APPLICATION NOTES

U.S. Department of Transportation
Federal Highway Administration

INTELLIGENT COMPACTION FOR ASPHALT PAVING

APPLICATION NOTES: INTELLIGENT COMPACTION IMPLEMENTATION ON SITKA AIRPORT PROJECT

With traditional rolling efforts, some areas of the asphalt mat do not receive total coverage. Contractors can use intelligent compaction (IC) to ensure the entire asphalt mat gets the correct amount of compaction effort.

BACKGROUND

Intelligent compaction (IC) takes all the guesswork out of rolling patterns. Because asphalt compaction is temperature and time dependent, IC seems like an obvious solution to ensure that the entire asphalt mat gets the correct amount of compaction effort. With traditional rolling efforts, there are always some areas of the asphalt mat that do not receive total coverage. The amount of these "missed" areas will vary depending on roller operators' experience. However, even the most talented roller operators will leave some areas of the mat with an inadequate coverage. This creates locations that will have less than optimum densities.

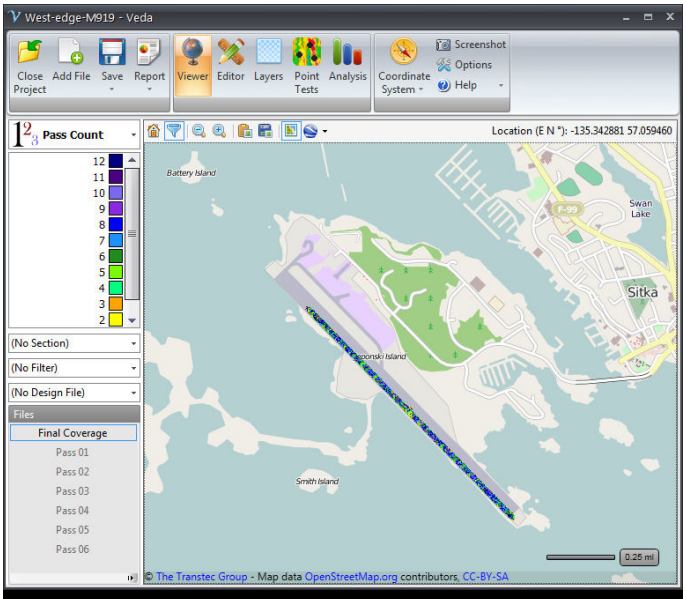
Few density tests are taken in comparison to the amount of asphalt that is placed. Because so few areas are tested for density, it makes sense to assume that areas that do not receive total compaction coverage can be, and are, easily overlooked. There are several factors that affect asphalt density, such as: temperature, existing subgrade and base course density, rolling patterns and variation in mix. To have a quality control tool that can eliminate one of these factors is very beneficial for a Contractor.

USE ON THE SITKA AIRPORT PROJECT

Intelligent compaction was required during asphalt paving per the specifications for the Sitka Rocky Gutierrez Airport Runway Overlay Project. This project required milling ½ inch of the existing runway and paving 2 ½ inches on the milled surface. The runway was closed nightly, and reopened each morning. All work had to be completed during the hours of 7:00 pm to 7:00 am.

IC was listed as a bid item in the contract. Per the specifications, one IC roller was required per paver. The contract required echelon paving, so two IC rollers were used. The standard FHWA IC specification was used.

The Contractor, Knik Construction Co., Inc. (Knik), used Wirtgen/HAMM Tandem HD+ 140 VO IC Rollers. The IC rollers were used in the breakdown rolling position. The onboard display was used to monitor pass counts and temperatures in real time. This was particularly useful for night paving. It was very dark and rolling lines were difficult to see. Both roller operators agreed that had it not been for the real time monitoring of roller position (pass counts) it would have been impossible to guarantee full coverage of the asphalt mat.



Screenshot of data in Veda software.

IC data was collected at the end of each shift. Collecting, analyzing, and sharing the data daily helped to keep the IC responsibilities manageable. The data collection (including setting up IC system for data storage and transferring the stored raw IC data from the rollers to other computers via USB flash drives) was handled by the Quality Control Manager (QCM). Depending on the amount of analysis that was performed on the data, this process took approximately 15-60 minutes. Data collection and transfer is conveniently done via USB drives. The data was viewed in the Wirtgen/HAMM HCQ software, and then exported to Veda compatible files. Per the project specifications, the raw Veda files were then shared with the Agency. Veda was a useful tool for viewing each roller pass individually and checking for consistency of coverage, and asphalt temperatures. It was also useful to view the roller speed, frequency, and amplitude settings. Statistical analysis was quickly performed using the Veda software.

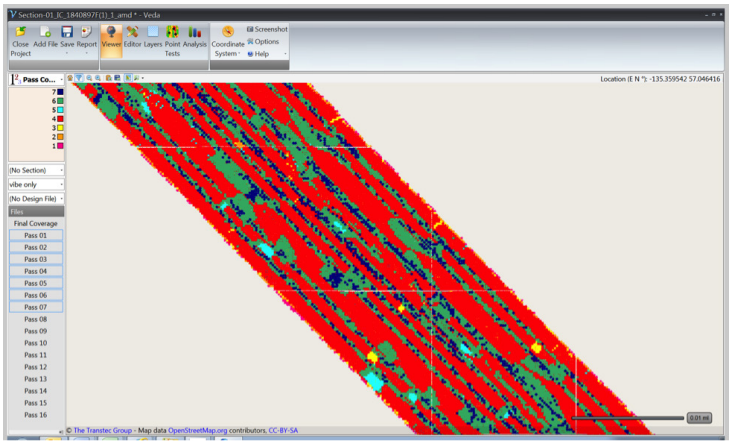
The Hamm Measurement Value (HMV) is the Intelligent Compaction Measurement Value (ICMV), or stiffness index for the Hamm/Wirtgen IC equipment. The HMV values vary drastically based on roller speed, frequency, and amplitude settings. It is important to note that because the IC rollers were new equipment, Knik experimented with several different roller settings. This resulted in inconsistent HMV values throughout the project. Because the values were so inconsistent, they were not useful as a QC tool.

HMV values do not correlate with asphalt density, so they cannot be used to predict asphalt density. The HMV value does not separate the stiffness of the asphalt layer from the stiffness from the existing surface. So, low HMV values gathered during paving do not necessarily reflect soft spots in the asphalt. In order to identify soft spots in the existing surface prior to paving, pre-mapping can be performed using the IC roller. This requires making vibratory passes on a low amplitude setting over the entire existing surface. The equipment manufacturer did not recommend using the IC rollers in a vibratory setting on the existing asphalt surface, so this was not performed for the Sitka Airport Project. However, there is a great benefit to both the Contractor and the Agency by pre-mapping existing surfaces prior to paving to locate soft spots. Pre-mapping can either identify areas that needed to be repaired, or at least identify potential areas where asphalt density could be compromised. Knik plans to use pre-mapping for quality control purposes on future projects.

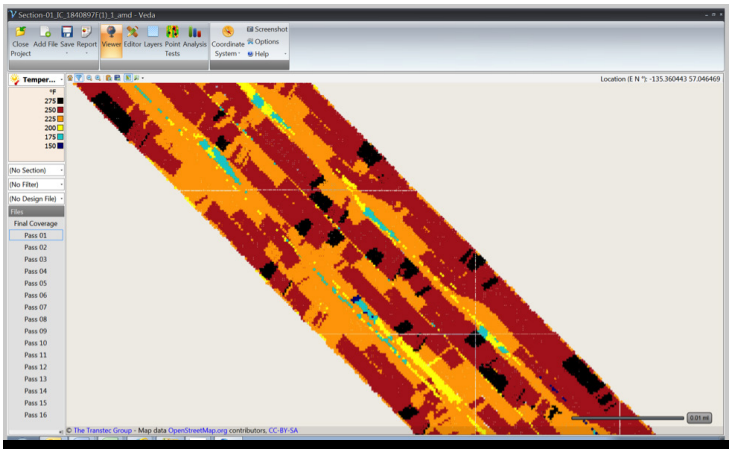
The IC rollers were very effective in helping to meet full coverage requirements. Both the mat and joint densities on the Sitka Airport Project met full bonus requirements and remained consistent throughout the project.

TRAINING FOR THE SITKA AIRPORT PROJECT

There were two parts of training required per the specifications: a classroom training for all Agency and Contractor personnel involved with the IC operation, and on-site training for the roller operators. Wirtgen representatives were on site to assist with the IC training. Prior to the start of paving, the QCM had one-on-one training with the Wirtgen representative. This training covered IC equipment setup, computer project setup, HCQ computer software, data transfer, and data analysis. The QCM also attended a FHWA ICDM-Veda workshop that explained how to use the Veda software.



Screenshot of project data in Veda data management software: Centerline, night two. Both rollers—vibe passes only, zoomed in to show pass counts (target is four vibe passes).



Screenshot of project data in Veda data management software: Centerline, night two. Both rollers—breakdown temperatures.

Having the training prior to the start of the project made it possible for the Contractor to utilize the IC equipment immediately once the paving operation began.

The roller operators were not initially responsible for any of the equipment or computer setup. It took a few hours of rolling for the operators to get used to having the on-board display. After a few hours both roller operators were able to utilize the real-time data to ensure that the asphalt mat received the right amount of passes (which were established during the test section). After a couple of days of using the IC equipment, the roller operators were taught how to set up new projects on the computer software. After one week, both roller operators were proficient in setting up the equipment and computer software. IC data collection and analysis was always performed by the QCM.

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STRENGTHS

From a Contractor standpoint, the greatest strengths of using IC equipment include:

1. Real-time data of pass counts. There are many reasons why the real time data collected with GPS equipment is so beneficial. It almost eliminates the possibility of missing areas of the asphalt mat during rolling. This helps to achieve consistent densities. The pass count mapping is particularly useful during night paving where roller lines are difficult to see. It also works as an excellent training tool for less experienced roller operators.

2. Real-time data of asphalt temperature. This ensures that the temperature of the mat behind the paver is uniform. This is also critical for achieving consistent densities.

3. Records of all roller settings (speed, frequency, amplitude), pass counts, and temperatures. If there are any issues with achieving asphalt density, these factors can be viewed and used to identify potential issues with the rolling operation.

4. Ability to identify weak spots in the existing surface prior to paving by pre-mapping. This is helpful when preparing the sub base/base course layers. Alternatively, it is also a great tool if the Contractor did not prepare the existing surface to be paved.

LIMITATIONS

From a Contractor standpoint, some of the limitations of using IC equipment include:

1. New system "bugs". IC is still a relatively new technology. There were times when the IC system would crash and have to be rebooted. This can be inconvenient if the roller operator has to frequently stop to reboot the system.

2. There is a large amount of data gathered during a project. It can become overwhelming if not kept up with. In order to keep the amount of data manageable, collection and analysis should be performed daily. This does add some responsibilities for the Contractor.

3. The ICMV values (stiffness modulus/stiffness index) do not correlate to asphalt density. There is also no way to separate the asphalt stiffness from the underlying material stiffness. These ICMV values are also dependent on roller settings. All roller settings (speed, frequency, amplitude) must remain fixed throughout the project in order to compare the values.

FUTURE FOR IC

Overall, Knik has had a positive experience with IC. Knik plans to continue using IC on different projects.

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