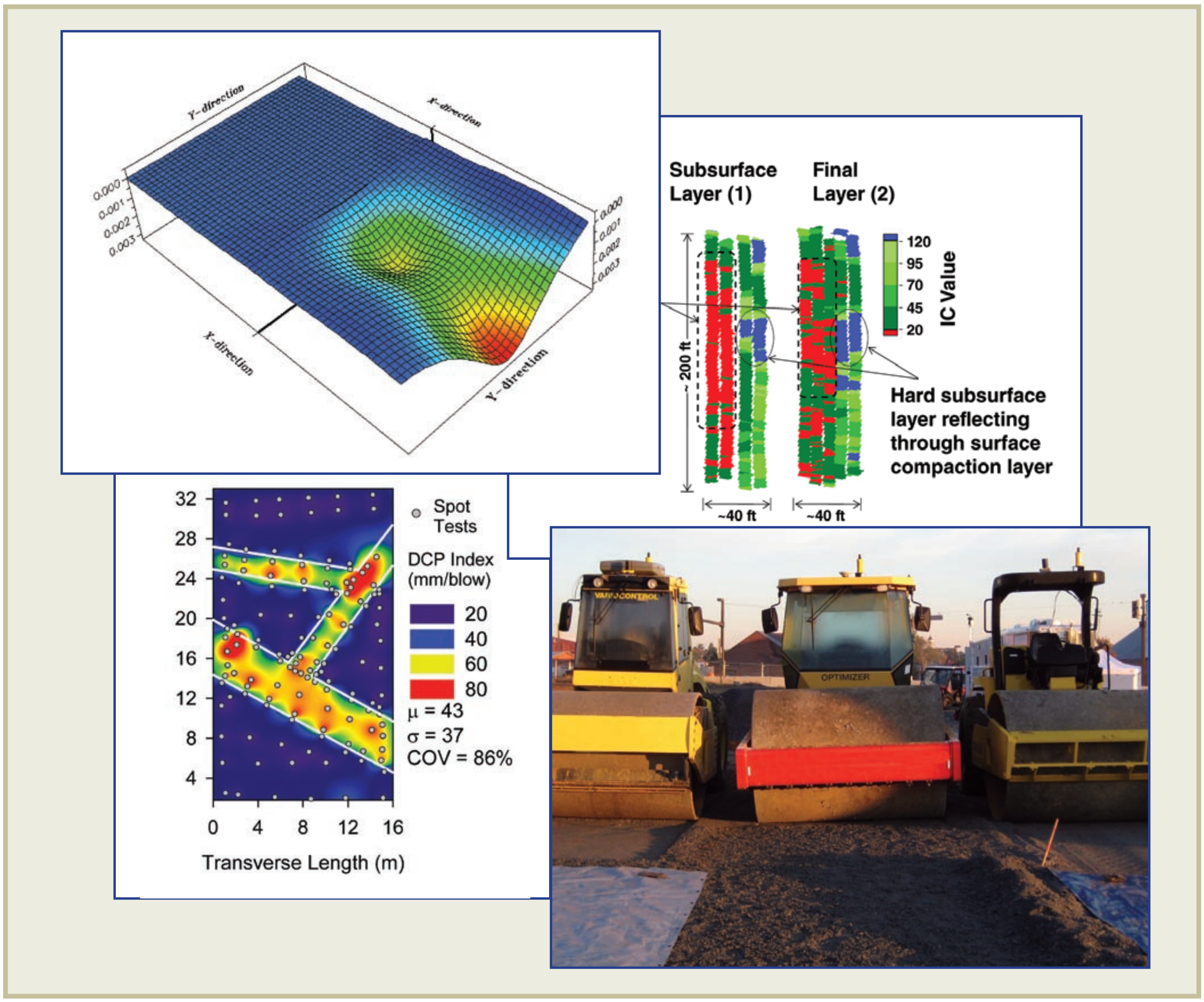
Executive Summary

Report of the
Workshop on Intelligent Compaction for Soils and HMA

ER08-01 **April 2–4, 2008**



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Iowa Department of Transportation

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April 2–4, 2008

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**Sponsored by the Iowa Department of Transportation
and the Earthworks Engineering Research Center at Iowa State University**

Preface

This document summarizes the discussion and findings of a workshop on intelligent compaction for soils and hot-mix asphalt held in West Des Moines, Iowa, on April 2–4, 2008. The objective of the meeting was to provide a collaborative exchange of ideas for developing research initiatives that accelerate implementation of intelligent compaction (IC) technologies for soil, aggregates, and hot mix asphalt. Technical presentations, working breakout sessions, a panel discussion, and a group implementation strategy session comprised the workshop activities. About 100 attendees representing state departments of transportation, Federal Highway Administration, contractors, equipment manufacturers, and researchers participated in the workshop.

Acknowledgments

The Earthworks Engineering Research Center (EERC) at Iowa State University of Science and Technology (ISU) gratefully acknowledges the Iowa Department of Transportation (Iowa DOT) for its sponsorship of this workshop. Travel support for most state DOT participants and support for the development of this report were made possible by the Iowa DOT.

The EERC also sincerely thanks the following individuals for their support of this workshop:

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Abbreviations

γ_d = dry unit weight
AMG = automated machine guidance
CBR = California bearing ratio
CCV = Sakai compaction control value; Caterpillar compaction value
CIV = Clegg impact value
CMV = compaction meter value
DCP = dynamic cone penetrometer
DOT = Department of Transportation
DTM = digital terrain model
EED = electronic engineering data
E_{LWD} = light weight deflectometer elastic modulus
E_{PLT} = plate load test elastic modulus
E_{SSG} = soil stiffness gauge elastic modulus
E_{vib} = BOMAG roller vibration modulus
FHWA = Federal Highway Administration
FWD = falling weight deflectometer
GPS = global positioning system
HMA = hot mix asphalt
IC = intelligent compaction
K = hydraulic conductivity
K_s = case/ammann roller stiffness
LWD = light weight deflectometer
MDP = Caterpillar machine drive power
RMV = resonant meter values
TDM = theoretical maximum density

Executive Summary

The objective of this workshop was to provide a collaborative exchange of ideas for developing research and educational initiatives that accelerate implementation of intelligent compaction (IC) technologies for soil, aggregates, and hot mix asphalt that will lead to conclusive and measureable improvements within five years. Several key strategies were identified and are documented in this report. Technical presentation slides, notes from the working breakout sessions, a summary of the panel discussion, and a summary of the group implementation strategy session are reported herein. A road map for implementation that identifies several key research and training focal areas is summarized at the end of this report.

Following several technical presentations, nine breakout sessions were conducted covering three topic areas: "IC for Soils and Aggregate," "IC for HMA," and "Implementation Strategies." Each group was asked to address their topic around the following questions:

- What are the existing knowledge gaps?
- What equipment advancements are needed?
- What educational/technology transfer needs exist?
- What standards/specifications and guidelines need to be developed?

Based on a detailed review of the results from this session, there were two levels of analysis of the results: (1) prioritized results for each topic area, and (2) a cross-cutting top 10 list of key research needs. The top 10 research needs are summarized in Table 2 from the report, replicated below.

Table 2. Summary of main IC technology research needs

Top 10 IC Technology Research Needs

1. **Correlation studies (cohesive, stabilized, granular, HMA, etc.) (136)**
2. **Education/training materials and programs (112)**
3. **Moisture content (influence + measurement) (61)**
4. **Integrated design + real-time data transfer (57)**
5. **Case histories + demos + benefit + successes (48)**
6. **Engineering parameter to measure (density, modulus, stiffness, core mat temperature) (47)**
7. **Addressing non-uniformity (34)**
8. **Establishing QC/QA framework - statistically significant (28)**
9. **Measurement influence depth (19)**
10. **Promoting good geotechnical practices (13)**

A panel discussion was carried out to reflect on the outcomes determined from the breakout sessions and what was learned from the workshop that may have changed perspectives on IC technology. The discussion points were divided into four categories:

- Reaction to breakout sessions
- New perspectives
- Specifications
- Technology developments

Each of these categories was summarized and condensed to four common themes. These themes are summarized in Table 3 of the report, which is replicated below.

Table 3. Summary of common themes from panel discussion

Common Themes from Panel Discussion Session
1. High level of interest from the state DOTs in further studying opportunities to implement IC.
2. Implementation strategies need to build on existing information and past research.
3. Specifications for IC and in situ testing should not restrict manufacturer/equipment developer innovations.
4. Contractor and state DOT field personnel and engineers need educational materials for IC and in situ QC/QA testing.

Following the panel discussion, the audience was given instructions to break up into groups to further brainstorm implementation strategies. A list of the three common strategies was derived from this exercise. The common strategies are summarized in Table 4 of the report, shown here.

Table 4. Summary of common themes from the group implementation strategy session

Common Themes from Group Implementation Strategy Session
1. Develop IC training and certification program.
2. Demonstrate benefits of IC through demonstration projects.
3. Promote partnership as key strategy to implementation.

At the conclusion of the workshop a discussion centered on understanding where we are and where we are going as a lead-in to developing a road map for implementation of IC technologies. Key points from the discussion are summarized in Table 5 of the report, shown on the following page.

To move from the current practice and knowledge base, several key strategies were considered and are listed in Table 6 of the report, shown on the following page.

Table 5. Summary of key points

Where we are:	Where we are going:
• Lack widely accepted IC specifications in U.S. • Need education/training materials • Innovative IC and in situ testing equipment • IC technologies provide documented benefits (smooth drum - granular) • Great potential and some limited successes for cohesive and HMA • Poor database development for IC projects and case histories • Human IC network initiated • Increasing acceptance/GPS infrastructure for stakeless grading/machine guidance • "Don't know what we don't know"	• Standardized and credible IC specifications inclusive of various IC measurement systems • Widespread implementation of IC technologies • High quality database of correlations • Several documented successes for cohesive/stabilized/granular/HMA • Better understanding of roadway performance - what are key parameters? • Innovative new sensor systems and intelligent solutions • Integrated and compatible 3D electronic plans with improved processes, efficiency and performance • Real-time wireless data sharing • Enhanced archival and visualization software • Improved analytical models of machine-ground interactions

Table 6. Strategies for moving forward

Strategies for Moving Forward
• Participate in partnerships for IC research and information exchange regionally and nationally • Be an advocate for IC implementation • Contribute to problem statement development for NCHRP, TRB, FHWA, AASHTO, ASCE Committees • Participate in IC conferences/studies and the annual EERC Workshop • Participate on EERC Scientific and Policy Advisory Council (35 members) – IC and other issues • Stay connected: Subscribe to EERC Technical Bulletins, Tech Transfer Summaries, Technical Reports, Educational Videos, etc. (www.intelligentcompaction.com). • Develop a comprehensive and strategic IC road map for research and educational/technology transfer

Results from the workshop provided significant information to outline the road map which can serve as a starting point for further discussions and assessment. Additional steps beyond peer reviewing the research/educational elements of the road map will be required to create an integrated research management plan, establish a schedule, and identify organizations, contractors, and equipment manufacturers that want to partner and leverage funding/equipment and human resources to move the program forward.