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Implementation of Intelligent Compaction (NACOE P105)

Intelligent compaction (IC) refers to the use of a compaction roller equipped with an integrated roller measurement system (often using an accelerometer mounted on the drum), and a survey-grade precision GPS unit. If used for asphalt compaction, infrared temperature sensors are also used. The IC technology has an on-board computer display that provides the operator with real-time feedback of the stiffness of compacted materials and roller passes. For asphalt application, infrared temperature sensors are also mounted on the roller to track asphalt surface temperature during compaction.

The main advantage of IC technology is the improvement of construction quality control, efficiency and uniformity, as well as the reduction in construction and maintenance cost. It can provide contractors with timely feedback of the compaction and can be used to pre-map the condition of existing layers before placing the next lift. The technology also captures and securely stores the compaction process information as permanent geo-referenced records.

First ICDM Workshop in Australia

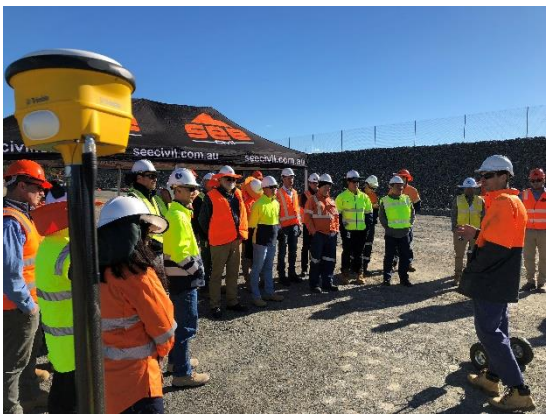
IC technology has been increasingly used in Europe, Asia, and the United States., and as part of the NACOE P105 project, the first two-day Intelligent Compaction Data Management (ICDM) workshop in Australia was held in South East Queensland on 3 – 4 June 2019. The event was delivered by Dr. George Chang (Transtec Group) and Dr. Jeffrey Lee (Australian Road Research Board).

Veta
INTELLIGENT CONSTRUCTION

ICDM-Veta Workshop
Intelligent Construction Data Management

The first day of the event covers the basics of intelligent compaction, and the participants have a hands-on experience of using the Veta software and explore its data management and analytical capability. On the second day of the event, a field demonstration was conducted using a Dynapac smooth drum roller with a Trimble IC retrofit kit at a test strip. Participants include members from Transport and Main Roads and Local Government representatives.

Day 1: Classroom lecture and Veta hands-on



Day 2: Field demonstration

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IC Field Demonstration Description and Site Preparation

During the field demonstration, the IC roller was used to compact a general fill area (60 m by 23 m). The test strips were prepared at three different moisture contents, namely WET (about 10% volumetric moisture content), OPTIMUM (about 8%), and DRY (about 6%). The exercise familiarised participants with IC technology and demonstrated how to use a test strip to establish a target ICMV value and roller passes for process control.

Preparing the surface of the test strip

Moisture conditioning and roller compaction

IC Roller and, In-situ Spot Tests

IC Technology used in the Field Demonstration

To complete the IC demonstration, the civil contractor used:

- A 15-ton Dynapac CA4600D single drum roller with Trimble retrofit kit. The roller operates at 30 Hz and has two settings in amplitude (i) 120 kN and (ii) 270 kN.
- A Trimble IC retrofit kit that include: RTK GPS, Compaction Meter Value (CMV) measurements, and an onboard computer display
- Online VisionLink data-managing software

Dynapac CA4600D 15-ton single drum

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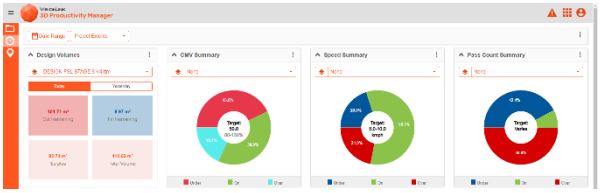
Trimble IC Retrofit Kit: Accelerometer of the CMV system

On-board display for real-time feedback to roller operator

CMV is an accelerometer-based ICMV system. The measurement uses the frequency analysis of the vertical drum acceleration to compute CMV that relates to the ground stiffness. The test strip was used to correlate ICMV and spot tests to determine a target value for ICMV and roller passes for the given material of the specific lift of the compaction.
The IC data was automatically uploaded to the Cloud in near real-time using a cellular data modem, so that compaction progress could be monitored using web-based, VisionLink software, or can access from an APP on a mobile phone.



Trimble VisionLink software

Spot-Tests

Spot test: Prima Light weight deflectometer (LWD)

Spot tests can include nuclear density-moisture gauge, lightweight deflectometer (LWD) and falling weight deflectometer (FWD). The portable LWD equipment drops weight from different heights and can quickly measure the in-situ modulus. Previous NACOE research project found that it is more capable of identifying soft spots in the field than conventional density measurements. The spot tests are also associated with GPS measurements to import to Veta for correlation analysis with IC data.

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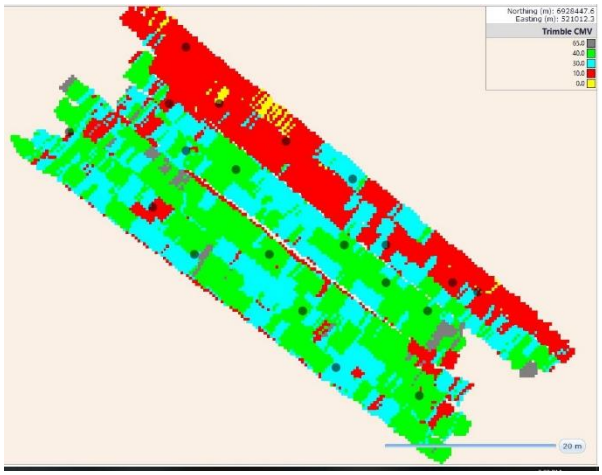
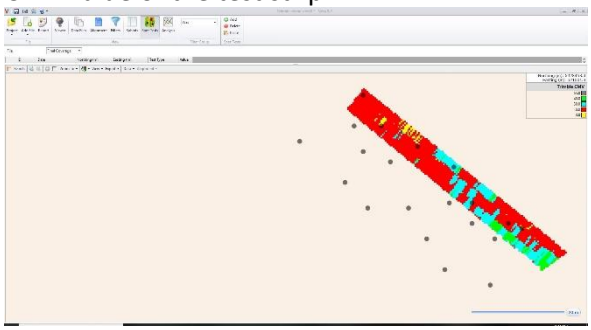
What can IC technology tell you with the help of the Veta Software?

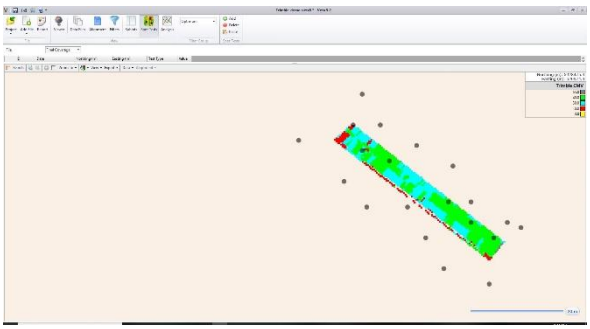
The Veta software is a public domain software which imports IC data from all vendors. Recent upgrades in Veta allows it to map data to the Australian and New Zealand grid systems. Users can use Veta to manage the vast amount of IC data, correlate with spot test results, and easily track the number of roller passes in each lift.



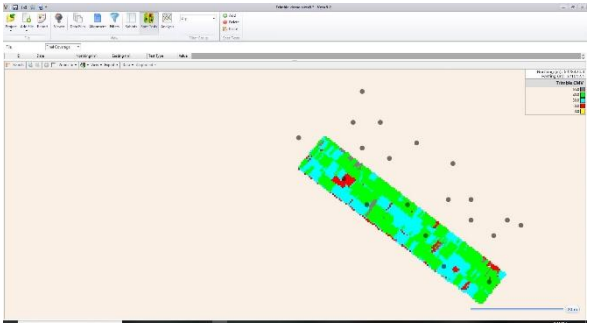
CMV value of the test strip



Subset of test strip compacted to WET of optimum



Subset of test strip compacted to OPTIMUM



Subset of test strip compacted to dry of optimum

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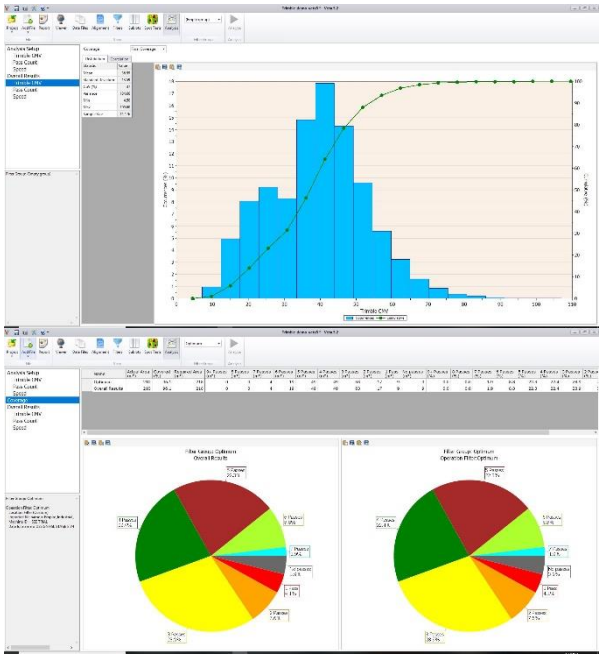
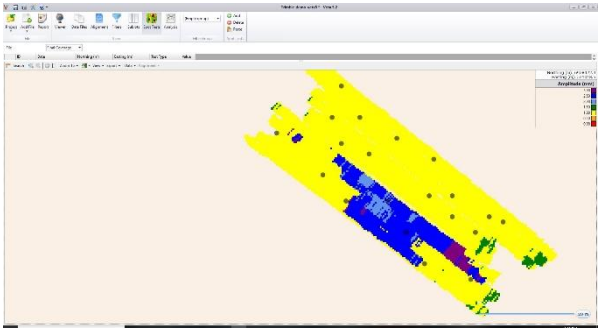
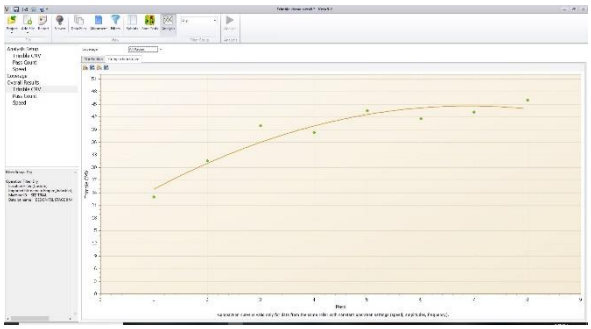


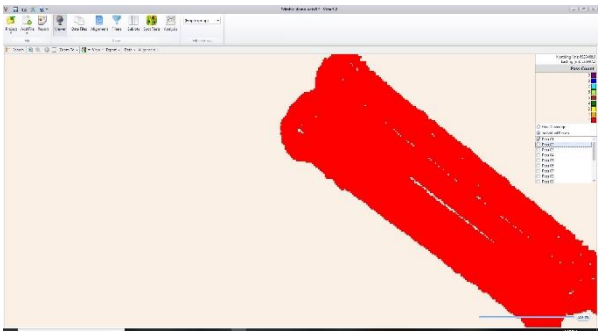
Histogram and pie charts showing distribution of roller pass values



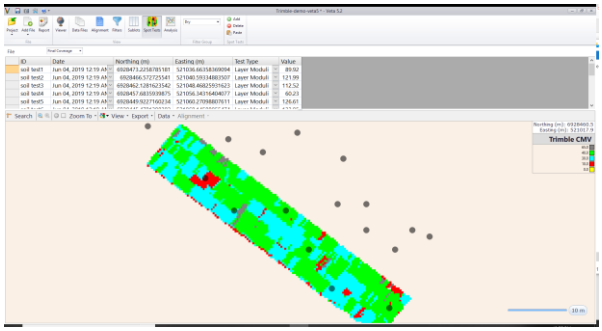
IC data shows area (blue) where vibration amplitude has increased.



Veta's compaction curve show CMV values increasing with each roller pass until plateauing after 5 roller passes



Roller pass #1 coverage



IC data reveals an artificial soft spot (red, at the centre of the upper quarter) where a truck tyre was buried underneath.

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Contact

For further information on intelligent compaction or more information of the NACOE P105 project, please contact the NACOE project leader:

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Acknowledgments

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See Civil

Trimble

FSG GEOTECHNICS +FOUNDATIONS

SITECH

LOGAN CITY COUNCIL

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