Welcome to the inaugural edition of the CBBG newsletter. Through the newsletter, we will keep you up to date on CBBG projects and events, and the activities of CBBG investigators, students, staff, and industrial partners. The CBBG is still taking shape as we develop our strategic plan. But, rather than wait until the plan is finalized, we have already initiated our first year research, outreach, and educational programs along the lines of our proposal and the Cooperative Agreement with the National Science Foundation (NSF).

Senior investigators and scholars (both graduate and undergraduate students) at each of the four partner Universities (ASU, Georgia Tech, NMSU, and UC, Davis) are hard at work on our initial portfolio of projects. Our Innovation, Diversity, and Education Activities (IDEA) working group is hard at work planning outreach activities, including the Young Scholar program for high school age students, the Research Opportunities for Teachers (RET) program (for pre-college teachers), and the Research Opportunities for Undergraduates (REU) program, that we will be launching this summer.

Excitement about the CBBG is building, both internally as we initiate our research activities and develop our education and outreach programs, and externally as we develop our Industrial Partner Membership Program. Senior staff has been busy spreading the word about the CBBG in industry publications, through presentations at professional society meetings, and to our potential Industrial Partners. Additional firms and agencies beyond those who committed to join the CBBG during the proposal phase are contacting us and signing up as Industrial Partner members.

We have been contacted by numerous other Universities about collaboration, both in the U.S. and internationally. It has been an extremely busy time for all of us at the CBBG as we put our programs and administrative procedures in place. All of these start-up activities will culminate in our first mid-year meeting to be held at ASU on Monday and Tuesday, April 4th-5th, where we will roll out our initial portfolio of research, education, and outreach activities, and vet our strategic plan with our Industrial Partners. I look forward to seeing many of you there.
Aging roadways pose a growing threat to transportation infrastructure that’s critical to the health of economies throughout the world. Beyond the daunting task of funding extensive restoration efforts, there’s an equally pressing challenge to find ways to rebuild major roads that are more sustainable. The need is one of the main motivating factors behind a new international initiative called Infravation – a combination of infrastructure and innovation.

Narayanan Neithalath, an assistant professor in the Materials Science and Engineering department at ASU, is leading the Infravation project. He has been experimenting with what are called phase-change materials to produce more resilient concrete surfaces for roads and bridges. Working with colleagues at the University of California, Los Angeles (UCLA), he is finishing up a National Science Foundation-funded project that is exploring the use of a phase-change material solution for reducing or preventing temperature-related cracks in concrete pavement.

Through the new Infravation project, he and his UCLA partners will expand their work in collaboration with researchers at Delft University in the Netherlands, the Swiss Federal Institute for Materials Science (commonly known as EMPA) and the Tecnalia Research and Innovation organization in Spain. His Infravation group has been awarded $1.6 million to find out if concrete solutions containing a phase-change material can significantly enhance the durability of concrete pavements and bridge decks. Phase-change materials are substances that respond to temperature variations by changing their state from solid to liquid or vice-versa, and can be sourced from petroleum (such as paraffin wax) or can be plant-based.

Like other phase-change materials, the substance his team is working with is especially effective at absorbing and releasing thermal energy. It means that over a wide range of temperature variations, it can store significantly more heat per unit of volume than water, rock or masonry.

That ability makes this phase-change material a good choice for mixing with concrete to boost its resistance to crack-inducing stresses. For instance, in hot weather the material can absorb much of the heat, thus protecting the concrete from a level of heat that can trigger fracturing.

Beyond how well the phase-change material performs in that particular fashion, his team needs to answer other big questions. What changes in the road design and construction techniques are necessary to optimize the use of the crack-reducing phase-change materials? What are the most effective ways to embed phase-change material into vast amounts of concrete? Can the new system provide enough durability to justify additional costs? How can this phase-change material be safely disposed of when the new road pavements are eventually replaced?

In addition, it will likely be necessary to devise strategies for use of the material on bridge decks that are different than how the material would be used in pavements for roadways built on solid ground. Finding answers “will require us to more fully understand the properties of the material and how it will behave in a range of situations,” said Neithalath, who is also on the faculty of the graduate studies program in materials science and engineering.

Fellow ASU civil engineers on the project team, Subramaniam Rajan and Mikhail Chester, will apply their specific expertise to aid Neithalath in pursuit of answers and solutions. Professor Rajan will provide computer modeling to validate results of extensive experiments with the material. Assistant Professor Chester will perform cost-benefit analysis as well as life-cycle analysis of the new pavement material – a major step in predicting how it will measure up to sustainability expectations. The project will also provide opportunities for a number of ASU post-doctoral lab assistants and engineering graduate students to get valuable research experience.

“We will have good research teams at each of the institutions in different countries that are partners in this project. We have experts for every component of what we need to accomplish our goal,” Neithalath said. “I think we can take concrete pavements to the next level.”

Media Contact: Joe Kullman, joe.kullman@asu.edu; 480-965-8122; Ira A. Fulton Schools of Engineering

Technology Transfer


An abstract prepared by Ed Kavazanjian and Jason DeJong on Bio-inspired and Bio-mediated Ground Improvement Technologies was accepted for presentation in the session on Soil Improvement Methods – Research and Practice at the ASCE GeoStructures Conference in Phoenix on February 16. Ed will make the presentation.
Rittman Receives DOE Grant; Honored by Washington University

Dr. Bruce E. Rittmann, Director of the Swette Center for Environmental Biotechnology at the Biodesign Institute and a Regents’ Professor in the School of Sustainable Engineering and Built Environment at Arizona State University, is the Principal Investigator on a recently awarded $1,000,000 grant for the Department of Energy: Atmospheric CO2 Capture and Membrane Delivery.

An international leader in the study of microbiological systems, Rittmann leads research teams that combine engineering with microbiology, biochemistry and geochemistry to address fundamental and applied issues in the treatment of wastewater, bioremediation of contaminated environments and production of renewable energy. Recently, Rittman was honored with an Alumni Achievement Award from his alma mater, Washington University in St. Louis.

Arson wins sought-after CAREER Award from NSF

Dr. Chloe Arson, an Assistant Professor in the School of Civil and Environmental Engineering at Georgia Institute of Technology, won one of the nation's premiere grants and the National Science Foundation’s most prestigious award for junior faculty, the Early Career Development Award, for her project, “Multiphysics Damage and Healing of Rocks for Performance Enhancement of GeoStorage Systems – A Bottom-Up Research and Education Approach.”

This award recognizes top educators and researchers in the country who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research,” according to the NSF.

“The CAREER award is really for you to lay out a plan for what you want to do in terms of research and education. It’s supposed to be a landscape or a broad description of what kind of academic you want to be,” Arson said. “It articulates what you already do with the academic objectives you want to pursue and provides a vision for the long term. It’s really a great proposal to write in the sense that it’s supposed to help you grow,” she said. “You really reflect on what kind of professor you are, what your style is, what are the essential things you want to do.”

The CAREER award is $500,000 over five years, and the idea is to help you become a leading expert in your field while setting you up for an impactful career.

Van Paassen of TU Delft Presents Research Work

Leon van Paassen, Assistant Professor in Department of Geotechnology at TU Delft, recently visited ASU to present a seminar on “Biology in Geotechnical Engineering: Bio-based Solutions for a Sustainable Society.” van Paassen has been working on a biological improvement of the physical properties of soil since his Ph.D. work at TU Delft on sustainable ground improvement by microbially-induced carbonate precipitation (MICP). His work in this area includes MICP via both hydrolysis of urea (the subject of his Ph.D. thesis) and dissimilatory reduction of nitrogen. He was principal investigator for one of the first field trials of MICP. His current research on sustainable bio-based methods in geotechnical engineering also includes using plants to store carbon dioxide, improve slope stability and erosion resistance, and accelerate drainage in land reclamation and tailings dewatering.

CBBG Director Kavazanjian Induction Ceremony as ASU Regents’ Professor

Dr. Ed Kavazanjian, CBBG Director, participated in the 2016 Induction Ceremony for ASU Regents’ Professors on Thursday, February 4, 2016. The position of Regents’ Professor is reserved for selected members of the faculty who have achieved, and are sustaining, the highest level of distinction within the national and international community of scholars, and have made exceptional contributions to the mission of the university. Congratulations, Ed, on this unique honor!
Great IDEAs Happening at CBBG

Since the grant was awarded last fall, CBBG’s Education, Outreach, and Diversity team, known as the IDEA working group for Innovation, Diversity, Education Activities has been busy building new activities.

Founding Arizona Education Partner: Dysart Unified School District

On December 17, 2015, Jean Larson, CBBG Education Coordinator, and Willi Savenye, CBBG Education Director, met with April Holton and Teresa Heatherly of the Dysart Unified School District. The district expressed excitement about the professional development opportunities that CBBG will offer teachers. Discussion included recruitment of RET teachers and Young Scholars from Dysart, for CBBG Summer 2016 programs. The CBBG also met the district’s public relations director, who offered to write features for the Surprise, Arizona newspaper.

New Partnership with Phoenix Indian Center (PIC)

The IDEA working group is pleased to announce another new collaborating partner. In December 2015, the IDEA team met with Kalah Polsean, Director of the Center’s Youth College and Career Readiness program, Kendra Tollackson, Development Director, and Jo Lewis, Program Manager for PIC. We are very excited about this collaboration, which will begin on the ASU campus on March 16th with activities for the youth programs.

DiscoverE Day, February 12, 2016, sponsored by the Fulton Schools of Engineering at ASU – Jean Larson and CBBG biogeotechnical and education graduate students will be demonstrating how CBBG researchers learn from nature and solve problems through biogeotechnics. Approximately 1,500 students (3rd – 8th grade) and their teachers, with many from underserved school populations, will converge on ASU’s campus for an exciting day learning about aspects of, and opportunities, in engineering.

ASU’s Night of the Open Door, February 27, 2016 – Jean Larson and the CBBG team again will be demonstrating the exciting work and opportunities of the Center, for the public, especially families, who will be visiting all of ASU during this Saturday evening.

EDUCATION & Outreach

ASU Mary Lou Fulton Teachers College Supports CBBG

With the valued and considerable support of the Teachers College administration, especially Dean Mari Koerner, Associate Dean Ida Malian and Alfredo Artiles, Division Director, Sherman Dorn, and Senior Assistant Dean, Nancy Perry, Willi Savenye and team have begun discussions toward CBBG collaborations with Education faculty, including Dr. Yi-Chun Hong (Learning Design & Technology), and Dr. Joi Merritt, (Science Education), both of whom joined CBBG for its Kickoff Meeting in September 2015.

Kristin Elwood, doctoral student in Learning, Literacies and Technologies, will work with CBBG summer programs to provide training on Design Thinking for RET and REU participants and Young Scholars. Krissy brings considerable knowledge to this program due to her many years of public high-school teaching experience, a master’s degree in Educational Technology, and a passion for helping teachers learn about Design. She hopes this becomes her dissertation study area.

Anna Reed, also a doctoral student in Learning, Literacies and Technologies, will join CBBG as we build our leadership training, as this is her planned doctoral research area. Anna brings to this program her many years of experience conducting leadership academies in the Air Force, especially overseas, as well as a master’s degree in educational and organizational leadership.

CBBG IDEA Working Group

Edward Kavazanjian (ASU)  Claudia Zapata (ASU)
Center Director  Deputy Director
Wilhelmina Savenye (ASU)  Martha Mitchell (NMSU)
Education Director  Diversity Director
Susan Brown (NMSU)  Delia Saenz (ASU)
Pre-College Education Director  Diversity Lead
Jean Larson (ASU)  Jean Vandergebeyn (UCD)
Education Coordinator  Diversity Lead
Colleen Brommer (UCD)  Diane Garvey (ASU)
Education Lead  Disability Representative
Wendy Nowcaster (GT)  Miriam Wooley (ASU)
Education Lead  Graduate Student
Felicia Benton-Johnson (GT)  Alizee Jenck (ASU)
Education Lead  Graduate Student
Anna McKenna (ASU)  Angel Gutierrez (ASU)
Innovation Advisor  Graduate Student
Introducing CBBG’s New Education Coordinator

CBBG is happy to introduce Dr. Jean Larson, as the new Education Coordinator. Jean comes to CBBG with a Ph.D. in Educational Technology, postgraduate training in engineering, and many years of experience teaching and developing curriculum for K-12 students, undergraduate and graduate students, and professionals in business and industry.

Founding Arizona Education Partner: Capitol Elementary School

On December 2, 2015, the IDEA working group met at Capitol Elementary School to demonstrate CBBG research ideas focused on “learning from nature.” 23 teachers, Principal, Russell Sanders, and School Social Worker, Marta Vargas, participated in this event.

Dr. Claudia Zapata, CBBG Deputy Director, presented information on CBBG, followed by Willi Savenye, CBBG Education Director, and Jean Larson, CBBG Education Coordinator, who described possible activities to share. The teachers provided input to help formulate the plan. Miriam Wooley, CBBG master’s student, drew the teachers’ interest with a wonderful real and active demonstration of how some soils liquefy in earthquakes, complete with a miniature house that sank into the soil!

The kickoff session was concluded with a discussion about what the teachers want and need from CBBG. It is hoped that someday Capitol students might go to college at a CBBG partner university and become a biogeotechnical engineer. Several teachers indicated that they would like to partner with CBBG for activities later this spring and the following academic year.

CBBG Student Leadership Council (SLC) Activities

A CBBG Student Leadership Council (SLC) was established in support of student collaboration, brainstorming, group discussions, mentoring, leadership development, communication skills, and interdisciplinary education. The SLC developed by-laws, and has identified 10 student members from undergraduate and graduate levels at all four partner campuses (ASU, Georgia Tech, New Mexico State University, and the University of California, Davis). The Student Leadership Council (SLC) members are: Mike Gomez (UCD), Alejandro Martinez (GT), Seth Mallett (GT), Alizee Jenck (ASU), Megan Altizer (ASU), Amelia Ochsenbein (ASU), Daniel Franco (NMSU), Adam Sanchez (NMSU), Charles Graddy (UCD), and Alexandra San Pablo (UCD).

Recent developments include the formation of a student directory in which students summarize their research topic, developments, and contact information, so that natural collaboration and teamwork can be fostered between students from different campuses. A CBBG SLC-organized seminar series has begun in which professors and students will present research developments for continued exposure of students to interdisciplinary research concepts and projects as well as fostering development of student communication skills.
Meeting STEM Faculty and Administrators at Founding Arizona Community College Partners

Dr. Willi Savenye and her doctoral student, Kristin Elwood, met with STEM faculty and leadership of Glendale Community College (GCC) to discuss great event ideas (Engineer Your Future Day, STEM and STEAM clubs), and collaborated on shared demonstration and activities related to grants (GCC and CBBG). GCC faculty noted that this new field of biogeotechnics definitely will appeal to students interested in careers that support their interests in biology, sustainability, environmental sciences, as well as engineering. During the CBBG Kickoff Meeting in September, CBBG researchers and leadership met with faculty and leaders from Phoenix College (PC), who also is a CBBG founding Arizona partner. Faculty began discussions about shared activities for Spring 2016 and the following academic year.

CBBG Looking Ahead to More Events

Phoenix Indian Center’s Youth College and Career Readiness: On March 16, 2016, Kalah Polsean and her group of Native American youth will visit the CBBG labs to learn about the Center’s biogeotechnical research. This is a great opportunity for them to meet many lab directors and graduate students, and is the first of what CBBG hopes will be an ongoing series of activities to help these youth see the many opportunities available to them in biogeotechnics, engineering and STEM, as well as help them form real relationships with our Center’s researchers and students.

Leadership Training: Jean Larson and Willi Savenye met with Dr. Jennifer Chandler, Lecturer, Faculty of Leadership and Interdisciplinary Studies in the College of Letters and Sciences at ASU’s Polytechnic campus to discuss leadership training. Dr. Chandler’s research area is distributed and transformative leadership. She will be providing CBBG graduate students and RETs/REUs with a highly interactive workshop on Distributed Leadership, focused on leadership in research teams.

Bronner Develops Engineering Education and Outreach Course

Dr. Colleen Bronner, UCD Education Lead for CBBG, developed a graduate course on Engineering Education and Outreach, which introduces engineering education topics to UCD graduate students. The course objectives include improving environmental and geotechnical engineering outreach design, and developing teaching skills of graduate students. The course is the first in a two-course series. The subsequent course will involve graduate students designing educational modules for use in undergraduate education and K-12 outreach.

Dr. Bronner gave an interactive talk at the Annual Conference for the Society of Women Engineers on strategies to develop outreach that uses ladder-mentoring to recruit and motivate female engineers. The second part of the session focused on future CBBG outreach activities that are planned at UCD. She also was invited by the UC Davis Section of the Society of Women Engineers to give a keynote talk at their Evening with Industry that focused on the importance of female role models and mentors in engineering.

Bronner also was the guest speaker to a group of Lee Middle School girls learning about engineering as part of the school’s Playbook for Teens Mastermind Program.

Industrial Engagement

Companies are welcome to join the CBBG ERC industrial consortium. The membership program provides benefits, including access to the Center’s researchers and facilities, a seat on the Industry Advisory Board, advanced access to technology, and early access to intellectual property. For more information about this program, please contact Nasser Hamdan, CBBG Industrial Liaison Officer, at nasser.hamdan@asu.edu or (480) 965-2277.

REU, RET and Young Scholar Applications due March 21, 2016
http://www.biogeotechnics.org/education

Diversity

Dr. Delia Saenz, Professor in the ASU Department of Psychology, Research Professor at ASU’s Hispanic Research Center, and CBBG Diversity Lead at ASU, was recently hosted at Iowa State University where she met with faculty and students at the Center for Biorenewable Chemicals and presented a lecture, “Building an inclusive environment: the role of social contextual factors.” Her lecture addressed how social psychological elements related to structure, content, and process play an important role in inhibiting or facilitating inclusion within educational settings. The work suggests that interventions must be broad-based and include cultural institutional changes within the academy.

Saenz’ scholarly research focuses on diversity, tokenism, intergroup processes, inclusion, and acculturation. This work, often cited for its innovation and contributions to the understanding of diversity in work groups, has been funded by the National Institutes of Mental Health, the National Science Foundation, the Ford and WT Grant Foundations, and the U.S. Agency for International Development.
Dr. Ed Kavazanjian, CBBG Director, made an invited presentation on Bio-mediated and Bio-inspired Geotechnics at the annual Technical Meeting of S&ME, Inc. on January 22, 2016 in Charlotte, North Carolina.

CBBG Director Kavazanjian represented the CBBG at the National Academy of Engineering symposium on Exploring a New Vision for Center-Based Multidisciplinary Engineering Research in Washington, DC, on Monday, January 25, 2016.

Dr. Ed Kavazanjian has been invited to make the featured presentation on Biogeotechnics Research and Practice at the annual meeting of the Virginia Polytechnic Institute and State University Center for Geotechnical Practice and Research (CGPR) on Thursday, March 24, 2016, in Blacksburg, Virginia.

CBBG Director, Ed Kavazanjian has been invited to make a presentation on Geo-Alchemy (Turning Sand into Sandstone) and other Biogeotechnologies at the annual meeting of CalGeo (the California Geotechnical Engineering Association) on Saturday, April 16, 2016, in Pasadena, California.

Dr. Ed Kavazanjian was on television recently discussing the effects of storms on Arizona bridges: http://www.azfamily.com/clip/12121902/more-than-250-arizona-bridges-deemed-deficient-as-storms-pound-state

Dr. Paola Bandini, CBBG Thrust 3 Lead, along with her colleague, Dr. Zohrab Samani, will be presenting, “Valorization of agricultural residuals through biophysical transformation into an organic soil enhancer” at the American Chemical Society National Meeting in San Diego, California on March 13-17, 2016.

Dr. Zohrab Samani, Professor of Civil Engineering at New Mexico State University, was invited to teach water conservation courses in Guadalajara, Mexico on January 21-22, 2016, entitled, “Calculation of consumptive use through data climatic and crop coefficients,” and “Such techniques as soil moisture sensors to define time of irrigation.”

Dr. Jason DeJong, CBBG Thrust 1 Leader, participated in an “NSF International Workshop on Geotechnical Fundamentals in the Face of New World Challenges,” which focused on identifying research priorities and opportunities in the coming decades. DeJong gave lead talk for biogeotechnics, moderated a session, lead a workshop discussion, and is now writing summary article.

Michael Gomez, a graduate research assistant at the University of California, Davis, attended the Bio-Geo-Civil Conference as a representative of CBBG, and presented on recent developments in MICP at UCD, including a large-scale bio cementation test and recent biostimulation column tests. Gomez also presented an overview of U.S. bio-soils funding to date, and introduced the CBBG vision. The conference included presentations and discussion sessions about emerging technologies in biogeotechnics, sustainable civil engineering, new funding and research initiatives, and future pilot studies. The conference allowed for networking and will likely promote future international collaboration. The international research community for bio-soils was extremely excited to hear about the NSF’s commitment to pursuing these research opportunities with the formation of CBBG. Discussions sparked the interest of European colleagues to make plans to pursue their own future research initiatives.

Following discussions with Mike Gomez at the BioGeoCivil Conference in The Netherlands, Professor Vernon Phoenix and James Minto visited the UCD laboratory, and discussed recent bio-soils research and the potential for future research collaboration. In particular, the potential for magnetic resonance imaging to enable new opportunities for non-invasive assessment of MICP and other biogeotechnical technologies was discussed as well as recent field and large-scale application experiences from both research teams.

Tim Ginn, UCD Professor, participated in the COMSOL/iCP Workshop providing technical consultation on the installation and operation of the combined computer program iCP developed by Amphos21 in Spain, for use in his lab in simulation of multi-physics reactive transport and flow processes involved in CBBG research activities.

Mohamed Nasser, Mehrdad Bastani, and Deviyani Gurung, all UCD students, participated in an AGU poster session, and attended talks related to flow and transport modeling as well as biogeochemistry. They received feedback from modeling experts on more efficient methodologies and codes.

ASU's Ira A. Fulton Schools of Engineering Honors CBBG Director, Dr. Ed Kavazanjian

Dr. Kyle Squires, Vice Dean and Interim Dean of the Ira A. Fulton Schools of Engineering, hosted a reception at ASU’s University Club on Wednesday, February 3, 2016, to honor CBBG Director, Dr. Ed Kavazanjian, for his continued academic, industrial leadership, and philanthropic contributions to the Ira A. Fulton Schools of Engineering and Arizona State University.
Partner universities
How does nature do it?

Nature has developed elegant, efficient and sustainable biologically-based solutions to many challenges that vex geotechnical infrastructure systems. Examples include ant excavation processes that are 1000 times more energy efficient than man-made tunneling machines, carbonate cemented sand that is exceptionally resistant to erosion and earthquakes, and self-sensing and self-healing tree root structures that are 10 times more efficient than any mechanical soil reinforcing/foundation system yet devised.

The NSF Engineering Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) will focus on ecologically friendly, cost-effective solutions, inspired by nature, for development and rehabilitation of resilient and sustainable civil infrastructure systems. It will serve as a nexus for two transformative trends in engineering: biologically-based design and sustainability.

CBBG is a National Science Foundation (NSF) Engineering Research Center funded in 2015 under cooperative agreement EEC-1449501, and headquartered at Arizona State University.