2 ICT BY THE NUMBERS
An overview of ICT’s statistics.

4 DIRECTOR’S REPORT
Director Imad Al-Qadi summarizes the positive impacts from ICT’s first six years and more than 140 research projects.

6 ICT FROM PAST TO PRESENT
The ICT builds on the rich history of the UI pavement program, which has been paving the way in highway research for more than 100 years.

10 IDOT INVOLVEMENT
The staff at the Illinois Department of Transportation (IDOT) play an active role in the administrative and research activities of the ICT.

12 STAFF
Meet the ICT staff who work together to deliver a full range of support services to the research team.

13 PRINCIPAL INVESTIGATORS
Meet the ICT research team that includes 90 principal investigators from a diverse array of universities, private consulting firms, and governmental agencies.

22 FACILITIES AND RESOURCES
Research at the ICT is supported by world class facilities that include the Advanced Transportation Research and Engineering Laboratory (ATREL) on 47 acres of the former Chanute Air Force Base.

26 THE RESEARCH PROCESS
Learn how a good research idea becomes reality and how to get involved in the ICT’s research.

28 IMPACT OF RESEARCH
Examples of ICT’s research are presented by focus area with tangible outcomes highlighted.

■ Sustainability/ Environment
■ Safety
■ Pavements
■ Structures
■ Innovative Solutions
■ Traffic Operations/ Roadside Maintenance
■ Advanced Developments

47 ICT.ILLINOIS.EDU
The ICT website provides updated progress reports for active research projects, downloadable final research reports for completed projects, and much more.

48 OUTREACH AND EVENTS
The ICT maximizes the impact of its research through training classes, publications, and conferences.

53 AWARDS AND HONORS
The ICT congratulates its investigators and students on several awards, honors, and degrees received during the past year.

56 RESEARCH PROJECT APPENDIX
The first 142 funded ICT projects are listed by focus area, including the project name, a short description of the research, research outcome, investigator(s), technical review chairperson, and status.

76 COMMONLY USED ACRONYMS
Several commonly used transportation acronyms are defined.
The Illinois Center for Transportation (ICT) produces groundbreaking research that directly impacts transportation policies and specifications and results in positive changes that affect the daily lives of the traveling public and transportation of goods. ICT has received strong ongoing support from the Illinois Department of Transportation (IDOT) and the Federal Highway Administration (FHWA).

**ICT BY THE NUMBERS**

| Research projects approved to date | 142 |
| Completed projects | 75 |
| Million dollar investment by IDOT and FHWA | 18 |
| Year the ICT was founded | 2005 |
| Researchers actively contributing | 90 |
| Graduate students supported | 137 |
| Universities and Institutes participating | 12 |
| Acres available for use at the ATREL facility | 47 |
| Square feet of laboratory space available at ATREL | 67,400 |
| Ranking of the affiliated UIUC civil engineering program * | 1 |

* According to U.S. News and World Report in March 2011, the University of Illinois at Urbana-Champaign is ranked #1 for undergraduate program and #2 for graduate program in civil engineering.
Director’s Report

We, at the Illinois Center for Transportation (ICT), are pleased to present this progress report of our accomplishments for the fiscal year 2010-2011. Thank you for taking the time to learn more about ICT. As you will see from this report, ICT has grown to become one of the leading transportation centers in the nation since its inception six years ago.

In 2005, the center started with 12 projects; nine of which were pavement projects, and all of the investigators were from the UIUC transportation group. Today, ICT has grown to include 142 projects from many disciplines that represent true diversity in transportation research.

The tremendous growth and success of the center has given us the opportunity to create relationships with more than 12 other universities through outsourcing to match new research needs with the most specialized investigators. Our research collaboration involves other UIUC departments, University of Illinois campuses, other universities across the nation, governmental agencies, and consultants. Overall, 90 investigators are actively contributing to this success through their cutting edge research. To date, the research of the past six years has helped support more than 137 young, talented graduate students in addition to many undergraduate students, and these numbers are ever-increasing.

The ICT continues to focus on the environment and sustainability. Our researchers are leading several major national initiatives to develop more sustainable transportation systems. We are also investigating ways to make other components of transportation, including rest areas, asphalt mixes, and storm water management practices, more environmentally friendly and sustainable.

Safety also remains at the forefront of our research. Illinois recently announced plans to improve 3,248 miles of road and replace or rehabilitate 611 bridges during fiscal years 2012-2017. ICT’s research on moving lane closures, speed photo-radar enforcement, and highway work zones, among other projects, will undoubtedly improve and save lives. ICT is proud to be a contributor to our state’s leading role in transportation safety.

ICT is actively involved in conferences and events to educate transportation professionals about our research. At the 2011 90th Annual Meeting of the Transportation Research Board, our group of investigators presented over 45 topics. During the past year, ICT also had an active role in many national and international conferences, including the First Congress of the Transportation and Development Institute of the American Society of Civil Engineers as well as the AASHTO’s annual Research Advisory Committee meeting among many others.

It is clear that our staff, facilities, researchers, and students are second to none. This is evident in the recognitions our investigators receive, the offers of employment our students enjoy, and most of all the implementation and far-reaching impacts of our research. To build on this success, we recently agreed to another five-year contract with the Illinois Department of Transportation to continue conducting groundbreaking and useful research through

In 2016, I have no doubt that in the years to come, ICT will maintain its status as a leading international transportation center and will continue to serve the state of Illinois, the nation, and the world through our cutting-edge research development and implementation.

Please visit our website, ict.illinois.edu, regularly for more information about our research activities, how to get involved, and to view all the final research reports and updated progress reports for our current research projects as well as short videos on ICT and our ATREL research facility.

Sincerely,

Imad L. Al-Qadi, PhD, PE, Dist.M.ASCE
Founder Professor of Engineering, UIUC
Director, ICT and ATREL
For More Than 100 Years

The University of Illinois (UI) has made lasting contributions to the world’s roadways. As roads changed from dirt, to gravel, to asphalt and concrete, engineers at UI have developed innovative methods to improve concrete analysis and design. His mechanical models have been used throughout the world to quantify their limits and optimal thickness, led by Sam Carpenter (faculty member from 1976-2006), gave transportation agencies a better understanding of their own mixes and how to achieve ideal thickness, which resulted in fewer construction needs.

UI Builds its Reputation through Advanced Material Testing and State-of-the-Art Laboratories

Minnesota Westergaard Pioneers Concrete Pavement Design

While completing his doctorate at UI, Harald Westergaard (PhD 1916 and faculty member from 1916-1936) developed the first theoretical basis for the design of concrete pavements. Westergaard’s mechanistic models have been used throughout the world to improve concrete analysis and design. His major consulting projects included Hoover Dam and the Panama Canal.

UI Collaborates on National Road Tests and Interstate System

Illinois is home to several early road tests, including the Bates Road Test and the AASHO Road Test in Ottawa. The results led to great advances in concrete and flexible pavements because, for the first time, trucks of different weights and axle spacings were taken into account. The road tests introduced such concepts as the load equivalency factor and roughness and performance measures. Moreland Herrin (faculty member from 1958-1987) worked as the Assistant Materials Engineer for the AASHO Road Test.

In the late 1950s, UI led by Ellis Danzer (faculty member from 1946-1973), established the Highway Engineering Technician Training Program, which was a first-of-its-kind summer program in the nation. Run similar to a boot camp, the program trained future highway engineers and many of the participants helped build the segment of Interstate 74 that runs east of Champaign to Danville, IL.

UI’s Ernest Barenberg (faculty member from 1960-1996) and Marshall Thompson (BS 66, MS 62, PhD 64 and faculty member from 1965-1996) were integral in developing the mechanistic-empirical design frameworks for pavements, which merged sophisticated modeling with prediction of performance after 20 years of traffic and weathering. This work is reflected in the Eisenhower Interstate System and in many agencies’ guidelines for the design and construction of flexible pavement systems. Barenberg and Thompson also conducted revolutionary work to stabilize clay soils with lime. UI’s worldwide impact became apparent when other countries began translating the lime stabilization work into their own languages.

UI Pavement Faculty, 1979: Standing are Sam Carpenter (L) and Ernie Barembren (R); Sitting (L to R) are Michael Darter, David Boyce, Moreland Herrin, Marshall Thompson, Barry Dempsey (L), and Lufti Raad (R).
ICT From Past To Present

**Program Timeline**

1906
First Professor of Highway Engineering joins UI.

1914
UI holds first highway engineering conference in U.S.

1952
UI signs first official agreement with IDOT to collaborate on transportation research. (Previously UI had served as contractor.)

1992
The Advanced Transportation and Engineering Laboratory established on former Chanute Air Force Base.

2001
Faculty help procure largest movable full-scale pavement testing facility in the country known as Advanced Transportation Loading Assembly (ATLAS).

2005
ICT established with an initial three-year agreement of $8.8 million with IDOT providing a majority of its $6.6 million share through federal highway dollars specifically earmarked for research purposes. UI provided the local match of $2.2 million to get the program underway. Of the initial 12 ICT projects, nine are pavement-related and all are performed by UIUC investigators.

2008
IDOT and ICT sign second three-year agreement providing $15.5 million for additional research through 2011. At the time the second agreement is signed, ICT has 68 projects in progress, 14 projects completed, and has greatly expanded the scope of its research (of the 68 projects, only 15 are pavement related).

June 2011
IDOT and ICT have agreed to over $30 million of funding through 2016. As outlined in the agreements, ICT continues its research with 142 approved projects that show great diversity, both in research topic and investigator outsourcing. ICT collaborates with investigators from 12 universities as well as government agencies and private firms. ICT has completed 75 projects with final reports published and posted to the ICT website and research findings making a true impact in Illinois and beyond.

**Growth**

ICT Project Growth

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Total Number of Projects</th>
</tr>
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<tbody>
<tr>
<td>Jan-06</td>
<td>20</td>
</tr>
<tr>
<td>Jan-07</td>
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<td>Jan-10</td>
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ICT Involvement Growth

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<th>Fiscal Year</th>
<th>Total Researchers &amp; Students</th>
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<tr>
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ICT Funding Growth

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<th>Dollars</th>
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<tr>
<td>2007</td>
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<tr>
<td>2009</td>
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<tr>
<td>2010</td>
<td>5.0M</td>
</tr>
<tr>
<td>2011</td>
<td>6.0M</td>
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</table>

**Diversity**

ICT’s Diversified Research Portfolio

Since its inception, ICT has greatly expanded the scope of its research to cover additional focus areas, including environment, planning, construction, renewable energy, and public transportation. Although it is still a core focus area, pavement research no longer defines ICT.

ICT in 2005

- Materials and Pavements (9 projects) $2.25M
- Structures (1 project) $.28M
- Safety (1 project) $.31M
- Traffic Opns. & Maint (1 project) $.44M

ICT Projects Added 2005–2011

- Safety (18 projects) $2.8M
- Environment (10 projects) $1.4M
- Public Trans. (8 projects) $.7M
- Planning (9 projects) $1M
- Construction (3 projects) $.9M
- Other (2 projects) $.4M

Outsourcing to Non-UI Researchers

A unique feature of ICT is that, even though it is administered by the University of Illinois at Urbana-Champaign, a portion of the funding is outsourced to schools outside of the University of Illinois system. This outsourcing develops cooperative relationships with other universities and exposes more students to transportation research. In recent years, ICT has significantly exceeded its target goals for outsourcing.

ICT Involvement Growth

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Target Outsourcing</th>
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<td>5.0M</td>
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<tr>
<td>2011</td>
<td>6.0M</td>
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</tbody>
</table>

Participating Universities and Institutes

- Bradley University
- Illinois Institute of Technology
- Roosevelt University
- Illinois State University
- Northwestern University
- Illinois State University
- North Western University
- John Carroll University
- Miami University
- University of Cincinnati
- Missouri State University
- University of Illinois at Chicago
The ICT administrative committee meets monthly to discuss the
ICT and IDOT involvement in other ICT activities. The committee
meets biannually to review and recommend projects to the ICT
Executive Committee. Each approved ICT project is assigned a Technical Review Panel
TAG LEADERS & BMPR REPRESENTATIVES
Also critical to the ICT research activities are the IDOT staff who
serve on the Technical Advisory Groups (TAGs), which review, pri-
oritize, and recommend projects to the ICT Executive Committee.
Each TAG includes a representative from the Bureau of Materials
and Physical Research (BMPR).

STRUCTURES/HYDRAULICS/GEOTECHNICAL
TAG LEADER: Tom Domalski
BMPR REPRESENTATIVE: Mark Gawedzinski

PAVEMENT DESIGN & MANAGEMENT/MATERIALS
TAG LEADER: David Lippert
BMPR REPRESENTATIVE: Mark Gawedzinski

TRAFFIC OPERATIONS & ROADSIDE MAINTENANCE
TAG LEADER: Aaron Weathersholt
BMPR REPRESENTATIVE: Michael Brownlee

SAFETY ENGINEERING
TAG LEADER: Priscilla Tobias
BMPR REPRESENTATIVE: Amy Schutzbach

ENVIRONMENT
TAG LEADER: Barbara Stevens
BMPR REPRESENTATIVE: Joe Vespa

PUBLIC TRANSPORTATION/MULTI-MODAL
TAG LEADER: Chuck Abraham
BMPR REPRESENTATIVE: Amy Schutzbach

PLANNING
TAG LEADER: Susan Stitt
BMPR REPRESENTATIVE: Amy Schutzbach

CONSTRUCTION
TAG LEADER: Tim Kell
BMPR REPRESENTATIVE: Charles Wiemrank

ICT Executive Committee Approves 12 New Projects
and Increases Funds to Support B.S. and M.S Students
(November 2010)

The ICT Executive Committee met at the Hanley Building in
Springfield on November 8, 2010, to review several projects
suggested for funding. The committee approved 12 new
research projects that included establishing native vegetation
for IDOT erosion control, improving the effectiveness of night-
time traffic control devices, and analyzing travel/activity plan-
rning and scheduling behavior of senior citizens in the Chicago
metropolitan area.

The committee also decided to set aside additional funds
annually to hire B.S. and M.S. degree students as hourly work-
ers on ICT projects. This will help meet the educational mis-
sions of ICT and IDOT while allowing IDOT access to a pool of
potential hires with experience in pavements and materials.

ICT Executive Committee Approves Eight New Projects
(April 2011)

The ICT Executive Committee held its spring meeting on April
26, 2011, in Springfield, Illinois and decided to fund eight new
research ideas. Some examples of the varied research topics
suggested for funding. The committee approved 12 new
ICT projects to 142. Several of the newly approved research
projects will be outsourced to other universities or private
researchers.

The committee also decided to set aside additional funds
annually to hire B.S. and M.S. degree students as hourly work-
ers on ICT projects. This will help meet the educational mis-
sions of ICT and IDOT while allowing IDOT access to a pool of
potential hires with experience in pavements and materials.

Each approved ICT project is assigned a Technical Review Panel
(TAG) overseeing and guiding the project on behalf of IDOT. The TAG
reviews and approves the work plan, provides regular feedback,
and reviews and approves the project’s final report. The TRP Chair
for each project is listed in the Research Appendix of this report.
The TRP members for each project are listed in the final reports,
which are posted on the ICT website.
Behind ICT’s innovative research are the staff who work together to deliver a full range of support services to the research team.

**ICT STAFF**

**IMAD AL-QADI** — FOUNDER PROFESSOR OF ENGINEERING & DIRECTOR OF ICT

Imad oversees all ICT research and administration.

**SAM CARPENTER** — ASSOCIATE DIRECTOR

Sam is a Professor Emeritus of the UIUC Department of Civil and Environmental Engineering and has served as the principal investigator on several projects for IDOT both before and after the inception of ICT.

**ANDREA RUEDI** — DEPUTY DIRECTOR

Andrea manages the day-to-day operations, technology transfer, and business development activities of the ICT.

**BILL BUTTLAR** — PROFESSOR & CEE M.S. ONLINE PROGRAM COORDINATOR

Bill oversees distance learning activities.

**LORI CARPENTER** — COMMUNICATIONS COORDINATOR

Lori monitors the status of ICT projects, documents TRB meetings, and allows the project teams to focus on research rather than administrative tasks.

**LESLIE EBLLE** — ASSISTANT TO THE DIRECTOR

Leslie oversees the daily administrative needs of the center and assists with special projects.

**JEFF KERN** — RESEARCH ENGINEER

Jeff works actively with IDOT, representatives from industry, and student researchers to ensure that the project needs are met.

**MARC KILLION** — INSTRUMENT MAKER

Marc helps maintain equipment, makes improvements to equipment, and fabricates prototype equipment at ATREL.

**DAVE KING** — RESEARCH AND POLICY ANALYST

Dave oversees ICT’s research funds, the center’s overall budget, the project’s progress, and the RFP process.

**JIM MEISTER** — RESEARCH ENGINEER

Jim supports student researchers and ICT investigators with their research at ATREL by making sure they have the right equipment, it is in proper working order; and they have a safe environment for their work.

**LESLIE MYRICK** — TECHNICAL EDITOR

Leslie coordinates the production of promotional materials, including the quarterly newsletter and the annual report, manages the website content, and edits all the ICT technical reports.

**CRAIG RAYMOND** — LABORATORY ASSISTANT

Craig prepares samples and performs tests for various ICT projects.

**JEFF ROESLER** — PROFESSOR AND ASSOCIATE DIRECTOR OF ATREL

Jeff oversees the ATREL facility and its laboratories.

**TRACHIA WILSON** — OUTREACH COORDINATOR

Trachia coordinates ICT outreach activities, including training courses and conferences.

**MOHAMMAD ALHASSAN**

ASSISTANT PROFESSOR

Indiana University – Purdue University Fort Wayne

alhassan@ipfw.edu

Mechanical properties and durability of plain and fibrous high performance concrete.

**IMAD AL-QADI**

FOUNDER AND DIRECTOR OF ICT AND ATREL

Department of Civil and Environmental Engineering

University of Illinois at Urbana-Champaign

alqadi@illinois.edu

Pavement mechanics, tire-pavement interaction; advanced modeling techniques; full-scale accelerated testing.

**BASSEM ANDRAWES**

ASSISTANT PROFESSOR

Department of Civil and Environmental Engineering

University of Illinois at Urbana-Champaign

andrawes@illinois.edu

Structural dynamics, earthquake engineering, bridge engineering, seismic retrofit of structures.

**FARHAD ANSARI**

PROFESSOR AND HEAD

Department of Civil and Materials Engineering

University of Illinois at Chicago

fasani@uic.edu

Structural engineering with emphasis in structural health monitoring, smart sensors, and nondestructive testing.

**SULEIMAN ASHUR**

ASSOCIATE PROFESSOR

College of Engineering, Technology, and Computer Science

Indiana University – Purdue University Fort Wayne

sul@engr.ipfw.edu

Transportation planning and logistics, traffic engineering, GIS, infrastructure rehabilitation and management.

**GRZEGORZ BANAS**

RESEARCH ENGINEER RETIRED

Department of Civil and Environmental Engineering

University of Illinois at Urbana-Champaign

gbanas@illinois.edu

Bridge design.

**BELTEMACCHI**

ASSOCIATE PROFESSOR

College of Architecture

University of Illinois at Urbana-Champaign

beltemacchi@iit.edu

Urban design, city and regional planning.

**RAHIM BENEKHAL**

PROFESSOR

Department of Civil and Environmental Engineering

University of Illinois at Urbana-Champaign

rahim@illinois.edu

Traffic flow modeling, traffic flow theory, intelligent transportation systems, and traffic operations and safety.

ICT’s research team includes 90 principal investigators from a diverse array of universities, private consulting firms, and governmental agencies.
Pavement management, evaluation, rehabilitation, and design.

Experimental and analytical characterization of the physical properties of asphalt mixtures, particularly at low temperatures.

Performance characterization and implementation of asphalt mixtures.

Pavement management, evaluation, rehabilitation, and design.

Statistical estimation.

Water quality and management.

Pavement design and modeling.

Economic development, office and industrial development, and downtown and neighborhood development.

Construction optimization, decision support systems, information technologies, construction productivity.

Structural steel analysis and design, development of advanced design applications, artificial intelligence applications.

Testing and evaluation of full-scale structures, including bridges and buildings’ responses to earthquake loads.

Real-time public transit monitoring and navigation; networked systems, especially wireless and vehicular networks.

Earthquake engineering, innovative structural systems, steel structures, and progressive collapse mitigation.

Modeling, analysis, and characterization of flexible pavement and pavement instrumentation.

Information technology, leadership, research, and development.

Pavement and asset management, pavement markings, pavement evaluation.

Earthquake engineering, innovative structural systems, steel structures, and progressive collapse mitigation.

Testing and evaluation of full-scale structures, including bridges and buildings’ responses to earthquake loads.

Real-time public transit monitoring and navigation; networked systems, especially wireless and vehicular networks.

Earthquake engineering, innovative structural systems, steel structures, and progressive collapse mitigation.

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Real-time public transit monitoring and navigation; networked systems, especially wireless and vehicular networks.

Earthquake engineering, innovative structural systems, steel structures, and progressive collapse mitigation.

Testing and evaluation of full-scale structures, including bridges and buildings’ responses to earthquake loads.
JEROME HAJJAR
Professor and Chair
Department of Civil and Environmental Engineering
Northeastern University (formerly Tufts)
fhajjar@northeastern.edu

Analysis, design, and field measurement of bridges; earthquake engineering.

LAURA HECKEL
Consultant
Hooke Engineering, Research, and Education, Inc.
HRE_LauraHeckel@tiglobal.net

Pavement engineering.

JAMES HALL
Associate Professor
Department of Management Information Systems
University of Illinois at Springfield
jhall1@uis.edu

Information systems management and implementation, GIS, decision support and e-government.

RIYADH HINDI
Associate Professor
Park College of Engineering, Analytics, and Technology
Saint Louis University
(formerly Bradley University)
rihindi@slu.edu

Bridge design and seismic behavior.

ANASTASIOS IOANNIDES
Associate Professor
College of Engineering and Applied Science
University of Cincinnati
astasios.ioannides@uc.edu

Response modeling for rigid and flexible pavements, pavement behavior and performance data interpretation.

YOUSEFF HASHASH
Professor
Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
yhashash@illinois.edu

Deep excavations, earthquake engineering, numerical modeling, and soil-structure interaction.

AUDREY ISHII
Hydroalogist
U.S. Geological Survey
Illinois Water Science Center
alishii@usgs.gov

Hydrologic/hydraulic analysis, surface and subsurface transport numerical simulation, flood frequency and data analysis.

JAMES LAFAVE
Associate Professor
Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
jlafave@illinois.edu

Experimental behavior and analytical modeling of structural connections and joints.

RAJENDRA LAKHUNDE
Professor
Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
rlakhund@illinois.edu

Self consolidating concrete, pavements, airport technology, relationships between microstructure and mechanical properties.

JEREMY LAMBERT
Senior Project Manager
Ott Engineering
Joel Lamber@otteng.com

Multimodal transportation network infrastructure, mobility, safety, security, and vehicle emission performance modeling.

LAURIE LAMBERT
Research Professor
Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
jlambert@illinois.edu

Soil-structure interaction, use of load test database for reliability-based design, earthquake engineering.

JON LAVERTY
Senior Research Engineer
Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
jlaverty@illinois.edu

Research support and field implementation for ICT projects.

ROBERT LAWRENCE
Senior Research Engineer
Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
rlawrence@illinois.edu

Geochemical, natural resources, and sustainability.

LAWRENCE LEWIS
Professor
School of Management
University of Illinois at Urbana-Champaign
llewes@illinois.edu

Information systems management and implementation, GIS, decision support and e-government.

HANNY LHAHMA
Research Director
Hanna Engineering
hannaeng@hannaeng.com

Civil infrastructure, sustainable construction, materials, and transportation.
Transportation modeling, transit planning, intelligent transportation systems planning, data development for freight planning.

Transportation planning, traffic safety including bicyclists and pedestrians, transportation modeling and traffic studies.

Concrete microstructure and the design of innovative and sustainable construction materials.

Transportation planning, traffic safety including bicyclists and pedestrians, transportation modeling and traffic studies.

Concrete-pavement design and analysis, continuously reinforced concrete pavements, characterizing concrete joint behavior.

Ground water and water quality investigations.

Stability and efficiency of transportation systems, transportation and supply network operations, and transportation safety.

Freight distribution activities.

Study design and methodology, survey research, sampling, questionnaire design, data collection and analysis.

Surveying, GIS, and transportation.

Traffic and transportation engineering.

Stability and efficiency of transportation systems, transportation and supply network operations, and transportation safety.

Traffic and transportation engineering.

Ground water and water quality investigations.

Asphalt mixes.

Asphalt mixes.

Concrete-pavement design and analysis, continuously reinforced concrete pavements, characterizing concrete joint behavior.

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Concrete-pavement design and analysis, continuously reinforced concrete pavements, characterizing concrete joint behavior.
Construction surveying, construction soils, and foundations.

Integrating solid super elements in building information models, laser scanning applications for construction.

Surface water investigations.

Transportation facilities evaluation, design, and research, including nondestructive testing of pavements.

River hydraulics, mechanics, and sediment transport modeling; bridge scour prediction in cohesive soils.

Concrete composition, microstructure, and performance.

Modeling, analysis, control and performance evaluation of discrete-state/descrete-event systems.

Transportation geotechnics and geosynthetics for the design, construction, and operation of roadways.

Transportation policy analysis, transportation data quality, intelligent transportation systems.

Mechanistic-empirical design procedures for flexible pavements.

Transportation geotechnics, pavement and railroad track subgrade soils and aggregates, recycled materials, geosynthetics.

Materials testing, geotechnical engineering, instrumentation.

Traffic operations and safety, pedestrian and bicycle safety, access management, intelligent transportation systems.

Pavement evaluation, design, and management; forensic investigations, work zone safety, pavement markings.

Pavement evaluation, design, and management; Pavement design, evaluation, materials assessment, and sustainability.

Pavement evaluation, design, and management; Pavement evaluation, design, and management.
ICT Facilities And Resources

ICT is headquartered in a state-of-the-art facility at the Advanced Transportation Research and Engineering Laboratory (ATREL). The ATREL complex is located on 47 acres just 15 miles north of the UIUC Campus. The complex includes 67,400 square feet of laboratories, continuing education classrooms, office space, a technical library, and a computer facility.

To sustain ICT’s leadership in transportation research, ATREL is staffed and equipped to accommodate the investigation of a wide range of projects from basic science and theoretical research to full-scale field testing and evaluation of pavements, bridges, railroad traffic, and transportation systems.

ATREL’s Ever-Growing Capabilities

ATREL is constantly upgrading its capabilities; just a sample of its improvements in the past year include:

- A new dynamic shear rheometer (DSR) device with the capability of "fluids to solids" testing. With a wide range of measurement geometries and accessories, the DSR can perform rheological characterization of asphalt binders and sealants and mechanical characterization of asphalt mixtures and mastic. The equipment provides precise control over a wide range of temperatures.
- A laboratory-scale foamed bitumen plant. This equipment can be used to investigate the foaming properties of different bitumen types at different temperatures and with various amounts of water and air to allow an optimum design of foamed bitumen. It is utilized for in-place cold recycling and warm mix design.
- A new large triaxial device for testing ballast.
- Increased oven capacity to handle larger volumes of asphalt work.
- Shear and fracture testing capabilities were added to the Interlaken asphalt testing machine.
- A second device for DC(T) fracture testing.
- IPC triaxial asphalt testing machine.
- Capability for fracture-energy interface bond testing.

ATREL’s Laboratories

Large and small-scale material samples can be tested in several labs at ATREL using state-of-the-art equipment, some of which were developed at ATREL. One laboratory area houses several servo-hydraulic and pneumatic systems for soil, granular materials, concrete, as well as HMA testing that includes simple performance, complex modulus, indirect tension, creep, four-point bending fatigue, and disk-shaped compact tension, among others.

Another lab houses SuperPave™ binder testing equipment, a linear rolling wheel compactor, triaxial shear apparatus, aggregate image analyzers, and the UI-FastCell capable of applying dynamic stresses on a soil cylinder in both vertical and radial directions. Another laboratory area has a 30 gpm hydraulic pump that can be connected to a variety of computer-controlled servo-actuators to simulate wheel loads on full-scale pavement slabs and bridge girders. This frame and soil containment box can test specimens approximately 8 ft. x 16 ft. Previous tests have included reinforced concrete slabs cut from an interstate pavement, static and fatigue of airfield concrete slabs, fiber reinforced concrete slabs, and two-lift concrete slabs.
The 2010 Round Robin testing included HMA volumetrics, gyratory compaction, TSR, ignition oven, and aggregate gradation. The Round Robin testing provides IDOT with a means to ensure that contractors, consultants, districts, and ATREL are consistent with laboratory procedures and results.

Accelerated Transportation Loading Assembly (ATLAS)
The Accelerated Transportation Loading Assembly (ATLAS) can evaluate full-scale transportation systems subject to real life traffic and environmental loads. The system is capable of simulating aircraft, truck, or rail traffic distributions, testing all types of pavement systems, and applying load levels exceeding that of highway and airfield limits. ATLAS can be covered by a moveable structure that controls the effects of daily temperature and moisture changes on the pavement section being studied. It also has data acquisition systems for instrument data collection. ATLAS can apply up to 6,000 repetitions per day, and it is equipped with insulated environmental control aluminum panels designed to provide a constant temperature for the top 2 inches of pavement.

Traffic Operations Laboratory
The Traffic Operations Laboratory (TOL) houses equipment to evaluate traffic signal components and fiber optic communications, offices, technology transfer classrooms, testing areas, and a 17-foot high bay area. TOL’s extensive collection of traffic signal control hardware, including controllers, detector units, and conflict monitors, provides a valuable resource for hands-on instruction and research.

ICT Facilities And Resources

American Concrete Pavement Association
Applied Pavement Technology
Colas Inc.
Federal Highway Administration
Heritage Research Group
Illinois Department of Transportation
Illinois Tollway
Malvern
Murphy Pavement Technologies
O’Hare Modernization Program
Pavement Rehabilitation Services (South Africa)
Research and Innovative Technology Administration (RITA)
Road Science LLC
Scott Air Force Base

Suleyman Demirel University (Turkey)
Test Quip LLC
Texas A&M University
Transportation Research Board
Transportation Technology Center, Inc.
U.S. D.O.T. Federal Railroad Administration
U.S. Transportation Command
University of Illinois-Springfield
University of Minho (Portugal)
University of North Carolina
University of Parma (Italy)
University of Washington
Washington State University
Wirtgen

A new triaxial device for testing ballast arrived at ATREL in April 2011.

Students help construct a test pavement at ATREL.

ICT investigators give Bob Skinner (Transportation Research Board Executive Director) a tour of ATREL. From left to right are: Erol Tutumluer, Imad Al-Qadi, Skinner, and Jeff Roesler.

Engineers from the O’Hare Modernization Program visited ATREL in February 2017.

Comprehensive performance tests on warm-mix asphalt samples were conducted at ATREL during fall 2010.

ICT welcomed the nation’s top transportation research official, Peter H. Appel, to ATREL in August 2010. Appel is the Administrator of the U.S. Department of Transportation’s Research and Innovative Technology Administration (RITA).

ATREL hosted social events throughout the year for students, faculty, staff, and their families.
As a testament to its commitment to diversity, ICT consistently outsources to other public and private universities, research institutions, and specialty consulting firms. In fiscal year 2010-2011, ICT outsourced 24% of its funded research.

1. Call for Research Ideas

Twice annually, the eight Technical Advisory Groups (TAGs) identify specific transportation topics or focus areas as priorities for new ICT research. A TAG is a subcommittee of the ICT Executive Committee with expertise in a specific research area. TAGs are comprised of representatives from IDOT, FHWA, academia, industry, local agencies, and other governmental agencies. These groups review, prioritize, and recommend projects to the ICT Executive Committee. ICT currently has eight standing TAGs – Construction, Environment, Pavement Design and Management/Materials, Planning, Public Transportation/Multi-Modal, Safety, Structures/Hydraulic/Geotechnical, and Traffic Operations and Roadside Maintenance. Other ad hoc TAGs may be added as needed. ICT then posts the TAG suggestions on its website and invites potential researchers and IDOT staff to submit specific research ideas. Although ICT encourages research ideas based on the priorities the TAGs identified, research ideas on any transportation-related topic are considered. Those who wish to suggest a specific research topic can download the Proposed Research Idea Form from the ICT website. The deadlines for these submissions are generally January 31 and June 30. *Submitters should be aware that not all ideas are selected for funding and that ideas may be shared with others. ICT also reserves the right to select any researcher to carry out a research idea.

2. Funding of Projects

After the Call for Research Ideas deadlines, the TAGs review the research ideas submitted in their respective subject areas and prioritize them for presentation to the ICT Executive Committee for funding consideration. The Executive Committee is chaired by the IDOT Director of Highways (or the Director’s designee) and is comprised of the ICT Director, the Directors of the Offices and Divisions of IDOT, and a representative from the Federal Highway Administration (FHWA). The ICT Executive Committee meets twice annually to review the prioritized recommendations of the eight TAGs and makes the final decision on which research projects are funded.

3. Selection of the Project Technical Review Panel

For each new project, IDOT appoints a Technical Review Panel (TRP) to oversee and guide the research. Chaired by an IDOT employee, members are appointed based upon their expertise to ensure there is sufficient subject expertise and diversity on each panel to assist and guide the ICT researcher(s). Members are selected from IDOT, FHWA, local agencies, industry, other governmental agencies, etc. The TRP chair is generally an IDOT employee. The TRP is responsible for reviewing RFPs (if proposals are solicited outside the University of Illinois system), reviewing and approving the research work plan and budget, providing regular feedback to the researchers about the research, and reviewing and approving the projects deliverables and final report.

4. Investigator Selection

Once a project is funded, ICT determines who serves as the Principal Investigator(s), the lead researcher(s) on an ICT project. ICT can select a Principal Investigator (PI) from one of the University of Illinois’ three campuses. Alternatively, ICT can solicit proposals from researchers outside the University of Illinois’ campuses.

5. Requests for Proposals

For projects not directly assigned to an investigator, ICT solicits research proposals. These requests for Proposals (RFPs) are widely advertised and posted on the ICT website semi-annually. In fiscal year 2010-2011, ICT advertised nine RFPs with a total value in excess of $1.6 million.

6. Evaluation of Proposals

The appropriate TAG evaluates all submitted proposals and makes a recommendation to ICT for award of the research.

7. Research Process

Once a researcher is selected for a project (either by the ICT or via RFP), he or she is asked to work with the TRP to prepare a work plan and budget. The PIs keep accurate records of the nature of their work performed and data analysis, and they submit quarterly reports on their research progress.

8. Completed Projects

After the researchers complete their project report and are ready to disseminate the findings and conclusions, they work with their TRP and an ICT editor to finalize a project report so that the research findings are presented clearly and the report’s formatting is consistent with ICT requirements. ICT considers a project as complete when the final research report is published and posted on the ICT website. *In some instances, IDOT may request the findings remain confidential for a period of time or IDOT may determine that the findings/conclusions are so specialized that they do not warrant a public report. In these cases, the findings or conclusions are shared internally within IDOT.

* Submitters should be aware that not all ideas are selected for funding and that ideas may be shared with others.

ICT also reserves the right to select any researcher to carry out a research idea.
ICT takes a proactive role in protecting our environment by developing technologies that conserve resources. Pavements, tires, and even rest areas all contain opportunities for environmentally friendly practices, and ICT’s research is at the forefront of these ideas.

**Impact of Research**

**SUSTAINABILITY / ENVIRONMENT**

The project, to begin during summer 2011, will identify sustainability issues with regard to pavements. The FHWA will use the information to help develop its sustainable pavements program to consider asphalt, concrete, granular, and other recyclable materials.

The desired outcome is to increase the awareness, visibility, and the body of knowledge of sustainability considerations for our nation’s pavements.

Other organizations that are part of this team include Applied Pavement Technology, Inc., the University of California Pavement Research Center, University of Washington, Virginia Tech, University of New Hampshire, The Right Environment, and CH2M Hill.

ICT’s work to develop green-friendly practices for rest areas will help the state of Illinois achieve energy savings and advance IDOT’s leadership in preserving the environment.

Pride of the Prairie Rest area in Illinois was a subject of the Phase I ICT study on best management practices.

The investigators are now working on Phase II of the study which will investigate, determine, and provide a list of green-friendly BMPs for six additional rest areas that together account for 32% of IDOT’s rest area energy bills. Implementing green-friendly practices in Illinois’ rest areas will lead to significant annual savings for IDOT and will show a commitment by the state of Illinois to be more environmentally conscious.

ICT’s work will increase the awareness, visibility, and the body of knowledge of sustainability considerations for our nation’s pavements.

The project researchers to support new national sustainable pavements program.

ICT Researchers to Support New National Sustainable Pavements Program

Pavement experts at the Illinois Center for Transportation, led by Director Imad Al-Qadi, will assist the Federal Highway Administration (FHWA) as it develops a national sustainable pavements program.

Illinois Interstate rest areas welcome nearly 40 million visitors annually. They are one of Illinois’ most visible amenities and are on display and used 365 days a year. The facilities are presently maintained as well as budgets allow but are in need of upgrades to become more energy efficient and “green friendly.”

To develop a list of “green friendly” best management practices (BMPs) for Illinois Interstate rest areas, ICT investigators Khaled El-Rayes and Liang Liu determined energy cost baselines, assessed existing conditions related to energy use, and evaluated existing and alternative BMPs. The investigators developed BMPs for specific locations, with expected costs and payback information as well as a total statewide cost estimate for full implementation with payback. The final report for Phase I of the study is posted on the ICT website.

ICT’s work to develop green-friendly practices for rest areas will help the state of Illinois achieve energy savings and advance IDOT’s leadership in preserving the environment.

ICT Director Imad Al-Qadi facilitates discussion at the kick off meeting for the sustainable pavements project on May 23, 2011.
Researchers at the Illinois Center for Transportation (ICT) have been selected to lead a $1.2 million FHWA project to model and validate the use and effects of wide-base tires as an alternative to the conventional dual-tire system on semi truck trailers. Wide-base tires have the potential to provide numerous benefits to the environment and the trucking industry. The team will use advanced theoretical modeling that is validated with testing on sensored full-scale pavements to determine the relationship between the tire characteristics, including width, aspect ratio, loading, inflation pressure, and actual tread width, and pavement damage. The team will develop a tool and methodology that allows engineers and agencies to assess the impact of wide-base tires on the pavement network and analyze the environmental advantages of wide-base tire implementation. The U.S. Environmental Protection Agency (EPA) Smartway Transport Project promotes the use of wide-base tires as a way to improve fuel economy by reducing weight, aerodynamic drag, and rolling resistance. Other potential benefits they cite include reduced drive-by noise and improved stability.

ICT’s previous work on wide-base tires has shown that they actually have similar total pavement impact on the interstate highway pavements as the dual-tire system; although the pattern of damage observed with the wide-base tires relative to the impact on pavement performance with the dual-tire system is different. As part of an earlier project, the ICT team showed the environmental advantages of wide-base tire implementation. The U.S. Environmental Protection Agency (EPA) Smartway Transport Project promotes the use of wide-base tires as a way to improve fuel economy by reducing weight, aerodynamic drag, and rolling resistance. Other potential benefits they cite include reduced drive-by noise and improved stability.

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ICT Collaborates with the Illinois Tollway on Environmentally Friendly Warm-Mix Asphalt

ICT researchers, lead by Director Imad Al-Qadi, and the Illinois Tollway have teamed up on a project involving the performance of warm mix asphalt (WMA), which has several environmental benefits compared to the performance of traditional hot mix asphalt.

In recent years, WMA techniques have been developed to reduce hot-mix asphalt (HMA) production temperatures. WMA is mixed and placed on the road at lower temperatures (as much as 50 to 100 degrees Fahrenheit lower than HMA). Compared to traditional asphalt construction, this reduction in production temperature uses less fossil fuel and produces fewer emissions, therefore, benefitting the environment. WMA may also perform better—a question which Al-Qadi and his team intend to answer. The research team also plans to determine how long WMA needs to cure to develop its ultimate performance strength. Knowing this ideal timeframe will help the agencies decide how soon it can open traffic on their roadways following construction. A past concern was that their roadways were being opened to traffic too soon after construction, and consequently the pavements were being prematurely distressed. There are two unique aspects about this research. The first is that this research is on Stone Mastic Asphalt (SMA), a specially designed mix that contains fibers and/or additives that enhance its performance for heavy traffic interstate/expressway placement. Several SMA mixes are being analyzed, containing a specific warm-mix technology, recycled pavement materials, rubber, and/or recycled roofing shingles. The second unique aspect is that performance tests are being conducted on field-compacted samples, rather than laboratory samples. This method better simulates the actual curing of WMA and avoids any effects from re-heating the WMA.

A testing program of this level has never been attempted before: some samples were flown immediately from a nearby airport to meet the strict performance testing schedule. Back at ATREL, comprehensive laboratory tests were conducted on the samples upon arrival and over the course of seven days (and some over three weeks). Those tests include complex modulus, flow number, wheel tracking, indirect tensile creep and strength, and semi-circular bending fracture. Additionally, this research project aims to verify the early age rutting potential of the innovative warm-mix SMA, using a lightweight deflectometer for in-situ performance testing.

The end result will be a performance evaluation of warm mix SMA at early age, which will allow pavement engineers and/or contractors to determine the minimum traffic opening time, especially for high traffic volume interstates or expressways. The early age performance will be based on stiffness, rut resistance, and life-cycle assessment. As a result of this study, the Illinois Tollway will have the information they need to select the best asphalt mix and maximize its performance for future projects, which will save them time and money while also providing environmental benefits when compared to traditional HMA.
ICT established the Erosion Control Research and Training Center (ECRTC) on the UIUC campus to demonstrate erosion, sediment, and storm water control practices suitable to Illinois conditions. This facility will be used for hands-on training, to demonstrate proper installation and evaluation techniques, and to initiate research to assess the applicability of erosion control and best practices for storm water management for relevant IDOT construction site conditions.

Land development and construction projects often alter the hydrologic responses that result in increased rates and volume of storm water runoff and soil erosion rates. This in turn contributes to increased and frequent flooding, channel erosion, sediment transport and deposition, loss of structures due to high runoff rates, and non-point pollution of our streams, lakes, and reservoirs. IDOT strives to excel in road construction technologies, including storm water management and adopting best management practices (BMPs) for erosion control and sediment transport.

The center, equipped with rainfall simulators (sprinklers) and automated water quality samplers, will provide a setting that will simulate a multitude of conditions typically found along Illinois roadways, highways, and urban settings. This facility will provide critical hands-on training in outdoor and indoor classrooms on proper installation, use and evaluation of erosion and sediment control products.

The ECRTC will be used to evaluate the performance of IDOT-identified storm water management and erosion control BMPs in real Illinois conditions and provide IDOT with staff training in a timely and cost-effective manner. In collaboration with UIUC’s Department of Agricultural and Biological Engineering, ICT will administer short courses to disseminate the outcome of the center’s research. Prasanta Kalita, co-investigator along with Richard Cooke, says, “Our vision is to make the ECRTC one of the best centers in the country where quality research, demonstration, and education will be provided to state, federal, and other groups.”

ICT Establishes Research and Training Center for Erosion Control

The erosion control center allows IDOT to evaluate practices and products in real Illinois conditions. It also allows for hands-on training opportunities for contractors, inspectors, designers, and others interested storm water management best management practices for a sustainable environment. ICT began offering its erosion and sediment control workshop in June 2011.

Impact of Research

SAFETY

Speed, work zones, and wrong-way traffic are three major contributors to accidents on Illinois highways. To prevent accidents and save lives, the ICT supports research to study driver behaviors related to these and other factors.
**PROJECT # R27-88**

**ICT Study Aims to Reduce Wrong-Way Driving on Freeways**

Statistics show that wrong-way driving is a factor in approximately 27% of fatal crashes in Illinois. By investigating these crashes individually, in as much depth as possible, ICT investigators Huaguo Zhou, Ryan Fries, Brent Vaughn, and Chiang Lin are determining the common contributing factors so they can recommend potential countermeasures. Specifically, the investigators are looking at crash data, crash reports, construction reports for fatal crashes, plan and site information, as well as interviewing the officers and engineers who are most familiar with the location and traffic operation. They are also considering less severe wrong-way crashes to confirm and contrast patterns.

ICT investigators Hani Mahmassani and Roger Chen are identifying the most effective patrol strategies on safety, design, and operational issues related to wrong-way driving on freeways. What are the wrong-way crash history, pattern, and severity in Illinois? And what are the significant contributing factors affecting severe and less severe wrong-way crashes? The information gained can help reduce these types of driving errors and therefore save lives.

Wrong-way driving is a factor in approximately 27% of fatal crashes in Illinois; ICT is investigating these crashes in depth to recommend the most effective countermeasures.

At completion of the project (set for June 2012), the research results will answer three basic questions: (1) What is the state of practices on safety, design, and operational issues related to wrong-way driving on freeways? (2) What are the wrong-way crash history, pattern, and severity in Illinois? And (3) What are the significant contributing factors affecting severe and less severe wrong-way crashes? The information gained can help reduce these types of driving errors and therefore save lives.

**PROJECT # R27-88**

**ICT Helps Illinois Better Allocate Resources for Speed Enforcement**

Speed contributes to 39% of traffic-related fatal crashes occurring on Illinois highways. The FHWA has identified Illinois as a Speed Focus State and has encouraged Illinois to develop a speed management program. In this era of a struggle for economy, reduced resources, and competing needs, leaders within the public and private sector are turning to intelligence-driven assignments to produce the greatest gain with the least amount of investment. Therefore, ICT is identifying the most effective speed enforcement patrol and saturation patrol procedures and methods, including effective enforcement duration and appropriate staffing level needs, so Illinois can more efficiently deploy valuable resources and maximize results.

ICT investigators Hani Mahmassani and Roger Chen are identifying statewide survey locations to test existence and extent of the halo effect and the effectiveness and efficiency of each speed enforcement technique.

Their analyses will result in more effective patrol strategies and procedures with the least amount of staff, allowing IDOT and the Illinois State Police to better allocate resources and ultimately reduce speed-related fatalities on Illinois highways.

Specifically, the research results (set for October 2012) will answer: 1) How does presence/absence and duration of speed enforcement affects speed on Illinois highways? 2) What are the best practices for patrol and saturation patrol procedures? 3) How does reduction of speed correlate to the reduction of severe crashes?

**PROJECT # R27-52**

**ICT Provides Recommendations to Improve Work Zone Layouts**

In Illinois alone, work zone accidents result in an average of 2,100 injuries and 27 fatalities per year. Contrary to popular belief, motorists are more likely to get hurt in work zones than workers. With the end goal of safer work zones for everyone, ICT supports research to study driver behavior and improve the set-up of work zones.

ICT researchers Khaleed El-Rayes and Liang Liu analyzed the frequency and severity of traffic-related work zone crashes and investigated the probable causes and contributing factors of these crashes. Next they developed practical recommendations for improved work zone layouts and merge techniques that minimize the probable causes of work zone crashes. As part of the project, they also evaluated the practicality and effectiveness of the strategies proposed by the Illinois Comprehensive Highway Safety Plan to add temporary/portable rumble strips within and prior to work zones.

With the end goal of safer work zones for everyone, ICT supports research to study driver behavior and improve the set-up of work zones. ICT researchers Khaleed El-Rayes and Liang Liu analyzed the frequency and severity of traffic-related work zone crashes and investigated the probable causes and contributing factors of these crashes. Next they developed practical recommendations for improved work zone layouts and merge techniques that minimize the probable causes of work zone crashes. As part of the project, they also evaluated the practicality and effectiveness of the strategies proposed by the Illinois Comprehensive Highway Safety Plan to add temporary/portable rumble strips within and prior to work zones.

As a result of this project, ICT has presented IDOT with a comprehensive analysis of work zone crashes in Illinois and specific recommendations for improving work zone layouts, merge techniques, and traffic control standards and specifications.

Their analyses will result in more effective patrol strategies and procedures with the least amount of staff, allowing IDOT and the Illinois State Police to better allocate resources and ultimately reduce speed-related fatalities on Illinois highways.

Specifically, the research results (set for October 2012) will answer: 1) How does presence/absence and duration of speed enforcement affects speed on Illinois highways? 2) What are the best practices for patrol and saturation patrol procedures? 3) How does reduction of speed correlate to the reduction of severe crashes?
To help meet the expectations of the travelling public while maximizing the use of their tax dollars, ICT investigates ways to improve pavement design, monitoring, evaluation, performance, and rehabilitation methods. The results lead to lower construction costs, increased maintenance intervals, extended pavement life, and reduced travel delays.

ICT is using innovative materials and construction techniques to provide IDOT with new HMA design alternatives.

Using the data collected, the investigators will perform an engineering benefit analysis and will provide IDOT with new mix designs that are durable, provide sufficient friction, and possibly lower noise.

ICT is using full-scale testing to evaluate Illinois aggregates and verify their performance levels at various thicknesses. The full-scale testing will provide data regarding the aggregates’ performance levels and ideal thicknesses linked to their properties and quality considerations.

The test sections of the aggregate materials (previously studied in a laboratory setting) were constructed at ATREL during fall 2010. Six different test cells, each with three different aggregate thicknesses, were loaded with the ATLAS accelerated loading system. The investigators measured permanent deformations that accumulated with ATLAS wheel passes under channelized traffic loading in two transverse locations in each test section. In addition, a total of 10 pressure cells were used to measure subgrade stresses during trafficking. The investigators used ground penetrating radar to measure the transverse rut profiles and identify amounts of rutting in the subgrade and aggregate cover individually.

After fully evaluating the test results, investigators will provide IDOT with recommended revisions to its Subgrade Stability Manual and specifications to potentially reduce expenditures for aggregates by optimizing treatment thickness and minimizing failures.

Through an innovative use of ground penetrating radar, ICT investigators were able to identify the levels of deformation in various layers of the test pavements.

ICT is using full-scale testing to optimize unpaved road design.
Impact of Research

From monitoring specific bridges to developing innovative technologies to improve bridge design, the ICT has an ongoing role in assuring the safety of our nation’s bridges.

STRUCTURES

PROJECT # 827-71
ICT Develops and Implements Sensor to Detect Scour Depth under Bridge Piers

Bridge scour, the erosion of stream material around the bridge foundation, is responsible for many of the bridge failures in the United States. An ICT study led by Farhad Ansari developed a fiber optic scour sensor capable of monitoring and providing quantitative characteristics of both scour depth and flow processes, i.e. rate.

ICT’s new scour sensor includes fiber optic bragg grating and is embedded inside a rod cantilevered into the river bed. The project involved development, testing, modeling, and fabrication of the field sensor and field implementation and testing. The results proved that the simple concept of developing a very low cost sensor with only one sensing element is sound.

The simplicity of ICT’s new sensor allows for widespread implementation in myriads of scour critical bridges. The new sensor will provide better monitoring of scour and therefore better bridge maintenance.

Because of its accuracy, simplicity, and low cost, ICT’s new scour sensor can be widely implemented to improve bridge maintenance.

PROJECT # 827-70
ICT Revisits Illinois Earthquake Resistance Strategy

ICT investigators are using both experimental and computational research to investigate, validate, calibrate, and adjust (if necessary) high-priority components of the current Illinois Earthquake Resisting System (ERS) strategy. The work will focus on the specific seismic hazard and structural characteristics appropriate for Illinois. IDOT is confident about the robustness of its developed ERS strategy but also realizes that more experiments and sophisticated finite element models would provide valuable information that could lead to improvements.

The basic idea behind the IDOT ERS is that the bridge deck should be isolated during major earthquakes (the bridge deck will stay nearly still while the ground moves the piers and abutments under it). ICT researchers are performing experiments to simulate the large displacements anticipated for major seismic events, such as a repeat of the 1811-1812 New Madrid earthquakes, to investigate how the bearings will behave (How much force does it take for the deck to start sliding? How much damage does the bearing incur while sliding on piers and abutments?)

The experimental data is then being used in computational models of full bridges to evaluate the performance of the bridge as a complete system (How does earthquake intensity correspond to forces in the bridge? What maximum displacements can be expected during large seismic events? How much permanent displacement is likely to remain at the bridge deck after an earthquake?)

Using the data obtained from the experiments and computer models, ICT will verify bearing fuse capacities and help to ensure prevention of span loss during a seismic event for appropriately designed bridges.

IDOT technical review panel members visit the earthquake resistance bridge testing facilities at Newmark Lab on the UIUC campus.

IDOT instrument box at the bridge site for remote acquisition and wireless transfer of data.

Installation of the scour sensor.
ICT investigators used an internet-based, prompted recall activity-travel survey using global positioning system (GPS) devices to collect activity-travel diaries and other necessary information from over 100 households in several northeastern Illinois counties.

A previous ICT study shed light on the factors that influence seniors’ choices about transit. For this follow-up study to better understand trip chaining behaviors, each respondent was asked to carry a portable GPS device for 14 consecutive days and complete activity-travel survey questionnaires. The results provided much insight into both the GPS surveying method and the differences in travel behavior among age groups.

ICT’s data sheds light on seniors’ activity-travel behavior and decision-making processes; these findings will be used to better target transit services to seniors.

ICT determined that age affects some aspects of activity-travel behavior such as planning horizons, trip flexibility, and trip chaining practices. This study’s results will therefore be used to plan more efficient transit services targeting senior travelers and help change their attitudes toward public transportation.

A recent South Suburban Mayors and Managers Association (SSMMA)’s freight study designated the I-80 East Logistics Corridor as a development opportunity to attract truckers and trucking-related industries. ICT supports SSMMA’s continuing efforts to encourage new business and meet the needs of truckers who provide pickups and deliveries to this area.

The ICT researchers categorized problems, developed a locally responsive design guide and engineering handbook, provided detailed site plans and designs to alleviate delivery problems, addressed scattered truck parking problems by identifying parking zones on major roads or small areas on otherwise unusable adjacent sites, and alleviated truck parking issues by forming agreements with property owners of existing facilities.

The team developed communications, both print and electronic, to help truckers safely and efficiently navigate the southern suburban freight corridors. The new resources include truck parking and rest facility locations, truck route maps, and emergency information. These resources make the south suburbs a choice destination for truckers, especially because other major trucking destinations are 10 to 11 hours away. This effort will ultimately help encourage trucking-dependent and manufacturing industries to stay, expand, or relocate to this area.

ICT developed handbooks and webpages to help truckers navigate freight corridors, alleviate parking problems, and encourage trucking-related commerce in the I-80 area.
The use of light emitting diodes (LED) as a light source in roadway lighting has the potential to save energy costs and reduce the frequency of maintenance. Many cities nationwide have switched to LED traffic lights from high-pressure sodium lights. ICT is investigating technological advancements in LED roadway lighting to determine applications where IDOT can reduce costs or improve lighting.

ICT has studied typical lighting applications, including interstate, urban arterial, intersection, bridge, streetscape, underpass, sign, highmast, and tunnel lighting and worked with the Village of Rantoul during August 2010 to set up a test site that included high pressure sodium luminaries along South Perimeter Road near ATREL. The research team, led by Ray Benekohal, used two ways to measure how efficient the light bulbs are for street travelers: an illumination meter that measures light 6 inches from the road surface that shows how much light is coming from the bulb to the location of the road and a lumination meter that shows how much light is reflected from the road’s surface.

In their findings, expected to be released during fall 2011, ICT will determine if LED lights have a longer life span and use less power for street lighting than the high-pressure sodium lights and if the manufacturers’ claims for performance are achievable in Illinois conditions. The researchers will compare LED performance to existing light sources and provide economic justification to IDOT for or against the use of LED roadway lighting.

ICT is helping the City of Chicago select traffic management and information technologies for the corridor extending from Midway Airport to the Loop, also known as the Cicero-Midway Smart Corridor. Monitoring this corridor of arterial streets presents several challenges compared to monitoring highways due to the spacing and impact of traffic signal controls.

To monitor performance and manage traffic, ICT investigator Jakob Eriksson has deployed and compared several different technologies, including a bus tracker based system, named Shuttletracker, WiFi-based travel time estimates, and probe-vehicle based estimates. This prototype project will support integrated corridor management strategies and enhanced information for travelers choosing route, mode, and time of day for travel to/from Midway Airport and the Loop.

The long-term goals of this project are to improve corridor performance, improve air quality, reduce fuel consumption, and enhance traveler service and comfort.
As smartphones show increased potential to monitor infrastructure and travel, ICT will be at the center of these developments. ICT affiliate Dan Work has developed and tested roles for smartphones in infrastructure monitoring, as part of the Mobile Millennium project in California. Mobile Millennium was developed with support from Caltrans, the U.S. DOT, Nokia, and Navteq, and uses smartphones equipped with a Global Positioning System (GPS) for real-time monitoring of traffic on highways and surface streets in Northern California. It then broadcasts traffic estimates back to the devices.

Because such systems rely on users opting in to contribute, a second component of Work's research is to design privacy aware sampling strategies for mobile devices. He designed Mobile Millennium to prevent user re-identification by an adversary, in collaboration with researchers at Nokia Research Center in Palo Alto. Towards sustainable mobility, Work strongly believes that mobile Internet services can also help commuters shift modes from private vehicles to public transit. He also developed a transit trip planner for mobile devices called Transitr to fill the critical gap between existing real time bus arrival systems which do not include routing, and the traditional static schedule based planners which lack real-time information.

Deployed in San Francisco, Seattle, Portland, and New York, Transitr users submit their origin and destination through a map-based iPhone application, and the server returns personalized route directions for the user. Mobile transit trip planning is an important step towards larger goals of mode shifting towards sustainable transit.

ICT researchers have extensive experiences and capabilities in pavement modeling based on computer simulation. A three-dimensional (3-D) modeling approach allows for consideration of various complex factors, including tire-pavement contact stresses, inelastic behavior of materials (viscoelastic asphalt layers, stress-dependent modulus for granular and subgrade materials), interface bonding conditions, and dynamic tire loading.

For example, ICT researchers use the 3-D measured contact stresses from tire-pavement interaction to model the pavement loading with moving tires at various loads, tire pressures, and speeds to identify the critical locations where pavement damage typically starts. The modeling results are often validated by full-scale testing and provide initial invaluable data for a much larger testing matrix than could be assembled in the field. Another innovative use for modeling techniques is to better understand the cracking mechanisms in pavements. ICT researchers utilized novel numerical methods such as the Generalized Finite Element Method (GFEM) to realistically model the complex phenomena that control fracture initiation and propagation. They have adapted the GFEM to analyze relatively thick flexible pavement structures to predict near-surface cracking. The 3-D and highly multi-axial nature of the problem is successfully captured by this method, which is ideally designed for 3-D fracture problems for complex geometries and mixed loading conditions.
As the demand for freight and passenger transportation continues to grow, ICT helps ensure the sustainability and resilience of the transportation systems for current and future generations through optimization techniques. To plan, manage, and control transportation systems, ICT researchers use integrated systems analysis frameworks that incorporate innovative management concepts and advanced mathematical techniques.

For the National Science Foundation, ICT researcher Yanfeng Ouyang and his colleagues address the interdependence, resilience, and sustainability of complex infrastructure systems (e.g., transportation, agricultural, hydrological, ecological, social-economic) in the context of the fast-growing biofuel production industry. While determining the optimal locations for biofuel refineries, for example, they incorporated agricultural development, roadway infrastructure expansion, shipment routing of feedstock and product, and the resulting traffic congestion impact into the model, so that the welfare of the biofuel industry, the agricultural farmers, and the general public are optimized.

ICT uses optimization techniques to improve transportation planning and operations in many other contexts. For example, Ouyang and his team developed multi-year pavement management programs to help IDOT prioritize rehabilitation activities. They also helped the railroad industry schedule track maintenance projects to keep the serviceability of the railroad network. These maintenance projects (of different types) cost billions of dollars each year, and they must be performed by specific maintenance teams with very complex business rules. A number of advanced network optimization models and efficient solution approaches were developed to minimize the total travel costs of the maintenance teams as well as the impact of maintenance projects on train traffic operations. Compared to the current industry practice, the outcome of their models reduced the total objective value (travel costs and business rule violation penalties) by over 60 percent.

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All consultants who perform construction inspection (Phase III) work for IDOT must take and pass the Documentation of Contract Quantities class administered by ICT. In 2010-2011, ICT offered 15 three-day classes that were attended by 542 people. ICT also offered eight re-tests to 131 previously certified consultants to renew their certifications. These classes and retests were held at numerous locations throughout the state.

This training, led by ICT instructor Mary Fries, assures well-educated, prequalified consultants to perform construction inspection in Illinois. This course is also offered to full-time IDOT and local agency personnel, which helps ensure that quality construction and documentation practices are followed throughout the state.

ICT maximizes the impact of its research through outreach activities, which include training classes, workshops, and peer exchanges. Additionally, ICT publishes its research in a wide variety of publications and presents its research at numerous national and international conferences and events throughout the year.

ICT investigators Huagu Zhou and Ryan Fries developed training materials and training events to educate responders from all agencies on how to improve their safety, work together more efficiently, and come home safe at the end of the day.

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The ICT’s training and certification classes ensure that quality construction and documentation practices are followed throughout the state.

While responding to incidents, police, fire, EMS, and towing personnel encounter a dangerous work environment. ICT developed a new Highway Incident Management Guide that multiple agencies will use to improve their management of highway incidents.

The ICT Investigators Huagu Zhou and Ryan Fries developed training materials and training events to educate responders from all agencies on how to improve their safety, work together more efficiently, and come home safe at the end of the day. The materials and training reinforce important topics such as safe parking, responder cooperation, and incident classification. Fries says, “Keeping Illinois responders safe is a priority to IDOT and ICT, and this training guide is a critical step in the right direction.”

Responders from various agencies discuss best practices for responding to highway incidents.
ICT Sponsors Illinois Bituminous Paving Conference and T.H.E. Conference

The ICT serves as a sponsor for two major conferences on the UIUC campus. The 51st Annual Bituminous Paving Conference convened in December 2010 and had a record attendance of 275.

The 97th Annual Transportation and Highway Engineering (THE) Conference convened in February 2010 and attracted nearly 1000 attendees.

ICT Participates in First Congress of the Transportation and Development Institute

ICT researchers presented at more than 45 sessions at the Transportation Research Board (TRB) Annual Meeting which convened in Washington D.C. on January 23-27, 2011. The ICT/UIUC researchers presented their cutting edge research on diverse topics and participated in various committee meetings and other conference activities.

Approximately 10,000 transportation officials from around the world attended this conference which covers all transportation modes, with more than 3,000 presentations in nearly 600 sessions addressing topics of interest to all attendees that included policy makers, administrators, practitioners, researchers, and representatives of government, industry, and academic institutions.

ICT had a strong presence at the first Congress of the Transportation and Development Institute (T&DI) of the American Society of Civil Engineers that convened in Chicago on March 13-16. ICT exhibited at the conference; ICT investigators presented on several topics; ICT Director Imad Al-Qadi served as co-chair; and ICT Investigator Bill Butler served as a track co-chair.

The four-day event brought together 240 attendees to discuss integrated strategies focusing on smart development and efficient multimodal movement of people and goods to support the economic pulse of our nation and the world. The impressive technical program included five concurrent paper/presentation tracks, technical tours that included O’Hare International, and pre-Congress workshops.

ICT Investigators and Students Present More than 45 Research Topics at Annual Transportation Research Board Meeting

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ICT was proud to welcome the Executive Director of the Transportation Research Board (TRB) of the National Academies Robert Skinner to campus and ATREL on April 5, 2011. Mr. Skinner was the guest speaker of the distinguished Kent Lecture series where he discussed “Transportation and Sustainability: Strategies to Reduce Green-House Gas Emissions and Improve Energy Security” to a room full of transportation students, faculty, and other interested attendees.

The Paul F. Kent Distinguished Lecture, initiated in 2007, honors outstanding leadership in the field of transportation engineering. Paul Kent was a 1920 graduate of the University of Illinois in Civil Engineering who wished to attend. The attendees are always served pizza and soda. The speakers during the past year included:

- Dr. Serji Amirkhanian, Consultant
- Behzad Behnia, UIUC
- Amanda Bordelon, UIUC
- Alex Brand, UIUC
- James Krstulovich, Applied Pavement Technology, Engineering Associate
- Zhen Leng, UIUC
- Deb Mishra, UIUC
- Jorge Pais, University of Minho (Portugal)
- Ricardo Serpell, UIUC
- Sarfraz Ahmed, UIUC
- Dong Wang, UIUC
- Eyad Masad, Texas A&M University
- Stephen Muench, University of Washington
- Balasingam Muhunthan, Washington State University
- Hazan Özer, UIUC
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The Kent Distinguished Lectures are sponsored by the Paul F. Kent Memorial Fund, established in 1977 to support education in transportation engineering. The fund also includes a weekly transportation seminar series for transportation students and anyone else who wishes to attend. The attendees are always served pizza and soda. The speakers during the past year included:

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- Onur Pekcan, UIUC
- Hao Wang, UIUC
ICT congratulates its investigators, staff, and student researchers on the following awards and honors received during fiscal year 2010-2011.

**Ibrahim Abuward and Kevan Awrani**, both ICT student researchers, were part of a team from the University of Illinois at Urbana-Champaign that placed second at the 2010 Midwestern Traffic Bowl Competition, sponsored by the Institute of Traffic Engineers. UI Traffic Bowl Team celebrates by the Mississippi River after the competition.

**Sarfraz Ahmed**, former ICT student researcher, has started as Assistant Professor at the National University of Sciences and Technology in Pakistan. Ahmed was a constant fixture in front of the fracture testing machine at ATREL.

**Ibrahim Al-Qadi**, ICT director, was awarded the American Society of Civil Engineers (ASCE) Central Illinois Distinguished Award for “legendary contributions to the profession of civil engineering and achievements of eminence in the field of pavement engineering and related technologies.”

**Bassem Andrawes**, ICT project investigator, received the National Science Foundation Faculty Early Career Development Award. Andrawes will receive $400,000 over the next five years to develop and study a new technology that uses smart materials to reinforce lifeline concrete structures with the aim of mitigating damage from strong earthquakes.

**Jongyuen Baek**, ICT researcher, has started as Research Professor at the Department of Civil and Environmental Engineering at Sejong University in Korea.

**Amanda Boddoloi**, former ICT student researcher, passed her qualifying exam for her PhD work on, “Flowable Fibrous Concrete for Thin Concrete Inlay Pavements” and has accepted a position at the University of Utah at Salt Lake City.

**Francisco Evangelista Junior**, ICT student researcher, received an award from the Graduate Research Award Program on Public Sector Aviation Issues. This award program is sponsored by the U.S. DOT, FAA, and administered by the Airport Cooperative Research Program of the Transportation Research Board. The title of his proposed research is “Prediction of Potential Cracking Failure Modes in Airfield Rigid Pavements Due to New Generation Aircraft and Environmental Effects.”

**Evgenii T. Filippov**, ICT student researcher, has been selected to receive a National Science Foundation (NSF) Graduate Research Fellowship. NSF Fellows are anticipated to become experts who can contribute significantly to research, teaching, and innovations in science and engineering. Filippov was also recently awarded the 2010-2011 Structural Engineers Foundation Scholarship. Filippov, left, with his student colleges on ICT’s earthquake resistance project.

**Ryan Fries**, ICT project investigator, was student-nominated for the Chi Epsilon James M. Robbins Award Excellence in Teaching Award. Fries (first from left) stands with other collaborators for ICT’s incident management training.

**Research Published**
A variety of publications and media, including those listed below, feature ICT research:

- Accident Analysis & Prevention
- Advances in Structural Engineering
- Asphalt Contractor
- Better Roads
- CEI Magazine (University Alumni Publication)
- Chicago Tribune
- Earthquake Spectra
- Engineering Structures
- European Journal of Environmental and Civil Engineering
- FHWA Transportation and Climate Change Newsletter
- Ingenieria Ductile
- International Journal of Pavement Engineering
- International Journal of Road Materials and Pavement Design
- International Journal of Transportation Research
- International Journal of Transportation Systems Engineering and Information Technology
- Journal of Civil Engineering Materials
- Journal of Construction Engineering and Management
- Journal of Engineering Mechanics
- Journal of Nondestructive Testing & Evaluation
- Journal of Public Transportation
- Journal of Solids and Structures
- Journal of Testing and Evaluation
- Journal of the Association of Asphalt Paving Technologists
- Journal of the Chinese Ceramic Society
- Journal of the Mechanics and Physics of Solids
- Journal of Transportation Engineering
- RANTool Press
- SITE’s Research and Creative Activities
- The Journal of the Acoustical Society of America
- The News-Gazette
- Traffic Technology International
- Transportation Research Record: Journal of the Transportation Research Board
- WSO-79

**Research Presented**
ICT affiliates were invited to present their research at numerous events throughout the year, including:

- 16th Annual Great Lakes Geotechnical and Geoenvironmental Conference
- 59th Annual Illinois Traffic Engineering and Safety Conference
- 90th Annual Meeting of the Transportation Research Board
- 91st Annual Transportation and Highway Engineering (T.H.E) Conference
- 2011 Green Council Annual Meeting of the Illinois Road & Transportation Builders Association
- 2011 Transport Chicago
- ASCE Airfield and Highway Pavements Conference
- ASUPT Research Advisory Committee Annual Meeting
- American Road and Transportation Builders Transportation Construction Management TCM-2 Conference
- Annual Meeting of the American Association of Asphalt Paving Technologists
- College of Engineering Industry Advisory Board
- Eighth Annual Midwest Bridge Symposium
- FHWA Warm Mix Expert Technical Group Meeting
- First Congress of the Transportation and Development Institute of the ASCE
- First CE-Asia Geotechnics Conference
- GeosciWorld 2010
- Greater IOWA ASPHALT Conference
- High Pressure Tests Workshop, Toulouse, France
- Illinois Bituminous Paving Conference
- Illinois Tollway Authority Board of Directors Meeting
- International Workshop on Energy and Environment in Development of Sustainable Asphalt Pavements
- Ninth International Congress on Advances in Civil Engineering
- University of Illinois at Chicago Distinguished Lecture
- University of Puerto Rico-Mayaguez
- University of Texas A&M Distinguished Seminar Series
ALI HARABALIEH, ICT student researcher, received the Best Student Paper Award at the American Society of Civil Engineers (ASCE) First Transportation and Development Institute Congress. The title of his paper was “Common or Variable Cycle Length Policy for a More Efficient Network Performance.”

Hajbabaie receives award at ASCE conference.

JAMIE HERNANDEZ, ICT student researcher, received the 2011 Society of Hispanic Professional Engineers Chicago Scholarship Award.

PRASANTA KALITA, ICT project investigator, received the Senior Faculty Award for Excellence from the University of Illinois College of ACES. He also received the Engineering Council Award for Excellence in Advising and the Rose Award for Teaching Excellence from the College of Engineering.

XIAOFENG LI, ICT student researcher, was selected to receive a 2010 Dwight David Eisenhower Graduate Fellowship from the FHWA. Li was also recognized with a “Best Doctoral Dissertation Presentation Award” at the 90th Annual Meeting of the Transportation Research Board in Washington, DC, January 2011 for his presentation, “Reliable Facility Location Design and Traffic Sensor Deployment under Probabilistic Disruptions.”

ZONGHUI LI, ICT project investigator, won the Arthur M. Wellington Prize from the American Society of Civil Engineers.

JIEH LUN, ICT project investigator, received third place for “Modeling Commercial Vehicle Daily Tour Chain at the TRB-SHP2 Freight Modeling and Data Symposium in Washington D.C. in September 2010.

LIANG LUL, ICT project investigator, received the University of Illinois at Urbana-Champaign’s Undergraduate Advising Award. He also won the ASCE-UIUC Chapter Outstanding Teaching Award 2010 and the Engineering Council Award for Excellence in Advising in 2011.

JIM MEISTER, ICT research engineer, was awarded the Annual Civil and Environmental Engineering Staff Award for Excellence at the University of Illinois at Champaign-Urbana.

SCOTT OLSON, ICT project investigator, was selected to take part in the National Academy of Engineering’s second Frontiers of Engineering Education Symposium. The three-day event assembled 53 of the nation’s most innovative young engineering educators to share ideas, learn from research and best practice in education, and leave with a charter to bring about improvement in their home institutions. Olson was also the first recipient of the University of Illinois at Urbana-Champaign’s CE/E Undergraduate Advising and Mentoring Award.

YANFENG QIU, ICT project investigator, was promoted to the rank of Associate Professor with indefinite tenure at the University of Illinois at Urbana-Champaign.

HASAN OZER, ICT student researcher, passed his qualifying exam for his PhD work on “Development of Domain Integral and Generalized Finite Element Methods for Three-dimensional Analysis of Near-surface Cracking in Flexible Pavements” and has started at UIC as a Research Assistant Professor.

JEFFREY ROESLER, ICT project investigator, was promoted to the rank of Full Professor at the University of Illinois at Urbana-Champaign.

TIMOTHY STARK, ICT project investigator, won the R.S. Ladd DI8 Standards Development Award for Standard Designation D7608: Standard Test Method for Torional Ring Shear Test to Determine Drained Fully Softened Shear Strength and Nonlinear Strength Envelope of Cohesive Soils from the American Society for Testing and Materials in 2011.

Enrol Tutumluer, ICT project lead, has been named the first Director of International Programs for the University of Illinois at Urbana-Champaign’s Department of Civil and Environmental Engineering.

ICT Study Selected As Regional High Value Research Project

An ICT project is included in the American Association of State Highway and Transportation Officials (AASHTO) Research Advisory Committee (RAC) Value of Research task force’s public relations brochure on high value research. The brochure was prepared for the AASHTO Standing Committee on Research, for whom RAC serves as an advisory body, and for state DOT CEOs.

Each state was asked to submit their high value research efforts to their RAC Region Chair for consideration for inclusion in the brochure. Each region then voted on their top four projects. Baloting among the nine states in Region 3 (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, and Wisconsin) resulted in the ICT study, “Speed Photo-Enforcement in Illinois Work Zones,” being selected as one of the top regional high value research projects.

The Principal Investigator for “Speed Photo-Enforcement in Illinois Work Zones” was Dr. Rahim Benekohal of the University of Illinois at Urbana-Champaign. The objective of the project was to determine the effectiveness of speed photo-radar enforcement in work zones as compared to traditional enforcement methods such as police presence and speed indicator signs.

Speed photo-radar enforcement was found to be most effective at reducing speeds for both cars and trucks. As a result, Illinois has implemented speed photo-radar enforcement statewide in work zones using specially trained state police officers to deploy vans equipped with speed photo-radar enforcement equipment, review and approve violations for citation issuance, and appear in court for adjudication of all approved work zone citations.

Numerous ICT Researchers have been named to 2010 List of Teachers Ranked as Excellent by their students. This list is compiled after each semester, and is based on the evaluation forms filled out by students. Faculty members receiving this honor include: Imad Al-Qadi, Bassem Andrawes, William Burtler, Carlos Armando Duarte, Khaled El-Rayes, Larry Fahnestock, Youssef Hashash, Dan Kushma, James LaFave, Liang Liu, James Long, John Popovic, and Timothy Stark.

Hao Wang, former student researcher, passed his qualifying exam for his PhD work on “Analysis of Tire-pavement Interaction and Pavement Responses using a Decoupled Modeling Approach.” He has accepted a faculty position at Rutgers.

Huangzhao Jiang, ICT project investigator, received the 2010 Outstanding Research Award from the Southern Illinois at Edwardsville School of Engineering.

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The investigation for this project participated in a scanning tour of Ohio, Michigan, and Indiana to study their state’s use of high-tension cable barriers. After gathering information on system characteristics and performance, the investigations chose a evaluated alternative high-tension cable barrier systems and products for use in Illinois. The final report identified barriers based approach to reduce the number and severity of freeway median crossover crashes in Illinois.

Outcome: High-tension cable barriers were implemented in Illinois.

**R27-2 Nighttime Construction: Evaluation of Lighting Choices for Construction in IL**

This project evaluated lighting plans during nighttime highway construction in Illinois and developed practical tools and objective lighting design criteria for nighttime construction operations.

Outcome: Provided ODOT with a scientific and objective approach for specifying the required lighting standards in nighttime highway construction projects.

**R27-3 SP1 Median Cable Scanning Tour**

Whaid El-Rays & Liang Liu

Juan Medina

David Lippert

Completed

**R27-4 SP4 Texas AASHTO Reflective Sign Shading Specifications**

When ODOT was appointed chair of an American Association of State Highway and Transportation Officials (AASHTO) technical committee on specification that will simplify and improve how sign shading materials will be specified for state, IL, and ICT representations attended a sign shading revise conference in College Station, Texas in May 2009. ICT then prepared inputs into the specifications and documented the demonstration.

Outcome: Novel proposed sign shading specifications for AASHTO and DOT.

**R27-5 TH Crash Data Analysis & Engineering Solutions for Local Agencies**

This project evaluated other states’ safety service programs for local agencies and developed a plan to establish a successful Illinois program, created a searchable database of local roads crashes, analyzed crash data, developed reports useful to local agencies, and provided crash analysis to local agencies.

Outcome: Developed tools to allow Illinois local agencies to plan safety based highway improvements.

**R27-6 DIP3 Traffic Safety Performance Function (TPF) Summit**

Safey Performance Functions (SPFs) are analytical tools developed in a previous ICT project. The IL528 project is to identify and manage a systems work process program of site-specific and systems improvements to develop strategies to prevent and reduce accidents and severe injuries resulting from motor vehicle crashes. The objective of this project is to convene a national SPF summit to discuss various ongoing and emerging activities and issues regarding the development and implementation of SPFs in order to support systems work process for locations with potential for improvements. Such a summit will also assist practitioners with the implementation of the proposed AASHTO Highway Safety Manual Key.

Outcome: Introduced the concept of SPFs to a wider audience and facilitated the exchange of ideas and best practices related to SPFs.

**R27-7 I-90 Illinois Highway Safety Manual Workshop**

The Illinois Highway Safety Manual is the primary document providing a scientific, data-supported decision making tool for practitioners when considering safety improvements during their daily work. The workshop will facilitate the manual’s implementation in Illinois and other states.

Outcome: Successful participation in a two-day workshop and facilitated the exchange of ideas and best practices related to SPFs.

**R27-8 I-90 Investigation of Controlling Factor HE: Wrong-Way Driving on Freeways**

The objective of this project is to identify trends with wrong-way crashes (parametric design, certain locations, age groups, etc.) and then to identify systematic and policy changes that will address these trends identified. Outcome: Determining contributing factors for wrong-way driving on freeways and ways to reduce these errors and related crashes.

**R27-9 Evaluation of Phasing Yellow Arrows (FYA) for Protected Permissive Left Turn (PLT) Control**

This study will evaluate the effectiveness of phasing yellow arrows (FYA) for protected permissive left turn signals in terms of safety and operation. The information will help ODOT quantify the safety and operational benefits of upgrading to FYA displays. Outcome: Improving intersection safety for Illinois motorists.

**R27-10 Permissive Left Turns: Study of Shoulder Attributes in Illinois**

This study assesses the extent to which the presence, absence and width of shoulders contributes to vehicle crashes by speed and type, and evaluate the safety effectiveness of shoulder paving, included, unpaved, bordered, and evaluated the potential shoulder safety improvements for existing high-speed highways, and ranked and prioritized shoulder segments with high potential for safety improvements. For rollover and single-lane crashes in Illinois in the most cost-effective manner.

Outcome: Ranked and prioritized highway segments for shoulder paving and updated current guidelines and practices for ODOT shoulder paving.

**R27-11 Permissive Left Turns: Study of Shoulder Attributes in Illinois**

This study assesses the extent to which the presence, absence and width of shoulders contributes to vehicle crashes by speed and type, and evaluate the safety effectiveness of shoulder paving, included, unpaved, bordered, and evaluated the potential shoulder safety improvements for existing high-speed highways, and ranked and prioritized shoulder segments with high potential for safety improvements. For rollover and single-lane crashes in Illinois in the most cost-effective manner.

Outcome: Ranked and prioritized highway segments for shoulder paving and updated current guidelines and practices for ODOT shoulder paving.

**R27-12 Study of & Minimizing Traffic-Related Work Zone Crashes in Illinois**

The objective of this project include analyzing the frequency and severity of traffic-related work zone crashes in Illinois, conducting a comprehensive analysis to investigate the probable cause and contributing factors of work zone crashes in Illinois, and evaluating the practicality and effectiveness of the Illinois Comprehensive Highway Safety Plan proposal strategy of adding temporary/partial variable striping within and prior to work zones.

Outcome: Developed practical recommendations for improved work zone layout, and design techniques that minimize the probable causes of work zone crashes in Illinois.

**R27-13 Study of Permissive Left Turns: Examination of Shoulder Attributes in Illinois**

This study assesses the extent to which the presence, absence and width of shoulders contributes to vehicle crashes by speed and type, and evaluate the safety effectiveness of shoulder paving, included, unpaved, bordered, and evaluated the potential shoulder safety improvements for existing high-speed highways, and ranked and prioritized shoulder segments with high potential for safety improvements. For rollover and single-lane crashes in Illinois in the most cost-effective manner.

Outcome: Ranked and prioritized highway segments for shoulder paving and updated current guidelines and practices for ODOT shoulder paving.

**R27-14 Study of Permissive Left Turns: Examination of Shoulder Attributes in Illinois**

This study assesses the extent to which the presence, absence and width of shoulders contributes to vehicle crashes by speed and type, and evaluate the safety effectiveness of shoulder paving, included, unpaved, bordered, and evaluated the potential shoulder safety improvements for existing high-speed highways, and ranked and prioritized shoulder segments with high potential for safety improvements. For rollover and single-lane crashes in Illinois in the most cost-effective manner.

Outcome: Ranked and prioritized highway segments for shoulder paving and updated current guidelines and practices for ODOT shoulder paving.

**R27-15 Study of Permissive Left Turns: Examination of Shoulder Attributes in Illinois**

This study assesses the extent to which the presence, absence and width of shoulders contributes to vehicle crashes by speed and type, and evaluate the safety effectiveness of shoulder paving, included, unpaved, bordered, and evaluated the potential shoulder safety improvements for existing high-speed highways, and ranked and prioritized shoulder segments with high potential for safety improvements. For rollover and single-lane crashes in Illinois in the most cost-effective manner.

Outcome: Ranked and prioritized highway segments for shoulder paving and updated current guidelines and practices for ODOT shoulder paving.
R27-36 Transfer/Development Length of Prestressing Tendons in AASHTO-LRFD Bridges Using 3-D Concrete

The primary interest among Illinois practitioners in using well consolidated concrete (SCC) in bridge girders motivated this synthesis study, which reviewed and combined information from numerous sources discussing the impact of using SCC on the transfer and development lengths of prestressing tendons in AASHTO-LRFD bridges. The study utilized the results of previous research to evaluate the effect of using SCC on the transfer and development lengths of prestressing tendons, failures of SCC girders compared to conventional girders, and investigated the feasibility of using SCC in AASHTO-LRFD bridge girders without the need for changing current design provisions recommended by the AASHTO Guide Specifications.

Samuel Arndt, Michael Drog & Joseph Pantel

Complete

R27-19 Prevent Panting in Cohesive Soils: Use of EFA-SRDC Method in IL

To assess scour in cohesive sediments, a new methodology, The Coriolis Rule in Cohesive Soils (Cohesive Coriolis: EFA-SRDC) has been developed and is being evaluated along with the current methodologies used in Illinois for non-cohesive sediments (primarily sand). HEC-18. The EFA-SRDC method is being tested for estimating scour depth of cohesive soils on potentially unstable site for Illinois streams. The project will then compare the EFA-SRDC method to the HEC-18 scour equations.

Timothy Straub (UIC Geological Survey)

Complete

R27-24 Evaluation/Modification of IDOT Foundation Filing Design & Construction Policy

The objective of this study was to assess IDOT’s other methods for estimating pile capacity, to improve IDOT’s methods if possible, and to determine resistance methods appropriate for the methodologies. This study reports pile load test data along with pile driving information and subsidence information, and uses this information to investigate and quantify the accuracy and precision with which the different methods and different dynamic formula predict capacity. Three databases were assembled and used to quantify the ability of these methods to predict capacity.

James Long

Complete

R27-25 Modification of IDOT Integral Abutment Design Limitations & Details

Because the former guidelines and limitations that apply to integral abutment bridges (IABs) had several gaps and gray areas, IDOT required further investigation. The objective of this project was to develop and document rational guidelines and limitations for IABs as well as construct and monitor plans for instrumenting existing and new planned IABs. A more rational design approach will allow pile and soil moduli to be re-evaluated, and the benefits of IAB’s which currently may not be considered.

Scott Olson & James Long

Complete

R27-26 Free-Counting Brass Breakaway Couplings

The objective of this project is to evaluate the design of a free-counting brass breakaway coupling device for use in supporting tight piles. Free-counting brass breakaway coupling devices could be used to replace the commonly used aluminum or steel couplings and potentially save IDOT significant resources. The evaluation will consist of a finite element analysis of brass coupling to predict distributions of stresses and experimental testing of single and finite coupling assemblies to evaluate energy absorbing capacity.

Scott Olson & Eric Donley

Complete

R27-27 Non-Destructive Evaluation of Reinforced Concrete Structures

As part of this project, low-volume, older bridges in Illinois were evaluated to ensure their structural integrity. Because most of the damage to these bridges is likely to occur at the bottom or internal, the bridges were evaluated using non-invasive non-destructive testing technology.

Inas Al Qud & John Papaceno

Complete

R27-28 Test Lame Design & Show on Safety & Operations

The research will include (1) a detailed crash-based evaluation of six test sections, and (2) observational studies to assess operational characteristics and user performance at selected test intersections.

Kerrie Schaller

Partial

R27-29 Effects of Intersection Right Turn Lane Design on Show Safety & Operations

The research will include (1) a detailed crash-based evaluation of six test sections, and (2) observational studies to assess operational characteristics and user performance at selected test intersections.

Kerrie Schaller

Partial

R28-10 Illinois Bridge Design & Bridge Plans

This project, which improved a quick turnaround, evaluated damaged bridge columns at two locations in the City of Chicago. After a high-water bridge girder suddenly collapsed in the Chicago City Expressway, the columns were reviewed for internal structural damage and the reinforcement steel condition was identified. For the Dan Ryan Expressway (I-90/94) bridge decks, a non-destructive evaluation was conducted using ground penetrating radar to measure the reinforcement cover depth.

Outcome: Developed standardized fracture and testing costs and reduced construction delays and costly construction downtime. Timely and accurate measurements of the Dan Ryan Expressway bridge resulted in IDOT changing its rehabilitation technique, which saved hundreds of dollars in repair costs.

Daniel Ruchin & Christopher Hart

Complete

R28-11 Chicago Bridge Deck & Bridge Plans

This project, which improved a quick turnaround, evaluated damaged bridge columns at two locations in the City of Chicago. After a high-water bridge girder suddenly collapsed in the Chicago City Expressway, the columns were reviewed for internal structural damage and the reinforcement steel condition was identified. For the Dan Ryan Expressway (I-90/94) bridge decks, a non-destructive evaluation was conducted using ground penetrating radar to measure the reinforcement cover depth.

Outcome: Developed standardized fracture and testing costs and reduced construction delays and costly construction downtime. Timely and accurate measurements of the Dan Ryan Expressway bridge resulted in IDOT changing its rehabilitation technique, which saved hundreds of dollars in repair costs.

Ming Wang (UIC) Jinsuk Shin, & Christopher Pantel

Complete

R28-12 DeKalb County Bridge Design & Bridge Plans

The project consisted of a detailed examination of the collapse of Bridge No. 251-011 (DeKalb County, Illinois) on August 19, 2008. Comprehensive experimental and analytical studies were conducted to determine the primary cause of failure.

Outcome: Developed and tested structural method, leading to factoring of the tender piles in the combined compression and flexure, was the likely reason for the bridge failure.

Samuel Arndt, Matthew Alpert, & Scott Olson

Complete
This research will investigate and experimentally evaluate the effect of using self-consolidating concrete (SCC) in the base and development lengths of prestressing tendons in prestressed box and girder bridges which are commonly used in Illinois bridges and compare it with the ACI and AASHTO code requirements.

Outcome: Developing a systematic technique for re-implementing high-performance concrete in Illinois’ bridge design.

R27-54 Transfer & Development Lengths in Prestressed Self-Consolidating Concrete Bridge Box & Girder

This research will investigate and experimentally evaluate the effect of using self-consolidating concrete (SCC) in the base and development lengths of prestressing tendons in prestressed box and girder bridges which are commonly used in Illinois bridges and compare it with the ACI and AASHTO code requirements.

Outcome: Developing a systematic technique for re-implementing high-performance concrete in Illinois’ bridge design.

R27-57 Superiority & Constructability of Fibers Addresses for Bridge Deck Overlays

This research will investigate and experimentally evaluate the effect of using self-consolidating concrete (SCC) in the base and development lengths of prestressing tendons in prestressed box and girder bridges which are commonly used in Illinois bridges and compare it with the ACI and AASHTO code requirements.

Outcome: Developing a systematic technique for re-implementing high-performance concrete in Illinois’ bridge design.

R27-56 Improved Design for Drives Piles Based on a Pile Load Test Program in Illinois

This project involves pile testing to improve piles foundation designs. The Pile Driving Analyzer (PDA) GPRW program, and static load testing will be used to increase the maximum normal required bearing capacities can specify to reduce the number of and weight of piles, whereas the difference between estimated and driving piles length in consultation and piles lengths by developing theoretical load factors, where necessary, and type to improve the expected resistance available to designers, reduce pile risk of pile driving damage during construction, and increase resistance factor (stress factors of safety) based on measured data and conclusions from load tests and in new piles.

Outcome: Developing more efficient, cost-effective pile foundation designs.

R27-69 Implementation & Monitoring of "Critical" Integral Abutment Bridges in Illinois

This project builds on a previous ICT project to improve the economy and applicability of integral abutment bridges (IABs) in Illinois. The researchers will select, instrument, and monitor one new or existing IAB to verify current design assumptions, validate the numerical analyses from the previous project, measure actual loadfoundation abutment performance, and monitor the long-term behavior of these systems.

Outcome: Revised Bridge Manual to expand the use of integral abutment bridges.

R27-104 Formability of New High Performance Grade 50 Structural Steel

This research will develop high toughness, atmospheric corrosion resistance, weldability, and fabrication. Outcome: Determining the formability of new steel for use as the base material for structural tubing.

R27-105 Fatigue Testing of Brass Bushing Couplings

This project will develop the feature characteristics of the low-cost brass bushing couplings in a pan-galvanic full-scale test at an NMMI-certified confessed test facility in order to place these couplings in actual service to evaluate their fatigue life under stress.

Outcome: Potential cost savings due to use of new source for brass bushing couplings.

R27-106 Improved Design of Short-Span Bridges in Illinois

This project will develop the feature characteristics of the low-cost brass bushing couplings in a pan-galvanic full-scale test at an NMMI-certified confessed test facility in order to place these couplings in actual service to evaluate their fatigue life under stress.

Outcome: Potential cost savings due to use of new source for brass bushing couplings.
# CONSTRUCTION

## R27-30 Evaluation of 3-D Laser Scanning for Construction Applications

This project evaluated the feasibility of using laser technology to monitor DOT highway construction activities and transportation structures. Data obtained using laser scanning technology was compared to data obtained using traditional methods.

**Outcome:** Validated a cost-effective and accurate laser technology, which can improve the efficiency and cost control of future construction projects.

Samuel Slattery & Barry Slattery (SIUE)
Brendan Gagnon, Joe Velek, & Brian Schuh
Tom Remby
Completed

## R27-49 Documentation of Contract Quantities Training

Beginning in 2007, the KY DOT took over the administration of the Documentation of Contract Quantities class. Documentation certification is required for all consultants to become prequalified with KY DOT to perform construction inspection (PCI) work.

**Outcome:** Improved the accuracy of the engineer’s estimate of contract quantities occurring in road and bridge projects.

Michael ZALESKI
Mike Hanner
Active

## R27-86 An Expert Systems Approach to Highway Constructions Scheduling

This project will develop a software product that leads engineers through the schedule logic design process by means of a graphical user interface that “visualize” construction operations as they progress over time.

**Outcome:** Improving the accuracy of the engineer’s estimate of contract quantities required for highway construction projects.

Shane Slattery, Barry Slattery, and Richard Brouse (Illinois State)
Mike Huyko
Completed


This project provides technical support for DOT concerning the mechanistic-empirical (M-E) design, implementation, and monitoring of flexible pavements. Although M-E research developed within IL, similar flexible pavement design concepts and procedures for IDOT in previous years (1996-1997 and 1997-1998), which have been implemented, continue to support a variety of IL’s design, implementation, and monitoring activities.

**Outcome:** Developed improved M-E flexible pavement design procedures for the IDOT Bureau of Design and Environment and the Bureau of Local Roads & Streets.

Dandan Ruan & George pikett & Leslie Sclarth
Dandan Lippert & Charles Wenzler
Active

## R28-167-20 Binder/ Mixture Testing and Analysis

As mechanistic designs rely more on dynamic modulus predictions, the generation of theoretical binder data (*E*) and rheological mixture data (*E*) becomes more crucial. This project provided support for data reduction, interpretation, and related testing.

**Outcome:** Developed a method to support rheological mixture selections for different binder grades.

Samuel Carpenter
Amy Schutzbach
Completed

## R28-167-10 Validation of Extended Life HMA Pavement Design

This research provided test data for dynamic modulus of the asphalt for 21 current HMA mixes in accordance with the American 2001 data requirements for pavement design. The *E* testing validated fatigue algorithms and illustrated the existence and magnitude of a fatigue endurance limit. Full depth HMA sections were constructed, instrumented, and inspected following the existing weight deflection tests and the ALAS, where binder sites were tested for crack bottom binder fatigue characteristics.

**Outcome:** Validated material behavior for an improved design procedure for extended life HMA pavements.

Samuel Carpenter & Marshall Thompson
Shahrooz Boushehri & Chris Ophardt
Amy Schutzbach & Completed

## PAVEMENT DESIGN & MANAGEMENT/MATERIALS

<table>
<thead>
<tr>
<th>PROJECT CODE &amp; TITLE</th>
<th>OBJECTIVE/OUTCOME</th>
<th>PRINCIPAL INVESTIGATOR(S)**</th>
<th>RESEARCH TEAM</th>
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<tr>
<td>R27-2 Nondestructive Pavement Evaluation Using ULI-PAVE Manual Artificial Neural Network Models</td>
<td>The objective of this project was to develop a non-destructive pavement structural analysis model for more accurate solutions with fast computation schemes. Soft computing and modeling approaches, specifically the Artificial Neural Network (ANN) and Genetic Algorithms (GA), techniques, were implemented to develop a forward and backcalculation type pavement analysis models based on the validated reference ULI-PAVE finite element simulator of the most commonly found structural flexible pavements in the state of Illinois. Outcome: Created a pavement evaluation tool that can be used for rapid and accurate backcalculation for o in-service pavement layer properties and thickness, predicting critical stress, strain, and deformation responses of those to in-service pavements in real time from the measured/field weights deflection/birefringence data, and incorporating predicted pavement response directly into DOT’s mechanistic pavement analysis and design.</td>
<td>Michael Pleck &amp; Marshall Thompson</td>
<td>Mohammad Al-Attar, Shehzad &amp; Amy Schutzbach</td>
<td>Completed</td>
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<tr>
<td>R64 Self-Consolidating Concrete</td>
<td>The objective of this project was to better understand how self-consolidating concrete (SCC) perform in fresh and hardened states and to provide protocols and criteria for specifications and test procedures for SCC mixtures and construction practice. The investigators based their investigations on the extensive reconstruction of I-74 through Peoria, IL, which used SCC for over 28 miles of retaining wall structures. Outcome: Developed six new test methods for measurement of SCC performance.</td>
<td>Marshall Lange &amp; Leslie Sclarth</td>
<td>Simon Kutschke</td>
<td>Completed</td>
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<td>R35 Concrete Distress Identification</td>
<td>This project included two distinct studies related to concrete distress. The first focused on distress observed in recently new pavement in Valmeyer, IL, and the second was to assess the alluvial-volcanic reactive (AVR) alkali risk. Outcome: Provided valuable input for pavement design and maintenance procedures due to a better understanding of AVR deterioration.</td>
<td>Leslie Sclarth</td>
<td>Brian Pfeiffer</td>
<td>Completed</td>
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<tr>
<td>R35 Evaluation/Optimization of TASK &amp; Bond of HMA Develops of PCC</td>
<td>This study included three major components to quantify the outcome of various parameters on the deformation behavior of HMA mixes: testing, numerical modeling, and accelerated pavement testing. The lab testing evaluated HMA material types, task coat types, task coat application rate, PCC surface treatment, temperature, and moisture conditions. The field work consisted of creating 21 test sections of HMA specimens placed on PCC with various HMA types, task coat types, task coat application rates, and PCC surface textures. The test sections were then loaded with AXLSS. The results validated laboratory determined optimum task coat application rate, which provides the internal interface strains and surface rating in the field. Outcome: Validated laboratory task coat application rates that are in DOT standard specifications.</td>
<td>Marshall Thompson &amp; Samuel Carpenter</td>
<td>Zhou Long &amp; Haibin Qian</td>
<td>Jim{{{Harper}}}}</td>
<td>Completed</td>
</tr>
<tr>
<td>R35 Evaluation &amp; Implementation of Improved CRCP &amp; JPCP Design</td>
<td>This study refined DOT’s currently plain concrete pavement (CRCP) design and developed a continuously reinforced concrete pavement (CRCPZ) design process based on the I-74 principles and recent findings, including the release of the new M-E (1998). The new developments in the proposed design process include fatigue damage accumulation at the critical top and bottom locations in the CDP/SP, requirements for calculating the equivalent damage integrals for several characteristic types and crack bottom sizes, calibration of a strength reduction factor to the concrete stress-strain calculation at the surface of the PCC, and a new logistic type prediction model used. Outcome: Developed input for two MD design guides: 1) mechanistic-empirical continuously reinforced concrete pavement and 2) plain concrete pavement.</td>
<td>Jeffrey Ramser</td>
<td>Matthew Browe, Amanda Thiel, Blake Miller, &amp; Doug Mang</td>
<td>Amy Schutzbach</td>
<td>Completed</td>
</tr>
<tr>
<td>R27-49 Documentation of Contract Quantities Training</td>
<td>This project provided technical support for DOT concerning the mechanistic-empirical (M-E) design, implementation, and monitoring of flexible pavements. Although U.S. researchers developed in 1996-1997 flexible pavement design concepts and procedures for IDOT in previous years (1996-1997 and 1997-1998), which have been implemented, continue to support a variety of IL’s design, implementation, and monitoring activities.</td>
<td>Dandan Ruan &amp; George pikett &amp; Leslie Sclarth</td>
<td>Dandan Lippert &amp; Charles Wenzler</td>
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</table>
| R85 | Cost-Effectiveness & Performance of Overlay Systems / Crack Control Methods in H. | This project used theoretical approaches, laboratory experiments, and field evaluations to evaluate different crack control methodologies and gain a better understanding of crack initiation, propagation, and control mechan-isms. Results were quantified in the field using a digital analysis and presented to the Illinois Department of Transportation.

#### Methods in Cores (P2008 Profile Survey)

- 27-SP6, 27-SP11
- 27-SP3, SP5, SP9, SP13
- 27-SP17

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Development of an expansive characteristics of rail tracks & recycled materials

The objective of this research was to benchmark Illinois material testing relative to the American Railway Engineering and Maintenance of Way Association (AREMA) to determine the safety risk of material related failures in Illinois track bed environment. Illinois can benefit from this knowledge by identifying other states that face limited staff to keep, such as attaining proper materials and ensuring proper materials are being supplied. In the current state their internal testing practices have not been modified to include the detrimental information needed to be in line with the risk of failure of the track.

Determining if Illinois can reduce its Benchmarking of Material Testing can be a cost-saving measure by using a different state’s standards for Illinois.

Outcome: Determined matrix of compatibility of marking systems with different hot mix asphalt (HMA) mixtus.

This project will evaluate the performance ranking system compatibility with different hot mix asphalt (HMA) mixtus.

This project will focus on the optimum application rate of tack coat in the testing of various Hot Mix Asphalt (HMA) on HMA.

This project will evaluate the pavement marking system compatibility with different Hot Mix Asphalt (HMA) mixtus.

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**TRAFFIC OPERATIONS & ROADSIDE MAINTENANCE**

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**PAVEMENT DESIGN & MANAGEMENT/MATERIALS CONT.**

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<td>R27-96 LED Roadway Lighting Evaluation &amp; Field Testing</td>
<td>This study will investigate technological advancements in LED roadway lighting to determine applications where LED may cost-effectively improve lighting. Outcome: Quantified benefits and costs of using LED for roadway lighting and recommendations for where to use in Illinois.</td>
<td>Ray Brekkenfield</td>
<td>Khanin Anvari, Hamid Karanian, &amp; Juan Miranda</td>
<td>Mark Szyper</td>
<td>Active</td>
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<tr>
<td>R27-91 Evaluation of Traffic Flow Monitoring Technologies: Ciso-Midway Smart Corridor Case Studies</td>
<td>This research evaluates and compares a number of existing and potential technologies through pilot deployments in the Ciso-Midway Smart Corridor. Outcome: Determining the accuracy and relative merits of traffic monitoring and travel time prediction technologies for arterial surface streets.</td>
<td>Joshua Erickson (SMU)</td>
<td>Ahf Elgas</td>
<td>Active</td>
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<tr>
<td>R27-94 Performance Evaluation of Snow and Ice Plows</td>
<td>This project will develop a performance evaluation procedure for snow and ice- related components, perform field tests on several new concepts, and develop finite element models to synthesize a comprehensive performance database to simulate the plowing process for each batch at the actual speed and compare the simulation results with the test data. Outcome: Developing a comprehensive performance database that IDOT can use to select snow plows.</td>
<td>Saebul Uddin &amp; Abdul Mohamed</td>
<td>Tim Peters</td>
<td>Active</td>
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<tr>
<td>R27-95 Field Evaluation of Smart Sensor Vehicle Detection at Intersections &amp; RR Crossings</td>
<td>This study will evaluate the performance of a vehicle detection system at railroad grade crossing locations and signalized intersections. Outcome: Improving traffic operation and safety at railroad grade crossings and at signalized intersections through accurate detection.</td>
<td>Ray Brekkenfield</td>
<td>Ali Rehman, Juan Miranda, &amp; Hamid Karanian</td>
<td>Yogi Gaurani &amp; Alex Milosse</td>
<td>Active</td>
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<tr>
<td>R27-96 Pedestrian/Bicycle Warning Devices &amp; Signs at New RR &amp; Pathway Rail Grade Crossings</td>
<td>This study will identify and evaluate the effectiveness of existing technology in use at passive and active highway-rail and pathway-rail grade crossings. Outcome: Fewer incidents between trains and non-motorized users at highway-rail and pathway-rail crossings.</td>
<td>Paul Hidestrand &amp; Steve Strong (SMU)</td>
<td>Sarah Jane Shermian &amp; Michael Moore</td>
<td>Kyle Armstrong</td>
<td>Active</td>
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<tr>
<td>R27-108 Improving the Effectiveness of Nighttime Temporary Traffic Control During Incidents</td>
<td>This study will evaluate the effectiveness and safety of currently used temporary traffic control devices and/or emergency vehicle lights. Outcome: Improved safety during nighttime operations where traffic control devices and/or emergency vehicle lights are used.</td>
<td>To Be Determined by RFP Process</td>
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<td>Steven Brink</td>
<td>Inactive</td>
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<tr>
<td>R27-109 Effects of Flaggers and Spotters in Spotting Work Zone Traffic for Illinois Multi-Lane Highways</td>
<td>Sometimes a flagger actually causes problems by being overly enthusiastic. The potential duties of flaggers may need alternates more accurately reflect traffic needs. The results of the research will be implemented through traffic control standards and specifications as well as the work site protection manual. Outcome: Improved safety and efficiency of mobile traffic control in work zones.</td>
<td>To Be Determined by RFP Process</td>
<td>Stan Lynch</td>
<td>To Be Determined by RFP Process (Illinois)</td>
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<tr>
<td>R27-110 Training and Implementing Findings of Queues and Other Costs in Highway Work Zones - Phase II</td>
<td>This study will improve the district’s understanding and usefulness of a previous ITC study (R27-11) and allow districts to better use of the data to plan effective projects. Outcome: Computer software and associated training to use in estimating queue and user costs in highway work zones.</td>
<td>Ray Brekkenfield</td>
<td></td>
<td>Stan Lynch (IDOT-IHL)</td>
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<tr>
<td>R27-97 Pedestrian/Bicycle Warning Devices &amp; Signs at New RR &amp; Pathway Rail Grade Crossings</td>
<td>The purpose of this project is to develop web-based training materials and supporting computer tools to accompany the one-day classroom training developed in Phase I (R27-94). Outcome: An easily effective way for incident response agencies to train their employees and maintain a skilled workforce.</td>
<td>Paul Hidestrand &amp; Steve Strong (SMU)</td>
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<td>Gross Raineri</td>
<td>Inactive</td>
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<tr>
<td>R27-111 Real-Time Information Determination Requirements for Illinois per New Federal Rules (59 CFR 64-422)</td>
<td>Recent legislation requires that IDOT must provide real-time travel information along all limited access roadway facilities. Specific benchmarks must be implemented before December 2014. This research will assist IDOT in establishing their real-time information program. Outcome: Timely guidance so that IDOT can meet the deadline cost-effectively.</td>
<td>To Be Determined by RFP Process</td>
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<td>R27-120 Evaluating All Weather Pavement Markings and Lab Methods to Simulate in Field Exposure</td>
<td>This research will evaluate the performance of various all-weather markings and evaluate test methods that may simulate degradation in the field. Outcome: Recommended best performing markings for IDOT roadways.</td>
<td>To Be Determined by RFP Process</td>
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<tr>
<td>R27-SPN Windows Internet on Trains</td>
<td>This study investigates competing technologies that are being given the vision of providing internet access to passengers on trains close to reality. The study was a result of the &quot;Broadband Access on Passenger Rail Line&quot; passed by the Illinois legislature that requires IDOT to develop plans for ensuring high-speed data access on all passenger rail systems in Illinois at fair and reasonable prices.</td>
<td>To Be Determined by RFP Process</td>
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<td>R27-92 Baa-De-Shouder Study</td>
<td>From the research, the feasibility of the Baa on DeShouder (BOS) operations for the northeastern Illinois region as part of competitive management. It included a review of the operational aspects of shoulder use and BOS-related concerns.</td>
<td>To Be Determined by RFP Process</td>
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<tr>
<td>R27-93 Baseline Study</td>
<td>This project explored the reasons seniors are reluctant to use public transit in the Chicago region’s economy and environment. The research identified the causes and solutions for the aging population.</td>
<td>To Be Determined by RFP Process</td>
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<td>R27-94 Regional Warehouse Trip Production</td>
<td>This research surveyed truck traffic and production at large warehouses in Northwest Illinois, which has become an internal &quot;hotspot&quot; to the final report illustrated the area of distribution activities, capabilities, truck movements, and meaningful ratios of truck traffic related to business and building profile factors. These factors allow for estimating the total movement and growth relationships to new distribution space being added to the Chicago area.</td>
<td>To Be Determined by RFP Process</td>
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<td>R27-95 Truck Parking Facilities Program Design</td>
<td>This study examined the current state of truck parking and rest area facilities in the northeastern Illinois region in order to determine how problems from truck parking affect freight transportation infrastructure, the safety, and the economy of surrounding areas. The research identified the causes and consequences of the problems, analyzed regional data, and made recommendations for improvements.</td>
<td>To Be Determined by RFP Process</td>
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<td>R27-17 Effectiveness of Transit Strategies Targeting Elderly People</td>
<td>This project explored the options available to reduce public transit and the affect of accessibility of public transit among the most independent in the public transit system. The results will help transportation researchers and policy makers in determining the most effective strategies to implement.</td>
<td>To Be Determined by RFP Process</td>
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**PUBLIC TRANSPORTATION/MULTI-MODAL**

- Pedestrian/Bicycle Warning Devices & Signs at New RR & Pathway Rail Grade Crossings
- Real-Time Information Determination Requirements for Illinois per New Federal Rules (59 CFR 64-422)
- Evaluating All Weather Pavement Markings and Lab Methods to Simulate in Field Exposure
- Evaluating All Weather Pavement Markings and Lab Methods to Simulate in Field Exposure
- Windows Internet on Trains
- Baseline Study
- Regional Warehouse Trip Production
- Truck Parking Facilities Program Design
- Effectiveness of Transit Strategies Targeting Elderly People
- Transit Capacity Planning
- Urban Mobility Planning
- Regional Planning
- Statewide Planning
- Long-Range Transportation Planning
- Metropolitan Planning
- Statewide Planning
- Long-Range Transportation Planning
- Metropolitan Planning
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- Long-Range Transportation Planning
- Metropolitan Planning

**OUTCOME:**
- Improved traffic operation and safety at railroad grade crossings and at signalized intersections through accurate detection.
- Improved safety during nighttime operations where traffic control devices and/or emergency vehicle lights are used.
- Improved safety and efficiency of mobile traffic control in work zones.
- Improved the district’s understanding and usefulness of a previous ITC study.
- Developed a comprehensive performance database that IDOT can use to select snow plows.
- Determined the accuracy and relative merits of traffic monitoring and travel time prediction technologies for arterial surface streets.
This project builds on a recently completed ICT project, effectiveness of Transit Strategies (Tipping) survey. A portion of the research tasks in the previous project will be surveyed again, and ICT-based inspections of seniors’ travel behavior and trip chaining behavior will be utilized followed by an activity travel recall interview with the goal of understanding the underlying travel activity scheduling process. The main objective of this study is to survey travel activity scheduling behavior of senior citizens in the Chicago region to better understand their trip chaining behavior.

Outcomes: Facilitate more efficient transit services that target senior travelers, positively change their attitude toward public transportation, and help transportation and transit agencies provide efficient transportation solutions for an aging population.

Karamo Mohamed

Paul Berthelot & Laurence Pithie

Amy Wells

Ran Liu

John Howard

Rajeev Nihalani & Dust Birnbaum

Jeffrey South

Rajeev Nihalani & Dust Birnbaum

Jeffrey South
R27.04  Develop Travel Reliability Inventory for Highway Networks

This project will develop necessary procedures and computer tools to systematically document travel reliability information for highway networks. This information will be used to help personnel make informed decisions about demand management strategies. The team will document the process for agencies to follow to implement a TPI, this process includes agency staffing, existing pavement inventory, type of condition rating, vendor support, pavement management system capabilities, and pricing. A selection model will be developed to determine the best functions that fit the agency needs to successfully implement a TPI.

Outcomes: Providing guidelines for local agencies to implement a TPI so they can enjoy cost savings and better performance over time.

Peter Nelson & John O’Herrin (UIC) & Tom Rose (Northwestern)
Jeff Gallahar
Active

R27.05  Storm Water Pollution, Emission & Sediment Control Products Demonstration & Training Center

This project will establish a research and training center at the University of Illinois that will demonstrate emission, sediment, and storm water control practices suitable in Illinois conditions. The center will be used for hands-on training and demonstrations of storm water control practices, and to initiate research to assess the applicability of emission control and storm water management best management practices for relevant DOT site conditions.

Outcomes: Providing DOT the ability to evaluate and demonstrate, under controlled conditions, proposed emission control products and methodologies.

Prasanta Kalita & Richard Cooke
Rahul Bhattacharya & Joseph Muthoka
Thomas Nohra
Active

R27.06  Midwest Transportation Air Quality Summit

This project supports a regional workshop on transportation and air quality issues in the Midwest to be attended by representatives of state DOTs, state air pollution control agencies, metropolitan planning organizations, and federal agencies. The goals is to bring together stakeholders from the transportation and air quality communities to discuss current and upcoming environmental challenges. Future and relevant research will be presented, and an open dialogues and collaborative problem solving with a wide range of perspectives will be encouraged.

Outcomes: Providing support to state agencies to work with federal air quality standards for ozone and particulate matter, reduce the impacts of hazardous air pollutants, and address climate change.

Michael Knorrer (UAW)
Walt Jozymski
Completed

ENVIRONMENT

R27.07  Update the Illinois Carbon Monoxide Screen for Intersection Modeling (CSSIM)

In 2007, regulatory changes in the Illinois Vehicle Inspection and Maintenance Program prompted the Illinois Environmental Protection Agency (IEPA) to recommend that IDOT update the CS Screen for Intersection Modeling (CSSIM) with new emission factor tables using the MORSEL model based recommended methodologies. This study was implemented to update the CSSIM model. As part of the update, IDOT also requested that the methodology used in creating the original criteria be recalculated and possibly revised based on the findings of the evaluation.


Scott Powers (Private Consultant)
Walt Jozymski
Completed

R27.10  Documenting Air Toxics in IDOT Documents: A Midwest Poor-Exchange

To address the many uncertainties with IDOT’s Airtoxics Guidance for documenting mobile source air toxics (MSAT) issued February 1, 2006, IDOT convened a meeting of six Midwestern states (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) to discuss the methodology and uncertainties arising from the new MSAT guidance and to exchange ideas and experience in documenting MSAT. This meeting was held on October 5-6, 2006, at Allerton Park, Monticello, Illinois. Twenty-one participants attended the meeting.

Outcomes: Documented challenges in practice, research needs, and practical guidelines for use by Illinois and other DOTs.

Jie Liu (UM)
Walt Jozymski
Completed

R27.12  Installation and Performance Testing of Hich Checks and Inlet Protection Structures

The objective of this project was to evaluate the performance of ditch checks and different drain configurations, installation and evaluate the performance of the new ditch protection structures. Results of the testing will be provided to DOT to refine the list of approved inlet products, provide demonstration and training, and to DOT for the evaluation and effectiveness of inlet protection measures.

Outcomes: Developing specifications, design guidelines, and construction details for the use of inlet controlling products under typical Illinois weather conditions.

Prasanta Kalita
Joseph Vigna
Active

R27.13  Erosion Control Best Management Practices (BMPs) for Interstate Rest Areas

This project will establish a research and training center at the University of Illinois that will demonstrate emission, sediment, and storm water control practices suitable in Illinois conditions. The center will be used for hands-on training and demonstrations of storm water control practices, and to initiate research to assess the applicability of emission control and storm water management best management practices for relevant DOT site conditions.

Outcomes: Providing DOT the ability to evaluate and demonstrate, under controlled conditions, proposed emission control products and methodologies.

Prasanta Kalita
Rahul Bhattacharya & Joseph Muthoka
Thomas Nohra
Active

R27.14  Restroom Provision and Flood Discharge at DOT Wetland Mitigation Sites

This project will determine the influence of flood hydrology on plant community development and the achievement of performance standards at wetland mitigation projects using existing data from the DOT wetlands program.

Outcomes: Improved planning and maintenance strategies for wetland mitigation projects and the identification of performance metrics for wetland mitigation in floodplains.

Susie Bums
New
COMMONLY USED ACRONYMS

**AASHTO**
American Association of State Highway and Transportation Officials

**ACI**
American Concrete Institute

**ASCE**
American Society of Civil Engineers

**ATLAS**
Accelerated Testing Loading Assembly

**ATREL**
Advanced Transportation and Research Engineering Laboratory

**CEE**
Civil and Environmental Engineering

**DOT**
Department of Transportation

**EPA**
Environmental Protection Agency

**FHWA**
Federal Highway Administration

**HMA**
Hot-mix asphalt

**ICC**
Illinois Commerce Commission

**ICHRI**
Illinois Cooperative Highway Research (Program)

**IDOT**
Illinois Department of Transportation

**PI**
Principal Investigator

**RFP**
Request for Proposal

**RITA**
Research and Innovative Technology Administration

**RPC**
Regional Planning Commission

**TAG**
Technical Advisory Group

**TRB**
Transportation Research Board

**TRP**
Technical Review Panel

**UI**
University of Illinois

**UIUC**
University of Illinois at Urbana-Champaign

**UIS**
University of Illinois at Springfield

**UIC**
University of Illinois at Chicago

**IDOT**
Installation of all epoxy reinforcement bars and tie bars in the superstructure on Airport Road in Peoria County. Photo courtesy of IDOT District 4 contractors R. A. Cullinan & Son, a division of UCM, Inc., and Central Illinois Rebar Installers, Inc.

**RPC**
Traffic control provided during structure replacement on IL 15 near the Edwards County line. Photo courtesy of IDOT District 7 contractor E.T. Simonds Construction Company.