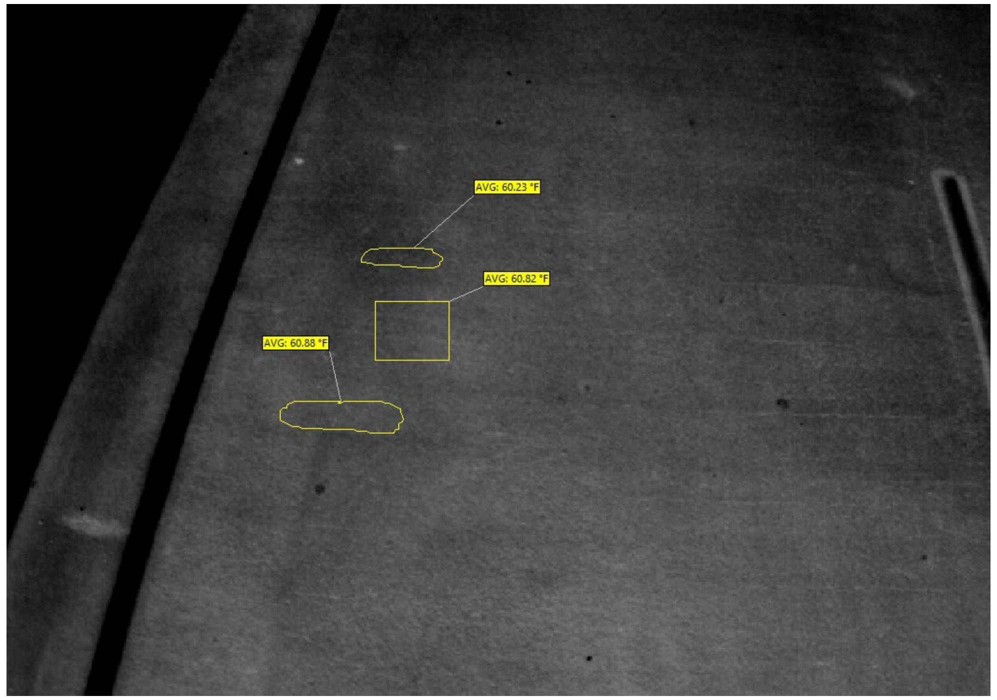
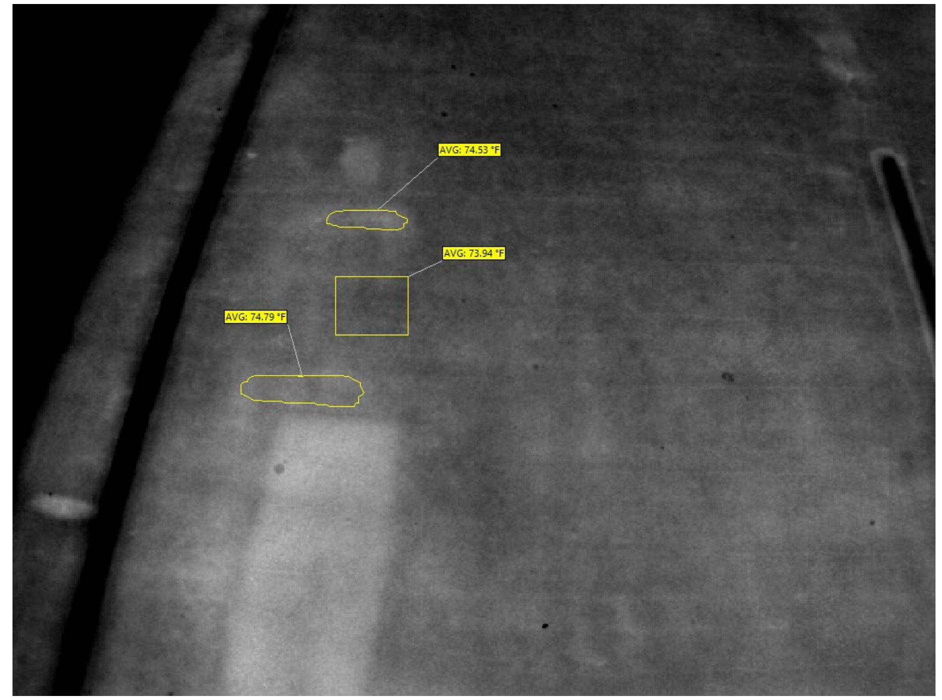
Live Image

B300073 WB Left Lane defects 1 and 2



9/14/2023 8:20



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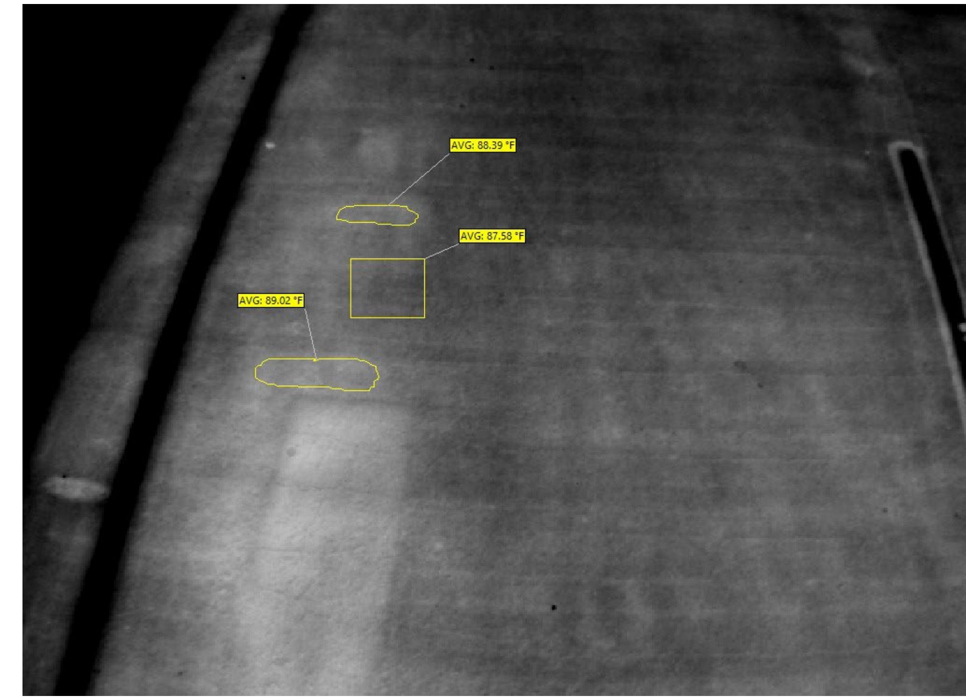

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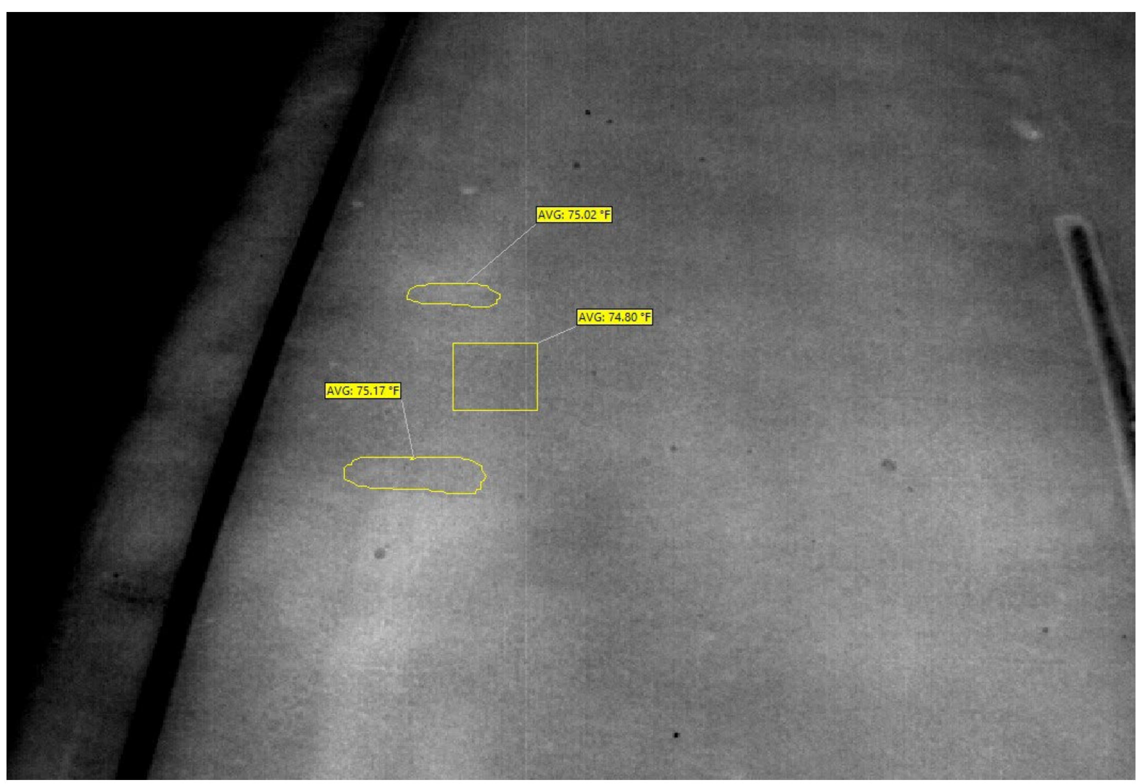

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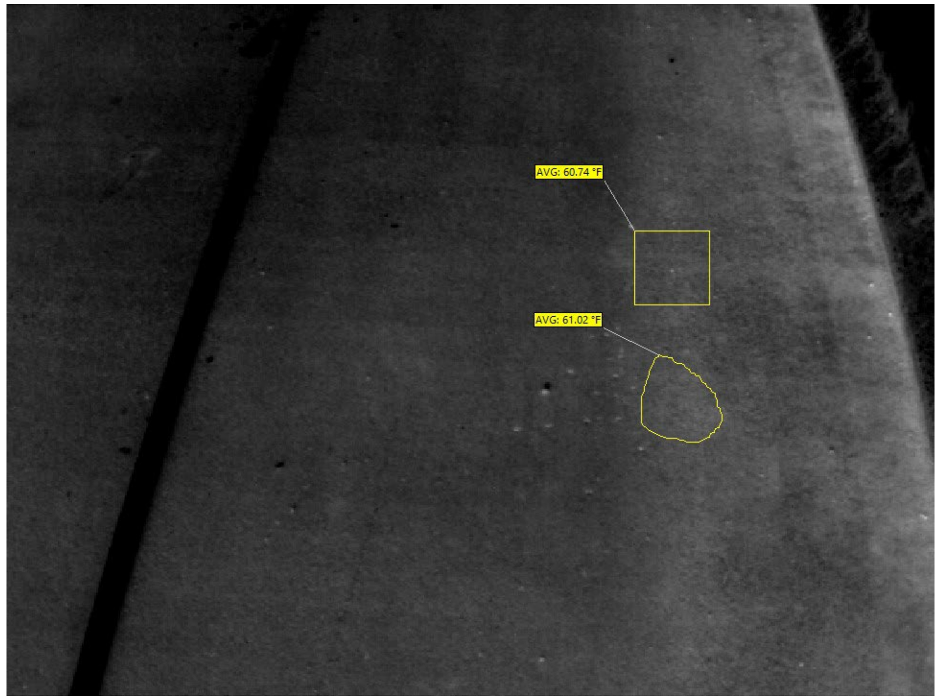
Live Image

B300073 WB Right Shoulder defect 3



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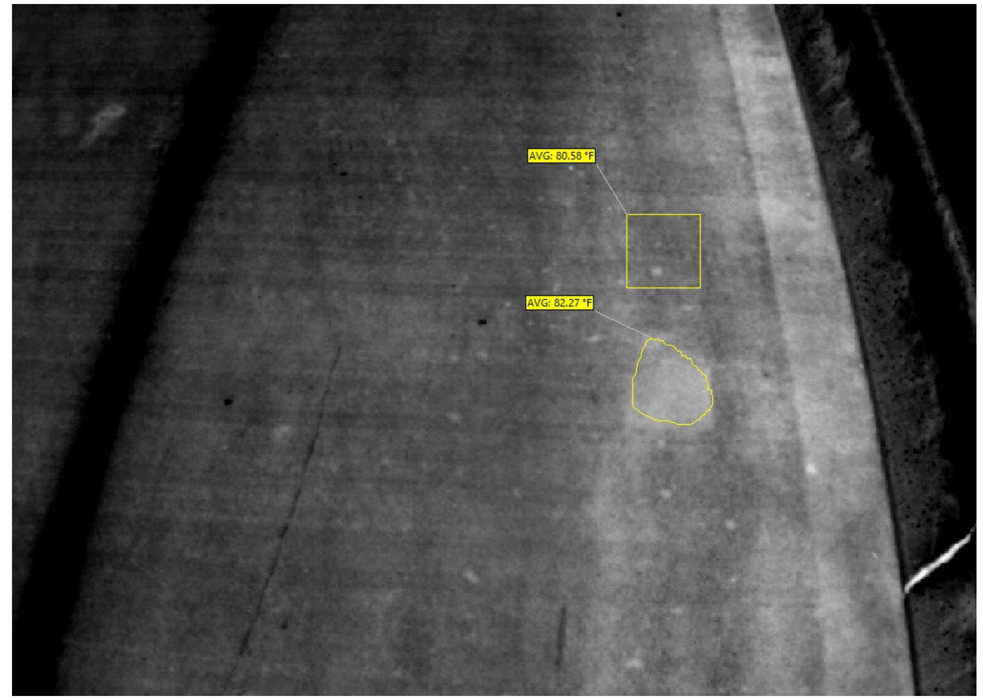

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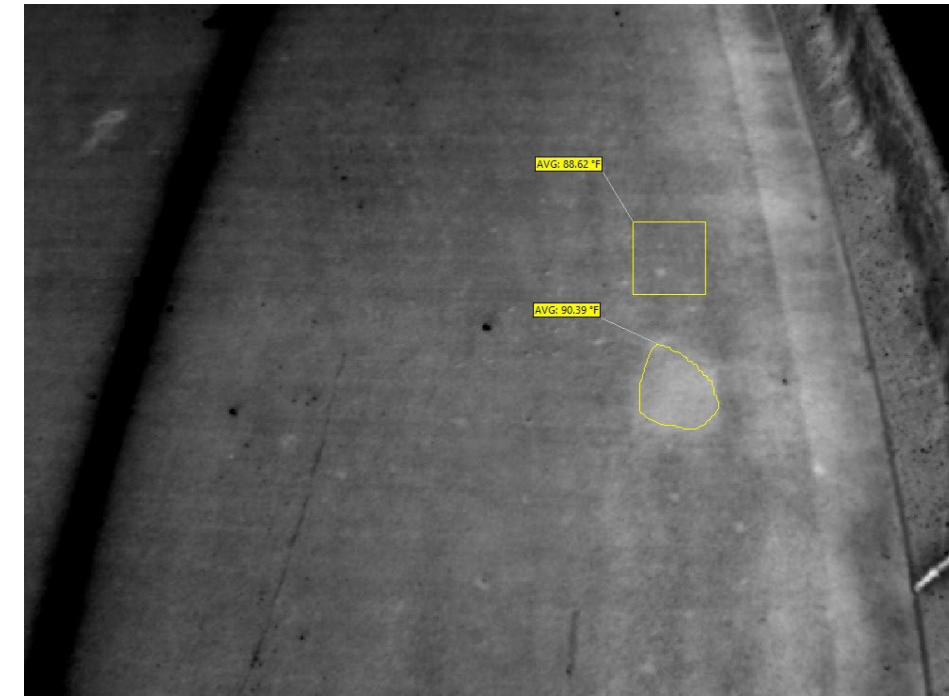

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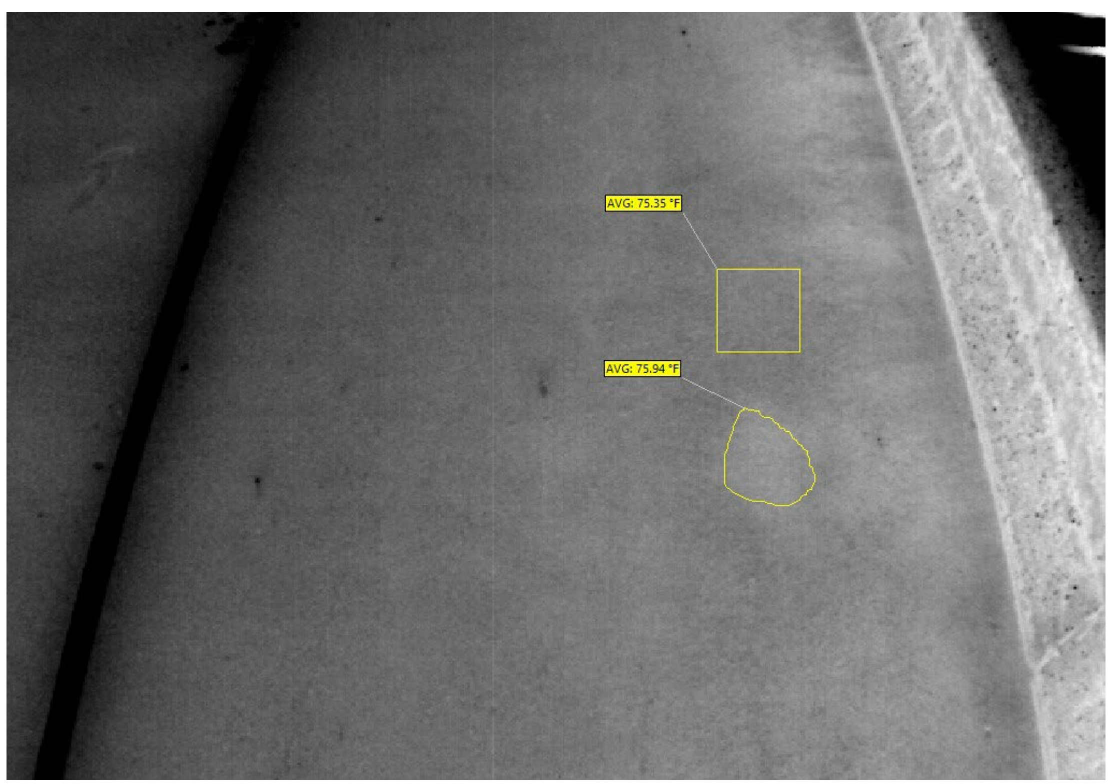
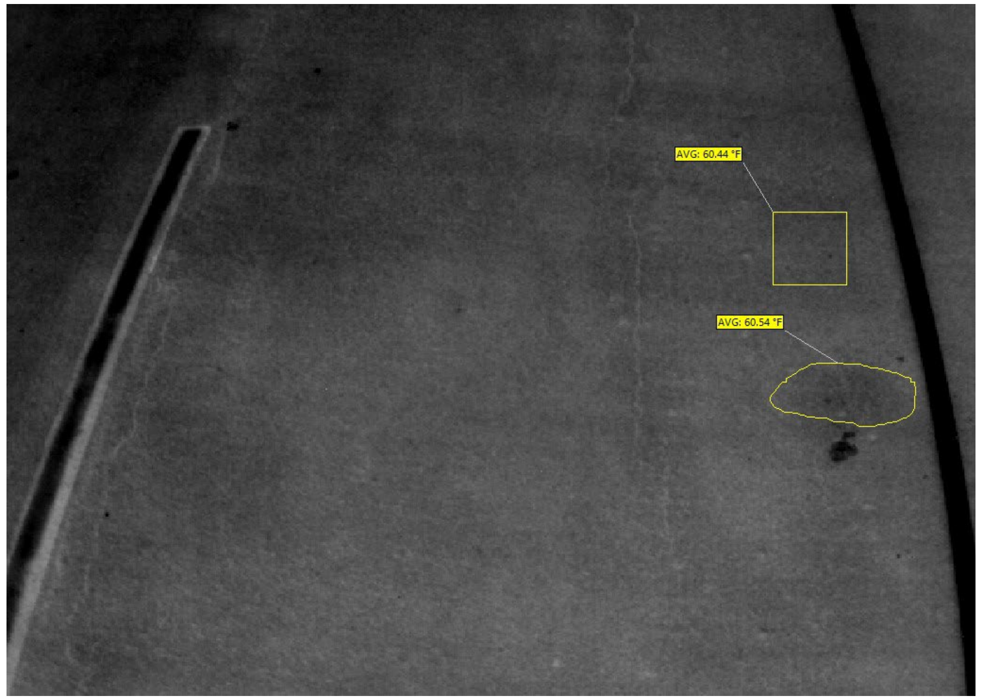


9/14/2023 17:45

Live Image

B300074 EB Right Lane defect 1



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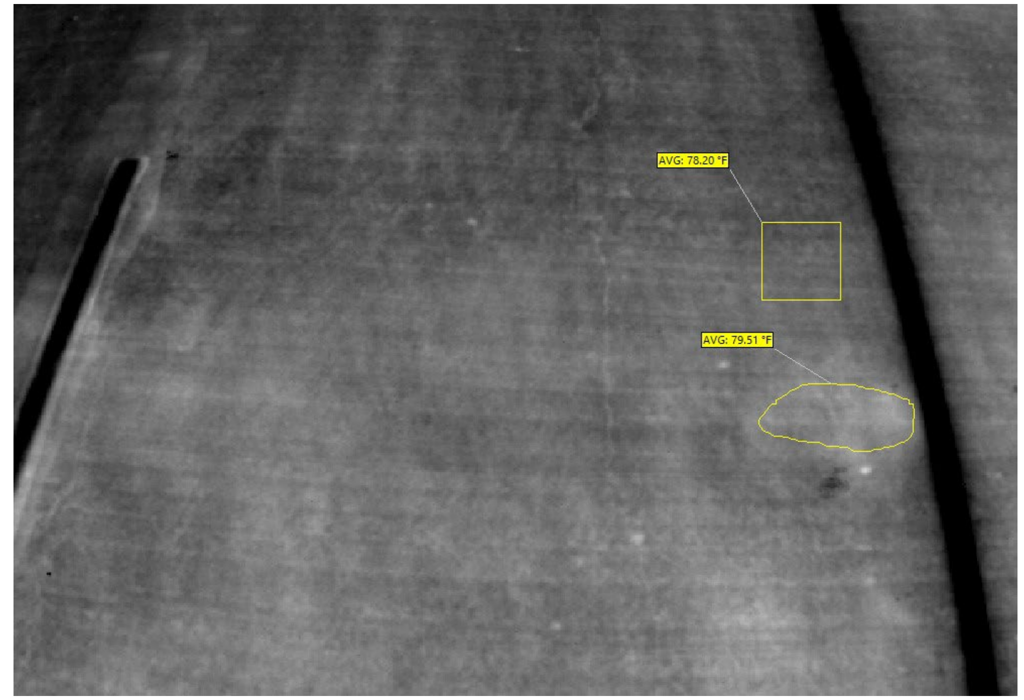

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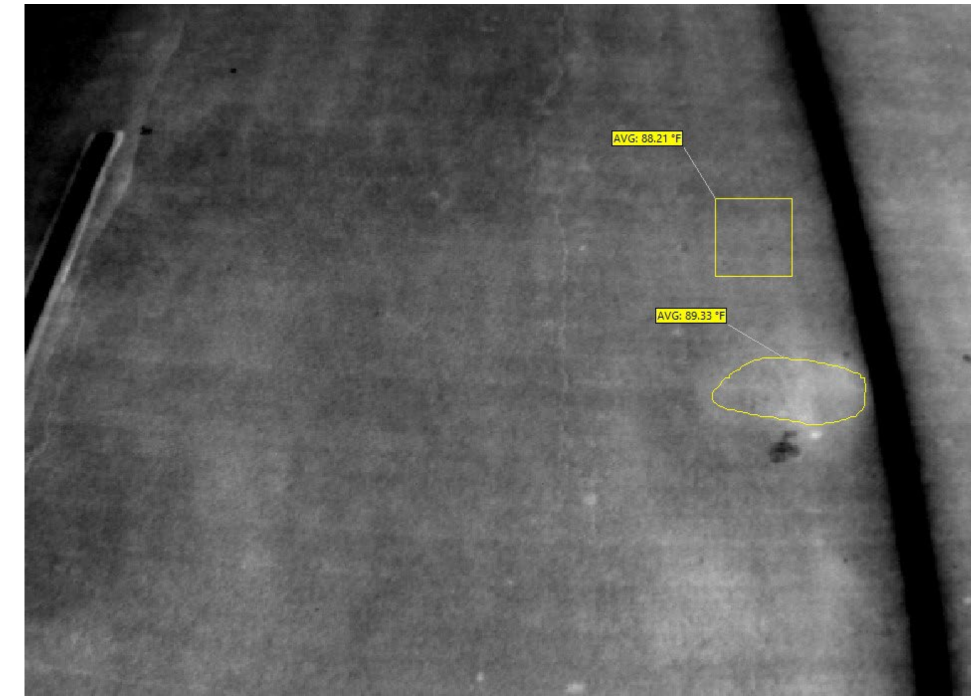

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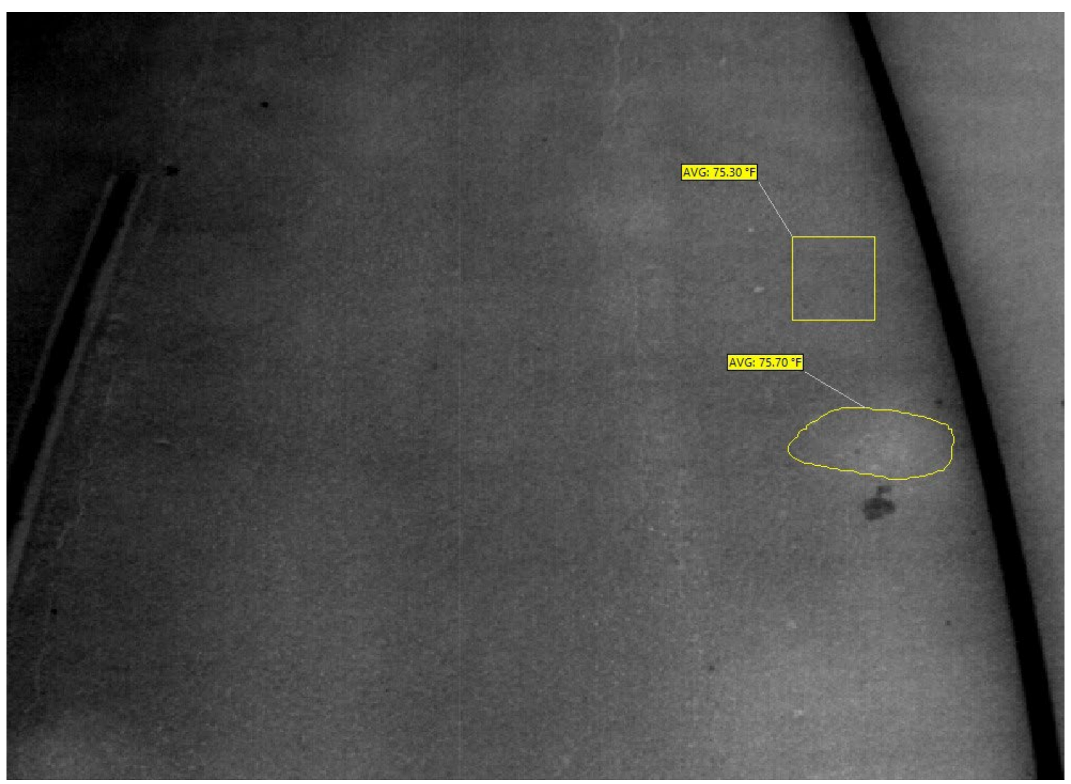

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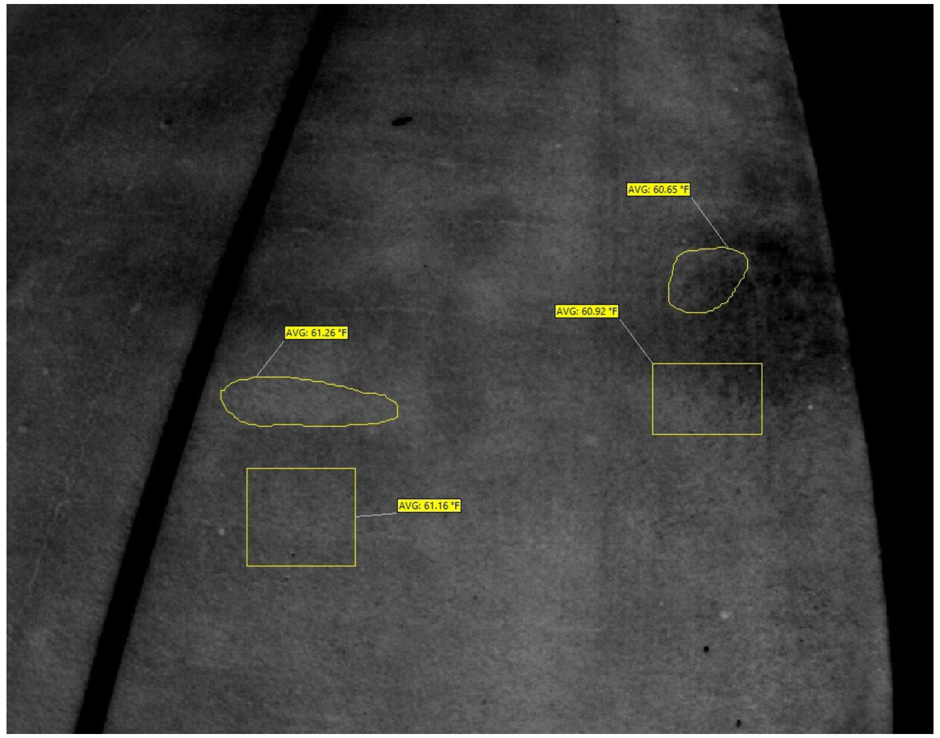
Live Image

B300074 EB Right Shoulder defects 2 and 3



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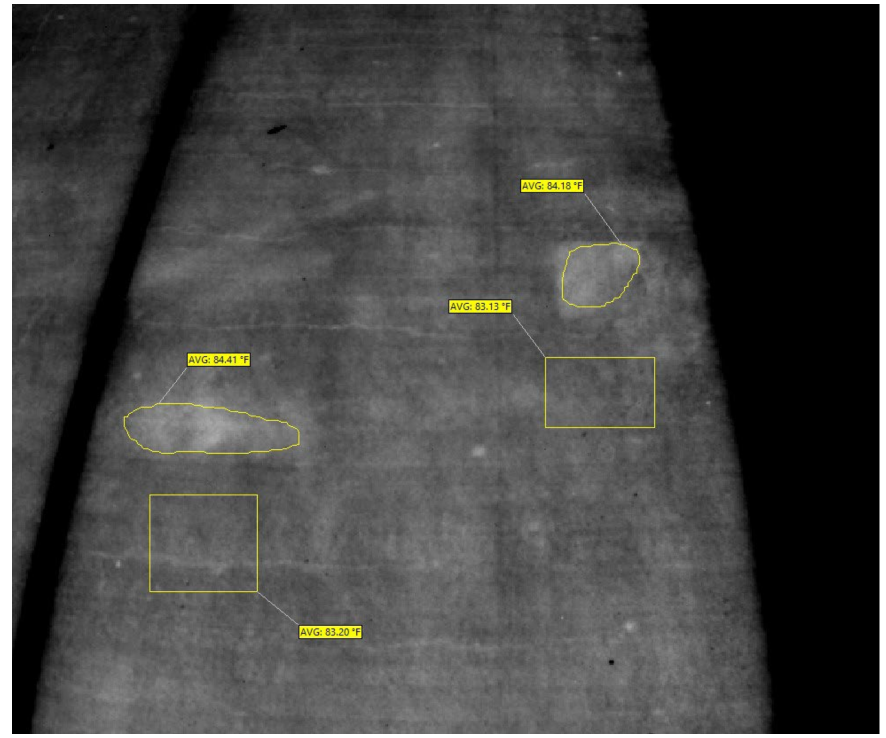

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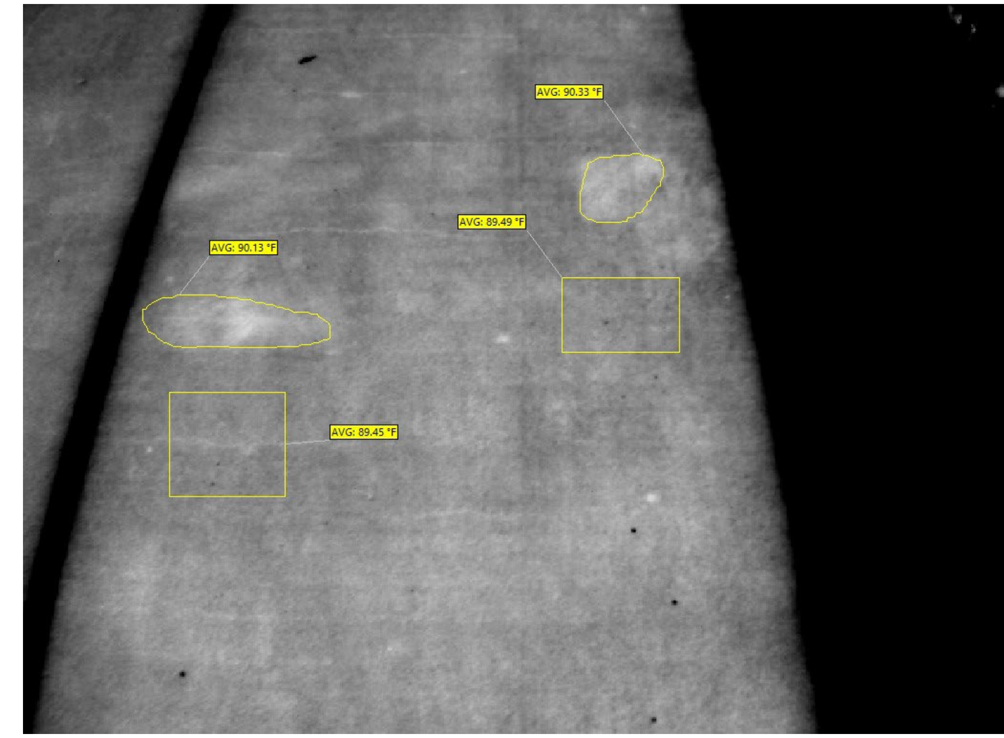

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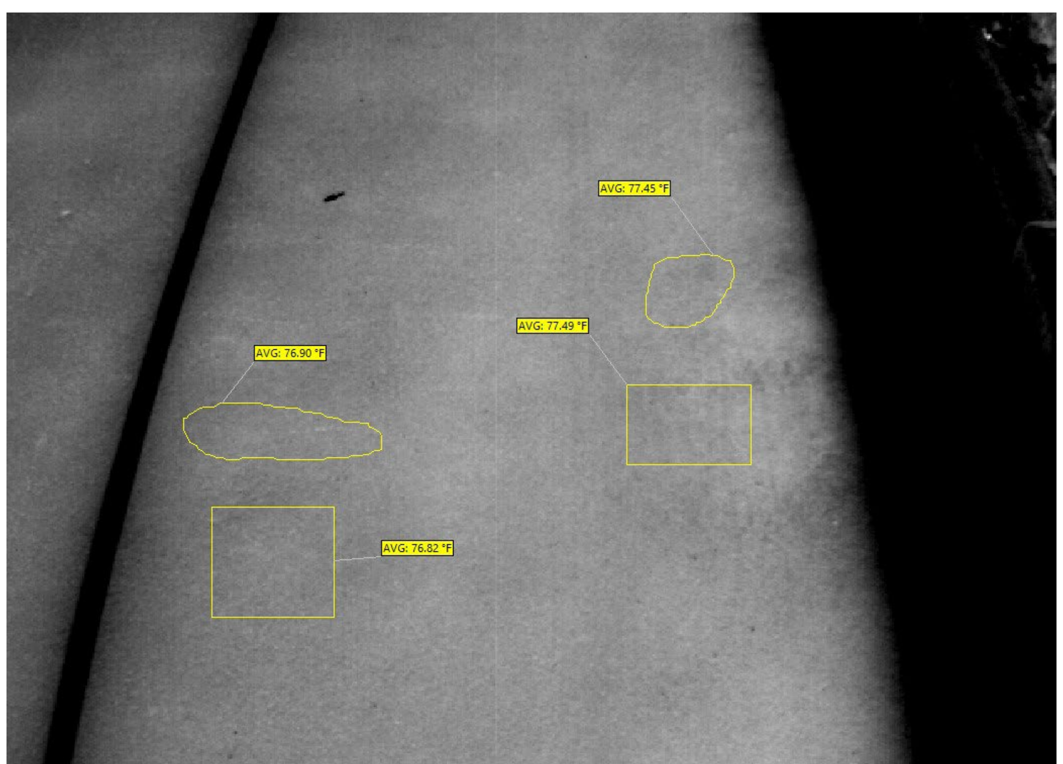

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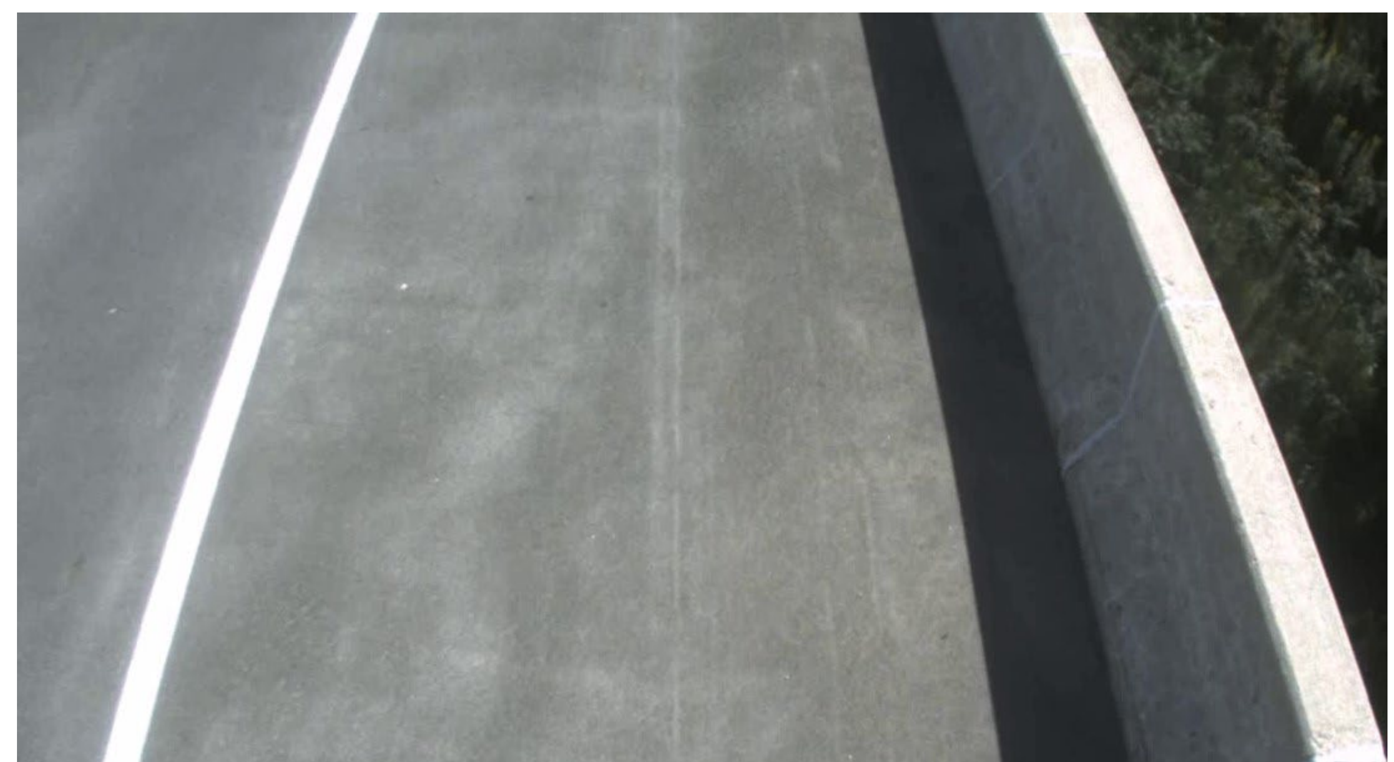
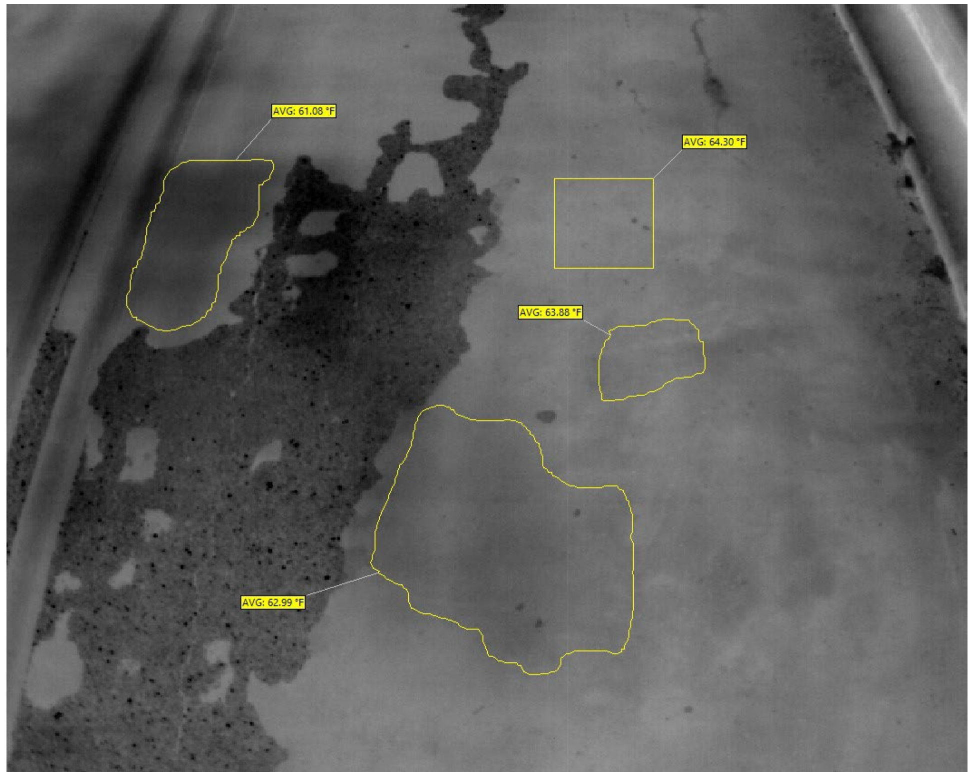


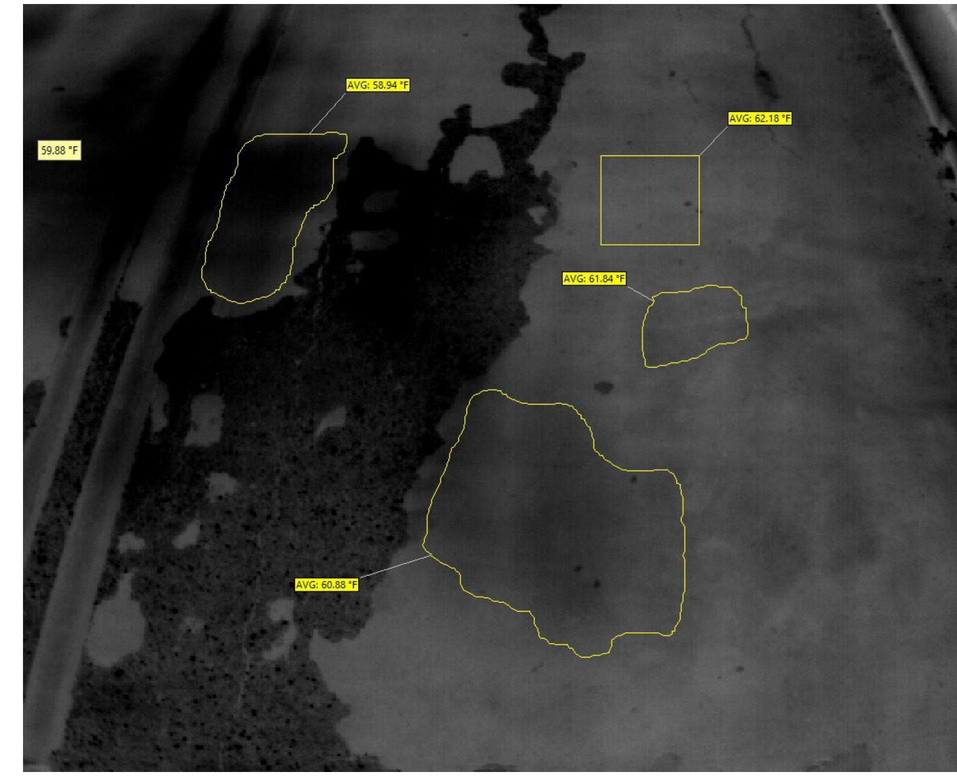
Live Image

B400330 SB Lane defects 1,2 and 3



8/31/2023 00:30

8/31/2023 01:25



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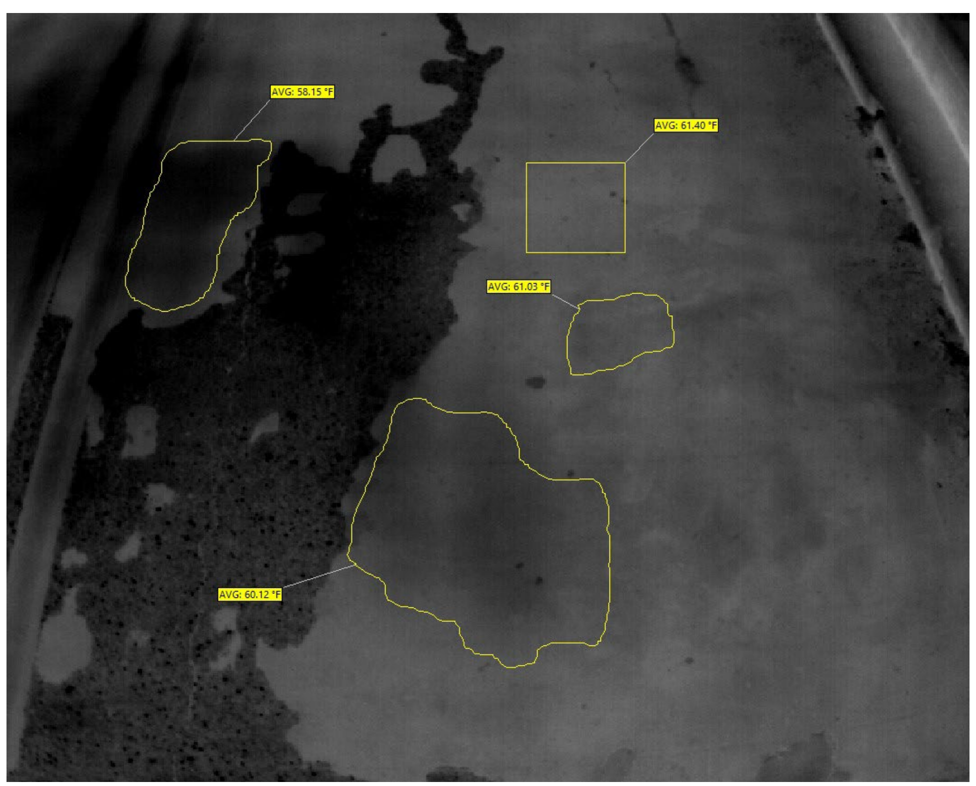

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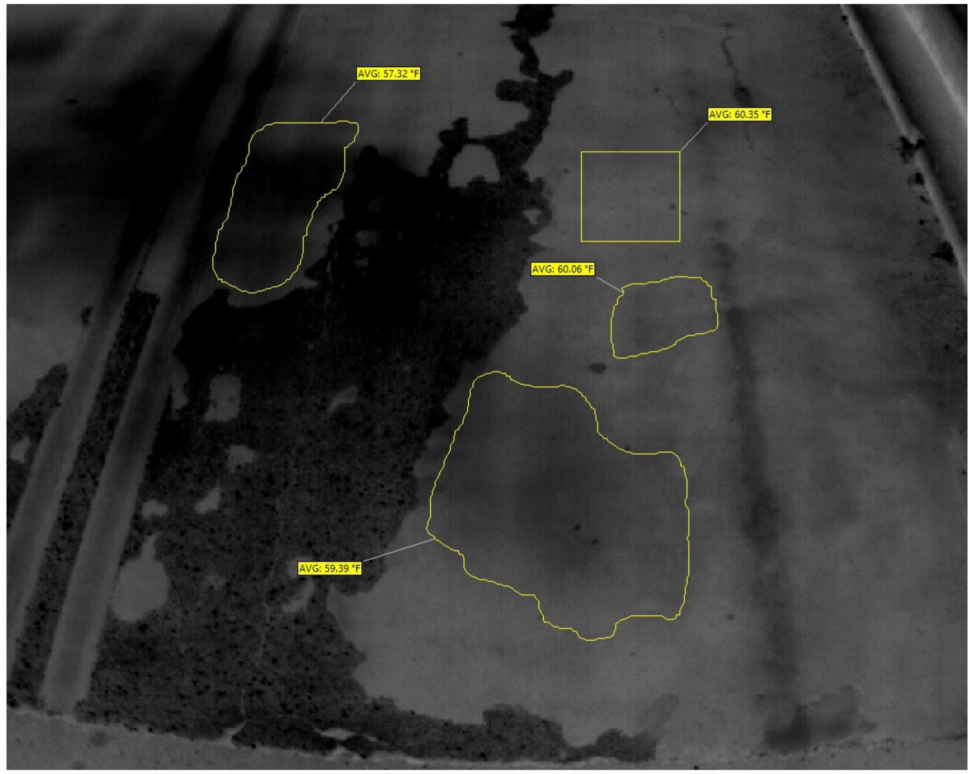
Live Image

B400330 SB Lane defects 1,2 and 3



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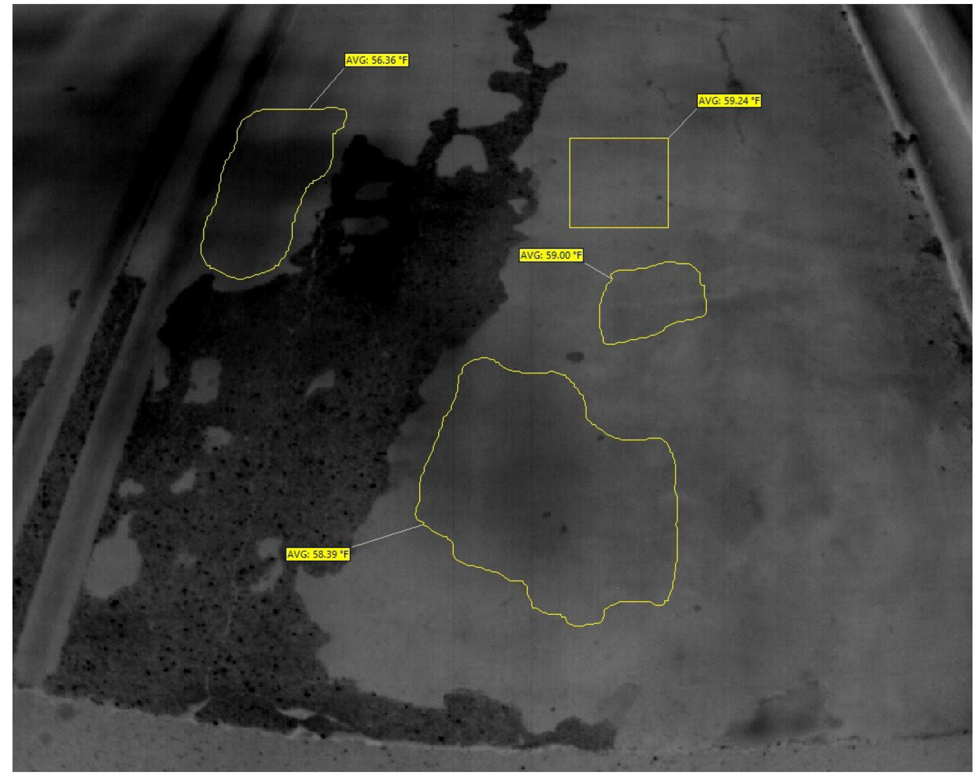

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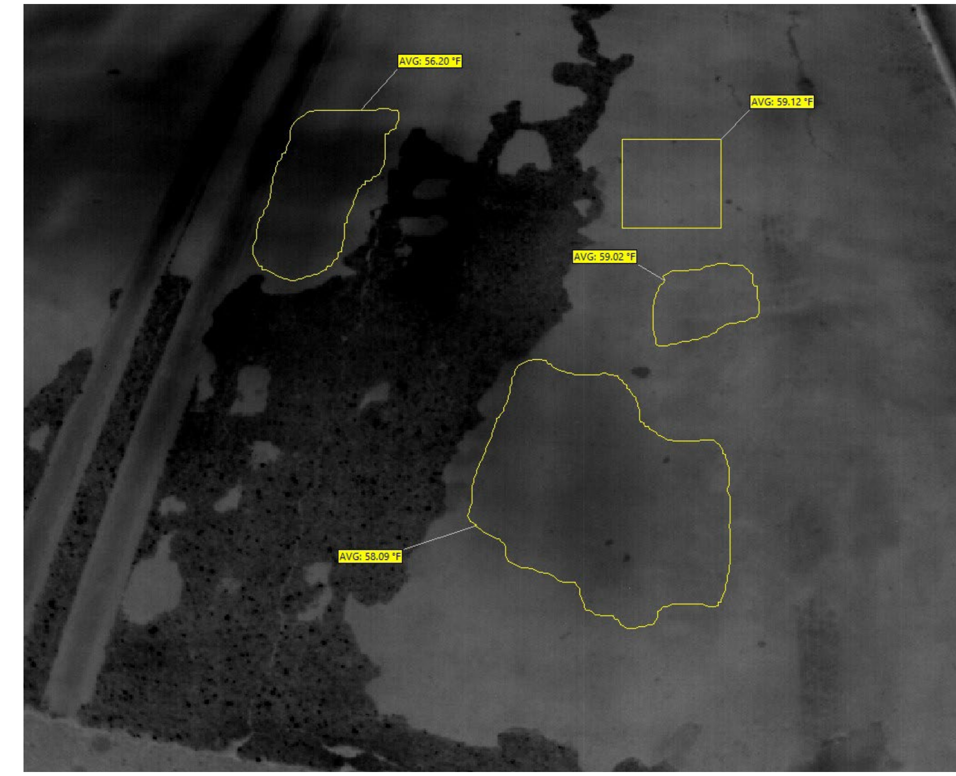

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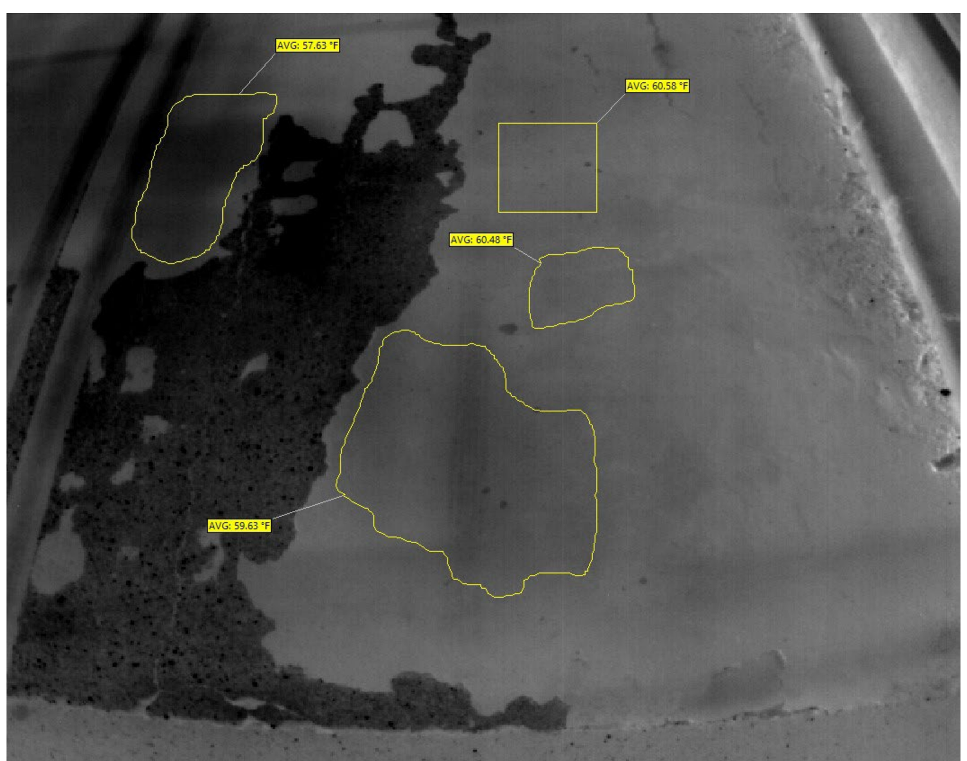

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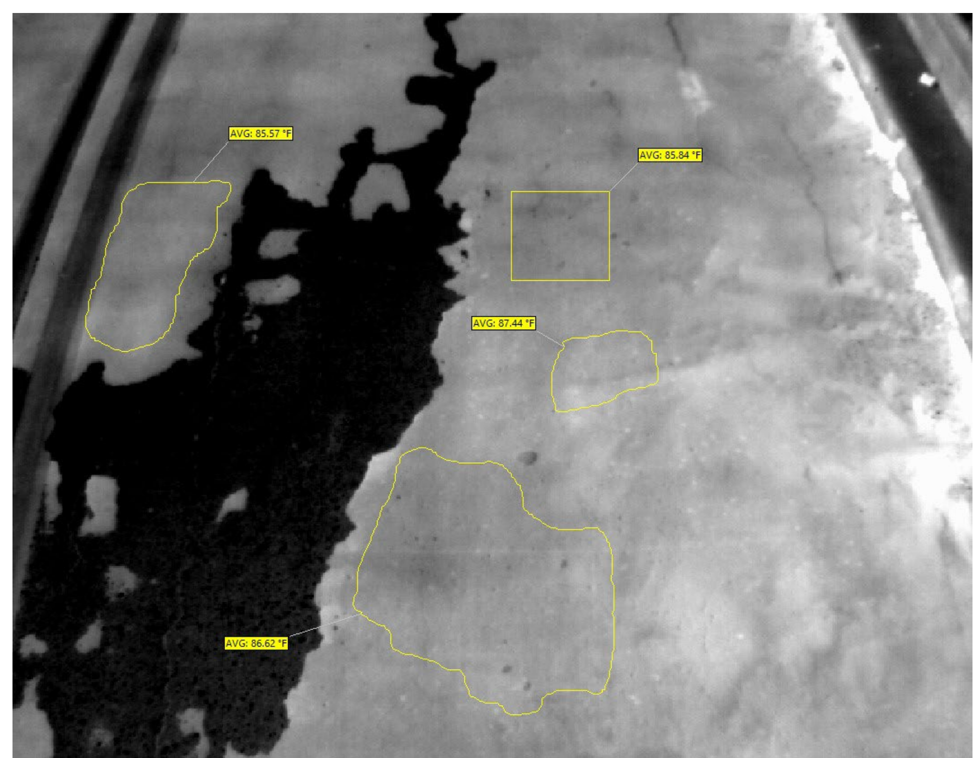

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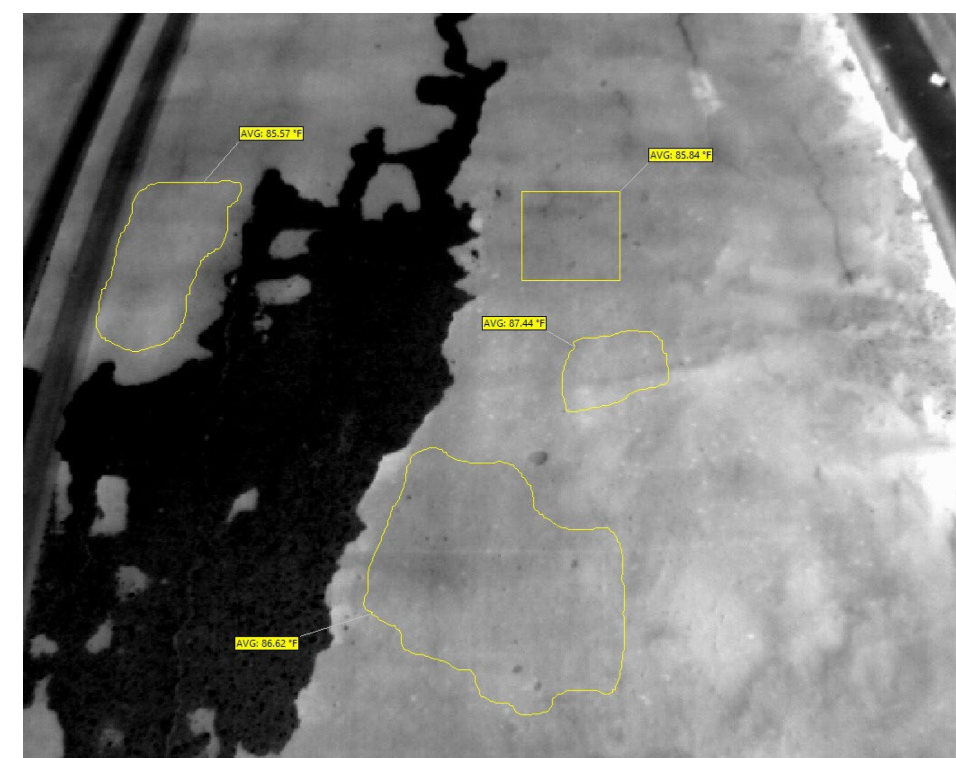

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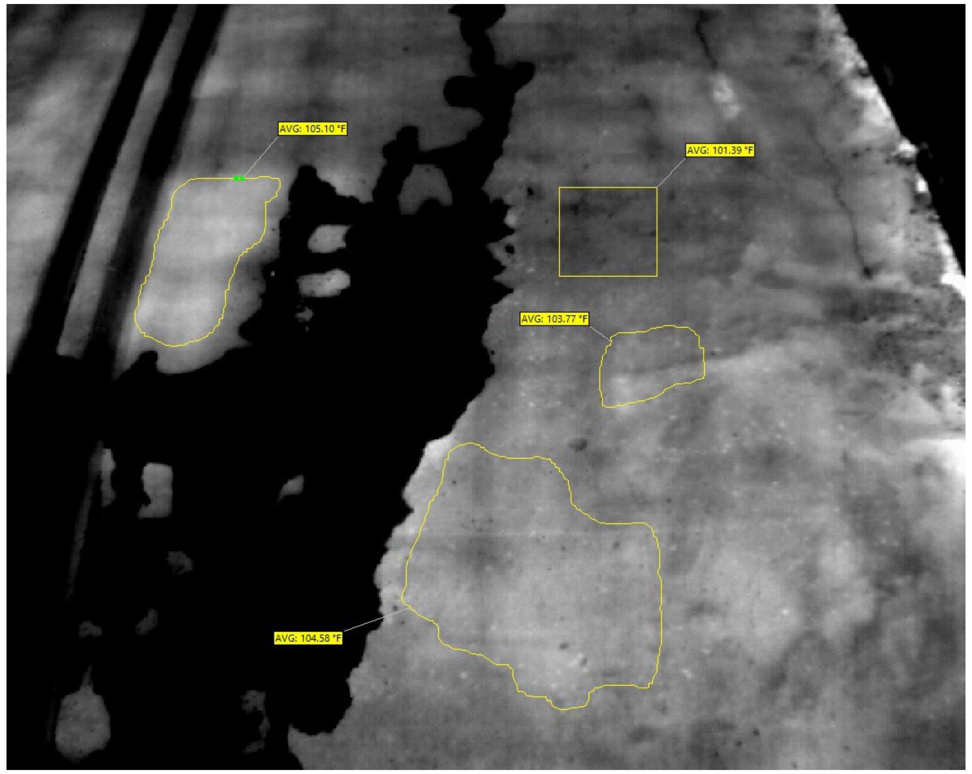
B400330 SB Lane defects 1,2 and 3



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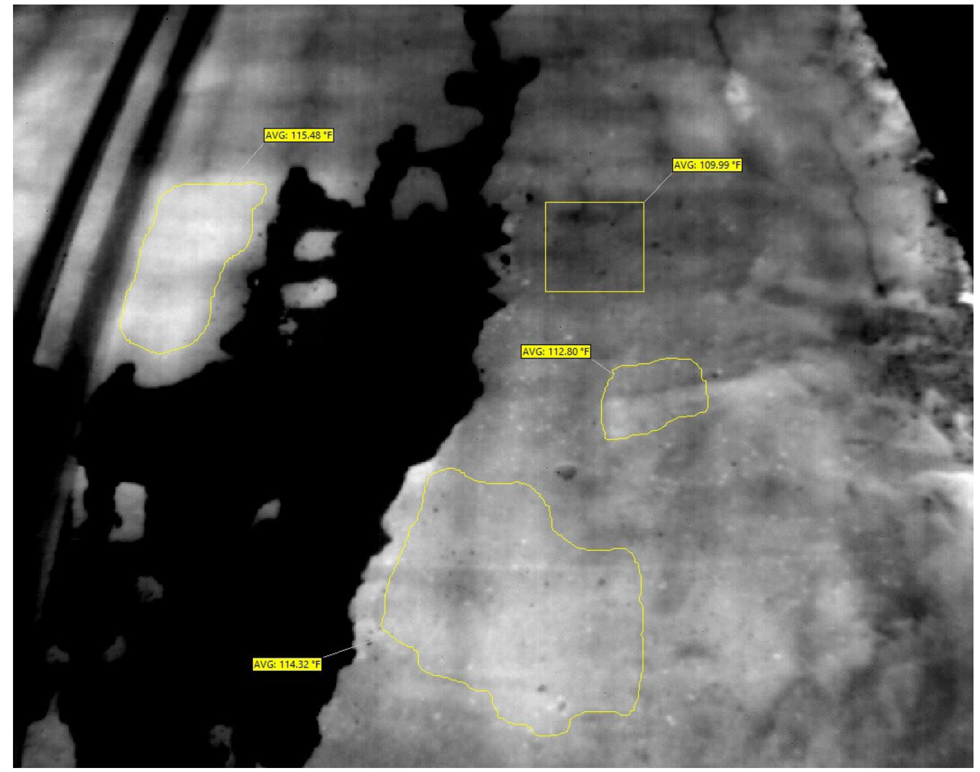

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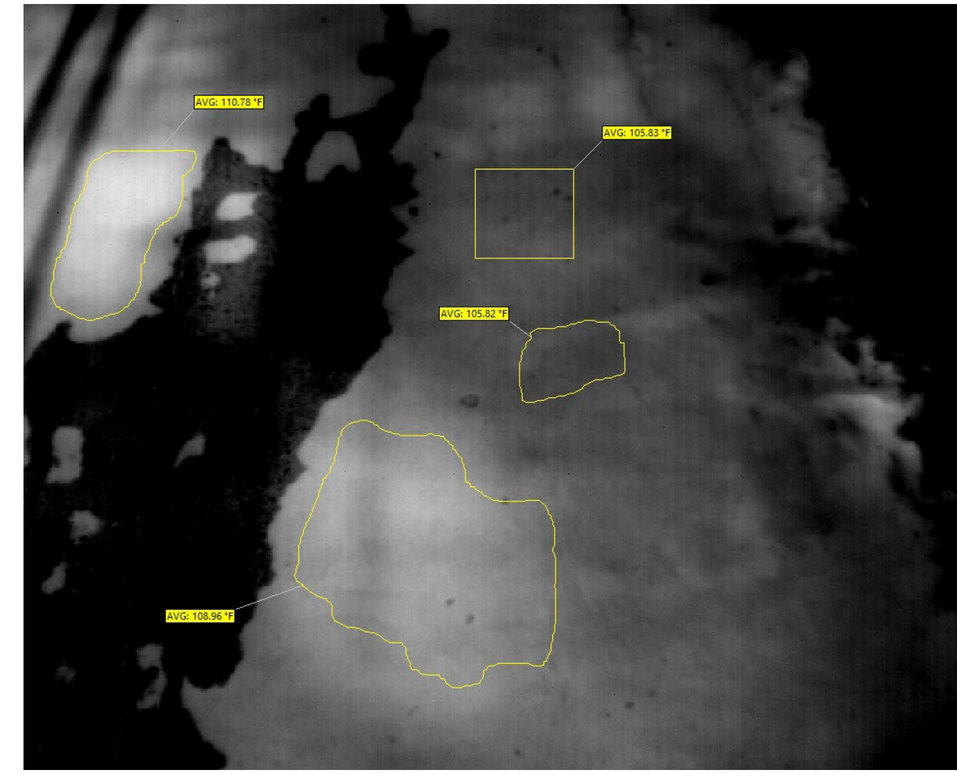

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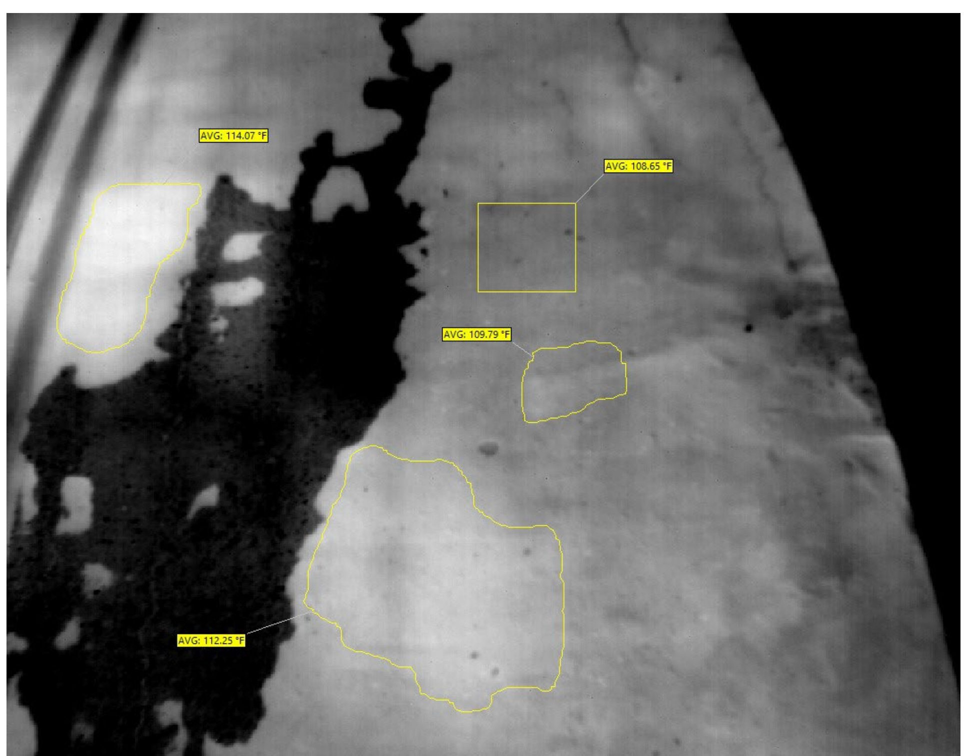

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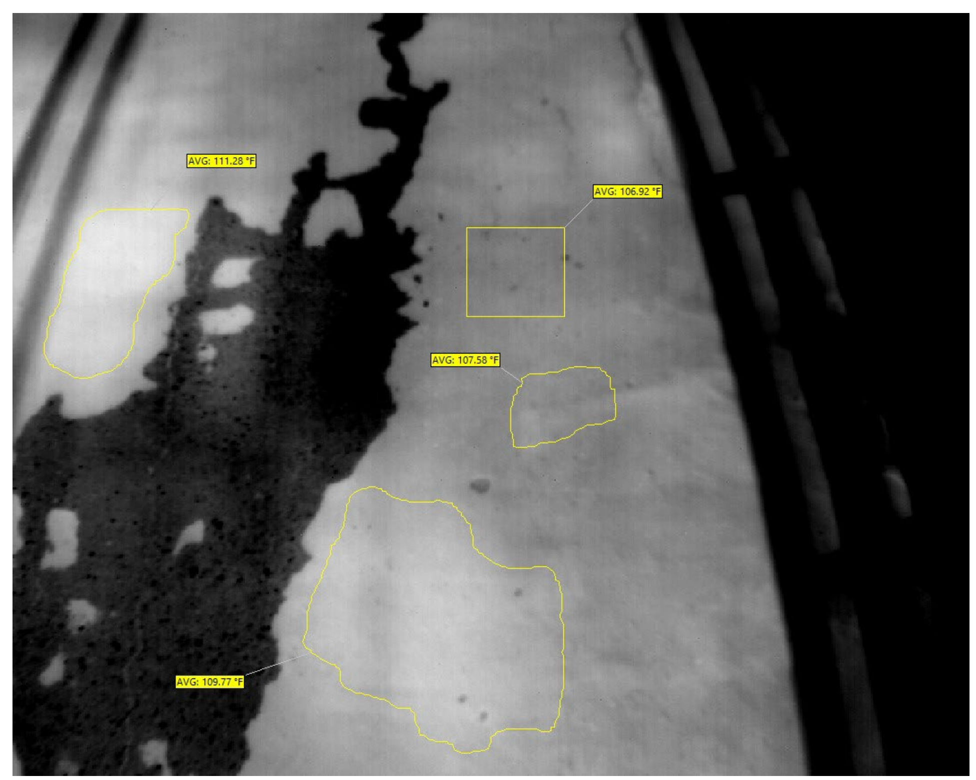

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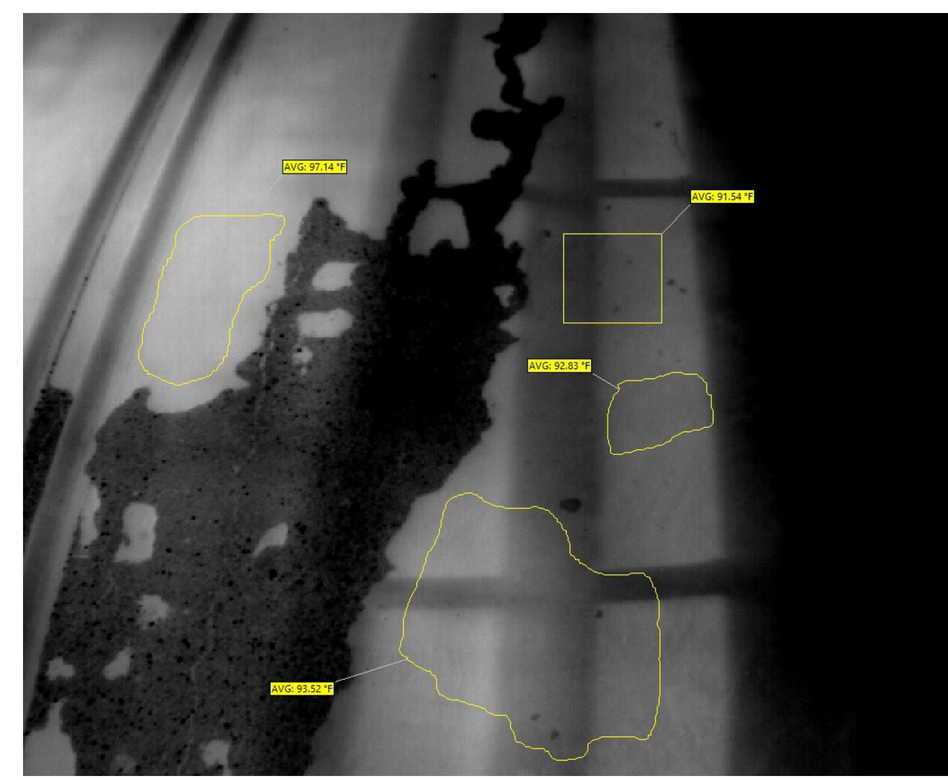

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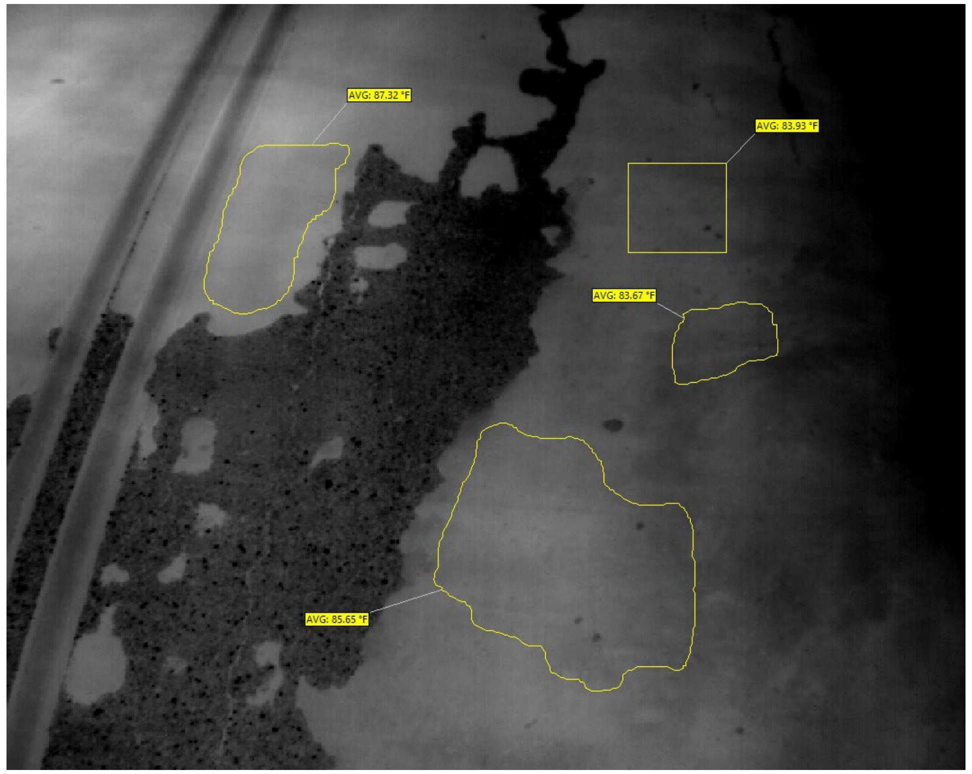
B400330 SB Lane defects 1,2 and 3



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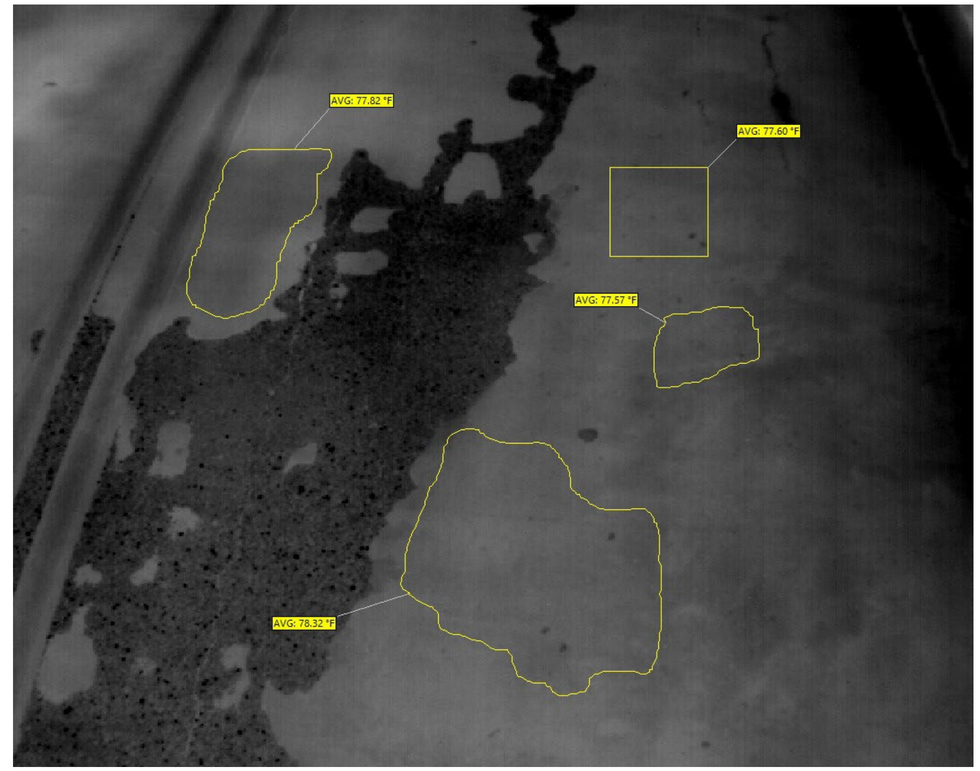

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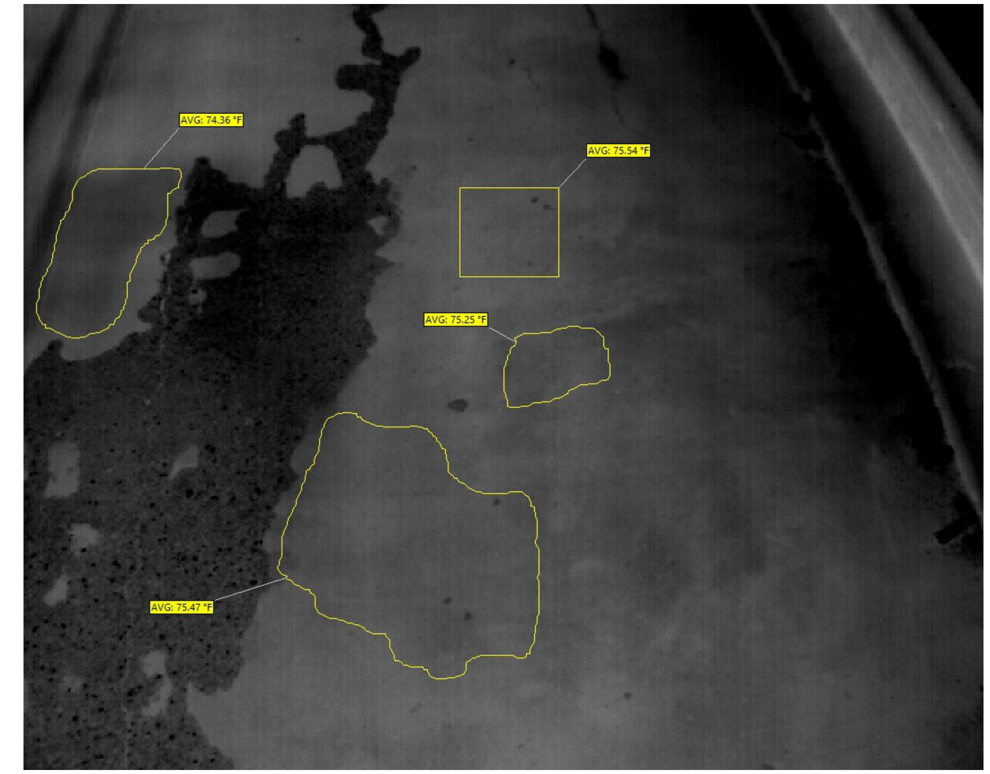

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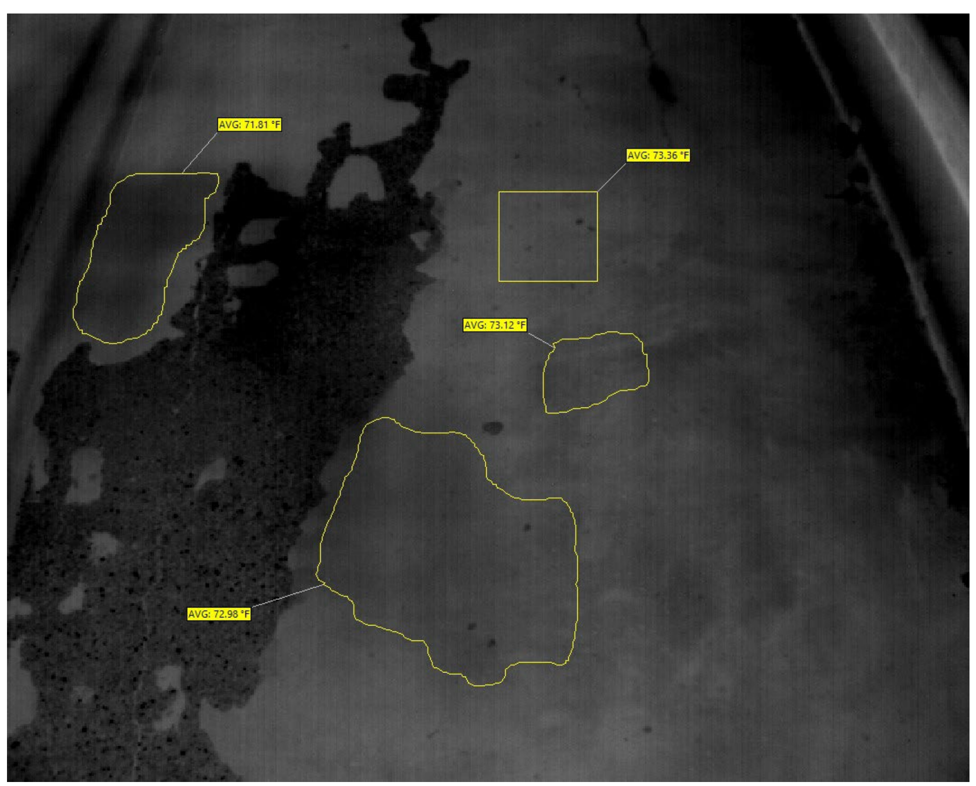

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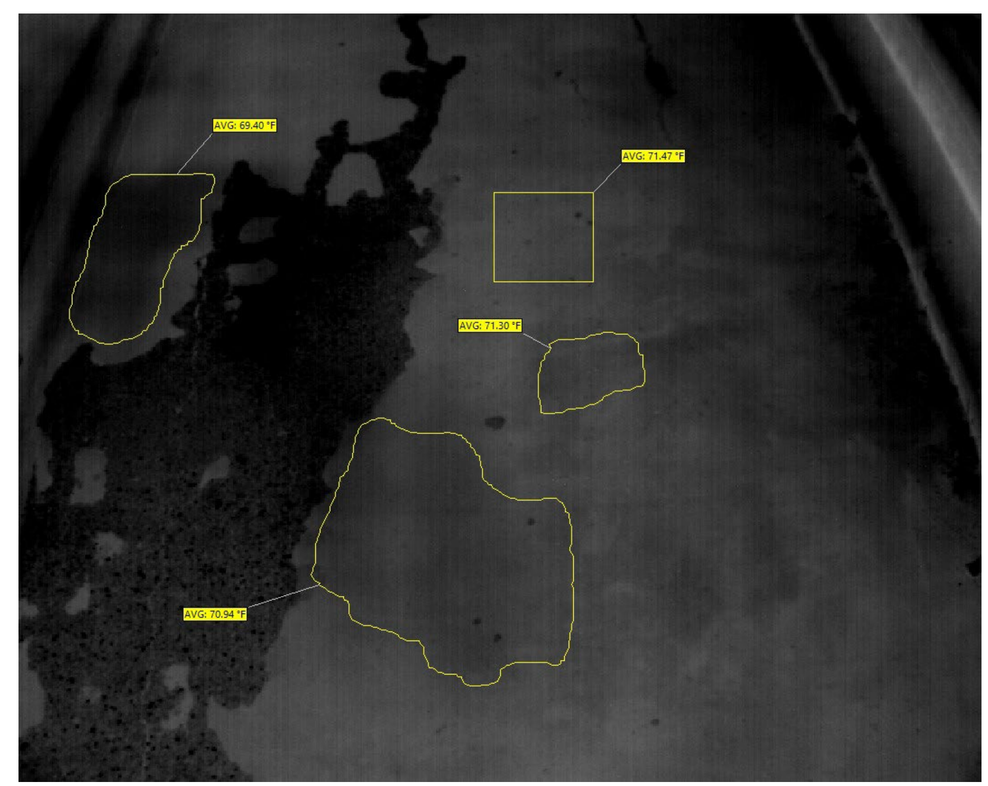

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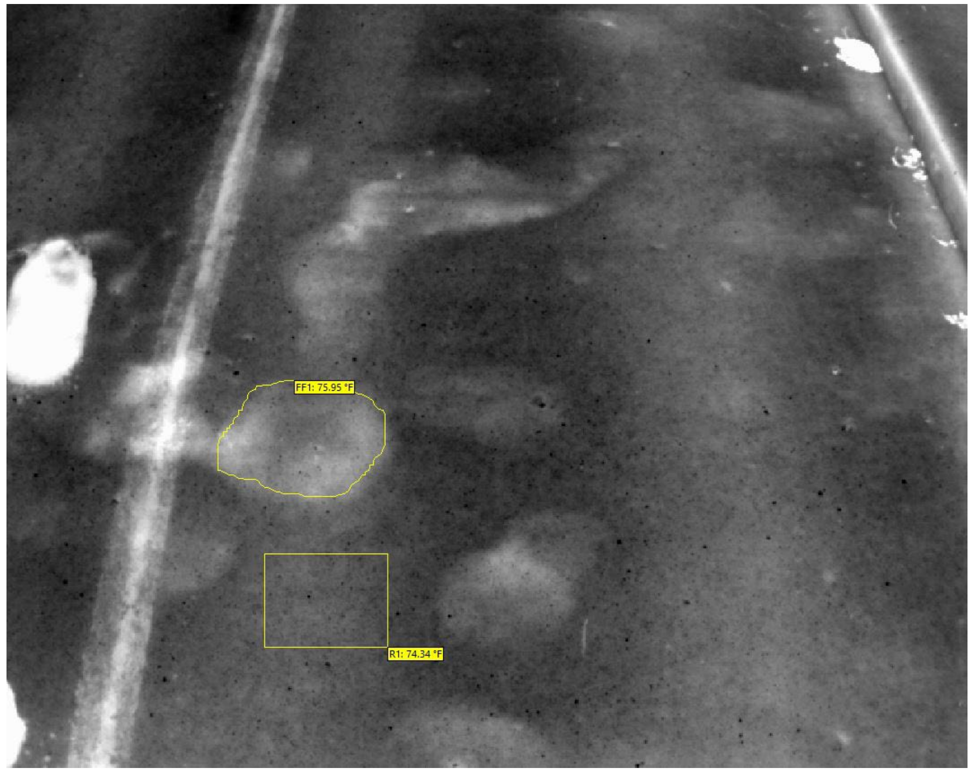
B400519 WB Right Lane defect 1



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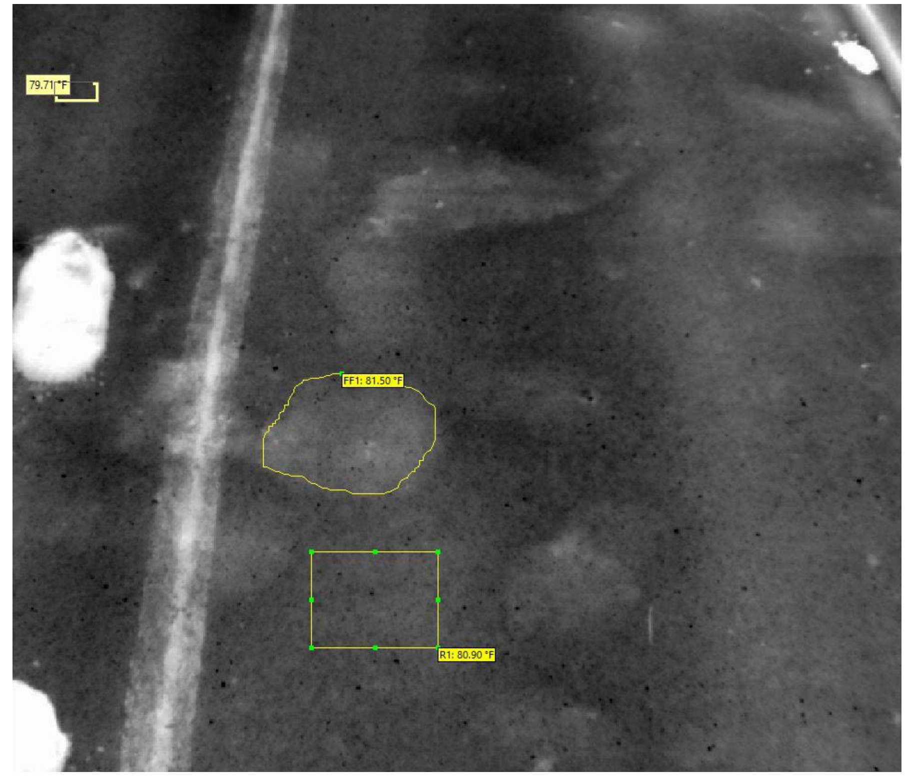

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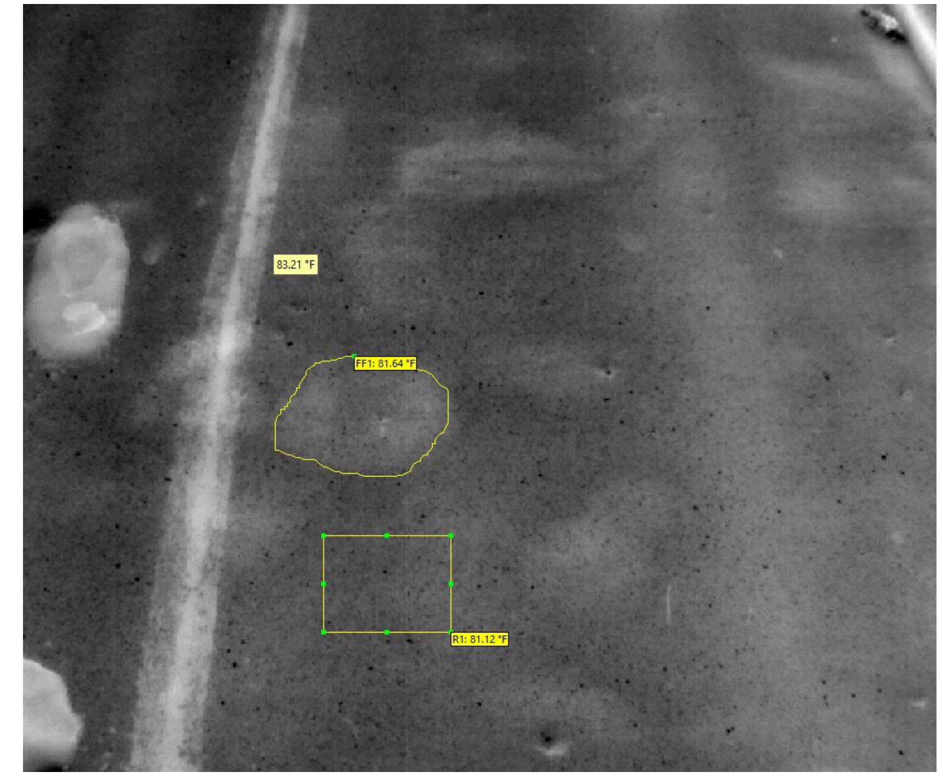

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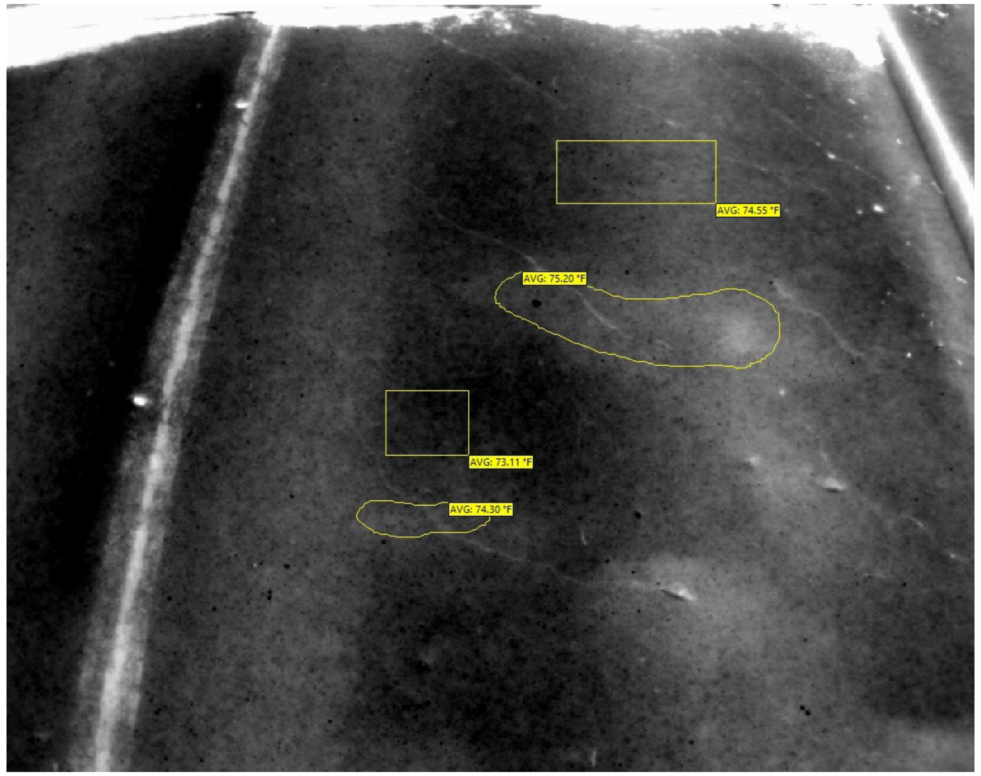
9/14/2023 20:00

Live Image

B400519 WB Right Lane defects 2 and 3



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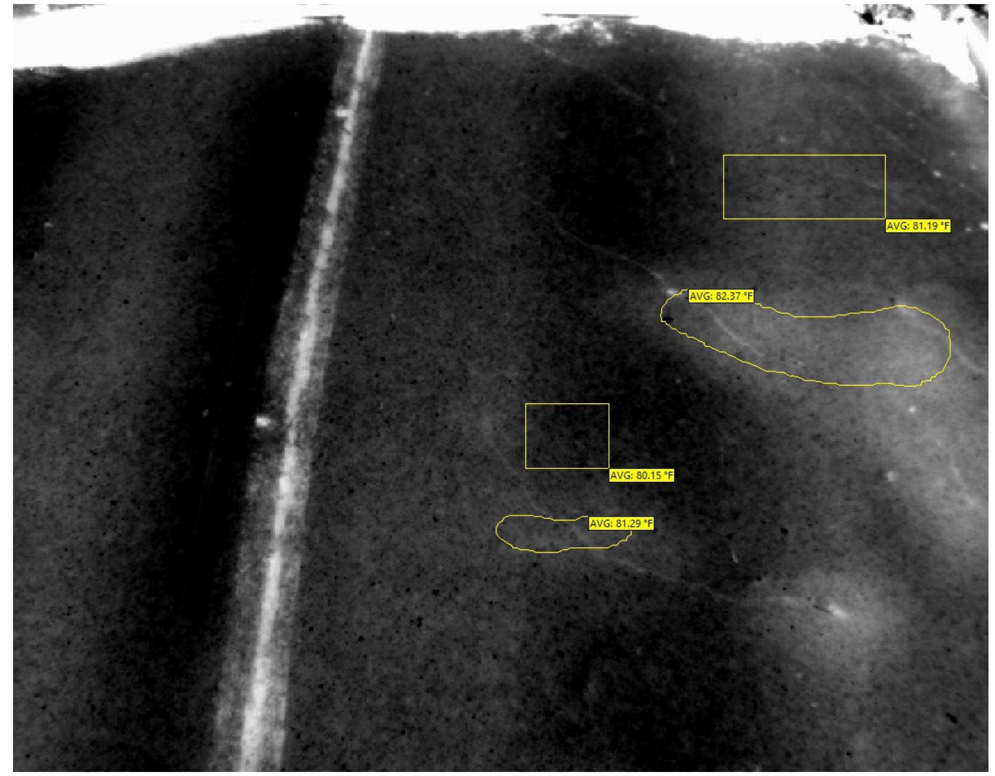

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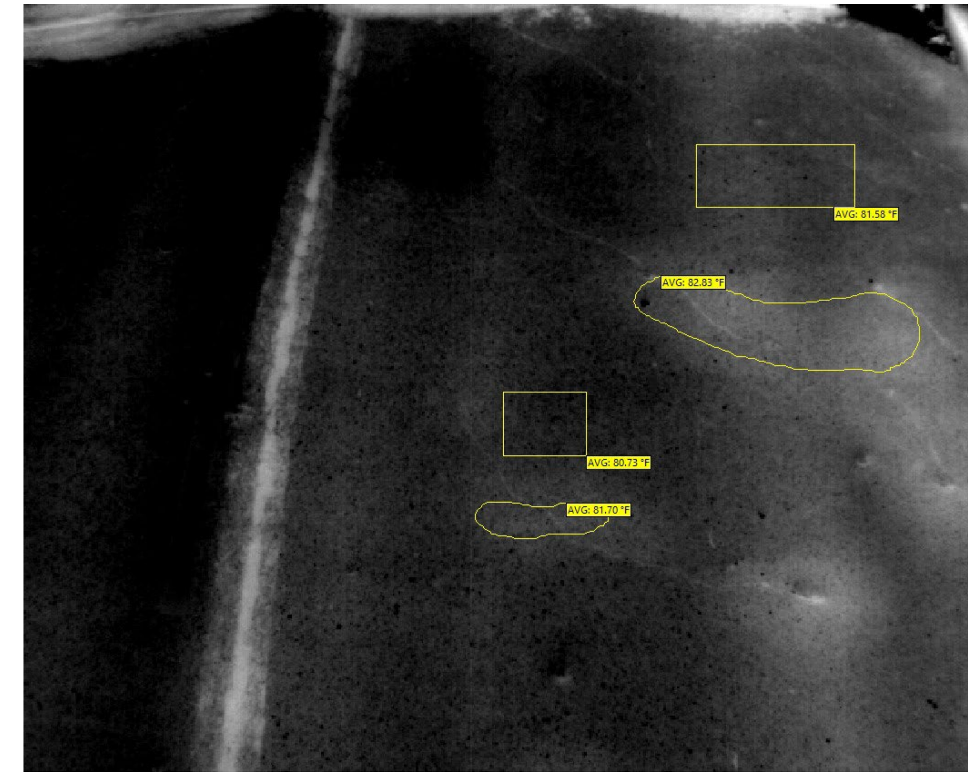

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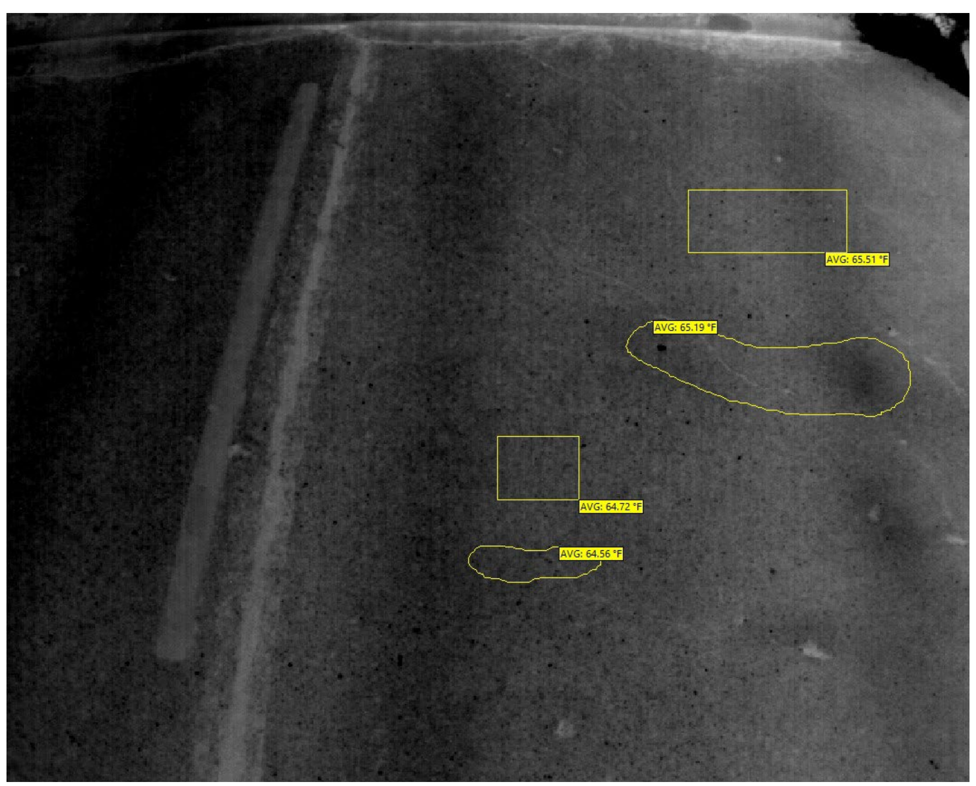

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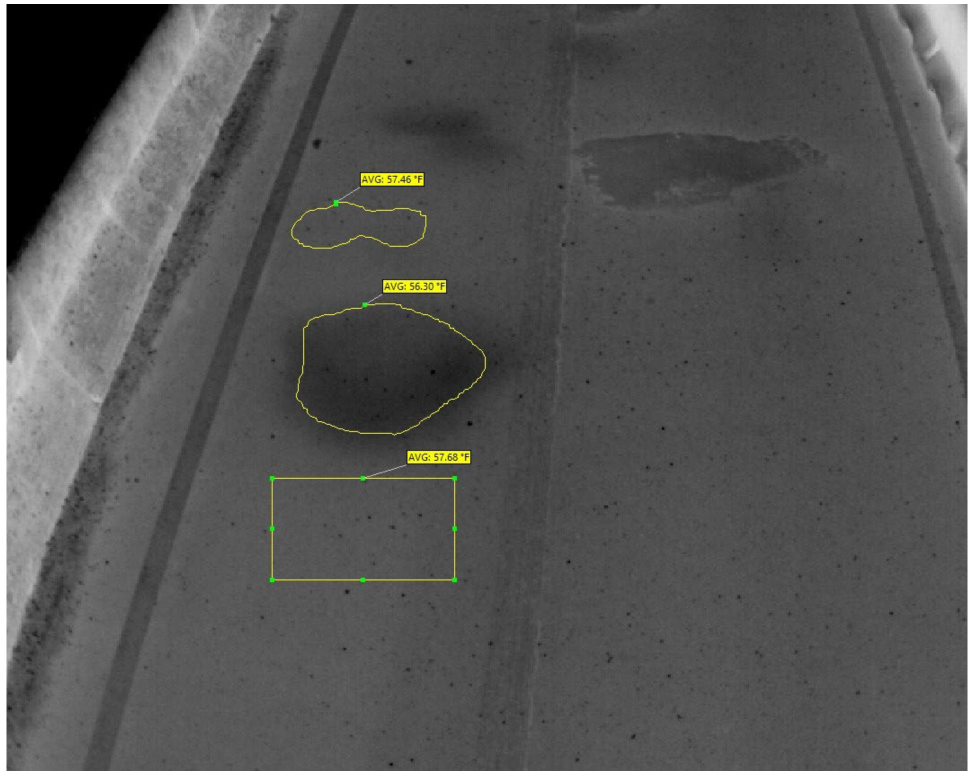
Live Image

B660037 Left Lane defects 1 and 2



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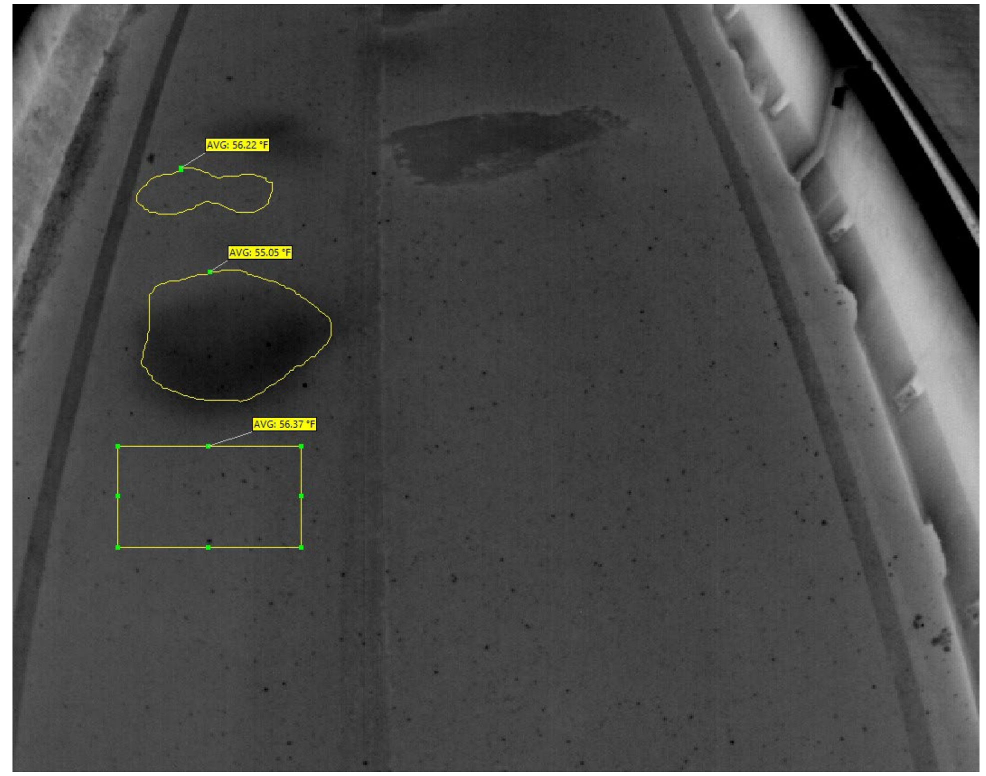

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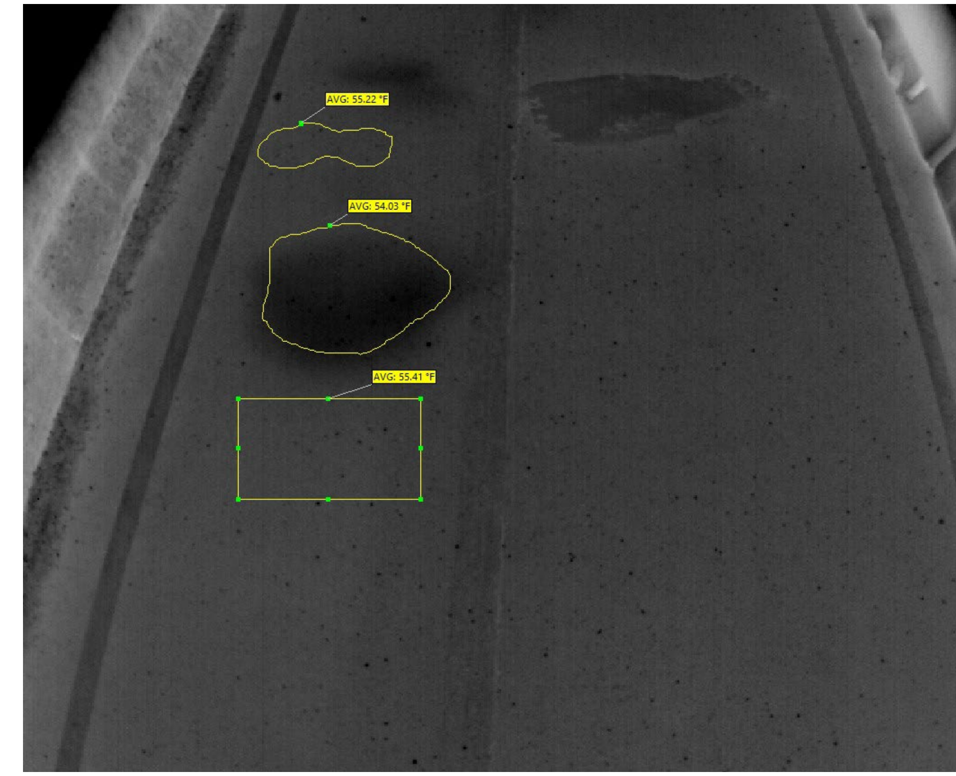

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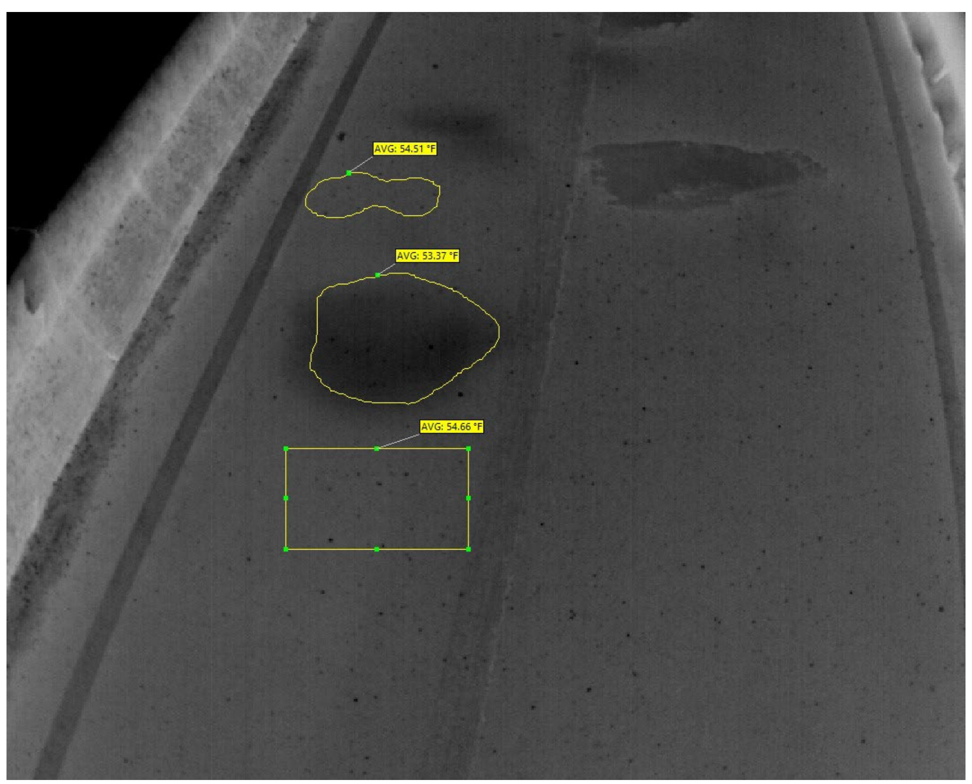
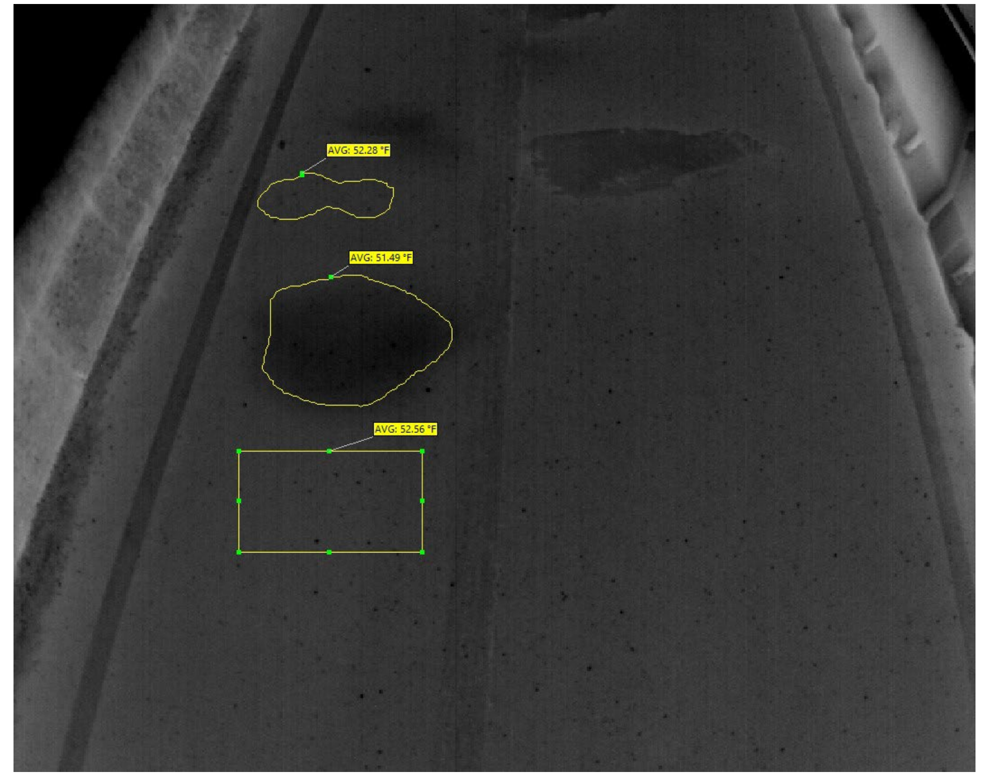


8/31/2023 03:10

Live Image

B660037 Left Lane defects 1 and 2

8/31/2023 04:10



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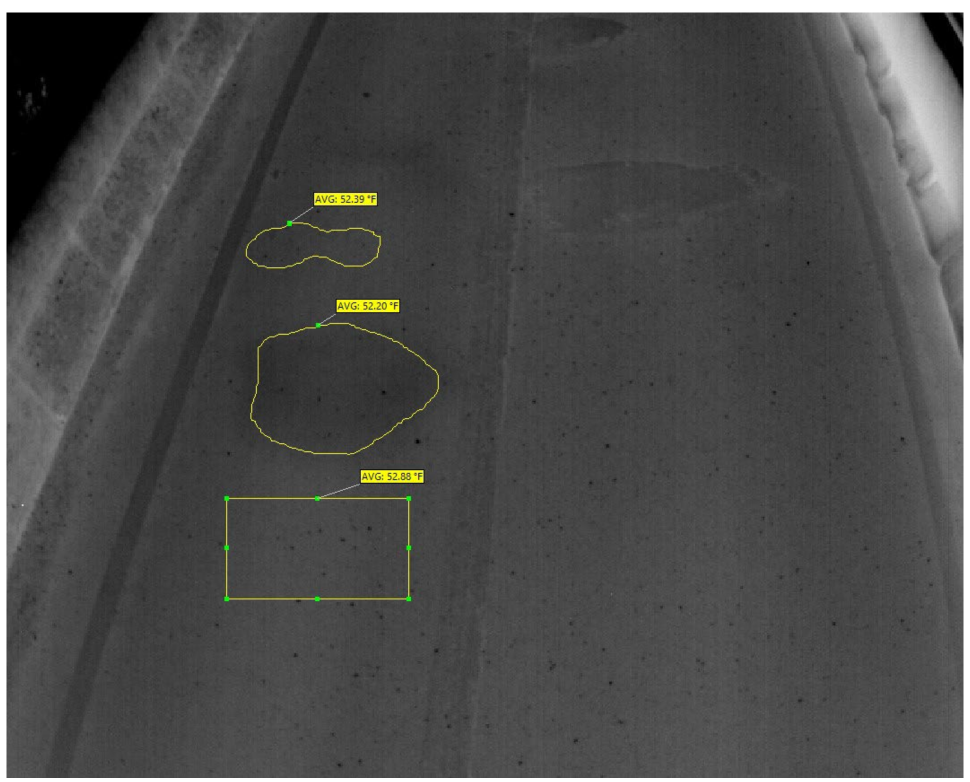
8/31/2023 06:05



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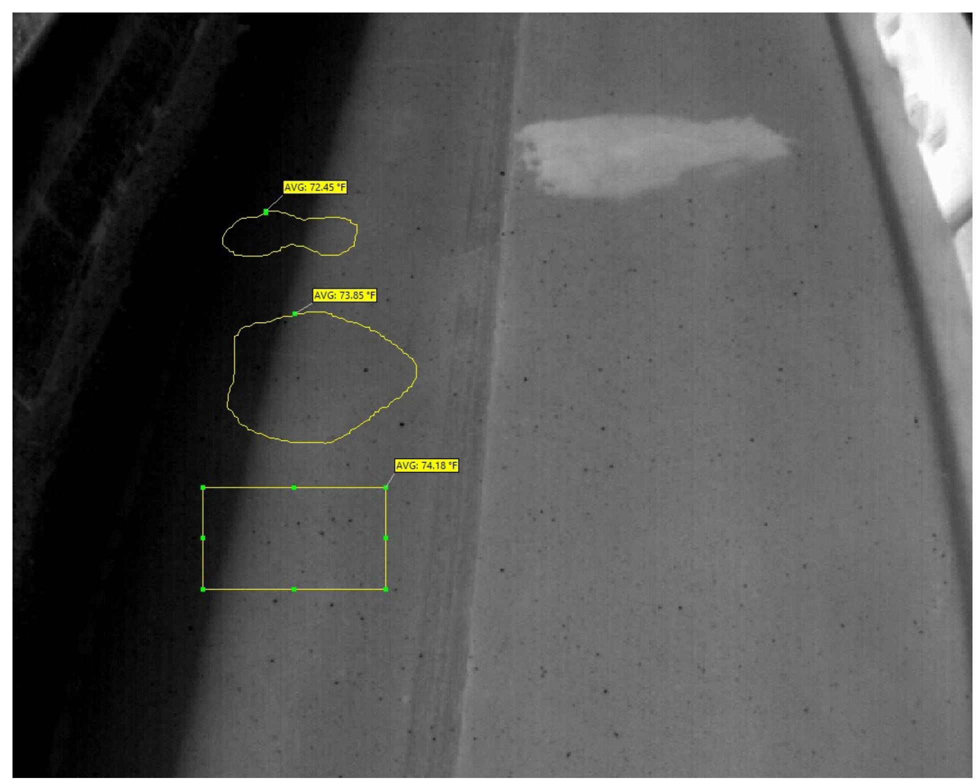

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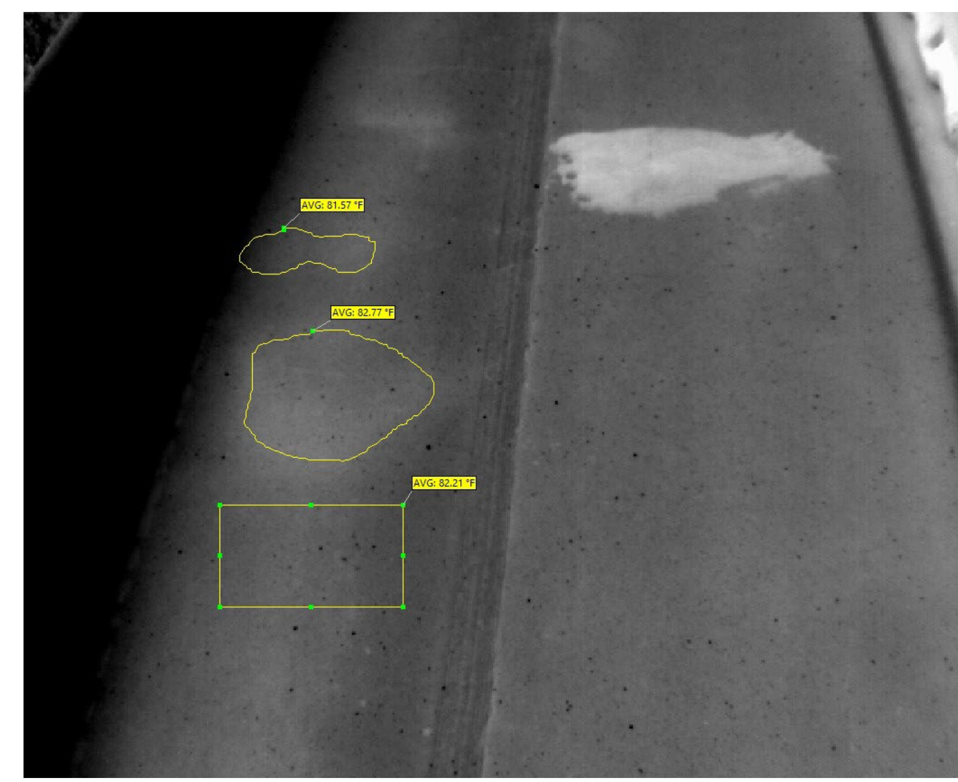

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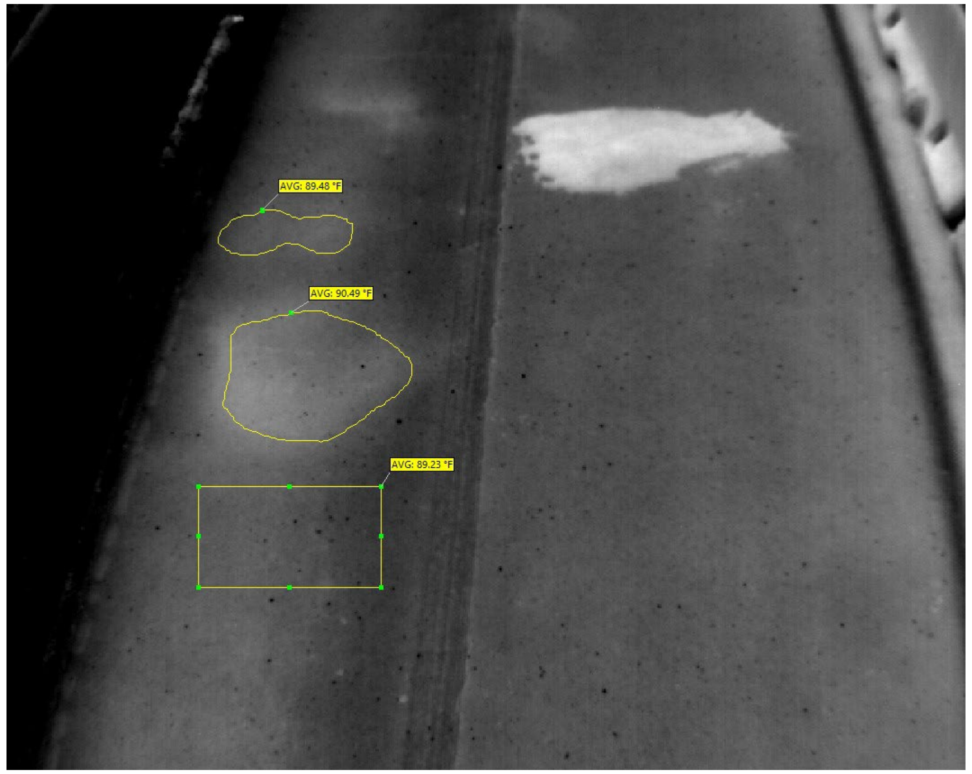
B660037 Left Lane defects 1 and 2



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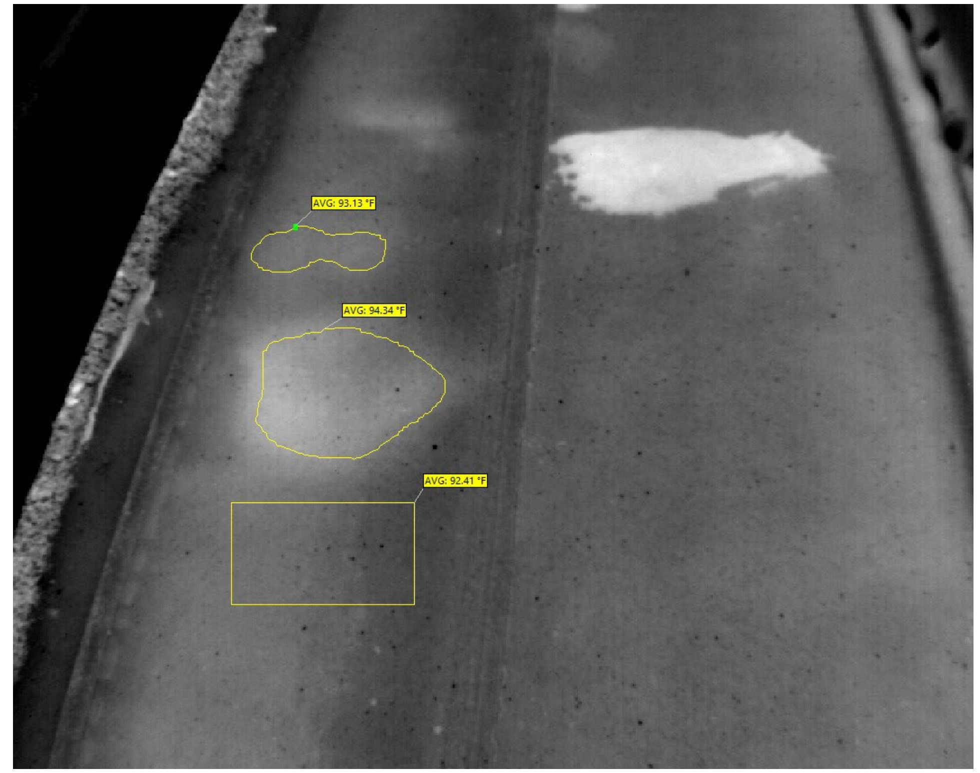

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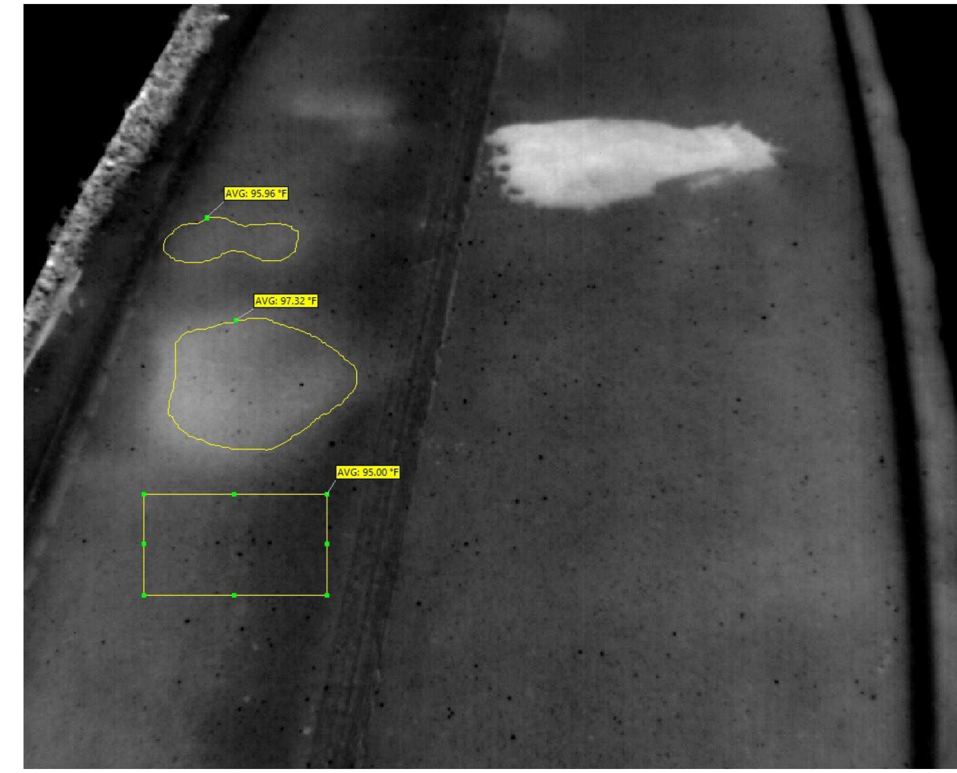

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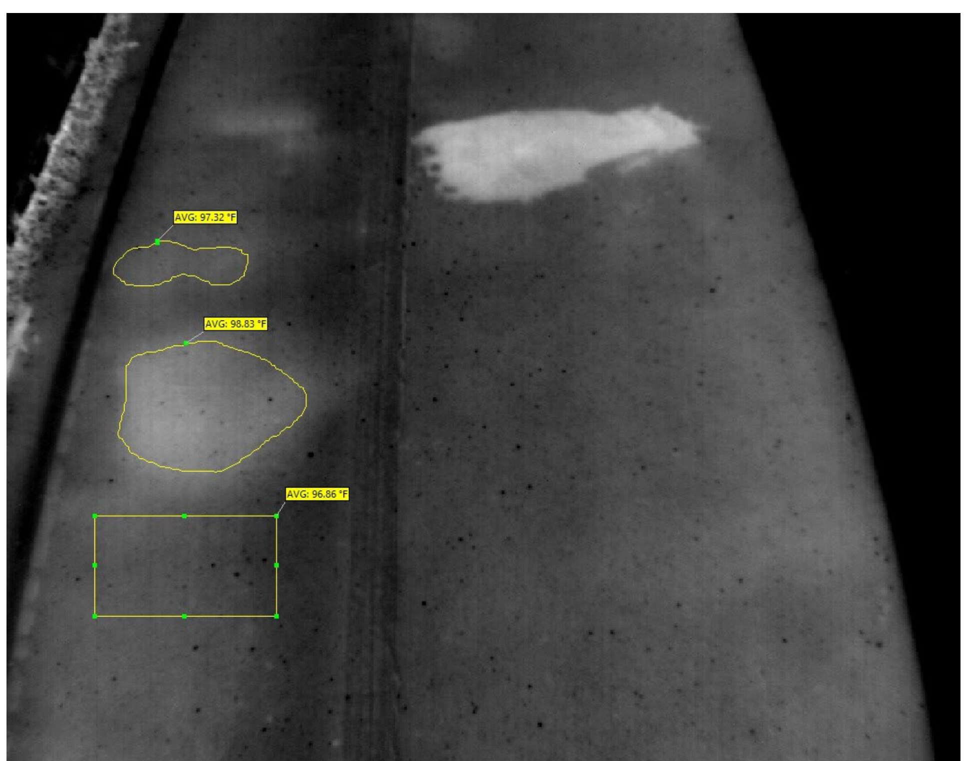

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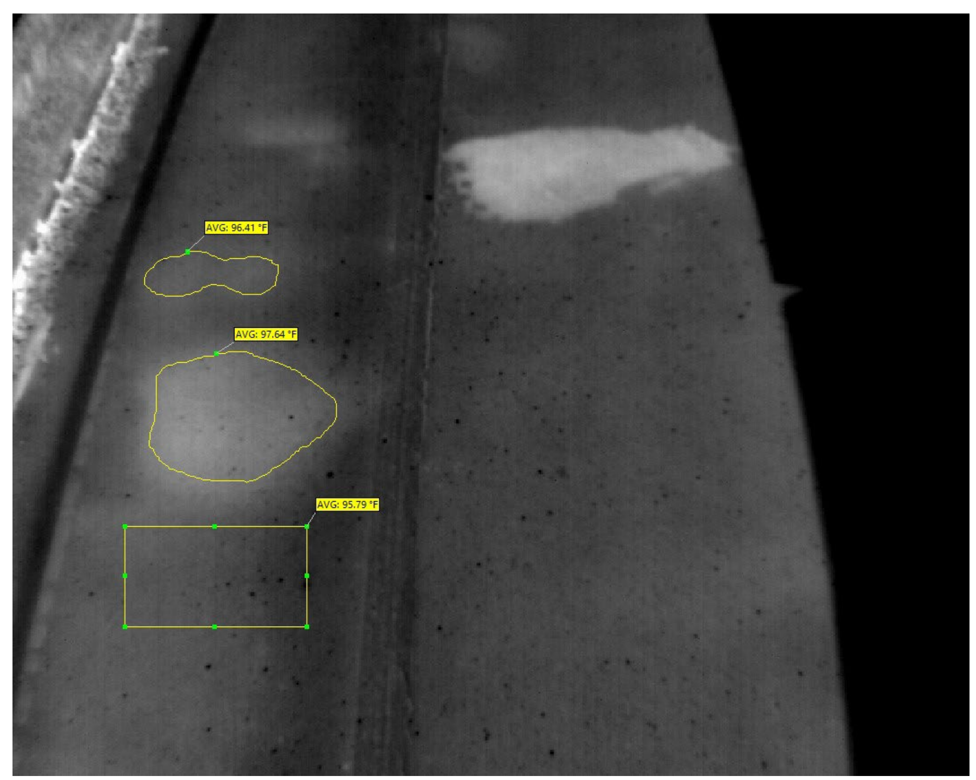
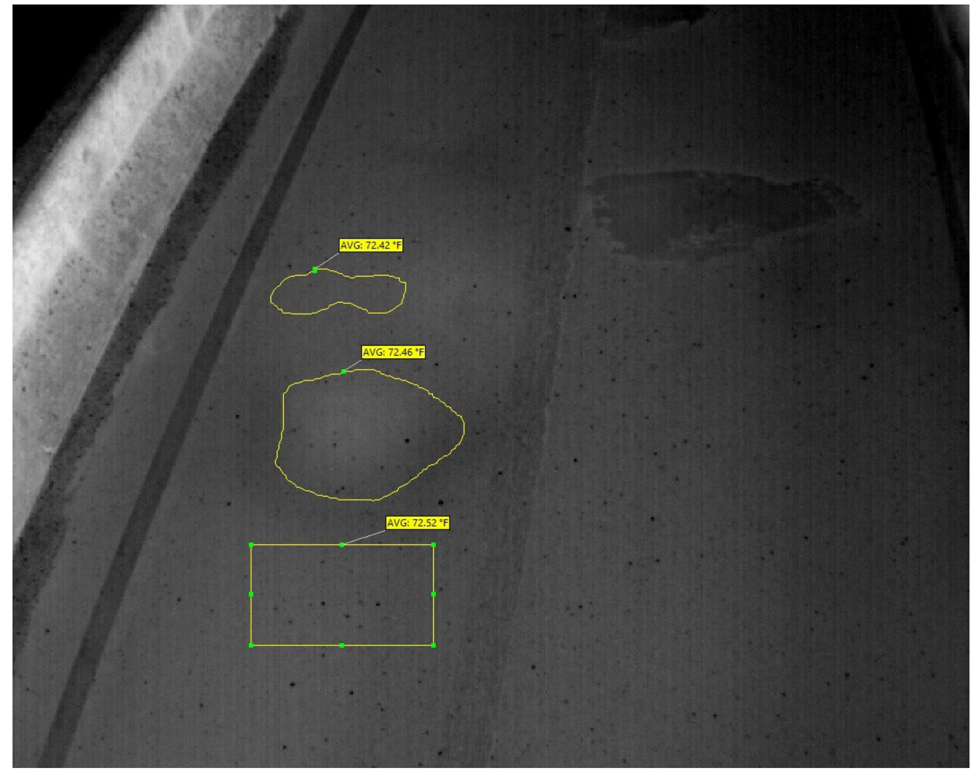


8/10/2023 16:05

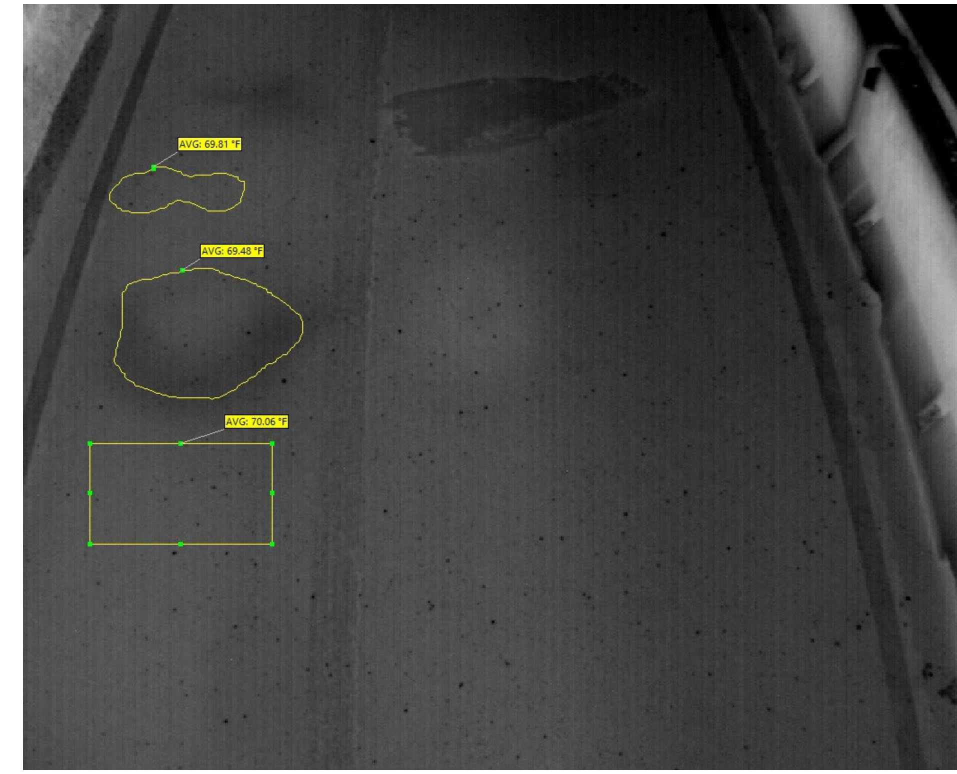
8/28/2023 17:30

B660037 Left Lane defects 1 and 2

8/28/2023 18:30

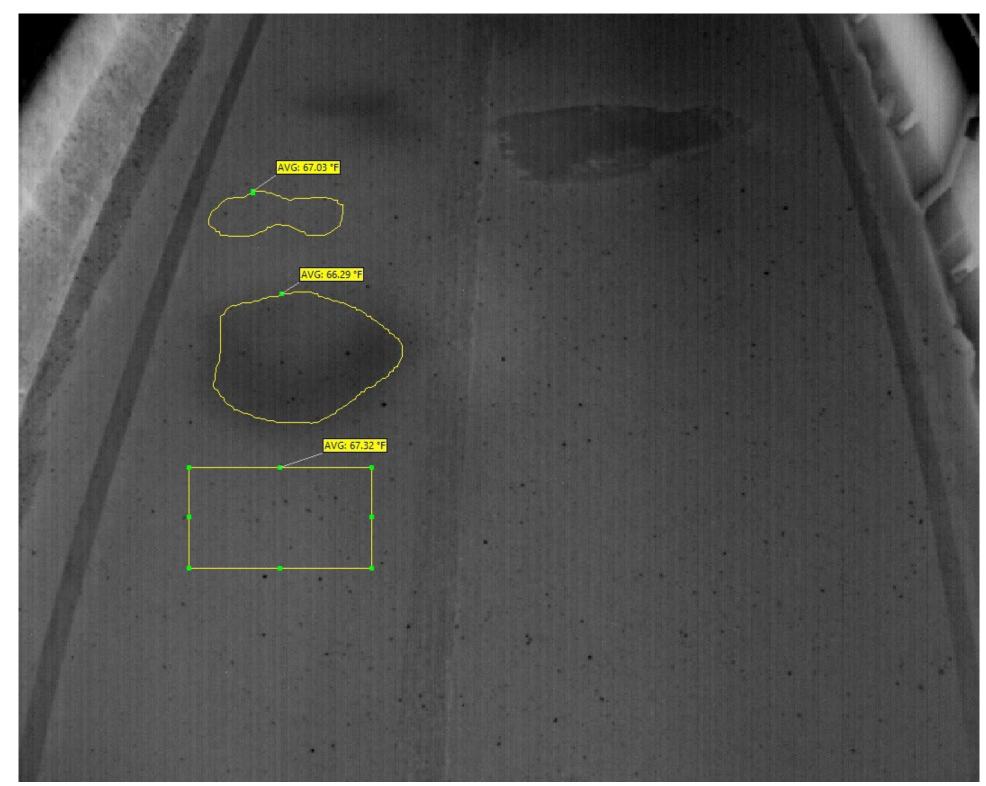


8/28/2023 20:00



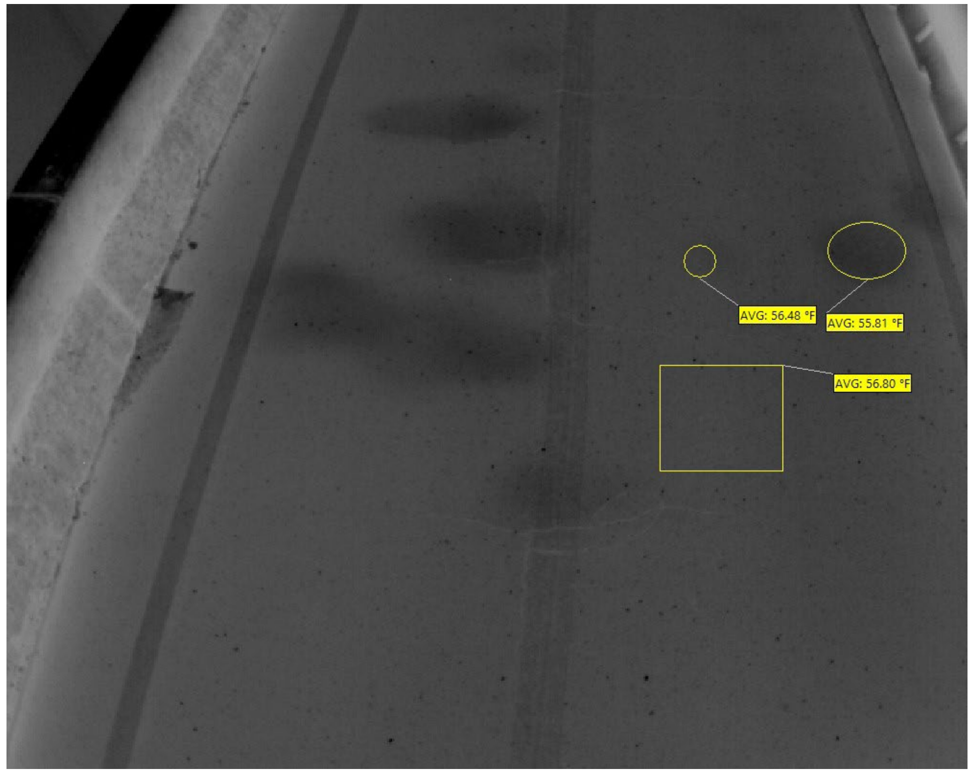
8/28/2023 21:05

8/28/2023 22:00



8/28/2023 23:15

B660037 Left Lane defects 3 and 4



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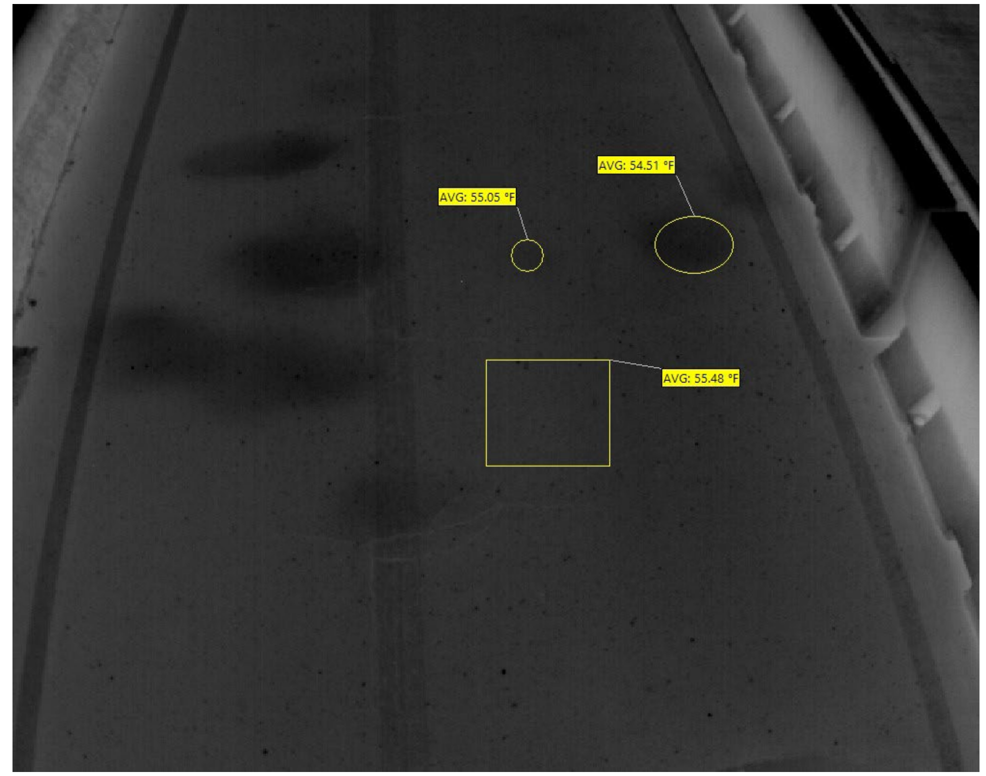

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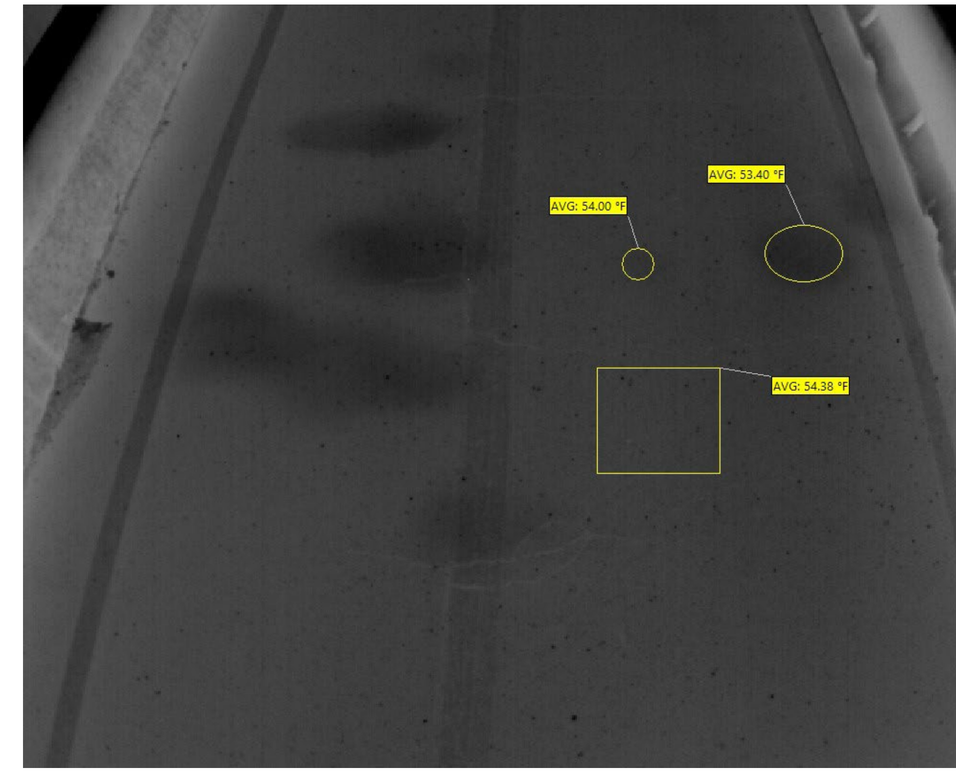

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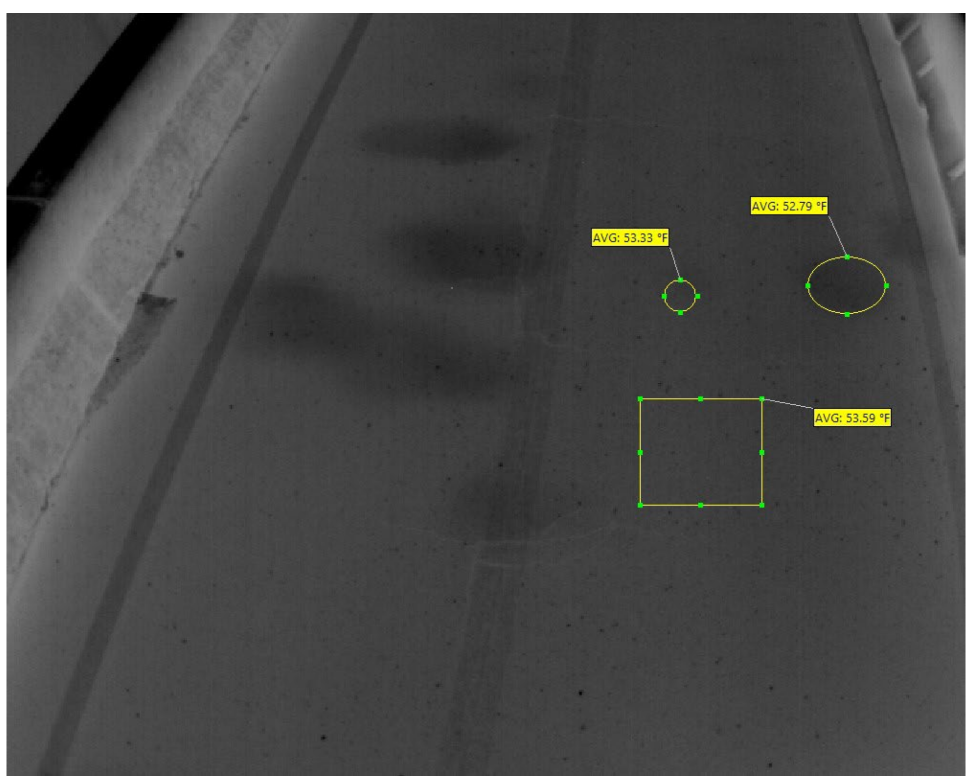

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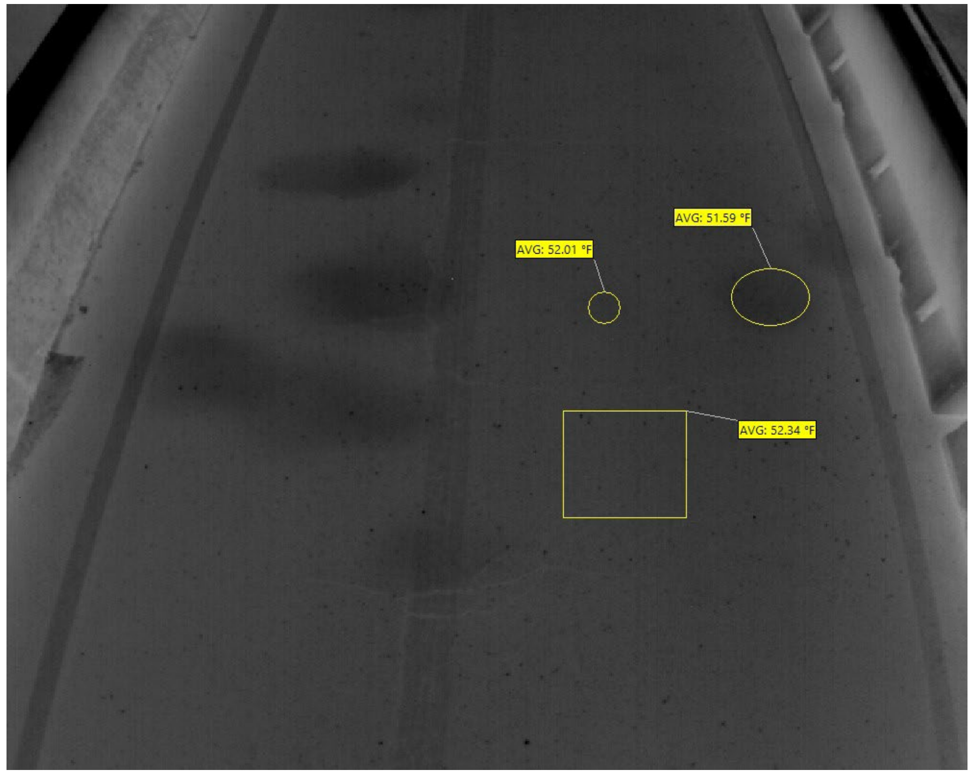
Live Image

B660037 Left Lane defects 3 and 4



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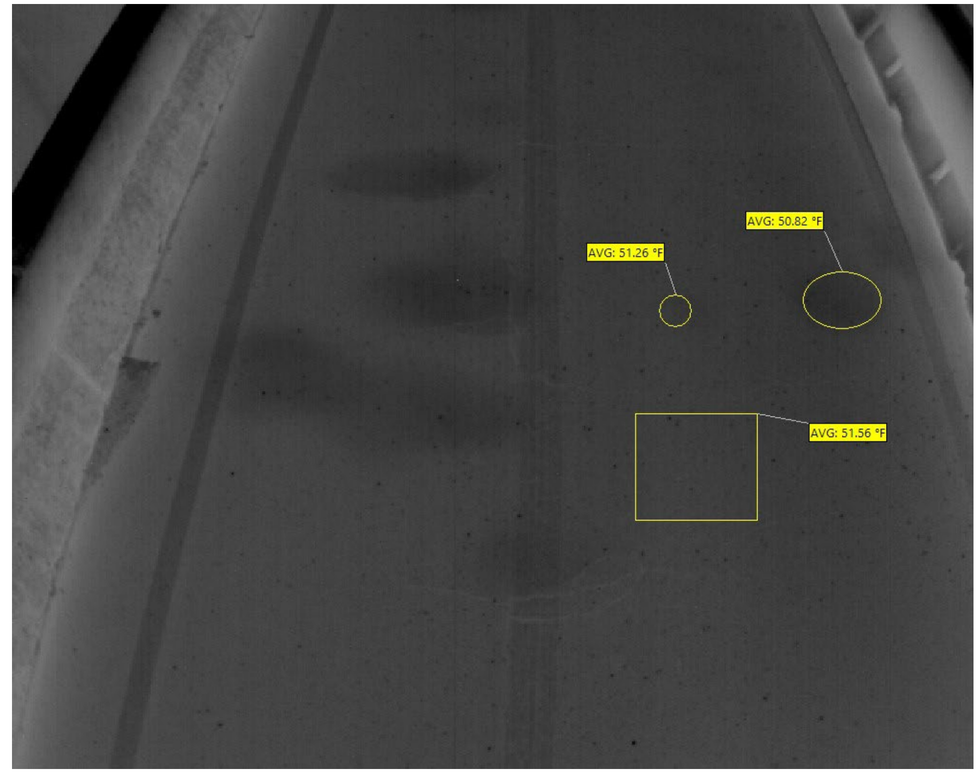

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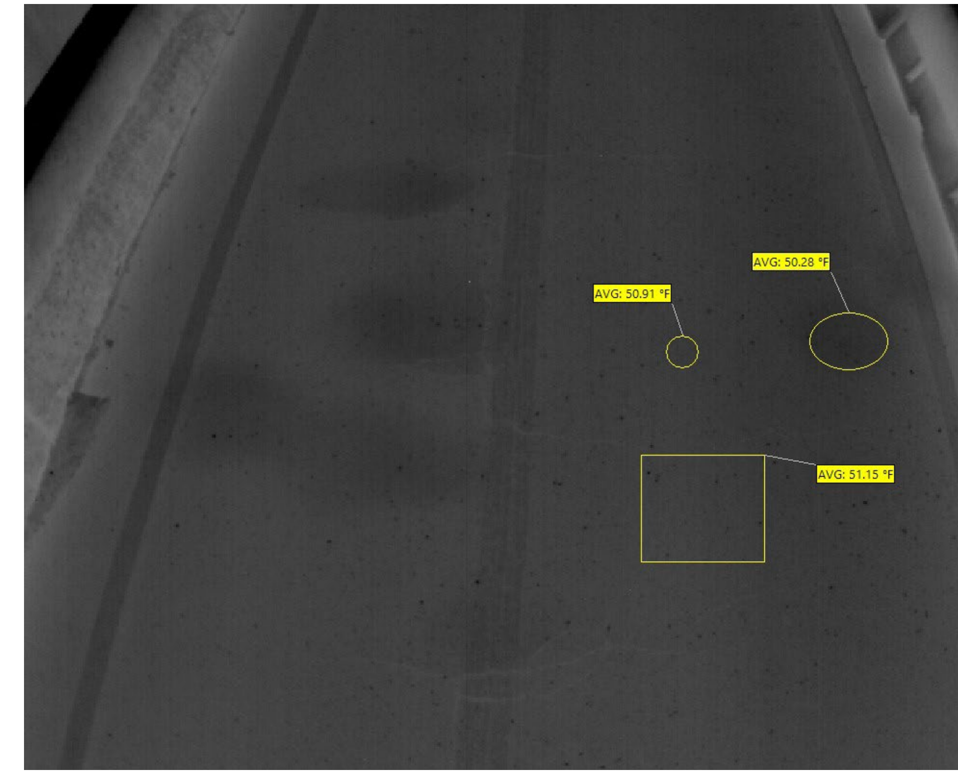

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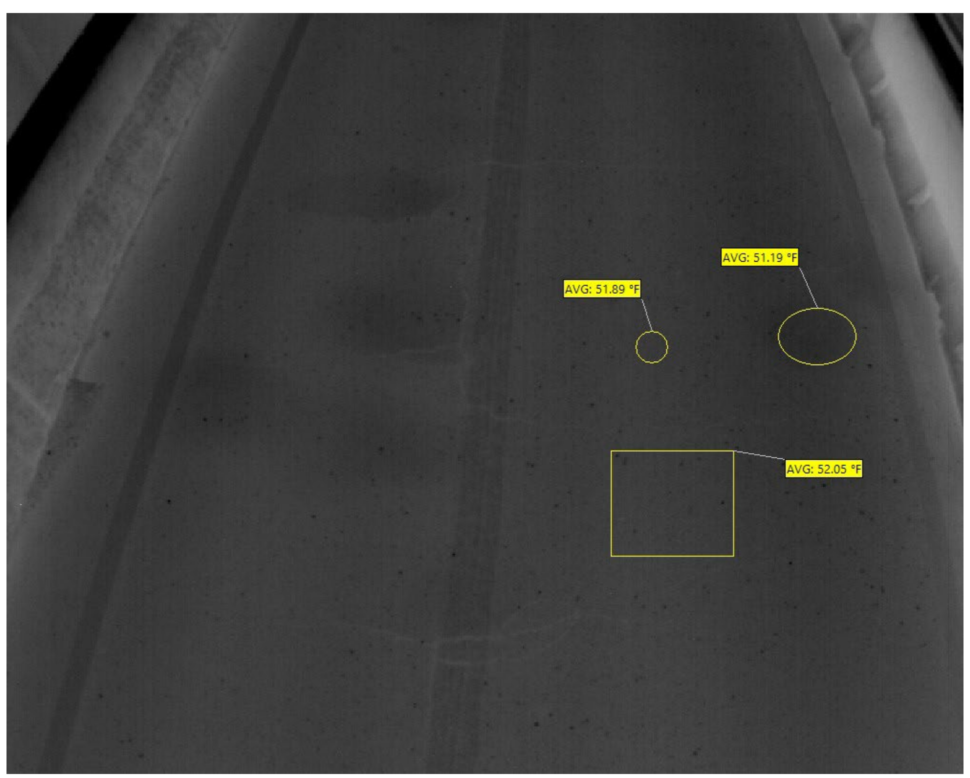

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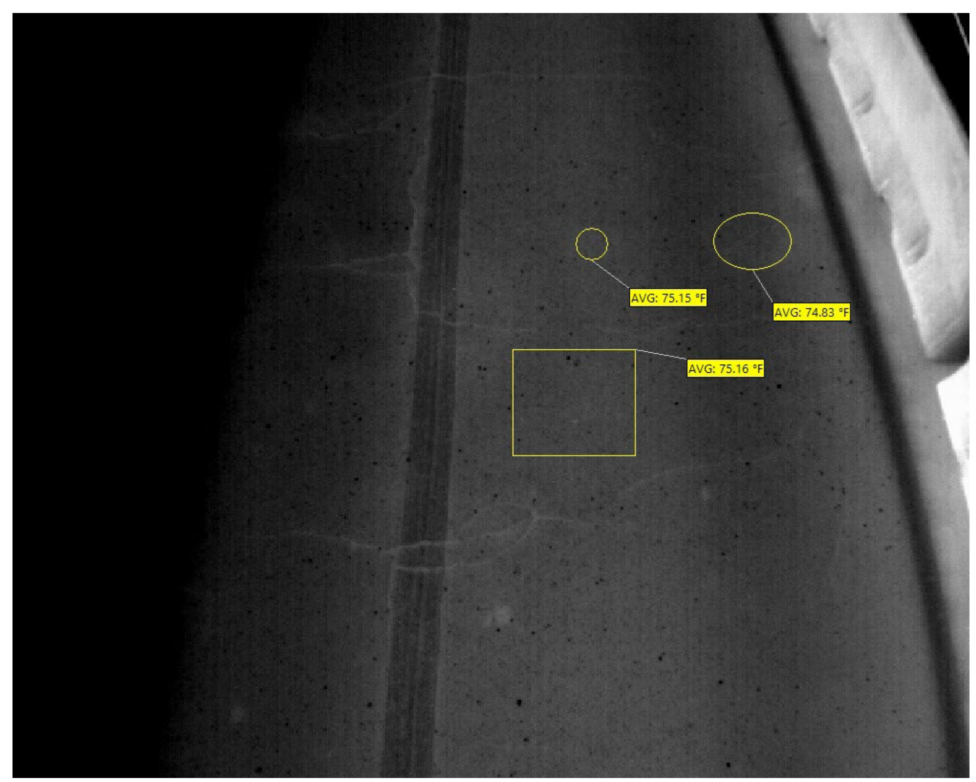

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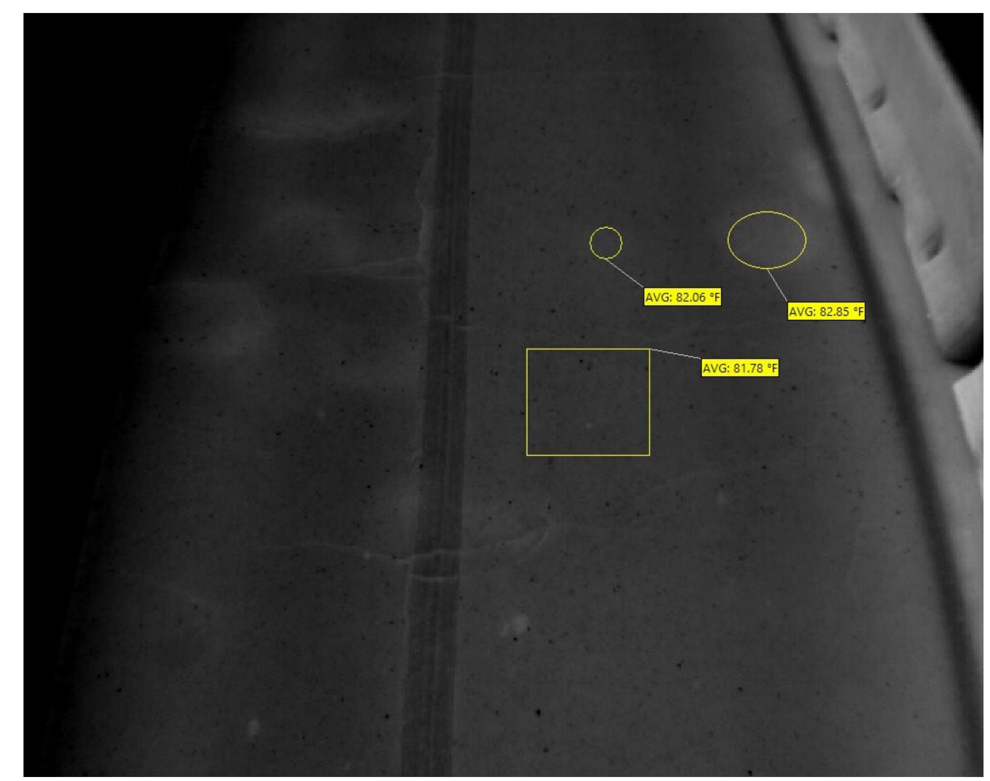

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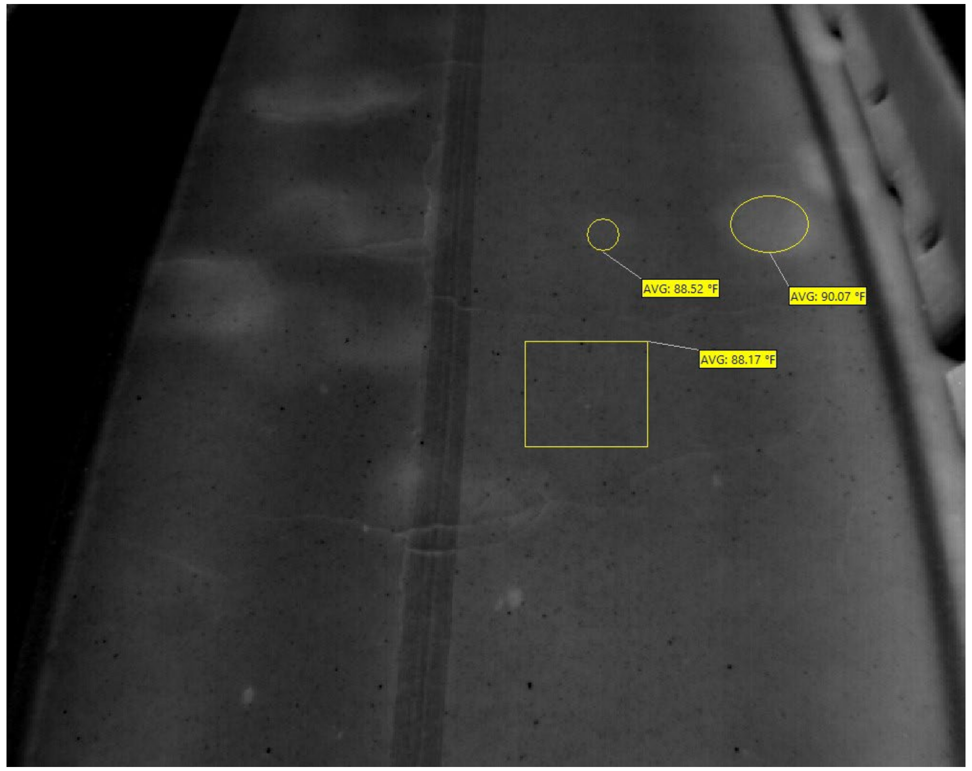
B660037 Left Lane defects 3 and 4



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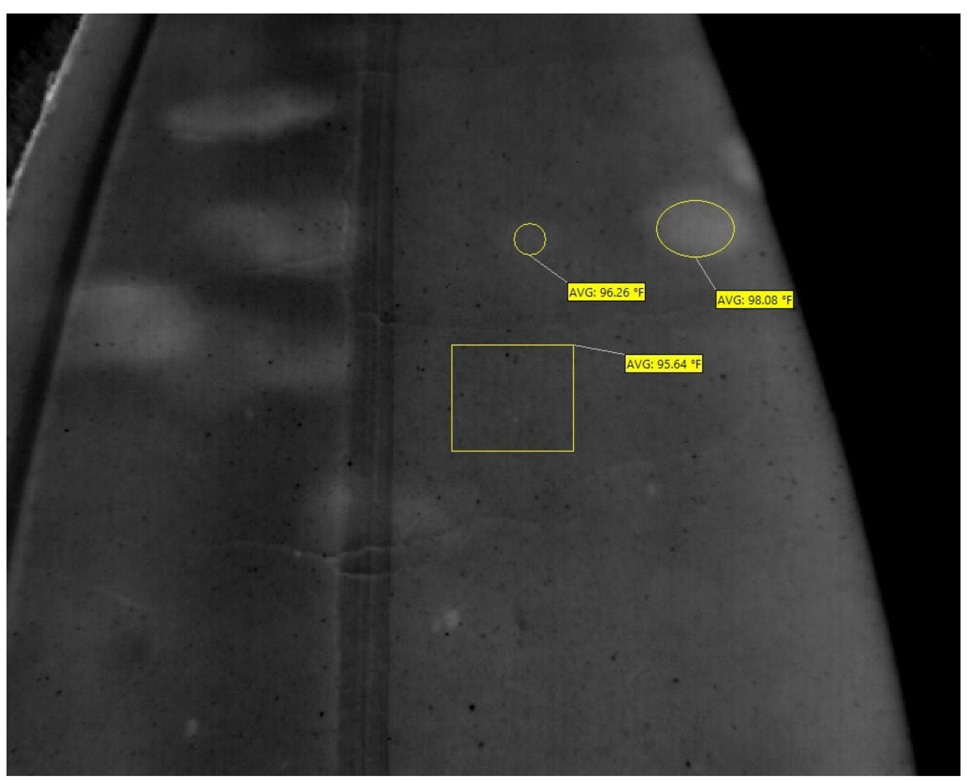
8/10/2023 12:20

8/10/2023 13:40



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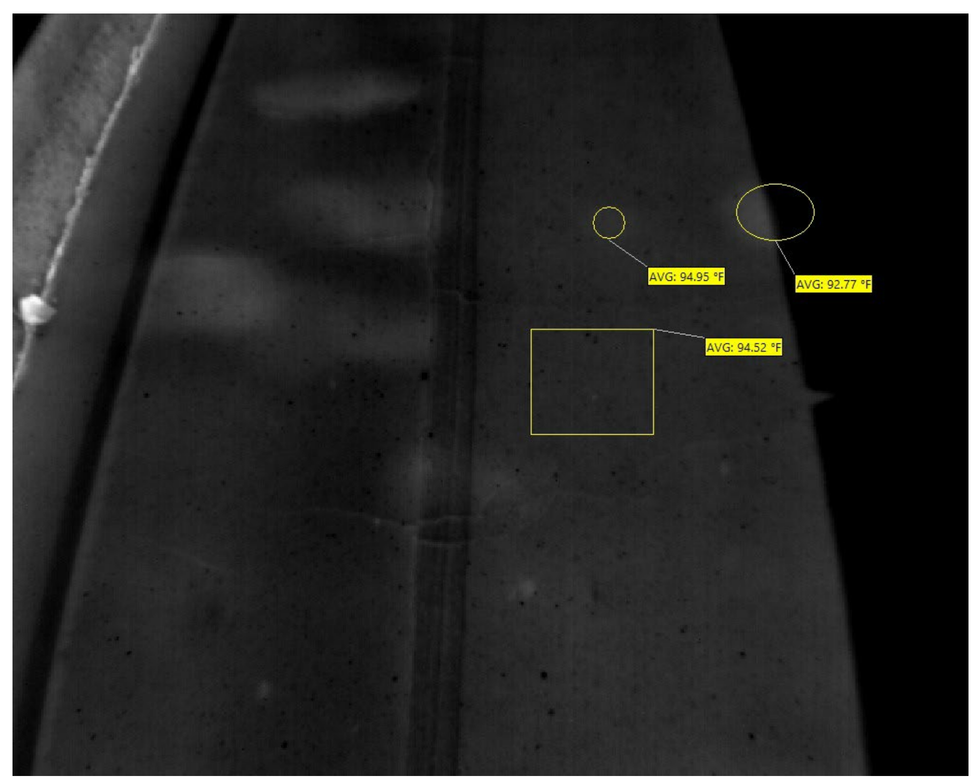

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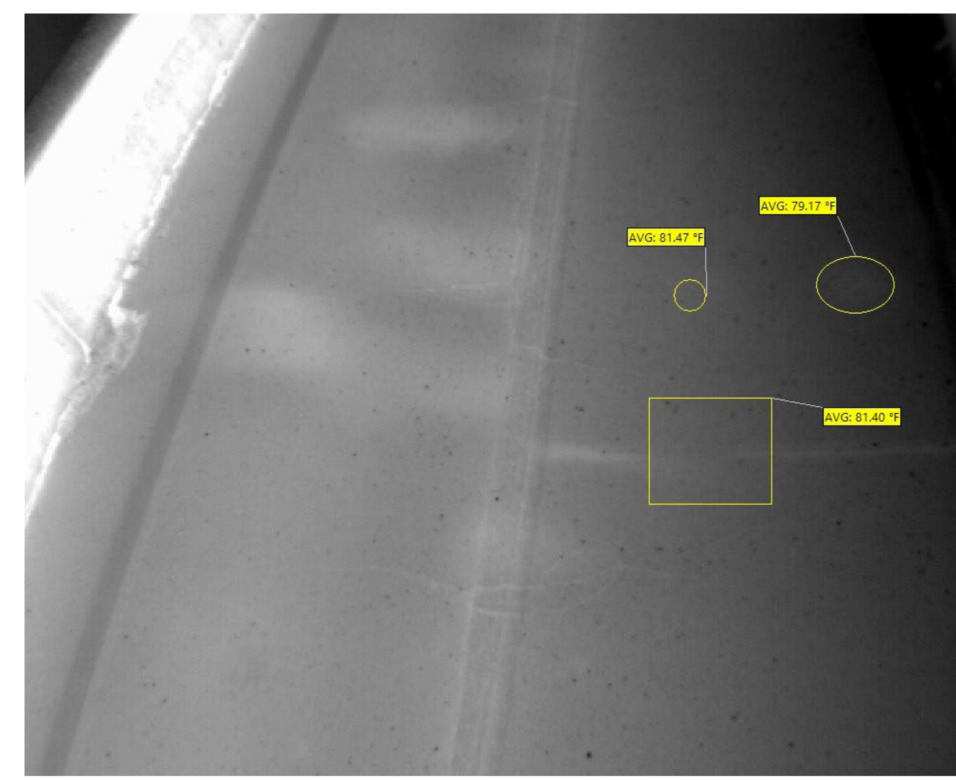

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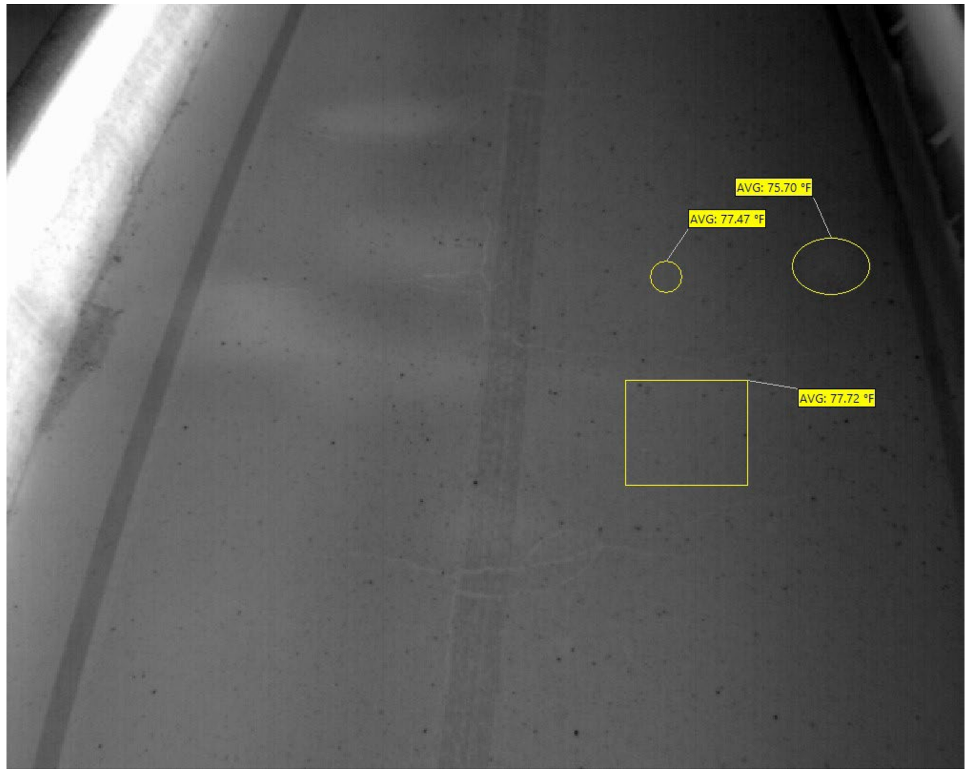
B660037 Left Lane defects 3 and 4



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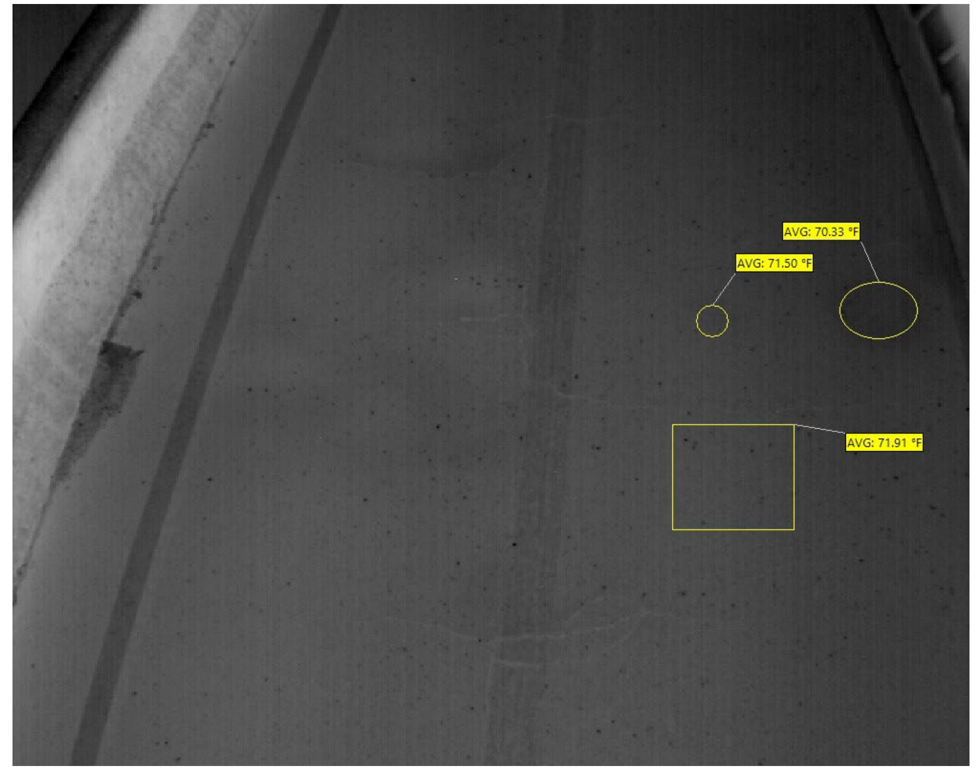

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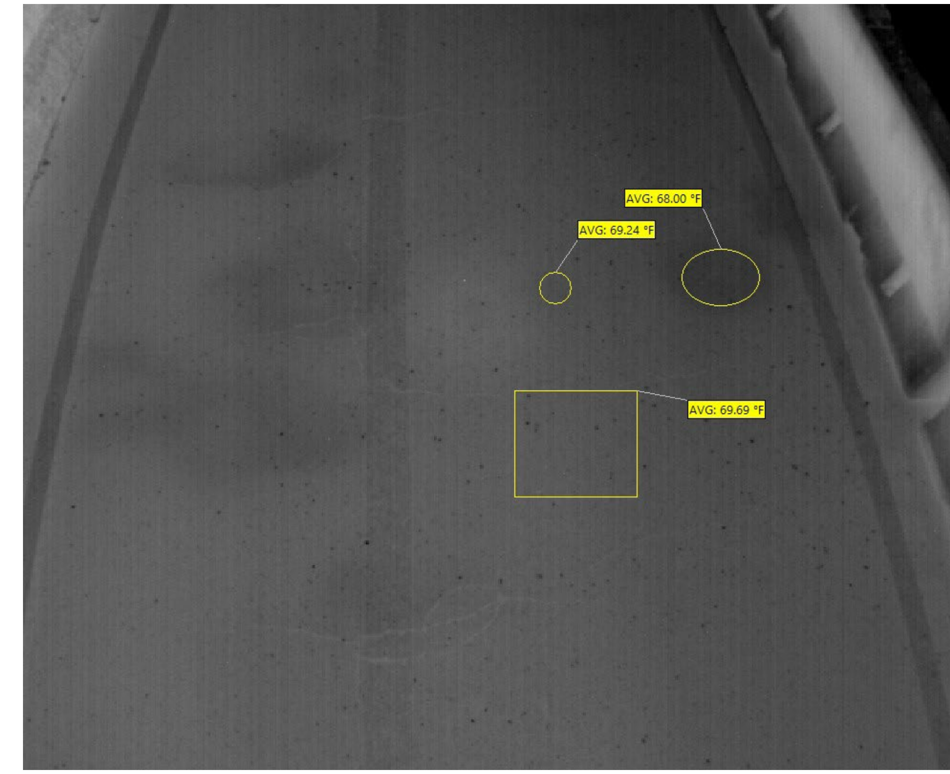

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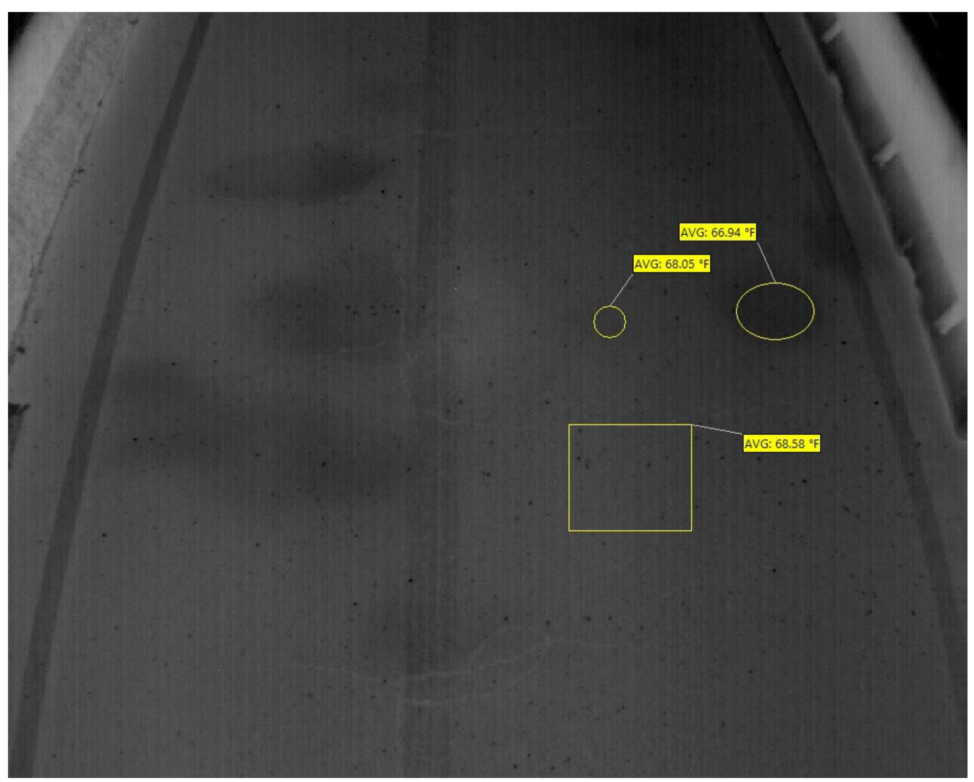

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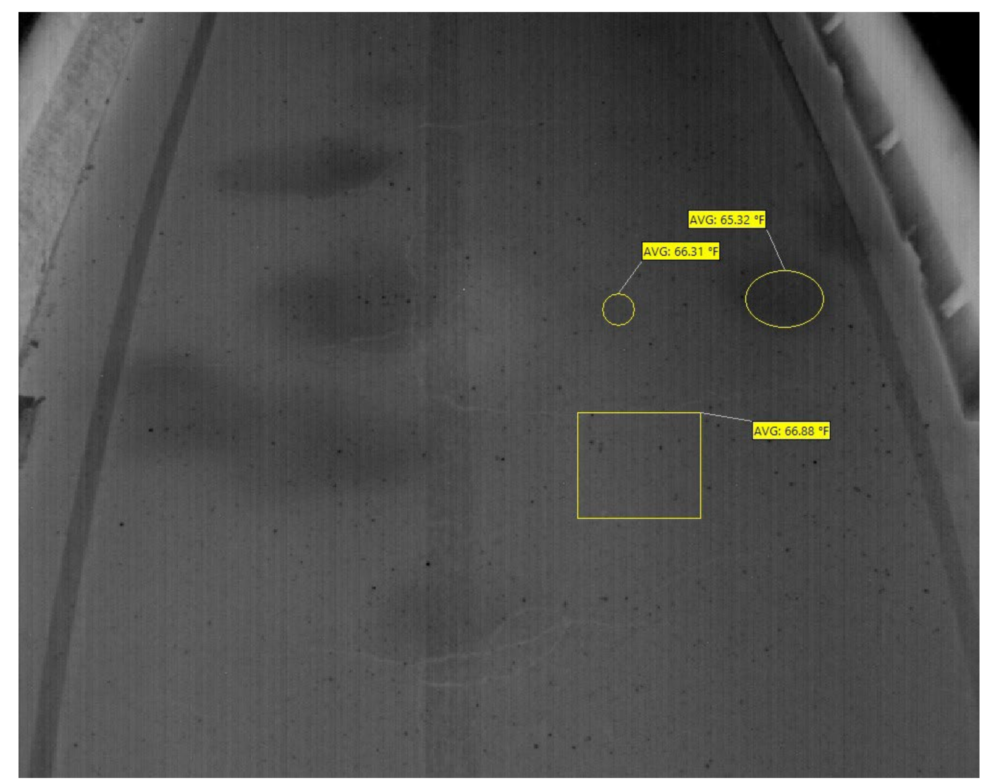

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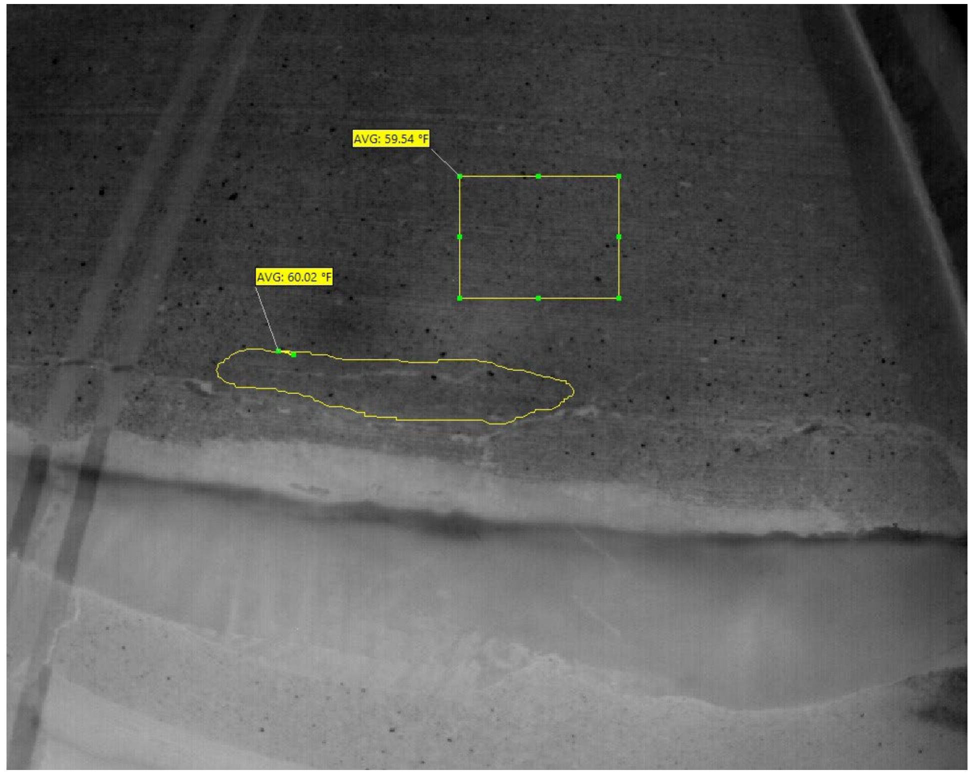
B660053 EB Lane defect 1



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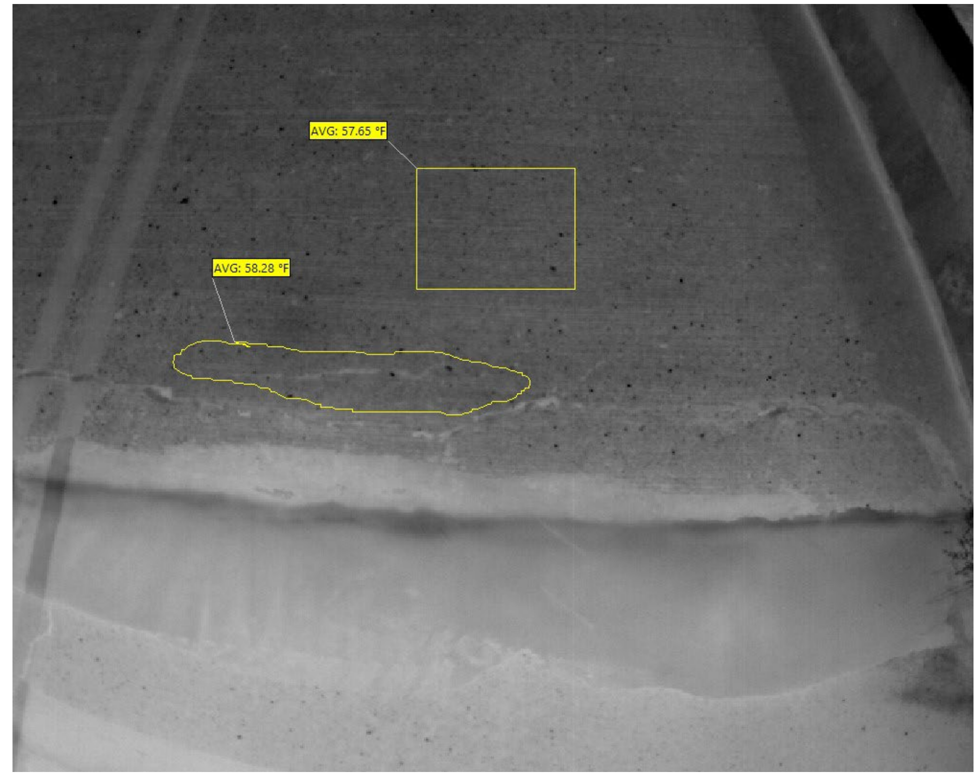

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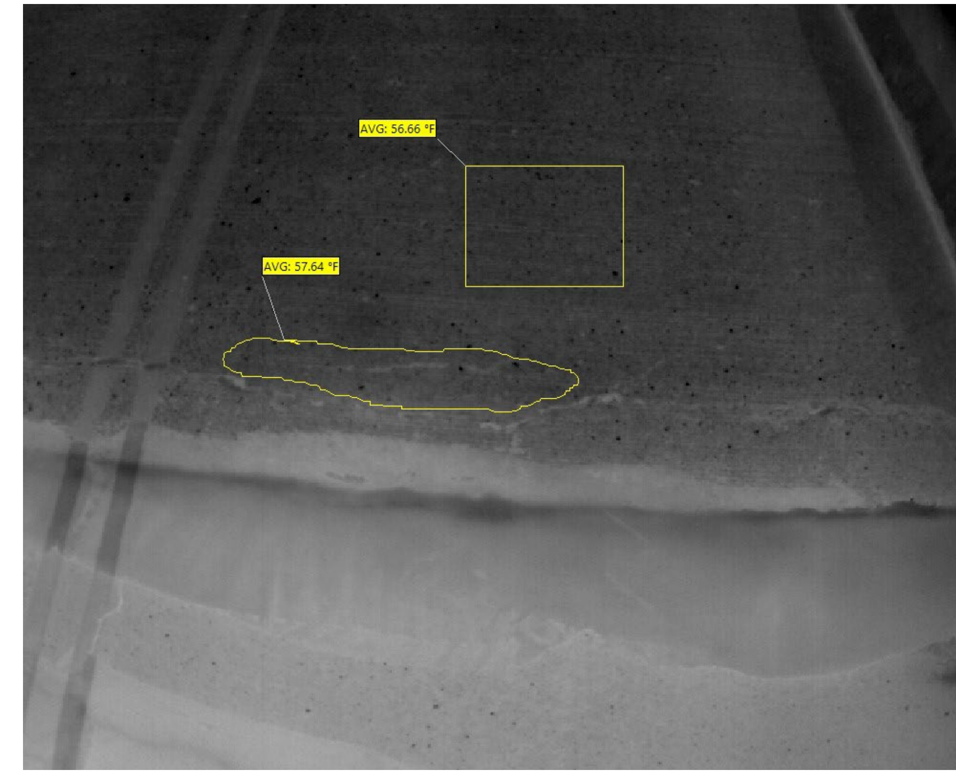

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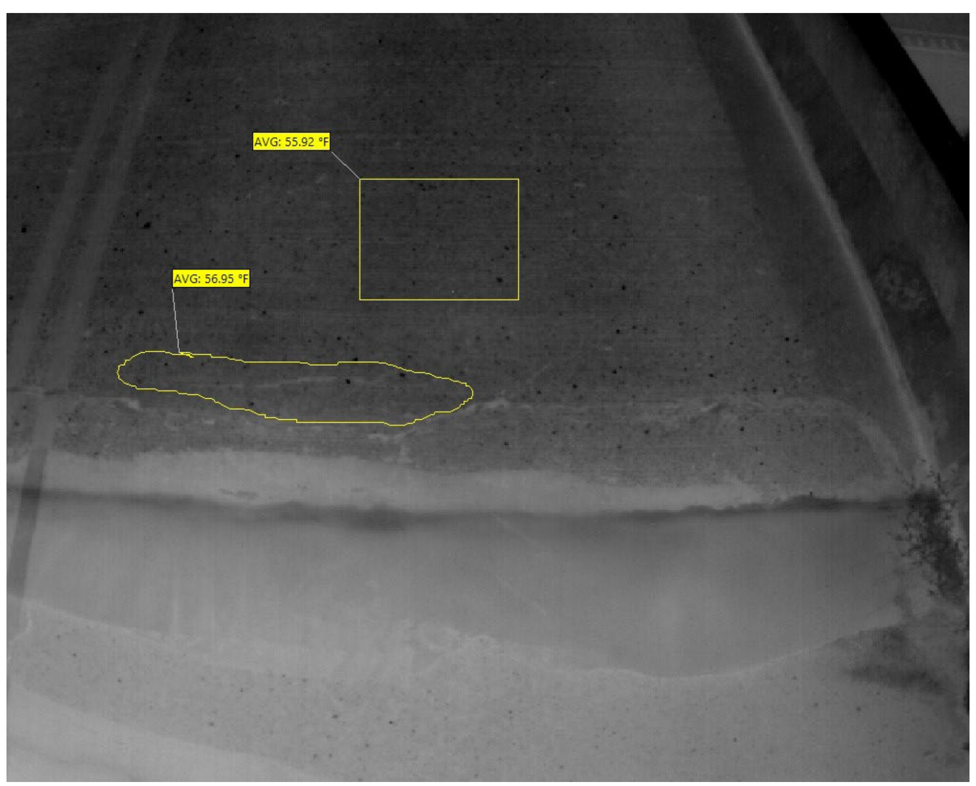
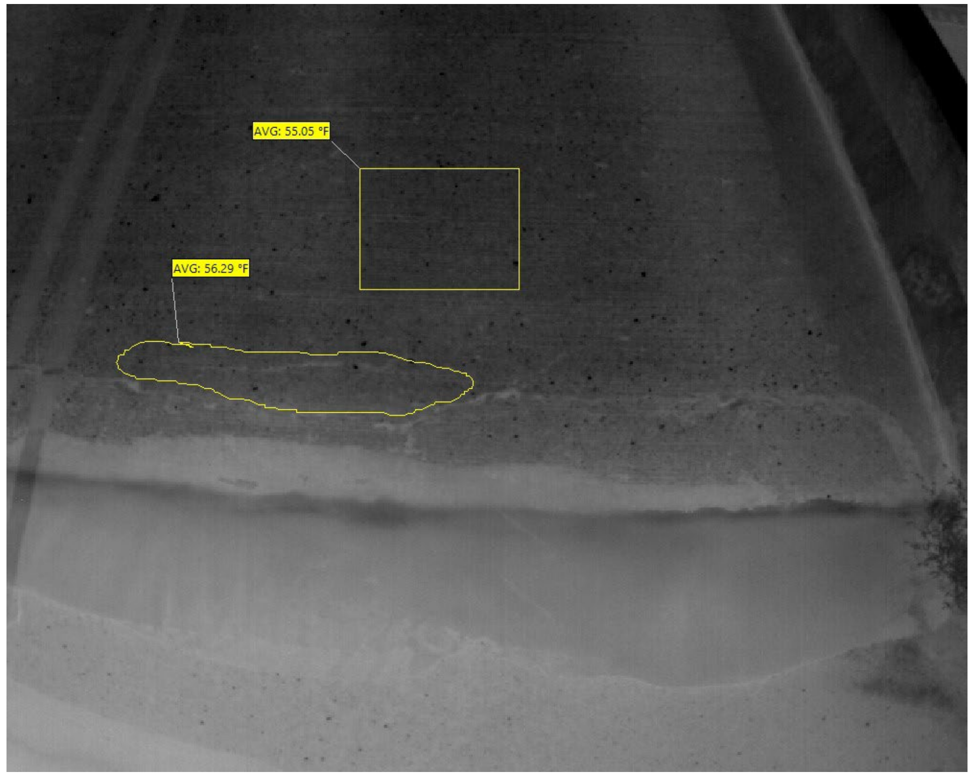


8/31/2023 03:00

Live Image

B660053 EB Lane defect 1



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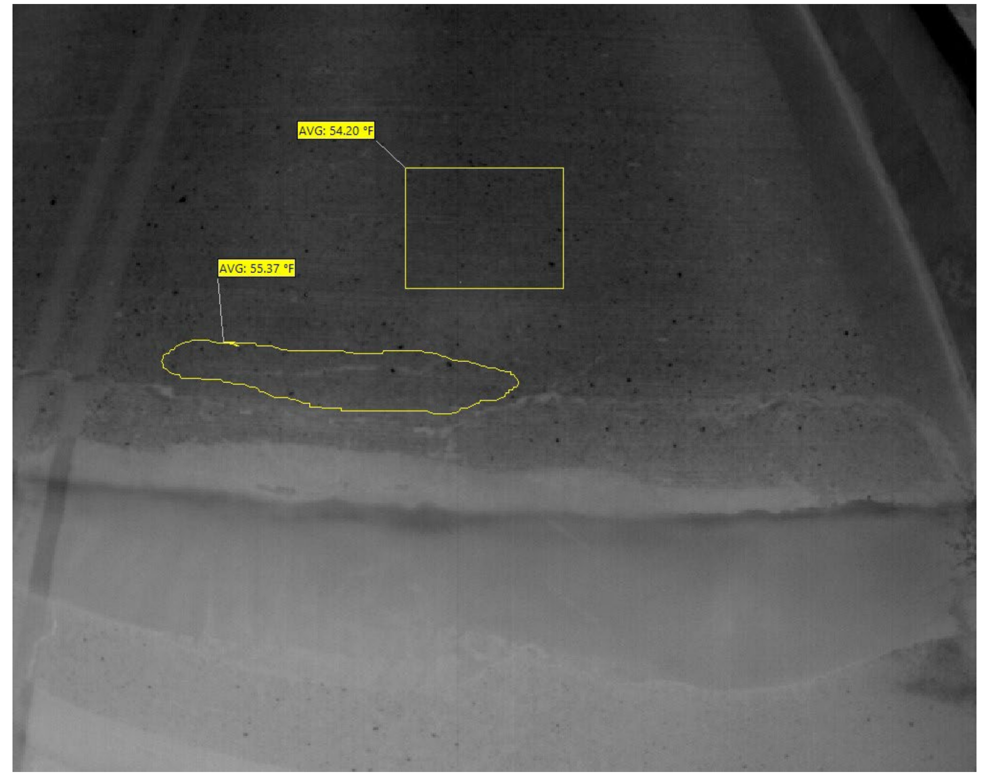

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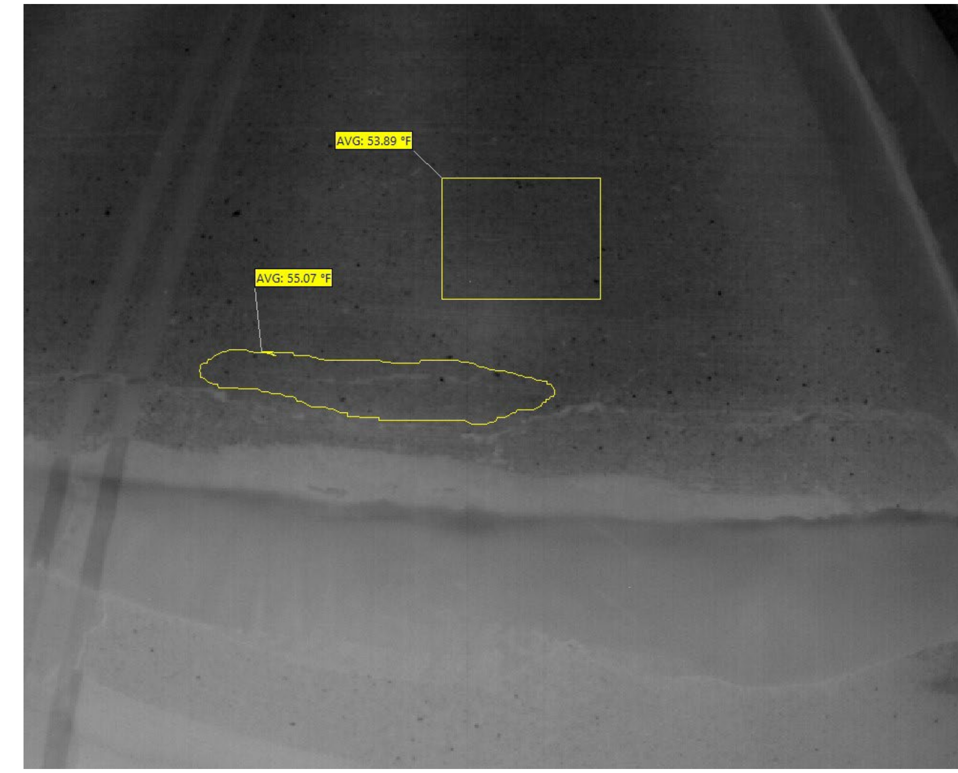

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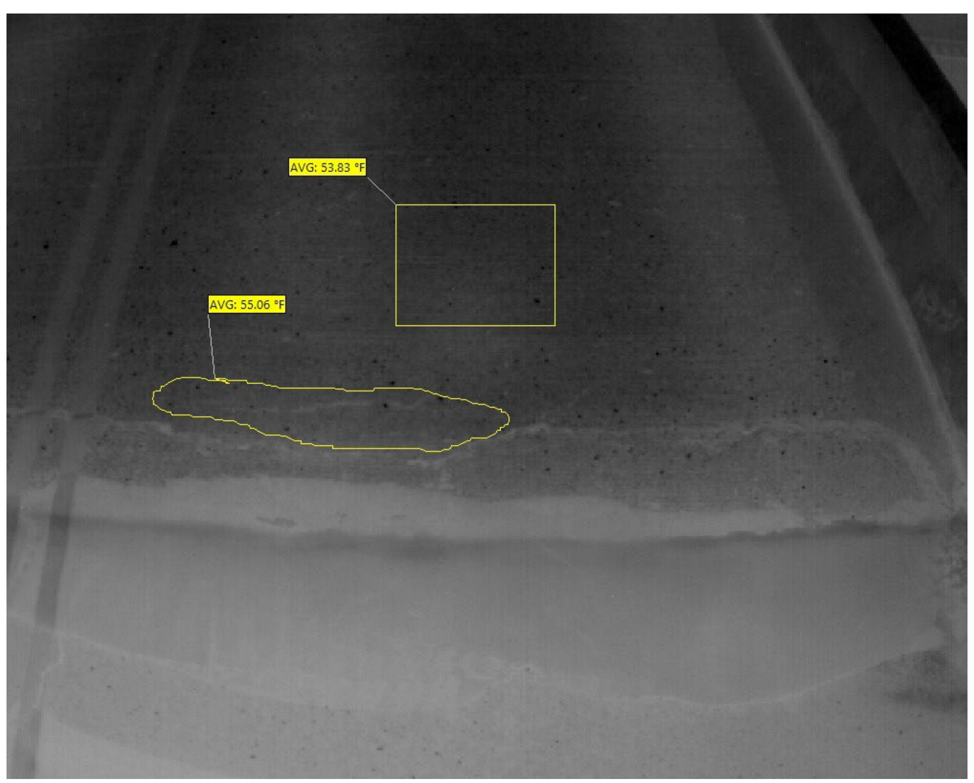

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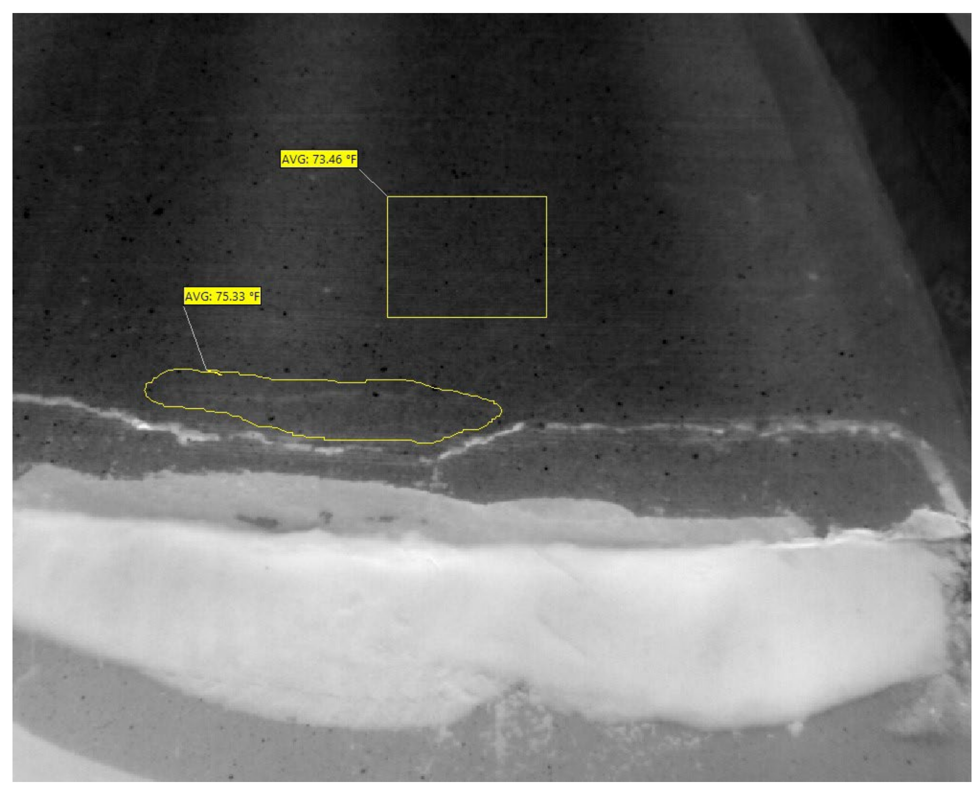

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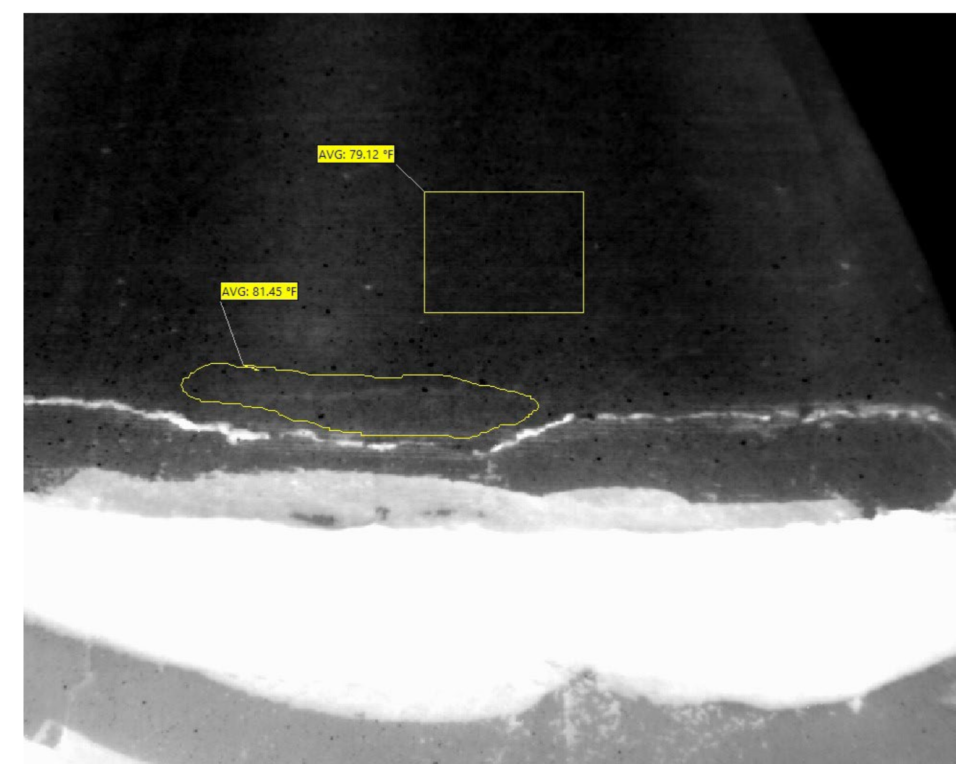

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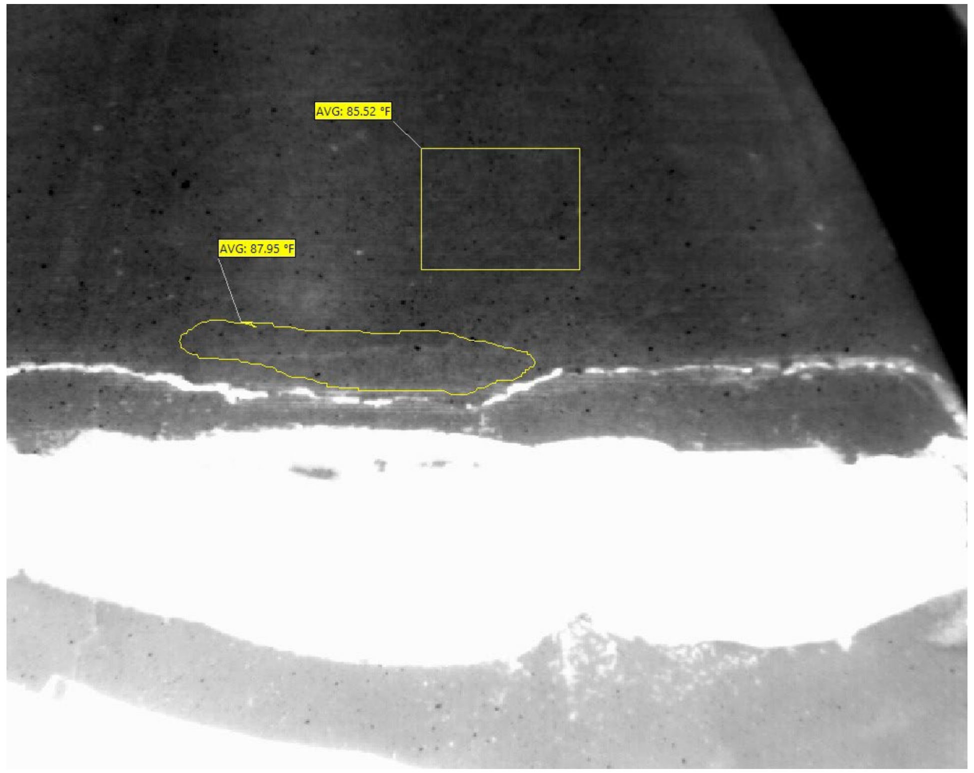
B660053 EB Lane defect 1



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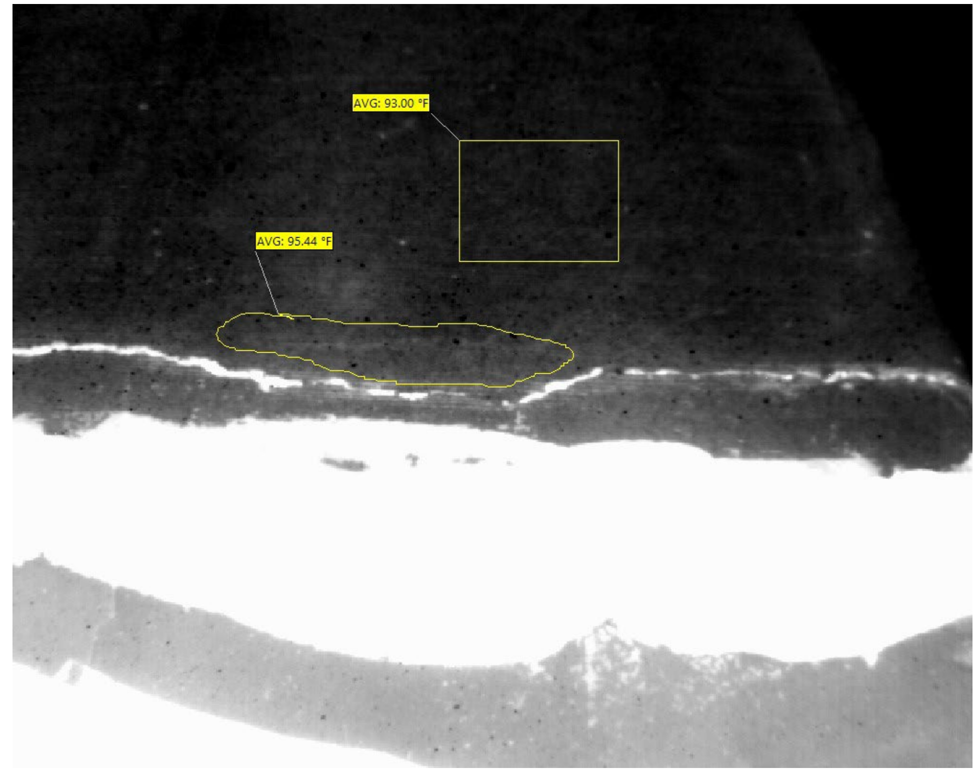

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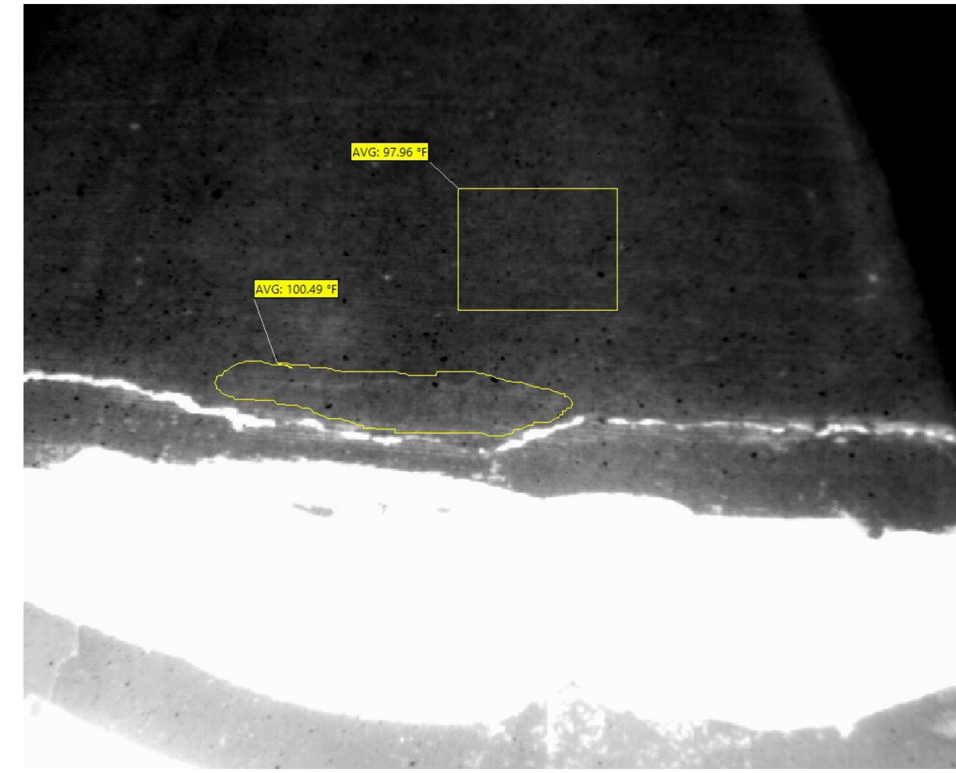

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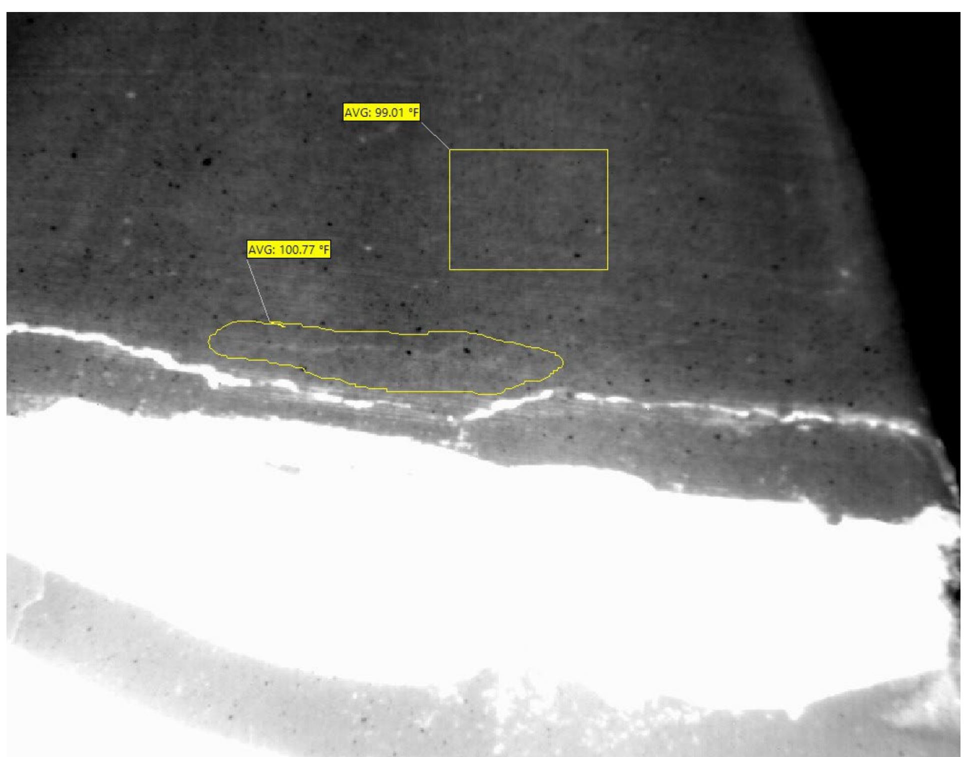

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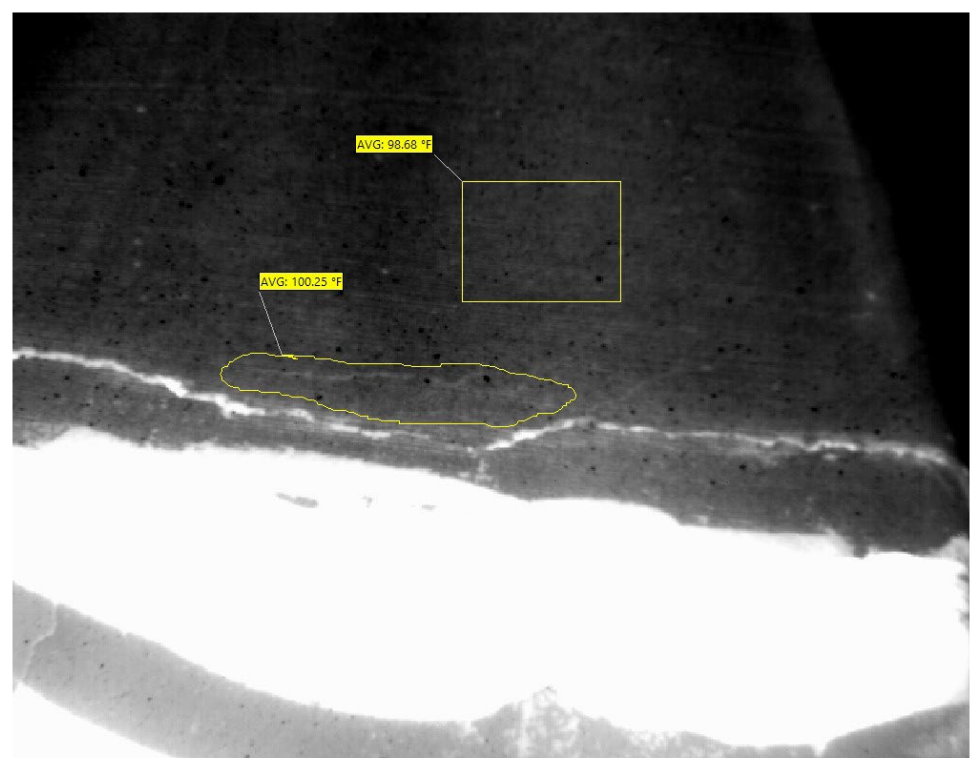

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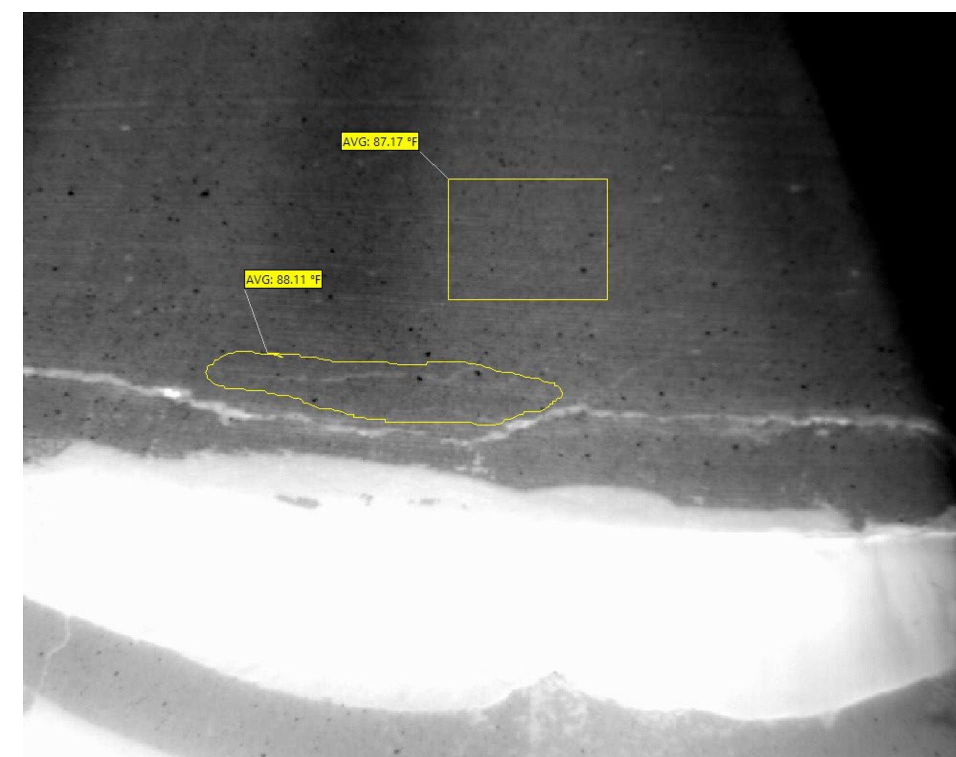
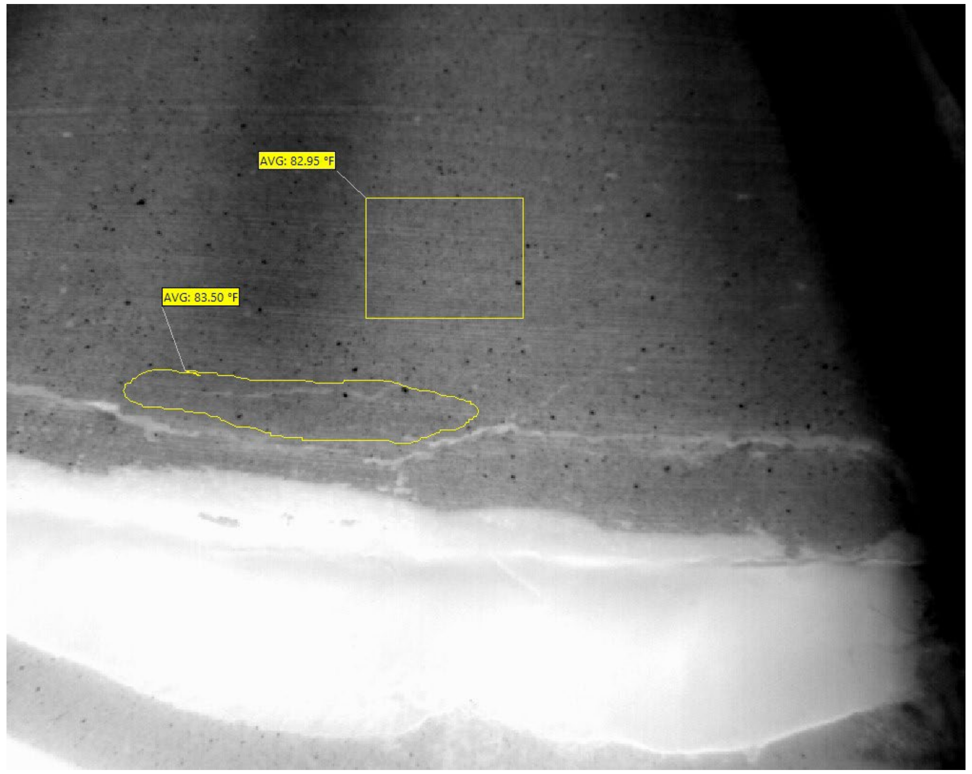


8/28/2023 17:20

B660053 EB Lane defect 1



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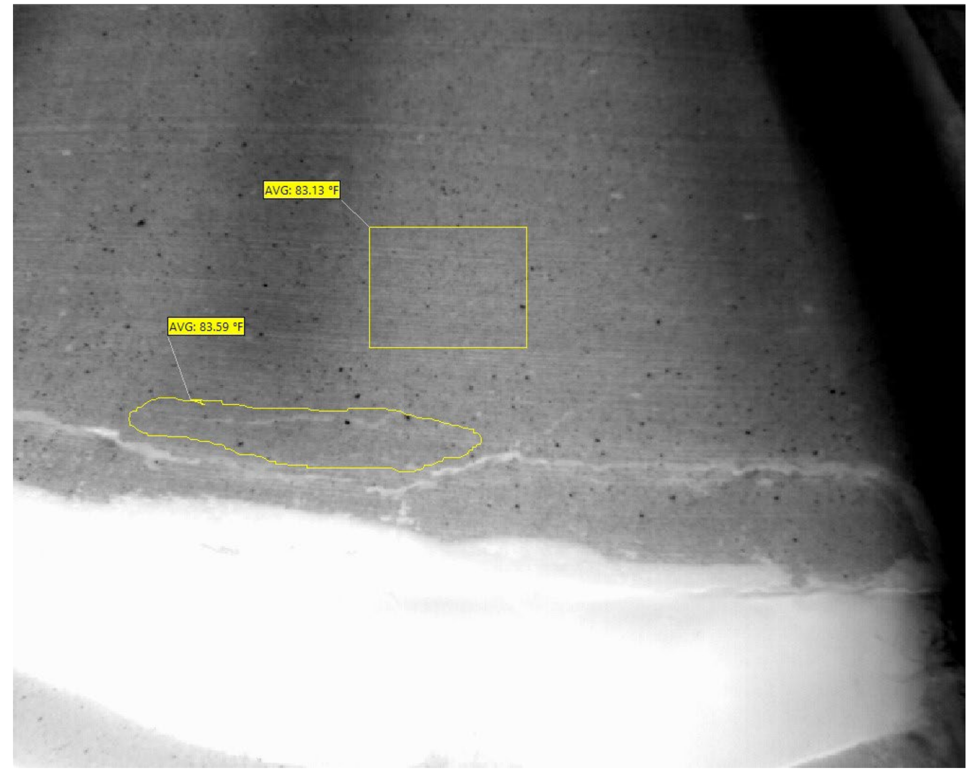

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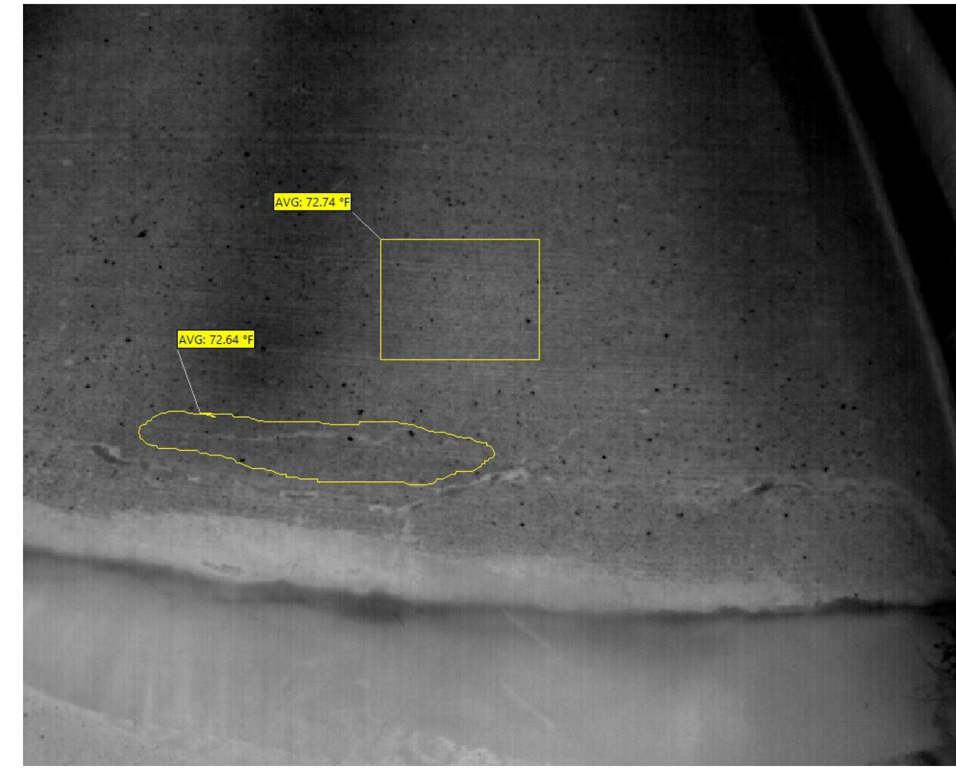

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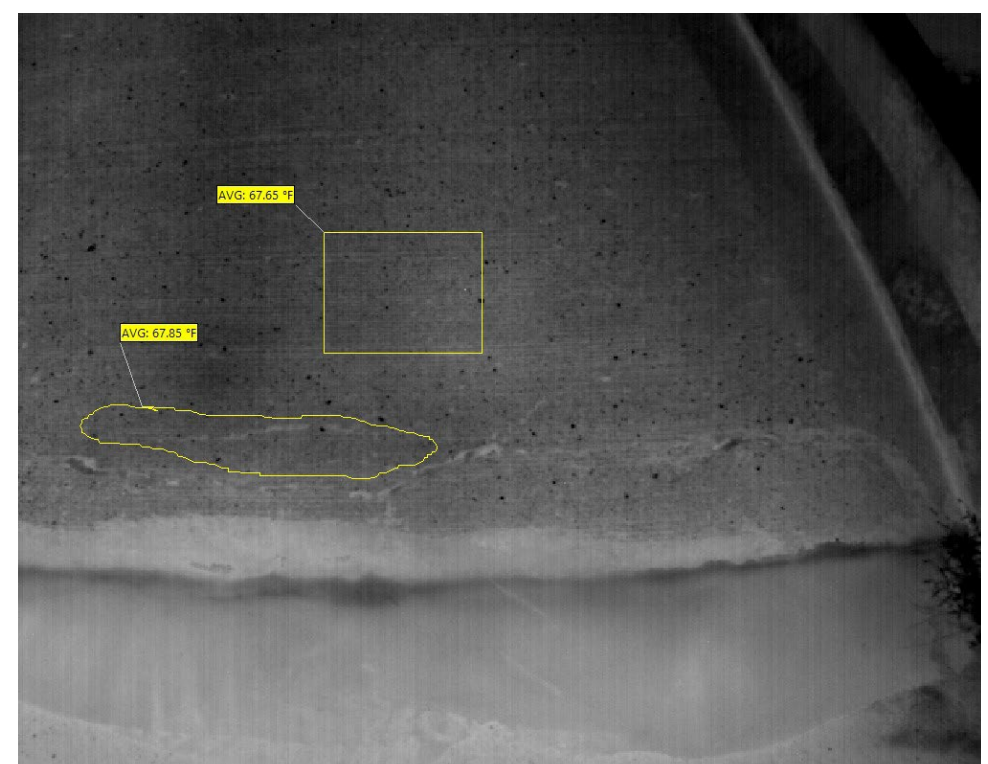
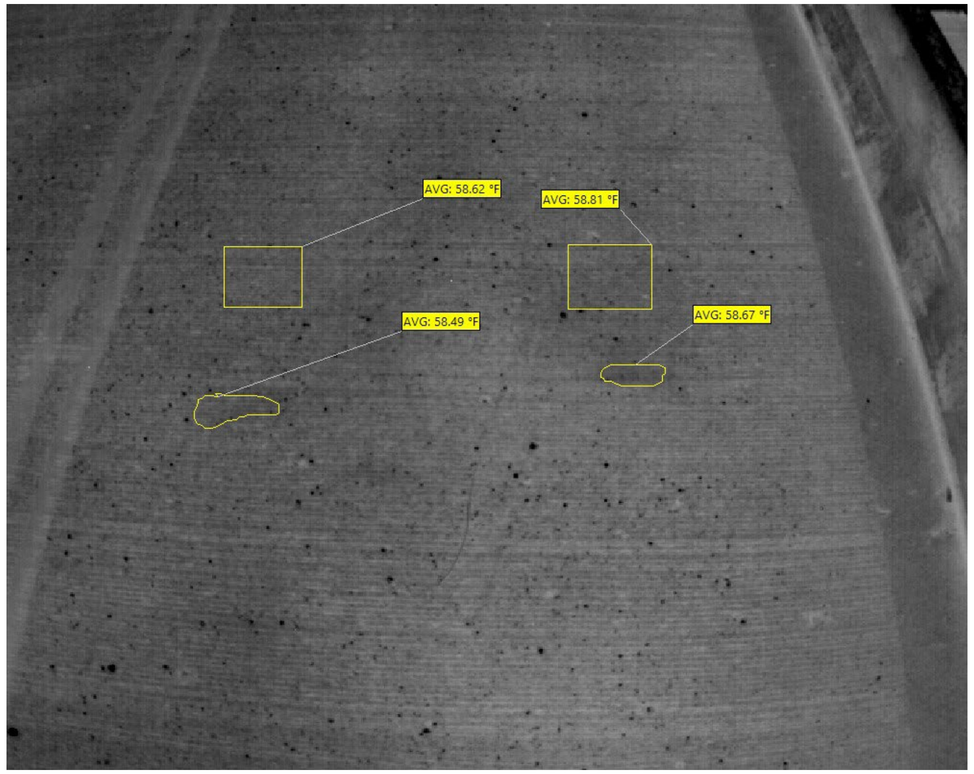
8/28/2023 21:50



8/28/2023 23:00

B660053 EB Lane defects 2 and 3



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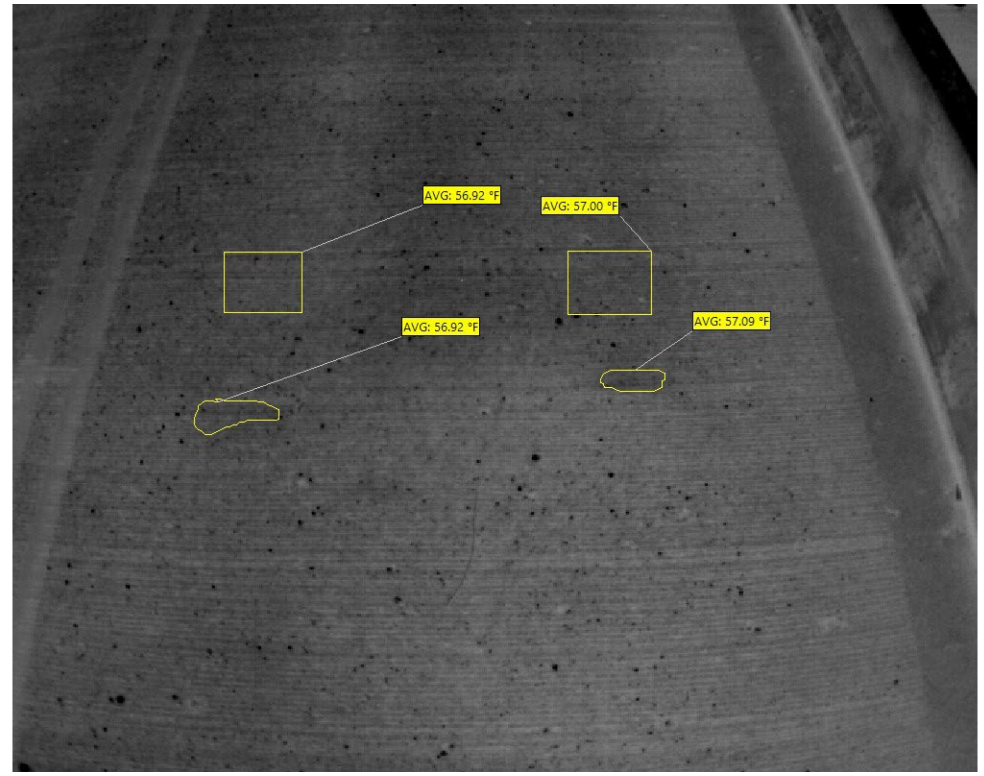

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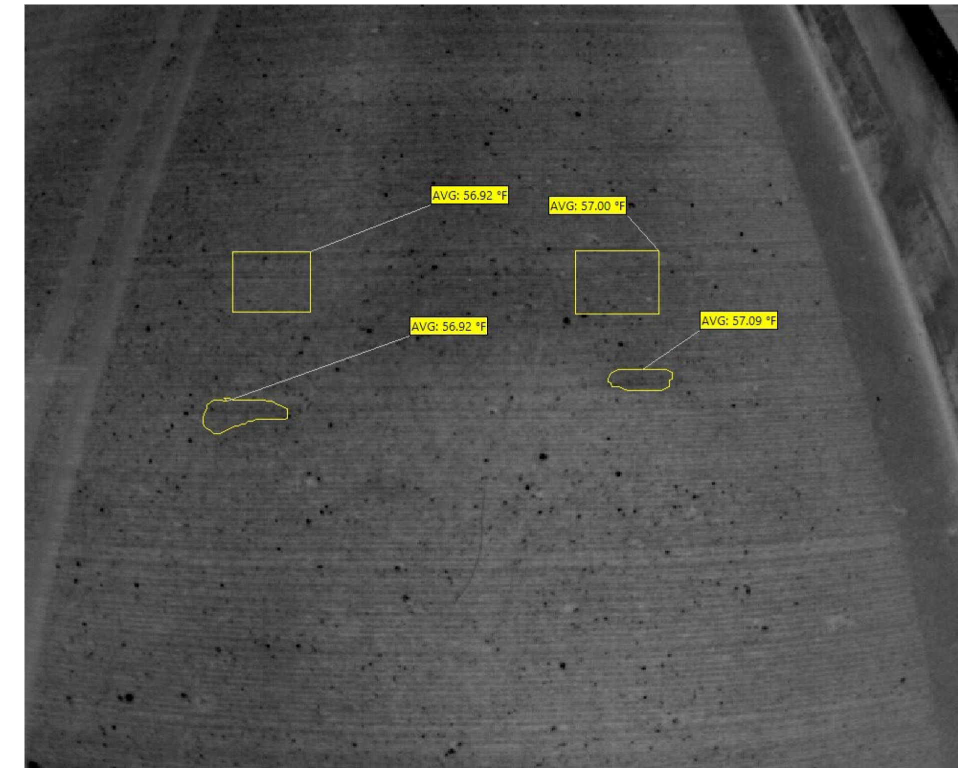

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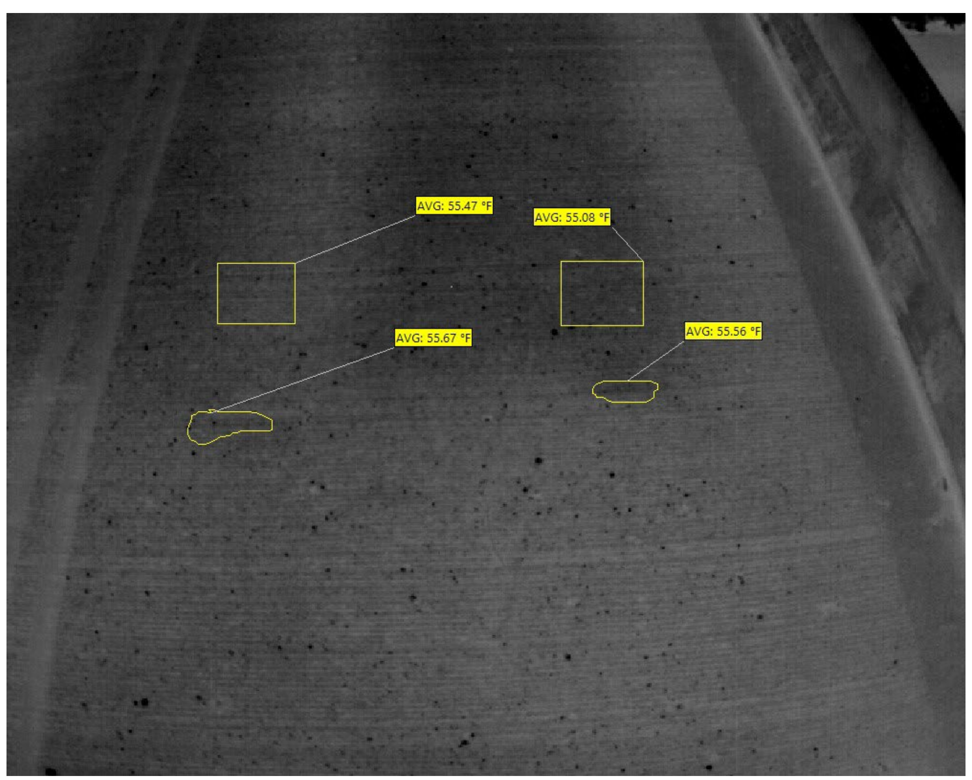
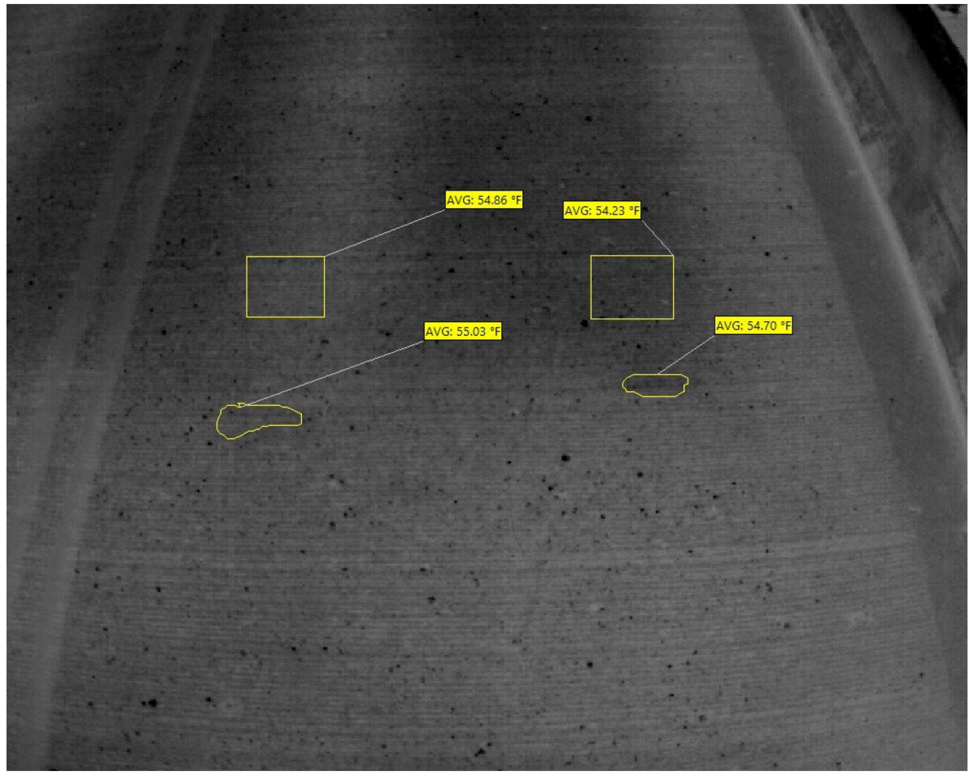


8/31/2023 03:00

Live Image

B660053 EB Lane defects 2 and 3



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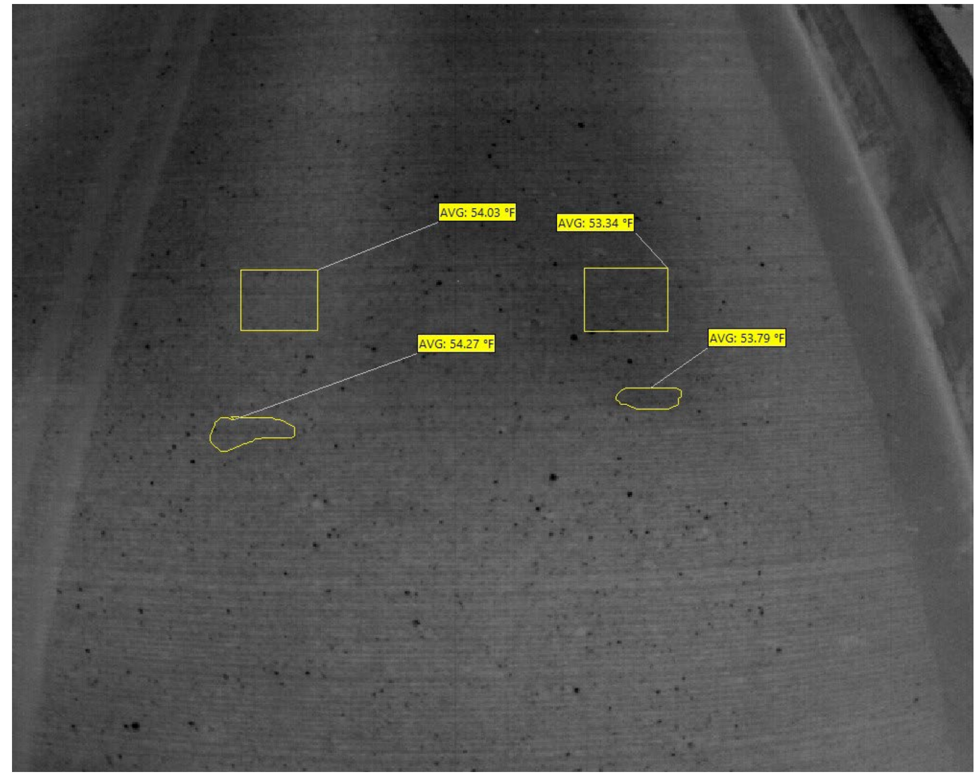

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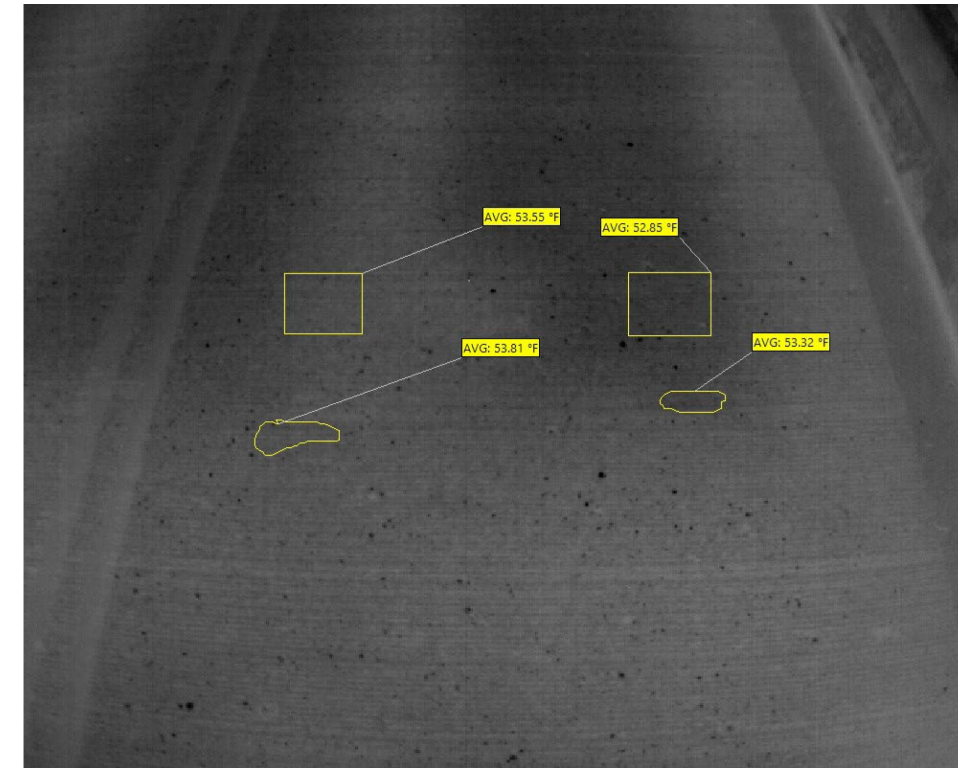

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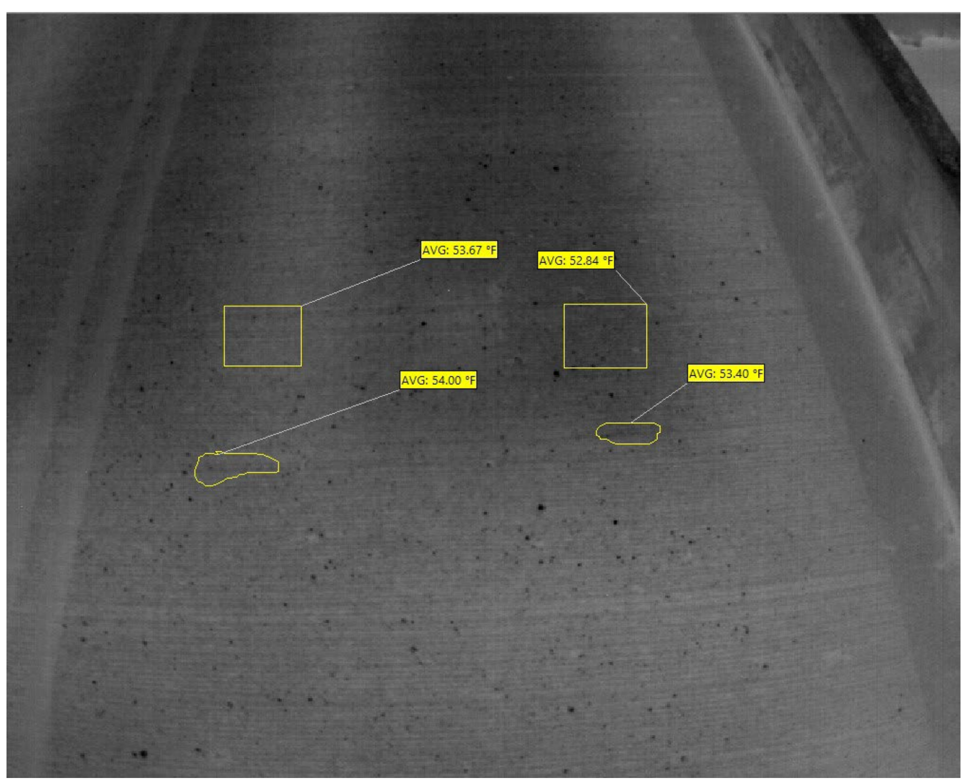

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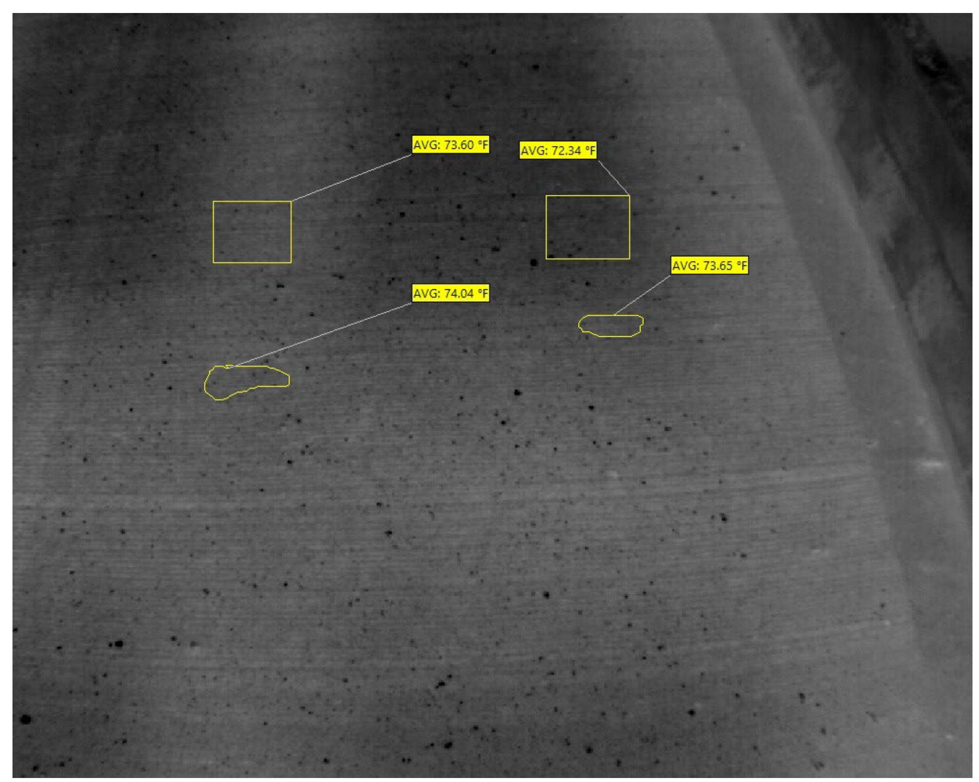

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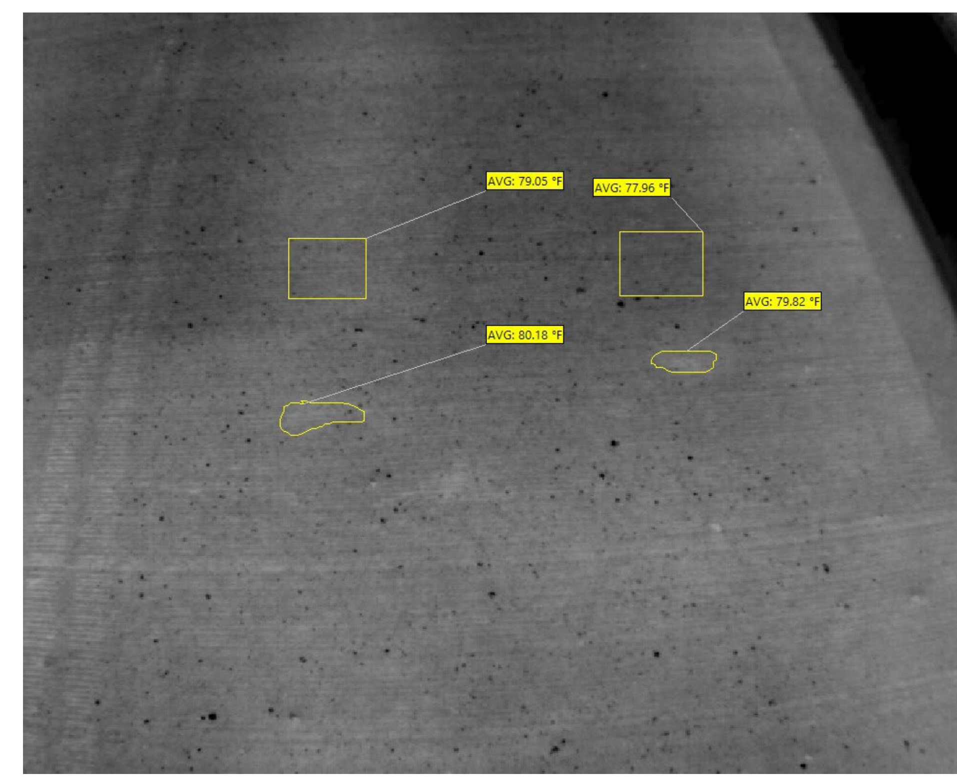

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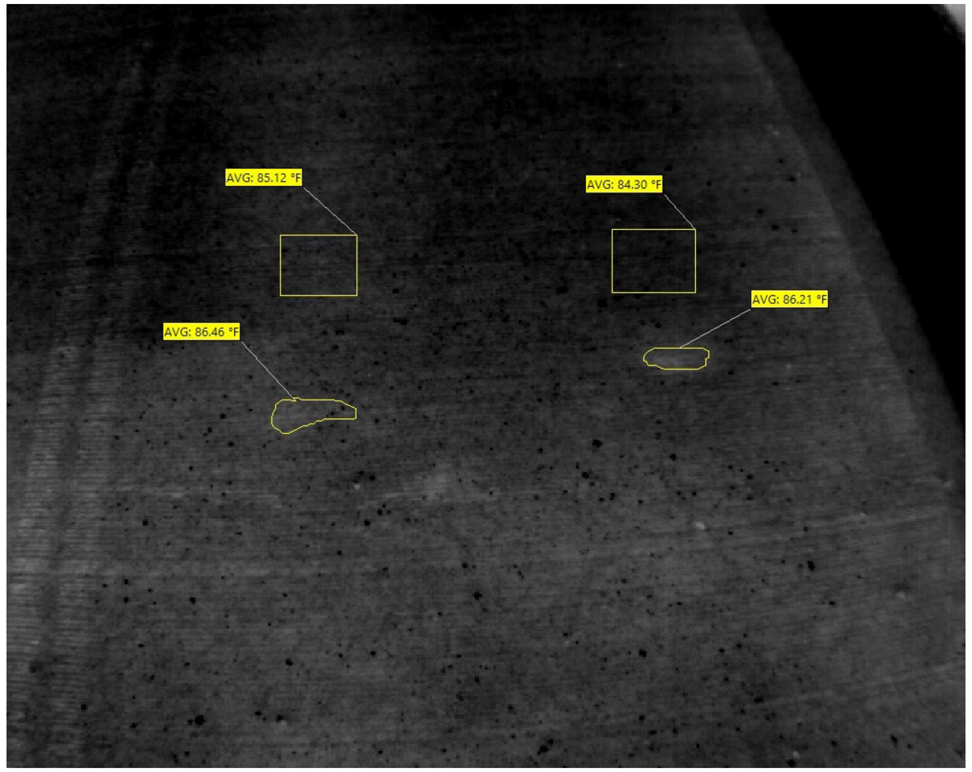
B660053 EB Lane defects 2 and 3



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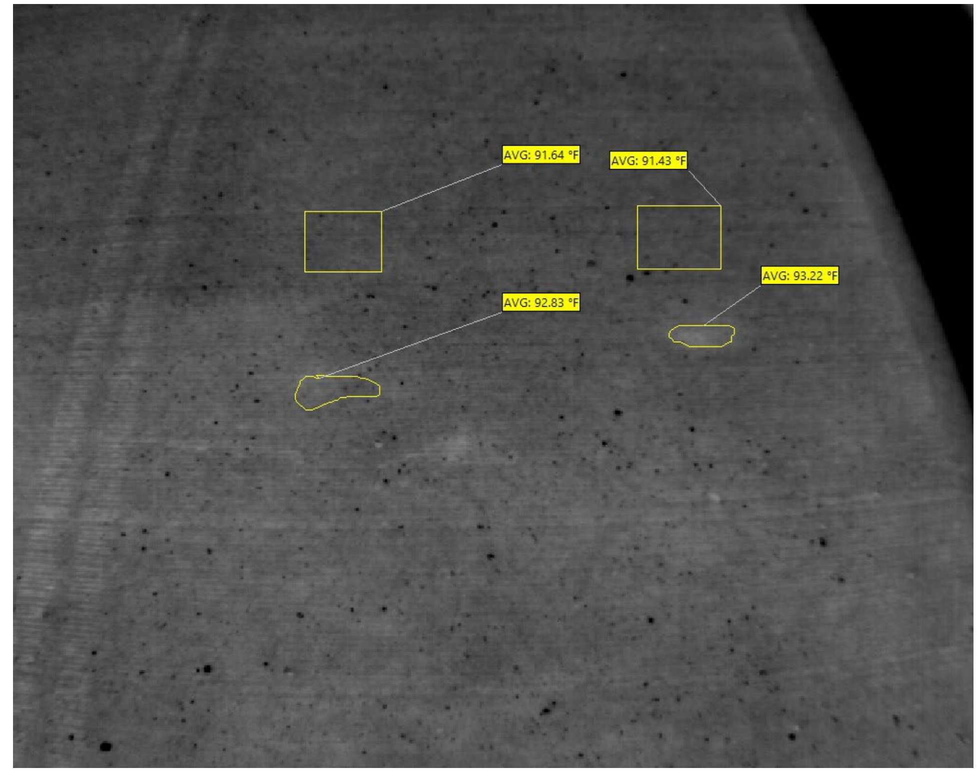
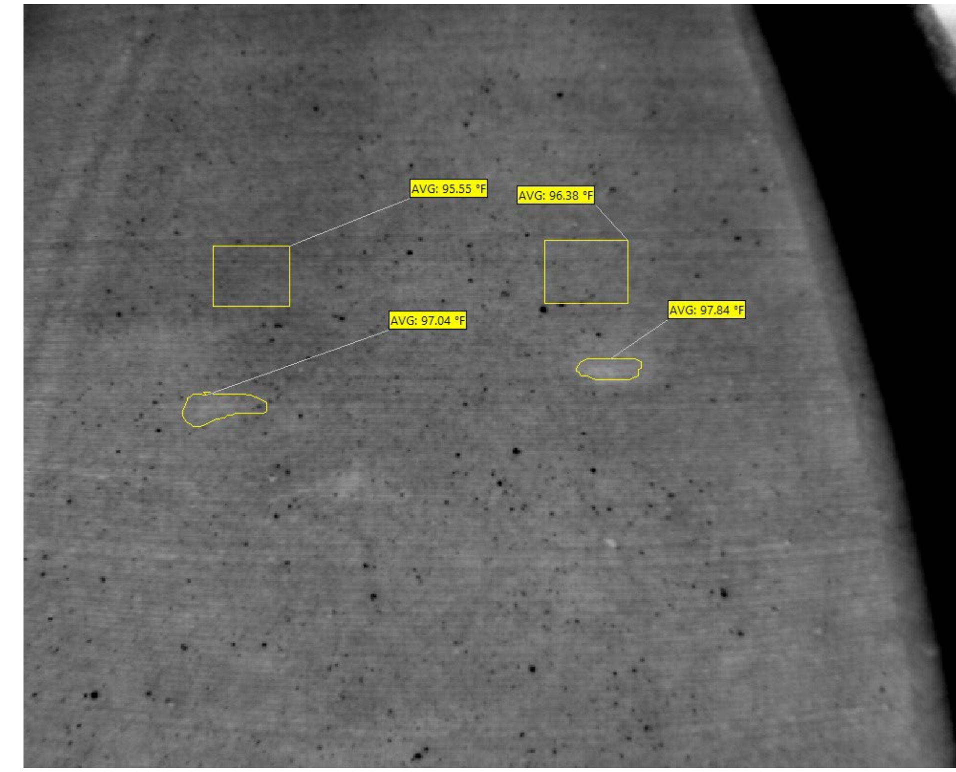


8/10/2023 12:10



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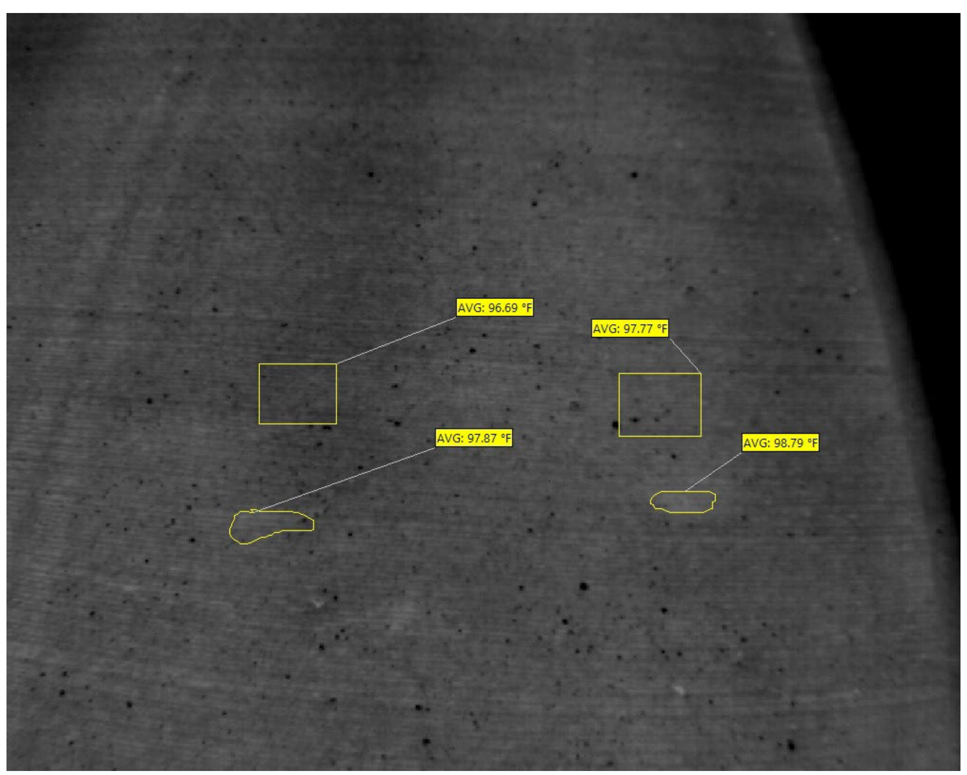

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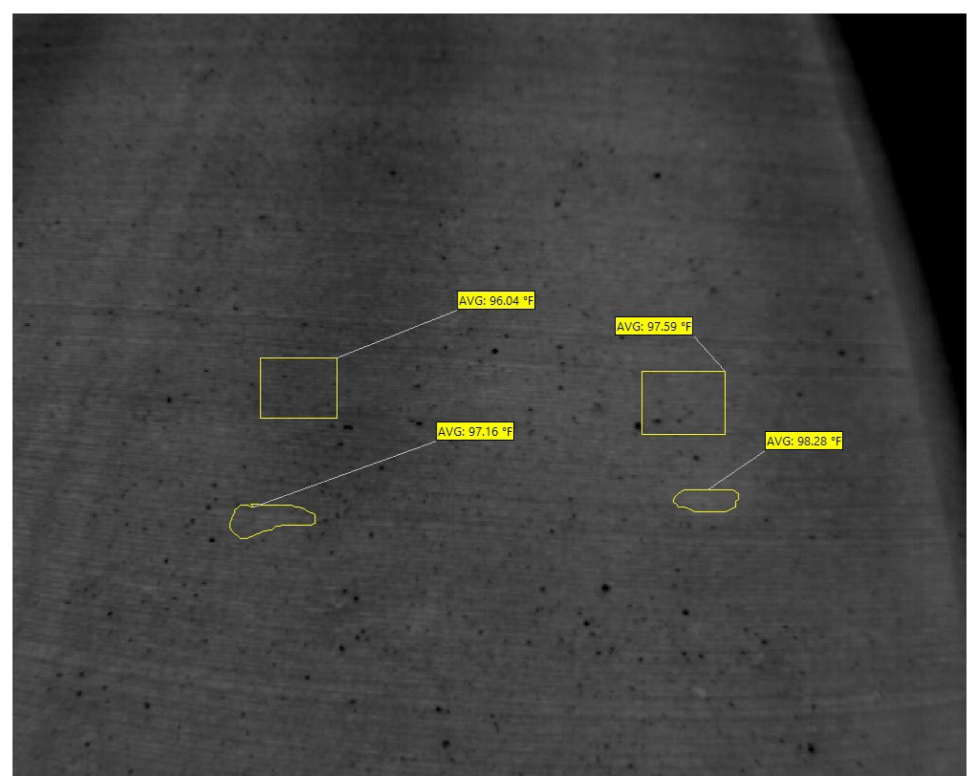

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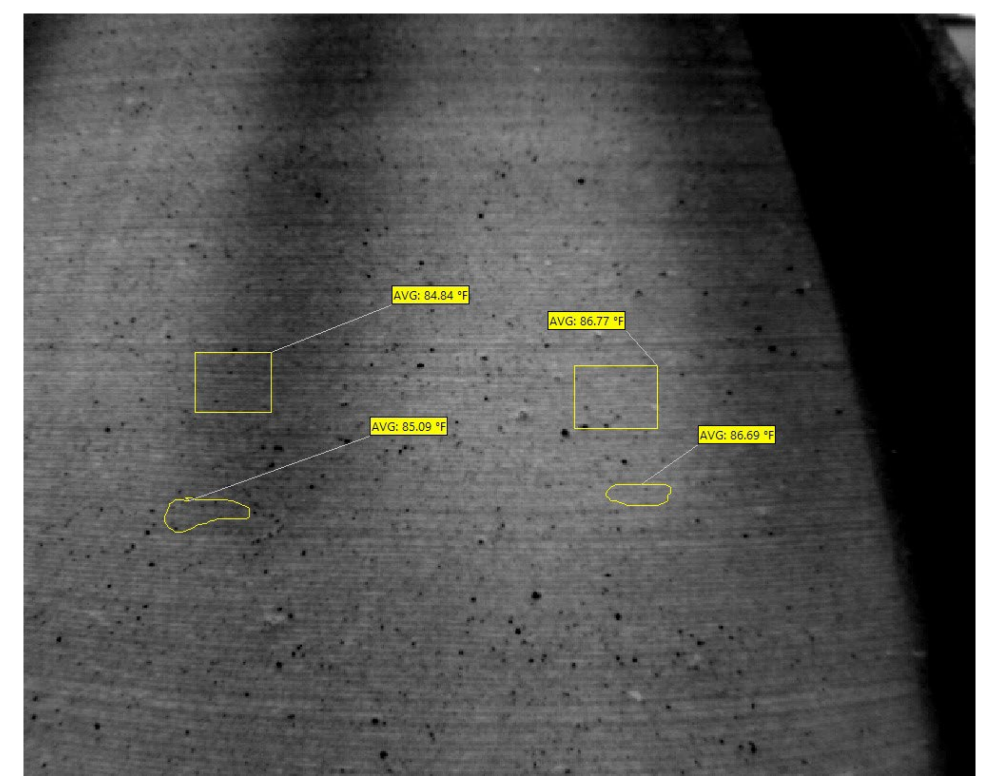

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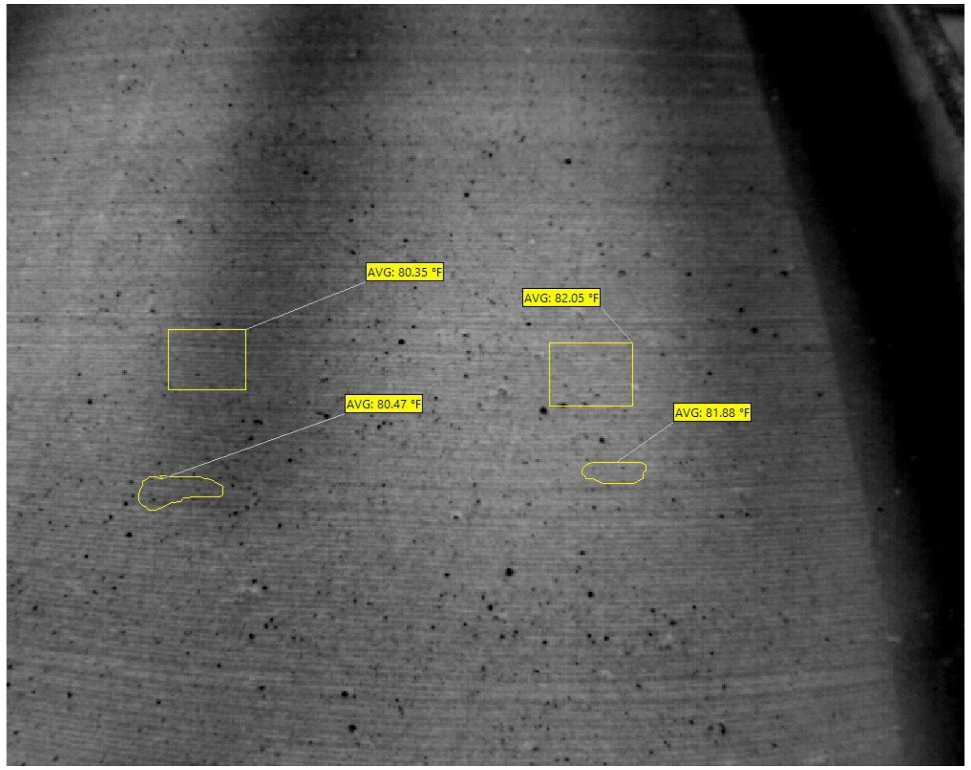
B660053 EB Lane defects 2 and 3



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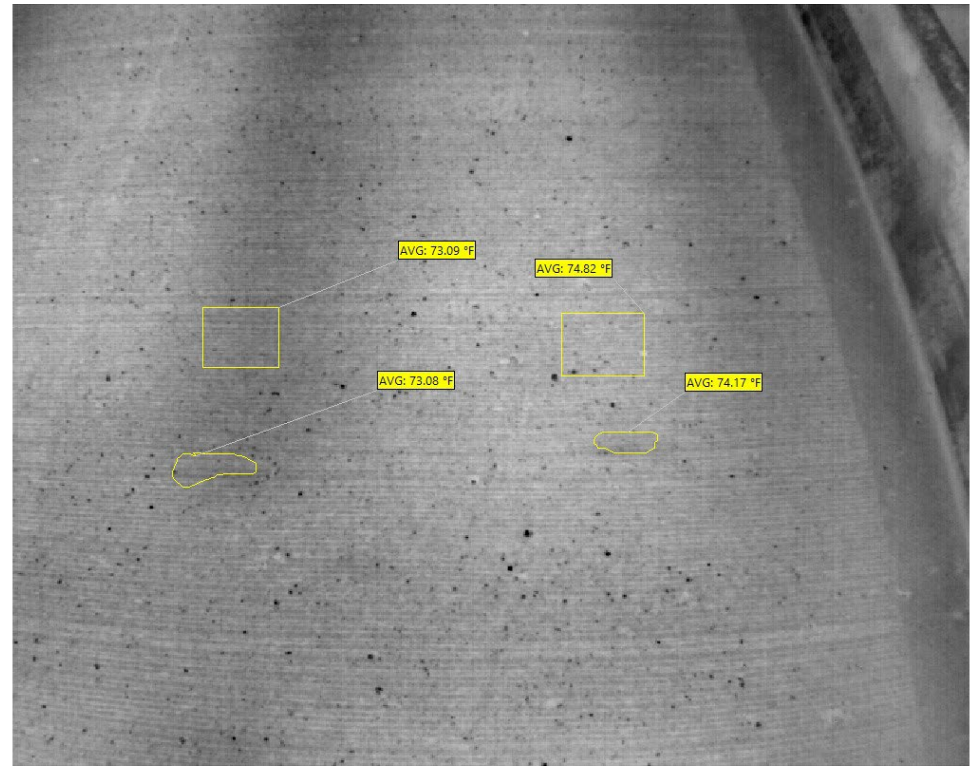

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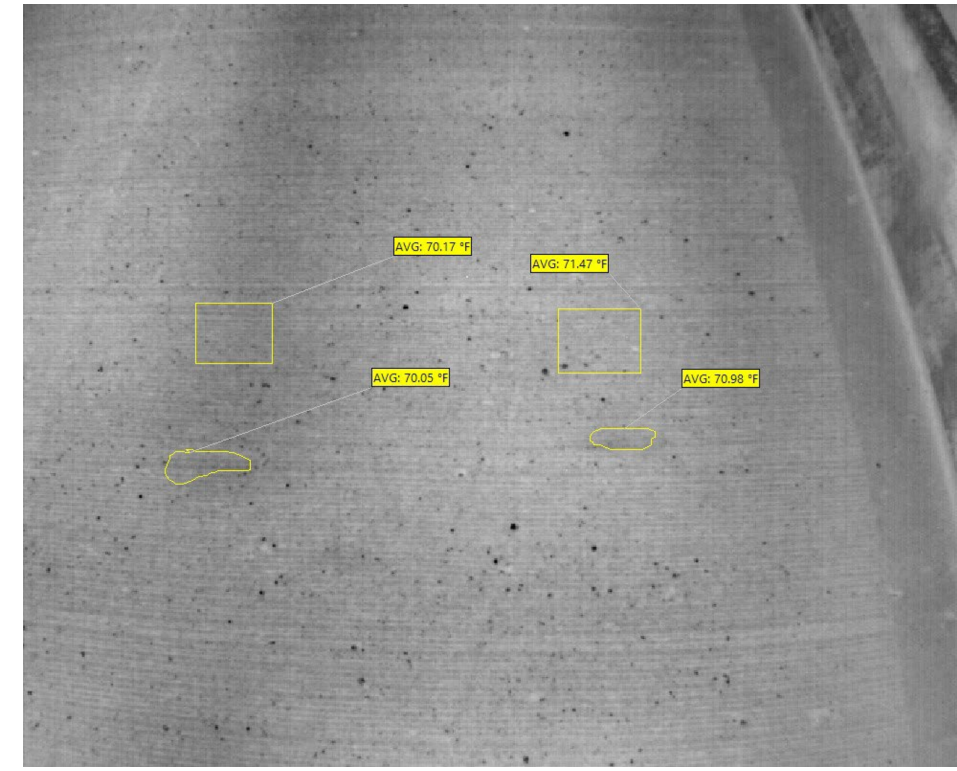

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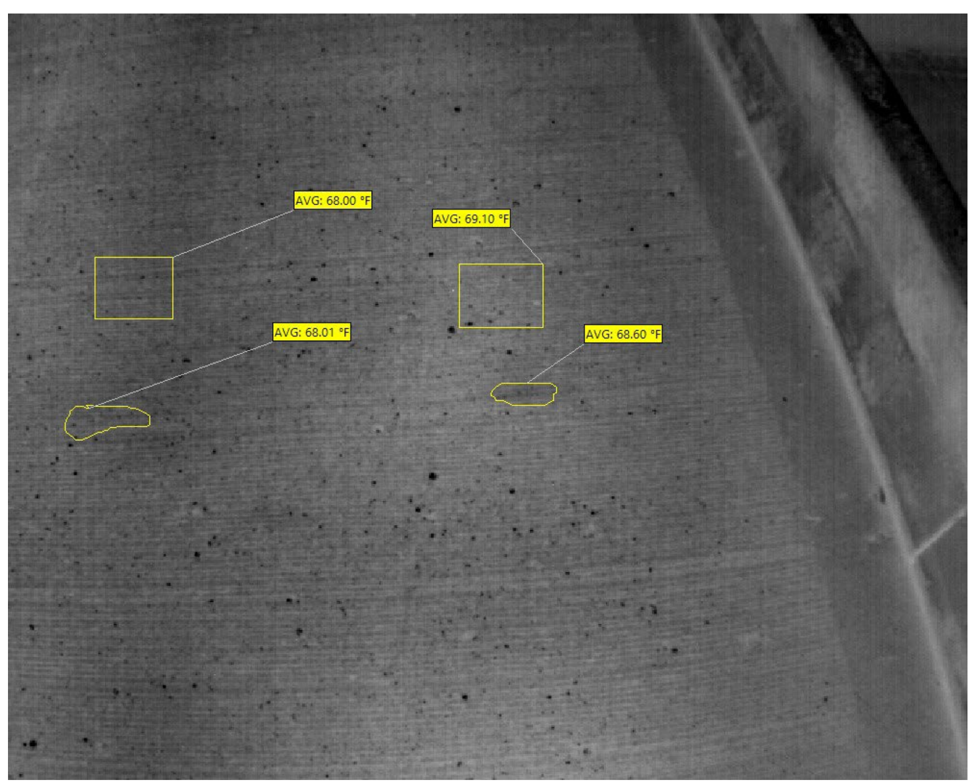

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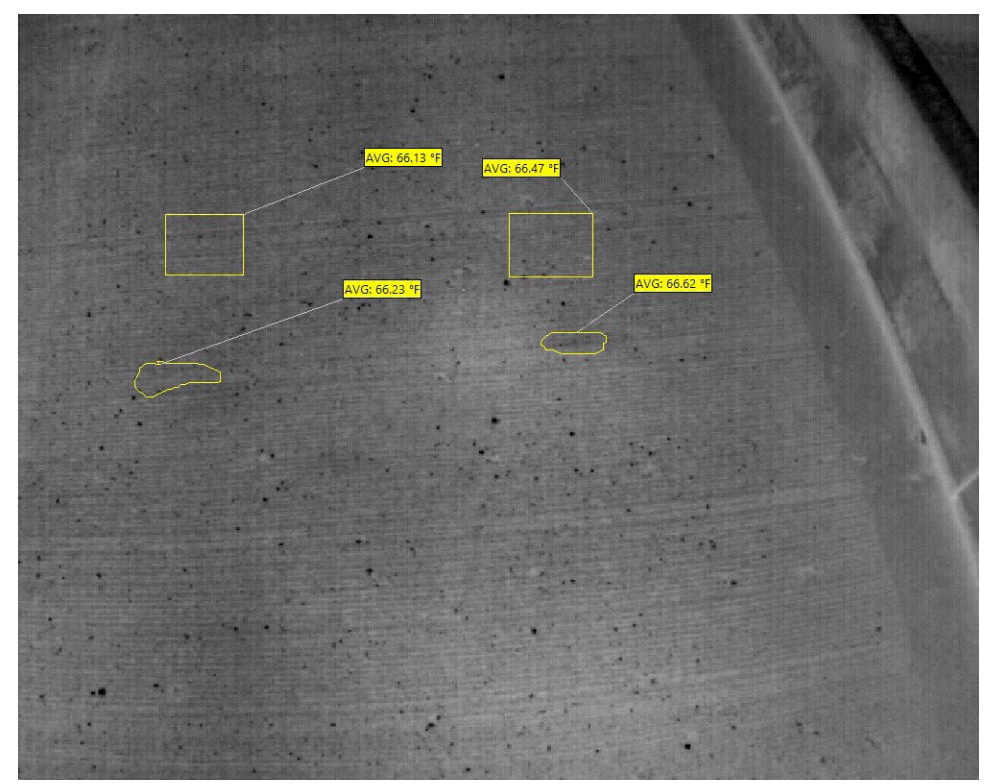
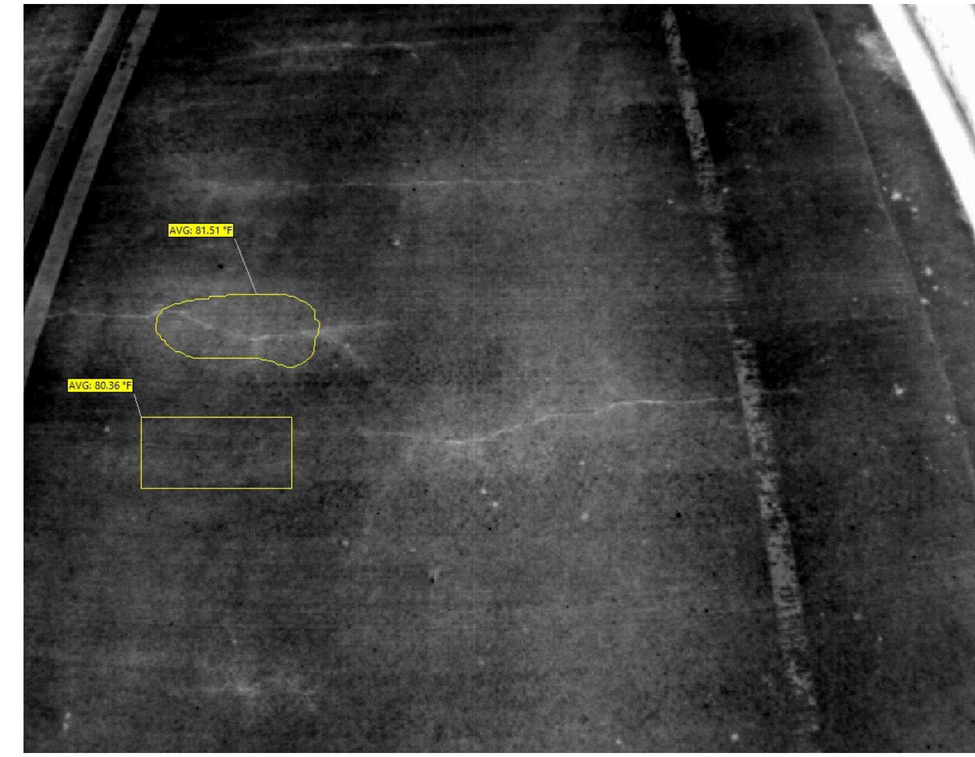


8/28/2023 23:00

B670122 NB Lane defect 1

9/14/2023 09:35

9/14/2023 13:20



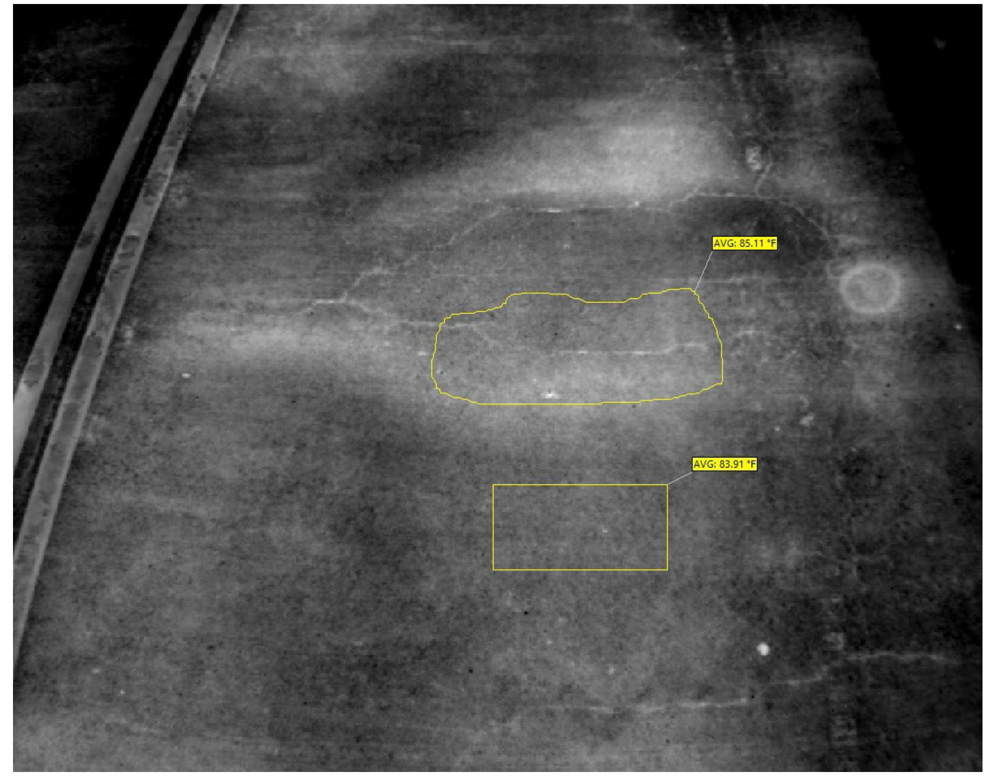
9/14/2023 16:15

9/14/2023 19:10

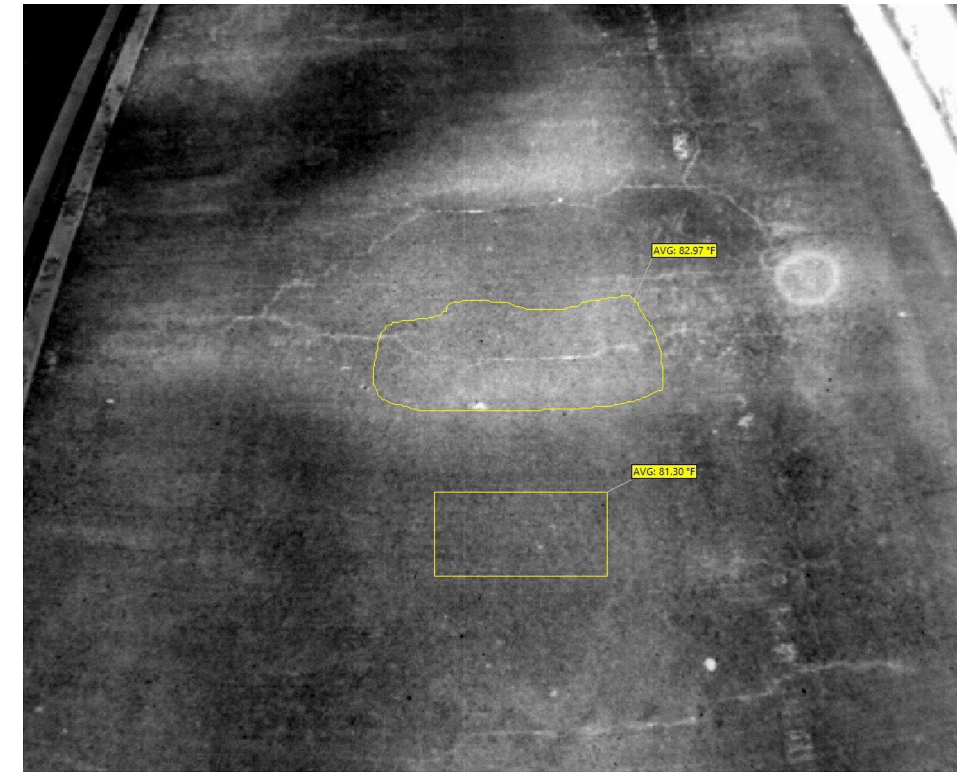
Live Image

B670122 NB Lane defect 2

9/14/2023 09:35



9/14/2023 13:20



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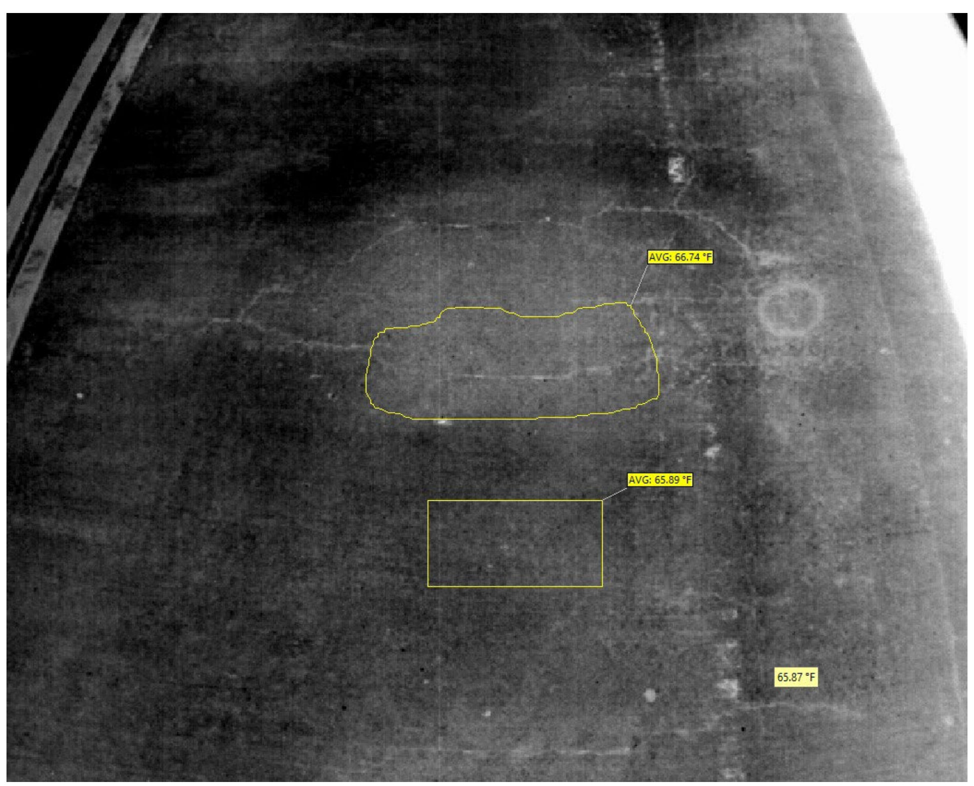
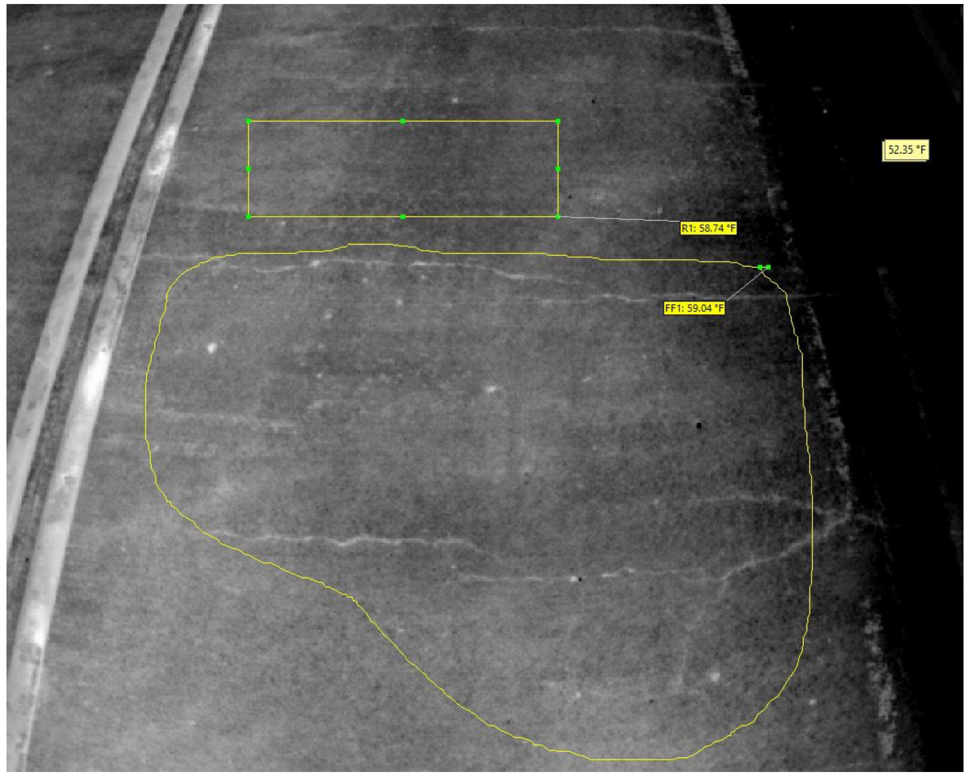


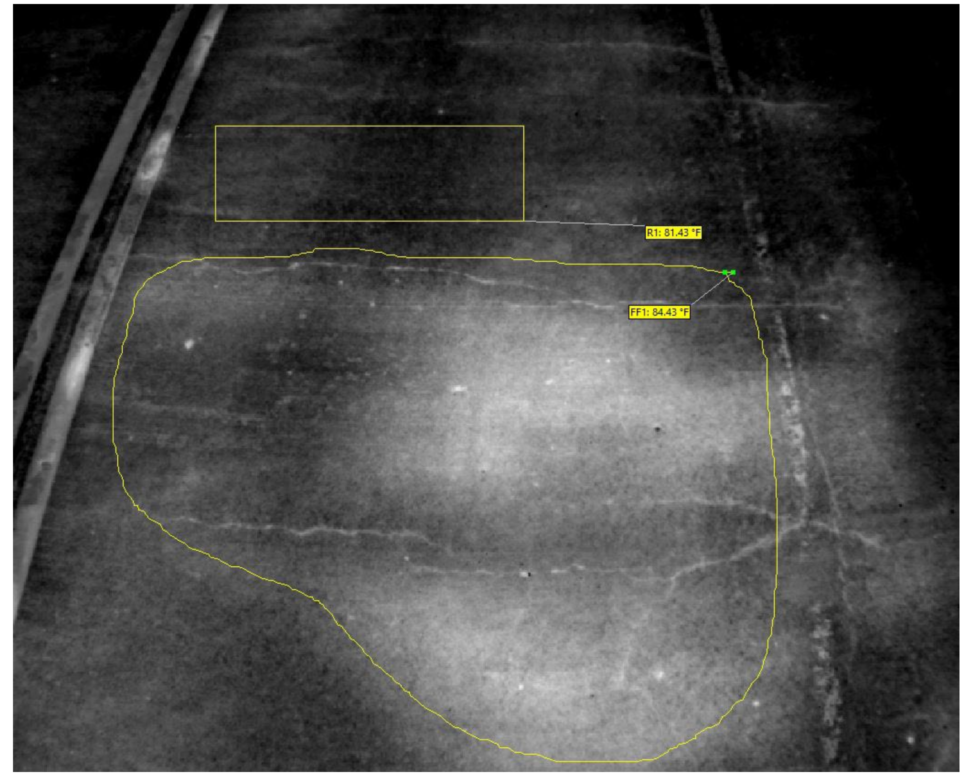
9/14/2023 19:10

Live Image

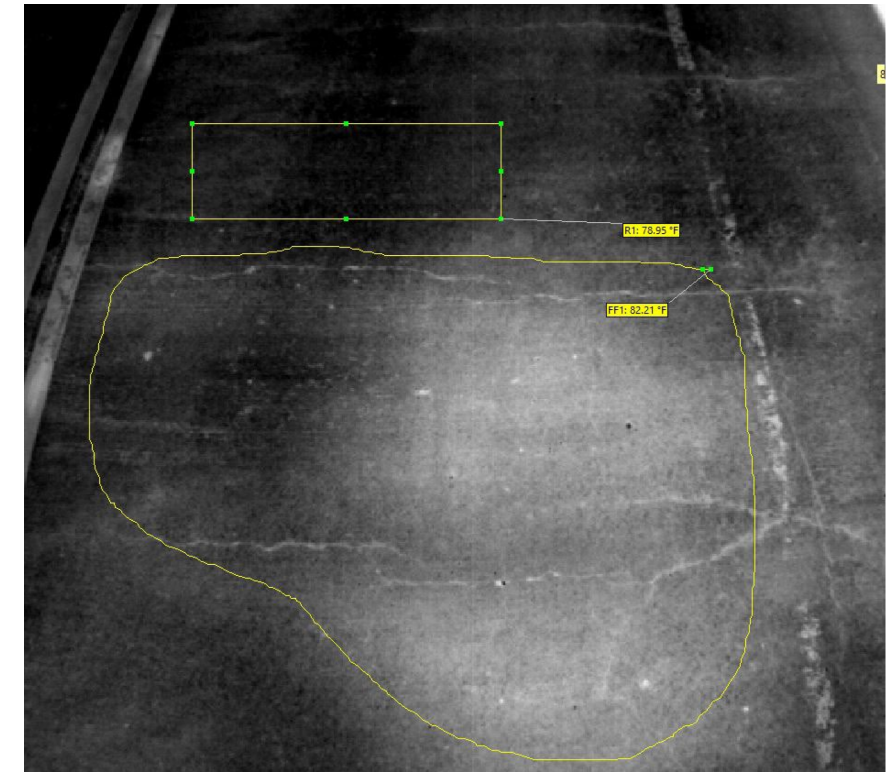
B670122 NB Lane defect 3



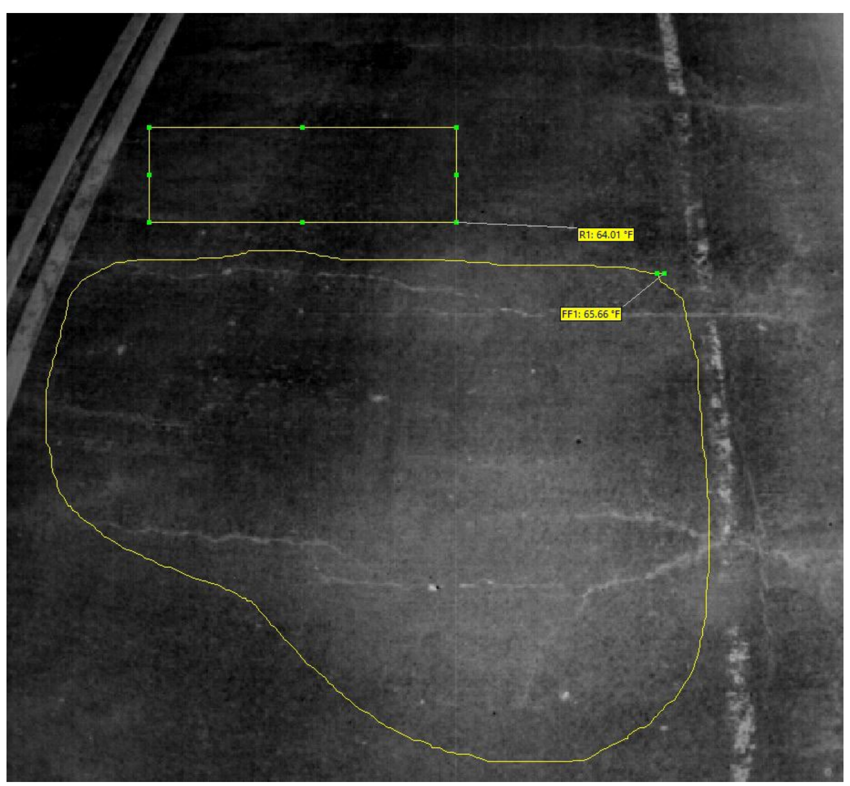
9/14/2023 09:30



9/14/2023 13:20



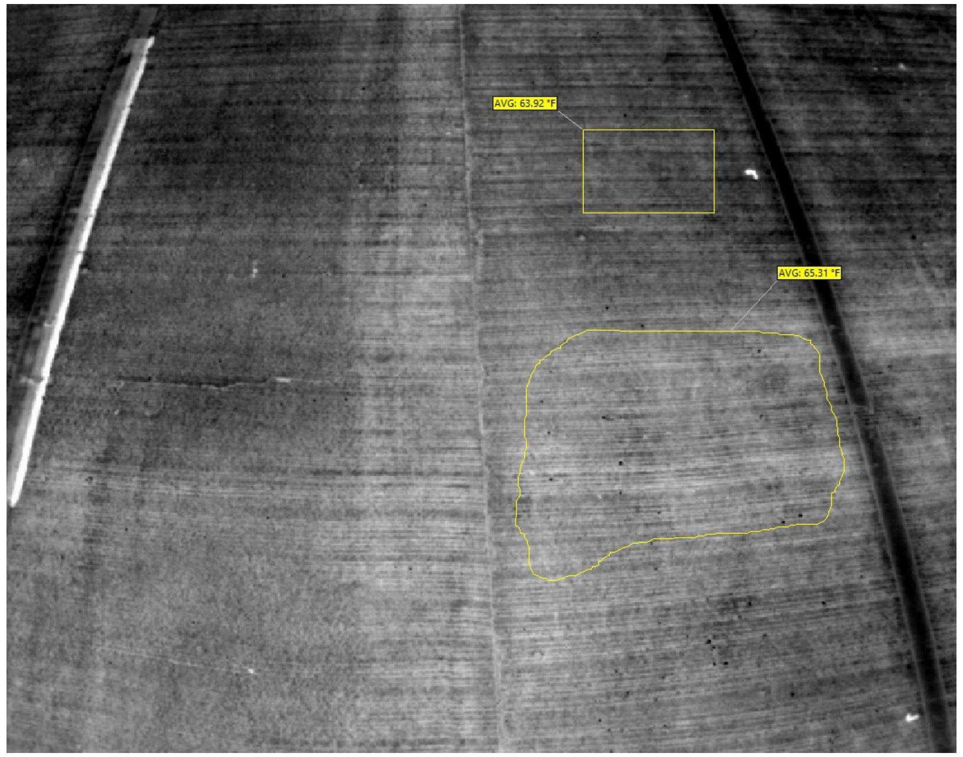
9/14/2023 16:15



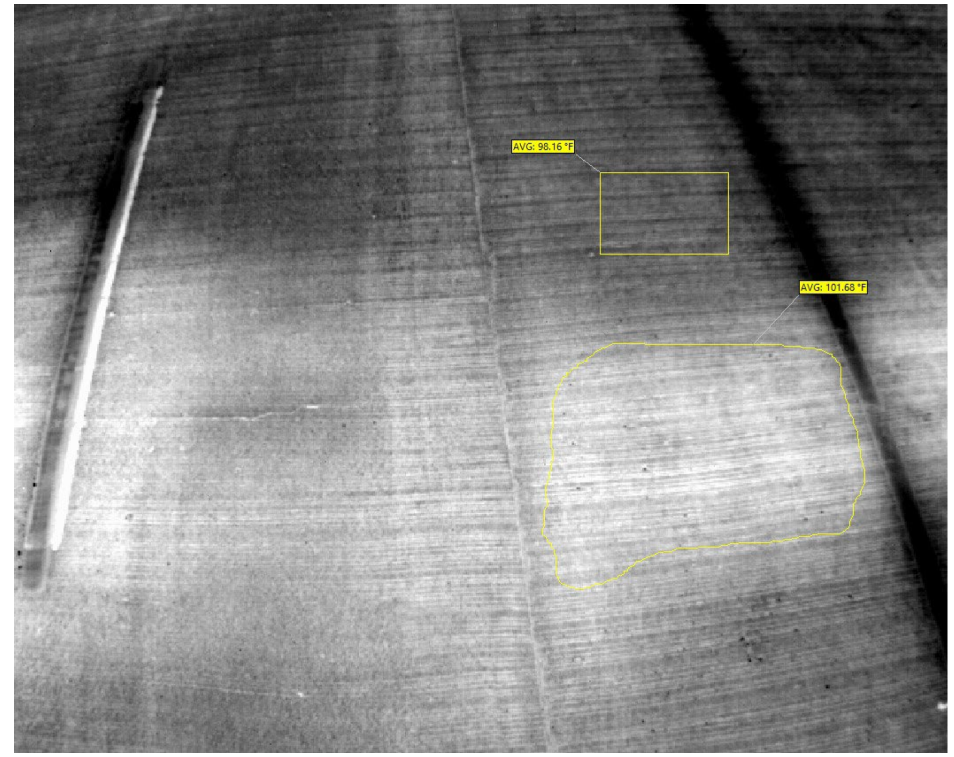
9/14/2023 19:10


Live Image

B670152 NB Right Lane defect 1



9/14/2023 09:55



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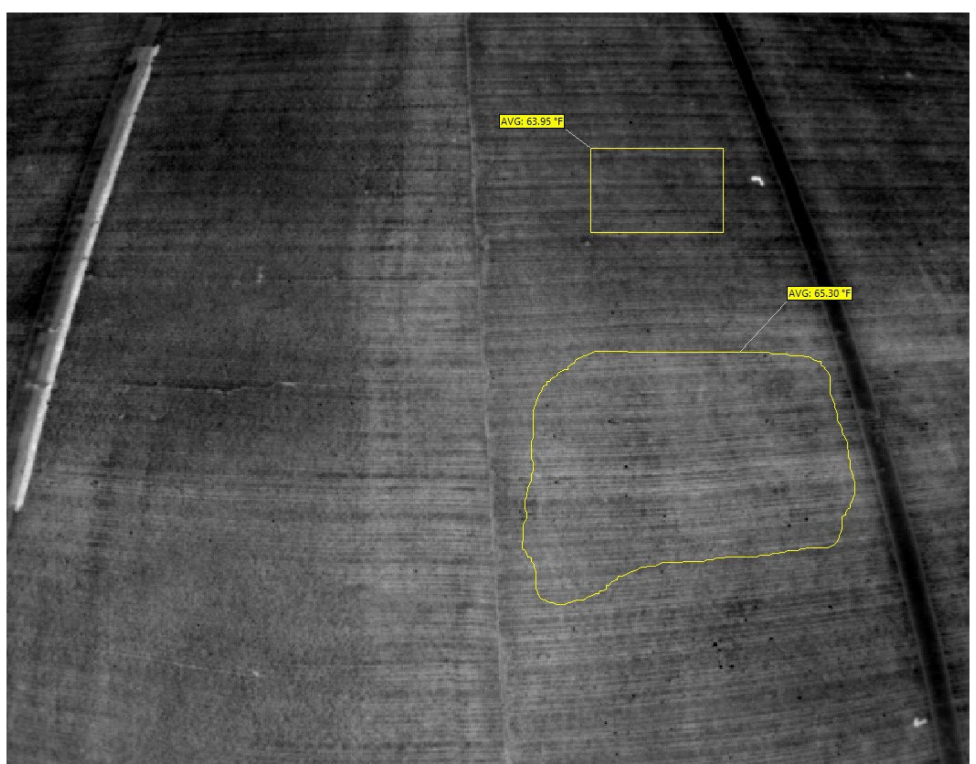
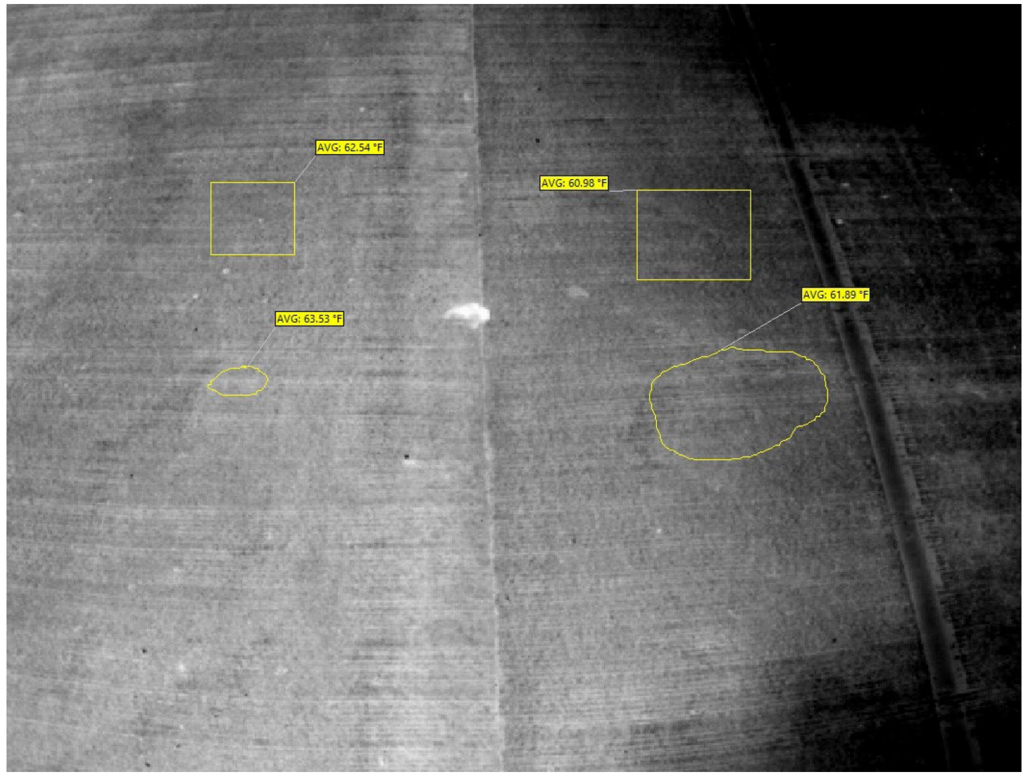


9/14/2023 19:25

Live Image

B670152 NB Right Lane defects 2 and 3



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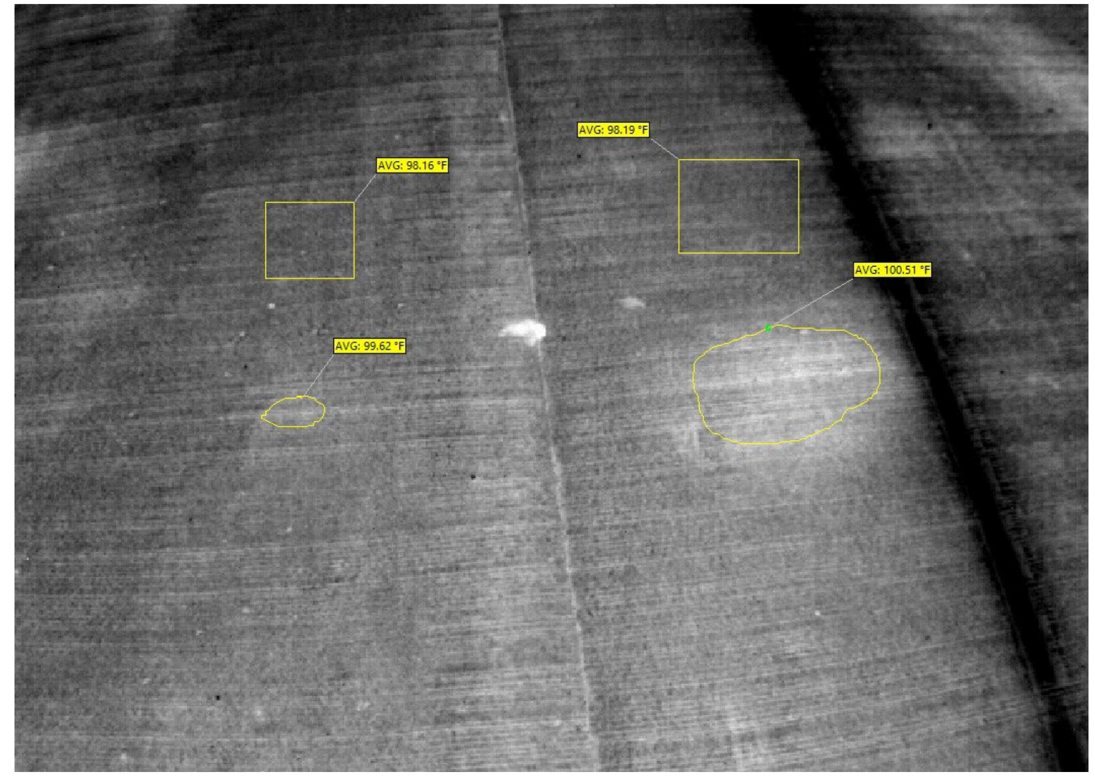

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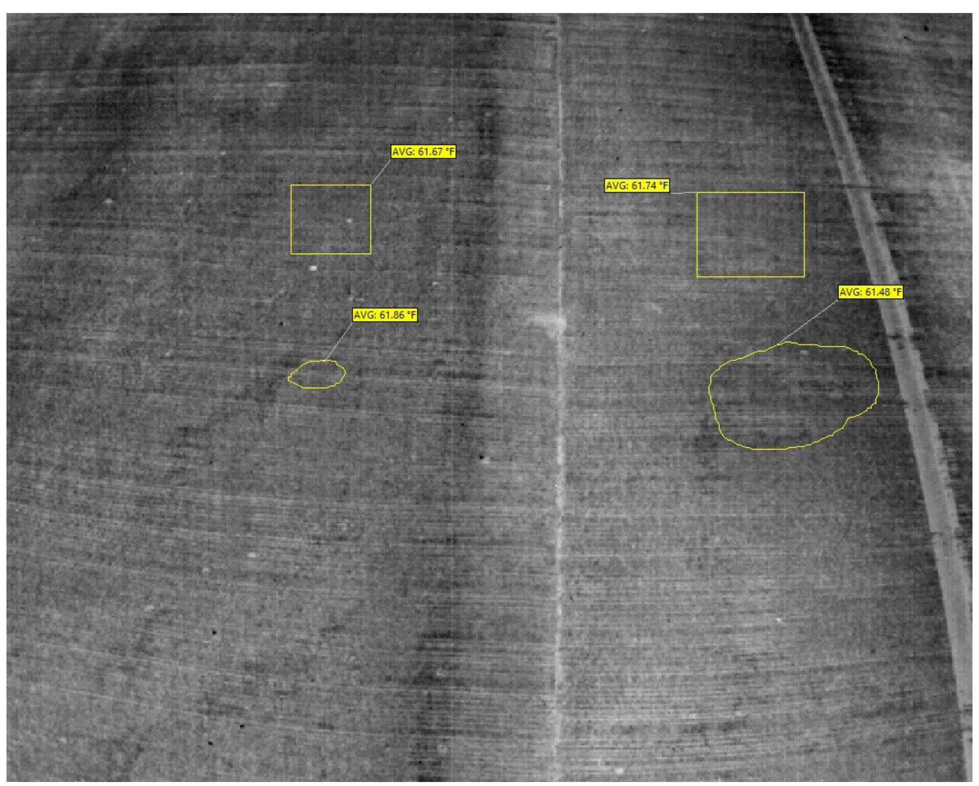


9/14/2023 19:25

Live Image

Bridge Defect Time Lapse

Bridge #	Defect #	Col. Date	Sunrise	Col. Time	Hrs after sunrise	Hrs decimal	Defect Temp. (F)	Control Temp. (F)	Temp. Difference (F) (Def-Cont)	Overlay Type	Overlay Type2
B-30-48	1	9/14/2023	6:30	9:00	2:30	2.50	56.36	56.24	0.12	06 AC / 80	AC
B-30-48	1	9/14/2023	6:30	12:30	6:00	6.00	82.02	79.72	2.30	06 AC / 80	AC
B-30-48	1	9/14/2023	6:30	15:40	9:10	9.17	78.70	77.04	1.66	06 AC / 80	AC
B-30-48	1	9/14/2023	6:30	18:25	11:55	11.92	70.47	70.00	0.47	06 AC / 80	AC
B-30-48	2	9/14/2023	6:30	9:00	2:30	2.50	55.94	56.06	-0.12	06 AC / 80	AC
B-30-48	2	9/14/2023	6:30	12:30	6:00	6.00	80.33	79.21	1.12	06 AC / 80	AC
B-30-48	2	9/14/2023	6:30	15:40	9:10	9.17	77.55	76.70	0.85	06 AC / 80	AC
B-30-48	2	9/14/2023	6:30	18:25	11:55	11.92	69.94	69.71	0.23	06 AC / 80	AC
B-30-48	3	9/14/2023	6:30	9:00	2:30	2.50	56.23	56.08	0.15	06 AC / 80	AC
B-30-48	3	9/14/2023	6:30	12:30	6:00	6.00	79.25	78.85	0.4	06 AC / 80	AC
B-30-48	3	9/14/2023	6:30	15:40	9:10	9.17	76.29	76.02	0.27	06 AC / 80	AC
B-30-48	3	9/14/2023	6:30	18:25	11:55	11.92	69.29	69.15	0.14	06 AC / 80	AC
B-30-58	1	9/14/2023	6:30	8:55	2:25	2.42	58.12	57.11	1.01	06 AC / 89	AC
B-30-58	1	9/14/2023	6:30	12:25	5:55	5.92	81.69	80.22	1.47	06 AC / 89	AC
B-30-58	1	9/14/2023	6:30	15:35	9:05	9.08	79.46	78.94	0.52	06 AC / 89	AC
B-30-58	1	9/14/2023	6:30	18:20	11:50	11.83	70.80	70.81	-0.01	06 AC / 89	AC
B-30-58	2	9/14/2023	6:30	8:55	2:25	2.42	57.85	57.11	0.74	06 AC / 89	AC
B-30-58	2	9/14/2023	6:30	12:25	5:55	5.92	81.32	80.22	1.1	06 AC / 89	AC
B-30-58	2	9/14/2023	6:30	15:35	9:05	9.08	79.37	78.94	0.43	06 AC / 89	AC
B-30-58	2	9/14/2023	6:30	18:20	11:50	11.83	70.98	70.81	0.17	06 AC / 89	AC
B-30-58	3	9/14/2023	6:30	8:45	2:15	2.25	55.31	55.06	0.25	06 AC / 89	AC
B-30-58	3	9/14/2023	6:30	12:20	5:50	5.83	77.50	76.89	0.61	06 AC / 89	AC
B-30-58	3	9/14/2023	6:30	15:30	9:00	9.00	78.74	78.39	0.35	06 AC / 89	AC
B-30-58	3	9/14/2023	6:30	18:15	11:45	11.75	70.65	70.63	0.02	06 AC / 89	AC
B-30-73	1	9/14/2023	6:30	8:20	1:50	1.83	60.23	60.82	-0.59	17 TPO / 93	TPO
B-30-73	1	9/14/2023	6:30	11:30	5:00	5.00	74.53	73.94	0.59	17 TPO / 93	TPO
B-30-73	1	9/14/2023	6:30	14:45	8:15	8.25	88.39	87.58	0.81	17 TPO / 93	TPO
B-30-73	1	9/14/2023	6:30	17:50	11:20	11.33	75.02	74.80	0.22	17 TPO / 93	TPO
B-30-73	2	9/14/2023	6:30	8:20	1:50	1.83	60.88	60.82	0.06	17 TPO / 93	TPO
B-30-73	2	9/14/2023	6:30	11:30	5:00	5.00	74.79	73.94	0.85	17 TPO / 93	TPO
B-30-73	2	9/14/2023	6:30	14:45	8:15	8.25	89.02	87.58	1.44	17 TPO / 93	TPO
B-30-73	2	9/14/2023	6:30	17:50	11:20	11.33	75.17	74.80	0.37	17 TPO / 93	TPO
B-30-73	3	9/14/2023	6:30	8:15	1:45	1.75	61.02	60.74	0.28	17 TPO / 93	TPO
B-30-73	3	9/14/2023	6:30	11:25	4:55	4.92	82.27	80.58	1.69	17 TPO / 93	TPO
B-30-73	3	9/14/2023	6:30	14:40	8:10	8.17	90.39	88.62	1.77	17 TPO / 93	TPO
B-30-73	3	9/14/2023	6:30	17:45	11:15	11.25	75.94	75.35	0.59	17 TPO / 93	TPO
B-30-74	1	9/14/2023	6:30	8:20	1:50	1.83	60.54	60.44	0.1	17 TPO / 93	TPO
B-30-74	1	9/14/2023	6:30	11:30	5:00	5.00	79.51	78.20	1.31	17 TPO / 93	TPO
B-30-74	1	9/14/2023	6:30	14:40	8:10	8.17	89.33	88.21	1.12	17 TPO / 93	TPO
B-30-74	1	9/14/2023	6:30	17:45	11:15	11.25	75.70	75.30	0.4	17 TPO / 93	TPO
B-30-74	2	9/14/2023	6:30	8:15	1:45	1.75	61.26	61.16	0.1	17 TPO / 93	TPO
B-30-74	2	9/14/2023	6:30	11:25	4:55	4.92	84.41	83.20	1.21	17 TPO / 93	TPO
B-30-74	2	9/14/2023	6:30	14:35	8:05	8.08	90.13	89.45	0.68	17 TPO / 93	TPO

Bridge Defect Time Lapse

Bridge #	Defect #	Col. Date	Sunrise	Col. Time	Hrs after sunrise	Hrs decimal	Defect Temp. (F)	Control Temp. (F)	Temp. Difference (F) (Def-Cont)	Overlay Type	Overlay Type2
B-30-74	2	9/14/2023	6:30	17:35	11:05	11.08	76.90	76.82	0.08	17 TPO / 93	TPO
B-30-74	3	9/14/2023	6:30	8:15	1:45	1.75	60.65	60.92	-0.27	17 TPO / 93	TPO
B-30-74	3	9/14/2023	6:30	11:25	4:55	4.92	84.18	83.13	1.05	17 TPO / 93	TPO
B-30-74	3	9/14/2023	6:30	14:35	8:05	8.08	90.33	89.49	0.84	17 TPO / 93	TPO
B-30-74	3	9/14/2023	6:30	17:35	11:05	11.08	77.45	77.49	-0.04	17 TPO / 93	TPO
B-40-330	1	8/31/2023	6:15	6:20	0:05	0.08	56.20	59.12	-2.92	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/31/2023	6:15	7:10	0:55	0.92	57.63	60.58	-2.95	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/10/2023	5:52	9:10	3:18	3.30	85.57	85.84	-0.27	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/10/2023	5:52	10:15	4:23	4.38	95.05	93.46	1.59	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/10/2023	5:52	11:15	5:23	5.38	105.10	101.39	3.71	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/10/2023	5:52	13:00	7:08	7.13	115.48	109.99	5.49	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/10/2023	5:52	14:00	8:08	8.13	110.78	105.83	4.95	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/10/2023	5:52	15:15	9:23	9.38	114.07	108.65	5.42	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/10/2023	5:52	16:30	10:38	10.63	111.28	106.92	4.36	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/28/2023	6:11	17:50	11:39	11.65	97.14	91.54	5.6	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/28/2023	6:11	18:45	12:34	12.57	87.32	83.93	3.39	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/28/2023	6:11	20:20	14:09	14.15	77.82	77.60	0.22	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/28/2023	6:11	21:20	15:09	15.15	74.36	75.54	-1.18	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/28/2023	6:11	22:15	16:04	16.07	71.81	73.36	-1.55	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/28/2023	6:11	23:30	17:19	17.32	69.40	71.47	-2.07	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/31/2023	6:15	0:30	18:15	18.25	61.08	64.30	-3.22	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/31/2023	6:15	1:25	19:10	19.17	60.10	63.07	-2.97	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/31/2023	6:15	2:30	20:15	20.25	58.94	62.18	-3.24	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/31/2023	6:15	3:25	21:10	21.17	58.15	61.40	-3.25	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/31/2023	6:15	4:25	22:10	22.17	57.32	60.35	-3.03	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	1	8/31/2023	6:15	5:30	23:15	23.25	56.36	59.24	-2.88	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/31/2023	6:15	6:20	0:05	0.08	58.09	59.12	-1.03	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/31/2023	6:15	7:10	0:55	0.92	59.63	60.58	-0.95	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/10/2023	5:52	9:10	3:18	3.30	86.62	85.84	0.78	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/10/2023	5:52	10:15	4:23	4.38	95.42	93.46	1.96	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/10/2023	5:52	11:15	5:23	5.38	104.58	101.39	3.19	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/10/2023	5:52	13:00	7:08	7.13	114.32	109.99	4.33	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/10/2023	5:52	14:00	8:08	8.13	108.96	105.83	3.13	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/10/2023	5:52	15:15	9:23	9.38	112.25	108.65	3.6	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/10/2023	5:52	16:30	10:38	10.63	109.77	106.92	2.85	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/28/2023	6:11	17:50	11:39	11.65	93.52	91.54	1.98	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/28/2023	6:11	18:45	12:34	12.57	85.65	83.93	1.72	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/28/2023	6:11	20:20	14:09	14.15	78.32	77.60	0.72	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/28/2023	6:11	21:20	15:09	15.15	75.47	75.54	-0.07	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/28/2023	6:11	22:15	16:04	16.07	72.98	73.36	-0.38	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/28/2023	6:11	23:30	17:19	17.32	70.94	71.47	-0.53	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/31/2023	6:15	0:30	18:15	18.25	62.99	64.30	-1.31	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/31/2023	6:15	1:25	19:10	19.17	62.05	63.07	-1.02	04 TPO/ 98 PCC/ 67	PCC/TPO

Bridge Defect Time Lapse

Bridge #	Defect #	Col. Date	Sunrise	Col. Time	Hrs after sunrise	Hrs decimal	Defect Temp. (F)	Control Temp. (F)	Temp. Difference (F) (Def-Cont)	Overlay Type	Overlay Type2
B-40-330	2	8/31/2023	6:15	2:30	20:15	20.25	60.88	62.18	-1.3	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/31/2023	6:15	3:25	21:10	21.17	60.12	61.40	-1.28	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/31/2023	6:15	4:25	22:10	22.17	59.39	60.35	-0.96	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	2	8/31/2023	6:15	5:30	23:15	23.25	58.39	59.24	-0.85	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/31/2023	6:15	6:20	0:05	0.08	59.02	59.12	-0.1	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/31/2023	6:15	7:10	0:55	0.92	60.48	60.58	-0.1	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/10/2023	5:52	9:10	3:18	3.30	87.44	85.84	1.6	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/10/2023	5:52	10:15	4:23	4.38	95.65	93.46	2.19	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/10/2023	5:52	11:15	5:23	5.38	103.77	101.39	2.38	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/10/2023	5:52	13:00	7:08	7.13	112.80	109.99	2.81	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/10/2023	5:52	14:00	8:08	8.13	105.82	105.83	-0.01	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/10/2023	5:52	15:15	9:23	9.38	109.79	108.65	1.14	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/10/2023	5:52	16:30	10:38	10.63	107.58	106.92	0.66	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/28/2023	6:11	17:50	11:39	11.65	92.83	91.54	1.29	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/28/2023	6:11	18:45	12:34	12.57	83.67	83.93	-0.26	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/28/2023	6:11	20:20	14:09	14.15	77.57	77.60	-0.03	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/28/2023	6:11	21:20	15:09	15.15	75.25	75.54	-0.29	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/28/2023	6:11	22:15	16:04	16.07	73.12	73.36	-0.24	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/28/2023	6:11	23:30	17:19	17.32	71.30	71.47	-0.17	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/31/2023	6:15	0:30	18:15	18.25	63.88	64.30	-0.42	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/31/2023	6:15	1:25	19:10	19.17	62.77	63.07	-0.3	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/31/2023	6:15	2:30	20:15	20.25	61.84	62.18	-0.34	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/31/2023	6:15	3:25	21:10	21.17	61.03	61.40	-0.37	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/31/2023	6:15	4:25	22:10	22.17	60.06	60.35	-0.29	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-330	3	8/31/2023	6:15	5:30	23:15	23.25	59.00	59.24	-0.24	04 TPO/ 98 PCC/ 67	PCC/TPO
B-40-519	1	9/14/2023	6:30	10:30	4:00	4.00	75.95	74.34	1.61	Bare-79	Bare
B-40-519	1	9/14/2023	6:30	13:50	7:20	7.33	81.50	80.90	0.6	Bare-79	Bare
B-40-519	1	9/14/2023	6:30	16:50	10:20	10.33	81.64	81.12	0.52	Bare-79	Bare
B-40-519	1	9/14/2023	6:30	20:00	13:30	13.50	63.41	64.40	-0.99	Bare-79	Bare
B-40-519	2	9/14/2023	6:30	10:35	4:05	4.08	74.30	73.11	1.19	Bare-79	Bare
B-40-519	2	9/14/2023	6:30	13:50	7:20	7.33	81.29	80.15	1.14	Bare-79	Bare
B-40-519	2	9/14/2023	6:30	16:45	10:15	10.25	81.70	80.73	0.97	Bare-79	Bare
B-40-519	2	9/14/2023	6:30	19:55	13:25	13.42	64.56	64.72	-0.16	Bare-79	Bare
B-40-519	3	9/14/2023	6:30	10:35	4:05	4.08	75.20	74.55	0.65	Bare-79	Bare
B-40-519	3	9/14/2023	6:30	13:50	7:20	7.33	82.37	81.19	1.18	Bare-79	Bare
B-40-519	3	9/14/2023	6:30	16:45	10:15	10.25	82.83	81.58	1.25	Bare-79	Bare
B-40-519	3	9/14/2023	6:30	19:55	13:25	13.42	65.19	65.51	-0.32	Bare-79	Bare
B-66-37	1	8/31/2023	6:15	6:55	0:40	0.67	52.39	52.86	-0.47	97 AC / 75	AC
B-66-37	1	8/10/2023	5:52	8:30	2:38	2.63	72.45	74.18	-1.73	97 AC / 75	AC
B-66-37	1	8/10/2023	5:52	9:50	3:58	3.97	81.57	82.21	-0.64	97 AC / 75	AC
B-66-37	1	8/10/2023	5:52	11:00	5:08	5.13	89.48	89.23	0.25	97 AC / 75	AC
B-66-37	1	8/10/2023	5:52	12:20	6:28	6.47	93.13	92.41	0.72	97 AC / 75	AC
B-66-37	1	8/10/2023	5:52	13:45	7:53	7.88	95.96	95.00	0.96	97 AC / 75	AC

Bridge Defect Time Lapse

Bridge #	Defect #	Col. Date	Sunrise	Col. Time	Hrs after sunrise	Hrs decimal	Defect Temp. (F)	Control Temp. (F)	Temp. Difference (F) (Def-Cont)	Overlay Type	Overlay Type2
B-66-37	1	8/10/2023	5:52	14:45	8:53	8.88	97.32	96.86	0.46	97 AC / 75	AC
B-66-37	1	8/10/2023	5:52	16:05	10:13	10.22	96.41	95.79	0.62	97 AC / 75	AC
B-66-37	1	8/28/2023	6:11	17:30	11:19	11.32	84.94	84.72	0.22	97 AC / 75	AC
B-66-37	1	8/28/2023	6:11	18:30	12:19	12.32	79.43	79.19	0.24	97 AC / 75	AC
B-66-37	1	8/28/2023	6:11	20:00	13:49	13.82	72.42	72.52	-0.1	97 AC / 75	AC
B-66-37	1	8/28/2023	6:11	21:05	14:54	14.90	69.81	70.06	-0.25	97 AC / 75	AC
B-66-37	1	8/28/2023	6:11	22:00	15:49	15.82	68.70	68.92	-0.22	97 AC / 75	AC
B-66-37	1	8/28/2023	6:11	23:15	17:04	17.07	67.03	67.32	-0.29	97 AC / 75	AC
B-66-37	1	8/31/2023	6:15	0:10	17:55	17.92	57.46	57.68	-0.22	97 AC / 75	AC
B-66-37	1	8/31/2023	6:15	1:10	18:55	18.92	56.22	56.37	-0.15	97 AC / 75	AC
B-66-37	1	8/31/2023	6:15	2:15	20:00	20.00	55.22	55.41	-0.19	97 AC / 75	AC
B-66-37	1	8/31/2023	6:15	3:10	20:55	20.92	54.51	54.66	-0.15	97 AC / 75	AC
B-66-37	1	8/31/2023	6:15	4:10	21:55	21.92	53.23	53.35	-0.12	97 AC / 75	AC
B-66-37	1	8/31/2023	6:15	5:10	22:55	22.92	52.28	52.56	-0.28	97 AC / 75	AC
B-66-37	1	8/31/2023	6:15	6:05	23:50	23.83	51.63	52.03	-0.4	97 AC / 75	AC
B-66-37	2	8/31/2023	6:15	6:55	0:40	0.67	52.20	52.88	-0.68	97 AC / 75	AC
B-66-37	2	8/10/2023	5:52	8:30	2:38	2.63	73.85	74.18	-0.33	97 AC / 75	AC
B-66-37	2	8/10/2023	5:52	9:50	3:58	3.97	82.77	82.21	0.56	97 AC / 75	AC
B-66-37	2	8/10/2023	5:52	11:00	5:08	5.13	90.49	89.23	1.26	97 AC / 75	AC
B-66-37	2	8/10/2023	5:52	12:20	6:28	6.47	94.34	92.41	1.93	97 AC / 75	AC
B-66-37	2	8/10/2023	5:52	13:45	7:53	7.88	97.32	95.00	2.32	97 AC / 75	AC
B-66-37	2	8/10/2023	5:52	14:45	8:53	8.88	98.83	96.86	1.97	97 AC / 75	AC
B-66-37	2	8/10/2023	5:52	16:05	10:13	10.22	97.64	95.79	1.85	97 AC / 75	AC
B-66-37	2	8/28/2023	6:11	17:30	11:19	11.32	85.93	84.72	1.21	97 AC / 75	AC
B-66-37	2	8/28/2023	6:11	18:30	12:19	12.32	79.92	79.19	0.73	97 AC / 75	AC
B-66-37	2	8/28/2023	6:11	20:00	13:49	13.82	72.46	72.52	-0.06	97 AC / 75	AC
B-66-37	2	8/28/2023	6:11	21:05	14:54	14.90	69.48	70.06	-0.58	97 AC / 75	AC
B-66-37	2	8/28/2023	6:11	22:00	15:49	15.82	68.16	68.92	-0.76	97 AC / 75	AC
B-66-37	2	8/28/2023	6:11	23:15	17:04	17.07	66.29	67.32	-1.03	97 AC / 75	AC
B-66-37	2	8/31/2023	6:15	0:10	17:55	17.92	56.30	57.68	-1.38	97 AC / 75	AC
B-66-37	2	8/31/2023	6:15	1:10	18:55	18.92	55.05	56.37	-1.32	97 AC / 75	AC
B-66-37	2	8/31/2023	6:15	2:15	20:00	20.00	54.03	55.41	-1.38	97 AC / 75	AC
B-66-37	2	8/31/2023	6:15	3:10	20:55	20.92	53.37	54.66	-1.29	97 AC / 75	AC
B-66-37	2	8/31/2023	6:15	4:10	21:55	21.92	52.21	53.35	-1.14	97 AC / 75	AC
B-66-37	2	8/31/2023	6:15	5:10	22:55	22.92	51.49	52.56	-1.07	97 AC / 75	AC
B-66-37	2	8/31/2023	6:15	6:05	23:50	23.83	51.15	52.03	-0.88	97 AC / 75	AC
B-66-37	3	8/31/2023	6:15	7:00	0:45	0.75	51.89	52.05	-0.16	97 AC / 75	AC
B-66-37	3	8/10/2023	5:52	8:30	2:38	2.63	75.15	75.16	-0.01	97 AC / 75	AC
B-66-37	3	8/10/2023	5:52	10:00	4:08	4.13	82.06	81.78	0.28	97 AC / 75	AC
B-66-37	3	8/10/2023	5:52	11:00	5:08	5.13	88.52	88.17	0.35	97 AC / 75	AC
B-66-37	3	8/10/2023	5:52	12:20	6:28	6.47	91.53	91.09	0.44	97 AC / 75	AC
B-66-37	3	8/10/2023	5:52	13:40	7:48	7.80	94.42	93.84	0.58	97 AC / 75	AC
B-66-37	3	8/10/2023	5:52	14:50	8:58	8.97	96.26	95.64	0.62	97 AC / 75	AC

Bridge Defect Time Lapse

Bridge #	Defect #	Col. Date	Sunrise	Col. Time	Hrs after sunrise	Hrs decimal	Defect Temp. (F)	Control Temp. (F)	Temp. Difference (F) (Def-Cont)	Overlay Type	Overlay Type2
B-66-37	3	8/10/2023	5:52	16:10	10:18	10.30	94.95	94.52	0.43	97 AC / 75	AC
B-66-37	3	8/28/2023	6:11	17:30	11:19	11.32	81.47	81.40	0.07	97 AC / 75	AC
B-66-37	3	8/28/2023	6:11	18:30	12:19	12.32	77.47	77.72	-0.25	97 AC / 75	AC
B-66-37	3	8/28/2023	6:11	20:00	13:49	13.82	71.50	71.91	-0.41	97 AC / 75	AC
B-66-37	3	8/28/2023	6:11	21:00	14:49	14.82	69.24	69.69	-0.45	97 AC / 75	AC
B-66-37	3	8/28/2023	6:11	22:00	15:49	15.82	68.05	68.58	-0.53	97 AC / 75	AC
B-66-37	3	8/28/2023	6:11	23:15	17:04	17.07	66.31	66.88	-0.57	97 AC / 75	AC
B-66-37	3	8/31/2023	6:15	0:10	17:55	17.92	56.48	56.80	-0.32	97 AC / 75	AC
B-66-37	3	8/31/2023	6:15	1:10	18:55	18.92	55.05	55.48	-0.43	97 AC / 75	AC
B-66-37	3	8/31/2023	6:15	2:15	20:00	20.00	54.00	54.38	-0.38	97 AC / 75	AC
B-66-37	3	8/31/2023	6:15	3:10	20:55	20.92	53.33	53.59	-0.26	97 AC / 75	AC
B-66-37	3	8/31/2023	6:15	4:10	21:55	21.92	52.01	52.34	-0.33	97 AC / 75	AC
B-66-37	3	8/31/2023	6:15	5:10	22:55	22.92	51.26	51.56	-0.3	97 AC / 75	AC
B-66-37	3	8/31/2023	6:15	6:05	23:50	23.83	50.91	51.15	-0.24	97 AC / 75	AC
B-66-37	4	8/31/2023	6:15	7:00	0:45	0.75	51.19	52.05	-0.86	97 AC / 75	AC
B-66-37	4	8/10/2023	5:52	8:30	2:38	2.63	74.83	75.16	-0.33	97 AC / 75	AC
B-66-37	4	8/10/2023	5:52	10:00	4:08	4.13	82.85	81.78	1.07	97 AC / 75	AC
B-66-37	4	8/10/2023	5:52	11:00	5:08	5.13	90.07	88.17	1.9	97 AC / 75	AC
B-66-37	4	8/10/2023	5:52	12:20	6:28	6.47	93.39	91.09	2.3	97 AC / 75	AC
B-66-37	4	8/10/2023	5:52	13:40	7:48	7.80	96.20	93.84	2.36	97 AC / 75	AC
B-66-37	4	8/10/2023	5:52	14:50	8:58	8.97	98.08	95.64	2.44	97 AC / 75	AC
B-66-37	4	8/10/2023	5:52	16:10	10:18	10.30	92.77	94.52	-1.75	97 AC / 75	AC
B-66-37	4	8/28/2023	6:11	17:30	11:19	11.32	79.17	81.40	-2.23	97 AC / 75	AC
B-66-37	4	8/28/2023	6:11	18:30	12:19	12.32	75.70	77.72	-2.02	97 AC / 75	AC
B-66-37	4	8/28/2023	6:11	20:00	13:49	13.82	70.33	71.91	-1.58	97 AC / 75	AC
B-66-37	4	8/28/2023	6:11	21:00	14:49	14.82	68.00	69.69	-1.69	97 AC / 75	AC
B-66-37	4	8/28/2023	6:11	22:00	15:49	15.82	66.94	68.58	-1.64	97 AC / 75	AC
B-66-37	4	8/28/2023	6:11	23:15	17:04	17.07	65.32	66.88	-1.56	97 AC / 75	AC
B-66-37	4	8/31/2023	6:15	0:10	17:55	17.92	55.81	56.80	-0.99	97 AC / 75	AC
B-66-37	4	8/31/2023	6:15	1:10	18:55	18.92	54.51	55.48	-0.97	97 AC / 75	AC
B-66-37	4	8/31/2023	6:15	2:15	20:00	20.00	53.40	54.38	-0.98	97 AC / 75	AC
B-66-37	4	8/31/2023	6:15	3:10	20:55	20.92	52.79	53.59	-0.8	97 AC / 75	AC
B-66-37	4	8/31/2023	6:15	4:10	21:55	21.92	51.59	52.34	-0.75	97 AC / 75	AC
B-66-37	4	8/31/2023	6:15	5:10	22:55	22.92	50.82	51.56	-0.74	97 AC / 75	AC
B-66-37	4	8/31/2023	6:15	6:05	23:50	23.83	50.28	51.15	-0.87	97 AC / 75	AC
B-66-53	1	8/31/2023	6:15	7:00	0:45	0.75	55.06	53.83	1.23	Bare-84	Bare
B-66-53	1	8/10/2023	5:52	8:15	2:23	2.38	75.33	73.46	1.87	Bare-84	Bare
B-66-53	1	8/10/2023	5:52	9:40	3:48	3.80	81.45	79.12	2.33	Bare-84	Bare
B-66-53	1	8/10/2023	5:52	10:45	4:53	4.88	87.95	85.52	2.43	Bare-84	Bare
B-66-53	1	8/10/2023	5:52	12:10	6:18	6.30	95.44	93.00	2.44	Bare-84	Bare
B-66-53	1	8/10/2023	5:52	13:30	7:38	7.63	100.49	97.96	2.53	Bare-84	Bare
B-66-53	1	8/10/2023	5:52	14:30	8:38	8.63	100.77	99.01	1.76	Bare-84	Bare
B-66-53	1	8/10/2023	5:52	15:50	9:58	9.97	100.25	98.68	1.57	Bare-84	Bare

Bridge Defect Time Lapse

Bridge #	Defect #	Col. Date	Sunrise	Col. Time	Hrs after sunrise	Hrs decimal	Defect Temp. (F)	Control Temp. (F)	Temp. Difference (F) (Def-Cont)	Overlay Type	Overlay Type2
B-66-53	1	8/28/2023	6:11	17:20	11:09	11.15	88.11	87.17	0.94	Bare-84	Bare
B-66-53	1	8/28/2023	6:11	18:20	12:09	12.15	83.50	82.95	0.55	Bare-84	Bare
B-66-53	1	8/28/2023	6:11	19:45	13:34	13.57	83.59	83.13	0.46	Bare-84	Bare
B-66-53	1	8/28/2023	6:11	20:45	14:34	14.57	72.64	72.74	-0.1	Bare-84	Bare
B-66-53	1	8/28/2023	6:11	21:50	15:39	15.65	69.93	69.73	0.2	Bare-84	Bare
B-66-53	1	8/28/2023	6:11	23:00	16:49	16.82	67.85	67.65	0.2	Bare-84	Bare
B-66-53	1	8/31/2023	6:15	0:00	17:45	17.75	60.02	59.54	0.48	Bare-84	Bare
B-66-53	1	8/31/2023	6:15	1:00	18:45	18.75	58.28	57.65	0.63	Bare-84	Bare
B-66-53	1	8/31/2023	6:15	2:00	19:45	19.75	57.64	56.66	0.98	Bare-84	Bare
B-66-53	1	8/31/2023	6:15	3:00	20:45	20.75	56.95	55.92	1.03	Bare-84	Bare
B-66-53	1	8/31/2023	6:15	4:00	21:45	21.75	56.29	55.05	1.24	Bare-84	Bare
B-66-53	1	8/31/2023	6:15	5:00	22:45	22.75	55.37	54.20	1.17	Bare-84	Bare
B-66-53	1	8/31/2023	6:15	6:00	23:45	23.75	55.07	53.89	1.18	Bare-84	Bare
B-66-53	2	8/31/2023	6:15	7:00	0:45	0.75	54.00	53.67	0.33	Bare-84	Bare
B-66-53	2	8/10/2023	5:52	8:20	2:28	2.47	74.04	73.60	0.44	Bare-84	Bare
B-66-53	2	8/10/2023	5:52	9:40	3:48	3.80	80.18	79.05	1.13	Bare-84	Bare
B-66-53	2	8/10/2023	5:52	10:45	4:53	4.88	86.46	85.12	1.34	Bare-84	Bare
B-66-53	2	8/10/2023	5:52	12:10	6:18	6.30	92.83	91.64	1.19	Bare-84	Bare
B-66-53	2	8/10/2023	5:52	13:30	7:38	7.63	97.04	95.55	1.49	Bare-84	Bare
B-66-53	2	8/10/2023	5:52	14:30	8:38	8.63	97.87	96.69	1.18	Bare-84	Bare
B-66-53	2	8/10/2023	5:52	15:50	9:58	9.97	97.16	96.04	1.12	Bare-84	Bare
B-66-53	2	8/28/2023	6:11	17:20	11:09	11.15	85.09	84.84	0.25	Bare-84	Bare
B-66-53	2	8/28/2023	6:11	18:20	12:09	12.15	80.47	80.35	0.12	Bare-84	Bare
B-66-53	2	8/28/2023	6:11	19:45	13:34	13.57	73.08	73.09	-0.01	Bare-84	Bare
B-66-53	2	8/28/2023	6:11	20:45	14:34	14.57	70.05	70.17	-0.12	Bare-84	Bare
B-66-53	2	8/28/2023	6:11	21:50	15:39	15.65	68.01	68.00	0.01	Bare-84	Bare
B-66-53	2	8/28/2023	6:11	23:00	16:49	16.82	66.23	66.13	0.1	Bare-84	Bare
B-66-53	2	8/31/2023	6:15	0:00	17:45	17.75	58.49	58.62	-0.13	Bare-84	Bare
B-66-53	2	8/31/2023	6:15	1:00	18:45	18.75	56.92	56.92	0	Bare-84	Bare
B-66-53	2	8/31/2023	6:15	2:00	19:45	19.75	56.92	56.92	0	Bare-84	Bare
B-66-53	2	8/31/2023	6:15	3:00	20:45	20.75	55.67	55.47	0.2	Bare-84	Bare
B-66-53	2	8/31/2023	6:15	4:00	21:45	21.75	55.03	54.86	0.17	Bare-84	Bare
B-66-53	2	8/31/2023	6:15	5:00	22:45	22.75	54.27	54.03	0.24	Bare-84	Bare
B-66-53	2	8/31/2023	6:15	6:00	23:45	23.75	53.81	53.55	0.26	Bare-84	Bare
B-66-53	3	8/31/2023	6:15	7:00	0:45	0.75	53.40	52.84	0.56	Bare-84	Bare
B-66-53	3	8/10/2023	5:52	8:20	2:28	2.47	73.65	72.34	1.31	Bare-84	Bare
B-66-53	3	8/10/2023	5:52	9:40	3:48	3.80	79.82	77.96	1.86	Bare-84	Bare
B-66-53	3	8/10/2023	5:52	10:45	4:53	4.88	86.21	84.30	1.91	Bare-84	Bare
B-66-53	3	8/10/2023	5:52	12:10	6:18	6.30	93.22	91.43	1.79	Bare-84	Bare
B-66-53	3	8/10/2023	5:52	13:30	7:38	7.63	97.84	96.38	1.46	Bare-84	Bare
B-66-53	3	8/10/2023	5:52	14:30	8:38	8.63	98.79	97.77	1.02	Bare-84	Bare
B-66-53	3	8/10/2023	5:52	15:50	9:58	9.97	98.28	97.59	0.69	Bare-84	Bare
B-66-53	3	8/28/2023	6:11	17:20	11:09	11.15	86.69	86.77	-0.08	Bare-84	Bare

Bridge Defect Time Lapse

Bridge #	Defect #	Col. Date	Sunrise	Col. Time	Hrs after sunrise	Hrs decimal	Defect Temp. (F)	Control Temp. (F)	Temp. Difference (F) (Def-Cont)	Overlay Type	Overlay Type2
B-66-53	3	8/28/2023	6:11	18:20	12:09	12.15	81.88	82.05	-0.17	Bare-84	Bare
B-66-53	3	8/28/2023	6:11	19:45	13:34	13.57	74.17	74.82	-0.65	Bare-84	Bare
B-66-53	3	8/28/2023	6:11	20:45	14:34	14.57	70.98	71.47	-0.49	Bare-84	Bare
B-66-53	3	8/28/2023	6:11	21:50	15:39	15.65	68.60	69.10	-0.5	Bare-84	Bare
B-66-53	3	8/28/2023	6:11	23:00	16:49	16.82	66.62	66.47	0.15	Bare-84	Bare
B-66-53	3	8/31/2023	6:15	0:00	17:45	17.75	58.67	58.81	-0.14	Bare-84	Bare
B-66-53	3	8/31/2023	6:15	1:00	18:45	18.75	57.09	57.00	0.09	Bare-84	Bare
B-66-53	3	8/31/2023	6:15	2:00	19:45	19.75	57.09	57.00	0.09	Bare-84	Bare
B-66-53	3	8/31/2023	6:15	3:00	20:45	20.75	55.56	55.08	0.48	Bare-84	Bare
B-66-53	3	8/31/2023	6:15	4:00	21:45	21.75	54.70	54.23	0.47	Bare-84	Bare
B-66-53	3	8/31/2023	6:15	5:00	22:45	22.75	53.79	53.34	0.45	Bare-84	Bare
B-66-53	3	8/31/2023	6:15	6:00	23:45	23.75	53.32	52.85	0.47	Bare-84	Bare
B-67-122	1	9/14/2023	6:30	9:35	3:05	3.08	60.75	60.56	0.19	01 PCC / 71	PCC
B-67-122	1	9/14/2023	6:30	13:20	6:50	6.83	84.79	83.36	1.43	01 PCC / 71	PCC
B-67-122	1	9/14/2023	6:30	16:15	9:45	9.75	81.51	80.36	1.15	01 PCC / 71	PCC
B-67-122	1	9/14/2023	6:30	19:10	12:40	12.67	65.48	65.26	0.22	01 PCC / 71	PCC
B-67-122	2	9/14/2023	6:30	9:35	3:05	3.08	59.38	59.87	-0.49	01 PCC / 71	PCC
B-67-122	2	9/14/2023	6:30	13:20	6:50	6.83	85.11	83.91	1.2	01 PCC / 71	PCC
B-67-122	2	9/14/2023	6:30	16:15	9:45	9.75	82.97	81.30	1.67	01 PCC / 71	PCC
B-67-122	2	9/14/2023	6:30	19:10	12:40	12.67	66.74	65.89	0.85	01 PCC / 71	PCC
B-67-122	3	9/14/2023	6:30	9:30	3:00	3.00	59.04	58.74	0.30	01 PCC / 71	PCC
B-67-122	3	9/14/2023	6:30	13:20	6:50	6.83	84.43	81.43	3	01 PCC / 71	PCC
B-67-122	3	9/14/2023	6:30	16:15	9:45	9.75	82.21	78.95	3.26	01 PCC / 71	PCC
B-67-122	3	9/14/2023	6:30	19:10	12:40	12.67	65.66	64.01	1.65	01 PCC / 71	PCC
B-67-152	1	9/14/2023	6:30	9:55	3:25	3.42	65.31	63.92	1.39	04 PCC / 74	PCC
B-67-152	1	9/14/2023	6:30	14:35	8:05	8.08	101.68	98.16	3.52	04 PCC / 74	PCC
B-67-152	1	9/14/2023	6:30	19:25	12:55	12.92	65.30	63.95	1.35	04 PCC / 74	PCC
B-67-152	2	9/14/2023	6:30	9:55	3:25	3.42	63.53	62.54	0.99	04 PCC / 74	PCC
B-67-152	2	9/14/2023	6:30	14:35	8:05	8.08	99.62	98.16	1.46	04 PCC / 74	PCC
B-67-152	2	9/14/2023	6:30	19:25	12:55	12.92	61.86	61.67	0.19	04 PCC / 74	PCC
B-67-152	3	9/14/2023	6:30	9:55	3:25	3.42	61.89	60.98	0.91	04 PCC / 74	PCC
B-67-152	3	9/14/2023	6:30	14:35	8:05	8.08	100.51	98.19	2.32	04 PCC / 74	PCC
B-67-152	3	9/14/2023	6:30	19:25	12:55	12.92	61.48	61.74	-0.26	04 PCC / 74	PCC

Appendix C – Lifecycle Data Analysis Tables

Bare Deck First Inspection Threshold Data

ALL 2.0 Threshold						ALL 2.6 Threshold					Post 2020 2.0 Threshold				
Wearing Surface Age	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<2.6 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev
1	12	12	100	0.091667	0.215146	12	12	100	0.091667	0.215146	11	11	100	0.1	0.223607
2	11	10	90.90909	0.363636	0.727011	11	11	100	0.363636	0.727011	6	6	100	0	0
3	19	11	57.89474	1.068421	1.25612	19	19	100	1.068421	1.25612	3	3	100	0.1	0.173205
4	27	13	48.14815	1.403704	1.192116	27	27	100	1.403704	1.192116	4	4	100	0.05	0.1
5	36	18	50	1.547222	1.052205	36	36	100	1.547222	1.052205	4	4	100	0.425	0.330404
6	38	26	68.42105	1.384211	1.676954	38	35	92.10526	1.384211	1.676954	10	9	90	0.63	1.992235
7	62	47	75.80645	0.862903	1.026091	62	62	100	0.862903	1.026091	11	11	100	0.163636	0.269343
8	53	44	83.01887	0.84717	1.904913	53	51	96.22642	0.84717	1.904913	10	10	100	0.29	0.517365
9	47	39	82.97872	0.685106	0.988626	47	47	100	0.685106	0.988626	2	2	100	0.25	0.070711
10	159	151	94.96855	0.358176	1.083198	159	157	98.74214	0.358176	1.083198	6	6	100	0.5	0.669328
11	137	136	99.27007	0.242336	0.485294	137	137	100	0.242336	0.485294	20	20	100	0.33	0.631706
12	98	91	92.85714	0.69949	1.150022	98	95	96.93878	0.69949	1.150022	34	34	100	0.452941	0.596574
13	105	102	97.14286	0.322381	0.555479	105	104	99.04762	0.322381	0.555479	31	29	93.54839	0.525806	0.683114
14	144	133	92.36111	0.573889	1.058285	144	138	95.83333	0.573889	1.058285	34	34	100	0.202941	0.358858
15	196	187	95.40816	0.701939	1.507472	196	190	96.93878	0.701939	1.507472	78	74	94.87179	0.94359	1.048758
16	198	172	86.86869	1.00399	1.917777	198	181	91.41414	1.00399	1.917777	91	82	90.10989	0.882418	1.21194
17	131	114	87.0229	0.951908	1.103428	131	121	92.36641	0.951908	1.103428	63	57	90.47619	0.930159	0.932329
18	185	159	85.94595	0.966486	1.281997	185	167	90.27027	0.966486	1.281997	90	78	86.66667	0.991111	1.26949
19	192	170	88.54167	0.835417	1.421505	192	177	92.1875	0.835417	1.421505	92	82	89.13043	0.68913	0.946185
20	167	149	89.22156	0.805689	1.030096	167	155	92.81437	0.805689	1.030096	69	59	85.50725	0.953623	1.175057
21	174	143	82.18391	1.159483	1.379404	174	160	91.95402	1.159483	1.379404	69	62	89.85507	1.052174	1.5029
22	163	131	80.3681	1.389571	2.152779	163	141	86.50307	1.389571	2.152779	64	53	82.8125	1.123438	1.249983
23	176	135	76.70455	1.828409	2.857944	176	145	82.38636	1.828409	2.857944	94	80	85.10638	0.98617	1.013734
24	227	183	80.61674	1.241189	1.847136	227	196	86.34361	1.241189	1.847136	91	79	86.81319	0.936264	1.336539
25	163	105	64.41718	2.550307	3.207748	163	118	72.39264	2.550307	3.207748	60	50	83.33333	1.226667	1.422205
26	120	85	70.83333	2.185833	3.563619	120	94	78.33333	2.185833	3.563619	54	44	81.48148	1.47963	1.623923
27	168	86	51.19048	3.083333	4.198624	168	116	69.04762	3.083333	4.198624	85	60	70.58824	1.58	1.427602
28	130	93	71.53846	1.929462	3.641349	130	105	80.76923	1.929462	3.641349	85	63	74.11765	1.497647	1.381078
29	127	83	65.35433	2.475984	3.887964	127	89	70.07874	2.475984	3.887964	81	51	62.96296	2.14321	2.699164
30	162	117	72.22222	3.11821	9.07972	162	121	74.69136	3.11821	9.07972	86	64	74.4186	2.410465	6.601391
31	123	82	66.66667	2.195935	3.927121	123	90	73.17073	2.195935	3.927121	81	57	70.37037	1.693827	1.80051
32	102	45	44.11765	3.920392	5.400542	102	54	52.94118	3.920392	5.400542	77	36	46.75325	3.081818	3.530496
33	111	70	63.06306	3.522523	6.136699	111	77	69.36937	3.522523	6.136699	83	62	74.6988	2.16747	3.146741
34	89	50	56.17978	3.043258	4.60415	89	55	61.79775	3.043258	4.60415	60	33	55	2.545	3.03937
35	59	26	44.0678	5.155085	8.349591	59	31	52.54237	5.155085	8.349591	31	14	45.16129	4.606452	6.728345
36	45	24	53.33333	3.543333	4.491742	45	27	60	3.543333	4.491742	36	20	55.55556	3.525	4.74368
37	47	21	44.68085	4.976596	8.820387	47	22	46.80851	4.976596	8.820387	32	16	50	5.625	10.30553
38	44	22	50	6.325	9.267758	44	24	54.54545	6.325	9.267758	31	16	51.6129	5.635484	8.296367
39	20	9	45	3.59	4.258354	20	10	50	3.59	4.258354	14	8	57.14286	2.685714	3.342928
40	25	14	56	4.656	6.993097	25	14	56	4.656	6.993097	20	12	60	4.625	7.636055
41	15	3	20	6.26	6.07992	15	3	20	6.26	6.07992	8	1	12.5	7.0625	6.865636
42	17	6	35.29412	4.988235	6.551897	17	9	52.94118	4.988235	6.551897	15	6	40	4.286667	6.441147
43	16	4	25	4.96875	4.710657	16	4	25	4.96875	4.710657	13	3	23.07692	5.192308	4.940388
44	10	4	40	6.15	6.663708	10	4	40	6.15	6.663708	8	4	50	5.1875	6.68248
45	11	2	18.18182	5.35	5.458434	11	4	36.36364	5.35	5.458434	5	1	20	7.84	7.500533

Concrete Overlay Deck First Inspection Threshold Data

ALL 2.0 Threshold						ALL 2.6 Threshold					Post 2020 2.0 Threshold				
Wearing Surface Age	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<2.6 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev
1	27	23	85.18519	0.703704	0.919231	27	27	100	0.703704	0.919231	5	5	100	0.02	0.044721
2	41	34	82.92683	0.656098	1.064671	41	39	95.12195	0.656098	1.064671	5	5	100	0.32	0.460435
3	54	45	83.33333	0.776852	0.947326	54	53	98.14815	0.776852	0.947326	5	5	100	0.28	0.626099
4	83	76	91.56627	0.722892	0.765781	83	81	97.59036	0.722892	0.765781	15	13	86.66667	0.693333	0.87869
5	98	82	83.67347	1.547959	3.253221	98	89	90.81633	1.547959	3.253221	34	32	94.11765	0.723529	0.802669
6	67	52	77.61194	1.268657	1.966708	67	58	86.56716	1.268657	1.966708	17	13	76.47059	1.517647	2.709759
7	97	77	79.38144	1.374227	2.252881	97	91	93.81443	1.374227	2.252881	28	26	92.85714	1.260714	3.403303
8	150	99	66	2.556667	5.740758	150	121	80.66667	2.556667	5.740758	19	17	89.47368	0.947368	1.034069
9	105	54	51.42857	3.311905	4.37564	105	74	70.47619	3.311905	4.37564	13	10	76.92308	1.730769	1.974582
10	85	40	47.05882	5.710588	11.21655	85	52	61.17647	5.710588	11.21655	28	23	82.14286	1.367857	1.133351
11	84	44	52.38095	3.578571	5.470624	84	56	66.66667	3.578571	5.470624	32	18	56.25	2.7125	2.591518
12	104	45	43.26923	7.752788	11.72742	104	56	53.84615	7.752788	11.72742	41	27	65.85366	2.312195	3.377069
13	117	45	38.46154	6.510256	9.687896	117	58	49.57265	6.510256	9.687896	54	32	59.25926	2.22037	2.201833
14	78	26	33.33333	8.015641	11.07168	78	34	43.58974	8.015641	11.07168	33	19	57.57576	3.945455	7.536623
15	104	27	25.96154	8.3375	11.96523	104	36	34.61538	8.3375	11.96523	19	9	47.36842	2.842105	2.59793
16	78	17	21.79487	7.936923	9.836398	78	26	33.33333	7.936923	9.836398	37	11	29.72973	4.181081	3.65778
17	72	9	12.5	13.18694	13.00672	72	13	18.05556	13.18694	13.00672	26	4	15.38462	14.57692	15.4947
18	75	15	20	12.64533	13.21508	75	19	25.33333	12.64533	13.21508	28	10	35.71429	11.26786	14.88298
19	47	4	8.510638	17.13936	18.62274	47	5	10.6383	17.13936	18.62274	23	4	17.3913	13.73043	19.09789
20	47	12	25.53191	12.94149	18.61632	47	17	36.17021	12.94149	18.61632	15	7	46.66667	10.39333	17.17117
21	36	3	8.333333	20.55556	16.04169	36	5	13.88889	20.55556	16.04169	10	2	20	17.23	13.42088
22	50	12	24	14.801	16.92476	50	13	26	14.801	16.92476	6	0	0	26.86667	12.58915
23	23	1	4.347826	25.12783	17.63637	23	1	4.347826	25.12783	17.63637	5	0	0	32.12	27.04925
24	31	4	12.90323	16.70355	17.65902	31	4	12.90323	16.70355	17.65902	9	0	0	18.27778	15.067
25	31	2	6.451613	20.12742	20.22297	31	2	6.451613	20.12742	20.22297	15	0	0	28.04667	25.53996
26	28	5	17.85714	13.15357	16.36857	28	5	17.85714	13.15357	16.36857	21	5	23.80952	11.80952	15.7777
27	31	5	16.12903	13.47419	16.00296	31	7	22.58065	13.47419	16.00296	19	3	15.78947	11.67368	11.23743
28	37	10	27.02703	12.83243	15.89056	37	12	32.43243	12.83243	15.89056	32	10	31.25	12.71563	16.78765
29	41	1	2.439024	17.64512	14.59413	41	3	7.317073	17.64512	14.59413	32	1	3.125	17.91875	15.80738
30	39	13	33.33333	8.44359	10.27971	39	15	38.46154	8.44359	10.27971	23	6	26.08696	11.03478	11.88018
31	25	1	4	11.576	9.12927	25	3	12	11.576	9.12927	24	1	4.166667	11.5375	9.323547
32	22	2	9.090909	11.99545	12.08448	22	4	18.18182	11.99545	12.08448	21	2	9.52381	12.40476	12.22565
33	19	5	26.31579	9.647368	12.55682	19	5	26.31579	9.647368	12.55682	17	5	29.41176	10.12941	13.22875
34	19	4	21.05263	10.17895	11.06815	19	4	21.05263	10.17895	11.06815	17	2	11.76471	11.31765	11.16682
35	11	1	9.090909	7.618182	7.610627	11	2	18.18182	7.618182	7.610627	10	1	10	7.53	8.016379
36	10	2	20	8.04	7.936722	10	2	20	8.04	7.936722	10	2	20	8.04	7.936722

HMA Overlay Deck First Inspection Threshold Data

ALL 2.0 Threshold						ALL 2.6 Threshold					Post 2020 2.0 Threshold				
Wearing Surface Age	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<2.6 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev
1	4	0	0	4.475	1.43846	4	1	25	4.475	1.43846	0	0	NA	NA	NA
2	15	5	33.33333	3.9	5.155441	15	9	60	3.9	5.155441	1	1	100	0	NA
3	12	6	50	2.591667	2.775693	12	8	66.66667	2.591667	2.775693	5	1	20	3.82	2.640455
4	40	29	72.5	2.595	5.307237	40	32	80	2.595	5.307237	3	1	33.33333	2.966667	1.814754
5	46	32	69.56522	3.98913	7.976639	46	34	73.91304	3.98913	7.976639	14	10	71.42857	6.7	12.77768
6	31	15	48.3871	6.279032	9.676421	31	19	61.29032	6.279032	9.676421	2	1	50	5	5.939697
7	15	6	40	6.726667	9.419165	15	7	46.66667	6.726667	9.419165	8	4	50	6.55	11.02167
8	48	23	47.91667	3.860417	4.740668	48	31	64.58333	3.860417	4.740668	5	1	20	6.86	5.718654
9	26	13	50	5.480769	7.586726	26	16	61.53846	5.480769	7.586726	4	3	75	4.675	7.584798
10	26	5	19.23077	7.434615	5.366261	26	7	26.92308	7.434615	5.366261	4	0	0	9.7	5.160103
11	34	13	38.23529	6.536765	8.141972	34	15	44.11765	6.536765	8.141972	3	1	33.33333	14	19.79874
12	63	18	28.57143	7.165079	7.806726	63	25	39.68254	7.165079	7.806726	2	1	50	2.15	1.626346
13	45	11	24.44444	7.571111	8.149097	45	16	35.55556	7.571111	8.149097	1	1	100	0	NA
14	33	6	18.18182	10.30273	14.18151	33	6	18.18182	10.30273	14.18151	0	0	NA	NA	NA
15	14	0	0	13.00714	6.573193	14	1	7.142857	13.00714	6.573193	0	0	NA	NA	NA
16	48	5	10.41667	8.102083	5.730341	48	6	12.5	8.102083	5.730341	2	0	0	5	1.414214
17	10	4	40	7.75	9.082737	10	5	50	7.75	9.082737	3	1	33.33333	10.63333	14.35142
18	25	10	40	10.376	11.97105	25	10	40	10.376	11.97105	2	1	50	25.2	33.7997
19	18	3	16.66667	14.55	9.755737	18	3	16.66667	14.55	9.755737	1	1	100	1	NA
20	9	1	11.11111	9.338889	8.714671	9	1	11.11111	9.338889	8.714671	1	0	0	3.9	NA
21	7	0	0	13.02857	11.7629	7	0	0	13.02857	11.7629	3	0	0	19.36667	16.67103
22	22	8	36.36364	7.768182	7.456757	22	8	36.36364	7.768182	7.456757	7	0	0	10.85714	8.054576
23	12	2	16.66667	16.00833	20.48842	12	3	25	16.00833	20.48842	10	2	20	14.42	20.36532
24	13	2	15.38462	13.23077	10.12525	13	2	15.38462	13.23077	10.12525	13	2	15.38462	13.23077	10.12525

PMA Overlay Deck First Inspection Threshold Data

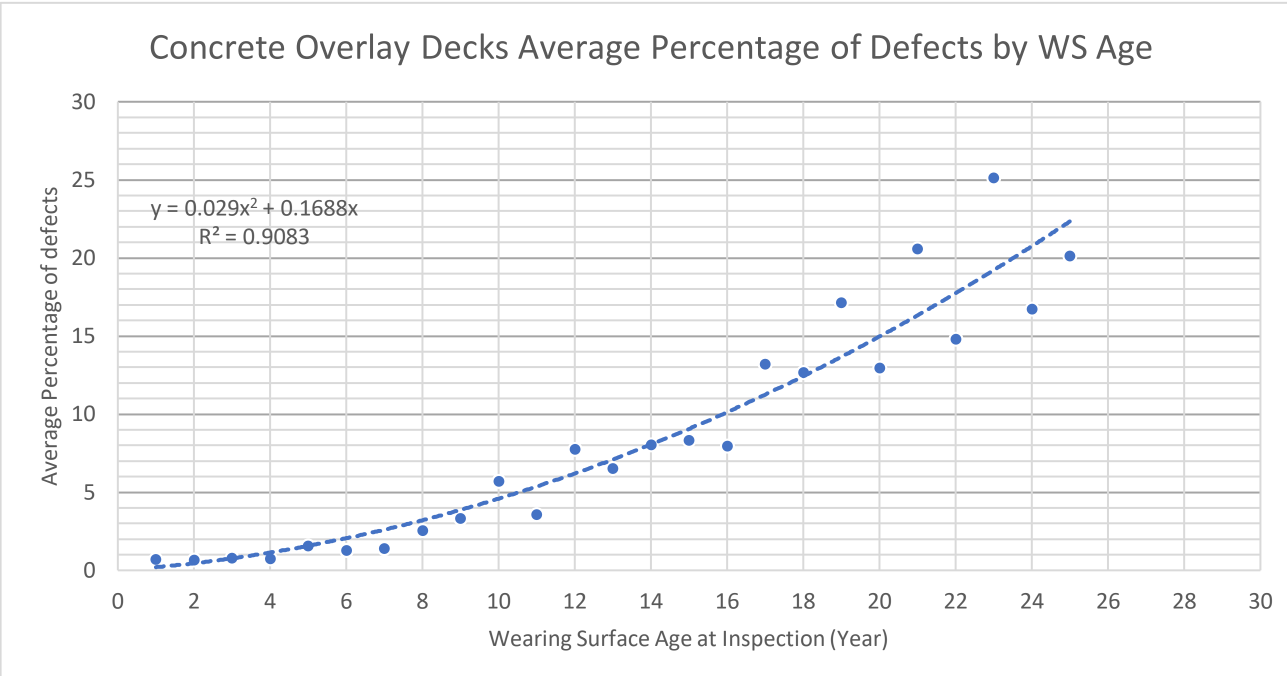
ALL 2.0 Threshold						ALL 2.6 Threshold					Post 2020 2.0 Threshold				
Wearing Surface Age	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<2.6 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev
1	8	5	62.5	4.4875	5.240076	8	5	62.5	4.4875	5.240076	1	1	100	2	NA
2	5	3	60	14.9	29.46693	5	3	60	14.9	29.46693	0	0	NA	NA	NA
3	6	5	83.33333	1.083333	0.801041	6	6	100	1.083333	0.801041	0	0	NA	NA	NA
4	11	9	81.81818	2.472727	5.250351	11	9	81.81818	2.472727	5.250351	3	2	66.666667	2.566667	2.730079
5	32	27	84.375	2.440625	5.919833	32	27	84.375	2.440625	5.919833	4	4	100	0.625	0.478714
6	10	8	80	2.29	3.070812	10	8	80	2.29	3.070812	1	1	100	0.9	NA
7	24	21	87.5	1.15	0.804336	24	23	95.83333	1.15	0.804336	19	18	94.736842	1.031579	0.778212
8	5	3	60	1.14	1.254193	5	5	100	1.14	1.254193	1	1	100	0	NA
9	16	6	37.5	5.4125	6.047245	16	10	62.5	5.4125	6.047245	1	1	100	0.1	NA
10	10	5	50	2.75	3.251068	10	6	60	2.75	3.251068	5	3	60	3.2	4.658326
11	24	3	12.5	6.9375	7.057762	24	4	16.66667	6.9375	7.057762	5	0	0	5.48	1.956272
12	12	2	16.66667	5.308333	3.511658	12	3	25	5.308333	3.511658	5	0	0	5.9	1.442221
13	12	2	16.66667	10.85417	10.84233	12	2	16.66667	10.85417	10.84233	4	0	0	6	1.968079
14	22	3	13.63636	13.55	12.73334	22	4	18.18182	13.55	12.73334	2	1	50	19.4	26.44579
15	9	2	22.22222	10.43333	13.10134	9	3	33.33333	10.43333	13.10134	6	1	16.666667	14.33333	14.789
16	8	3	37.5	4.29375	3.993248	8	4	50	4.29375	3.993248	2	2	100	0	0
17	6	1	16.66667	11.45	5.848333	6	1	16.66667	11.45	5.848333	1	0	0	12.5	NA
18	3	1	33.33333	13.63333	14.37231	3	1	33.33333	13.63333	14.37231	2	1	50	15.85	19.58686
19	4	0	0	20.35	23.25088	4	1	25	20.35	23.25088	4	0	0	20.35	23.25088
20	2	0	0	5.05	3.889087	2	1	50	5.05	3.889087	2	0	0	5.05	3.889087
21	0	0	#DIV/0!	#DIV/0!	#DIV/0!	0	0	NA	NA	NA	0	0	NA	NA	NA
22	2	0	0	5.7	4.101219	2	0	0	5.7	4.101219	2	0	0	5.7	4.101219

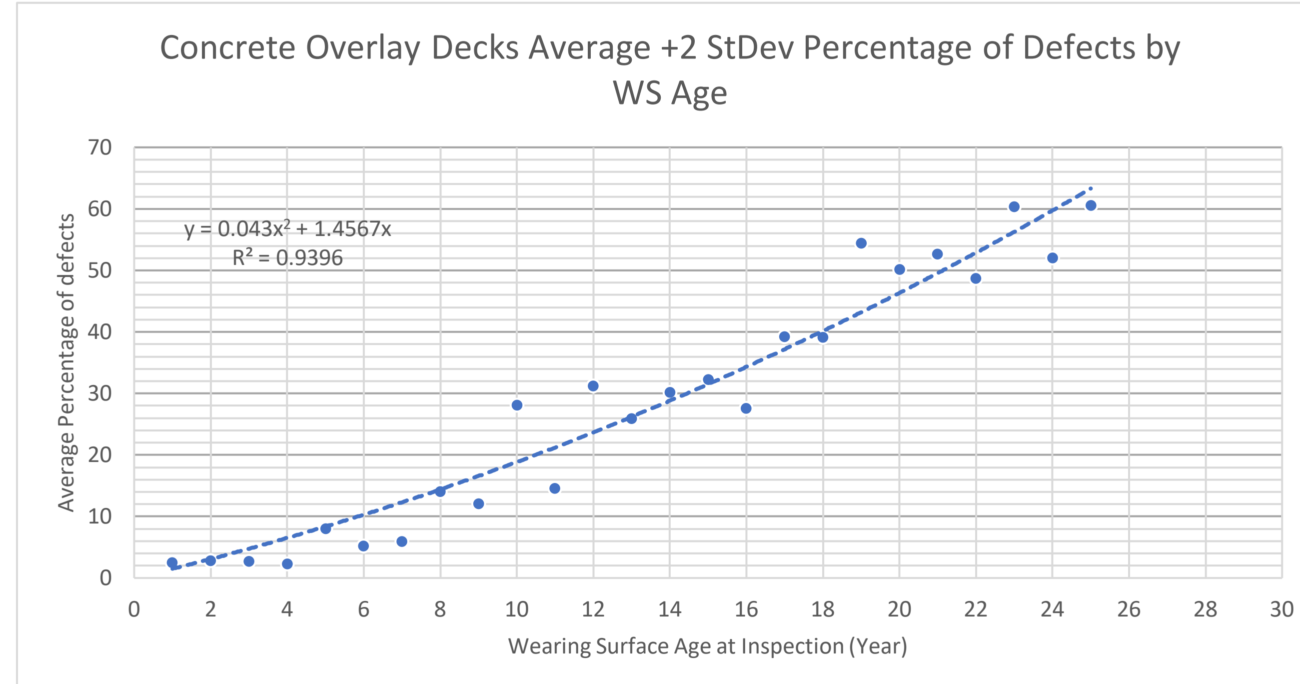
TPO Deck First Inspection Threshold Data

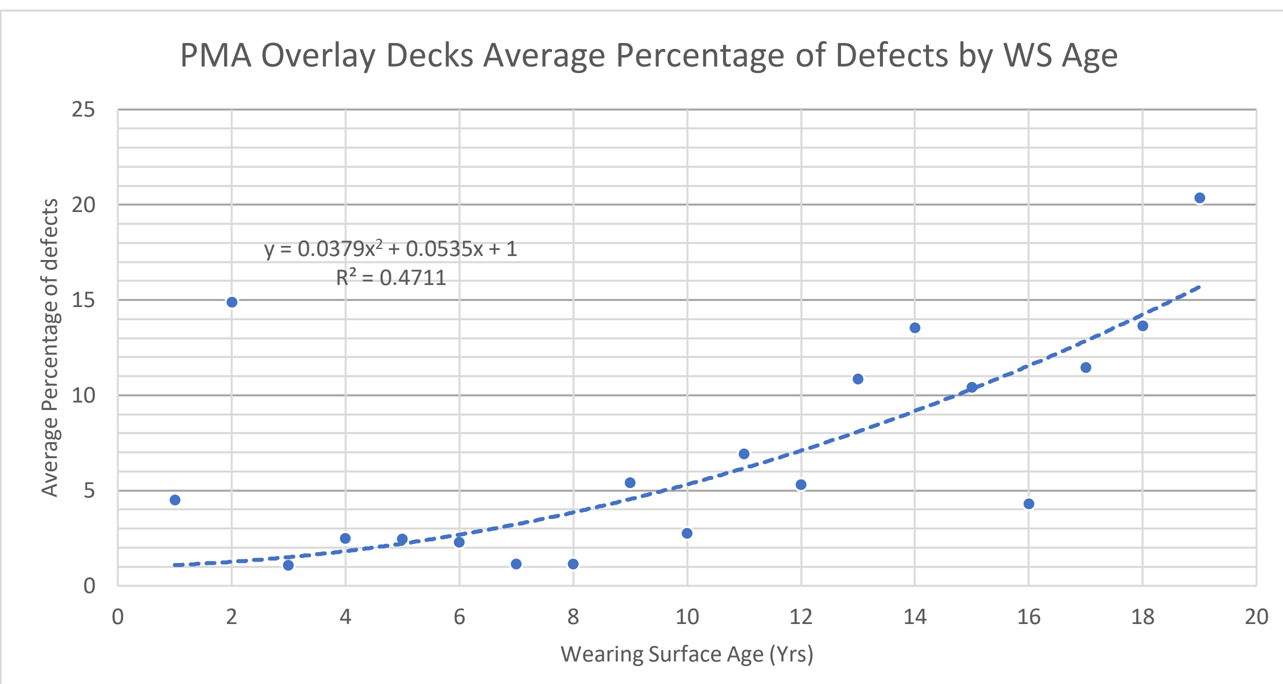
ALL 2.0 Threshold						ALL 2.6 Threshold					Post 2020 2.0 Threshold				
Wearing Surface Age	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<2.6 Inspec Cnt	% Inspec	Average	stDev	Inspec Cnt	<=2 Inspec Cnt	% Inspec	Average	stDev
1	50	43	86	0.546	1.426171	50	47	94	0.546	1.426171	30	28	93.33333	0.253333	0.999218
2	64	58	90.625	0.401563	0.780617	64	64	100	0.401563	0.780617	45	44	97.77778	0.248889	0.492499
3	42	34	80.95238	0.928571	2.27717	42	40	95.2381	0.928571	2.27717	32	31	96.875	0.296875	0.9025
4	65	59	90.76923	0.52	1.422058	65	60	92.30769	0.52	1.422058	50	45	90	0.564	1.562541
5	106	78	73.58491	2.216038	6.718874	106	86	81.13208	2.216038	6.718874	103	75	72.81553	2.270874	6.808611
6	42	38	90.47619	1.45	3.796292	42	38	90.47619	1.45	3.796292	27	25	92.59259	1.488889	4.088665
7	46	44	95.65217	0.419565	0.696218	46	45	97.82609	0.419565	0.696218	37	36	97.2973	0.451351	0.678488
8	64	60	93.75	0.509375	1.495466	64	60	93.75	0.509375	1.495466	32	29	90.625	0.909375	1.95751
9	23	22	95.65217	0.791304	1.974131	23	22	95.65217	0.791304	1.974131	20	19	95	0.91	2.097342
10	47	37	78.7234	2.525532	6.913046	47	39	82.97872	2.525532	6.913046	36	26	72.22222	3.269444	7.768648
11	31	27	87.09677	1.632258	4.529267	31	27	87.09677	1.632258	4.529267	28	24	85.71429	1.807143	4.739818
12	35	24	68.57143	2.882857	5.853028	35	26	74.28571	2.882857	5.853028	29	19	65.51724	3.393103	6.31189
13	19	15	78.94737	5.057895	11.26288	19	15	78.94737	5.057895	11.26288	19	15	78.94737	5.057895	11.26288
14	11	10	90.90909	0.427273	0.691507	11	11	100	0.427273	0.691507	7	6	85.71429	0.642857	0.801784
15	3	2	66.66667	0.8	1.385641	3	3	100	0.8	1.385641	0	0	NA	NA	NA
16	1	1	100	0	NA	1	1	100	0	NA	0	0	NA	NA	NA
17	2	0	0	6.5	0.424264	2	0	0	6.5	0.424264	2	0	0	6.5	0.424264
18	8	4	50	4.4875	5.414382	8	5	62.5	4.4875	5.414382	7	3	42.85714	5.128571	5.510509
19	4	3	75	1.65	3.3	4	3	75	1.65	3.3	1	0	0	6.6	NA

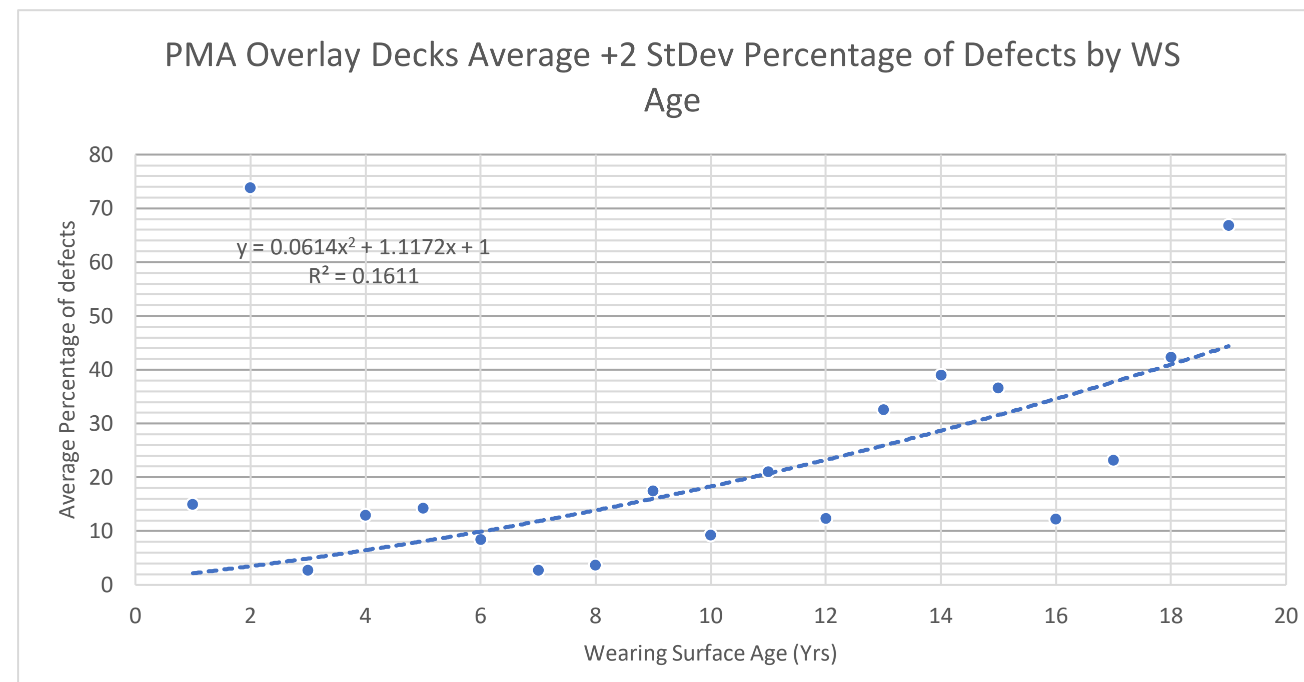
Appendix D – Inspection Interval Graphs

Inspection Interval Graphs

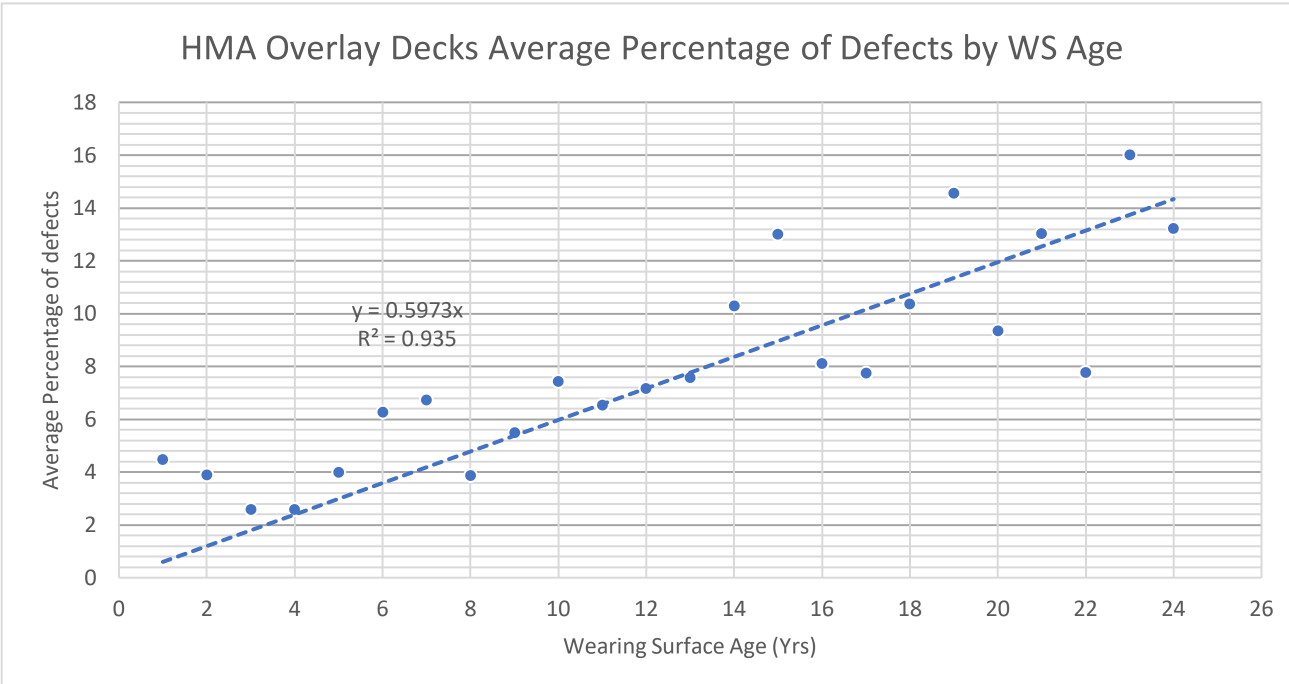


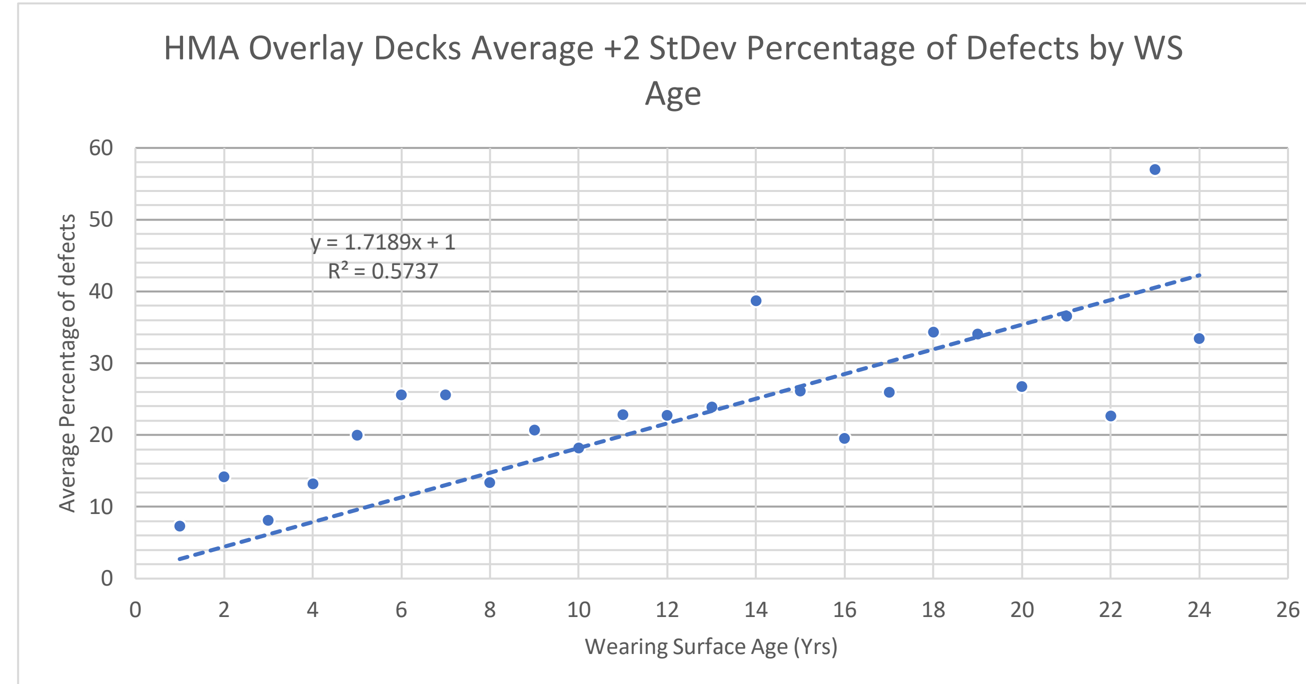


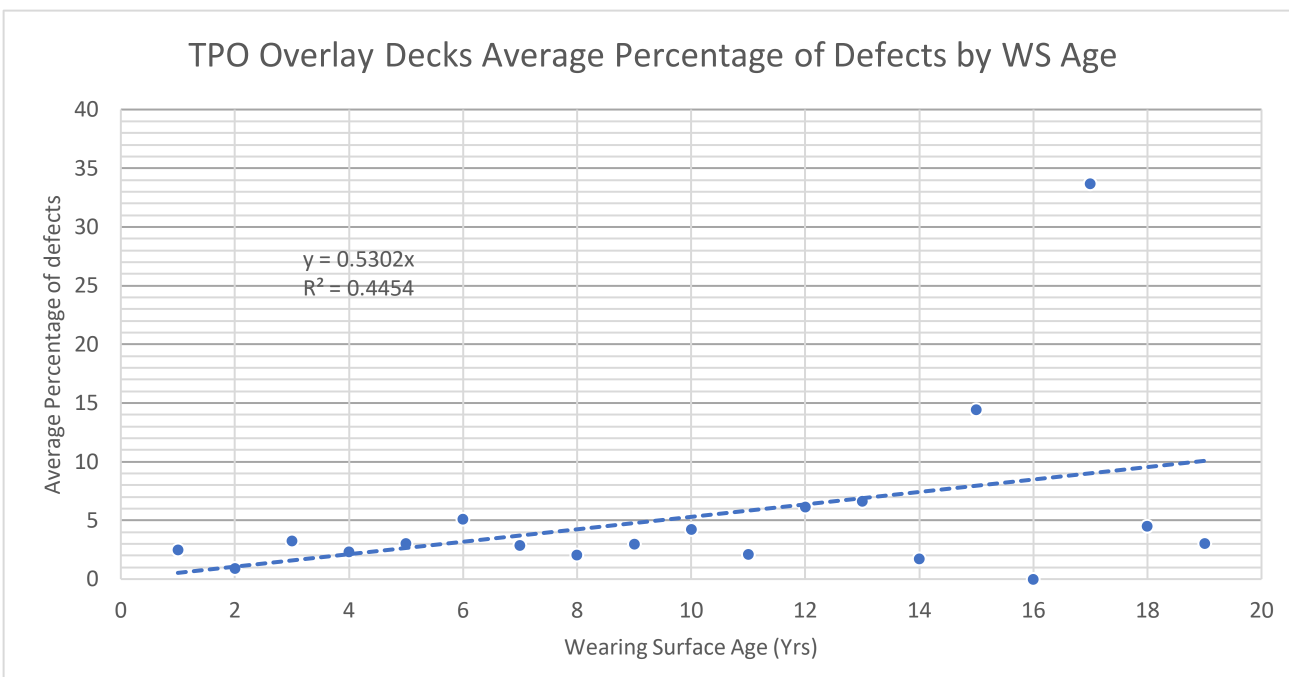


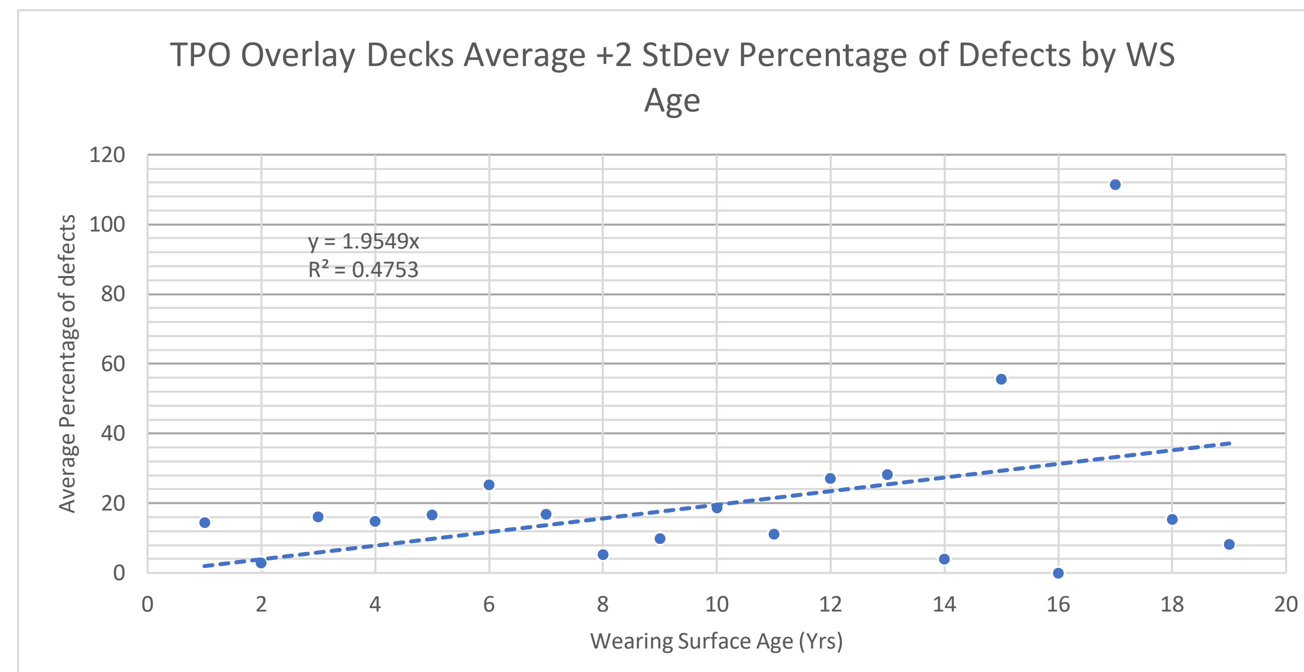


Inspection Interval Graphs









Inspection Interval Comparison Table

Wearing Surface	IRT Start Year	Life Span Year	Rehabilitation Threshold	Average % at Life Span	Average Age at Threshold	2SD Age at Threshold	Average %/Year	2SD %/YR	Recommended Inspection Interval
Bare	18	40	15%	5% at Year 40	73 (extrapolated)	36	0.2%	0.5%	7
PCC	5	15 to 20	20%	15% at Year 20	23	10	1%	2.4%	5
PMA	5	10 to 15	20%	10% at Year 15	22 (extrapolated)	11	1%	2%	5
HMA	2	3 to 15	20%	9% at Year 15	33 (extrapolated)	11	0.6%	1.7%	5
TPO	2	7 to 15	20%	8% at Year 15	37 (extrapolated)	10	0.5%	2%	5

Appendix E – Rehabilitation Analysis Table

The Percent Difference of Type 1 Rehab and IR Defects as a Percentage of Deck Area						
All Inspection Levels (0, 1, 2 and 3)						
Year	count	min	max	ave	stdev	90th%
1	70	-3.3%	12.1%	2.4%	3.8%	8.8%
2	20	-4.4%	15.4%	2.1%	4.9%	12.5%
3	12	-0.9%	32.8%	8.0%	10.1%	28.6%
By Wearing Surface (WS)						
WS	count	min	max	ave	stdev	90th%
Bare	42	-2.7%	18.7%	1.4%	4.0%	6.2%
PCC	25	-3.3%	32.8%	4.4%	7.8%	14.7%
PMA	17	0.1%	12.1%	6.1%	4.3%	11.2%
HMA	16	-4.4%	8.8%	1.9%	3.2%	7.8%
TPO	2	0.7%	2.1%	1.4%	1.0%	NA
Total	102	-4.4%	32.8%	3.0%	5.4%	9.5%

Level 2 and 3 Inspections						
Year	count	min	max	ave	stdev	90th%
1	52	-3.3%	12.1%	2.5%	3.9%	9.4%
2	13	-1.2%	15.4%	1.7%	4.4%	11.4%
3	2	1.0%	18.7%	9.8%	12.6%	NA
By Wearing Surface (WS)						
WS	count	min	max	ave	stdev	90th%
Bare	25	-2.7%	18.7%	0.9%	4.1%	3.8%
PCC	13	-3.3%	15.4%	1.8%	4.8%	11.3%
PMA	17	0.1%	12.1%	6.1%	4.3%	11.2%
HMA	12	-2.8%	4.1%	1.6%	1.8%	3.9%
TPO	0	0.0%	0.0%	0.0%	0.0%	0.0%
Total	67	-3.3%	18.7%	2.5%	4.4%	9.5%

IRT Defect and Type 1 Rehabilitation Quantities Comparison

BRIDGE ID	Construction Year	Description	Awarded Qty	Current Paid Qty	Inspection Year	Method	Measured by	Level	Asphalt Patching	Concrete Patching	Debonding	Delmanination	% Deck w/ defects
B010017	2021	Preparation Decks Type 1	34	22.85	2020	IR	AECOM	1 - values only	0.3	3.7	0	1.2	5.2
B030015	2022	Preparation Decks Type 1	85	48.72	2021	IR	Infrasense	2 - plan sheet	0	2.1	0	7.2	9.3
B030017	2022	Preparation Decks Type 1	30	3.8	2021	IR	Infrasense	2 - plan sheet	0	0	0	1	1
B030021	2022	Preparation Decks Type 1	100	158.27	2021	IR	Infrasense	2 - plan sheet	0	6.2	0	4.1	10.3
B030038	2022	Preparation Decks Type 1	175	209.82	2020	IR	Infrasense	0 - aerial	0	0	0	3	3
B050202	2020	Preparation Decks Type 1	1	11.54	2019	IR	AECOM	3 - deck preparation	0	0	30.5	0	0
B050203	2020	Preparation Decks Type 1	28	12.9	2019	IR	AECOM	3 - deck preparation	0	0	29.6	0.8	0.8
B050209	2020	Preparation Decks Type 1	53	88.88	2019	IR	AECOM	3 - deck preparation	0.2	0	1.2	3.2	3.4
B050210	2020	Preparation Decks Type 1	64	66.49	2019	IR	AECOM	3 - deck preparation	0	0	0	5.5	5.5
B050211	2020	Preparation Decks Type 1	6	27.95	2019	IR	AECOM	3 - deck preparation	0	0	1.9	0.5	0.5
B050212	2020	Preparation Decks Type 1	119	151.28	2019	IR	AECOM	3 - deck preparation	0.2	0	0	6.8	7
B050214	2020	Preparation Decks Type 1	92	103.24	2019	IR	AECOM	3 - deck preparation	0	0	7.4	8.9	8.9
B050216	2020	Preparation Decks Type 1	347	316.31	2019	IR	AECOM	3 - deck preparation	0.9	0	3.3	25.7	26.6
B050219	2020	Preparation Decks Type 1	43	20.57	2019	IR	AECOM	3 - deck preparation	0	0	6.9	2.8	2.8
B050220	2020	Preparation Decks Type 1	51	69.48	2019	IR	AECOM	3 - deck preparation	0.6	0	1.6	1.8	2.4
B050221	2020	Preparation Decks Type 1	170	176.28	2019	IR	AECOM	3 - deck preparation	7	0	0	4.2	11.2
B050222	2020	Preparation Decks Type 1	24	26.6	2019	IR	AECOM	3 - deck preparation	0.1	0	0	1.8	1.9
B050223	2020	Preparation Decks Type 1	105	111.68	2019	IR	AECOM	3 - deck preparation	0	0	0	11	11
B050224	2020	Preparation Decks Type 1	403	443.23	2019	IR	AECOM	3 - deck preparation	4.3	0	0.7	6.8	11.1
B050239	2021	Preparation Decks Type 1	400	514	2020	IR	AECOM	2 - plan sheet	0	0	0	26.2	26.2
B050240	2016	Preparation Decks Type 1	2	7	2015	IR	AECOM	2 - plan sheet	0	0	1.5	0.1	0.1
B050241	2016	Preparation Decks Type 1	27	34.25	2015	IR	AECOM	2 - plan sheet	0	0	2.5	1.7	1.7
B050242	2016	Preparation Decks Type 1	193	86.2	2015	IR	AECOM	2 - plan sheet	0	0	0	6.1	6.1
B050243	2016	Preparation Decks Type 1	13	14	2015	IR	Infrasense	2 - plan sheet	0	0	0	4.1	4.1
B050243	2016	Preparation Decks Type 1	13	14	2015	IR	AECOM	3 - deck preparation	0	0	9	0.4	0.4
B050244	2016	Preparation Decks Type 1	18	16	2015	IR	AECOM	2 - plan sheet	0	0	1.7	0.5	0.5
B050245	2016	Preparation Decks Type 1	4	12	2015	IR	AECOM	2 - plan sheet	0	0	0	0.2	0.2
B050246	2016	Preparation Decks Type 1	11	16	2015	IR	AECOM	2 - plan sheet	0.7	0	0	0.2	0.9
B050254	2016	Preparation Decks Type 1	1	1	2015	IR	Infrasense	2 - plan sheet	0	0	0	2	2
B050254	2016	Preparation Decks Type 1	1	1	2015	IR	AECOM	2 - plan sheet	0	0	0	0	0
B070006	2022	Preparation Decks Type 1	60	12.4	2021	IR	Infrasense	2 - plan sheet	0	1.3	0	2.4	3.7
B090031	2022	Preparation Decks Type 1	1.7	1.7	2021	IR	Infrasense	2 - plan sheet	0	0	0	3	3
B100178	2021	Preparation Decks Type 1	76	57	2020	IR	Infrasense	0 - aerial	0	0	0	4	4
B110001	2017	Preparation Decks Type 1	3	7.3	2015	IR	AECOM	2 - plan sheet	0	0	0	0.6	0.6
B110039	2016	Preparation Decks Type 1	21	10.66	2014	IR	AECOM	2 - plan sheet	0	0	0	1.6	1.6
B110104	2017	Preparation Decks Type 1	142	110	2015	IR	AECOM	3 - deck preparation	0	0.8	0	4.2	5
B120006	2019	Preparation Decks Type 1	21	32	2016	IR	Infrasense	1 - values only	0	0	0	1	1
B120029	2020	Preparation Decks Type 1	298	380.39	2017	IR	Infrasense	1 - values only	0	0	0	7.3	7.3
B120030	2020	Preparation Decks Type 1	774	930.66	2017	IR	Infrasense	1 - values only	0	0	0	17.7	17.7
B120035	2017	Preparation Decks Type 1	16	118.7	2014	IR	Infrasense	1 - values only	0	0	0	2.1	2.1
B130228	2017	Preparation Decks Type 1	15	38	2016	IR	AECOM	2 - plan sheet	0	0	0	0.6	0.6
B130303	2022	Preparation Decks Type 1	66	129	2020	IR	Infrasense	0 - aerial	0	1	0	10	11
B130337	2017	Preparation Decks Type 1	200	221.2	2014	IR	AECOM	2 - plan sheet	0	0	0	13	13
B200023	2018	Preparation Decks Type 1	358	226.3	2017	IR	AECOM	1 - values only	0	0	0	25.8	25.8
B220617	2021	Preparation Decks Type 1	33	76.71	2020	IR	Infrasense	0 - aerial	0	1	0	10	11
B290021	2022	Preparation Decks Type 1	2	6.52	2021	IR	AECOM	2 - plan sheet	0	0	0	1.7	1.7

IRT Defect and Type 1 Rehabilitation Quantities Comparison

RoadwayArea	DeckSurface	Pre Ins WS	Pre Ins WS YR	Defect (SY)	Diff (SY)	DIF (SF)	DIF - Def % of RDWY (SF)	YRS After Inspection	YEAR_BUILT	DIF Award v Paid sy	dif % of RW
1778	EPOXY OVERLAY	Bare	1993	10.27288889	12.57711111	113.194	0.063663667	1	1993	-11.15	-0.05643982
5888	LOW SLUMP CONCRETE	PCC	1989	60.84266667	-12.12266667	-109.104	-0.018529891	1	1972	-36.28	-0.055455163
6060	LOW SLUMP CONCRETE	Bare	1991	6.733333333	-2.933333333	-26.4	-0.004356436	1	1972	-26.2	-0.038910891
10416	LOW SLUMP CONCRETE	PCC	1992	119.2053333	39.06466667	351.582	0.033754032	1	1972	58.27	0.050348502
18071	LOW SLUMP CONCRETE	PCC	1994	60.23666667	149.5833333	1346.25	0.074497814	2	1972	34.82	0.017341597
7188	CONCRETE	PMA	2005	0	11.54	103.86	0.014449082	1	1981	10.54	0.013196995
7188	CONCRETE	PMA	2005	6.389333333	6.510666667	58.596	0.00815192	1	1981	-15.1	-0.018906511
6188	CONCRETE	PMA	2005	23.37688889	65.50311111	589.528	0.095269554	1	1979	35.88	0.052184874
4303	CONCRETE	PMA	2005	26.29611111	40.19388889	361.745	0.084068092	1	1979	2.49	0.005207994
5530	CONCRETE	PMA	2005	3.072222222	24.87777778	223.9	0.040488246	1	1979	21.95	0.035723327
7578	CONCRETE	PMA	2005	58.94	92.34	831.06	0.109667458	1	1979	32.28	0.038337292
5137	CONCRETE	PMA	2005	50.79922222	52.44077778	471.967	0.091875998	1	1979	11.24	0.019692427
8445	CONCRETE	PMA	2005	249.5966667	66.71333333	600.42	0.071097691	1	1979	-30.69	-0.032706927
5152	CONCRETE	PMA	2005	16.02844444	4.541555556	40.874	0.007933618	1	1979	-22.43	-0.039182842
6022	CONCRETE	PMA	2005	16.05866667	53.42133333	480.792	0.079839256	1	1979	18.48	0.027618731
7259	CONCRETE	PMA	2002	90.33422222	85.94577778	773.512	0.10655903	1	1978	6.28	0.007786196
4872	CONCRETE	PMA	2002	10.28533333	16.31466667	146.832	0.030137931	1	1978	2.6	0.004802956
4904	CONCRETE	PMA	2002	59.93777778	51.74222222	465.68	0.094959217	1	1978	6.68	0.01225938
17169	CONCRETE	PMA	2002	211.751	231.479	2083.311	0.121341429	1	1978	40.23	0.02108859
13390	CONCRETE	PMA	2005	389.7977778	124.2022222	1117.82	0.083481703	1	1980	114	0.076624347
5352	CONCRETE	HMA	2003	0.594666667	6.405333333	57.648	0.0107713	1	1980	5	0.008408072
5352	CONCRETE	HMA	2003	10.10933333	24.14066667	217.266	0.040595291	1	1980	7.25	0.012191704
8816	CONCRETE	Bare	1980	59.75288889	26.44711111	238.024	0.026999093	1	1980	-106.8	-0.109029038
9576	EPOXY OVERLAY	HMA	2003	43.624	-29.624	-266.616	-0.027842105	1	1981	1	0.00093985
9576	EPOXY OVERLAY	HMA	2003	4.256	9.744	87.696	0.009157895	1	1981	1	0.00093985
9400	EPOXY OVERLAY	HMA	2003	5.222222222	10.77777778	97	0.010319149	1	1980	-2	-0.001914894
5492	EPOXY OVERLAY	PCC	2017	1.220444444	10.77955556	97.016	0.017664967	1	1980	8	0.013109978
5652	EPOXY OVERLAY	PCC	2017	5.652	10.348	93.132	0.016477707	1	1980	5	0.007961783
7308	CONCRETE	Bare	1980	16.24	-15.24	-137.16	-0.018768473	1	1980	0	0
7308	CONCRETE	Bare	1980	0	1	9	0.001231527	1	1980	0	0
7611	LOW SLUMP CONCRETE	Bare	1984	31.28966667	-18.88966667	-170.007	-0.022337012	1	1984	-47.6	-0.056286953
4807	LOW SLUMP CONCRETE	Bare	1993	16.02333333	-14.32333333	-128.91	-0.026817142	1	1966	0	0
10248	CONCRETE	Bare	1995	45.54666667	11.45333333	103.08	0.010058548	1	1995	-19	-0.016686183
20424	EPOXY OVERLAY	PCC	1982	13.616	-6.316	-56.844	-0.002783196	2	1955	4.3	0.00189483
5222	LOW SLUMP CONCRETE	PCC	1987	9.283555556	1.376444444	12.388	0.002372271	2	1961	-10.34	-0.017820758
19335	EPOXY OVERLAY	Bare	1991	107.4166667	2.583333333	23.25	0.001202483	2	1991	-32	-0.014895268
3471	BITUMINOUS	HMA	1998	3.856666667	28.14333333	253.29	0.072973207	3	1956	11	0.02852204
15945	LOW SLUMP CONCRETE	PCC	1991	129.3316667	251.0583333	2259.525	0.141707432	3	1974	82.39	0.046504233
16579	LOW SLUMP CONCRETE	PCC	1991	326.0536667	604.6063333	5441.457	0.328213825	3	1974	156.66	0.08504373
13732	LOW SLUMP CONCRETE	Bare	1983	32.04133333	86.65866667	779.928	0.056796388	3	1983	102.7	0.067309933
14040	LOW SLUMP CONCRETE	Bare	1988	9.36	28.64	257.76	0.018358974	1	1988	23	0.01474359
8472	LOW SLUMP CONCRETE	Bare	1984	103.5466667	25.45333333	229.08	0.02703966	2	1984	63	0.066926346
6274	LOW SLUMP CONCRETE	Bare	1979	90.62444444	130.5755556	1175.18	0.187309531	3	1979	21.2	0.030411221
5883	EPOXY OVERLAY	HMA	1998	168.646	57.654	518.886	0.088200918	1	1971	-131.7	-0.201478837
3751	CONCRETE	Bare	1990	45.84555556	30.86444444	277.78	0.074054919	1	1939	43.71	0.104876033
3955	CONCRETE	Bare	1964	7.470555556	-0.950555556	-8.555	-0.002163085	1	1964	4.52	0.010285714

IRT Defect and Type 1 Rehabilitation Quantities Comparison

B290039	2019	Preparation Decks Type 1	70	0.14	2016	IR	Infrasense	1 - values only	0	0	0	0.9	0.9
B300066	2019	Preparation Decks Type 1	10	0.75	2018	IR	AECOM	2 - plan sheet	0	0	4.4	0	0
B300067	2019	Preparation Decks Type 1	10	2.08	2018	IR	AECOM	2 - plan sheet	0	0	0.6	0	0
B300654	2022	Preparation Decks Type 1	50	7.3	2019	IR	AECOM	3 - deck preparation	0.1	0.7	2.2	1.1	1.9
B310018	2018	Preparation Decks Type 1	204	97	2017	IR	AECOM	2 - plan sheet	0	0	0	11.2	11.2
B310023	2018	Preparation Decks Type 1	102	83	2017	IR	AECOM	2 - plan sheet	0	0.3	0	1.1	1.4
B320025	2019	Preparation Decks Type 1	1	32.52	2018	IR	Infrasense	0 - aerial	0	0	0	2.5	2.5
B320026	2019	Preparation Decks Type 1	1	1.39	2018	IR	Infrasense	0 - aerial	0	0	0	2.5	2.5
B320079	2021	Preparation Decks Type 1	167	107.31	2018	IR	Infrasense	1 - values only	0	0	0	3.1	3.1
B320082	2016	Preparation Decks Type 1	126	84.3	2015	IR	Infrasense	1 - values only	0	0	0	0.4	0.4
B360037	2016	Preparation Decks Type 1	8	0.1	2014	IR	AECOM	2 - plan sheet	0	0	0	0	0
B360043	2016	Preparation Decks Type 1	10	1.1	2014	IR	AECOM	2 - plan sheet	0	0	0	0.1	0.1
B360046	2016	Preparation Decks Type 1	5	0.3	2015	IR	AECOM	2 - plan sheet	0	0	0	0.05	0.05
B360052	2016	Preparation Decks Type 1	50	37	2015	IR	AECOM	2 - plan sheet	0	0	0.2	2.7	2.7
B360053	2016	Preparation Decks Type 1	27	17	2015	IR	AECOM	2 - plan sheet	0	0	0.1	1.3	1.3
B360074	2016	Preparation Decks Type 1	8	0.4	2014	IR	AECOM	2 - plan sheet	0	0	0	0	0
B370162	2015	Preparation Decks Type 1	115	34	2014	IR	Infrasense	1 - values only	0	0	0	2.2	2.2
B370165	2015	Preparation Decks Type 1	84	34	2014	IR	Infrasense	1 - values only	0	0	0	2.2	2.2
B370166	2015	Preparation Decks Type 1	84	37	2014	IR	Infrasense	1 - values only	0	0	0	2.5	2.5
B400052	2019	Preparation Decks Type 1	6.49	6.49	2018	IR	AECOM	1 - values only	0	2	0	0	2
B400118	2019	Preparation Decks Type 1	100	8.9	2017	IR	AECOM	2 - plan sheet	0	0.05	0	1.5	1.55
B400193	2019	Preparation Decks Type 1	19	2.1	2017	IR	AECOM	2 - plan sheet	0	0	0	0	0
B400261	2022	Preparation Decks Type 1	1	1	2021	IR	AECOM	2 - plan sheet	0	0	0	0.4	0.4
B400285027H	2017	Preparation Decks Type 1	583	251	2016	IR	AECOM	2 - plan sheet	0.4	0.2	7.4	0.05	0.65
B400285027I	2017	Preparation Decks Type 1	180	193	2016	IR	AECOM	2 - plan sheet	0	0	0.7	0.05	0.05
B400285027J	2017	Preparation Decks Type 1	414	203	2016	IR	AECOM	2 - plan sheet	0.7	0.1	3.8	0.1	0.9
B400335	2022	Preparation Decks Type 1	550	356.71	2021	IR	AECOM	3 - deck preparation	0	0	0	37.3	37.3
B400336	2022	Preparation Decks Type 1	225	134.02	2021	IR	AECOM	3 - deck preparation	0	0	0	38.1	38.1
B400392	2019	Preparation Decks Type 1	22	1.13	2017	IR	AECOM	2 - plan sheet	0	0	0	0	0
B400584	2020	Preparation Decks Type 1	10	26	2018	IR		1 - values only	7.5	0	1	0	7.5
B4011110001	2017	Preparation Decks Type 1	1	0.1	2016	IR	AECOM	1 - values only	0	0	0	0	0
B4011110002	2017	Preparation Decks Type 1	1	1	2016	IR		1 - values only	0	0	0	0	0
B4012210001	2017	Preparation Decks Type 1	4.31	4.31	2016	IR		1 - values only	0	0	0	0	0
B4012210002	2017	Preparation Decks Type 1	1.93	1.93	2016	IR		1 - values only	0	0	0	0	0
B401322	2017	Preparation Decks Type 1	0.75	0.75	2016	IR		1 - values only	0	0	0	0	0
B410030	2017	Preparation Decks Type 1	24	40.11	2014	IR	Infrasense	1 - values only	0	0	0	1.6	1.6
B410031	2017	Preparation Decks Type 1	49	243.27	2014	IR	Infrasense	1 - values only	0	0	0	3.2	3.2
B410062	2020	Preparation Decks Type 1	24	5.5	2018	IR	Infrasense	1 - values only	0	0	0	3.1	3.1
B410064	2020	Preparation Decks Type 1	4	1.2	2018	IR	Infrasense	1 - values only	0	0	0	1.5	1.5
B410076	2018	Preparation Decks Type 1	96	71.9	2016	IR	Infrasense	1 - values only	0	0	0	4.6	4.6
B410077	2018	Preparation Decks Type 1	70	147.81	2016	IR	Infrasense	1 - values only	0	0	0	4.8	4.8
B410111	2018	Preparation Decks Type 1	121	32	2015	IR	Infrasense	1 - values only	0	0	0	0.1	0.1
B440009	2017	Preparation Decks Type 1	142	4.2	2016	IR	Infrasense	2 - plan sheet	0	0	0	1.5	1.5
B450039	2019	Preparation Decks Type 1	17	26.9	2017	IR	AECOM	2 - plan sheet	0	0	9.3	0.5	0.5
B510078	2020	Preparation Decks Type 1	70	9.4	2019	IR	AECOM	3 - deck preparation	0	0	0	0.6	0.6
B510079	2020	Preparation Decks Type 1	45	2.6	2019	IR	AECOM	3 - deck preparation	0	0	0	0.2	0.2
B550118	2022	Preparation Decks Type 1	1	1.37	2021	IR	Infrasense	2 - plan sheet	0	0	0	0.9	0.9

IRT Defect and Type 1 Rehabilitation Quantities Comparison

9722	LOW SLUMP CONCRETE	Bare	1964	9.722	-9.582	-86.238	-0.008870397	3	1964	-69.86	-0.064671878
6057	BITUMINOUS	PMA	2006	0	0.75	6.75	0.001114413	1	1989	-9.25	-0.013744428
6057	BITUMINOUS	PMA	2006	0	2.08	18.72	0.003090639	1	1989	-7.92	-0.011768202
2303	LOW SLUMP CONCRETE	HMA	1998	4.861888889	2.438111111	21.943	0.009528007	3	1926	-42.7	-0.166869301
7000	EPOXY OVERLAY	Bare	1977	87.11111111	9.888888889	89	0.012714286	1	1977	-107	-0.137571429
22417	EPOXY OVERLAY	Bare	19865	34.87088889	48.12911111	433.162	0.019322925	1	1985	-19	-0.007628139
13540	EPOXY OVERLAY	PCC	2003	37.61111111	-5.091111111	-45.82	-0.003384047	1	1968	31.52	0.020951256
13540	EPOXY OVERLAY	PCC	2003	37.61111111	-36.22111111	-325.99	-0.024076071	1	1968	0.39	0.000259232
25520	EPOXY OVERLAY	TPO	1999	87.90222222	19.40777778	174.67	0.006844436	3	1982	-59.69	-0.021050549
30683	POLYESTER POLYMER CONCRETE	TPO	2004	13.63688889	70.66311111	635.968	0.020727048	1	1981	-41.7	-0.012231529
7453	LOW SLUMP CONCRETE	Bare	1977	0	0.1	0.9	0.000120757	2	1977	-7.9	-0.009539783
9096	LOW SLUMP CONCRETE	Bare	1977	1.010666667	0.089333333	0.804	8.83905E-05	2	1977	-8.9	-0.008806069
10371	LOW SLUMP CONCRETE	Bare	1977	0.576166667	-0.276166667	-2.4855	-0.000239659	1	1977	-4.7	-0.004078681
5592	EPOXY OVERLAY	HMA	2001	16.776	20.224	182.016	0.032549356	1	1979	-13	-0.020922747
6272	EPOXY OVERLAY	HMA	2001	9.059555556	7.940444444	71.464	0.011394133	1	1979	-10	-0.01434949
6846	LOW SLUMP CONCRETE	Bare	1978	0	0.4	3.6	0.000525855	2	1978	-7.6	-0.009991236
5020	LOW SLUMP CONCRETE	PCC	2001	12.27111111	21.72888889	195.56	0.038956175	1	1974	-81	-0.145219124
4520	EPOXY OVERLAY	PCC	2001	11.04888889	22.95111111	206.56	0.045699115	1	1974	-50	-0.099557522
4520	EPOXY OVERLAY	PCC	2001	12.55555556	24.44444444	220	0.048672566	1	1974	-47	-0.093584071
11460	LOW SLUMP CONCRETE	PCC	2014	25.46666667	-18.97666667	-170.79	-0.014903141	1	1958	0	0
21235	LOW SLUMP CONCRETE	Bare	1986	36.57138889	-27.67138889	-249.0425	-0.011727926	2	1962	-91.1	-0.038610784
16484	EPOXY OVERLAY	Bare	2007	0	2.1	18.9	0.001146566	2	1966	-16.9	-0.009227129
11181	EPOXY OVERLAY	PCC	2013	4.969333333	-3.969333333	-35.724	-0.003195063	1	1965	0	0
52988	LOW SLUMP CONCRETE	HMA	1996	38.26911111	212.7308889	1914.578	0.036132294	1	1968	-332	-0.056390126
62830	LOW SLUMP CONCRETE	HMA	1996	3.490555556	189.5094444	1705.585	0.027146029	1	1968	13	0.001862168
75125	LOW SLUMP CONCRETE	HMA	1996	75.125	127.875	1150.875	0.015319468	1	1968	-211	-0.02527787
7711	LOW SLUMP CONCRETE	PCC	2003	319.5781111	37.13188889	334.187	0.043338996	1	1966	-193.29	-0.225601089
3463	LOW SLUMP CONCRETE	PCC	2003	146.6003333	-12.58033333	-113.223	-0.032695062	1	1967	-90.98	-0.236448166
18118	LOW SLUMP CONCRETE	Bare	1999	0	1.13	10.17	0.00056132	2	1968	-20.87	-0.010367038
7515	BITUMINOUS	HMA	1996	62.625	-36.625	-329.625	-0.043862275	2	1992	16	0.019161677
53671	POLYESTER POLYMER CONCRETE	Bare	2006	0	0.1	0.9	1.67688E-05	1	2006	-0.9	-0.000150919
57120	POLYESTER POLYMER CONCRETE	Bare	2006	0	1	9	0.000157563	1	2006	0	0
21803	POLYESTER POLYMER CONCRETE	Bare	2008	0	4.31	38.79	0.001779113	1	2008	0	0
33310	POLYESTER POLYMER CONCRETE	Bare	2008	0	1.93	17.37	0.000521465	1	2008	0	0
19052	POLYESTER POLYMER CONCRETE	Bare	2006	0	0.75	6.75	0.000354294	1	2006	0	0
13700	LOW SLUMP CONCRETE	Bare	1994	24.35555556	15.75444444	141.79	0.010349635	3	1968	16.11	0.010583212
13700	LOW SLUMP CONCRETE	Bare	1994	48.71111111	194.5588889	1751.03	0.127812409	3	1968	194.27	0.127622628
7580	LOW SLUMP CONCRETE	Bare	1995	26.10888889	-20.60888889	-185.48	-0.024469657	2	1968	-18.5	-0.021965699
4416	LOW SLUMP CONCRETE	Bare	1995	7.36	-6.16	-55.44	-0.012554348	2	1968	-2.8	-0.005706522
7461	LOW SLUMP CONCRETE	PCC	1994	38.134	33.766	303.894	0.040731001	2	1968	-24.1	-0.02907117
7461	LOW SLUMP CONCRETE	PCC	1994	39.792	108.018	972.162	0.130299156	2	1968	77.81	0.093860072
9832	LOW SLUMP CONCRETE	Bare	1991	1.092444444	30.90755556	278.168	0.028292107	3	1968	-89	-0.081468674
12539	EPOXY OVERLAY	Bare	1987	20.89833333	-16.69833333	-150.285	-0.011985406	1	1952	-137.8	-0.098907409
13967	BITUMINOUS	HMA	2002	7.759444444	19.14055556	172.265	0.012333715	2	1974	9.9	0.006379323
12464	LOW SLUMP CONCRETE	Bare	1996	8.309333333	1.090666667	9.816	0.000787548	1	1996	-60.6	-0.043758023
8040	LOW SLUMP CONCRETE	Bare	1996	1.786666667	0.813333333	7.32	0.000910448	1	1996	-42.4	-0.047462687
22034	EPOXY OVERLAY	Bare	1991	22.034	-20.664	-185.976	-0.00844041	1	1991	0.37	0.00015113

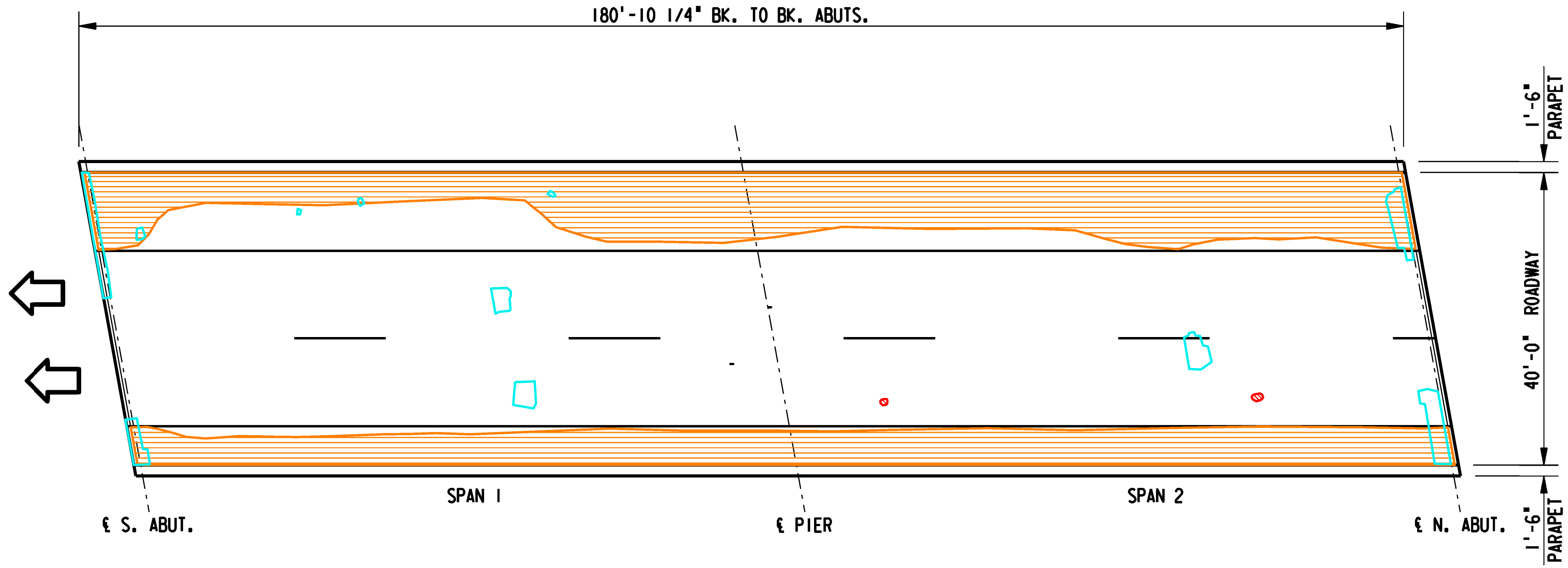
IRT Defect and Type 1 Rehabilitation Quantities Comparison

B590034	2017	Preparation Decks Type 1	7	1.9	2016	IR	AECOM	2 - plan sheet	0	0	0	1.6	1.6
B590051	2017	Preparation Decks Type 1	5	0.6	2016	IR	AECOM	2 - plan sheet	0	0	0	1.1	1.1
B590108	2020	Preparation Decks Type 1	33	31	2018	IR	AECOM	2 - plan sheet	0.3	0.3	0	2.6	3.2
B660092	2019	Preparation Decks Type 1	2	0.2	2016	IR	AECOM	1 - values only	0	0	1	0	0
B670087	2018	Preparation Decks Type 1	80	69.14	2017	IR			0	0	0	17.7	17.7
B670201	2018	Preparation Decks Type 1	14	0.41	2017	IR			0	0	0	0.3	0.3
B670230	2019	Preparation Decks Type 1	15	11.67	2017	IR	AECOM	2 - plan sheet	0	0	0	0.05	0.05
B680031	2019	Preparation Decks Type 1	200	591	2017	IR	Infrasense	2 - plan sheet	0	0	0	3.1	3.1
B700061	2006	Preparation Decks Type 1	4800	3747	2005	IR	EarthTech	2 - plan sheet	0.1	0	0	9.7	9.8

IRT Defect and Type 1 Rehabilitation Quantities Comparison

3830	EPOXY OVERLAY	PCC	2009	6.808888889	-4.908888889	-44.18	-0.011535248	1	1967	-5.1	-0.011984334
3871	EPOXY OVERLAY	PCC	2010	4.731222222	-4.131222222	-37.181	-0.009605012	1	1971	-4.4	-0.010229915
3240	LOW SLUMP CONCRETE	Bare	1981	11.52	19.48	175.32	0.054111111	2	1981	-2	-0.005555556
3180	LOW SLUMP CONCRETE	HMA	1997	0	0.2	1.8	0.000566038	3	1981	-1.8	-0.00509434
2660	LOW SLUMP CONCRETE	PCC	1992	52.31333333	16.82666667	151.44	0.056932331	1	1965	-10.86	-0.036744361
17088	LOW SLUMP CONCRETE	Bare	1983	5.696	-5.286	-47.574	-0.002784059	1	1983	-13.59	-0.007157654
7993	CONCRETE	Bare	1996	0.444055556	11.22594444	101.0335	0.012640248	2	1996	-3.33	-0.003749531
28680	EPOXY OVERLAY	PCC	2004	98.78666667	492.2133333	4429.92	0.154460251	2	1976	391	0.122698745
228479	EPOXY OVERLAY	PCC	1991	2487.882444	1259.117556	11332.058	0.04959781	1	1975	-1053	-0.041478648

Appendix F – Infrared Thermography and Rehabilitation Plan Views



PLAN

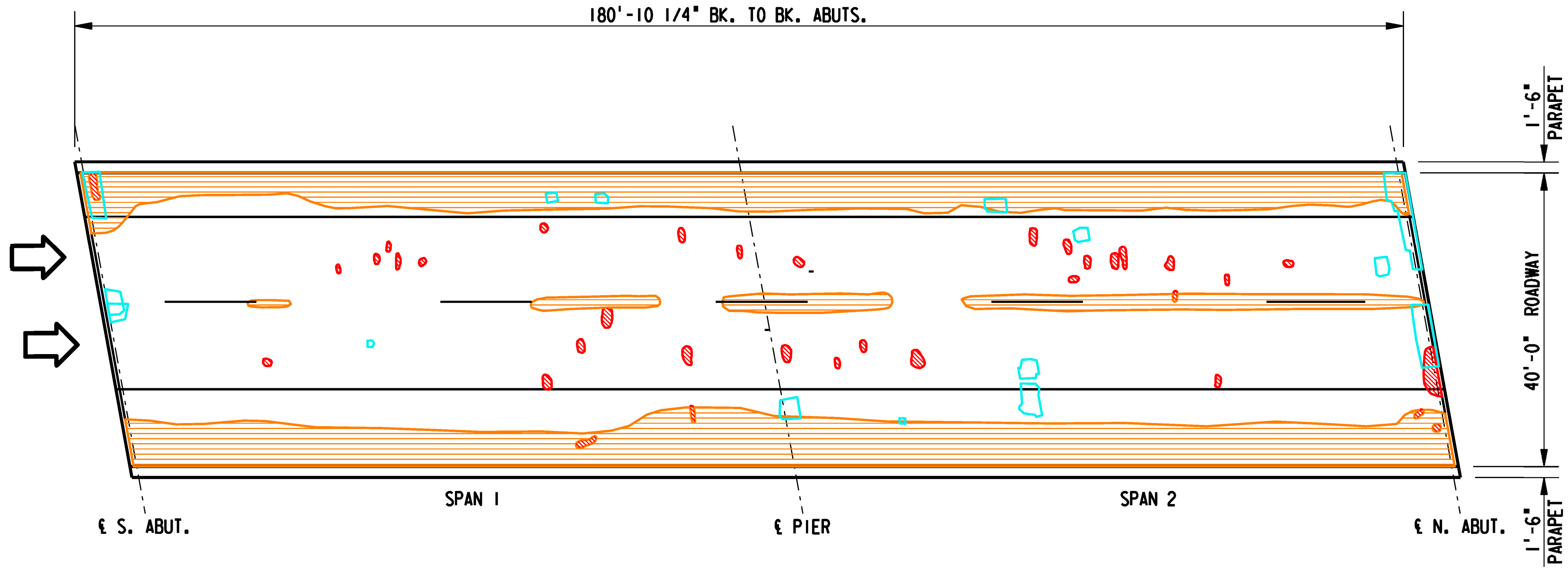
B-5-202

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-202	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	7188	
TOTAL DEFECTS*	ft^2	2	<0.1
TOTAL TYPE-1 REHAB	ft^2	104	1.5
DEFECTS/REHAB OVERLAP	ft^2	0	0
IR FALSE POSITIVES	ft^2	2	<0.1
REHAB NOT DETECTED BY IR	ft^2	104	1.5

FIELD OBSERVATIONS SUMMARY		STRUCTURE NO. B-5-202		LEGEND
ITEM	UNIT	QUANT.	%	DELAMINATION
TOTAL AREA	ft^2	7188		SPALL
SHADE/DEBRIS	ft^2	0		DEBOND/SCALING
DELAMINATION	ft^2	2	<0.1	ASPHALT PATCH
SPALL	ft^2	0	0	CONCRETE PATCH
DEBOND/SCALING	ft^2	2189	30.5	SHADE/DEBRIS
ASPHALT PATCH	ft^2	0	0	REHAB
CONCRETE PATCH	ft^2	0	0	
TYPE-1 REHAB AREA	ft^2	104	1.5	

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/9/19

*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-203

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-203	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	7188	
TOTAL DEFECTS*	ft^2	61	0.8
TOTAL TYPE-1 REHAB	ft^2	113	1.6
DEFECTS/REHAB OVERLAP	ft^2	7	0.1
IR FALSE POSITIVES	ft^2	54	0.8
REHAB NOT DETECTED BY IR	ft^2	106	1.5

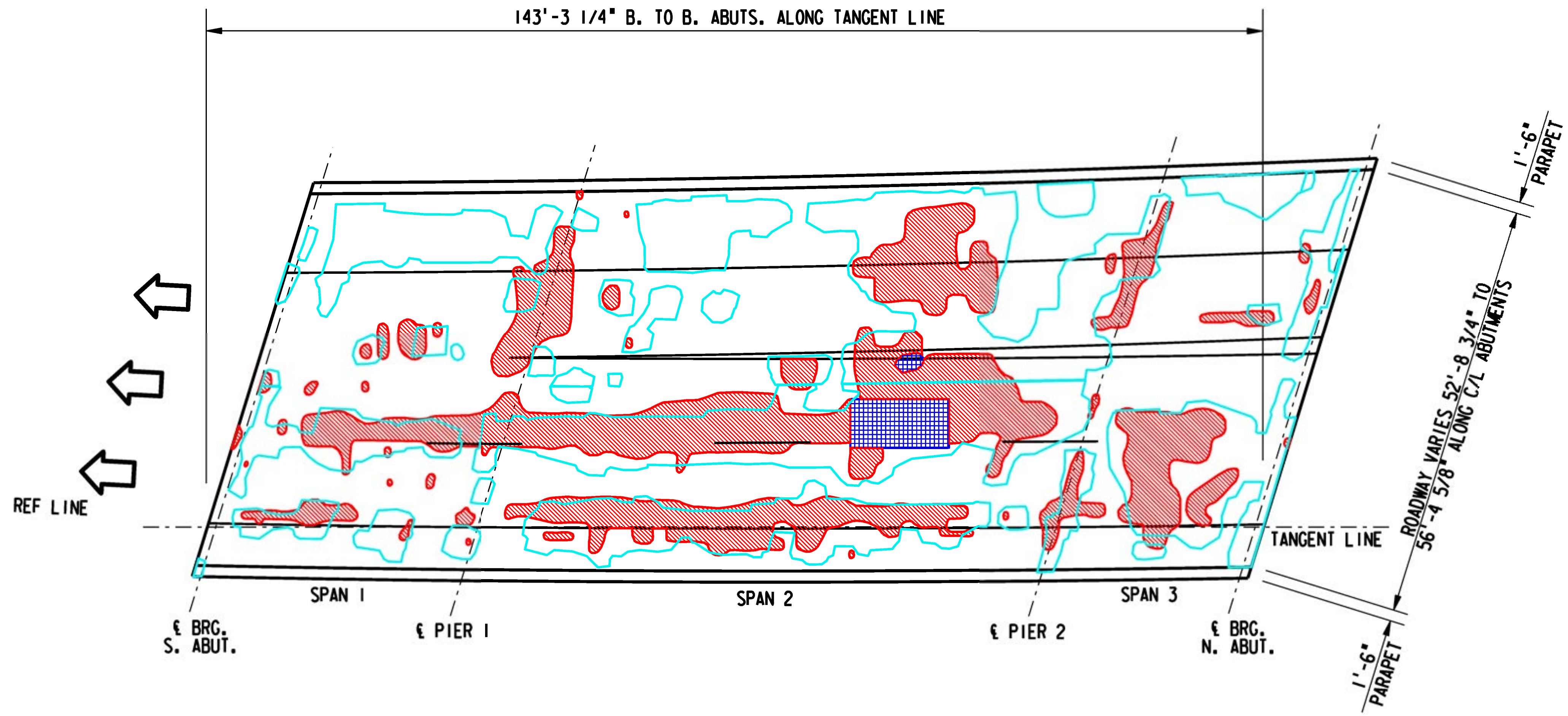
FIELD OBSERVATIONS SUMMARY		STRUCTURE NO. B-5-203	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	7188	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	61	0.8
SPALL	ft^2	0	0
DEBOND/SCALING	ft^2	2129	29.6
ASPHALT PATCH	ft^2	0	0
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	113	1.6

LEGEND

- DELAMINATION
- SPALL
- DEBOND/SCALING
- ASPHALT PATCH
- CONCRETE PATCH
- SHADE/DEBRIS
- REHAB

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/9/19

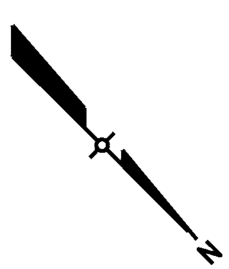
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA

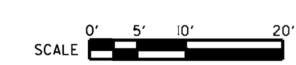


PLAN

B-5-208

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-208	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	7454	
TOTAL DEFECTS*	ft^2	1684	22.6
TOTAL TYPE-1 REHAB	ft^2	3318	44.5
DEFECTS/REHAB OVERLAP	ft^2	1377	18.5
IR FALSE POSITIVES	ft^2	307	4.1
REHAB NOT DETECTED BY IR	ft^2	1941	26.0



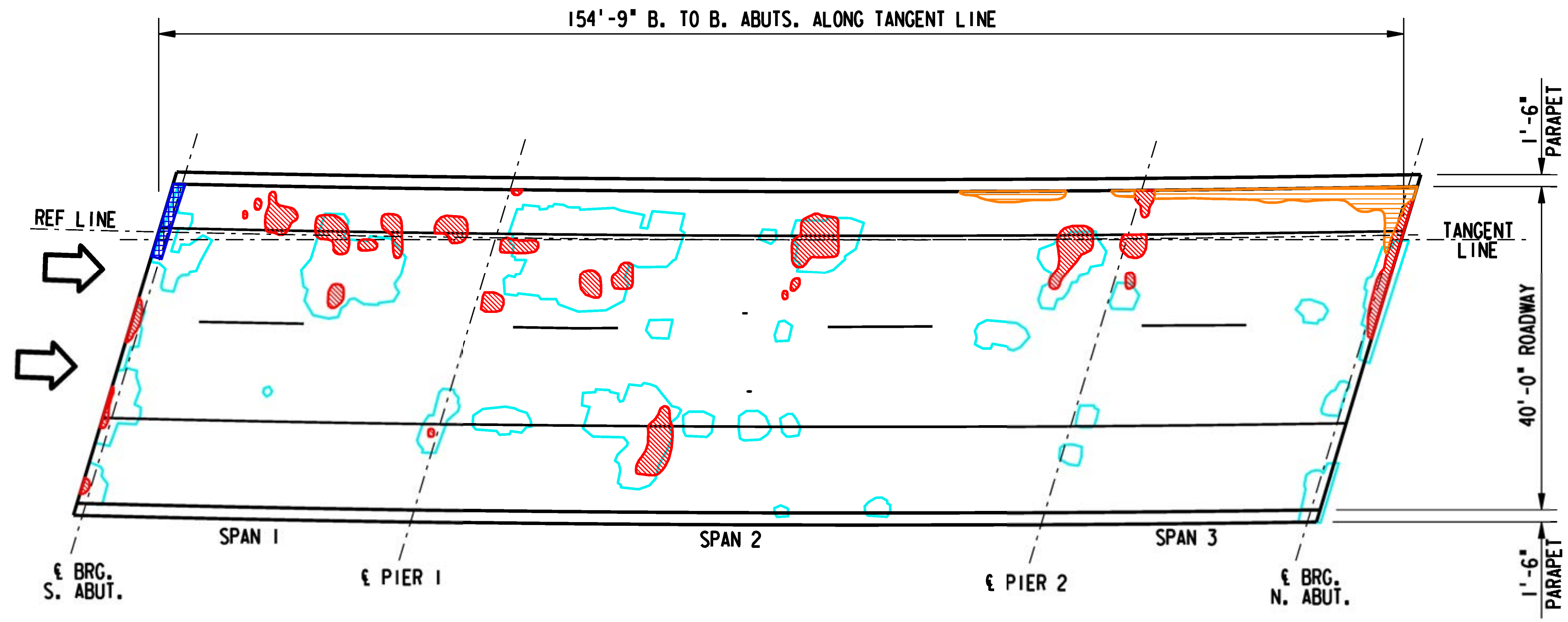


FIELD OBSERVATIONS SUMMARY		S.N. B-5-208	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	7454	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	1589	21.3
SPALL	ft^2	0	0
DEBOND/SCALING	ft^2	0	0
ASPHALT PATCH	ft^2	95	1.3
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	3318	44.5

LEGEND
DELAMINATION
SPALL
DEBOND/SCALING
ASPHALT PATCH
CONCRETE PATCH
SHADE/DEBRIS
REHAB

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/24/19

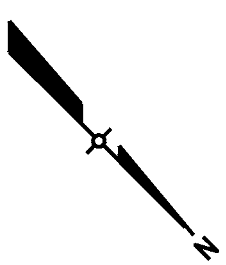
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-209

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-209	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft²	6188	
TOTAL DEFECTS*	ft²	214	3.5
TOTAL TYPE-1 REHAB	ft²	800	12.9
DEFECTS/REHAB OVERLAP	ft²	132	2.1
IR FALSE POSITIVES	ft²	82	1.3
REHAB NOT DETECTED BY IR	ft²	668	10.8



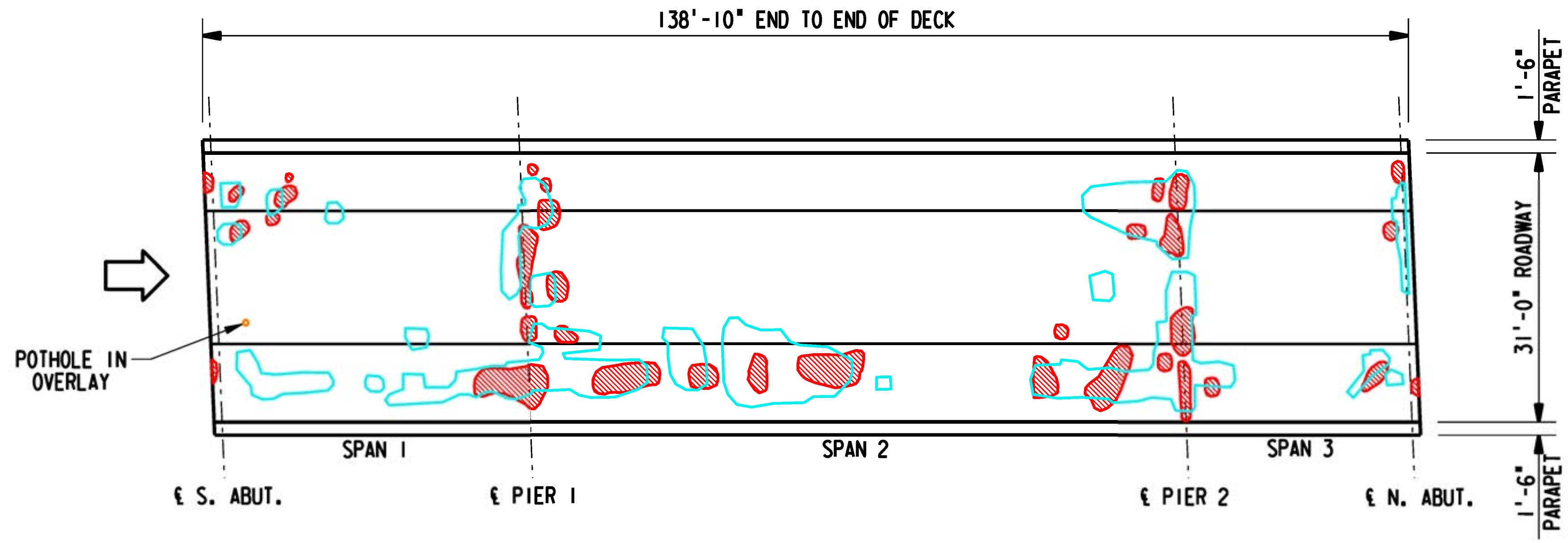
SCALE 0' 5' 10' 20'

FIELD OBSERVATIONS SUMMARY		S.N. B-5-209	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft²	6188	
SHADE/DEBRIS	ft²	0	
DELAMINATION	ft²	201	3.2
SPALL	ft²	0	0
DEBOND/SCALING	ft²	76	1.2
ASPHALT PATCH	ft²	13	0.2
CONCRETE PATCH	ft²	0	0
TYPE-1 REHAB AREA	ft²	800	12.9

LEGEND
- DELAMINATION
- SPALL
- DEBOND/SCALING
- ASPHALT PATCH
- CONCRETE PATCH
- SHADE/DEBRIS
- REHAB

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/24/19

*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-210

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-210	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	4303	
TOTAL DEFECTS*	ft^2	236	5.5
TOTAL TYPE-1 REHAB	ft^2	598	13.9
DEFECTS/REHAB OVERLAP	ft^2	158	3.7
IR FALSE POSITIVES	ft^2	79	1.8
REHAB NOT DETECTED BY IR	ft^2	441	10.2

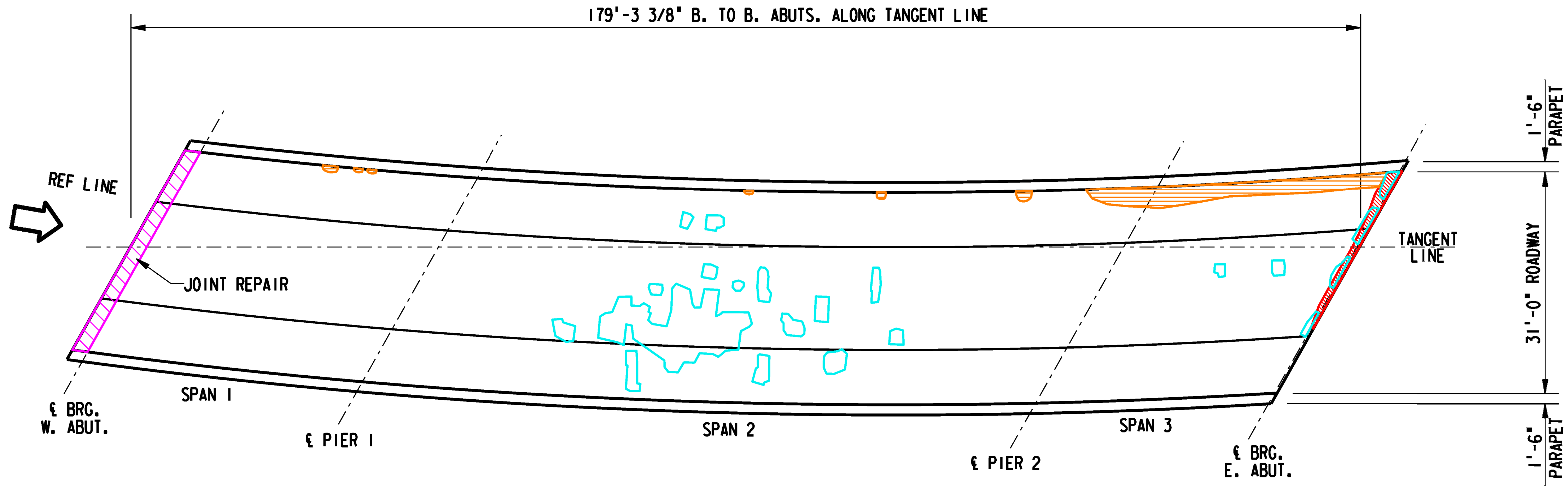
SCALE 0' 5' 10' 20'

FIELD OBSERVATIONS SUMMARY		S.N. B-5-210	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	4303	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	236	5.5
SPALL	ft^2	0	0
DEBOND	ft^2	0	0
ASPHALT PATCH	ft^2	0	0
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	598	13.9

LEGEND
DELAMINATION
SPALL
DEBOND/SCALING
ASPHALT PATCH
CONCRETE PATCH
SHADE/DEBRIS
REHAB

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/9/19

*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-211

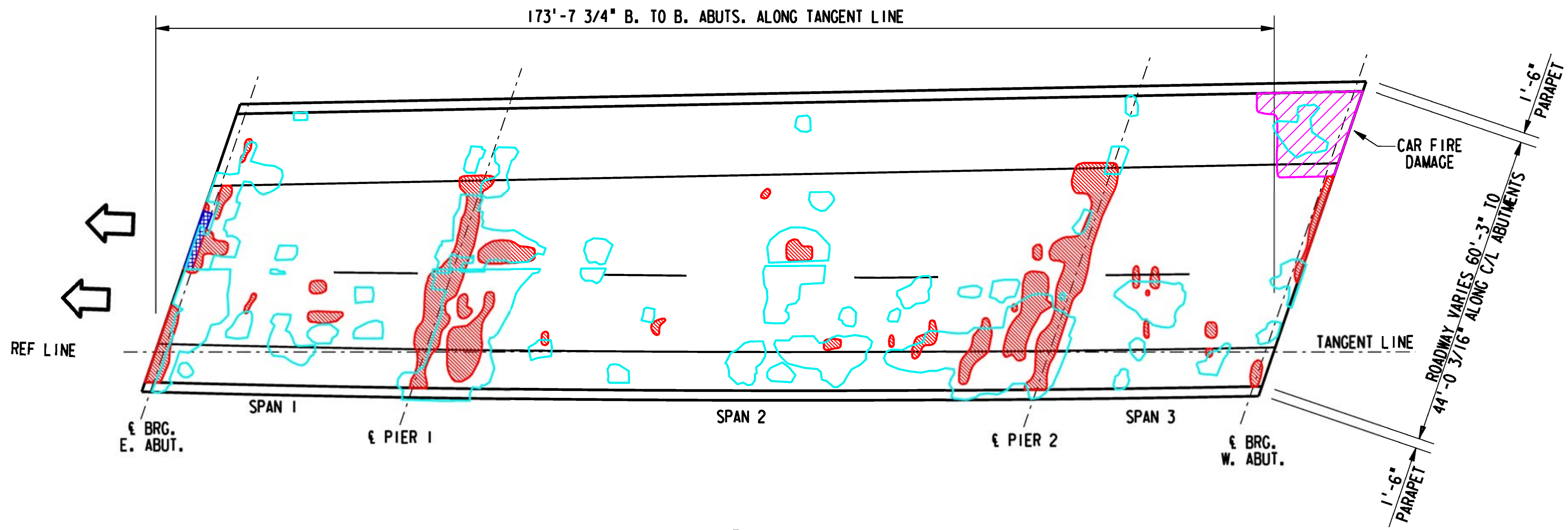
DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-211	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	5530	
TOTAL DEFECTS*	ft^2	30	0.5
TOTAL TYPE-1 REHAB	ft^2	252	4.5
DEFECTS/REHAB OVERLAP	ft^2	13	0.2
IR FALSE POSITIVES	ft^2	17	0.3
REHAB NOT DETECTED BY IR	ft^2	239	4.3

FIELD OBSERVATIONS SUMMARY		S.N. B-5-211	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	5530	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	30	0.5
SPALL	ft^2	0	0
DEBOND/SCALING	ft^2	105	1.9
ASPHALT PATCH	ft^2	0	0
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	252	4.5

LEGEND
DELAMINATION
SPALL
DEBOND/SCALING
ASPHALT PATCH
CONCRETE PATCH
SHADE/DEBRIS
REHAB

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/24/19

*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-212

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-212	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	7578	
TOTAL DEFECTS*	ft^2	531	7.0
TOTAL TYPE-1 REHAB	ft^2	1359	17.9
DEFECTS/REHAB OVERLAP	ft^2	292	3.9
IR FALSE POSITIVES	ft^2	239	3.2
REHAB NOT DETECTED BY IR	ft^2	1067	14.1

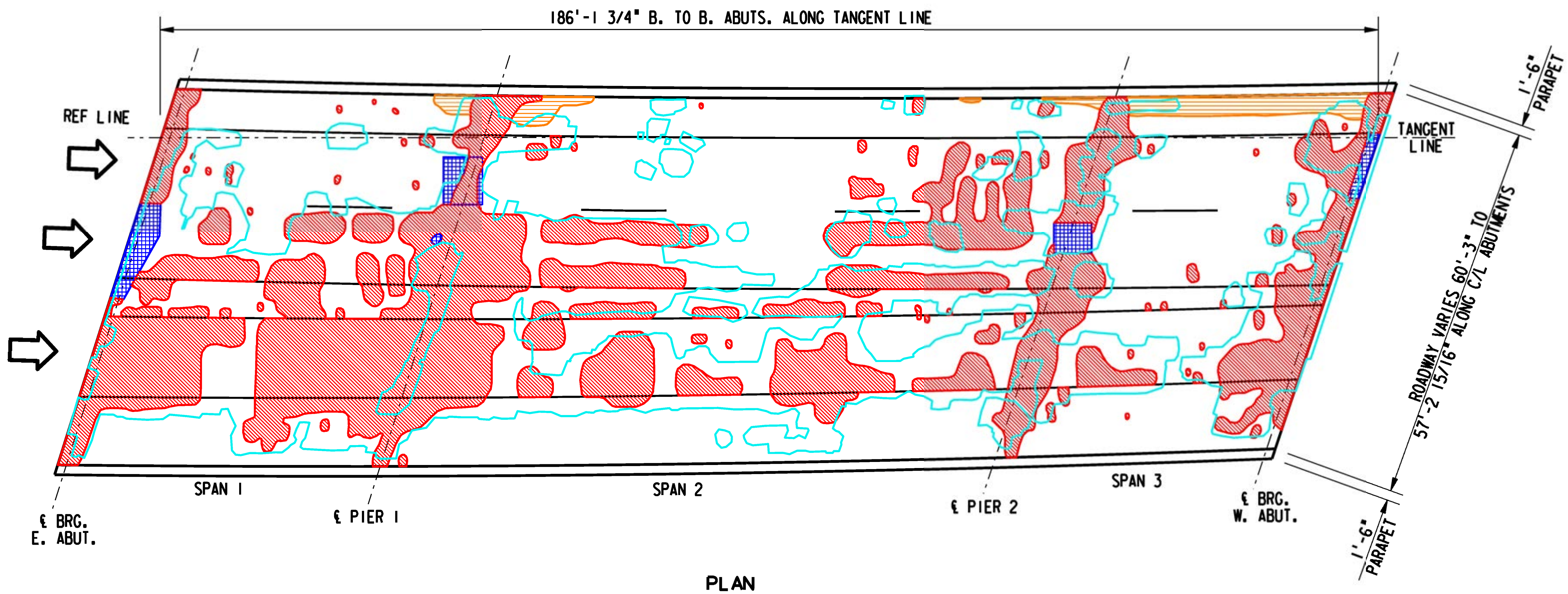
SCALE 0' 5' 10' 20'

FIELD OBSERVATIONS SUMMARY		S.N. B-5-212	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	7578	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	519	6.8
SPALL	ft^2	0	0
DEBOND/SCALING	ft^2	0	0
ASPHALT PATCH	ft^2	12	0.2
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	1359	17.9

LEGEND
- DELAMINATION
- SPALL
- DEBOND/SCALING
- ASPHALT PATCH
- CONCRETE PATCH
- SHADE/DEBRIS
- REHAB

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/24/19

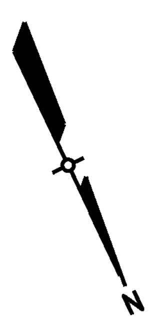
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-213

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-213	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	10364	
TOTAL DEFECTS*	ft^2	3470	33.5
TOTAL TYPE-1 REHAB	ft^2	4850	46.8
DEFECTS/REHAB OVERLAP	ft^2	2732	26.4
IR FALSE POSITIVES	ft^2	738	7.1
REHAB NOT DETECTED BY IR	ft^2	2118	20.4

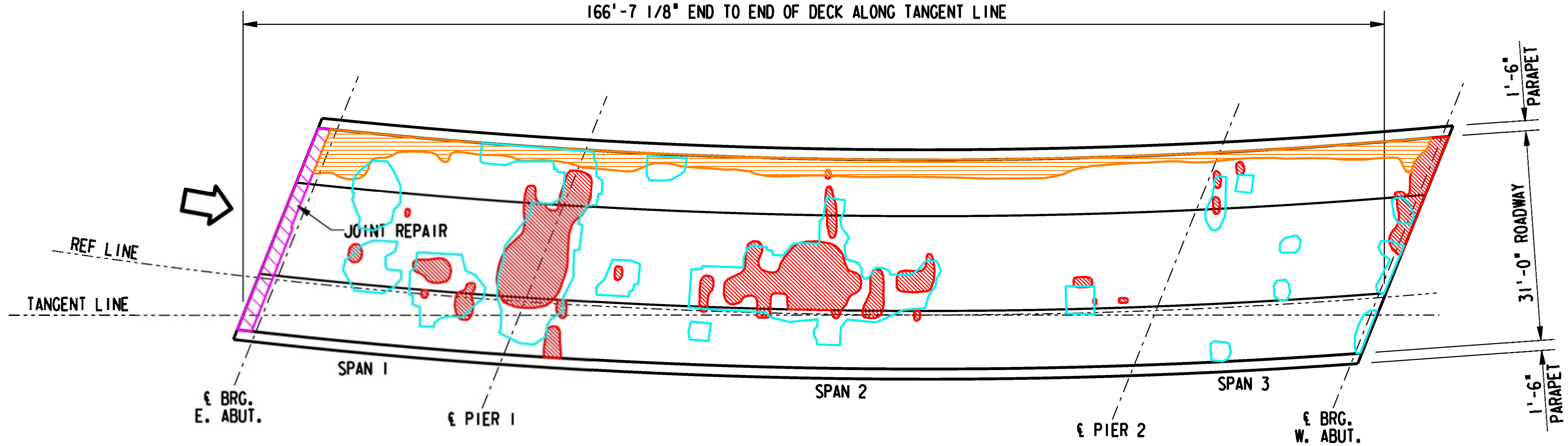


SCALE 0' 5' 10' 20'

FIELD OBSERVATIONS SUMMARY		STRUCTURE NO. B-5-213		LEGEND
ITEM	UNIT	QUANT.	%	
TOTAL AREA	ft^2	10364		DELAMINATION
SHADE/DEBRIS	ft^2	0		SPALL
DELAMINATION	ft^2	3330	32.1	DEBOND
SPALL	ft^2	0	0	ASPHALT PATCH
DEBOND/SCALING	ft^2	166	1.6	PCC PATCH
ASPHALT PATCH	ft^2	140	1.4	SHADE/DEBRIS
PCC PATCH	ft^2	0	0	REHAB
TYPE-1 REHAB AREA	ft^2	4850	46.8	

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/24/19

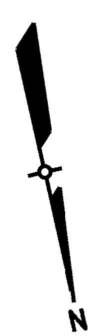
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-214

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-214	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	5137	
TOTAL DEFECTS*	ft^2	459	8.9
TOTAL TYPE-1 REHAB	ft^2	929	18.1
DEFECTS/REHAB OVERLAP	ft^2	378	7.4
IR FALSE POSITIVES	ft^2	82	1.6
REHAB NOT DETECTED BY IR	ft^2	552	10.7

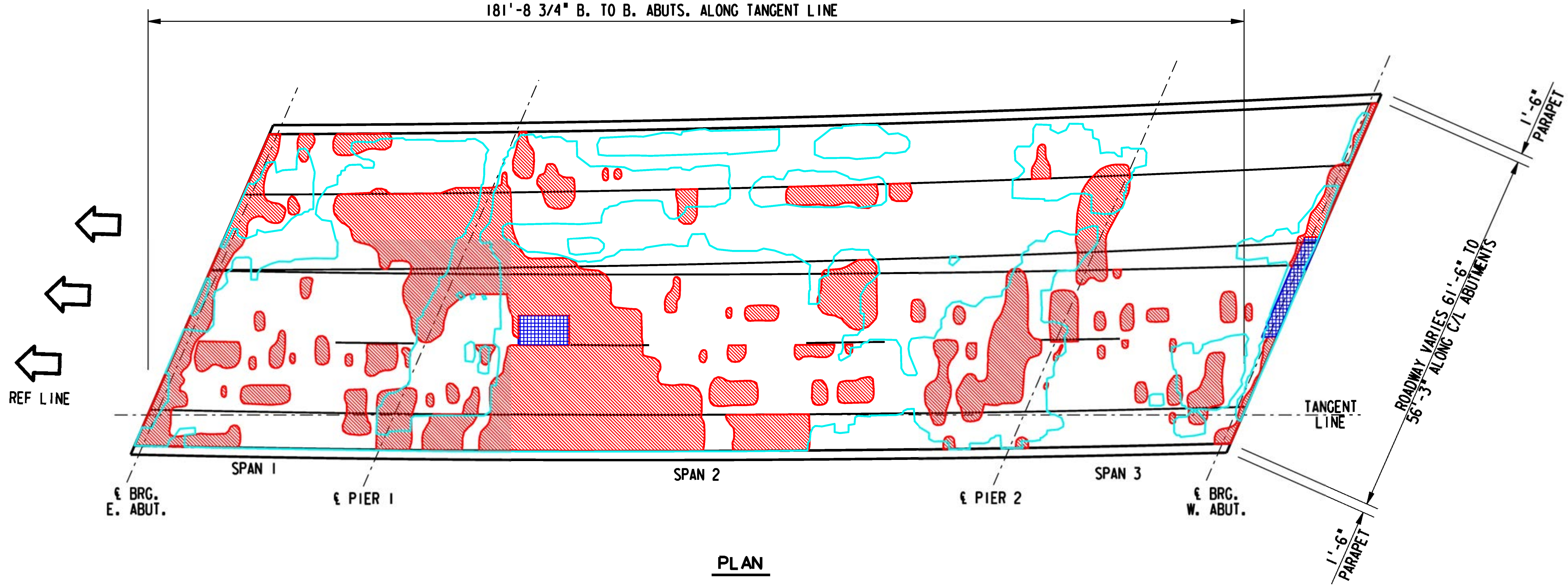


FIELD OBSERVATIONS SUMMARY		STRUCTURE NO. B-5-214	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	5137	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	459	8.9
SPALL	ft^2	0	0
DEBOND/SCALING	ft^2	380	7.4
ASPHALT PATCH	ft^2	0	0
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	929	18.1

LEGEND
DELAMINATION
SPALL
DEBOND/SCALING
ASPHALT PATCH
CONCRETE PATCH
SHADE/DEBRIS
REHAB

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/24/19

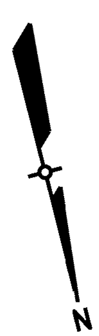
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-215

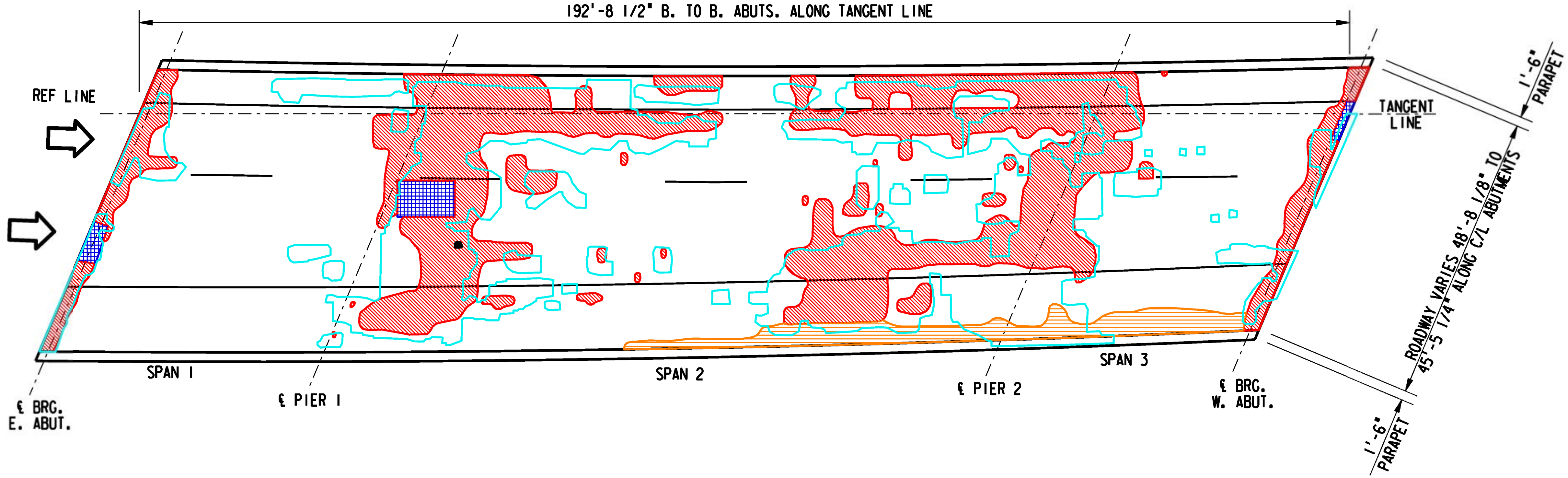
DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-215	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	9826	
TOTAL DEFECTS*	ft^2	2783	28.3
TOTAL TYPE-1 REHAB	ft^2	5688	57.9
DEFECTS/REHAB OVERLAP	ft^2	2271	23.1
IR FALSE POSITIVES	ft^2	512	5.2
REHAB NOT DETECTED BY IR	ft^2	3417	34.8



FIELD OBSERVATIONS SUMMARY		S.N. B-5-215		LEGEND
ITEM	UNIT	QUANT.	%	
TOTAL AREA	ft^2	9826		DELAMINATION
SHADE/DEBRIS	ft^2	0		SPALL
DELAMINATION	ft^2	2702	27.5	DEBOND/SCALING
SPALL	ft^2	0	0	ASPHALT PATCH
DEBOND/SCALING	ft^2	0	0	CONCRETE PATCH
ASPHALT PATCH	ft^2	82	0.8	SHADE/DEBRIS
CONCRETE PATCH	ft^2	0	0	REHAB
TYPE-1 REHAB AREA	ft^2	5688	57.9	

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/24/19

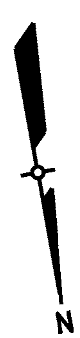
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-216

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-216	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	8445	
TOTAL DEFECTS*	ft^2	2208	26.2
TOTAL TYPE-1 REHAB	ft^2	2846	33.7
DEFECTS/REHAB OVERLAP	ft^2	1608	19.0
IR FALSE POSITIVES	ft^2	601	7.1
REHAB NOT DETECTED BY IR	ft^2	1238	14.7

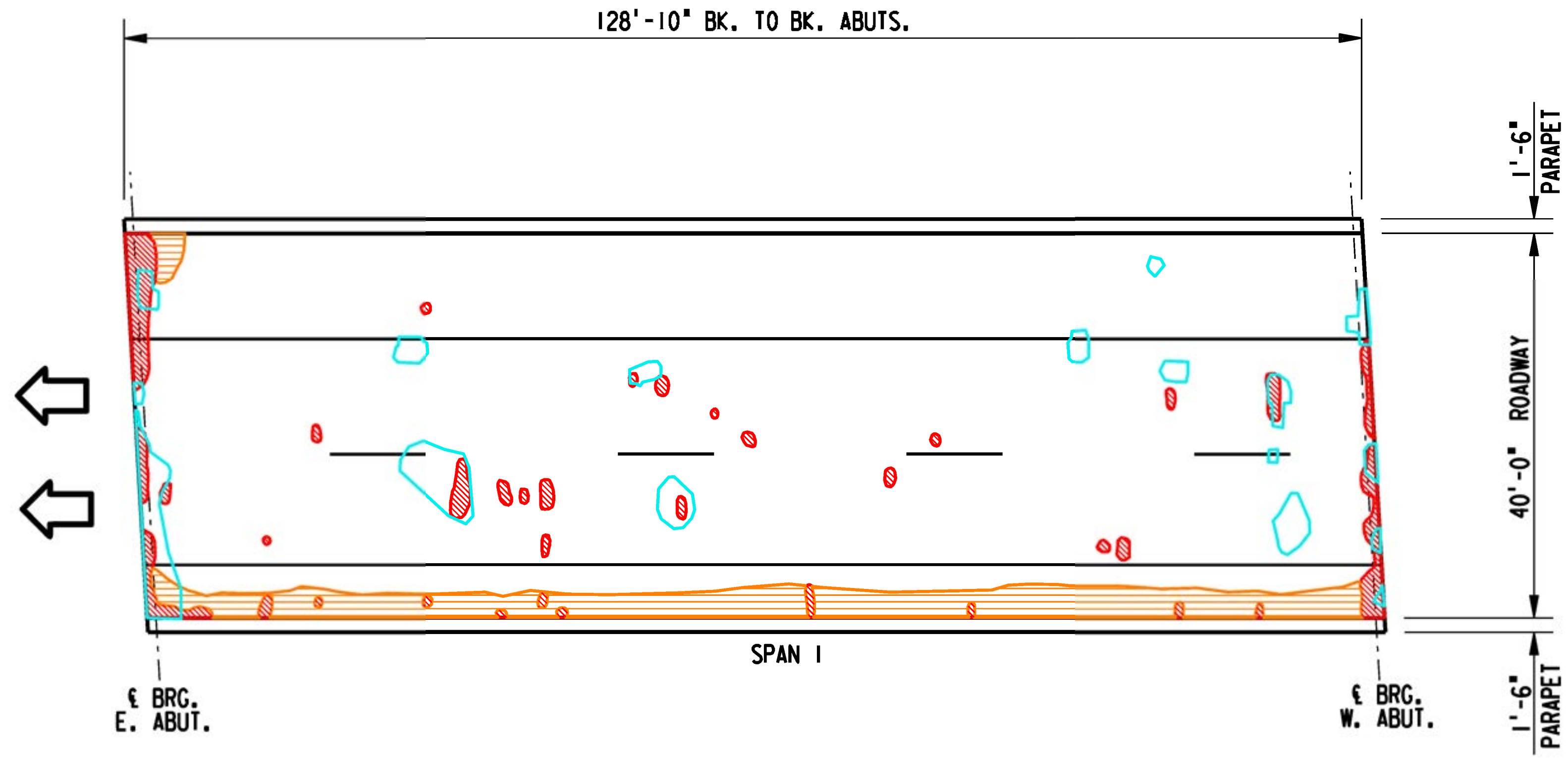


FIELD OBSERVATIONS SUMMARY		S.N. B-5-216	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	8445	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	2170	25.7
SPALL	ft^2	1	<0.1
DEBOND/SCALING	ft^2	278	3.3
ASPHALT PATCH	ft^2	78	0.9
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	2846	33.7

LEGEND
DELAMINATION
SPALL
DEBOND/SCALING
ASPHALT PATCH
CONCRETE PATCH
SHADE/DEBRIS
REHAB

SURFACE TYPE: CONCRETE - PMA OVERLAY
INFRARED INSPECTION DATE: 7/24/19

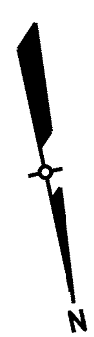
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-219

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-219	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	5152	
TOTAL DEFECTS*	ft^2	144	2.8
TOTAL TYPE-1 REHAB	ft^2	185	3.6
DEFECTS/REHAB OVERLAP	ft^2	47	0.9
IR FALSE POSITIVES	ft^2	98	1.9
REHAB NOT DETECTED BY IR	ft^2	138	2.7

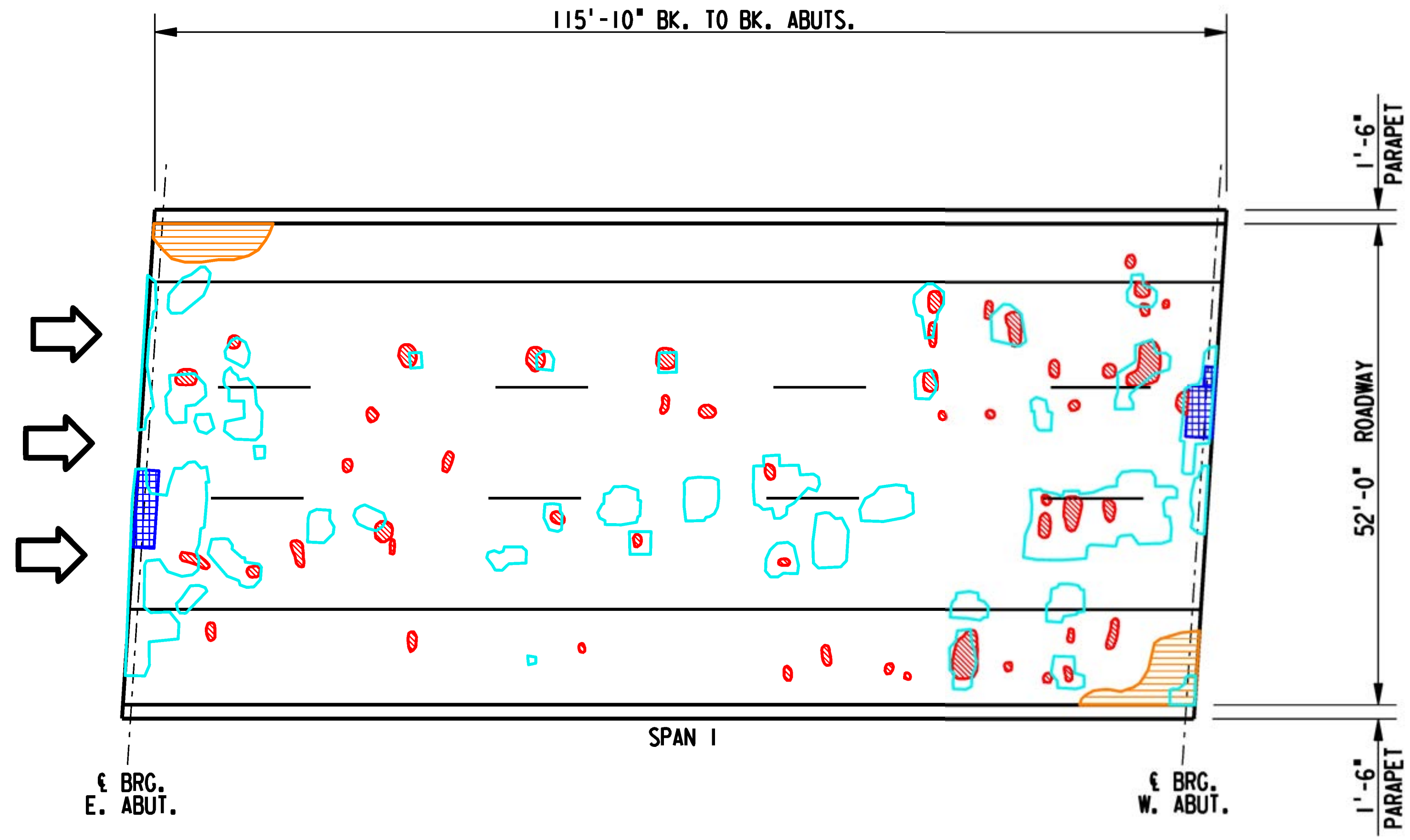


SCALE 0' 5' 10' 20'

FIELD OBSERVATIONS SUMMARY		STRUCTURE NO. B-5-219		LEGEND
ITEM	UNIT	QUANT.	%	
TOTAL AREA	ft^2	5152		DELAMINATION
SHADE/DEBRIS	ft^2	0		SPALL
DELAMINATION	ft^2	144	2.8	DEBOND/SCALING
SPALL	ft^2	0	0	ASPHALT PATCH
DEBOND/SCALING	ft^2	354	6.9	CONCRETE PATCH
ASPHALT PATCH	ft^2	0	0	SHADE/DEBRIS
CONCRETE PATCH	ft^2	0	0	REHAB
TYPE-1 REHAB AREA	ft^2	185	3.6	

SURFACE TYPE: PMA OVERLAY
INFRARED INSPECTION DATE: 7/23/19

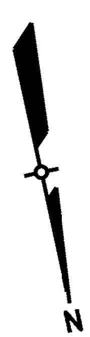
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-220

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-220	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft²	6022	
TOTAL DEFECTS*	ft²	149	2.5
TOTAL TYPE-1 REHAB	ft²	617	10.2
DEFECTS/REHAB OVERLAP	ft²	95	1.6
IR FALSE POSITIVES	ft²	54	0.9
REHAB NOT DETECTED BY IR	ft²	522	8.7

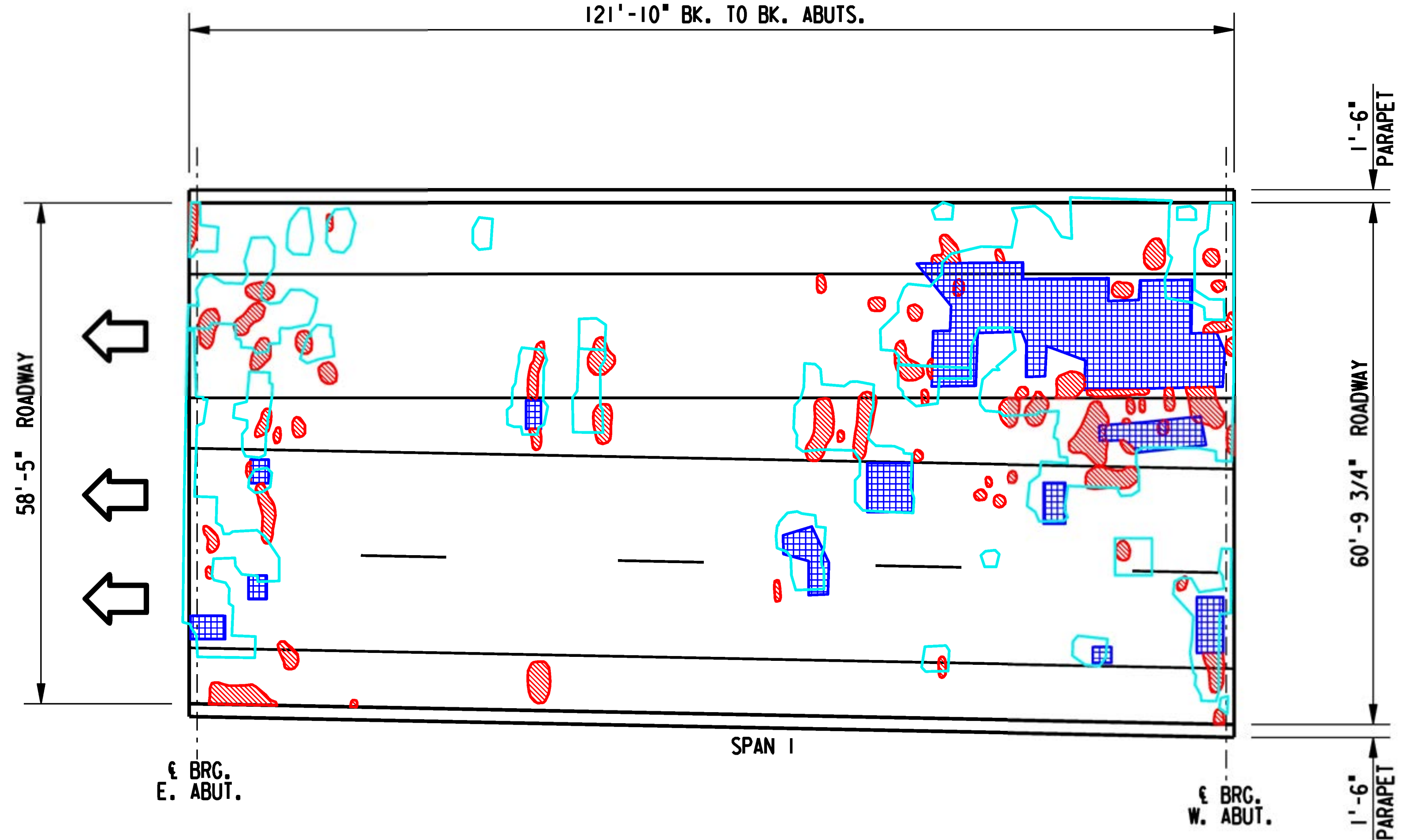


FIELD OBSERVATIONS SUMMARY		STRUCTURE NO. B-5-220		LEGEND
ITEM	UNIT	QUANT.	%	DELAMINATION
TOTAL AREA	ft²	6022		SPALL
SHADE/DEBRIS	ft²	0		DEBOND/SCALING
DELAMINATION	ft²	111	1.8	ASPHALT PATCH
SPALL	ft²	0	0	CONCRETE PATCH
DEBOND/SCALING	ft²	95	1.6	SHADE/DEBRIS
ASPHALT PATCH	ft²	37	0.6	REHAB
CONCRETE PATCH	ft²	0	0	
TYPE-1 REHAB AREA	ft²	617	10.2	

SURFACE TYPE: PMA OVERLAY

INFRARED INSPECTION DATE: 7/23/19

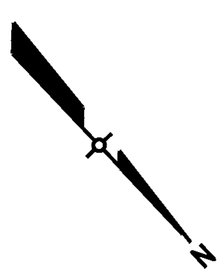
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA

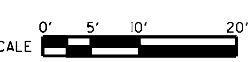


PLAN

B-5-221

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-221	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	7259	
TOTAL DEFECTS*	ft^2	805	11.1
TOTAL TYPE-1 REHAB	ft^2	1586	21.8
DEFECTS/REHAB OVERLAP	ft^2	661	9.1
IR FALSE POSITIVES	ft^2	144	2.0
REHAB NOT DETECTED BY IR	ft^2	925	12.7



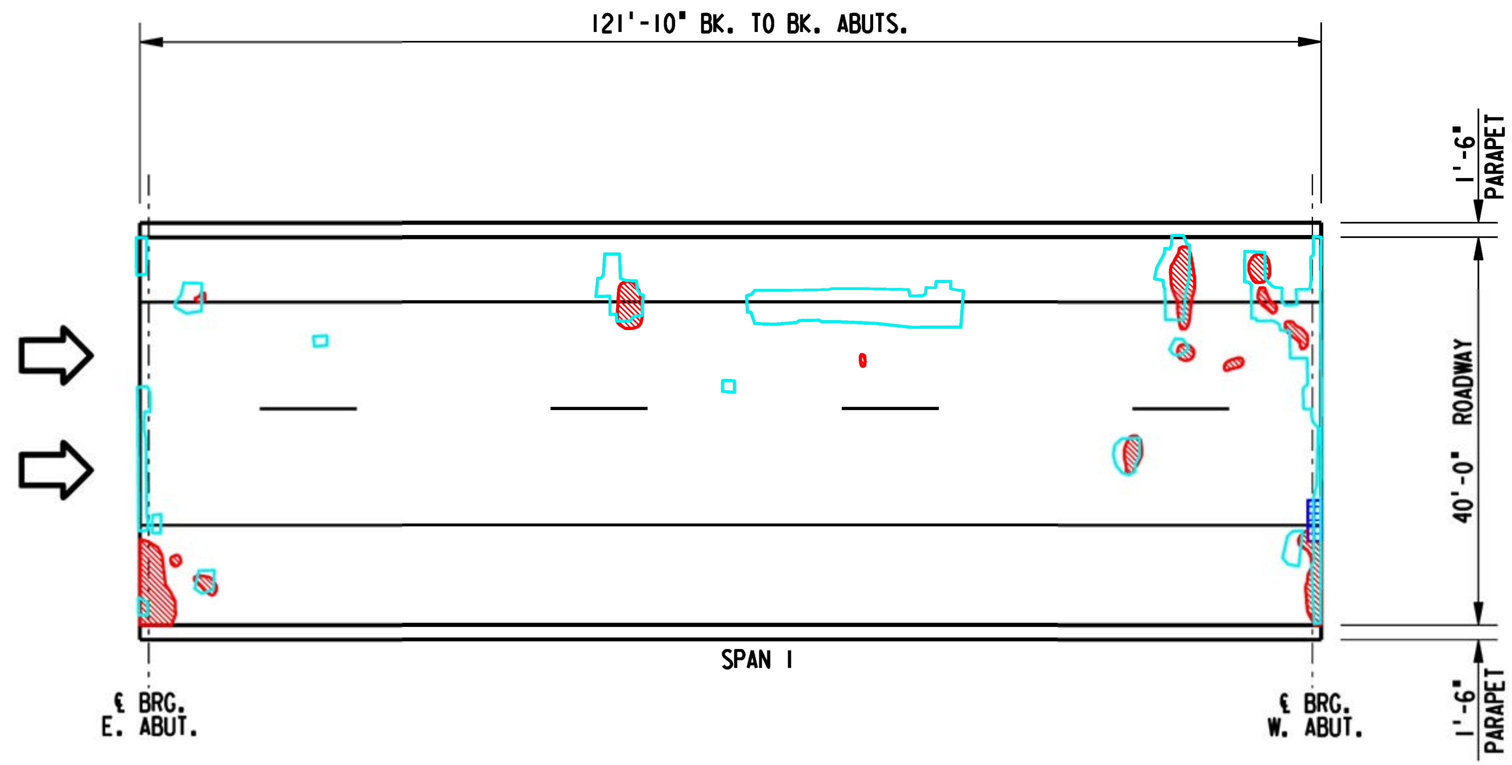


FIELD OBSERVATIONS SUMMARY		STRUCTURE NO. B-5-221	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	7259	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	306	4.2
SPALL	ft^2	0	0
DEBOND/SCALING	ft^2	0	0
ASPHALT PATCH	ft^2	505	7.0
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	1586	21.8

LEGEND
DELAMINATION
SPALL
DEBOND/SCALING
ASPHALT PATCH
CONCRETE PATCH
SHADE/DEBRIS
REHAB

SURFACE TYPE: BITUMINOUS OVERLAY
INFRARED INSPECTION DATE: 7/23/19

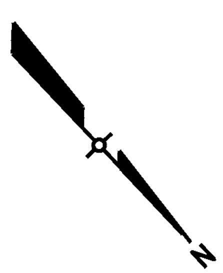
*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-222

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-222	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	4872	
TOTAL DEFECTS*	ft^2	92	1.9
TOTAL TYPE-1 REHAB	ft^2	239	4.9
DEFECTS/REHAB OVERLAP	ft^2	47	1.0
IR FALSE POSITIVES	ft^2	45	0.9
REHAB NOT DETECTED BY IR	ft^2	192	3.9



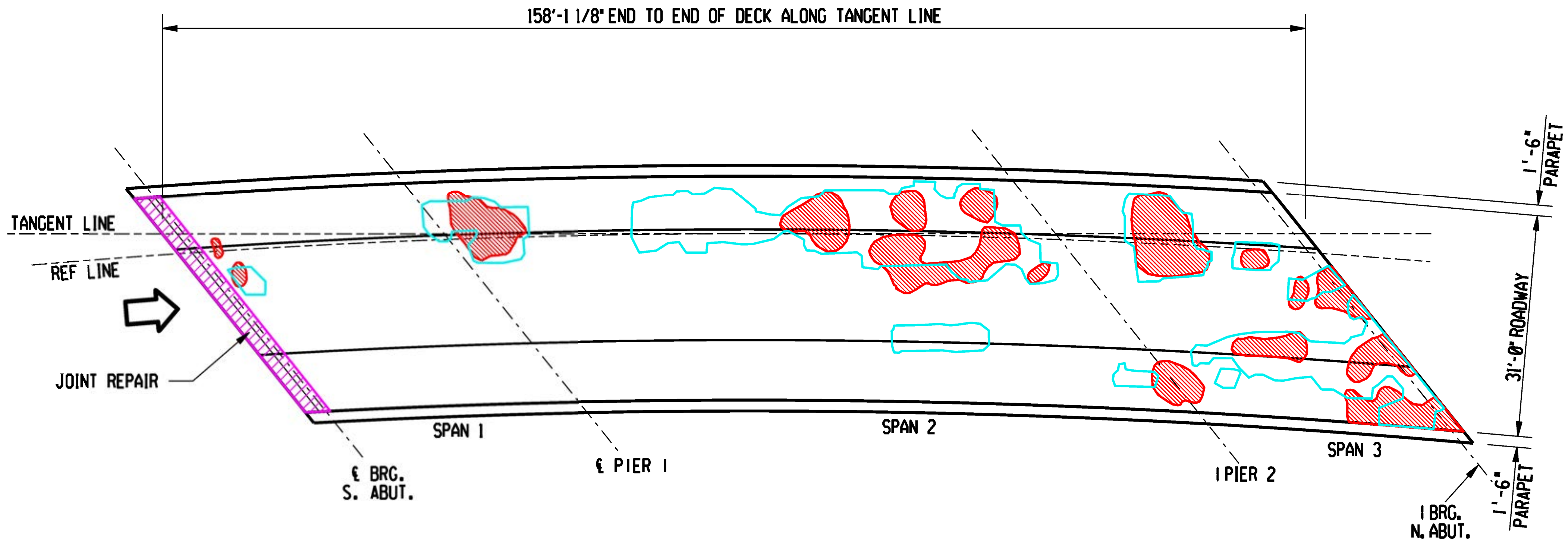
FIELD OBSERVATIONS SUMMARY		STRUCTURE NO. B-5-222	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	4872	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	87	1.8
SPALL	ft^2	0	0
DEBOND/SCALING	ft^2	0	0
ASPHALT PATCH	ft^2	6	0.1
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	239	4.9

LEGEND

- DELAMINATION
- SPALL
- DEBOND/SCALING
- ASPHALT PATCH
- CONCRETE PATCH
- SHADE/DEBRIS
- REHAB

SURFACE TYPE: BITUMINOUS OVERLAY
INFRARED INSPECTION DATE: 7/23/19

*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



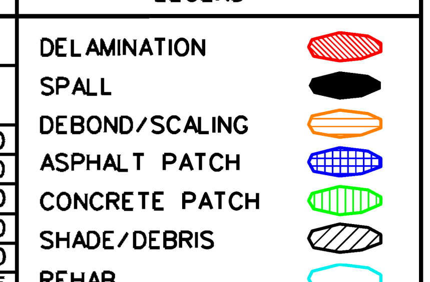
PLAN

B-5-223

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-223	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	4904	
TOTAL DEFECTS*	ft^2	541	11.0
TOTAL TYPE-1 REHAB	ft^2	1005	20.5
DEFECTS/REHAB OVERLAP	ft^2	423	8.6
IR FALSE POSITIVES	ft^2	118	2.4
REHAB NOT DETECTED BY IR	ft^2	582	11.9

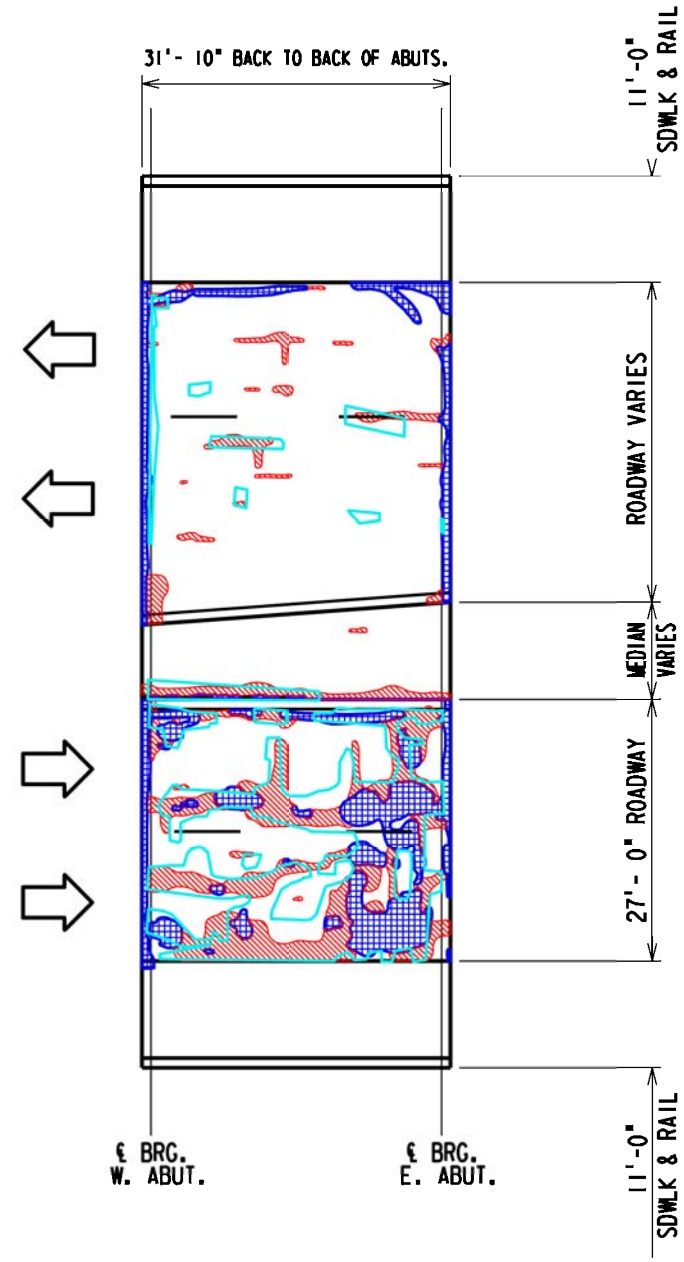
FIELD OBSERVATIONS SUMMARY		STRUCTURE NO. B-5-223	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	4904	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	541	11.0
SPALL	ft^2	0	0
DEBOND/SCALING	ft^2	0	0
ASPHALT PATCH	ft^2	0	0
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	1005	20.5

LEGEND



SURFACE TYPE: BITUMINOUS OVERLAY
INFRARED INSPECTION DATE: 7/23/19

*DEBONDING/SCALING NOT INCLUDED IN TOTAL DEFECTS AREA



PLAN

B-5-284

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-5-284	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft²	2228	
TOTAL DEFECTS	ft²	539	24.2
TOTAL TYPE-1 REHAB	ft²	474	21.3
DEFECTS/REHAB OVERLAP	ft²	323	14.5
IR FALSE POSITIVES	ft²	216	9.7
REHAB NOT DETECTED BY IR	ft²	151	6.8

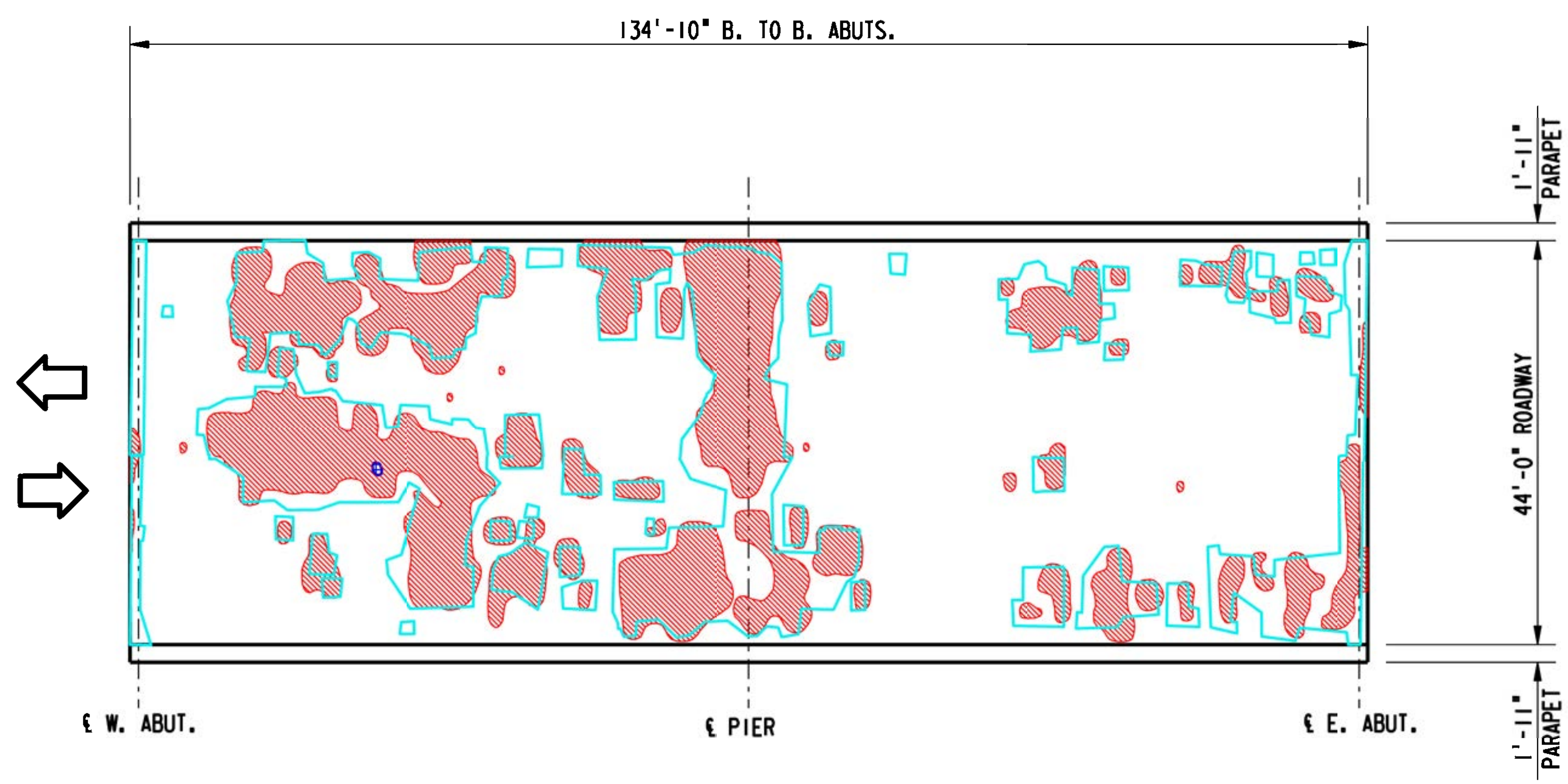
STRUCTURE NO. B-5-284

FIELD OBSERVATIONS SUMMARY		DECK AREA	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft²	2228	
SHADE/DEBRIS	ft²	0	
DELAMINATION	ft²	283	12.7
SPALL	ft²	0	0
DEBOND	ft²	N/A	N/A
ASPHALT PATCH	ft²	256	11.5
PCC PATCH	ft²	0	0
TYPE-1 REHAB AREA	ft²	474	21.3

LEGEND
DELAMINATION
SPALL
DEBOND/SCALING
ASPHALT PATCH
CONCRETE PATCH
SHADE/DEBRIS
REHAB

SCALE 0' 5' 10' 20'

SURFACE TYPE: CONCRETE - NO OVERLAY
INFRARED INSPECTION DATE: 6/23/22



PLAN

B-20-23

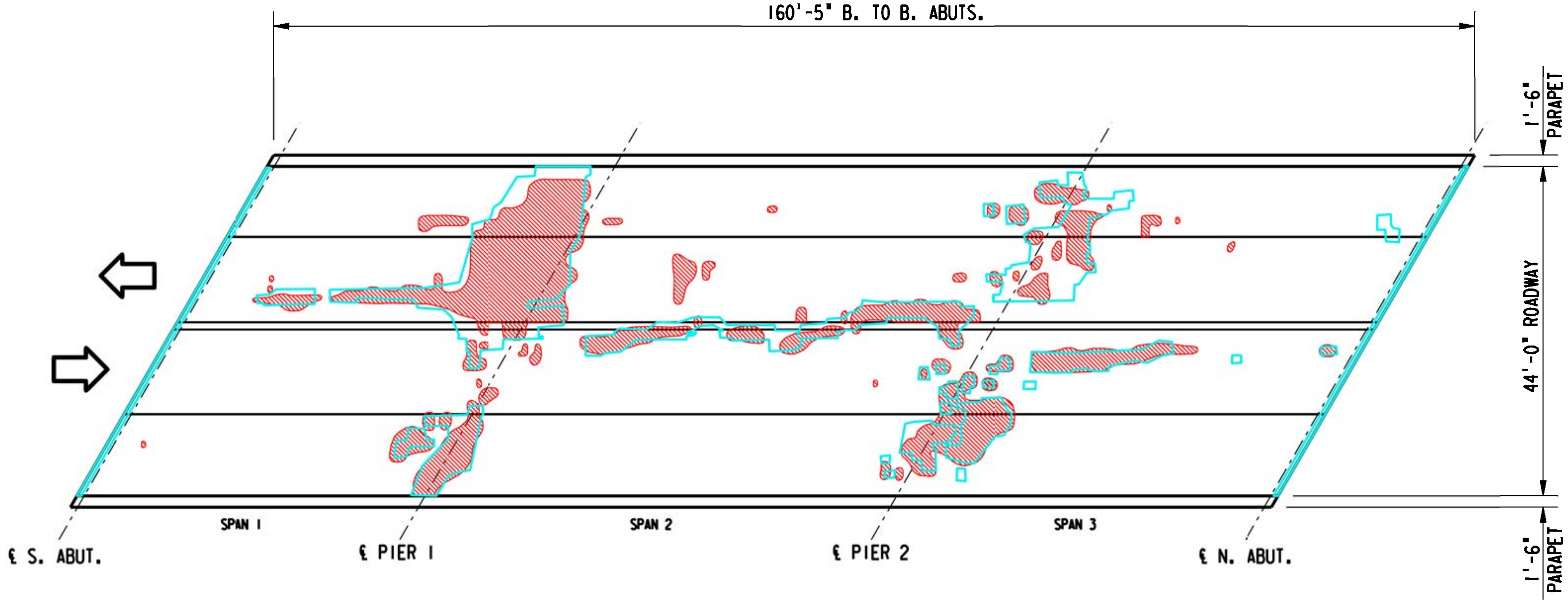
DEFECT-REHAB COMPARISON		STRUCTURE NO. B-20-23	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	5883	
TOTAL DEFECTS	ft^2	1517	25.8
TOTAL TYPE-1 REHAB	ft^2	1949	33.1
DEFECTS/REHAB OVERLAP	ft^2	1335	22.7
IR FALSE POSITIVES	ft^2	182	3.1
REHAB NOT DETECTED BY IR	ft^2	614	10.4

FIELD OBSERVATIONS SUMMARY		S.N. B-20-23	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	5883	
SHADE/DEBRIS	ft^2	0	
DELAMINATION	ft^2	1516	25.8
SPALL	ft^2	0	0
DEBOND	ft^2	0	0
ASPHALT PATCH	ft^2	1	<0.1
CONCRETE PATCH	ft^2	0	0
TYPE-1 REHAB AREA	ft^2	1949	33.1

LEGEND

- DELAMINATION
- SPALL
- DEBOND/SCALING
- ASPHALT PATCH
- CONCRETE PATCH
- SHADE/DEBRIS
- REHAB

SURFACE TYPE: BITUMINOUS OVERLAY
INFRARED INSPECTION DATE: 6/1/17



PLAN

B-31-18

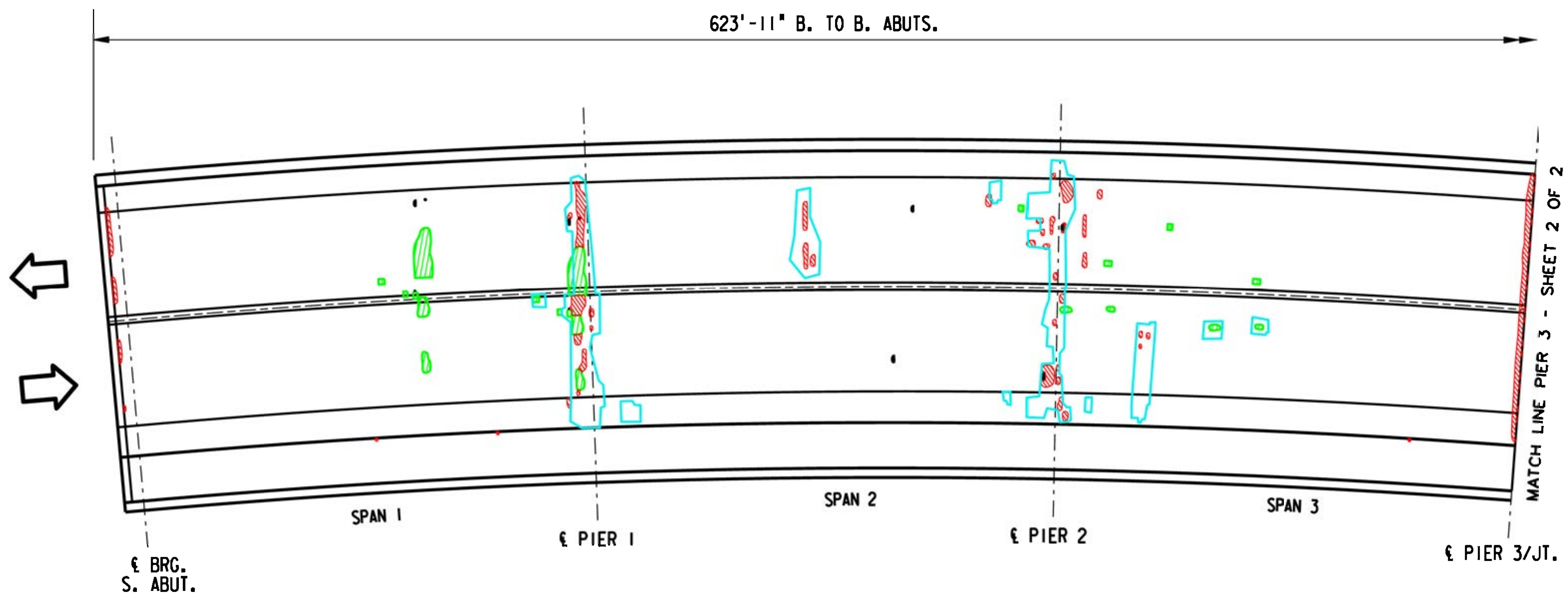
DEFECT-REHAB COMPARISON		STRUCTURE NO. B-31-18	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft²	7000	
TOTAL DEFECTS	ft²	782	11.2
TOTAL TYPE-1 REHAB	ft²	882	12.6
DEFECTS/REHAB OVERLAP	ft²	608	8.7
IR FALSE POSITIVES	ft²	173	2.5
REHAB NOT DETECTED BY IR	ft²	274	3.9

SCALE 0' 5' 10' 20'

FIELD OBSERVATIONS SUMMARY		S.N. B-31-18	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft²	7000	
SHADE/DEBRIS	ft²	0	
DELAMINATION	ft²	785	11.2
SPALL	ft²	0	0
DEBOND	ft²	0	0
ASPHALT PATCH	ft²	0	0
CONCRETE PATCH	ft²	0	0
TYPE-1 REHAB AREA	ft²	882	12.6

LEGEND
DELAMINATION
SPALL
DEBOND/SCALING
ASPHALT PATCH
CONCRETE PATCH
SHADE/DEBRIS
REHAB

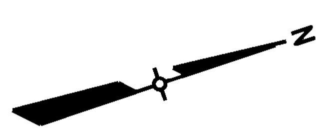
SURFACE TYPE: BITUMINOUS OVERLAY
INFRARED INSPECTION DATE: 7/27/17

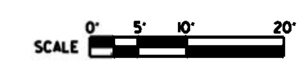


PLAN

B-31-23

DEFECT-REHAB COMPARISON		STRUCTURE NO. B-31-23	
ITEM	UNIT	QUANT.	%
TOTAL AREA	ft^2	22417	
TOTAL DEFECTS	ft^2	301	1.3
TOTAL TYPE-1 REHAB	ft^2	768	3.4
DEFECTS/REHAB OVERLAP	ft^2	155	0.7
IR FALSE POSITIVES	ft^2	146	0.7
REHAB NOT DETECTED BY IR	ft^2	613	2.7

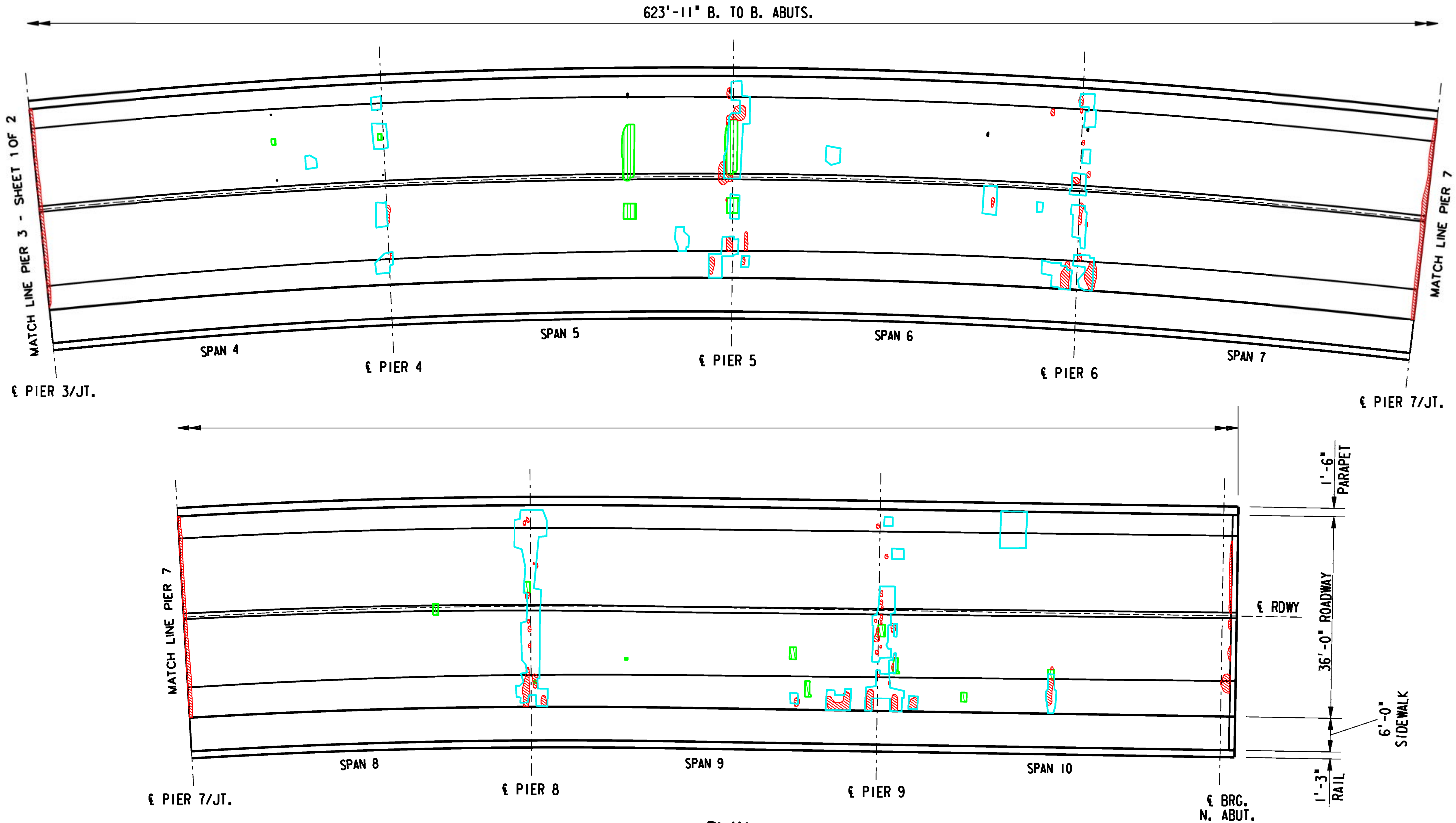




S.N. B-31-23

FIELD OBSERVATIONS SUMMARY		ROADWAY		LEGEND
ITEM	UNIT	QUANT.	%	
TOTAL AREA	ft^2	22417		DELAMINATION
SHADE/DEBRIS	ft^2	0		SPALL
DELAMINATION	ft^2	240	1.1	DEBOND/SCALING
SPALL	ft^2	3	<0.1	ASPHALT PATCH
DEBOND	ft^2	N/A	N/A	CONCRETE PATCH
ASPHALT PATCH	ft^2	0	0	SHADE/DEBRIS
CONCRETE PATCH	ft^2	58	0.3	REHAB
TYPE-1 REHAB AREA	ft^2	768	3.4	

SURFACE TYPE: CONCRETE - NO OVERLAY
INFRARED INSPECTION DATE: 7/27/17



PLAN

B-31-23

LEGEND
DELAMINATION
SPALL
DEBOND/SCALING
ASPHALT PATCH
CONCRETE PATCH
SHADE/DEBRIS
REHAB

NOTE: SEE SHEET 1 OF 2
FOR DEFECT/REHAB QUANTITIES

SCALE 0' 5' 10' 20'

SURFACE TYPE: CONCRETE - NO OVERLAY
INFRARED INSPECTION DATE: 7/27/17

IRT Defect and Rehabilitation Overlap Comparison

Bridge ID	WS	Total Deck SQ FT	Total IRT SQ FT	Total Rehab SQ FT	Overlap SQ FT	False Positives SQ FT	FP/Deck Area	Rehab Not Detected by IRT SQ FT	RND/Deck Area	IRT % Correct by Deck Area
B-5-202	PMA	7188	2	104	0	2	0.0%	104	1.4%	98.5%
B-5-203	PMA	7188	61	113	7	54	0.8%	106	1.5%	97.8%
B-5-208	PMA	7454	1684	3318	1377	307	4.1%	1941	26.0%	69.8%
B-5-209	PMA	6188	214	800	132	82	1.3%	668	10.8%	87.9%
B-5-210	PMA	4303	236	598	158	79	1.8%	441	10.2%	87.9%
B-5-211	PMA	5530	30	252	13	17	0.3%	239	4.3%	95.4%
B-5-212	PMA	7578	531	1359	292	239	3.2%	1067	14.1%	82.8%
B-5-213	PMA	10364	3470	4850	2732	738	7.1%	2118	20.4%	72.4%
B-5-214	PMA	5137	459	929	378	82	1.6%	552	10.7%	87.7%
B-5-215	PMA	9826	2783	5688	2271	512	5.2%	3417	34.8%	60.0%
B-5-216	PMA	8445	2208	2846	1608	601	7.1%	1238	14.7%	78.2%
B-5-219	PMA	5152	144	185	47	98	1.9%	138	2.7%	95.4%
B-5-220	PMA	6022	149	617	95	54	0.9%	522	8.7%	90.4%
B-5-221	HMA	7259	805	1586	661	144	2.0%	925	12.7%	85.3%
B-5-222	HMA	4872	92	239	47	45	0.9%	192	3.9%	95.1%
B-5-223	HMA	4904	541	1005	423	118	2.4%	582	11.9%	85.7%
B-20-23	HMA	5883	1517	1949	1335	182	3.1%	614	10.4%	86.5%
B-31-18	HMA	7000	782	882	608	173	2.5%	274	3.9%	93.6%
B-31-23	Bare	22417	301	768	155	146	0.7%	613	2.7%	96.6%
B-5-284	Bare	2228	539	474	323	216	9.7%	151	6.8%	83.5%