

**A NATIONAL UNIVERSITY TRANSPORTATION CENTER  
AT MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**CENTER FOR TRANSPORTATION  
INFRASTRUCTURE  
AND SAFETY**

**ADVANCED MATERIALS, TRANSITION-STATE FUELS AND  
NON-DESTRUCTIVE TESTING TECHNOLOGIES**

**Seventh Year Annual Report**  
July 1, 2012 – June 30, 2013

**PART B: RESEARCH PROJECTS STATUS REPORT**

Submitted by  
**Kamal H. Khayat, Ph.D., P.E.**  
Center Director

**AUGUST 31, 2013**

**Seventh Year Annual Report  
Part B: Research Projects Status Report**

**Table of Contents**

<b>PART B: RESEARCH Projects Status REPORT .....</b>	<b>3</b>
National University Transportation Center (NUTC): Years I-VII .....	3
<i>New Projects</i> .....	3
<i>Ongoing Projects</i> .....	5
<i>Completed Projects</i> .....	5
<i>Discontinued Projects</i> .....	8
University Transportation Center (UTC): Year I through Year IX.....	9
<i>Completed Projects</i> .....	9

## PART B: RESEARCH PROJECTS STATUS REPORT

The following lists show the status of currently and previously funded projects at the University Transportation Center at Missouri University of Science and Technology. Though the Center was granted National status in 2006, the National Center theme areas and goals are an outgrowth of the former Center's activities. Project lists and statuses from the former Center's activities are included in this reporting to illustrate the continuity and success of the Center's overall activities from start to present.

Note: For all projects listed below a sequence number and a letter designation is attached to each title. R = Research; ETT = Education & Technology Transfer; and RE = Research Equipment.

### National University Transportation Center (NUTC): Years I-VII

#### *New Projects*

The following 57 projects have not been reported on a previous Research Project Status List:

- Assessment of Active Karst Features in Proximity to Paved Roadways (R367 – *Anderson*)
- Admixture Compatibility of Alternative Supplementary Cementitious Materials for Pavement and Structural Concrete (R366 – *Khayat*)
- Structural Health Monitoring and Remote Sensing of Transportation Infrastructure Using Embedded Frequency Selective Surfaces (R365 – *Kinzell*)
- Highway Rockfall Measurements Using LIDAR (R364 – *Maerz*)
- Roller Compacted Concrete – Ripley County Rt 160 (R363 – *Khayat*)
- Second Annual Transportation Infrastructure Engineering Conference (ETT362 – *Khayat*)
- Acquisition of Specialized Testing Equipment for Advanced Cement-based Materials – Addendum (RE361 – *Khayat*)
- Integrated Embedded Frequency Selective Surface Sensors for Structural Health Monitoring (R360 – *Donnell*)
- Analysis of Carbon Emission Regulations in Supply Chains with Volatile Demand-University of Missouri St. Louis (R359 – *Campbell*)
- Analysis of Carbon Emission Regulations in Supply Chains with Volatile Demand-Missouri S&T (R358 – *Konur*)
- Behavior of Double-Skin Bridge Columns (R357 – *Elgawady*)
- Feasibility Analysis of System Dynamics for Inland Maritime Logistics (R356 – *Long*)
- Missouri S&T Formula Electric Racing (ETT355 – *Hutcheson*)
- Functionally Graded Biomimetic Energy Absorption Concept Development for Transportation Systems (R354 – *Birman*)
- Reliability-based Optimization Design of Geosynthetic Reinforced Road Embankment (R353 – *Luna*)
- Long-term Behavior of GFRP Reinforced Panels after Eight Years of Field Exposure (R352 – *Myers*)
- Implementation of RFID Sensors for Monitoring of Bridge Deck Corrosion in Missouri (R351 – *Myers*)
- Non-invasive Imaging and Assessment of Active Karst Features in Proximity to Paved Roadways (R350 – *Anderson*)
- Strength of Unbonded Post-Tensioned Walls (R349 – *Elgawady*)
- Adapting Risk Management and Computational Intelligence Network Optimization Techniques to Improve Traffic Throughput and Tail Risk Analysis (R348 – *Wunsch*)
- Numerical Simulation of CFRP-Repaired Reinforced Concrete Columns (R347 – *Sneed*)

- Quantitative Modeling of Failure Propagation in Intelligent Transportation Systems (R346 – *Sedigh*)
- Nano-Engineered Polyurethane Resin - Modified Concrete (R345 – *Chandrashekhara*)
- Optimization of Rheological Properties of Self-Consolidating Concrete by Means of Numerical Simulations, to Avoid Formwork Filling Problems in Presence of Reinforcement Bars (R344 – *Feys*)
- Mechanical Characteristics of Low-cost Hybrid Fiber Reinforced Polymer (R343 – *Elgawady*)
- Dilation Characteristics of Rubberized Concrete (R342 – *Elgawady*)
- Novel Integrated Nondestructive Testing Methodology for Detection and Evaluation of Corrosion in Cement-Based Materials (R341 – *Donnell*)
- Data Acquisition, Detection and Estimation for Structural Health Monitoring (R340 – *Cheng*)
- Using Shear Wave Velocity to Monitor the Curing Process of High Performance Flowable Concrete (R339 – *Bate*)
- Site Assessment using Echo Sounding, Side Scan Sonar and Sub-bottom Profiling (R338 – *Anderson*)
- Life Cycle Maintenance Cost Analysis of RC Columns Rehabilitation Techniques under Various Durability Exposures (R337 – *Elgawady*)
- Extending the Usage of High Volume Fly Ash in Concrete (R336 – *Volz*)
- Automated Measurement of Concrete Slump Using the Verifi System (R335 – *Khayat*)
- Bridge Hydro-mining Thickness Measurements (R334 – *Maerz*)
- Influence of Mixing Procedure on Robustness of Self-Consolidating Concrete (R333 – *Feys*)
- Recycled Concrete Aggregate Field Implementation – MRB Project (R332 – *Khayat*)
- LIDAR Scanner for Highway Rock Fall and Slope Movement Monitoring (R331 – *Maerz*)
- Unbonded Portland Cement Concrete/Pavement Monitoring with Integrated Grating (Local) and Scattering (Global) Optical Fiber Sensors (R330 – *Chen*)
- Non-invasive Imaging and Assessment of Pavements (R329 – *Anderson*)
- Self-Consolidating Concrete for Connecting Precast Concrete Deck Panels and I-Girders (R328 – *Khayat*)
- Development and Testing of Synthetic Riprap Constructed from Coal Combustion Products (CCPs) (R327 – *Volz*)
- Cyclic Behavior of Self-Consolidated Concrete (R326 – *Elgawady*)
- Women In Science & Engineering and Minority Engineering Scholarships/ Programs (ETT325 – *Elmore*)
- 2013 Missouri Local Technical Assistance Program (LTAP) at Missouri S&T (ETT324 – *Pickerill*)
- Adding Faculty in the Areas of Transportation – Engineering Management (R323 – *Khayat*)
- Sustainable Crack-Free, Environmental-Friendly Concrete “Crack Free Eco-Crete” (R322 – *Khayat*)
- Ultra High Strength Concrete Wearing Surface for Asphalt and Concrete Road as well as Bridge Deck (R321 – *Khayat*)
- Fast Construction and Repair of Bridge Elements Using Low Carbon Foot Print SCC and UHPC Prefabricated Panels Reinforced with FRP (R320 – *Khayat*)
- The NASP Bond Test as a Predictor of Strand Bond, Transfer Length, and Development Length (R319 – *Volz*)
- Adding Faculty in the Areas of Transportation – Civil Engineering (R318 – *Khayat*)
- Lightweight Concrete Modification Factor for Shear Friction (R317 – *Sneed*)
- NCHRP 24-38 Payload Project – Development of Bridge Girder Movement Criteria for Accelerated Bridge Construction (R316 – *Chen*)
- High-Strength Self-Consolidating Concrete (HS-SCC) and High-Volume Fly Ash Concrete (HVFAC) for Infrastructure Elements: Implementation (R315 – *Myers*)
- Seventh International Conference on Case Histories in Geotechnical Engineering (ETT314 – *Prakash*)
- Experimental Investigation of the FRCM/Concrete Interfacial Debonding (R313 – *Sneed*)
- Recycled Concrete Aggregate (RCA) for Infrastructure Elements (R312 – *Volz*)
- Nondestructive Evaluation of MoDOT Bridge Decks – Pilot Study (R311 – *Sneed*)

### ***Ongoing Projects***

The following 24 projects have been reported on a previous Research Project Status List and are still in progress:

- Effects of Organic Additives on the High Volume Reuse of Fly Ash in Geotechnical Engineering (R309 – *Bate*)
- Effects of Road Construction Intensity and Operations on Rural Freeway Work Zone Capacity (R307 – *Luna*)
- Breaking Wire Detection and Strain Distribution of Seven-Wire Steel Cables with Acoustic Emission and Optical Fiber Sensors- Civil Engineering portion (R306 – *Chen*)
- Breaking Wire Detection and Strain Distribution of Seven-Wire Steel Cables with Acoustic Emission and Optical Fiber Sensors- Mining Engineering portion (R305 – *Ge*)
- Use of Adsorption Mechanism to Decrease Heavy Metal Mobility in Soil (R304 – *Wang*)
- Polyurethane Foam Infill for Fiber-Reinforced Polymer (FRP) Bridge Deck Panels (R302 – *Volz*)
- Development and Testing of Synthetic Riprap Constructed from Coal Combustion Products (R301 – *Volz*)
- MoDOT Pavement Preservation Research Program (R300 – *Richardson*)
- Acquisition of Specialized Testing Equipment for Advanced Cement-based Materials (RE299 – *Khayat*)
- Emergency Repair of Damaged Bridge Columns Using Mechanical Splices (R298 – *Sneed*)
- Testing and Assessment of Portable Seismic Property Analyzer (R297 – *Anderson*)
- Advanced Moisture Modeling of Polymer Composites (R296 – *Chandrashekhara*)
- Polyurethane Foam Infill for Fiber-Reinforced Polymer (FRP) Bridge Deck Panels (R295 – *Volz*)
- Women in Science and Engineering Scholarships Year 7 (ETT294 – *Elmore*)
- Field Evaluation of Thermographic Bridge Concrete Inspection Techniques (R293 – *Washer*)
- Minority Engineering Scholarships Renewal 2012 (ETT290 – *Perkins*)
- Effect of Trona on the Leaching of Trace Elements from Coal Fly Ash (R285 – *Wang*)
- Imaging of Voids Beneath Bridge Bent Using Electrical Resistivity Tomography (R283 – *Anderson*)
- Field Evaluation of Hybrid-Composite Girder Bridges in Missouri – UMC Portion (R282 – *Washer*)
- Field Evaluation of Hybrid-Composite Girder Bridges in Missouri – MS&T Portion (R281 – *Myers*)
- The NASP Bond Test as a Predictor of Strand Bond, Transfer Length, and Development (R277 – *Volz*)
- Lightweight Concrete Modification Factor for Shear Friction (R276 – *Sneed*)
- Field Evaluation of Alternative and Cost-Efficient Bridge Approach Slabs – UMKC (R273 – *Thiagarajan*)
- Field Evaluation of Alternative and Cost-Efficient Bridge Approach Slabs (R272 – *Myers*)

### ***Completed Projects***

The following 92 projects have been reported on a previous Research Project Status List and are now complete:

- Repair of Earthquake-damaged Bridge Columns with Fractured Bars (R310 – *Sneed*)
- Fiber Reinforced Cementitious Matrix (FRCM) Composites for Reinforced Concrete Strengthening (R308 – *Sneed*)
- A Pilot Study on Diagnostic Sensor Network for Structure Health Monitoring (R303 – *Cheng*)
- Determination of Optimum “Multi-Channel Surface Wave Method” Field Parameters (R292 – *Anderson*)
- 2012 Missouri Local Technical Assistance Program (LTAP) at Missouri S&T (ETT291 – *Pickerill*)
-

- Rapid Repair of Severely Damaged Reinforced Concrete Columns (R289 – *Sneed*)
- Evaluation of Long Carbon Fiber Reinforced Concrete to Mitigate Earthquake Damage of Infrastructure Components (R288 – *Volz*)
- Ground Penetrating Radar (GRP) for Pavement Evaluation - Supplement to R261 (R287 – *Anderson*)
- Beneficial Reuse of Fly Ashes in Geotechnical Engineering with Physicochemical and Electron Microscopic Methods (R286 – *Bate*)
- Bottom Ash as Aggregate Replacement in Concrete (R284 – *Volz*)
- Minority Engineering Scholarships Renewal (ETT280 – *Perkins*)
- Women In Science & Engineering Scholarships and Summer Camp Outreach Programs, Year 6 (ETT279 – *Elmore*)
- High-Volume Fly Ash Concrete (R278 – *Volz*)
- Bridge on Arnault Branch, Washington County, Missouri (R275 – *Chen*)
- Development of a Quantitative Model for the Mechanism of Raveling Failure in Highway Rock Slopes and Cuts (R274 – *Maerz*)
- Use of Coal Fly Ash and Other Waste Products in Soil Stabilization and Road Construction – Including Non-Destructive Testing of Roadway – Columbia (R271 – *Rosenblad*)
- Use of Coal Fly Ash and Other Waste Products in Soil Stabilization and Road Construction – Including Non-Destructive Testing of Roadway (R270 – *Ge*)
- Evaluation of LED Roadway Luminaries (R269 – *Long*)
- Design and Evaluation of High-Volume Fly Ash Concrete Mixes (R268 – *Volz*)
- Self-Consolidating Concrete for Infrastructure Elements (R265 – *Myers*)
- Mapping Subsurface in Proximity to Newly-Developed Sinkhole Along Roadway (R262 – *Anderson*)
- Ground Penetrating Radar (GPR) for Pavement Utilization (R261 – *Anderson*)
- The Guayule Plant: A Renewable, Domestic Source of Binder Materials for Flexible Pavement Mixtures (R253 – *Richardson*)
- 2011 Missouri Local Technical Assistance Program (LTAP) at Missouri S&T (ETT267 – *Pickerill*)
- Leaching Behavior of Coal Combustion Products and the Environmental Implication in Road Construction: Phase III (R266 – *Wang*)
- Structural Polyurethane Foam Infill for Fiber Reinforced Polymer Bridge Deck Panels (R264 – *Volz*)
- Soy-based UV Resistant Polyurethane Pultruded Composites: Phase II (R263 – *Chandrashekhara*)
- Alternative Energy Sources for MoDOT (R260 – *Grasman*)
- 2010 Missouri Local Technical Assistance Program (LTAP) at Missouri S&T (ETT259 – *Pickerill*)
- Women In Science & Engineering and Minority Engineering Scholarships: Year 5 (ETT258 – *Elmore*)
- Evaluation of the Orientation of 90° and 180° Reinforcing Bar Hooks in Wide Members (R257 – *Sneed*)
- Mapping of Previously Mined Ground for Infrastructure Citing Purposes (R256 – *Anderson*)
- Soy-Based UV Resistant Polyurethane Pultruded Composites (R255 – *Chandrashekhara*)
- Missouri S&T Hydrogen Transportation Test Bed Equipment & Construction (RE254 – *Sheffield*)
- Acquisition of Equipment for Composite Manufacturing Laboratory (RE252 – *Chandrashekhara*)
- Women in Science & Engineering and Minority Engineering Scholarships: Year 4 (ETT251 – *Elmore*)
- Innovative Concrete Bridging Systems for Pedestrian Bridges: Implementation and Monitoring (R250 – *Myers*)
- 2009 Summer Transportation Institute (ETT249 – *Pickerill*)
- 2009 Missouri Local Technical Assistance Program (LTAP) at Missouri S&T (ETT248 – *Pickerill*)
- MTI/MoDOT Transportation Geotechnical Research Program – Task 2 & 4 (R247 – *Loehr*)
- MTI/MoDOT Transportation Geotechnical Research Program – Task 2 & 4 (R246 – *Luna*)
- MTI/MoDOT Transportation Geotechnical Research Program – Task 3 (R245 – *Bowders*)
- MTI/MoDOT Transportation Geotechnical Research Program – Task 1 & 3 (R244 – *Maerz*)

- MTI/MoDOT Transportation Geotechnical Research Program – Task 1 (R243 – *Ge*)
- MTI/MoDOT Transportation Geotechnical Research Program – Task 1 (R242 – *Likos*)
- Project 2c: Alternative and Cost-Effective Bridge Approach Slabs – UMKC (R241 – *Thiagarajan*)
- Project 2c: Alternative and Cost-Effective Bridge Approach Slabs – UMC (R240 – *Gopalaratnam*)
- Project 2a: Reliability-based Evaluation of Bridge Components for Consistent Safety Margins – UMC (R239 – *Orton*)
- Project 1a: Structural Steel Coating for Corrosion Mitigation – UMC (R238 – *Washer*)
- Project 2d: Calibration of Load and Resistance Factors in LRFD Foundation Design Specifications (R237 – *Chen*)
- Project 2b: Coated Steel Rebar for Enhanced Concrete-steel Bond Strength and Corrosion Resistance (R236 – *Chen*)
- Project 2a: Reliability-based Evaluation of Bridge Components for Consistent Safety Margins – Missouri S&T (R235 – *Kwon*)
- Project 1b: Spalling Solution of Precast – Prestressed Bridge Deck Panels (R234 – *Belarbi*)
- Project 1a: Structural Steel Coatings for Corrosion Mitigation – Missouri S&T (R233 – *Myers*)
- Developing Raman Spectroscopy for the Nondestructive Testing of Composite Materials (R232 – *Washer*)
- Graduate Research Training in Transportation Areas: Year 3 funds (R231 – *Myers*)
- Coaxial Cable Sensors and Sensing Instrument for Crack Detection in Bridges (R230 – *Chen*)
- 2008 Summer Transportation Institute (ETT229 – *Pickerill*)
- Structural Assessment of Highway “N” Power Substation Under Earthquake Loads (R228 – *Chen*)
- A Laboratory Investigation on Three-Sided Structures (R227 – *Belarbi*)
- American Concrete Institute 2008 Fall Conference: Sponsorship and Student Training (ETT226 – *Myers*)
- Adding Faculty in Transportation Areas: Year 2 & 3 (R225 – *Collier*)
- Outreach for the Missouri University of Science and Technology National University Transportation Center (ETT224 – *Rolufs*)
- Geophysical Investigation of Seepage Associated with the Lake Sherwood Earth Fill Dam (R223 – *Anderson*)
- Rolla West Task 2, I-44 Interchange Master Plan – Sub Consultant Service for HNTB (R222 – *Rolufs*)
- Investigation of Subsidence Along a Segment of MO Route 65, Springfield, Missouri (R221 – *Anderson*)
- Missouri Local Technical Assistance Program (LTAP) at Missouri S&T: Year 2 (ETT220 – *Rolufs*)
- Concrete Durability Factor Estimation (R219 – *Richardson*)
- Quick Test for Percent of Deleterious Material (R218 – *Richardson*)
- Women in Science & Engineering and Minority Engineering Scholarships: Year 3 (ETT216 – *Elmore*)
- Outreach Activities in Support of the Missouri S&T National UTC (ETT215 – *Rolufs*)
- Leaching Behavior of Coal Combustion Products and the Environmental Implication in Road Construction: Year 2 Funds (R214 – *Wang*)
- Structural Assessment of Highway “N” Power Substation Under Earthquake Loads (R213 – *Chen*)
- 6<sup>th</sup> National Seismic Conference on Bridges and Highways, Charleston, South Carolina, July 27-30, 2008 (ETT212 – *Chen*)
- Pultruded Composites Using Soy-Based Polyurethane (R211 – *Chandrashekhara*)
- Freight Optimization & Development in Missouri – Waterways and Ports Module (R210 – *Grasman*)
- Serviceability and Prestress Loss Behavior of SCC Prestressed Concrete Girders Subjected to Increased Compressive Stresses at Release (R209 – *Myers*)
- Mechanical Characterization of Enamel Coated Steel Bars (R208 – *Chen*)
- Concrete Crack and Spalling Detection in a 6.1-meter Precast RC Piles with Novel Distributed Cable Sensors and ETDR Measurement (R207 – *Chen*)
- Acquisition of a Leica ScanStation LiDAR Unit (RE206 – *Maerz*)

- Preparing for a Significant Central U.S. Earthquake: Science Needs of the Emergency Response Community (ETT205 – *Anderson*)
- Show Me the Road to Hydrogen (R204 – *Sheffield*)
- Graduate Research Training in Transportation Areas: Year 2 (R203 – *Myers*)
- Geophysical Characterization of Tunnel Construction Site, Louisville, Kentucky (R202 – *Anderson*)
- Leaching Behavior of Coal Combustion Products and the Environmental Implication in Road Construction: Year 1 Funds (R201 – *Wang*)
- Development of Teaching Material to Integrate GT-POWER into Combustion Courses for IC Engine Simulations (R200 – *Koylu*)
- Missouri Local Technical Assistance Program (LTAP) at Missouri S&T: Year 1 (ETT199 – *Rolufs*)
- Development of Hand-held Thermographic Inspection Technologies (R198 – *Washer*)
- Design of FRP Systems for Strengthening Concrete Girders in Shear: Phase II (R197 – *Belarbi*)
- Women In Science & Engineering and Minority Engineering Scholarships: Year 2 (ETT196 – *Elmore*)
- Long-Term Remote Sensing System for Bridge Piers (R195 – *Washer*)

### ***Discontinued Projects***

The following project has been reported on a previous Research Project Status List and, because of a situation with match funding, has since been retired:

- GeoMO 2008 – Geotechnical Earthquake Engineering – Site Response (ETT217 – *Luna*)



# University Transportation Center (UTC): Year I through Year IX

## *Completed Projects*

The following 191 projects have been reported on a previous Research Project Status List and are now complete:

- Investigation of Karst Features Within MODOTROW (R194 – *Anderson*)
- Design, Construction, Laboratory and Field Testing of the Bridge on the Arnault Branch, Washington County, Missouri (R193 – *Chen*)
- Quality Geotechnical Testing Workshop and Short Course (ETT192 – *Stephenson*)
- Best Practices for Implementing a Biodiesel Program (R191 – *Grasman*)
- GeoMo 2007 - Soil Stabilization - Foundations and Pavements (ETT190 – *Luna*)
- Investigation of Karst Features within Pipeline/Roadway (R189 – *Anderson*)
- Detection of Subsurface Zone of Seepage Beneath Earth Fill Dam: Phase II (R188 – *Anderson*)
- Geophysical Characterization of Soil and Bedrock, Monroe City Bridge (R187 – *Anderson*)
- Design of FRP Systems for Strengthening Concrete Girders in Shear: Phase I (R186 – *Belarbi*)
- 5th National Seismic Conference on Bridges & Highways (ETT185 – *Chen*)
- Optimization of Electromagnetic Acoustic Transducers (EMATs) for Condition Assessment of Civil Infrastructure (R184 – *Washer*)
- Back Movement Monitor Field Testing (R183 – *Apel*)
- Detection of Subsurface Zone of Seepage Beneath Earth Fill Dam and Beneath Roadway (R182 – *Anderson*)
- Structural Materials Technology (SMT): NDE/NDT for Highways and Bridges Conference (ETT181 – *Washer*)
- Adding Faculty in Transportation Areas: Year 1 (Continued) (R180 – *Schonberg*)
- 2006-2007 Summer Transportation Institute (ETT179 – *Rolufs*)
- Leaching Behavior of Coal Combustion Products and the Environmental Implication in Road Conditions (R178 – *Wang*)
- Mapping of Underground Voids at Construction Site (R177 – *Anderson*)
- 2007 ICONIC Conference (ETT176 – *Zoughi*)
- Resilient Moduli of Typical Missouri Soils and Unbound Granular Base Materials (R175 – *Petry*)
- Development and Testing of High Resolution Target Monitor (R174 – *Apel*)
- Missouri Local Transportation Center 2006 (ETT173 – *Qureshi*)
- Workshop on Seismic Retrofit Design of Continuous Span Steel-Girder Highway Bridges (ETT172 – *Chen*)
- Mapei Scholar Program (ETT171 – *Krishnamurthy*)
- Transportation Fuel Research and Development (R170 – *Krishnamurthy*)
- Acquisition of a High-Quality Temperature Chamber (RE169 – *Richardson*)
- GeoMO 2006: Shear Strength and Slope Stability (ETT168 – *Stephenson*)
- Cyclic Load Testing and Acoustic Emission Methods of In-Situ Load Testing: Comparison and Development of Evaluation Criteria (R167 – *Galati*)
- Adding Faculty in Transportation Areas: Year 1 (R166 – *Mitchell*)
- Graduate Research Training in Transportation Areas (R165 – *Krishnamurthy*)
- Assessment of the Bill Emerson Memorial Bridge Based on Seismic Instrumentation Data (R164 – *Chen*)
- Structural Assessment of the I-70 Blanchette Bridge (R163 – *Marianos*)
- Scholarships for Women and Minority Students Studying Engineering and Science (ETT162 – *Elmore*)
- Geotechnical Site Characterization of Transportation Construction Sites and Structures (R161 – *Anderson*)

- Incorporation of Hands-On Experiments in an Introductory Analysis Course (ETT160 – *Belarbi*)
- Seismic Simulation and Design of Bridge Columns Under Combined Actions, and Implications or System Response (R159 – *Belarbi*)
- Dependable Wireless Sensor Networks for Intelligent Infrastructures (R158 – *Sedighsarvestani*)
- Analyzing Microscopic Behavior of Traffic Flow (R157 – *Bham*)
- Influence of Ore Physical Properties on the Transportable Moisture Limit for Barged Materials (R156 – *Stephenson*)
- Field Testing of Soil-Foundation-Structure Interaction Under Explosive Load (R155 – *Ge*)
- Stay-In-Place (SIP) formwork for Rapid Construction of Corrosion-free Concrete Bridge Decks (R154 – *Banks*)
- National Society of Black Engineers National Conference; NSBE Pre-College Initiative; Society of Hispanic Professional Engineers National Conference; MEP/SHPE High School Recruitment (ETT153 – *Fransaw*)
- Minority Engineering and Science Program: Minority Intro to Technology and Engineering, Mathematics Engineering Science Achievement (ETT152 – *Fransaw*)
- Women in Science and Engineering: Girls Lock-In Conference, Summer Solutions, Girls Camp, SWE National Conference Expanding Your Horizons (ETT151 – *Vogt*)
- 6<sup>th</sup> International Conference on Case Histories in Geotechnical Engineering (ETT150 – *Prakash*)
- Travel Support to Establish the Center for Transportation Security (CTS) (R149 – *Kiger*)
- Manufacturing and Performance Evaluation of Soy Protein Based Plastics and Composites: Phase II (R148 – *Chandrashekhara*)
- Summer Transportation Institute 2005 (ETT147 – *Yoest*)
- Geophysical Detection of Voids within the Levee, Duck Creek Conservation Area, Missouri (R146 – *Anderson*)
- Geophysics 2006: Conference on Applied Geophysics (ETT145 – *Anderson*)
- The Effect of Fatigue and Creep on Shear-Critical RC Beams Reinforced with CFRP Laminate Stirrups (R144 – *Budek*)
- Development and Field Testing of FRP Composite Bridge Decks Comprising of Guard Rail System for Bridge 1480230, Greene County, MO (R143 – *Myers*)
- Experimental Evaluation of FRP Strengthening of Real Size Reinforced Concrete Columns (R142 – *Galati*)
- Remote Health Monitoring of Hillsborough County Bridges (R141 – *Ayoub*)
- Minority Intro To Engineering (MITE), Mathematics Engineering Science Achievement (MESA) (ETT140 – *Harris*)
- Girls Lock-In Conference; Summer Solutions 2005; SWE National & Regional Conferences (ETT139 – *Elmore*)
- National Society of Black Engineers National Conference; National Society of Black Engineers Pre-College Initiative; MEP/SHPE Kansas City High School Recruitment Program; MEP Seven Week Summer Enrichment Program for Pre-College Freshmen (ETT138 – *Huggans*)
- GeoMO 2005 Design of Retaining Walls (ETT137 – *Stephenson*)
- Quality Geotechnical Testing Workshop and Short Course (ETT136 – *Stephenson*)
- Strengthening of Rural Bridges Using Rapid-Installation FRP Technology (R135 – *Bennish*)
- Manufacturing and Performance Evaluation of Soy Protein Based Plastics and Composites: Phase I (R134 – *Chandreshekhara*)
- Assessment of Bridge Technologies through Field Testing (R133 – *Galati*)
- Missouri Local Transportation Resource Center 2005 (ETT132 – *Qureshi*)
- Geotechnical and Bridge Design Workshop: New Madrid Seismic Zone Experience (ETT131 – *Chen*)
- Validation and Calibration of Testing Equipment for In-Situ Load Tests (R130 – *Galati*)

- Low Energy Alkali Resistant Iron Phosphate Glass Fibers (R129 – *Brow*)
- Monitoring of Bridge Structures Equipment (RE128 – *Galati*)
- Enhancing Student Awareness and Faculty Capabilities in Transportation (ETT127 – *Schonberg*)
- Evaluation and Utilization of the WP4: Phase II (R126 – *Petry*)
- University Student Design Competition Center (USDCC) (ETT125 – *Stone*)
- In Situ Load Testing of Bridge A6358 and Bridge A6101 (R124 – *Nanni*)
- Evaluation of Anchors for CFRP Tendons (R123 – *Soudki*)
- Design, Fabrication, and Testing of Low-Profile Composite Bypass Road Panel: Phase I (R122 – *Nanni*)
- GeoMO 2004: Geotechnical Uncertainty and Reliability (ETT121 – *Stephenson*)
- SASW/Study of Greater St. Louis and Surrounding Region (R120 – *Anderson*)
- GPR investigation of bridge deck, Willow Springs, MO (R118 – *Anderson*)
- Determination of MASW Shear-Wave Velocities at Various Sites in SE Missouri (R117 – *Anderson*)
- Acquisition of a Engineering Seismograph (RE116 – *Anderson*)
- Acquisition of an Impact Testing Machine (RE115 – *Chandrashekhara*)
- Comprehensive Shear-Wave Velocity Study in the Popular Bluff Area, Southeast Missouri (R114 – *Anderson*)
- GPR and Resistivity to Determine Depth to Bedrock at the Roaring River Hatchery (R113 – *Anderson*)
- Strut Failures of Paseo Suspension Bridge in Kansas City, Missouri (R112 – *Chen*)
- Finite Element Modeling of Reinforced Concrete Bridge Decks with ABAQUS (R111 – *Ganesh*)
- Summer Transportation Institute 2004 (ETT110 – *Yoest*)
- League of United Latin American Citizens (LULAC) Kansas City H.S. Hispanic Recruitment and Society of Hispanic Professional Engineers (SHPE) National Technical Career Conference (ETT109 – *Harris*)
- Experimental Study on Seismic Retrofit Techniques Phase: II (R108 – *Silva*)
- GeoMO-1: 2003 Deep Foundations for Transportation Structures (ETT107 – *Stephenson*)
- Girls Lock-In Conference, Summer Solutions 2004 (ETT106 – *Harris*)
- Minority Intro To Engineering (MITE), National Society of Black Engineers National Conference (ETT105 – *Harris*)
- GPR Study of Imbedded Dowel Bars, Van Buren, Missouri (R104 – *Anderson*)
- Southview Bridge Rehabilitation in Rolla (R103 – *Nanni*)
- Geophysics 2003: Conference on Applied Geophysics (ETT102 – *Anderson*)
- Soy-Based Composite Sandwich Structure: Phase II (R101 – *Chandrashekhara*)
- Determination of Shear Wave Velocity along a Segment of Interstate I-70, St. Louis (R100 – *Anderson*)
- Missouri Local Resource Center 2004 (ETT99 – *Qureshi*)
- Preservation of Missouri Transportation Infrastructure: Flexural upgrade of deficient bridges with composites (R93, R95, R96, R97, R98, R119 – *Ibell, Myers, Maerz, Zoughi, Nanni*)
- Development and Validation of Steel-Reinforced Polymer (SRP) for Strengthening of Transportation Infrastructures (R94 – *Watkins*)
- A Study of the Effects of Injected Chemical Soil Stabilizers on Expansive Clays and Claystones (R92 – *Petry*)
- Evaluation & Utilization of the WP4 Depowling Potentiometer: Phase I (R91 – *Petry*)
- Post-earthquake Damage Evaluation of Bridge Structures (R90 – *Chen*)
- Experimental Study on Seismic Retrofit Techniques for Cap Beams, Columns and their Connections of Highway Bridges (R89 – *Chen*)
- 2003 USDOT Summer Transportation Institute (ETT88 – *Spring*)
- Experimental Investigation of Bond-Slip Relationship Between Fiber Reinforced Polymers (FRP) Bars and Concrete (R87 – *Thiagarajan*)

- Study on Seismic Retrofit Techniques for Cap Beams, Columns and their Connections of Highway Bridges: Phase 1 (R86 – *Silva*)
- Creep, Shrinkage and CTE Evaluation: Normal Strength Concrete Bridge Deck Companion Testing for an Adjacent HPC Bridge (R85 – *Myers*)
- Expanding Your Horizons in Math, Science, and Technology; Girls Lock-In Conference; Summer Solutions 2003 (ETT84 – *Schoenborn*)
- Minority Introduction To Engineering and National Society of Black Engineers National Conference (ETT83 – *Harris*)
- FRP Alignment Measurement Using Digital Image Analysis (R82 – *Maerz*)
- Nondestructive Ultrasonic Detection of FRP De-lamination (R81 – *Maerz*)
- Evaluation of Bridge Approach Slabs Performance and Design (R80 – *Luna*)
- Optimization of HPC for Missouri Bridge Structures (R79 – *Myers*)
- Soy-Based Composite Sandwich Structures: Phase I (R78 – *Chandrashekhara*)
- Micro-Macro Modeling of the External Strengthening of Concrete with Fiber Reinforced Polymer: Phase II (R77A – *Dharani*)
- Study to Determine the Effects of Organics on the Results of Quicklime Slurry Treatment of Clay Soils (R76 – *Petry*)
- GPR Investigation of Concrete Integrity, Sheppard of the Hills Hatchery, Branson, MO (R75 – *Anderson*)
- Design and Installation of Torque Anchors for Tiebacks and Foundations (R74 – *Stephenson*)
- The Effects of a Curved Soffit on FRP-Strengthening of Concrete Bridges (R73 – *Ibell*)
- Determination of Shear-Wave Velocity Profiles from Surface Seismic Waves (R72 – *Anderson*)
- Dynamic Testing Equipment (RE71 – *Stephenson*)
- Missouri's Local Technical Assistance Program Center (LTAP) (ETT70 – *Qureshi*)
- Fifth International Conference on Case Histories in Geotechnical Engineering (ETT69 – *Prakash*)
- Structures Laboratory Equipment Enhancement – Hydraulic Distribution System (RE68 – *LaBoube*)
- Sappington Bridge Demolition, Crawford County, MO (R67 – *Baird*)
- Strengthening of Martin Springs Outer Road Bridge, Phelps County, MO (R66 – *Nanni*)
- Assessment and Rehabilitation of West 7<sup>th</sup> Street Bridge, City of Fulton, MO (R65 – *Nanni*)
- Rapid Strengthening of Reinforced Concrete Bridges (R64 – *Bank*)
- Joint KDOT-MODOT: Evaluation of FRP Repair Method for Cracked PC Bridge Members (R63 – *Nanni*)
- 82<sup>nd</sup> Transportation Research Board Student Technology Transfer (ETT62 – *Spring*)
- 2002 Summer Transportation Institute (ETT61 – *Spring*)
- Highway/Rail Crossing Project Selection (R60 – *Qureshi*)
- Micro-Macro Modeling of the External Strengthening of Concrete with FRP (R59 – *Dharani*)
- Implementation Issues of Metallic Dampers for Seismic Retrofit of Highway Bridges (R57 – *Chen*)
- 2001 Summer Transportation Institute (ETT56 – *Spring*)
- Acquisition of an Integrated Testing System for Civil Infrastructure Engineering Research and Education (R55 – *Belarbi*)
- Acquisition of an Integrated Testing System for Civil Infrastructure Engineering Research and Education (RE55A – *Belarbi*)
- Ground Penetrating Radar Evaluation of Contaminated Concrete Pavement (R54 – *Cardimona*)
- Steel-Free Hybrid Reinforcement System for Concrete Bridge Decks (R52 – *Belarbi*)
- Ground-Penetrating Radar/Seismic Study-Branson/Springfield, MO (R50 – *Anderson*)
- Characterization of a New FRP Bar for Reinforcement of Concrete (R49 – *Myers*)
- Doctoral Training in Civil Infrastructure Engineering (ETT48 – *Belarbi*)
- Determination and Prioritization of MODOT Geotechnical Related Problems with Emphasis on Effectiveness of Designs for Bridge Approach Slabs and Pavement Edge Drains Phase II (R47 – *Petry*)

- Course Development for the Transportation Graduate Program at UMR (ETT46 – *Spring*)
- Development of a Pull Tester (R45 – *Galecki*)
- Automated Mobil Highway Sign Retro Reflectivity Measurement (R44 – *Maerz*)
- National Society of Black Engineers National Conference (ETT43 – *Harris*)
- Laboratory and Field Testing of FRP Reinforced Concrete Bridge (R42 – *Watkins*)
- Micro-Macro Modeling of the External Strengthening of Concrete with FRP (R41 – *Roy*)
- USAES-UMR Cooperative Degree Program (ETT40 – *Anderson*)
- High Performance Concrete for Bridge A6130 – Route 412 Pemiscot County, MO (R39 – *Myers*)
- Acquisition of Asphalt Pavement Analyzer (R38 – *Richardson*)
- Evaluating FRP Repair Method for Cracked PC Bridge Members Subjected to Repeated Loadings (R37 – *Peterman*)
- Evaluating FRP Repair Method for Cracked PC Bridge Members Subjected to Repeated Loading (R37A – *Peterman*)
- Effect of Contaminants on Bond Characteristics of Deformed Reinforcing Bars (R36 – *Belarbi*)
- Summer Transportation Institute 2000 (ETT35 – *Spring*)
- Non-Destructive Imaging of Shallow Sandstone in Support of Hydraulic Study of Litho Logic Unit (R34 – *Anderson*)
- Non-Invasive Geophysical Investigation of Landfill Site: Grandview Triangle Area (R33 – *Anderson*)
- Assessment/Mitigation of EQ Hazards Along Designated Priority Emergency Vehicle Access Routes, SE MO (R32 – *Anderson*)
- CE 401 – Health Monitoring & Retrofit of Geotechnical Systems (ETT29 – *Luna*)
- Composite Structures Using Asphalt Based Roofing Scrap Materials (R28 – *Chandrashekhara*)
- Laboratory and Field Testing on FRP Composite Decks for the City of St. James, Phelps County, MO (R27 – *Nystrom*)
- Strengthening of an Impacted PC Girder on Bridge A10062, St. Louis County, MO (R26 – *Nanni*)
- Structural Integrity Evaluation of RC Columns with FRP Wraps (R25 – *Belarbi*)
- Model of Demonstration Bridge for Classroom and Laboratory Teaching (ETT24 – *Watkins*)
- Determination and Prioritization of MODOT Geotechnical Related Problems w/Emphasis on Effectiveness of Designs for Bridge Approach Slabs and Pavement Edge Drains (R23 – *Petry*)
- Investigation of Agents of Practical Use to Stabilize Slopes & Erosion Along the I-55 Corridor South of Sikeston: Phase I (R22 – *Petry*)
- Signal Mast Arm Failure Investigation (R21 – *Dharani*)
- Development of a Prototype Imaging Concrete Roughness Measurement Device (R20 – *Maerz*)
- Constructability and Performance of CFRP Prestressed Concrete Members (R19 – *Nanni*)
- Strengthening of Bridge G270, Route 32, Iron County, MO (R18 – *Myers*)
- 1999 Summer Transportation Institute (ETT17 – *Spring*)
- Web-Based Technology Transfer (ETT16 – *Nystrom/Watkins*)
- Low Cost Renewable Resin for Pultruded Projects (R15 – *Chandrashekhara*)
- Replacement Pedestrian Bridge at UMR (R14 – *Watkins*)
- The Influence of Surface Area to Volume Ratio on the Quality Control of High Performance Concrete (R13 – *Myers*)
- PCI Girder Cracking Phase II: Causes and Design Detail (R12 – *Myers*)
- Destructive and Non-Destructive Test of Bridge J857, Highway 72, Phelps County, MO (R11 – *Barker*)
- Comparison of High Performance Steel and Conventional Steel Girder Bridges (R10 – *Barker*)
- Cracking in Prestressed I-Girder Bridges (R9 – *Gopalaratnam*)
- UTC-Advanced Materials and Non-Destructive Test Technologies/Educator (ETT8 – *Watkins*)
- UTC Center Evaluation – Self Assessment Process (R7 – *Nystrom*)

- Feasibility Study: Concrete Roughness Measuring Device (R6 – *Maerz*)
- Minority Introduction to Engineering (ETT5 – *Harris*)
- Metallic Dampers for Seismic Design and Retrofit of Bridges (R4 – *Chen*)
- Experimental Testing and Modeling of an FRP Box Culvert Bridge (R3 – *Chandrashekhara*)
- Application of Ground Penetrating Radar to Highway Related Problems (R2 – *Anderson*)
- Route Characterization & Geophysical Survey Feasibility Study of Previously Mined Ground Along Alternate “E” Proposal Highway 71 Bypass, Joplin, MO (R1 – *Anderson*)