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# Thermal imaging paving the way for lower road maintenance costs

## Application Note

Testing Functions
**Case Study**

**Tool:** Fluke Ti Flexcam Series Portable Thermal Imagers with IR-Fusion®

**Profile:** Martin Lavoie, Engineer Project Manager, Ministry of Transport, Government of Quebec

**Inspections:** Asphalt temperature differences pre, during, and post application

Climate extremes wreak havoc with roads and expressways. Every year, provincial governments in Canada spend billions of dollars on repairing and resurfacing roads that have suffered damage from freezing temperatures, salt and high traffic volumes.

Those involved in managing road repairs face a significant challenge because new asphalt must be maintained within specific temperatures before and during application to surfaces. Any temperature differences and the asphalt consistency can change, meaning a poorer quality surface that will deteriorate more quickly over time. This in turn leads to added repair costs and higher maintenance fees.

In 2007, the Quebec Ministry of Transport decided it was time to find better ways to maximize their ongoing investment in road repair activities. The road system under the Ministry's jurisdiction is 29,100 km, (18,081 miles) in length. Approximately 75 % of the highways are in the Montréal metropolitan area, which accounts for 35 % of automobile traffic for Quebec's entire road system. The province estimated that road and bridge work would cost $2.7 billion in 2008 alone and include nearly 2,000 repair projects.

As part of its improvement initiative, the Ministry turned to Montreal-based ITM Instruments Inc. to find a way to better manage the quality control processes for asphalt being used to pave highways and streets. After careful consideration, it decided to see what thermal imaging technology could do to help inspectors and paving contractors check and monitor asphalt temperatures throughout the delivery and application process.

### Temperature control

Incorrect asphalt temperatures can create no end of problems for pavers—not to mention the organizations that have to pay the bill for ongoing maintenance and repair. If an asphalt mix or portions within it are too cold during application, the viscosity is increased to the point where the asphalt layer can not be compacted as much as it should. This leads to porous and weak zones and allows water infiltration which contributes to pavement deterioration (freeze and thaw cycle and pressure). If the asphalt mix is too hot, oxidation affecting asphalt properties occurs faster. In both cases, roads will deteriorate much faster than they should.

Taking asphalt temperatures during application.

"If asphalt is not applied at the right temperature it will cost much more in maintenance," Claude Boudrault of ITM explains. "Technically asphalt is supposed to last a certain number of years. However, if there are segregation problems from asphalt temperatures that are too hot or cold, then those years could be cut in half—and repairs are required much earlier in the cycle."

Martin Lavoie, Engineer Project Manager, Ministry of Transport, Government of Quebec, says the problem begins with the trucks delivering the asphalt. "Sometimes portions of the surface of the load are cooling down, so then it ends up not being properly remixed by the finishers. Finding cold spots in the fresh laid asphalt layer or mat is critical for us because segregation will lead to a non-uniform mixture and poor compacting. There can also be overheated sections and oxidation problems, so we must test for both maximum and minimum temperature levels at the same time to ensure uniformity."

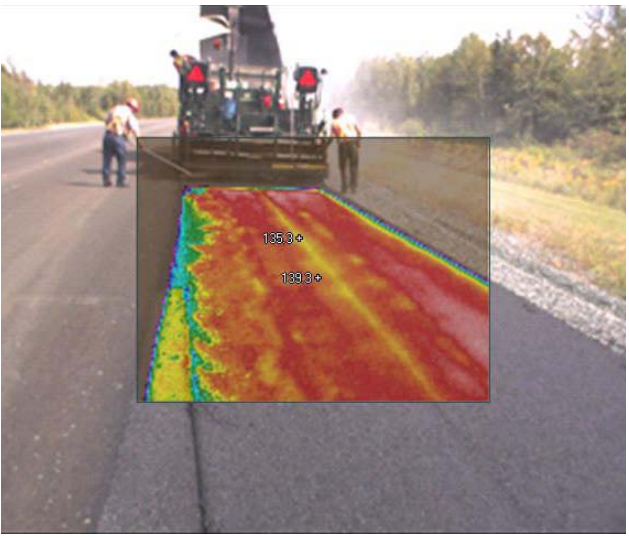
Although every effort is made to check asphalt load temperatures on arrival at the site, traditional methods do not provide a complete picture of potential temperature fluctuations. One particular challenge is that asphalt does not cool evenly during haul time, making it difficult to get readings of all the multiple temperature variations within the truck's interior. As a result, portions of the asphalt outside the temperature ranges may go undetected until the paving job is complete.

Another challenge for pavers is mid-lane segregation, where temperature changes can happen in the middle of a strip that is laid down. "This is a big issue for us—and the contractors—because it can lead to longitudinal distress," explains Lavoie. "In some cases, repairs have to be made within as little as two years."

On application, an inspector will typically use a nuclear density gauge to take a reading for every 250 tons to ensure everything is within the prescribed temperature limits (average six readings per day). In some cases, they may have to resort to a visual inspection to detect problems in the applications. Given that neither process can address all surface areas, it can lead to costly oversights.

"The problem is we can't always see lapses in uniformity just after a paving operation," says Lavoie. "Sometimes it all seems good but the problems will appear a few years after that. While nuclear density measurement gauges are a good tool for seeing general compaction and density, we have to be lucky to find those colder spots that tend be less compact."

Visual inspections for their part will not yield the information they need since they won't provide quantifiable results, he adds. "Sometimes we might see segregation, but what can you do with that? You have no numbers or objective way to verify it. You need [objective data] like temperature readings obtained from camera which are based on correlations already established between temperatures and uniformity of the application density."




Thermal differentials, uneven temperatures, and longitudinal center streaks in fresh asphalt can indicate quality control problems.

## The thermal imaging solution

Thermal imaging addresses the uniformity issue by providing a visual image of all temperatures within a given area at once, as well as verifying minimum and maximum temperature ranges. If any portions of the asphalt fall outside those parameters, then the appropriate adjustments can be made before the job is finalized.

They chose the Fluke Ti45 and Ti55 Thermal Imagers because they feature everything needed for detailed thermography tasks, including a 160 x 120 detector (320 x 240 on the Ti55) and a temperature sensitivity down to 0.08 °C (80 mK) (NETD). Sensors deliver high resolution images of even the smallest temperature differences to an easy-to-read screen on the handheld unit. The technology also offers an extended troubleshooting feature set to allow on the spot analysis in the field through the IR-Fusion technology. This feature captures visible light image in addition to the infrared image to simplify IR image analysis and can help users view the location of measurements and share information with contractors and inspectors.

"With these IR-Fusion® infrared thermal imagers we can control results much better because we can clearly see the temperature readings on the screen," says Lavoie. "We can immediately detect any spots that are not consistent with the minimum/maximum temperature ranges and have the paver fix them before the job is complete."

The Quebec Ministry of Transport began its thermography program on six pilot projects. Plans are to increase the number of units in the field to 14 in the coming months. In addition, the Ministry is encouraging paving contractors to use infrared thermal imagers to check asphalt shipments before delivery, which will help to improve consistency and reduce the added time spent on on-site repairs.

"With thermal imaging we can be more focused on the effect of laydown operations and pavers adjustment problems during applications and not after the fact," says Lavoie. "Less repairs and longer pavement life will result in tremendous cost savings for the government over the long term."

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