



# The Innovative Engineer

*“Innovative Engineering Against Hazards”*

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## Welcome to the Utah Transportation Center

*A Letter from the Director*  
by Dr. Kevin C. Womack, Director

Welcome to the Utah Transportation Center. The purpose of this inaugural newsletter is to introduce you to our theme, the colleagues that make up the Center and the research projects that are currently being executed utilizing Center funds.



The theme for the Utah Transportation Center is “Innovative Engineering Against Hazards.” Colleagues in the Center have expertise in many hazard type areas: earthquake engineering, landslides, flooding, scour and we will be looking to apply congestion modeling and simulation to hazard events in terms of evacuation and traffic flow. Our hope is to branch out beyond our highway focus and into mass transit and even freight rail as a way of diversifying our efforts.

Within this newsletter you will find short biographies of the Center colleagues that are currently involved with Center research or educational activities. There are also more detailed descriptions of the active research projects being funded through the Center. Our Student of the Year is introduced to you, and last, but certainly not least, the membership of our Advisory Board is announced.

I look forward to distributing many more newsletters to you in the future. Should you have any questions or desire information about our Center, please contact me at [Kevin.womack@usu.edu](mailto:Kevin.womack@usu.edu). Thank you.

## A Brief Introduction to Our Center Colleagues

*Listed in alphabetical order.*

The Utah Transportation Center taps into the expertise of many faculty members in the Civil & Environmental Engineering Department at Utah State University. We are pleased to introduce the faculty who will be a big part of our focus on innovative transportation engineering at the Utah Transportation Center.

**Dr. Paul Barr**  
Assistant Professor

Dr. Paul Barr joined the faculty at Utah State University in 2003. His research interests have focused on nondestructive evaluation of bridges due to earthquake loads, live loads, changes in temperature, and prestress losses.

**Dr. James A. Bay**  
Associate Professor

Dr. James A. Bay has been on the USU faculty since 1998. He works in the areas of soil dynamics, geophysical site characterization, nondestructive evaluation of engineering materials, and geotechnical earthquake engineering.

**Dr. Joseph A. Caliendo**  
Associate Professor

Dr. Joseph A. Caliendo specializes in deep foundations and he teaches numerous American Society

of Civil Engineer's and National Highway Institute short courses. He also conducts short courses on deep foundations each summer for university professors and practicing engineers.

### **Dr. Anthony Chen**

Associate Professor & Head, Transportation Division

Dr. Anthony Chen's research focus is on modeling and analysis of transportation systems, network equilibrium models and solution algorithm development, meta-heuristics for discrete network location and network design problems, and transportation network reliability analysis.

### **Dr. Marvin W. Halling, P.E.**

Associate Professor & Head, Structural Division  
Associate Director, Utah Transportation Center

Dr. Halling is currently working in the areas of structural health monitoring and damage detection. He is a member of the ASCE Seismic Effects Committee and Structural Health Monitoring Committee and serves as an Associate Editor of the ASCE Journal of Structural Engineering. His current research projects include "Real Time Health Monitoring of the 21st South Overpass" and "Strong Motion Instrumentation Plan for the State of Utah."

### **Dr. Robert T. Pack**

Associate Professor & Director, Center for Advanced Imaging Ladar

Dr. Robert T. Pack joined the faculty at USU in 1998. He is currently working on the development of a helicopter-borne lidar system for utility and transportation corridor surveys. As a geomatics specialist, he works extensively with GPS/IMU navigation systems for highly accurate laser measurements.

### **Dr. Keri Ryan**

Assistant Professor, Structures Division

Dr. Ryan joined the faculty at USU in 2004. Dr. Ryan's expertise lies in analytical modeling and seismic analysis of structural components and systems, with emphasis in the area of seismic isolation and protective systems.

### **Dr. Blake Tullis**

Assistant Professor

Dr. Tullis joined the faculty at Utah State University in 1997. His research has focused on hydraulic structures and erosion control. Recent projects have included predicting the effects of composite roughness on open channel flow resistance, multi-barrel culvert hydraulics, and submerged head-discharge relationships for labyrinth and ogee crest weirs.

More information about these colleagues of the Utah Transportation Center can be found at the following Web site: <http://www.engineering.usu.edu/cee/faculty/>

## **Center Welcomes Advisory Board**

To help us carry out the Utah Transportation Center mission and focus on innovative engineering against hazards, we are pleased to have a distinguished and knowledgeable Advisory Board in place.

Board members include:

- [Dr. William Rahmeyer](#), P.E. (Advisory Board Chair), Head, Department of Civil and Environmental Engineering, Utah State University
- [Bryan Cawley](#), P.E., Assistant Division Administrator, Federal Highway Administration
- [Clair Fiet](#), Chief Technology Officer, Utah Transit Authority
- [Ian M. Friedland](#), P.E., Technical Director, Bridge and Structures R&D, Federal Highway Administration
- [Ron Hynes](#), Deputy Associate Administrator, Federal Transit Administration
- [Jim McMinimee](#), P.E., Director, Project Development Division, Utah Department of Transportation
- [Benjamin Tang](#), P.E., Principal Bridge Engineer, Federal Highway Administration

Check out our Center Web site:

<http://transportation.usu.edu>

# Center “Projects in Progress”

These projects are co-sponsored and funded by the Utah Transportation Center & the Utah Department of Transportation

## **Strong Motion Instrumentation Plan for UDOT Bridges: Array Design, Typical Details, and Specifications**

PI: Dr. Marvin W. Halling

Earthquakes have the potential of causing millions of dollars of damage to Utah’s transportation infrastructure. Much of the damage will come from strong motion and the subsequent shaking and overstressing of the structures. It is important from an engineering and scientific standpoint to have estimates of the amplitude and duration of strong motion for earthquake resistant design. The objectives of this project are: 1) develop a set of standard drawings and specifications for strong motion instrumentation, 2) select and instrument representative UDOT bridges 3) model the structure and sub-surface to optimize the placement of the instruments, 4) make a priori predictions of the earthquake response, 5) develop a plan for instrumentation of future highway projects, 6) develop a memorandum of understanding between UDOT and the Advanced National Seismic Systems (ANSS).

## **UDOTs Calibration of AASHTO’s New Prestress Loss Design Equations**

PIs: Dr. Paul J. Barr and Dr. Marvin W. Halling

Many of the bridges built in Utah do not use specifically high performance concrete, but a self consolidating concrete that is different than the mixes that were used to develop the new AASHTO LRFD Bridge Design specification equations. Appropriate design parameters need to be established in order to apply them in the new AASHTO LRFD prestress loss calculations.

The main object of this research is to determine the appropriate design parameters that should be used in order to more accurately account for the prestress losses in precast, prestressed concrete bridges built within the state of Utah. This research will be accomplished in two fold: 1- obtain design parameters elastic modulus (i.e.,  $k_1$  and  $k_2$  for the elastic modulus) shrinkage and creep for typical Utah concrete girders mixes and 2- quantify the effects of deck casting and differential

shrinkage on prestress gains to be used in the new procedures.

## **Evaluation of Bridges for Seismic Retrofit**

PI: Dr. Keri Ryan

UDOT plans to launch a program to identify and update or replace critical highway bridges that are deficient in lateral resistance. To help UDOT prioritize and evaluate highway bridges, we are developing a retrofit evaluation procedure for bridges in the state of Utah specialized for the needs of UDOT. The suggested procedure will be based on existing literature and consultation with state DOTs experienced with seismic retrofit. As validation, we will provide examples of the procedure applied to bridges within Utah. The specific objectives are: (1) develop an internal process for detailed retrofit evaluation of individual bridges, including a decision-tree based on recurring vulnerabilities in common bridge types, use of software, and modeling guidelines, (2) for each of 6 highway bridges selected by UDOT, perform a seismic vulnerability assessment and develop a recommended course of action, and (3) develop general guidelines for preliminary screening of bridges to identify the most vulnerable bridges on which to focus further efforts.

## **Failure Modes Analysis of UDOT’s MSE Wall Inventory**

PI: Dr. James A. Bay

Mechanically Stabilized Earth (MSE) walls have become an important part of the highway infrastructure system. The Utah Department of Transportation has been very aggressive in using MSE walls for many of its projects. Some of the older MSE walls, approaching 30 years of age, are near the end of their design life. This project has three major objectives: 1) Develop a database (inventory) of UDOT’s MSE walls, that includes the type of wall structural system, soil conditions, and construction; 2) perform a probabilistic failure modes analysis of UDOT’s MSE walls that will identify pos-

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sible failure modes; and, 3) Develop a plan to mitigate the hazards of MSE wall failures to a level of risk that is acceptable to UDOT. The primary outcomes of this project are to be the database (inventory) and a Risk Assessment and Hazard Mitigation Plan against the failures of MSE walls in the UDOT inventory.

## Center Recognizes “Student of the Year” *Brian M. Kukay*

The Utah Transportation Center is pleased to recognize Brian M. Kukay as our “Student of the Year”! Brian is from Butte, Montana and is currently pursuing a Ph.D in Civil Engineering at Utah State University. Under the direction of Dr. Paul Barr, Dr. Marv Halling and Dr. Kevin Womack, his research efforts focus on the development (and testing) of a non-destructive method to determine residual tendon stress in pre-stressed girders.



### About the Utah Transportation Center

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