

PROGRAM PROGRESS PERFORMANCE REPORT #1

GRANT: DTRT13-G-UTC45
Reporting Period: 9/30/13 – 3/31/14

RE-CAST:
**REsearch on Concrete Applications for
Sustainable Transportation**
Tier 1 University Transportation Center

Consortium Members:

Missouri University of Science and Technology
Rolla, MO

University of Illinois at Urbana-Champaign
Urbana, IL

Rutgers, The State University of New Jersey
Piscataway, NJ

University of Miami
Coral Gables, FL

Southern University and A&M College
Baton Rouge, LA

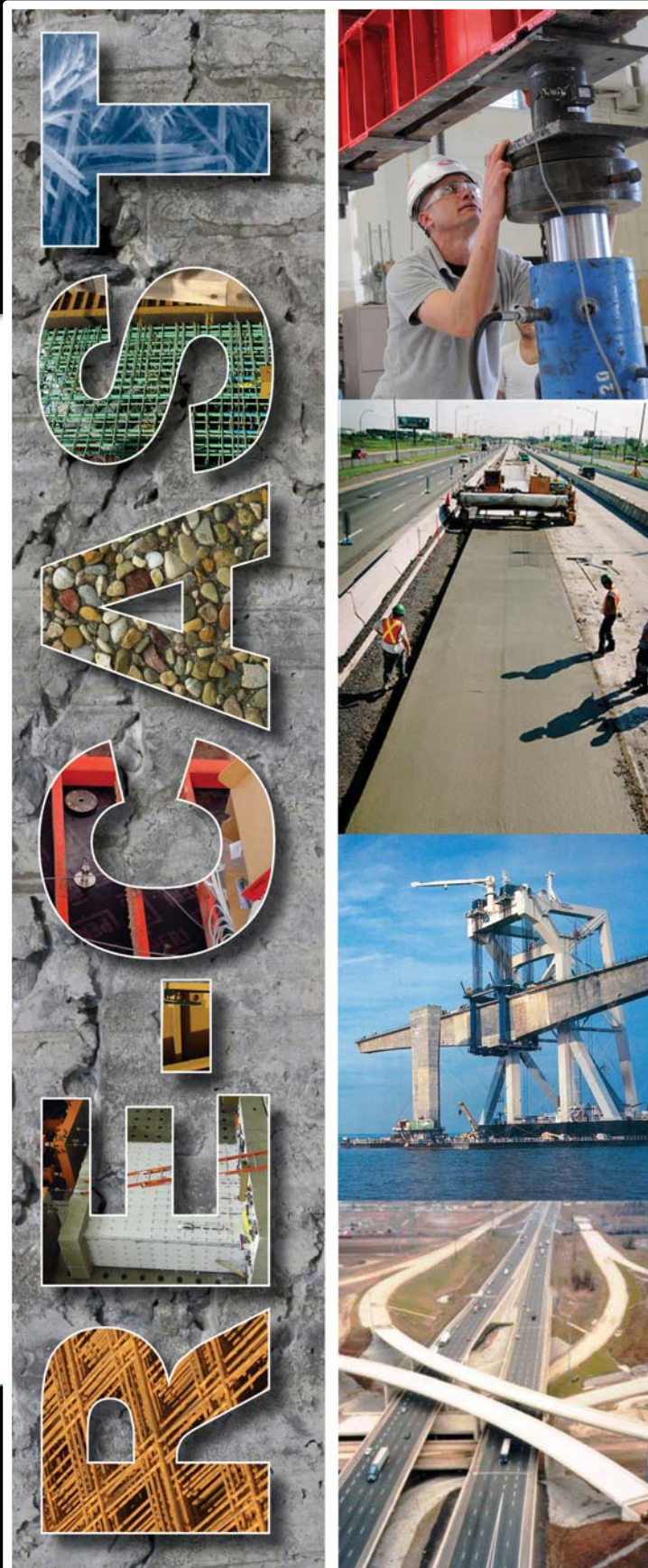


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1. ACCOMPLISHMENTS

1.A - What Are The Major Goals And Objectives Of The Program?

The overall goal of this grant is to develop the next generation of cement-based construction materials that are essential to address the growing technical and environmental requirements of the transportation infrastructure. The research program aims to fast-track the acceptance of these technologies and develop national standards and guidelines for their use in the reconstruction of the nation's infrastructure for the 21st Century.

Research Goals –

The overall RE-CAST program goal stated above will be accomplished by performing the following 9 research projects:

- 1-A. Ecological and Crack-Free High-Performance Concrete with Adapted Rheology
- 1-B. Formwork Pressure Measurements and Prediction of High-Performance Concrete with Adapted Rheology
- 1-C. Influence of Casting Conditions on Durability and Structural Performance of High-Performance Concrete with Adapted Rheology
- 2.A. High-Volume Recycled Materials for Sustainable Pavement Construction
- 2.B.1 Rapid Pavement Rehabilitation
- 2-B.2 Rapid Pavement Construction
- 3-A. Performance of Fiber Reinforced Self-Consolidating Concrete for Repair of Bridge Sub-Structures and fiber-reinforced Super-workable Concrete for Infrastructure Construction
- 3-B. Ultra-High Performance Fiber Reinforced Concrete for Infrastructure Rehabilitation
- 3-C. Performance of Reinforced Concrete Decks Strengthened with Fabric-Reinforced-Cementitious-Matrix Composites

Education and Workforce Development (EWD) Goals –

The main goal of RE-CAST's Education and Workforce Development program is to develop a workforce trained in the interdisciplinary scholarship needed to understand and address the complex issues facing the implementation of a durable, reliable, and sustainable infrastructure. This is to be achieved by creating multidisciplinary educational opportunities for undergraduate and graduate students in the theme areas of the Center, as well as outreach activities for practitioners.

Education Objectives:

- 1) RE-CAST faculty members will collaborate to create the following courses related to the major thrust areas of the Center:
 - Fundamentals of Rheology and Self-Consolidating Concrete (S&T and UIUC)
 - SHM Applied to Transportation (Rutgers University and SUBR)
 - Repair Materials and Strategies for Civil Infrastructure (Multiple Universities)
- 2) RE-CAST is to collaborate with national laboratories and DOT research entities, such as NIST and MoDOT-R&D, to host students on scholarly efforts.

- 3) The Center will actively contribute to annual conferences in the transportation field organized by the consortium Universities, including the Transportation and Highway Engineering Conference and the Structural Engineering Conference at UIUC as well as the Transportation Infrastructure Conference at S&T.

Workforce Development / Outreach Objectives:

A. Outreach Activities to Attract New Entrants into the Transportation Field

- 1) RE-CAST members will seek opportunities to invite junior faculty from complementary fields, such as engineering management, mechanical engineering, chemical engineering and chemistry to team up with RE-CAST faculty on various research projects.
- 2) *Graduate Research Assistantship in Transportation Areas (GRATA)* - RE-CAST will provide graduate research assistantships to highly qualified Ph.D. students.
- 3) *Invited Speakers and Field Trip Visits* – RE-CAST will collaborate with the CIES at S&T and student societies at the participating Universities, including ASCE and ACI to organize bi-monthly seminars featuring invited speakers from industry
- 4) *ACI / Portland Cement Association (PCA) / Prestressed Concrete Institute (PCI) Co-Funded Scholarships* – RE-CAST will explore the possibility of providing matching funds to the scholarship programs that these organizations currently offer on a nationwide basis for Fellowship students working within a focus area of RE-CAST.
- 5) *Student Competition* – RE-CAST will work with professional student societies to organize a new competition on sustainable construction materials.
 - Two competitions will be organized at different locations: (a) design of concrete with a minimum of 50% of recycled materials with the highest strength at Rutgers University/SUBR; and (b) development of fiber-reinforced thin elements with minimum fiber content and maximum ductility at UM/S&T.
- 6) *UTC Student of the Year* – Each year, RE-CAST will select a Student of the Year based on scholarly merit and academic achievement.

B. Primary and Secondary School Transportation Workforce Outreach

- 1) RE-CAST will support the *Minority Introduction to Technology and Engineering* MITE summer program.
- 2) *Proposed Activities with Career Technical Education System* – RE-CAST will reach out to local technical trade schools to offer short courses for students in construction-related degree programs to showcase recent developments within their trade.

Technology Transfer Goals –

The main goal of RE-CAST related to technology transfer is to work towards advancing transportation proficiency through technology transfer and educational opportunities and to make research results available to potential users in a form that can be implemented.

Technology Transfer Objectives:

A. Partnerships Across Sectors to Move Research into Practice

- 1) RE-CAST will collaborate with MO-LTAP and LA-LTAP to introduce and deliver new

materials related to RE-CAST research themes that can be incorporated into workshops and technology transfer activities to service providers and professionals from the transportation industry.

- 2) RE-CAST will also work with the Louisiana Transportation Research Center (LTRC) on technology transfer.

B. Technical Assistance to Others in Applying Research Results

- 1) The Center's website will publish detailed documentation of special construction procedures through videos and photos and will also provide data from the research investigations.
- 2) Faculty from RE-CAST as well as technical staff will be available to provide technical assistance to practicing engineers and state and local agencies in the design and construction of the various materials developed by the RE-CAST program.
- 3) RE-CAST faculty will actively disseminate knowledge and develop guidelines and standards through numerous technical committees (TRB, ACI, ASCE, PCI, ACerS, RILEM, and CSA).
- 4) RE-CAST faculty members will also organize sessions at the technical conventions (e.g., TRB, ACI, ASTM, and ASCE) to disseminate the latest findings in the theme areas of sustainable construction materials, NDE and monitoring of infrastructure, service life prediction, and LCCA of transportation infrastructure.
- 5) RE-CAST will also collaborate with various technical committees (e.g., ACI) to develop certification programs on special test methods dealing with the characterization of the materials developed in the research program, including rheological properties, dynamic segregation, and pumpability of HPC-AR.
- 6) RE-CAST will also collaborate with other UTCs working in the State of Good Repair focus area as well as other national/regional centers, including the NSF Industry/University Coop. Research Center for the Integration of Composites into Infrastructure (CICI) at UM and the Infrastructure Monitoring and Evaluation (RIME) Group at Rutgers University.

C. Technology Transfer Mechanisms/Creation of New Business Entities

- 1) The RE-CAST research team will work with the Technology Transfer and Economic Development Center (TTED) at S&T to develop marketing plans and subsequent commercialization of any product(s) and deliverables that can stem from the research program.

D. Information Exchanges

- 1) The team will publish the findings of the proposed research in joint publications involving the different faculty and their students from the partnering consortium members.
- 2) Social media (Facebook and LinkedIn) will be utilized to publicize on-going research, training, and technology transfer events, including field demonstrations, webinars, and educational videos stemming from research activities.

- 3) Research outcomes of the RE-CAST program will be uploaded into the U.S. DOT Research Hub in a timely manner.
- 4) A website with links to a listing of upcoming technology transfer events, educational seminars and workshops, presentations, and project reports.
- 5) Quarterly newsletters highlighting project updates, featured faculty and students, and field implementations of research projects.

Diversity Goals –

The main goal of RE-CAST with regard to Diversity is to broaden participation and enhance diversity of the students, researchers, and practitioners involved in transportation-related activities and careers. In the consortium Universities, many initiatives have been created to ensure an inclusive environment related to race, ethnicity, gender, gender identity, sexuality, disability, economic class, religion, and country of origin.

Diversity Objectives:

- 1) Summer Internship for Underrepresented Students - SUBR and Rutgers University, through collaborative projects among faculty members of the Center, will offer summer internship programs to undergraduate students to undertake internship programs at partner institutions.
- 2) RE-CAST will provide support in educational and outreach activities and financial aid in the form of scholarships to bring underrepresented students into transportation engineering-learning opportunities through the following programs:
 - *The Women's Leadership Program* at S&T
 - *The Summer Transportation Institute* at SUBR
 - *The Gates Millennium Scholars Program* at UM
 - *The Hammond Scholars Program* at UM

1.B - What Was Accomplished Under These Goals?

Research Objectives Accomplished –

- 1) RE-CAST research projects have been developed to involve multiple partners. The majority of the project will be completed in a period of two years with faculties from three universities and corresponding non-federal partners involved. In total, 9 projects have been identified and non-federal match agencies have been contacted for each.
- 2) RE-CAST faculty members have collaborated to create the following course, being offered at Missouri S&T from July 14-17, 2014 – see Attachment A
 - a. Fundamentals of Rheology and Self-Consolidating Concrete (S&T and UIUC)
- 3) S&T Transportation Infrastructure Conference
 - a. Khayat - October 3, 2014 at Missouri S&T with two of the RE-CAST faculty giving keynote lectures

Education and Workforce Development (EWD) Objectives Accomplished -

- 1) RE-CAST contacted the American Concrete Institute (ACI), Portland Cement Association (PCA) and Prestressed Concrete Institute (PCI) to discuss the possibility of

providing matching funds to the scholarship programs that these organizations. These organizations were very receptive to the idea and encouraged our students to apply for these scholarship funds. Several proposals were submitted from the Center.

- 2) RE-CAST hosted its inaugural research seminar on March 5th – see Attachment B
- 3) RE-CAST hosted its second research seminar on April 25 – see Attachment C

Technology Transfer Objectives Accomplished –

- 4) Social media (Facebook and LinkedIn) pages has been created to publicize on-going research, training, and technology transfer events.
- 5) A RE-CAST website has been created that contains links to listing of upcoming technology transfer events, educational seminars and workshops, presentations, and project reports.
- 6) The first quarterly newsletter was published in February 2014 – see Attachment D

Diversity Objectives Accomplished –

- 1) The partner institutions have been in discussion regarding sending underrepresented students from SUBR and Rutgers University for Summer Internships at the partner universities to work on Center-related activities. If no students are identified to participate in this program this year, it will be offered again in Summer 2015 with greater allocations offered to the second year.
- 2) Plans are in place to provide assistance to the following outreach programs during the Summer 2014.
 - The Women’s Leadership Program at S&T
 - The Summer Transportation Institute at SUBR

1.C - What Opportunities For Training And Professional Development Has The Program Provided?

The RE-CAST has provided two research seminars as professional development opportunities. The topics/dates of those seminars are:

- Date: Wednesday, March 5th, 2014
 - i. Presenter: John Myers
 - ii. Topic: Structural Health Monitoring (SHM) & Non-Destructive Evaluation (NDE): In-Situ Load Testing and Instrumentation for Advanced Construction Material Applications
 - iii. Attendees: 35
 - iv. Problems with audio recording: need to re-record and then post on RE-CAST website
- Date: Friday, April 25, 2014
 - i. Presenter: Dr. Kenneth Hover, Professor Cornell University, former ACI President
 - ii. Topic: There Is More to Concrete than Meets the Eye

- iii. Attendees: 35
 - iv. Broadcast to RE-CAST partners and open to S&T campus
- 2) RE-CAST Summer Course: *Fundamentals of Rheology and Applications on Cement-Based Materials*
- <http://recast.mst.edu/media/research/recast/documents/RE-CAST%20Course.pdf>
 - **July 14-17, 2014** at Missouri S&T campus
 - **Instructors:** Dr. Khayat and Feys (Missouri S&T) and Dr. Lange (UIUC)
 - **Cost:** free for RE-CAST students, \$750 for non-RE-CAST students

1.D - How Have The Results Been Disseminated?

The March seminar will be made available on the RE-CAST website once the audio is re-recorded. That is scheduled to take place the week of May 12-16.

A summary of the summer rheology course will be included in the RE-CAST newsletter.

Initial findings of various research projects are being compiled to prepare scientific papers and technical presentations at various conventions (e.g., ACI Fall Convention, 2015 TRB Conference, and World of Concrete 2015).

1. E - What Do You Plan To Do During The Next Reporting Period To Accomplish The Goals And Objectives?

- 1) MoDOT Summer Camp for high school students
 - July 2, 2014 at Missouri S&T
 - RE-CAST to co-sponsor program by sponsoring lunch and providing graduate students to lead hands-on activities and demonstrations
- 2) First annual student competition
 - Design of Concrete with a Minimum of 50% of recycled materials with the highest strength
 - To be held at Rutgers University or SUBR vs. internally at all RE-CAST Universities in Summer 2014
- 3) Provide assistance to Minority Introduction to Technology and Engineering (MITE) at Missouri S&T
 - Will have graduate student volunteer to lead hands-on-experience focused on the behavior of various novel construction materials and characterization techniques
 - Session 1: June 1-6, 2014; Session 2: June 15-20, 2014
- 4) Begin plans for short course on SHM & Modeling of Pavement
 - to be scheduled at day/time designated by Drs. Shin and Nassif
- 5) Publish second newsletter
- 6) Schedule third bi-monthly research seminar
 - to be held in June 2014 and broadcast via WebEx to all partner universities

- 7) Contact **Rolla Technical Institute** to provide hands-on laboratory experience in order to introduce students to novel construction materials as well as short course in construction-related degree programs to showcase recent developments within their trade

2. PRODUCTS

2.A - Publications, Conference Papers, and Presentations

March seminar: see Appendix B

April seminar: see Appendix C

Newsletter: see Appendix D

2.B - Website(s) or Other Internet Site(s)

A website was created for the RE-CAST University Transportation: <http://recast.mst.edu>. This website will be the central location for listing all activities related to the grant. In this reporting period, the following information/tabs have been added:

- The Center
- Research Team
- Directory
- Research Areas
- Research Advisory Committee
- Newsletters
- Events

When the RE-CAST research projects have been approved, a new tab will be added to post the project information sheets, as indicated in the Grant Deliverables and Requirements For 2013 University Transportation Centers (UTCs).

A tab for PPRs will also be added once this report is approved.

In addition to the main website, RE-CAST has also created a Facebook and LinkedIn Group for announcements. Those links are:

Facebook: <https://www.facebook.com/pages/Re-Cast-University-Transportation-Center/628790710502751>

LinkedIn: https://www.linkedin.com/groups/RECAST-University-Transportation-Center-6626216?trk=anet_ug_hm&gid=6626216&home=

2.C - Technologies or Techniques

Nothing to Report

2.D - Inventions, Patent Applications, and/or Licenses

Nothing to Report

2.E - Other Products, Such As Data Or Databases, Physical Collections, Audio Or Video Products, Software Or Netware, Models, Educational Aids Or Curricula, Instruments, Or Equipment.

Nothing to Report

3. PARTICIPANTS & COLLABORATING ORGANIZATIONS

3.A - What Organizations Have Been Involved As Partners?

The main consortium members of this University Transportation Center remain the same as the proposal:

- Missouri University of Science and Technology, Rolla, MO - LEAD
- University of Illinois at Urbana-Champaign, Urbana, IL
- Rutgers, The State University of New Jersey, Piscataway, NJ
- University of Miami, Coral Gables, FL
- Southern University and A&M College, Baton Rouge, LA

As stated in the proposal, the RE-CAST team is also partnered with Dr. H. Celik Ozyildirim, as a consultant, from the Virginia Center for Transportation Innovation and Research, Charlottesville, VA. He will provide input for field implementation and development of specifications and standards.

In addition to the main consortium members, two additional universities are collaborating with with RE-CAST, due to faculty moving to those universities after the proposal was submitted.

Those new partners are:

- The University of Oklahoma, Norman, OK (Dr. Jeffrey Volz)
- New York University Polytechnic School of Engineering, Brooklyn, NY (Dr. Kaan Ozbay)

Several state governments and industrial partners are in the process of partnering with Re-CAST to provide financial and in-kind support to the research program. Those agencies include:

- Missouri Department of Transportation, Jefferson City, MO, financial support
- Missouri University of Science and Technology, Rolla, MO, in-kind support
- Virginia Center for Transportation Innovation and Research (via VirginiaTech), Charlottesville, VA , financial support
- Structural Technologies, Hanover, MD, financial support
- University of Miami, Coral Gables, FL, financial support
- Louisiana Transportation Research Center (LTRC), Baton Rouge, LA, financial support
- O'Hare Modernization Program, Chicago, IL, financial support
- University of Illinois, Urbana-Champaign, Champaign, IL, in-kind support
- Bowman, Barrett and Associates, Chicago, IL, financial support
- New York University Polytechnic School of Engineering, Brooklyn, NY, financial support
- NJ Department of Transportation Research Division, West Trenton, NJ, financial support

3.B - Have Other Collaborators Or Contacts Been Involved?

During this reporting period, the Research Advisory Committee (RAC) has been established. The committee is composed of the following people:

William Stone, RAC President, Research Administrator

Missouri Department of Transportation, Jefferson City, MO

Ross Anderson, Senior Vice President

Bowman Barrett & Associates, Chicago, IL

Casimir Bognacki, Chief of Materials Engineering

Port Authority of New York and New Jersey, New York, NY

Harvey DeFord, Ph.D., Structural Materials Research Specialist

Florida Department of Transportation State Materials Office, Gainesville, FL

Chiara “Clarissa” Ferraris, Ph.D., Physicist

National Institute of Standards and Technology, Gaithersburg, MD

Jim Myers, Senior Staff Engineer

Coreslab Structures, Inc., Marshall, MO

Karthik Obla, Ph.D. P.E., Vice President, Technical Services

National Ready Mix Concrete Association, Silver Spring, MD

Zhongjie “Doc” Zhang, Ph.D., Pavement Geotechnical Research Administrator

Louisiana Transportation Research Center, Baton Rouge, LA

The objectives of the RAC to advise the Center’s Director and Associate Directors on management and activities of the Center and to contribute to the Center core mission. The Center will interact with state DOTs, public agencies, and three primary industry components (material and equipment suppliers, general/specialty contractors, and design firms) through the Center Research Advisory Committee (RAC).

4. IMPACT

4.A - What Is The Impact On The Development Of The Principal Discipline(s) Of The Program?

Nothing to report at this time.

4.B - What Is The Impact On Other Disciplines?

Nothing to report at this time.

4.C - What Is The Impact On The Development Of Transportation Workforce Development?

Several graduate and undergraduate students have been recruited to staff the RE-CAST projects for FY2013.

4.E - What Is The Impact On Physical, Institutional, And Information Resources At The University Or Other Partner Institutions?

Nothing to report at this time.

4.F - What Is The Impact On Technology Transfer?

Several invited speakers/keynote speaker lectures are scheduled for the Summer of 2014, many of which include some of the research findings of the RE-CAST projects.

4.G - What Is The Impact On Society Beyond Science And Technology?

The RE-CAST projects are developing the next generation of cement-based construction materials to address the growing technical and environmental requirements of the nation's transportation infrastructure. The ultimate goal of the RE-CAST program is to fast-track the acceptance of these technologies and develop national standards and guidelines for their use in the reconstruction of the nation's infrastructure for the 21st Century, which will have a lasting impact on our nation's society.

5. CHANGES/PROBLEMS

5.A - Changes In Approach And Reasons For Change

There is now a total of 9 projects to include an additional project on Rapid Pavement Rehabilitation.

5.B - Actual Or Anticipated Problems Or Delays And Actions Or Plans To Resolve Them

In addition to the main consortium members, two additional universities are collaborating with RE-CAST, due to faculty moving to those universities after the proposal was submitted. Those new partners are:

- The University of Oklahoma, Norman, OK (Dr. Jeffrey Volz)
- New York University Polytechnic School of Engineering, Brooklyn, NY (Dr. Kaan Ozbay)

The Office of Sponsored Programs at Missouri S&T has worked with each University in the consortium, as well as the universities listed above, to establish master contractual agreements to disperse funds. This process as well as collecting all required documentation took time to coordinate and finalize. As of April 17, 2014 all master contracts are signed.

5.C - Changes That Have A Significant Impact On Expenditures

Nothing to report at this time.

5.D - Significant Changes In Use Or Care Of Animals, Human Subjects, And/or Biohazards

Not Applicable.

5.E - Change Of Primary Performance Site Location From That Originally Proposed

No Change to Report.

6. SPECIAL REPORTING REQUIREMENTS

Nothing to Report.

APPENDIX A

RE-CAST Summer Course Flyer:

Fundamentals of Rheology and Applications on Cement-Based Materials

PRESENTS:



GRADUATE STUDENT WORKSHOP

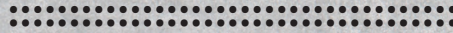
Fundamentals of Rheology and Applications on Cement-Based Materials

July 14 - 17, 2014



<http://recast.mst.edu>

PROGRAM

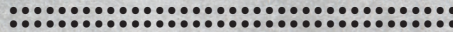


Monday, July 14th

9:00 – 11:00: Optional guided tour of Missouri S&T's materials and structural labs

12:30 – 13:45: Welcome and introduction

14:00 – 17:30: Fundamentals of rheology
General rheology
Rheological models for liquids
General rheometry



Tuesday, July 15th

8:30 – 10:15: Fundamentals of rheology
Rheology of suspensions

10:30 – 12:00: Rheology of cement-based materials
Rheological behavior
Influence of constituents

13:30 – 14:30: Rheology of cement-based materials
Rheological modeling
Thixotropy and workability loss

14:45 – 17:30: Lab 1 – Demonstration and application of rheometry and rheology

PROGRAM (cont)

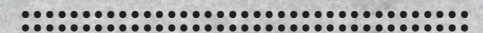


Wednesday, July 16th

8:30 – 10:30: Rheology of cement-based materials
Measuring rheology of cement-based materials

10:45 – 12:00: Applications of rheology
Links between rheology and workability

13:30 – 17:30: Applications of rheology
Links between rheology and workability
Rheology and stability
Rheology and casting
Rheology as a mix design tool



Thursday, July 17th

8:30 – 10:45: Lab 2 – Rheology of grout, water and concrete

11.15 – 12.00: Applications of rheology
Practical applications

13:30 – 17:00: Summary
Discussion of lab results
Conclusions
Closure

INSTRUCTORS



Kamal Khayat
RE-CAST Director

Vernon and Maralee Jones
Professor of Civil Engineering
at Missouri S&T



David Lange
RE-CAST Assoc. Director

Narbey Khachaturian Faculty
Scholar and Professor of
Civil Engineering at
University of Illinois,
Urbana-Champaign



Dimitri Feys
RE-CAST Researcher

Assistant Professor of Civil
Engineering at Missouri S&T

<http://recast.mst.edu/researchteam>

FACILITIES



The two laboratory sessions will take place in the Center for Infrastructure Engineering Studies Advanced Construction Materials Laboratory. This laboratory features six different rheometers that can be used for cement-based materials.

The **Anton Paar MCR 302** is an advanced rheometer used in polymer industry, capable of measuring flow curves and visco-elasticity with different measurement configurations and temperatures.

The **ConTec Viscometers 5 and 6** are coaxial cylinders rheometers especially developed for concrete and micro-mortars, respectively.

The **ICAR rheometer** is a portable concrete rheometer that is flexible for use on-site.

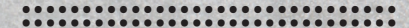
The **Eirich intensive mixer** will be used to produce concrete during the laboratory sessions.



LOCATION



**Missouri University of Science
and Technology, Rolla, MO**



Lectures:
Butler-Carlton Civil Engineering Hall
1401 N. Pine Street

Labs:
Engineering Research Laboratory
500 W. 16th Street

Closest airport:
St. Louis, MO (STL)

Directions:
<http://www.mst.edu/map/>

Optional post-workshop activity:
Float trip on the Meramec River
Friday, July 18th (weather permitting)

For More Information:

Contact: Abigayle Sherman
RE-CAST Coordinator
Email: abigayle@mst.edu
Phone: 573-341-7884

APPENDIX B

RE-CAST March 2014 Research Seminar Flyer:
*In-Situ Load Testing and Instrumentation for Advanced
Construction Material Applications*



RE-CAST

2014 SEMINAR SERIES

Structural Health Monitoring (SHM) & Non-Destructive Evaluation (NDE): **In-Situ Load Testing and Instrumentation for Advanced Construction Material Applications**

Presenter: John J. Myers, Ph.D., P.E., F.ACI, F.ASCE
Professor of Civil, Architectural and Environmental Engineering

**DATE: Wednesday
March 5th, 2014**

TIME: 1:00 pm*

**LOCATION:
Room 213, Butler
Carlton CE Hall**

**Note: The seminar is scheduled for approx. 1 hour (60 minutes), but the room has been reserved for 90 minutes to allow for attendee interaction as required.*

**ALL FACULTY &
STUDENTS ARE
INVITED TO
ATTEND.**

Description: This seminar will provide an introductory overview of the motivation for assessment and load testing of bridge structures. During the seminar, advanced construction materials, including composites for repair and new construction, as well as advanced concrete materials, will be introduced. The seminar will include an overview of these new technologies and demonstrate field implementation applications. Additionally, an overview of SHM & NDE instrumentation sensors and equipment used for assessment and load testing will be presented. Finally, two case studies will be presented to articulate a typical instrumentation project and load testing project.

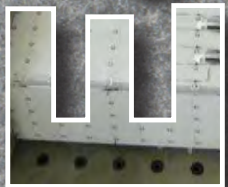
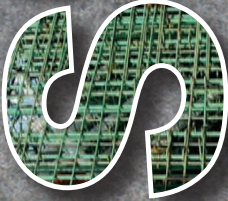
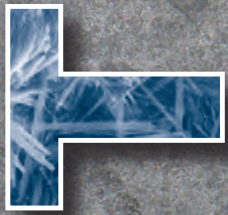
Seminar Learning Objectives:

- What are common composite strengthening materials and advanced concrete materials often used in implementation projects within the past decade for SHM and NDE?
- What type of instrumentation is used for monitoring and load testing of innovative implementation projects?
- How is a typical instrumentation and/or load testing project undertaken?

**FOR INQUIRIES, PLEASE CONTACT:
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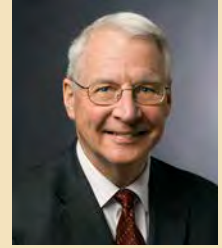
APPENDIX C

RE-CAST April 2014 Research Seminar Flyer:
There is More to Concrete than Meets the Eye



Guest Speaker

Kenneth Hover



There is More to Concrete Than Meets the Eye

**10-11 a.m.
Friday, April 25, 2014**

**317 Butler-Carlton
Civil Engineering Hall**

Plain, reinforced, and prestressed concrete are “multi-scale” composite materials with key internal binding elements characterized at the micro- and nano-level. These chemical and mechanical bonds enable construction of large structures and networks with dimensions stretching to Mega-meters. In between is the human-scale, over which most of us comprehend materials and structures on the basis of what we can see with our eyes. But, when we go beyond the eye in resolving power, and above and below the frequencies of visible light we can expand the database from which we understand concrete, and find bases for many practical applications.

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPENDIX D

RE-CAST Winter 2014 Newsletter

RE-CAST



Vol. 1 :: Issue 1 :: WINTER 2014

In this issue:

- Director's Message
- Center Overview
- Research Team
- Summer Course
- Advisory Committee

CONSORTIUM MEMBERS:

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Director's Message



Dr. Kamal H. Khayat
 Director,
 RE-CAST University Transportation Center

Missouri University of Science and Technology is honored to be selected to lead this Tier-1 University Transportation Center, in partnership with University of Illinois at Urbana-Champaign, Rutgers, The State University of New Jersey, Southern University and A&M College and University of Miami. The synergism created by this network is critical to the mission of providing leadership in conducting basic and applied research in the field of transportation infrastructure, in addition to education and workforce development, and technology transfer. RE-CAST will foster research excellence and the needed expertise and technology to develop the next generation of sustainable transportation structures.

"This grant has opened an avenue of opportunity for collaborations amongst the consortium members and many outside organizations. The ultimate goal of the proposed research program is to fast-track the acceptance of these technologies and develop national standards and guidelines for their use for the reconstruction of the nation's infrastructure for the 21st Century.

This consortium has the opportunity to do great things. We have assembled a wonderful team of researchers, staff and students — this grant will give them the opportunity to shine."

-Dr. Kamal H. Khayat, RE-CAST Director

CENTER OVERVIEW

The University Transportation Center for REsearch on Concrete Applications for Sustainable Transportation (RE-CAST) will provide a collaborative and multidisciplinary vehicle for addressing the nation's complex and growing transportation infrastructure needs, with the ultimate goal of ensuring a sustainable, reliable, and safe national transportation infrastructure.

The US Department of Transportation identified five strategic goals specific to the nation's infrastructure: Safety, State of Good Repair, Economic Competitiveness, Livable Communities, and Environmental Sustainability. RE-CAST will focus research efforts primarily on State of Good Repair.

This UTC program will specifically seek to improve transportation infrastructure condition and performance through increased use of design, materials, construction, and maintenance innovations and will also aim to reduce the environmental impacts of such infrastructure through innovations in design, construction, operation, preservation, and maintenance.

THEMES AREAS

- A. Innovative Materials for Accelerated Construction and Sustainable Construction
- B. Durable Materials for Rehabilitation of Transportation Infrastructure

RESEARCH FOCUS AREAS

Focus Area 1: High-Performance Concrete with Adapted Rheology (HPC-AR)

The first Focus Area deals with the design and implementation of HPC-AR for civil infrastructure applications. HPC-AR requires less consolidation compared to conventional concrete and relies more on fresh concrete characteristics to properly fill the formwork. HPC-AR is specifically targeted for the construction of bridges, airports, and rail systems, as well as port and harbor facilities that must be maintained in a State of Good Repair to ensure the nation's economic growth.

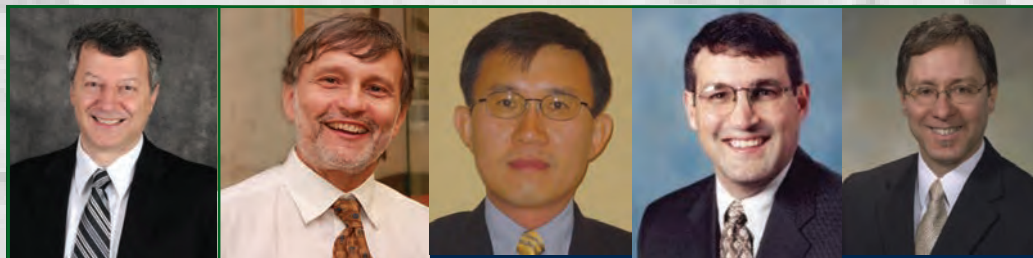
Focus Area 2: Sustainable Pavement Construction

The second research Focus Area deals with the use of high volume recycled materials for infrastructure construction. The primary research projects in this Focus Area include: (2-A) high-volume recycled materials for pavement construction and (2-B) rapid pavement construction.

Focus Area 3: Novel Fiber-Reinforced Composites

The third Focus Area involves the design and implementation of novel fiber-reinforced composites for infrastructure rehabilitation. Such materials can lead to improved cracking resistance and sustainable repair applications. Inclusion of fiber can result in a new generation of repair materials to restore structural capacity and improve the service life of the structure.

Meet the RE-CAST Research Team



Dr. Kamal Khayat is the Director of the RE-CAST University Transportation Center. He joined Missouri S&T in August of 2011 as the Vernon and Maralee Jones Professor of Civil Engineering and Director of the Center for Infrastructure Engineering Studies. He specializes in the development of high-performance cement-based materials for structural applications and rehabilitation, particularly focusing on self-consolidating concrete and high-performance concrete behavior.



Dr. Antonio Nanni is the RE-CAST Associate Director for the University of Miami campus. He is a structural engineer interested in construction materials, their structural performance, and field application. His interests are in the field of civil infrastructure sustainability and renewal. In the past 27 years, he has obtained experience in concrete and advanced composites based systems as the principal investigator of projects sponsored by federal and state agencies, and private industry.

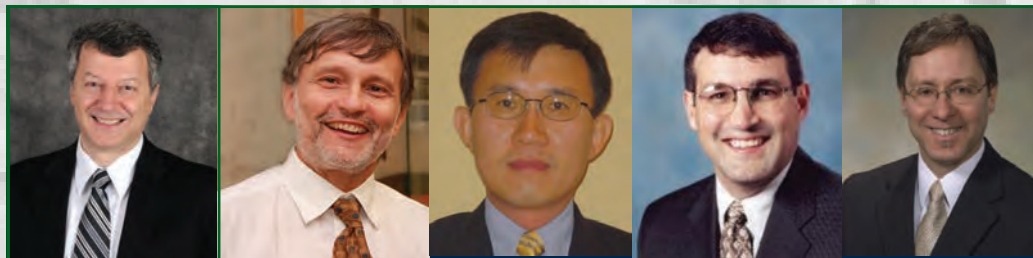


Dr. David A. Lange is the RE-CAST Associate Director for the University of IL-Urbana-Champaign campus, where he is a professor of civil engineering. Lange served as Associate Head of the Department of Civil and Environmental Engineering from 2004-10. His research area is microstructure and properties of construction materials. Recent topics include characterization of pore structure, drying phenomenon and measurement of internal relative humidity gradients, shrinkage/creep, and cracking.



Dr. Hanif Nassif is the RE-CAST Associate Director for the Rutgers campus. He established the Bridge Engineering program at Rutgers. He previously worked various projects related to fatigue behavior of bridges, Weigh-In-Motion, and analytical modeling. He is currently involved in similar projects sponsored by the New Jersey Turnpike Authority related to finite element modeling, field instrumentation and monitoring, and WIM data collection. He was also involved in the pioneering work of the calibration and development of the new LRFD-AASHTO Bridge Design Specifications, as well as the Ontario Bridge Design Code.

Meet the RE-CAST Research Team



Kaan M.A. Özbay is a Professor at the department of Civil and Urban engineering at NYU-Poly and Center for Urban Science and Progress (CUSP). Dr. Özbay's research interest in transportation covers advanced technology and sensor applications, incident and emergency management, development of real-time control techniques for traffic, traffic safety, and transportation economics with an emphasis on life cycle cost analysis and appraisal of transportation projects using cost and benefit analysis.



Dr. John J. Myers is a Professor of Civil Engineering at Missouri S&T. Over the past 18 years, his focus has concentrated on high-strength / high performance concrete (HS/HPC), SCC, HVFAC behavior and durability performance; fiber-reinforced polymers in structural repair and strengthening applications; development of environmentally sensitive construction materials; and blast resistance of structures.



Dr. Alex Shin is an Associate Professor of Civil Engineering at the Southern University and A&M College. He specializes in the characterization of



high-performance cement-based materials for the applications of pavement and structural rehabilitation. In particular, his focus has concentrated on the bonding behavior between old concrete and new layers, including new concrete, elastomeric materials, and FRC.

Dr. Jeffery S. Volz is an Associate Professor of Civil Engineering at University of Oklahoma. He has over sixteen years of practical design experience in both bridge and building design areas, including eight years for a subsidiary of the Portland Cement Association investigating cementitious materials for strength, durability, fatigue, impact, and blast resistance.

Dr. Dimitri Feys is Assistant Professor of Civil Engineering at the Missouri University of Science and Technology. His research area is in mix design, fresh properties and casting of concrete. Main subjects deal with rheology of highly-workable cement-based materials, mix design of high-performance, highly workable concrete and casting of concrete, including pumping.

Do something constructive this summer!

RE-CAST five-day graduate summer course: Fundamentals of Rheology & Applications on Cement-Based Materials



This is an accelerated short course for graduate students being offered this summer at Missouri University of Science and Technology. It is designed to give graduate students an understanding of rheology fundamentals, principles of measurements and the applications on cement-based materials. The theoretical lectures will be supported by three lab sessions. Students will receive hands-on experience with no less than six different rheometers.

When: July 14 - 18, 2014

Where: Butler-Carlton Hall, 1401 N. Pine Street, Rolla, MO

Instructors:

Kamal Khayat

Vernon and Maralee Jones Professor of Civil Engineering: Materials, Missouri S&T

David Lange

Narbey Khachaturian Faculty Scholar and Professor, University of Illinois at Urbana-Champaign

Dimitri Feys

Assistant Professor, Civil Engineering: Materials, Missouri S&T

FEATURES AND BENEFITS

- Review the basic concepts of rheology and rheometry
- Learn fundamental physics of suspension rheology
- Apply this knowledge on cement-based materials
- Use the latest and greatest equipment
- Understand day-to-day practical situations
- Improve the quality of your research

The RE-CAST team is currently determining the number of credits earned and cost. If interested, please contact Abigail Sherman at 573-341-7884 or by email at abigail@mst.edu.

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