FHWA Intelligent Compaction National Workshop Report No. 2, Salt Lake City, Utah

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16. Abstract The FHWA has been leading a national effort to advance the Intelligent Compaction (IC) technology through a transportation pooled funded project, TPF-5(128), with twelve (12) States (DTFH61-07-C-00032) since 2008. Under this project, the Transtec Group has conducted seventeen (17) field IC demonstrations successfully to address material types that include granular soils, cohesive soils, stabilized base, and Hot Mix Asphalt (HMA) pavements. The FHWA Intelligent Compaction National Workshops are the continuing effort to fulfill the IC Road Maps developed under the TPF IC project in order to provide training to States and industry. The first workshop was conducted on December 13, 2011 in Atlanta, Georgia. The second workshop was conducted on February 28, 2012 in Salt Lake City, Utah. This document is the report for the second workshop.		
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Background

The FHWA has been leading a national effort to advance the Intelligent Compaction (IC) technology through a transportation pooled funded project, TPF-5(128), with twelve (12) States (DTFH61-07-C-00032) since 2008. Under this project, the Transtec Group has conducted seventeen (17) field IC demonstrations successfully to address material types that include granular soils, cohesive soils, stabilized base, and Hot Mix Asphalt (HMA) pavements.

The FHWA/TPF project, led by the Transtec Group, also developed an IC Road Map that addresses the gaps and barriers for implementation that includes four major tracks: (1) Equipment and Technologies, (2) Data Management and Integration, (3) Specifications, and (4) Technology Transfer and Training (see Figure 1). An extensive knowledge base was built from those field demonstrations and is readily available to the public via the IC website (www.intelligentcompaction.com), also developed and maintained by the Transtec Group. The IC National Workshops under the FHWA TOPR No. 5 (DTFH61-10-D-00027) are intended to address key elements of the IC Road Map.

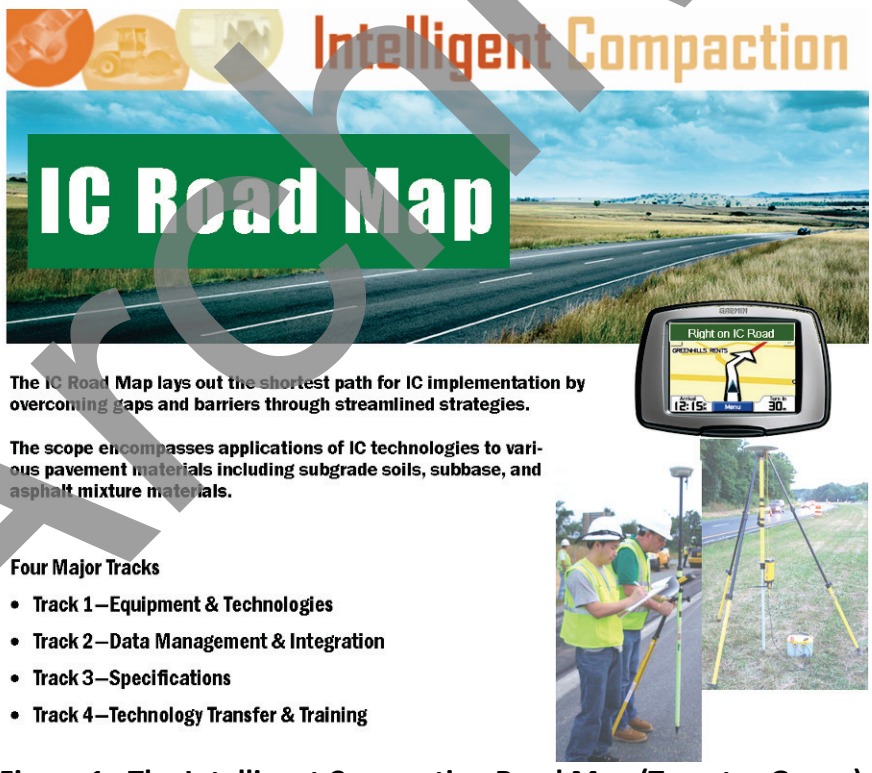

Figure 1. The Intelligent Compaction Road Map (Transtec Group)

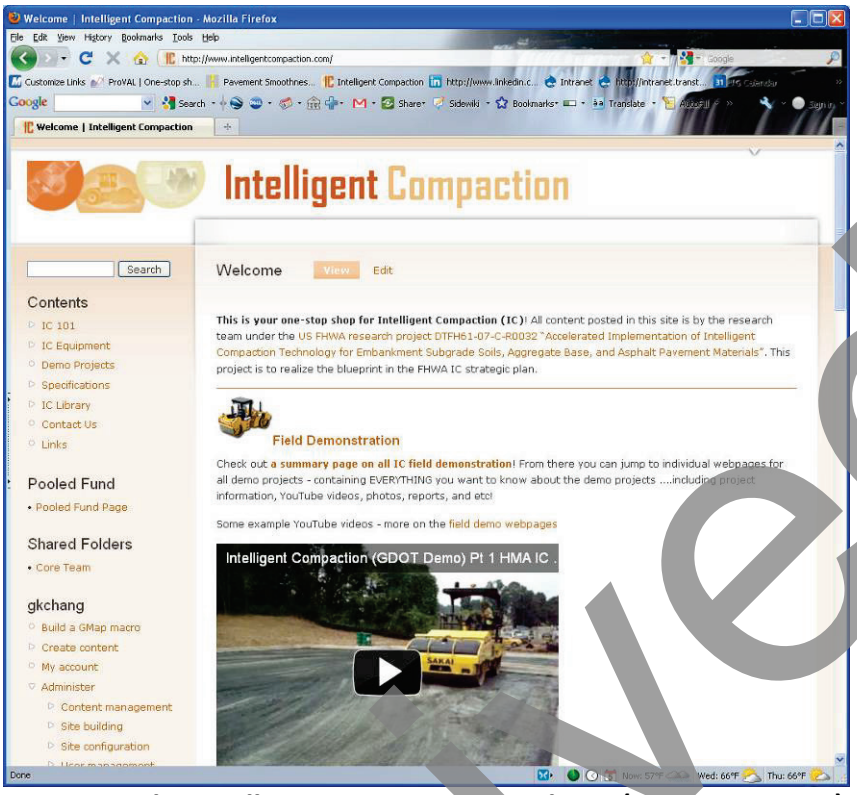

Figure 2. The Intelligent Compaction Website (Transtec Group)

Project Objectives

The objective of this task order is to provide non-personal support services to The Federal Highway Administration (FHWA) in facilitating, coordinating and documenting the Intelligent Compaction (IC) National Workshops in three (3) different regions of the country (e.g., Atlanta, GA, Salt Lake City, UT, and Minneapolis, MN). Specific activities will include: scheduling, organizing, and documenting the meetings, and coordinating and providing travel support to State Department of Transportation representatives and the non-Federal presenters who speak and participate in the workshops. Furthermore, the FHWA is offering professional development hours (PDH) hours to the attendees as part of the workshops and needs support in documenting and processing the requests.

The following includes the details about the second IC National Workshop in Salt Lake City, Utah on February 28, 2012.

Workshop Event

The IC National Workshop No.2 was conducted in Salt Lake City, Utah on February 28, 2012. The workshop facility was located at the Salt Lake Plaza Hotel (122 West South Temple, Salt Lake City, Utah 84101).

Participants

This workshop was a one-day event attended by 85 participants. The sign in sheet is included in Appendix A. The list of participants is in Table 1, Table 2, and Table 3 (sorted by the last names). The distribution of participants is balanced from FHWA, State DOTs, contractors, vendors, and consultants/academic.

Table 1. List of Workshop Participants (1 of 3)

Last Name	First Name	Affiliation
Alexander	Gary	Granite Construction Company
Anderson	Derek	Raba Kistner
Anderson	Howard	UDOT
Anderson	Steven	UDOT
Andrus	Scott	UDOT
Ashton	Dennis	PnK Constructors
Bice	Cory	URS Corporation
Biel	Tim	CME Transportation Group
Bingham	Newton	State of Alaska/ DOT & PF CRML
Boone	Eric	AMEC
Brunette	Bruce	Alaska DOT&PF
Butterfield	Kyle	The City of Cottonwood Heights
Campbell	Chris	Granite Construction Company
Carr	Eric	STRATA, A Professional Services Corporation
Chang	George	The Transtec Group
Christian	James	FHWA
Clark	Mark	Horrocks Engineers
Connolly	Chris	BOMAG Americas
Corless	Steve	Reclamation
Craner	Michelle	Horrocks Engineers
Darji	Rafiq	FHWA - FL
Dietz	Jason	FHWA - EFLHD
Doerstling	Janet	Arizona Department of Transportation
Dominguez	David	FHWA
Drake	Jeff	Trimble
Embacher	Rebecca	Minnesota DOT
Everett	Kevin	PnK Constructors
Farnsworth	Clifton	Brigham Young University
Folk	Pete	Granite Construction Company
Gallivan	Lee	FHWA
Gaschler	Brent	UDOT

Table 2. List of Workshop Participants (2 of 3)

Last Name	First Name	Affiliation
Giannonatti	Darrell	Heavy Highway Engineering Group
Giles	Bill	Stanley Consultants
Groves	Jason	State of Alaska DOT
Guthrie	Spencer	Brigham Young University
Hawks	Eugene	Reclamation
Haynes	John	FHWA - Utah Division
Holman	Kyle	FHWA - ID Division
Horan	Bob	Asphalt Institute
Irick	Jeramiah	Raba Kistner
Jones	Don	Sakai
Kaiser	Reid	Nevada DOT
Kowalski	Tim	Wirtgen America Inc.
Leatham	Douglas	UDOT
LeFevre	Brandon	Staker Parson Companies
Limburg	John	Western Technologies
Lindemann	Mark	Nebraska Department of Roads
Madrigal	Stevan	Raba-Kistner Infrastructure
Marble	Dave	Sandy City Public Works
Marchant	Lonnie	UDOT
Marcum	Bob	Volvo
Mayhew	Deryl	Horrocks Engineers
Michael	Larry	Asphalt Technology Consulting
Munro	Mike	Horrocks Engineers
Murphy	James	STRATA, A Professional Services Corporation
Nazarian	Soheil	UTEP
Nielsen	Sheldon	Geneva Rock
Nordquist	David	AGEC
Nussbaum	L. Scott	UDOT
O'Camb	George	Western Technologies
Ogden	Jon	UDOT
Olsen	Gordon	AMEC
Olson	Scott	Horrocks Engineers
Park	Steve	Region 3/ UDOT
Poloni	Amy	UDOT
Potter	Chris	UDOT
Rasmussen	Kevin	Sandy City Public Works

Table 3. List of Workshop Participants (3 of 3)

Last Name	First Name	Affiliation
Roberts	Jeff	Project Engineering Consultants
Russell	Mark	WSDOT
Rutledge	Jennifer	The Transtec Group
Santi	Mike	Idaho Transportation Department
Shi	Bin	UDOT
Si	Jimmy	Texas DOT
Smith	Aaron	Raba Kistner
Stokes	Travis	Geneva Rock
Sylvester	James	Granite Construction Company
Talbot	Mike	US Bureau of Reclamation
Taylor	Wade	Horrocks
Tsukimoto	Yuki	Sakai
VanFrank	Kevin	Utah Department of Transportation
Wakil	Abdul	UDOT
Walbeck	Jeff	Stanley Consultants Inc
Whitaker	Aaron	Project Engineering Consultants
Wing	Justin	Granite Construction Company
Ziman	Paul	FHWA - UDOT Division

Each attendee received printouts of the workshop agenda, IC Road Map, IC demo solicitation, and workshop evaluation. The scanned feedback forms are included in Appendix B.

All attendees were emailed the link to download a PDF of workshop materials. Ten binders with hard copies of the materials were distributed to key attendees. The workbook content includes: agenda, contact information, presentation slides, top-ten questions and answers, the workshop roster, and the generic HMA IC specification. The workbook content is included in Appendix C.

Photos of several sessions are shown below.

Agenda and Speakers

The objectives of this workshop are to:

- Familiarize attendees with fundamentals of intelligent compaction;
- Demonstrate the route to successful IC implementation; and
- Develop attendees into technology champions of IC for their organizations or companies.

The agenda is described in Table 4.

Table 4. Workshop Agenda

Time	Sessions		Length (min.)
08:30 am	Welcome (James Christian, FHWA)		10
08:40 am	1 - Introduction and Overview (Lee)		25
09:05 am	2 - Fundamentals of Intelligent Compaction (George)		55
10:00 am	break		20
10:20 am	3A - IC for HMA (Bob)	3B - IC for Soils/Subbase (Rebecca)	50
11:10 am	4A - Panel Discussion on HMA IC (Larry)	4B - Panel Discussion on Soils IC (George)	50
12:00 pm	Lunch break		60
01:00 pm	5A - IC-based QC Specifications for HMA (Lee)	5B - IC-based QC Specifications for Soils (George)	45
01:45 pm	6A - Panel Discussion on QC/QA HMA IC (Bob)	6B - Panel Discussion on QC/QA for Soils/Subbase IC (Rebecca)	45
02:30 pm	break		15
02:45 pm	7 - Veda: IC Data Management Program (Jennifer)		45
03:30 pm	8 - Panel Discussion on IC Implementation and Barriers-to-Overcome (Larry)		45
04:15 pm	9 - Conclusion and Workshop Evaluations (Lee)		15
04:30 pm	Adjourn		

The workshop speakers included:

- James Christian, Division Administrator, FHWA Utah Division
- Victor (Lee) Gallivan, P.E., FHWA
- Dr. George Chang, P.E., Transtec Group
- Bob Horan, P.E., Asphalt Institute
- Rebecca Embacher, Minnesota Department of Transportation
- Larry Michael, LLM Asphalt Consultant
- Jennifer Rutledge, Transtec Group

Workshop Notes

There were many discussions during the workshop – one of the key elements that drew positive feedback from the participants. The following includes discussions and questions/answers during various workshop sessions.

HMA IC Breakout Sessions

Q: How does GPS work on projects several miles long?
A: It can be a challenge. It may be necessary to reset the base station.

Comments: It would be nice to know vibrations in impacts/ft.
Wirtgen has impact spacing on regular control.

Q: Is the accelerometer on one side of the drum?
A: There is one ICMV for the entire roller width.
A: (Tim Kowalski) The sensor is normally on the front left of the vibratory drum. There is too much data if on two drums.

Comment: Reading what first drum compacts, not what is left behind.

Comment: (Chris Connolly) If a roller operator creeps up on a cold side, you will get a very stiff reading. The material has to be warm to build a stiffness curve. Slab or cold joints throw this off; you don't have density.

Q: How big is the footprint measured by temperature IR?
A: (Yuki Tsukimoto) Believe it is the full width of the drum.

Q: Can you use IR behind the screed to measure surface temperature?
A: (Bob Horan) This has been done on some projects. George is working with MOBA to incorporate the data into Veda.
A: (Lee Gallivan) Georgia just put this into specs.

Q: Has there been an FHWA statistical study on density? Will FHWA allow modifications to the statistical acceptance procedure (attendee disagreed with upper limit)?
A: (Lee Gallivan) Not for QA. Lee does not see a need for the upper limit. Attendees can work with division office to decide on one number or two.

Q: Has density consistency on mat been compared for IC and non-IC?
A: (Bob Horan) There is improved consistency of passes, so likely improved consistency of density.
A: (Larry Michael) One problem is what do you compare it to? Cores would require lots.
A: Compare pay factor with IC and without.

Comment: Bomag has a warning light for double jumps.

Q: Have you seen rolling to get stiffness after the mat has cooled to ambient temperature? Can this be related to modulus?
A: (Bob Horan) Have not seen this, but this is a good idea.
A: The rolling FWD is similar and is used for PMS. There is a move toward mechanistic design.

Q: If contractors make the investment for IC, what is the advantage?
A: (Larry Michael) Better efficiency (improved roller pattern). A Minnesota project failed as paving.

Comments from manufacturers:
Chris Connolly (Bomag): IC is a QC tool, giving contractors a better guideline. Still need a decent QC team. Can only measure when have viscosity (material has to be hot). Not looking at final aspect, so not QA.
Tim Kowalski (Wirtgen America): IC is a great tool for those with experience to be better, and for those without to get experience and be better. Roller patterns are more consistent, so density should be more consistent.
Yuki Tsukimoto (Sakai): Conventional rollers aren't bad. However, the number of passes isn't consistent, especially during night paving. Japan specifies compaction temperature.

Q: On test trips, nuclear gauge density increases with each roller. During the process of rolling and compaction, use nuclear gauge?
A: (Lee Gallivan) Yes, will show comparison of compaction.

Q: Did states want a technical representative on site? Is this in the spec?
A: Yes, roller manufacturers and/or technical advisors need to be present for setup and the first seven days of production.

Q: Are survey contractors required to set up GPS for proper coverage? Is this a pay item?
A: This is part of the spec but is up to you. It is a lump sum price.

Comment: Rollers are available if contractors plan ahead.

Q: How many IC projects are there this year?
A: No answer.

Comment: The first question for States will be "How much does it cost?"

Q: Is there information to send to contractors and department people to demo?
A: Absolutely. There will be open houses after demos for academia and other contractors. Transfer of technology is the main goal.

Comment: Roller manufacturers' contact information is on website.

Q: How many of these pieces of equipment are in the US?
A: Bomag has 15 in the field and 15 ready to go. Five days lead time. Distributors and equipment are available throughout the US.
A: Wirtgen doesn't have them sitting on the shelf but can get some when needed.
A: (Bob Horan) There is a limited supply.

Q: Are there short-term rental options?
A: (Bomag) Depends.

Q: How realistic is it to ship equipment from Maryland to California?
A: (Lee Gallivan) Sakai shipped from Georgia to California.

Comment: (Don Jones) We don't have dealers in the room. That is still another layer to educate.
Comment: Manufacturers have dealer directories.

Comment: State agencies have to answer the question of whether this is a one-time deal or they are going to commit to it.

Comment: (Bob Horan) The more demand there is, the more it will be available.
Comment: (Tim Kowalski) Now IC is a specialty product. It will be on every roller once it's not a specialty product.

Comment: Can retrofit some systems, but others you can't.

Comment: Pooled fund states drew the line on requirements for IC equipment.

Comment: Can call consultants for one-day training on Veda. Not in specs yet but really encouraging use of Veda.

Q: Does it say how to check the GPS, location of rover, roller coordinates, etc.?
A: Yes, this is the process that should be done on a daily basis.

Q: How reliable is the equipment? If specifying certain equipment, do we need special provisions for delays?
A: Only one instance where this was an issue, and it was with a non-IC part. Normal construction practices apply.

Q: Bid prices for lump sum cost?
A: (Lee Gallivan) Didn't see this in Vermont.
A: Minnesota has been putting it as a bid item for soil and would know better. It is up to the agency to decide how to address cost.
A: Want to get technology out there for proper evaluation.
A: (Chris Connolly) Not proprietary. Cost has been minimal. The cost may have gone down in MN.

Soils IC Breakout Sessions

Q: How does MnDOT require IC in its specifications?
A: The MnDOT IC specs require IC for quality control but not for quality assurance. They have been applied to granular soils, non-granular soils, and asphalt materials.

Q: How often does MnDOT require IC data submission?
A: It is on a daily basis. Based on MnDOT experiences, data submission has been a big issue while data loss is very common.

Q: What does MnDOT mean for the "independent sensor range" issue?
A: It is related to the calibration but not the technology itself.

Q: What corrective actions does MnDOT require for "weak spots" identified with IC?
A: Currently, MnDOT does not require any corrective actions and it is up to the contractors to make decisions. The main reason is that MnDOT cannot satisfactorily determine target measurement values for IC in the field.

Q: What does MnDOT require for QA tests for soils compaction?
A: MnDOT requires conventional tests such as: DCP, LWD, and sand cone tests. However, it is up to the districts to determine what tests to use.

Q: How does MnDOT determine optimum moisture contents?
A: Using Proctor tests.

Q: Does MnDOT have QC and QA inspectors for IC projects?
A: Currently, MnDOT only requires QC inspectors but it would eventually require QA inspectors. Its goal is "near real time" IC data inspection using wireless technologies and Veda.

Q: Has MnDOT studied the life cycle cost (LCC) for IC projects?
A: Though MnDOT has conducted IC projects since 2004, it does not perform LCC analysis due to difficulties in filtering and delineating IC data. It is another reason why MnDOT is stressing the IC data management issues.

Q: What are all passes data and proof data?
A: All passes data are time series data that includes all IC passes over a compacted area. Proof data are the final pass data for a given area. They can be best illustrated using the two figures from Dr. Chang's presentation.

Q: Can IC data be standardized?
A: The IC data format and elements can be standardized similar to the standardization process for GPS data. However, the standardization of IC measurements will be much more difficult due to current patented systems from various vendors.

Q: What are the immediate benefits of IC and machine control for grading work?
A: It reduces the steps and cost for grading process.

Q: How does surface irregularity affect IC measurements?
A: It would affect the contact surfaces between the roller drum and soil surfaces – thus the measurement values.

Q: Does MnDOT observe any contractors taking advantage of IC technologies?
A: "Good contractors" would cut cost by including IC rollers in their construction process. Return of invest is a no-brainer for large projects.

Q: How does MnDOT determine pay items in its IC specs?
A: It is currently based on lump sums since bid items are sometimes hard to do.

Q: How does MnDOT deal with equipment and personnel certification?
A: It is currently done on a project by project basis by the project managers. However, MnDOT elects not to include a pre-approved list of IC rollers in its IC specs.

Q: Why does MnDOT target only grading in its IC spec?
A: It is due to the non-linearity of process and data handling.

Q: Does MnDOT require specific standard settings for IC operations?
A: No. It would need a certification process for IC equipments. TxDOT's current soils IC spec does include standard settings for IC operations.

Q: How would target IC measurement values be set?
A: It would require a test strip 300 ft long with full width of construction. A test strip is required whenever a new Proctor is needed. A test strip normally focuses the top 5 ft of grading materials. The IC data and conventional tests (e.g., LWD) are correlated and the compaction curves from the all passes IC data are then used to determine target values.

Q: If no Proctor tests are available, can the IC operations be continued?
A: No. Though it happens in the real world, it would be difficult to do the guessing work without the Proctor data.

Q: As the current MnDOT soils compaction spec is the most stringent in the US, will MnDOT relax the spec in the future?
A: No.

Q: How is MnDOT enforcing the certification of IC equipment?
A: MnDOT does not enforce the certification of IC equipment, as it is up to the districts. However, there is 10% pay for this process. Therefore, they would lose the 10% pay if not doing it.

Q: Will there be any AASHTO specs for IC?
A: The FHWA is planning an expert technical group (ETG) for intelligent construction. It is FHWA's vision that IC will be a sub-set of the intelligent construction. The ETG may start with the current FHWA generic IC specs to develop future AASHTO IC specs.

Q: Do IC vendors offer rental options?
A: Most vendors don't provide rental options. In terms of retrofit, Trimble offers IC options for any single drum and double drum rollers with or without measurement systems. Dynapac and Hamm/Wirtgen can retrofit rollers of their own brands.

Comment: IC is still a chicken-and-egg and supply-and-demand issue.

Plenary Sessions

Q: Can more than two Hamm rollers communicate with one another? Can one be a pneumatic roller?
A: (Tim Kowalski) Yes.

Q: What are the motivations for implementing IC?
A: (Alaska DOT) An evidence of cost-and-benefits analysis.

Q: What incentive/disincentive requirements exist for State DOTs?
A: Most States have incentive/disincentive requirements for asphalt but not for soils.

Q: What are the barriers for implementing IC?
A: (MnDOT) Training, understanding stiffness measurements, data management (therefore, wireless will be huge to overcome IC data management issues), lack of resource (since paving/earthwork crews get tired at the end of a day's work, it can be very difficult to perform any IC related tasks then).

Q: What are the target audiences for IC training?
A: Residence engineers, contractors (including reps, foremen, and roller operators), management (however, the upper management may over-simplify and jump into incentive/disincentive requirements).

Q: How to market IC to top management?
A: No answers.

Q: Is there any study for IC on pavement longevity?
A: Not yet. MnDOT has IC data since 2004, but the analysis for IC's contribution is not performed due to the difficulties of filtering data.

Q: Are there any other barriers for implementing IC?
A: Lack of DOT personnel. A solution is to train existing personnel to perform IC tasks.

Q: Can digital IC data replace the needs for printing IC maps?
A: Not totally. Most contractors do not want to deal with complexity of IC data. On the other hand, printing large volume of IC maps can be daunting task.

Q: Does the generic FHWA IC spec include training for quality control personnel?
A: Not yet, but it will be included in the next revision.

Q: Can thermal bar data behind the paver be imported to Veda?
A: Not yet. MnDOT has a plan to support such work, and Georgia DOT has started paver mounted thermal bar specs to go with the IC spec. Combining IC and thermal bar technologies has great potential to achieve better density.

Comment: Cost is also a barrier.

Q: Can segregation be eliminated by IC?
A: No. If material and/or thermal segregation occur behind the paver, IC won't help much.

Discussion: IRI is a ride quality issue relating to the surface characteristics. IC deals with material compaction which relates to the density and stiffness. They are targeting different properties of the pavement. However, some combination of roller operations may produce undesired IRI.

Q: Can IC be used for warm mix and SMA?
A: Yes.

Comment: (Jimmy Si) It would be nice for Veda to have a column for notes with the point tests.

Q: Can equipment transmit IC data wirelessly?
A: Trimble, CAT, and Bomag can.

Q: Can Veda show lots by pounds of asphalt?
A: It is only possible to create sections based on time or location now.

Q: How do you export IC data?
A: It depends on the vendor. See the Veda user's guide for specifics.

Panel Discussion and Conclusion

Comment: (AK) IC is a very good process control tool.

Comment: (Larry Michael) With different bases in Eastern Federal Lands, IC would be perfect.

Comment: (NV) Percent within limits being implemented in specs now. Need to show benefits for contractors.

Barriers to implementation:

- Cost benefit
- Education
- ROI (what and when)
- For Alaska, it is a big commitment due to shipping. Can't just do it for 1-2 projects. Some jobs aren't on connected roads. Sometimes work in winter. Believes there is value but have to identify benefits and make the commitment.
- Some states don't offer a bonus for consistency. There is no incentive or disincentive.
- Equipment is not standardized
- Data management
- Loss of data due to wireless connectivity or human error
- Contractors already have lots to do and long days
- Staffing issue for contractors
- Money, present bid prices

Comment: Training recommended for management. They need to understand what IC entails and what the growing pains are.

Q: How to get decision makers to buy in?
A: No answer.

Q: The numbers on the screen are in metric. Can it change to English?
A: Bomag and Veda can do English and SI. Phase 2 of Veda may allow mixture of units.

Q: Has anyone looked at pavement longevity / quality?
A: The project in Minnesota has been since 2004. There is no analysis yet, but the data is ready after additional filtering. This is on the roadmap and will help with cost-benefit analysis.

Q: Is it possible for existing staff or contractor process control to lessen the amount of work on construction staff?
A: There are not enough resources in Minnesota.
A: The map quality is not good enough to just be given printed maps for QC.
A: If maps are not good enough, data files validate with geographic reference. This is preferred, but means more work for personnel.

Q: Are there minimum competencies or qualifications for QC technicians?
A: Not yet.

Q: Washington uses IR for uniformity. Has this been looked at in conjunction with IC?
A: Yes, Georgia is working on this.
A: Minnesota used Pave-IR on 35 job. Would like this included in Veda.

Q: If you don't deal with the IC data but just use the real-time screen for the operator, does this increase performance?
A: It depends on the operator and his or her work ethic. Some will use the screen, and some won't. They may be more likely if there is an incentive. Acceptable density is not enough of an incentive now because of spot testing.

Comment: Stiffness correlates to density. They are not the same.

Q: Is there any study on contractors QC accepted vs. bad material?
A: No.

Q: Can you identify segregation in asphalt?
A: It is possible to see different density and temperature.

Comment: ROI comes from having a new tool for contractors.

Q: Has IC been tied to smoother roads and the possibility of bonuses?
A: Roller operators should know the required speed and frequency from test strips.
A: Minnesota tried to use IC data on a road with poor ride quality, but needed base map. There is chatter in the stiffness data because it can't be filtered adequately.
A: IRI is related to IC / stiffness but is not the same.
A: Density is different from modulus, stiffness. Density does not change with moisture as significantly as modulus does.

Workshop Feedback

There were 34 evaluation forms completed and submitted. The scanned pages are included in Appendix B. The summary for the workshop evaluation is presented in Table 5. Individual responses follow.

Table 5. Summary of Workshop Evaluation

	E	G	F	P	VP
Meeting facilities	2	15	14[a]	3[b]	
Preparation of the instructors	19	15			
Friendliness of the instructors	26	8			
Overall quality of the instructors	20	12	2		
Ability of the instructors to respond to questions/comments	23	11			
Ability of the instructors to lead the discussion	19	14	1		
Instructors' knowledge of the topics covered	24	9	1		
Usefulness of the materials/information for your needs	6	22	6		
Timeliness of the materials/information presented	7	24	3		
Quality of the technical presentation	12	20	1		1
Workshop agenda	10	18	4	2	
Quality of folders, handouts, and other workshop materials	7[d]	18	4	4	
Overall quality of the workshop	12	19	3		

E - Excellent, G - Good, F - Fair, P - Poor, VP - Very Poor

a – Room was long and narrow. Parking garage was a problem for trucks with light bars.
b – Couldn't see screen. Had to pay for parking.
c – N/A – Didn't know to download.
d – Had to print out myself, but sent prior, so not a problem

What did you like most about the workshop?

- Having industry and state reps
- Really enjoyed the group participation and discussions about issues observed
- The Q&A's
- Obviously, an expanded understanding of intelligent compaction, particularly the areas still developing
- Resources: website, Veda, specs. Didn't know these tools were available until I took this seminar.
- Great knowledge of instructors – good presentations – willing to answer questions that were probably controversial
- Best part was having roller manufacturers present with Lee and Larry. The on-site knowledge was valuable.
- Presentations
- Clarification of pros and cons of the technology
- Span of technical info for various abilities to understand
- Great overview about IC

- Applicable to field work
- Yes. Excellent.
- Good mix of DOT's, industry, and knowledgeable presenters
- New technology I am not familiar with that has real application potential
- Very nice job of bringing together knowledgeable experts, users, and manufacturers. Questions were effectively answered because of it.
- Opportunity to hear and discuss IC with members of other parts of the industry
- Information is new and very interesting
- Good opportunity for discussion
- The participation by all and experience some have in the field
- Very upfront about remaining obstacles
- Good overview of IC process
- Timely transfer of info
- Lunch, good information, good interaction
- Interacting with speakers and other participants
- I liked the general make-up. I knew nothing of IC prior to the course.
- Learning what others are doing. What is being worked on by industry and FHWA.
- Quality of presenters and useful real world examples
- Presentation of IC research data, real world data review of projects

What do you feel could be improved about the workshop?

- Maybe show further examples of IC projects. Industry and representative sharing lessons learned.
- Discuss how to champion IC. In my state it will take a lot of convincing and education to management to convince them of the value of IC.
- More examples. Less pontification from Lee!
- Address other uses for compaction; i.e. earth fill dam repair, construction, modification
- Room layout and sound system
- Still developing technology, so data collected in IC is not consistent – makes a harder sell to the agencies. Technology still has great promise.
- Not much
- More folders
- Allow people to switch to other breakout sessions. As it was, the instructors didn't stop talking at the ending time to allow us to leave.
- Ability to see / hear

- Not sure where or how to start using IC. I found myself wanting more visualization – videos, pictures, case study, etc. You probably fit what you could into the time. The demonstration of Veda was nice. What would be better – a step by step summary with example files that we can play with later (not sure what's in users manual yet). Watching software demo is good. Playing with them ourselves is better ☺
- Stress how a contractor can improve quality and increase profits
- Do not split soil and HMA group continuously please. I missed a chance to join the soil section while I was joining HMA's. Sorry.
- It was all good!
- You must be willing to share costs. Not sharing known bid prices and effects defeats the purpose of the workshop. States are not willing to utilize new technology when there is no cost information shared. The perception is you are hiding the cost of a product that is too expensive.
- Fundamentals of IC was too technical and hard to follow
- Room was too long – difficult to see screen and hear presenters, particularly Dr. Chang
- More contractors need to be involved. This technology truly needs to be driven by contractors.
- Focus discussion towards those who have not used IC. Send out additional notices for the workshop materials – if they are not provided.
- Live demo
- It was hard to see projector at times. Sometimes the discussion didn't seem focused.
- The room was quite long making visibility of slide shows difficult from some areas of room.
- Examples of places and times where it does not work… must be some to share
- Viewing of the screen was poor
- As a geotechnical engineering consultant, I don't feel it was technical enough for me. I was not sold on the idea of IC (only that I better plan on dealing with it someday).
- I did not like the split agenda. I needed to listen to both the asphalt and soil presentations but could not.
- A hands on portion of the workshop would be useful.
- Additional detail on impact, benefit, ROI to the earthworks and paving contractor

Do you feel that all of the workshop objectives were met? If not, please explain which objectives were not satisfied.

Yes – 13

Other:

- Validate parking. Information on PDH's.
- Yes. I am uncertain, however, where to get a .pdf summary of the information. It never was sent to me however. I noticed that contractors left at lunch. So have a good summary in the morning… not too technical upfront.
- Yes, excellent
- Yes… excellent workshop!
- Without cost information, the route to successful IC completion or developing IC champions were not achieved.
- Good
- What has the host state done, did it work or not
- I think the objectives were met, but I didn't like the objectives. They were too DOT spec based rather than technical advantage based.
- See above comment [A hands on portion of the workshop would be useful.]
- Excellent workshop!!

Workshop Improvements

The following changes were implemented for Workshop No. 2 based on suggestions from the first workshop:

- Include IC specifications in workbooks
- Include attendance sheets
- Include attendees' agencies/companies on nametags
- Adjust times for sessions based on the actual time usage during the first workshop
- Improve the look-&-feel of workbooks (able to view color PDFs)
- Remove Mn/DOT Soils IC spec reviews in the soil IC presentation to avoid overlap with the generic FHWA specification
- Add contact information for both single-drum and double-drum IC roller suppliers (online)
- Present the slogan "Consistency and Uniformity" through the IC workshop

The FHWA IC team concluded the following workshop improvements to be made in future IC workshops:

- Changes to several slides:
    - Add 2012 publications to Session 1
    - Change Session 2 Coordinate Systems slide to "MN County Coordinates"
    - Change spelling of Session 3A "IC Mapping of Underlying Layers"
- Send out multiple notices about downloading the workshop materials

Appendixes

The appendixes include:

- Appendix A – Roster Sign In Sheets
- Appendix B – Evaluation Forms
- Appendix C – Workshop Content