

CELEBRATING 30 YEARS  
1988—2018



# InTrans En Route

— ANNUAL REPORT —

JULY 2017 to JUNE 2018



IOWA STATE  
UNIVERSITY

Institute for  
Transportation

# TABLE OF CONTENTS

3.....	Director's Message
4.....	Centers & Programs
6.....	InTrans Innovation Demonstration and Training Day 2018
7.....	Two InTrans events emphasize traffic safety
8.....	Staff Awards
9.....	Student Awards
9.....	Warner wins 2018 Eisenhower Fellowship
10.....	Research reports showcase InTrans scope of work
11.....	InTrans by the numbers
12.....	PEM Program: Delivering concrete to survive the environment
13.....	Passages
13.....	New department chair joins CCEE
14.....	Bolstering Iowa's bridges
16.....	Big data flow at InTrans
17 ...	Traffic safety insights for motorcyclists from CTRE efforts
18.....	RET Program brings teachers to InTrans and vice versa

**InTrans EnRoute is published by the Communications Department  
at Iowa State University's Institute for Transportation.**

Editor: Mary Adams

Designer: Alicia Hoermann

Photos by Institute for Transportation staff  
and students except where noted

## **Front Cover Photo Credits**

*Top: Christopher Gannon; Second: Iowa DOT*

*Third: Christopher Gannon; Bottom: InTrans Staff*

Iowa State University does not discriminate on the basis of race, color, age, ethnicity, religion, national origin, pregnancy, sexual orientation, gender identity, genetic information, sex, marital status, disability, or status as a U.S. Veteran. Inquiries regarding non-discrimination policies may be directed to Office of Equal Opportunity, 3410 Beardshear Hall, 515 Morrill Road, Ames, Iowa 50011, Tel. 515 294-7612, Hotline 515-294-1222, email eooffice@iastate.edu.



Photo by Christopher Gannon

## DIRECTOR'S MESSAGE

We all like to note the milestones in life. During the coming year, we plan to celebrate a major milestone for InTrans—the 30th anniversary of its beginnings with a single research grant in 1988. At the end of fiscal year 2018, the annual budget for work at InTrans was \$20 million, a 5 percent increase from last year. (A decade ago, the budget was \$12 million, which reflects a healthy 40 percent rise in revenue.)

The steady increases in financial support for InTrans efforts offer evidence of the confidence that state agencies from Iowa and other states, industry groups, and federal government organizations have placed in our ability to perform well and deliver results for them and their constituents.

None of this would be possible without the bright, dedicated, innovative staff at InTrans. We collaborate with 31 faculty members from the Iowa State University College of Engineering, and employ another 72 research scientists, traffic engineers, and professional staff. They are supported by the 140 graduate students who work on a variety of research and demonstration projects under the guidance of InTrans staff. The knowledge and expertise that the students gain here will be transferred to a thousand different future endeavors, from traffic safety to highway construction to bridge repair to creating a more resilient, sustainable transportation system wherever they go.

For those working on the ground today in transportation, InTrans provides short courses, workshops, continuing education opportunities, and resources ranging from guides on topics from recycling concrete to work zone safety. This spring we sponsored an Innovation Day that featured a hands-on Transportation Safety Roadshow trailer and demonstrations from InTrans faculty and staff showing some of the newest options in transportation practices.

Several of our staff and graduate students won awards, which are noted in this report. We published 58 technical reports on completed projects, all available for downloading on the InTrans website (which is nearly ready to unveil a new look). Our faculty members took time to work with high school teachers on STEM subjects, talk to geologists, demonstrate concrete mixtures, and offer guidance to Iowa road managers.

In the coming year, InTrans will continue doing what it has always done in terms of research, development, ISU support, and outreach. Some of our work attracts much attention, other efforts are more low key, but all of it is important for the future of transportation in Iowa and nationally. This annual report shares some of this year's milestones.

**Shauna Hallmark**

**Director, Institute for Transportation**

Professor, Department of Civil, Construction,  
and Environmental Engineering  
Iowa State University





## INSTITUTE FOR TRANSPORTATION AT IOWA STATE UNIVERSITY

Creating, sharing, and applying transportation knowledge.

From big data to driver behavior and from preservation to education, InTrans focuses on research and service that impacts transportation now and into the future.

Our innovative research is sponsored by a variety of state and national transportation-related organizations, both public and private.

### CENTERS

#### Bridge Engineering Center (BEC)

Conducting research to solve real-world structural problems

#### Center for Earthworks Engineering Research (CEER)

Solving critical geotechnical engineering and earthworks construction challenges through research and advanced technologies  
Vernon Schaefer, Interim Director

#### Center for Transportation Research and Education (CTRE)

Exploring safety, infrastructure management systems, and sustainability in transportation  
Omar Smadi, Director

#### Center for Weather Impacts on Mobility and Safety (CWIMS)

Facilitating better and safer ways to travel when weather impacts transportation systems  
Zach Hans, Director

#### Midwest Transportation Center (MTC)

Employing data-driven performance measures for enhanced infrastructure condition, safety, and project delivery  
Shauna Hallmark, Director

#### National Center for Wood Transportation Structures (NCWTS)

Integrating research, demonstration, and education to improve wood transportation structures  
Travis Hosteng, Director

#### National Concrete Pavement Technology (CP Tech) Center

Serving as the national hub for concrete pavement research and technology transfer  
Peter Taylor, Director

InTrans administers 15 centers and programs, several distinct yet affinitive research specialties, and a variety of technology transfer and professional education initiatives.

AMPP director, Chris Williams,  
assisting students in the  
Advanced Asphalt Materials Lab

*Photo by Christopher Gannon*



Members of Iowa State University's  
Transportation Student Association  
helping clean a roadway in fall of 2017

## INSTITUTE FOR TRANSPORTATION

2711 South Loop Drive, Suite 4700  
Ames, IA 50010-8664  
ph: 515.294.8103 | fax: 515.294.0467

Shauna Hallmark, Director  
Neal Hawkins, Associate Director

[intrans.iastate.edu](http://intrans.iastate.edu)

## PROGRAMS

### Asphalt Materials and Pavements Program (AMPP)

Improving asphalt pavements through  
research and education  
Chris Williams, Director

### AURORA Program

Working to advance road weather  
information systems technology  
Neal Hawkins, Director

### Construction Management and Technology (CMAT) Program

Researching innovative construction  
technologies and processes for the  
transportation industry  
Jennifer Shane, Director

### Iowa Local Technical Assistance Program (Iowa LTAP)

Helping Iowa's local governments keep  
up with growing transportation demands  
Keith Knapp, Director

### Program for Sustainable Pavement Engineering and Research (PROSPER)

Investigating and integrating  
innovative, sustainable pavement  
materials and technologies  
Halil Ceylan, Director

### Smart Work Zone Deployment Initiative (SWZDI)

Investigating better ways to control  
traffic through work zones  
Keith Knapp, Director

### Statewide Urban Design and Specifications (SUDAS)

Providing uniform design guidelines and  
construction specifications for Iowa's  
urban public improvement projects  
Paul Wiegand, Director

### REACTOR (Real Time Analytics of Transportation Data) Laboratory

Completing traffic calculations within  
seconds to enable the delivery of near  
real-time solutions  
Anuj Sharma, Co-Director  
Neal Hawkins, Co-Director

# EVENTS

## INTRANS INNOVATION DEMONSTRATION AND TRAINING DAY 2018

One hundred twenty-plus participants who visited InTrans on a cool, windy April 17 got a look at the future of transportation in Iowa, thanks to displays and presentations on highway safety practices, high-tech traffic operations surveillance, and the latest advances in high performing concrete mixtures. The Innovation Demonstration Day schedule and offerings were coordinated by InTrans Associate Director Neal Hawkins. He commented,

“It was gratifying to see the strong interest in the many innovative options InTrans was able to share with our colleagues and collaborators. There is so much potential for advances in transportation these days, and as educators and practitioners we need to reach out with these demonstration opportunities.”

The Innovations event was anchored by the appearance of the 70-foot

3M Transportation Safety Roadshow Trailer. Stationed in the InTrans west parking lot, the truck attracted a steady stream of visitors to check out the hands-on demonstrations and information on new technologies. The InTrans REACTOR traffic operations laboratory was open for visitors to check out how Iowa's traffic flow can be monitored continuously. InTrans staff members from several centers led demonstrations on their specialties, including Chris Williams of the Asphalt Materials and Pavement Program and Travis Hosteng of the Bridge Engineering Center.

Several vendors displayed their latest products, including Horizon Signal Technologies, Iowa Plains Signing, Inc., and Traffic Control Corporation. Nearly one-third of the participants combined the trip to see the InTrans Innovation displays with participation in a training workshop to review the latest in the Manual on Uniform Traffic Control Devices (MUTCD) signing rules and regulations.



Travis Hosteng, of the Bridge Engineering Center, gives a demonstration on timber piling inspections



Attendees line up to get a peek at the 3M Transportation Safety Roadshow Trailer



## TWO INTRANS EVENTS EMPHASIZE TRAFFIC SAFETY: FORUM IN NOVEMBER AND FOCUS GROUP IN FEBRUARY

More than 100 city and county engineers, Iowa Department of Transportation (DOT) staff, consultants, vendors and traffic researchers gathered for the annual Traffic and Safety Forum on November 21. The forum, a joint effort of InTrans and the Iowa DOT, gives traffic and safety professionals a chance to network with their colleagues and learn what things are working or not working in their areas as they strive to keep drivers and non-drivers safe on the roads.

Joe Kearney, a University of Iowa (UI) professor in the Department of Computer Science, told the audience about new technologies that expand the safety possibilities for vulnerable

road users, including pedestrians and bicyclists. He cited UI research, using simulation technology at the Hank Virtual Environments Lab, which runs trials on sending alerts and warnings via cell phone to pedestrians attempting to cross a single-lane road.

A facilitated talk session allowed attendees to share what was on their minds, which allowed for a wide-ranging discussion of autonomous vehicle potential (and peril), funding concerns, and working with the public in a more productive manner. InTrans personnel presented information on enhanced data collection on traffic and safety measures.

The Traffic and Safety Research Focus Group, a more tightly focused research event held in February 2018, offered a forum for direct input from practitioners on future InTrans research. A group of 40 professionals gathered to discuss, develop, and prioritize research topic ideas to pursue for future funding. Ultimately, the participants selected a handful of research ideas in traffic engineering and operations, safety, and enforcement for further development. Center for Transportation Research and Education (CTRE) director Omar Smadi conducted the group activity and facilitated the deliberations.



Joe Kearney talking about his research at the 2017 Traffic and Safety Forum

Breakout groups strategizing ideas with one another and discussing potential research topics related to enforcement during the Traffic and Safety Research Focus Group meeting

# STAFF AWARDS



**Peter Taylor**, director of the National Concrete Pavement Technology (CP Tech) Center, was the recipient of the Technological Innovation Award from the Iowa Chapter of the American Public Works Association in October 2017. Taylor was honored for outstanding technical advancement of practices or products resulting in improved performance of public infrastructure. Taylor has been active in professional education and research efforts on the potential of using performance engineered mixtures (PEM) for concrete. He has been on the staff at CP Tech since 2007 and became director in 2015.



*Above photos by Christopher Gannon*

InTrans researcher **Alice Alipour** was honored with a Faculty Early Career Development (CAREER) award from the National Science Foundation (NSF) in April 2018. The NSF presents the award in support of early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the missions of their organizations. Alipour, a Civil, Construction, and Environmental Engineering assistant professor, will use the award funding to support her research team's work toward creating more resilient electric power networks that can hold up under extreme weather conditions and aging effects.

## TWO INTRANS PROGRAM LEADERS HONORED BY ISU



**Halil Ceylan**, a Civil, Construction, and Environmental Engineering assistant professor, and director of the Program for Sustainable Pavement Engineering and Research (PROSPER) at InTrans, received two faculty awards from Iowa State University at the end of the school year in May 2018. He was honored with the Margaret Ellen White Graduate Faculty Award, which was established by a long-time staff member of the Graduate College. The award recognizes superior performance by a member of the graduate faculty in enriching the student-professor relationship and enabling students to finish their work in a timely and scholarly manner. In addition, he received an ISU Award for Mid-Career Achievement in Research. The award recognizes a tenured or tenure-track faculty member who has demonstrated exemplary research performance or scholarship accomplishments as documented by peers or experts in the field.



**Chris Williams**, a Civil, Construction, and Environmental Engineering assistant professor, and director of the Asphalt Materials and Pavements Program (AMPP) at InTrans was honored with an award for Achievement in Intellectual Property. The award recognizes individuals or teams of faculty or professional and scientific staff for outstanding university-based achievements in producing intellectual property.



# STUDENT AWARDS

## GROUP HONORS



The ISU Transportation Student Association (TSA) was honored for the sixth year running with an outstanding student chapter award. The award came from the Institute of Transportation Engineers (ITE) Missouri Valley

Section (MOVITE) and TSA members accepted their latest award at the MOVITE spring meeting in Omaha, NE in April.

Ahmed AlBughdadi, president of the TSA during 2017-18, noted that the group had been able to expand its activities and outreach by involving more TSA members in the planning and organizing stages. They arranged to present several workshops, attended regional conferences, sponsored a roadside cleanup event, and offered a high school safe driving class.

## INDIVIDUAL STUDENT PLAUDITS

Graduate students who are working with InTrans faculty members continued their winning ways this year. Two of them were named as 2018 Lifesavers Traffic Safety Scholars and a third was awarded an Eisenhower Fellowship (see right).

The Lifesavers Traffic Safety Scholar program awards the winners a \$1,000 stipend to attend the largest traffic safety conference in the US. The 2018 conference was held in San Antonio, TX on April 22 to 24.



**Georges Bou-Saab**, who attended the conference as a scholar for the second year, wrote an essay on how his experiences growing up in Dubai led him to become an advocate for traffic safety, both in his home country and on the ISU campus. In addition, his work has been recognized by the second Strategic Highway Research Program (SHRP2)

safety data program, and the Transportation Research Board (TRB) oversight committee, as part of their student paper competition. Research he conducted for his Ph.D. dissertation used data to estimate vehicular emissions of harmful pollutants for various work zone configurations.



**Ashirwad Barnwal**, also a Safety Scholar for a second year, has been studying and writing about ways to reduce roadway fatalities in a variety of circumstances. His research has included a study on roadway departure crashes on Iowa interstates, using the Roadside Safety Analysis Program to assist in the choice of roadside safety treatments, and

on improving bicycle and pedestrian infrastructure in Washington, IA. Barnwal received his M.S. in Civil, Construction, and Environmental Engineering at ISU and is currently pursuing his doctorate degree at Iowa State.

## WARNER WINS 2018 EISENHOWER FELLOWSHIP



**Jacob Warner**, a transportation engineering graduate student at Iowa State, received a 2018 Dwight David Eisenhower Transportation Fellowship

awarded by the Federal Highway Administration. His outstanding research abilities were on display when he was asked to present a critical analysis of speed limits on the nationwide rural interstate system at the annual meeting of the Transportation Research Board in Washington, D.C in January.

The Eisenhower fellowship provides \$31,900 for Warner to continue his research with Peter Savolainen, former associate professor of civil engineering and safety engineer at InTrans. Their team is conducting an examination of the safety ramifications to a potential speed limit increase on rural Iowa interstates, specifically any potential changes that might affect crash or fatality rates. They can draw on data about changes in safety that followed after Iowa's previous speed limit change in 2005. Warner notes that, "Data from other states that have recently increased their speed limits will be examined as well." This investigative work will help the Iowa DOT and state legislators as they make decisions about altering the state's speed limits.

Savolainen remarks about his accomplished graduate student, "I have been thoroughly impressed with his intellectual capabilities, his attention to detail, the passion with which he works, and his untiring desire to better understand how we, as engineers, can design and maintain an infrastructure system that addresses growing concerns as to traffic safety and operations."

Warner is one of three InTrans graduate students to be honored with the Eisenhower Fellowship in the last three years.

# RESEARCH REPORTS SHOWCASE INTRANS SCOPE OF WORK

**One way to appreciate the depth and breadth of research conducted by InTrans faculty, staff, and graduate students is to scan the list of research reports published during the past year.**

These 58 reports were the products of research efforts that spanned all aspects of the nation's transportation system: pavements, bridges, traffic safety, airports, trucks, drones, urban transit, rural roads, and more.

Copies of these reports are available for download from the InTrans website at URL: <http://www.intrans.iastate.edu/research/reports/>

## 2018

### JUNE

Prevention of Longitudinal Cracking in Iowa Widened Concrete Pavement  
Investigation of Gender Differences in Large-Truck Crash Injury Severity in Missouri  
Using CHAID Decision Trees to Evaluate Severities of Missouri Truck Crashes  
Assessment of the Consumer Reasons for Selection of Ethanol Fuel  
Evaluation of Otta Seal Surfacing for Low Volume Roads in Iowa  
Estimating Energy Efficiency of Connected and Autonomous Vehicles in a Mixed Fleet  
Evaluation of Rural Intersection Treatments

### MAY

Emerging Freight Truck Technologies: Effects on Relative Freight Costs  
Why TNCs Will Be Regulated Like Taxis—Historically Speaking  
In-Service Performance Evaluation of Median Cable Barriers in Iowa  
Missouri Highway Safety Manual Recalibration  
Paving the Way for Autonomous and Connected Vehicle Technologies in the Motor Carrier Industry  
Evaluation of Successful Forested Wetland Mitigation in Iowa  
Development of Rural Road Bridge Weigh-in-Motion System to Assess Weight and Configuration of Farm-to-Market Vehicles  
Evaluation of the Metal Fatigue Solutions Electrochemical Fatigue Sensor System

### APRIL

Strategic Decision Support for Airport Capacity Planning  
Durable Pavement Marking and Grooving  
Iowa DOT Traffic Operations Open Data Service User Guide and Software Requirements Specification  
Feasibility of Gravel Road and Shoulder Recycling  
Automated Plate Load Testing on Concrete Pavement Overlays with Geotextile and Asphalt Interlayers: Poweshiek County Road V-18  
Improving the Foundation Layers for Concrete Pavements: Field Assessment of Variability in Pavement Foundation Properties

### MARCH

NCHRP Web-Only Document 250: Use of Automated Machine Guidance (AMG) within the Transportation Industry  
Development of a Rapid Assessment Tool for Pile Capacity and Stability in Response to Scour Situations  
Use of Ultra-High-Performance Concrete for Bridge Deck Overlays  
Central Iowa Expo Pavement Test Sections: Pavement and Foundation Construction Testing and Performance Monitoring  
Optimizing Fleet Composition and Size under Uncertainty in Urban Transit Systems  
Pavement Performance: Approaches Using Predictive Analytics  
An Assessment of the Models to Predict Pavement Performance  
Exploration of Machine Learning Approaches to Predict Pavement Performance

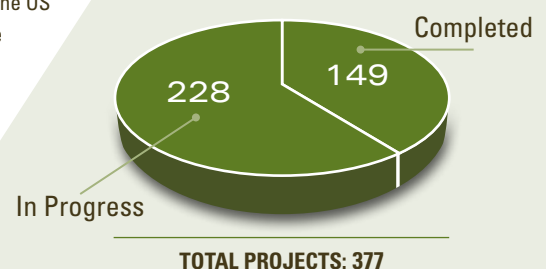
### FEBRUARY

Evaluation of Work Zone Split Traffic Symbol Sign  
Development of Iowa Road Safety Assessment (RSA) Guidelines

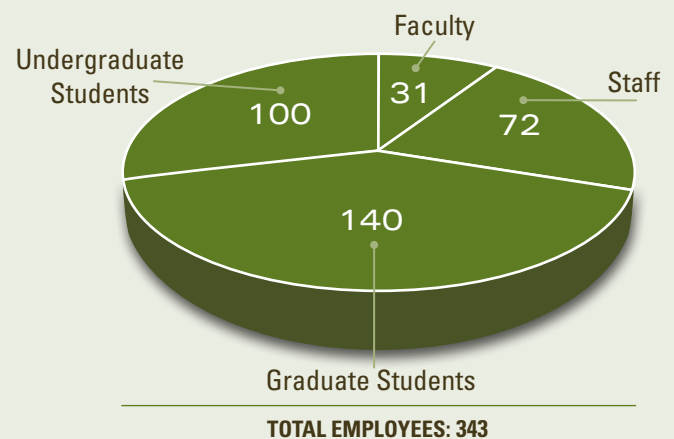
### JANUARY

Recycled Concrete Aggregate Usage in the US  
Understanding the Impacts of Work Zone Activities on Traffic Flow Characteristics  
Strategic Design for Delivery with Linked Transportation Assets: Trucks and Drones

### FY 2018 INTRANS PROJECTS



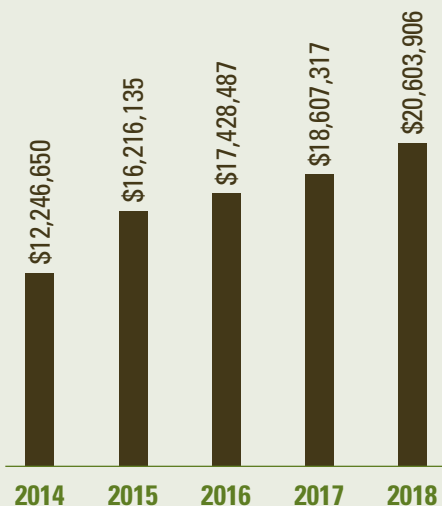
### FY 2018 EMPLOYEE STATISTICS



## INTRANS BY THE NUMBERS

FUNDING SOURCES	2014	2015	2016	2017	2018
Iowa DOT	43%	42%	41%	41%	44%
Other Iowa Govt. Agencies	1%	1%	1%	1%	1%
Other State Agencies	5%	5%	4%	2%	2%
Other (conferences, fees, misc. services, etc.)	16%	12%	13%	12%	15%
Industry	4%	3%	4%	5%	7%
Federal Agencies	31%	37%	37%	39%	31%

### TOTAL FUNDING FROM ALL SOURCES



### 2017

#### DECEMBER

Estimating Crash Modification Factors for Lane Departure Countermeasures in Kansas

Lifecycle Cost Analysis of Internally Cured Jointed Plain Concrete Pavement

Impacts of Internal Curing on the Performance of Concrete Materials in the Laboratory and the Field

Installation Guidance for Centerline and Edgeline Rumble Strips in Narrow Pavements

#### NOVEMBER

Guide Specification for Internally Curing Concrete

#### OCTOBER

Advancing Implementation of Geosynthetic Reinforced Soil-Integrated Bridge Systems

Evaluation of Intersection Collision Warning Systems in Minnesota

Traffic Impact Assessment Tool for Moving Work Zone Operations

Technology Transfer, Delivery, and Implementation of Best Practices for Jointed Concrete Pavements Summary Report

Investigation of the Link Between Macroscopic Traffic Flow Characteristics and Individual Vehicle Fuel Consumption  
Calibrating the Iowa Pore Index with Mercury Intrusion Porosimetry and Petrography

#### SEPTEMBER

Crash Cushion Selection Criteria

Advancing Implementation of Geosynthetic Reinforced Soil-Integrated Bridge Systems (GRS-IBS)

Bridge Maintenance Program for the City of Columbia, Missouri

Study of the Impacts of Implements of Husbandry on Bridges / Volume I: Live Load Distribution Factors and Dynamic Load Allowances

Study of the Impacts of Implements of Husbandry on Bridges / Volume II: Rating and Posting Recommendations

Concrete Overlay Performance on Iowa's Roadways

Study of the Impacts of Implements of Husbandry on Bridges / Volume III: Appendices  
Evaluation of the Buchanan County IBRD Bridge on Victor Avenue over Prairie Creek

Improving Traffic Safety through Better Snow Fences: Image-Based Methods to Measure Trapped Snow Volume and the Snow Relocation Coefficient

Collection of Freeze-Thaw Performance Data on Vail Avenue

#### JULY

Top-Down Construction Cost Estimating Model/ Guide using a Neural Network Within an Off-the-Shelf Spreadsheet and Database Programs

MnDOT Thin Whitetopping Selection Procedures

Small City Work Zone Sign Package Program Implementation



# PEM PROGRAM: DELIVERING CONCRETE TO SURVIVE THE ENVIRONMENT

Today's concrete paving materials can be engineered to meet all manner of specific regional performance requirements. Practitioners increasingly are looking to incorporate key performance parameters into a robust specification and quality process. However, concrete paving specifications have not kept pace with these advances, and in some cases are still based on 50-year-old practices.

Recognizing the need to make the latest advances in technology an integral part of general concrete specifications, a joint government/industry effort—the Performance Engineered Mixtures (PEM) program—began in 2015 followed by the first new pavement specification statement issued by the American Association of State Highway and Transportation Officials (AASHTO) in 2017. The focus now shifts to technical education of agencies and industry on how to apply the PEM specification locally.

The PEM program is a pooled fund, collaborative effort of the Federal Highway Administration (FHWA), 15 state highway agencies, and the concrete industry. Each entity is contributing at least \$1 million over a five-year period to aid the progress of this initiative.

**Peter Taylor and Gordon Smith, director and associate director, respectively, of the National Concrete Pavement Technology (CP Tech) Center are leading the seven-member implementation team for the PEM program.**

The CP Tech Center hosted a meeting in Chicago on February 27-28 for members of the Technical Advisory Committee (TAC) of the PEM pooled fund project. The TAC heard reports from the research team and the Federal Highway Administration, updates from state departments of transportation on

their implementation efforts, and comments from representatives of the concrete industry on their progress.

The FHWA is offering a PEM incentive program and an equipment loan program to encourage education and adoption of these practices. Contractors will be working with their state highway agencies to conduct PEM shadow tests on projects to be featured at open houses in five states each year.

As part of ongoing national education effort, the National Concrete Consortium (NC2) meeting in Idaho featured two sessions on the work of the PEM initiative. One session focused on the PEM pooled fund activities and FHWA efforts. The second session explored how Idaho and Michigan have approached the implementation of PEM in construction. For more information about the PEM program, see <http://www.cptechcenter.org/technical-library/documents/PEM-program-brochure.pdf>.

Demonstration day in Colorado where the FHWA Mobile Concrete Trailer was present to illustrate new tests for the PEM program, including the V-Kelly test developed at the CP Tech Center



Photo by Angela James Folkestad, CO/WY Chapter – American Concrete Pavement Association

# PASSAGES

## ARRIVALS



**Gordon Smith** joined the National Concrete Pavement Technology (CP Tech) Center as associate director in August 2017. Smith has a history of working with the center, dating through his time as a paving contractor and in leadership positions with the Iowa Concrete Paving Association and the Iowa Ready Mixed Concrete Association. His extensive experience in design and construction of concrete pavements made him an excellent fit for sharing technology and advancements in the field. Smith is playing a key role in the CP Tech Center's work with the national Performance Engineered Concrete Mixtures (PEM) program.

## RETIREMENT



**Robert (Bob) Steffes** has skillfully guided ISU students and faculty through thousands of concrete tests, exams, and procedures at the Portland Cement Concrete Research Lab (PCC Lab). At the end of July 2018, Bob retired from the PCC Lab manager position, where he spent 15 years. During his years in the PCC Lab, research activities have increased approximately ten-fold.

Steffes was an integral player in a multitude of concrete investigations involving the National CP Tech Center. His wide-ranging duties as laboratory manager covered every aspect of concrete and concrete research, and even included welcoming elementary and high school students to the PCC Lab for workshops that showcased the many uses of Portland cement concrete and the value of civil engineering as a career.

Bob joined InTrans and ISU as a research engineer after retiring from 17 years in Materials Research in the Iowa DOT. Prior to that he amassed 17 years of overseas oil rig engineering experience with a French company, Schlumberger, following his graduation from Colorado State University with his M.E. degree.

## FAREWELLS



A well-known and much admired member of the ISU engineering community, who also had a long association with InTrans, died in November 2017. **Lowell Griemann** joined the InTrans staff in 2006 and served as interim director at one point. Most of his work was done with the Bridge Engineering Center as associate manager, where his efforts led to building safer bridges. Griemann, who was 75, had also been

chair of ISU's Civil, Construction, and Environmental Engineering department from 1990 until his 2005 retirement. ISU plans to honor him in 2018 with the Order of the Knoll Faculty and Staff Award.



**Jim Cable**, a longtime collaborator with InTrans, passed away on July 10. Cable was a Civil, Construction, and Environmental Engineering Associate Professor Emeritus, and was widely known for his 30-year career supporting advances in the concrete pavement engineering industry through his teaching and outreach work with ISU Engineering Extension. He worked on more than 20 research and demonstration

projects related to concrete overlays and pavement construction as part of his long association with various InTrans research centers. A fellowship named after Cable has been created to support ISU engineering graduate students working with concrete pavements and particularly overlays.

# NEW DEPARTMENT CHAIR JOINS CIVIL, CONSTRUCTION, AND ENVIRONMENTAL ENGINEERING



**David Sanders** became chair of the Iowa State University Department of Civil, Construction, and Environmental Engineering (CCEE)

on July 1, 2018. Sanders has been a University Foundation Professor in the Department of Civil and Environmental Engineering at the University of Nevada-Reno. He was recognized for his research contributions in the area of behavior and design of structural concrete with seismic design of bridges, which led to his selection as Fellow of the Structural Engineering Institute, ASCE, and ACI.

Sanders replaces **Terry Wipf**, who had served as department chair of CCEE since 2011. Wipf has also been a longtime partner in research efforts at the Bridge Engineering Center. InTrans faculty and staff are deeply appreciative for Wipf's years of service to the CCEE department and the ISU College of Engineering.

Twenty-five CCEE faculty members are affiliated with InTrans, which means there is considerable crossover and collaboration between the on-campus academic department and the activities of InTrans at the Research Park. InTrans faculty and staff welcome Sanders to ISU and the world of Iowa transportation.

# BOLSTERING IOWA'S BRIDGES



Placing of the UHPC overlay on Mud Creek Bridge in Buchanan County, Iowa

Recent InTrans research on an Iowa bridge shows the potential for modern concrete technology to heal aging bridges. The Mud Creek Bridge in Buchanan County, Iowa, was the site of a recent project highlighting the use of ultra-high performance concrete (UHPC) as an overlay on top of normal concrete (NC). Sri Sritharan, ISU professor of Civil, Construction, and Environmental Engineering, built on his 2014 study that suggested how UHPC might extend the life span of a bridge deck.

Why are bridges a subject of concern for transportation specialists? Many of the nation's bridges are rated as structurally deficient and require immediate retrofits or replacements.

Sritharan's solution of applying a thin layer of UHPC to bolster a bridge deck offers a win-win for the bridge and the bridge owners because it is easier to adopt, reduces the maintenance cost, and increases the longevity of the bridges.

## CRACKS IN THE SURFACE

The most common bridge deterioration begins with cracking in the deck, followed by water and chloride infiltration into the concrete core and corrosion damage to the reinforcement of the deck. Further damage to the bridge deck occurs due to the impact of freeze-thaw cycles, exposure to deicing salts, and deterioration due to dynamic loads from vehicle traffic and plow trucks. Bridge deck deterioration is a leading cause of the structurally deficient inspection rating of US bridges.

Sritharan theorized that since UHPC has a higher tensile strength and low permeability, cracking as well as water and chloride ingress would decrease, which in turn could extend the deck's lifespan. Moreover, UHPC is considered to have higher fatigue resistance capacity than normal concrete.

## UHPC ON THE BRIDGE

The new UHPC mix developed by LafargeHolcim Company was found

to be suitable for use in bridge deck overlay projects. The material proved appropriate for crowning and for placing the material on sloping deck surfaces. Both nondestructive and destructive evaluations were performed on the Mud Creek Bridge deck to evaluate the performance of the overlay over the course of one year. No concerns were identified for the top surface or the interface bond between the old concrete deck and the UHPC overlay.

Laboratory tests were conducted on three concrete deck specimens, two of which had increased depth due to the addition of the overlay and wire mesh reinforcement. The specimen with the UHPC overlay on top showed increased stiffness and strength compared to the NC deck-only specimen. Though the main reason for this increase was due to the increased deck thickness, the test provided proof of sufficient bonding between the NC deck and UHPC layer. This suggested that the UHPC overlay can be designed to enhance the deck's properties and longevity.



The complete report on the details of Sritharan's project is available at [http://www.intrans.iastate.edu/research/documents/research-reports/UHPC\\_for\\_bridge\\_deck\\_overlays\\_w\\_cvr.pdf](http://www.intrans.iastate.edu/research/documents/research-reports/UHPC_for_bridge_deck_overlays_w_cvr.pdf).

Sritharan reports on a new bridge project underway in 2018, <http://intrans.iastate.edu/enroute/?action=main.item&newsID=436>.



### **UHPC overlay equipment makes US debut in Iowa**

In June of 2018, UHPC was implemented on a primary bridge in Sheldon, Iowa. The project was the result of multiple local and national transportation parties working together. International companies, LafargeHolcim and Walo Bertschinger (WALO), aided in the efforts, providing UHPC materials and one-of-a-kind equipment, respectively.

Top: Sri Sritharan (right) observes and discusses progress with Philipp Hadl (left) of WALO

Middle: WALO equipment used during the placement of UHPC on the first lane

Bottom: Closeup view of UHPC material





## BIG DATA FLOW AT INTRANS

Whoever came up with the term “big data” used a simple tag for a highly complex phenomenon.

*Big data* refers to the *large* volume of *data*—both structured and unstructured—that inundates (and occasionally overwhelms) us daily, but also has significant potential to be mined for valuable information and insights.

A number of researchers at InTrans are doing just that sort of mining—figuring out how to manipulate large, diverse data sets about traffic patterns, driver behavior, and evolving traffic safety technology. Their results have the potential to inform, alter, and potentially improve many aspects of the transportation industry.

Anuj Sharma, one of the co-directors of the Real Time Analytics of Transportation Data (REACTOR) laboratory, has been investigating the cutting-edge technology of deep learning to revolutionize the use of cameras in traffic operations. Cameras used for traffic monitoring of all sorts in multiple roadway situations collect huge volumes of information. Sharma’s research aims at converting this wealth of data into actionable information by automating the image processing and alerting the operator when the overarching algorithm detects any anomaly. This will reduce the workload of operators who are required to monitor hundreds of cameras in an attempt to detect anything that looks out of the ordinary. Sharma presented his case study (“Application of Deep Learning for Advancing the Use of Cameras as a Sensor”) to an enthusiastic audience of several hundred at a Transportation Research Board workshop in January 2018.

Chris Day, a research scientist and CCEE faculty member, specializes in performance measurement and related applications of data. Day is helping to prepare the Iowa Department of Transportation’s annual Interstate Congestion report, which analyzes and summarizes performance statewide. The report focuses on Iowa interstates and assesses congested hours and reliability of travel, with the goal of developing more effective visualization tools to monitor traffic performance. These data also have the potential to steer engineers toward better traffic management schemes, which fits well with Day’s goal of eventually integrating big data into business practices. This points to another way that InTrans research is working to help Iowa’s transportation industries.



The REACTOR lab collects data from work zones that it processes to aid in decision making

Neal Hawkins, another of the REACTOR laboratory co-directors, cites the group efforts to extend the boundaries of traditional research and create a teaching, research, and support laboratory with its foundation firmly embedded in big data collection and analysis.

He points out that the REACTOR team is working on a number of high impact projects, including statewide performance monitoring, work zones performance monitoring, predictive analytics, and the TIMELI project, led by Sharma and funded by the National Science Foundation. The goal for TIMELI, which stands for Traffic Incident Management Enabled by Large-Data Innovations, is to use emerging large-scale data analytics to reduce the number of road incidents through proactive traffic control and to assist operators in the statewide traffic management center.

Hawkins comments, “We live in a world of big data and that amount of information can be difficult for almost any agency to use, so REACTOR provides access to big data analytics using traffic, weather, and other data that otherwise would not be available. REACTOR supports agency decision making by handling data requests and through analysis and visualization of real-world conditions.”

## TRAFFIC SAFETY INSIGHTS FOR MOTORCYCLISTS FROM CTRE EFFORTS

May is a month when plenty of motorcyclists are out enjoying their early springtime travels on the open roads. May is also Motorcycle Safety Awareness Month, and InTrans staff from the Center for Transportation Research and Education (CTRE) weighed in with the release of a new interactive tool to help investigate the causes of motorcycle crashes. Researchers Skylar Knickerbocker and Zach Hans used crash data from the Iowa DOT and data visualization tools from the Real Time Analytics of Transportation Data (REACTOR) lab, an important part of the InTrans high-tech research infrastructure, in developing the valuable new tool.

Knickerbocker and Hans used data from 2015 to 2017 that covered 3,043 motorcycle crashes, which were split nearly evenly between incidents involving a single motorcycle and those that involved other vehicles. (The data include statistics on additional selected classes of unenclosed vehicles such as ATVs, mopeds, autocycles, and snowmobiles.)

Knickerbocker noted that the crash data turned up some telling observations about how the roadway, driver, and weather conditions affect motorcycle incidents, not all of which are related directly to the motorcycle drivers.

**He pointed out that in crashes involving another vehicle, there was no improper action by 58 percent of the motorcycle operators.**

Timing was a factor, too, with more than half of the motorcycle-involved crashes taking place between Friday and Sunday, and a third of the reported motorcycle incidents occurred between 3 p.m. and 6 p.m. Roadway configuration played a role with 54 percent of fatal motorcycle crashes happening on horizontal curves. Driver impairment was also a factor in crashes, as researchers found that 15 percent of the single motorcycle crashes involved drugs or alcohol.

The new tool based on the REACTOR data analysis capabilities allows users to access several crash-related attributes, such as severity, time, vehicle action, driver condition, and various roadway characteristics. Another useful aspect of the tool is the map interface or location component. The aim is to help officials, planners, and trainers learn why motorcycle crashes occur, where and when they are likely to occur, and hopefully take positive steps to prevent future motorcycle accidents. Users can access the tool at the REACTOR lab website: <https://reactor.ctre.iastate.edu/index.php/crash/motorcycle-crashes-in-iowa/>



## RET PROGRAM BRINGS TEACHERS TO INTRANS AND VICE VERSA

ISU faculty members, post-docs, and graduate students studying for their M.S. or Ph.D. degrees carry out a good deal of the work at InTrans. Amid all that advanced technical and academic learning, is there a place for high school teachers and their students to engage with InTrans?

It turns out there is, thanks to ISU's Research Experiences for Teachers (RET) program. It offers high school teachers opportunities to conduct research and build relationships with professionals in the science, technology, engineering, and mathematics (STEM) fields. The knowledge and experience they gain can be passed along to their students. InTrans has participated in the RET program, hosted through ISU's Center for Biorenewable Chemicals and funded by the National Science Foundation, for the past four years. The RET program continued in 2018, between June 11 and July 27. (<https://www.cbirc.iastate.edu/education/precollege/ret/>)

### MEET THE HIGH SCHOOL TEACHERS FROM SUMMER 2017

Three high school teachers participated in the program, benefitting from the opportunity to collaborate with InTrans faculty and staff.

Two Iowa teachers, Ankeny High School's Joe Carey and Laura Rosendahl of Estherville Lincoln Central High School, spent two summers at InTrans in order to continue work on their respective RET projects.

Carey worked with research scientist Basak Aldemir Bektas on a project aimed at identifying the bridge attributes that lead to higher likelihood of bat habitation two years in a row. She visited his Ankeny HS class last year to give a presentation on the project and their work together and returned this fall to assist with a statistics lesson he had prepared.

With background from Bektas about the project and its importance—to identify bridges that are more likely for bat habitation while ensuring necessary bridge repairs can be made with fewer delays—Carey gave his students a list of bridge factors and the observed numbers of those that housed bats. Their job, then, was to assess the likelihood of each bridge being a bat habitat.

The students' work mirrors one small part of the actual research that helped determine correlations between various variables and bat roosting behavior. He noted that his students were particularly interested in the interdisciplinary nature of the work they did on the project. In her visits to Carey's classes, Bektas took the opportunity to engage with students and tell them about her interdisciplinary education and research. The students had many questions on potential future careers in engineering and she hopes to have inspired some to pursue careers in STEM. She was also inspired with Carey's teaching and their pedagogical discussions as a professor and is very glad to have Carey back at InTrans for a third year to continue their collaboration.

Rosendahl worked with InTrans director Shauna Hallmark and statewide multidisciplinary safety team (MDST) facilitator Theresa Litteral on traffic safety issues, including merging emergency detour routes that gave her experience with GIS and mapping technologies.

"I knew that the work I was doing was part of some bigger project that would benefit a majority of the people in Iowa (if not beyond), and I liked feeling like I had a part in those changes," Rosendahl said.



InTrans research scientist, Basak Aldemir Bektas, visits Ankeny, Iowa high school class taught by RET program participant, Joe Carey, to present and assist with education involving bat habitation of bridges

Katelyn Freeseaman of the Bridge Engineering Center working with high school students on beam load effects as part of the RET program



Katelyn Freeseaman pictured on the far right with RET program participant, Darwin Daugaard, and his high school class in Dell Rapids, South Dakota

Darwin Daugaard, a teacher in Dell Rapids, SD, worked with the Bridge Engineering Center's Katelyn Freeseaman and they concentrated on gauging the stability of bridge girders while the deck is being poured. During his seven-week stint with the project, he visited a bridge site as sensors were added, and then collected and reviewed the data the sensors provided.

Following up on their summer 2017 experiences with the RET program, Freeseaman traveled to South Dakota in April 2018 to talk with Daugaard's students about their project regarding exterior

girder rotation. To bring that research into the classroom, the students investigated the effects of loading a sample beam. They pushed on the beam with varying levels of strength for differing time periods, and then looked at the data collected from gages that measured the strain and rotation over time. Their observations and comparison of results gave them a clearer view of how different load types affect girder performance.

Freeseaman also saw the classroom visit as an opportunity to promote STEM studies and training for the students. She noted that her path as

a female engineer could serve as a guide for young women pondering further education or a career in the sciences. The students aren't the only ones who benefit. Freeseaman points out that as a researcher with multiple projects, it is easy to get caught up in the highly detailed, academic work. Exposure to high school students reminded her that there are also real opportunities to show younger people some of the compelling aspects of engineering.

**THE INSTITUTE FOR TRANSPORTATION IS THE FOCAL POINT FOR TRANSPORTATION AT IOWA STATE UNIVERSITY.**

### **InTrans performs**

transportation research for public and private agencies and companies.

### **InTrans manages**

its own education program for transportation students and provides K-12 resources.

### **InTrans conducts**

local, regional, and national transportation services and continuing education programs.



**IOWA STATE  
UNIVERSITY**

