Alexander S. Brand

Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
abrand2@illinois.edu, (630) 930-3856

EDUCATION

University of Illinois at Urbana-Champaign

Doctor of Philosophy in Civil Engineering — Defended August 2015, Deposit Fall 2015
Dissertation: "Interfacial Transition Zone Composition and Bonding in Cementitious Materials with Asphalt-Coated Particles"

Master of Science in Civil Engineering — May 2012
Thesis: "Fractionated Reclaimed Asphalt Pavement as a Coarse Aggregate Replacement in a Ternary Blended Concrete Pavement"

Bachelor of Science in Civil Engineering — May 2010
Construction Materials and Transportation Engineering

RESEARCH INTERESTS

- Concrete with recycled aggregates (i.e., reclaimed asphalt pavement, recycled concrete aggregate, slag aggregates) and with high volumes of supplementary cementitious materials (i.e., fly ash, ground granulated blast furnace slag) and their effect on the durability and fracture properties of concrete
- Advanced materials characterization techniques (i.e., x-ray diffraction, x-ray fluorescence, scanning electron microscopy, thermal analysis, infrared spectroscopy) and their application to concrete, cementitious materials, and asphalt
- Nature of bonding in concrete and cementitious materials, with particular emphasis on the interfacial transition zone and how it is affected by recycled materials
- Sustainable concrete pavements, principally concerning two-lift concrete paving, roller-compacted concrete, and fiber-reinforced concrete

RESEARCH PUBLICATIONS

Journal Publications

Brand, **A.S.**, and J.R. Roesler. "Bonding in Cementitious Materials with Asphalt-Coated Aggregates: Part I – The Interfacial Transition Zone," *Cement and Concrete Research*, in review.

Brand, **A.S.**, and J.R. Roesler. "Bonding in Cementitious Materials with Asphalt-Coated Aggregates: Part II – The Nature of the Cement-Asphalt Interactions," *Cement and Concrete Research*, in review.

Brand, **A.S.**, and J.R. Roesler. "Ternary Concrete with Fractionated Reclaimed Asphalt Pavement," *ACI Materials Journal*, 112(1), 2015, 155-163.

Brand, **A.S.**, and J.R. Roesler. "Steel Furnace Slag Aggregate Expansion and Hardened Concrete Properties," *Cement and Concrete Composites*, 60, 2015, 1-9.

Brand, **A.S.**, and J.R. Roesler. "Expansive and Concrete Properties of SFS-FRAP Aggregates," *Journal of Materials in Civil Engineering*, in preprint.

Brand, **A.S.**, A.N. Amirkhanian, and J.R. Roesler. "Flexural Capacity of Full-Depth and Two-Lift Concrete Slabs with Recycled Aggregates," *Transportation Research Record*, 2456, 2014, 64-72.

Brand, **A.S.**, and J.R. Roesler. "Finite Element Analysis of a Concrete Slab under Various Nonuniform Support Conditions," *International Journal of Pavement Engineering*, 15(5), 2014, 460-470.

Brand, **A.S.**, J.R. Roesler, and A. Salas. "Initial Moisture and Mixing Effects on Higher Quality Recycled Coarse Aggregate Concrete," *Construction and Building Materials*, 79, 2015, 83-89.

Ferrebee, E.C., **A.S. Brand**, A.S. Kachwalla, J.R. Roesler, D.J. Gancarz, and J.E. Pforr. "Fracture Properties of Roller-Compacted Concrete with Virgin and Recycled Aggregates," *Transportation Research Record*, 2441, 2014, 128-134.

Roesler, J.R., H.L. Chavan, King, D., and **A.S. Brand**. "Finite Element Analysis of a Concrete Slab Modeled with Field-assigned Non-uniform Support Conditions," *International Journal of Pavement Engineering*, in preprint.

Brand, **A.S.**, J.R. Roesler, and A. Salas. "Replacement of Coarse and Fine Aggregate in Concrete Pavement Mixtures with Recycled Concrete Aggregate," *Construction and Building Materials*, in review.

Moaveni, M., S. Cetin, **A.S. Brand**, S. Dahal, J.R. Roesler, and E. Tutumluer. "Machine Vision Based Characterization of Particle Shape and Asphalt Coating in Reclaimed Asphalt Pavement," *Transportation Geotechnics*, in review.

Conference Proceedings

Brand, **A.S.**, A.N. Amirkhanian, and J.R. Roesler. "Load Capacity of Concrete Slabs with Recycled Aggregates," *Proceedings of Airfield and Highway Pavement 2013*, Los Angeles, California, 9-12 June 2013.

Gillen, S.L., **A.S. Brand**, J.R. Roesler, and W.R. Vavrik. "Sustainable Long-Life Composite Concrete Pavement for the Illinois Tollway," *Proceedings of the International Conference on Long-Life Concrete Pavement*, Seattle, Washington, 18-21 September 2012.

Brand, **A.S.**, R. Smith, J.R. Roesler, I.L. Al-Qadi, and S.L. Gillen. "Fresh and Hardened Properties of Concrete with Fractionated Reclaimed Asphalt Pavement," *Proceedings of the 10th International Conference on Concrete Pavements*, Québec City, Canada, 8-12 July 2012.

Brand, **A.S.**, and J.R. Roesler. "Effect of Nonuniform Foundation Support on Concrete Slab Responses," *Proceedings of 10th International Conference on Concrete Pavements*, Québec City, Canada, 8-12 July 2012.

Final Reports

Brand, **A.S.**, and J.R. Roesler. *Concrete with Steel Furnace Slag Fractionated Reclaimed Asphalt Pavement*, Report No. ICT-14-015, Illinois Center for Transportation, Illinois State Toll Highway Authority, National Slag Association, 2014.

Brand, **A.S.**, A.N. Amirkhanian, and J.R. Roesler. *Flexural Capacity of Rigid Pavement Concrete Slabs with Recycled Aggregates*. Report No. ICT-13-018, Illinois Center for Transportation, Illinois State Toll Highway Authority, 2013.

Brand, **A.S.**, J.R. Roesler, H.L. Chavan, and F. Evangelista Jr. *Effects of a Nonuniform Subgrade Support on the Responses of Concrete Pavement*. Report No. ICT-13-027, University of Illinois at Urbana-Champaign, Iowa State University, 2013.

Salas, A., **A.S. Brand**, J.R. Roesler, C. Arboleda, and D.A. Lange. *Properties of Recycled Concrete Aggregates for Airfield Rigid Pavements*. COE Report No. 34, Center of Excellence for Airport Technology, O'Hare Modernization Program, 2013.

Brand, **A.S.**, J.R. Roesler, I.L. Al-Qadi, and P. Shangguan. *Fractionated Reclaimed Asphalt Pavement (FRAP) as a Coarse Aggregate Replacement in a Ternary Blended Concrete Pavement*. Report No. ICT-12-008, Illinois Center for Transportation, Illinois State Toll Highway Authority, 2012.

Grant Writing Experience

Roesler, J., and **A. Brand**. "ASTM C1609 Testing of BarChip and Forta-Ferro Fibers," PNA Construction Technologies, 2014.

Roesler, J., and **A. Brand**. "Evaluation of Steel Furnace Slag FRAP Aggregates in Concrete," Illinois State Toll Highway Authority and National Slag Association, 2013.

Works in Preparation for Publication

Brand, **A.S.**, and J.R. Roesler. "The Interfacial Transition Zone in Concrete with Steel Furnace Slag Aggregates," in preparation for *Cement and Concrete Research*.

Amirkhanian, A.N., **A.S. Brand**, and J.R. Roesler. "Statistical Comparison of the Concrete Fracture Properties Derived from Disk-Shaped Compact Tension and Single Edge Notched Beams," in preparation for submission.

Bittner, J., A.N. Amirkhanian, J.S. Popovics, **A.S. Brand**, and J.R. Roesler. *Ultrasonic Imaging for Concrete Infrastructure Condition Assessment and Quality Assurance*, Interim Report, Illinois Center for Transportation, Illinois Department of Transportation.

RESEARCH EXPERIENCE

Graduate Research Assistant University of Illinois May 2010-Present

1. Concrete with Fractionated Reclaimed Asphalt Pavement (FRAP) (Illinois Tollway)
    - Conducted research into the hardened, durability, shrinkage, and fracture properties of concrete with FRAP
    - Learned that concrete with FRAP will experience reductions in the mechanical properties but retain suitable shrinkage and durability properties while the fracture properties are statistically similar to or potentially higher than concrete with dolomite aggregates
    - Performed tests on full-scale concrete slabs and found that full-depth or two-lift concrete slabs with FRAP can experience higher ultimate flexural capacities compared to virgin aggregate concrete, likely as a result of the similar fracture properties
    - This research has directly contributed to the design and use of concrete with FRAP aggregates by the Illinois Tollway in their two-lift long-life sustainable concrete pavements
2. Concrete with Steel Furnace Slag FRAP (Illinois Tollway and National Slag Association)
    - Examined the chemical, mineralogical, and physical properties and expansive potential of steel furnace slag FRAP aggregates in concrete with regard to the concrete mechanical, durability, shrinkage, and fracture properties
    - Revealed that, despite years in service, steel slag FRAP still retains a significant quantity of free calcium oxide and therefore substantial expansion potential
    - Results of concrete testing suggests that steel slag in the FRAP does not affect the concrete properties, indicating potential suitable usage
    - Recommendations from these tests indicate that steel slag FRAP needs to be fully characterized by its chemical and expansive properties prior to being utilized in concrete
3. Microstructure of Concrete with FRAP
    - Studying the interfacial transition zone (ITZ) of epoxy-impregnated polished concrete samples using a scanning electron microscope
    - Found that the asphalt layer on the FRAP results in a larger, more porous ITZ with less calcium hydroxide and calcium silicate hydrate at the interface
4. Bond Improvement between Cement and Asphalt-Coated Particles
    - Conducted experiments with various techniques to improve chemical bonding between the cement and asphalt on the FRAP particles
    - Discovered that chemical oxidation of the asphalt can lead to improved bonding, as detected by measuring the surface free energy of asphalt
    - Ascertained that the asphalt work of cohesion is less than the work of adhesion between asphalt and cement paste, which revealed that the failure mode in concrete with FRAP occurs through the asphalt layer

5. Effect of Nonuniform Support Condition on Slab Stresses (Federal Highway Administration)
    - Performed two-dimensional finite element analysis to determine the effects of various nonuniform support environments on the stresses in a concrete slab
    - Determined that certain configurations of nonuniform support, particularly when soft edge support is present, can cause drastic increases in slab tensile stresses

Undergraduate Research Assistant University of Illinois May 2009-May 2010

6. Recycled Concrete Aggregate in Airfield Concrete Pavements (O'Hare Modernization Program)
    - Evaluated the effects of coarse and fine recycled concrete aggregate (RCA) on the hardened and durability properties of concrete for airport rigid pavements
    - Found that concrete with 100% coarse RCA can have statistically similar mechanical properties to virgin aggregate concrete
    - RCA was used on concrete aprons at O'Hare Airport as a direct result of this research
7. Flowable Fiber-Reinforced Concrete Inlays
    - Assisted in creating and testing fiber reinforced concrete, including fracture and toughness specimens and a full-scale pavement section

U.S. Department of Energy Science Argonne National Laboratory May-August 2008
Undergraduate Laboratory Internship

1. Pavement Distress Analysis
    - Catalogued and characterized distresses on the 25 miles of rigid and flexible pavement to assess roadway reconstruction importance and viability of roadway closures

TEACHING EXPERIENCE

Laboratory Teaching Assistant August-December 2012
Construction Materials Characterization

- Instructed and trained a graduate course of 15 students in operation and data analysis of advanced techniques, including x-ray diffraction, scanning electron microscopy, and thermal analysis

Laboratory Teaching Assistant and Grader January-May and August-December 2013
Pavement Design I, Pavement Design II January-May 2015

- Coordinated and assisted graduate students in class projects on roller-compacted concrete, fiber-reinforced concrete, and concrete with recycled materials and testing mechanical, fracture, and toughness properties

HONORS, AWARDS, AND ACHIEVEMENTS

Illinois Concrete Industry Graduate Fellowship in Concrete Paving	2014
Best Paper Award, Harbin Institute of Technology Doctoral Annual Symposium on Transportation Science and Engineering	2012
Harvey Hagge Scholarship, Illinois Ready Mixed Concrete Association	2012
Member, Phi Kappa Phi Honor Society	2011
Illinois Association of County Engineers Award	2009
Member, Chi Epsilon, The National Civil Engineering Honor Society	2008
Member, National Society of Collegiate Scholars	2008
Goethe Institute Certificate and Book Prize	2007

LEADERSHIP AND MENTORING

American Concrete Institute Student Chapter May 2012-Present

President, Vice President, Secretary

- Increased student involvement at the university and with the ACI Illinois national chapter
- Coordinated guest speakers from industry for monthly meetings
- Arranged travel plans to and from the ACI biyearly conventions
- Interacted with the College of Engineering as the ACI representative

Mentoring for New Graduate Students May 2012-Present

- Guided new transportation graduate students on how to plan and start research projects
- Instructed graduate students on how to conduct advanced concrete experiments, including fracture, toughness, and durability testing
- Acted as an informational resource for new graduate students

Mentoring for Undergraduate Students January 2011-Present

- Trained undergraduate research assistants on mixing concrete, designing concrete, and conducting mechanical property tests

PRESENTATIONS AND POSTERS

Presentations

"Concrete with Steel Furnace Slag Fractionated Reclaimed Asphalt Pavement: Properties and Expansion Potential," *ACI Fall 2014 Convention,* Session on Concrete with Recycled Materials, Washington D.C., 26-30 October 2014.

"Characterization of SFS FRAP: Expansion and Concrete Properties," *3rd International Transportation PhD Student Conference,* Stockholm, Sweden, 29-30 August 2014.

"Flexural Capacity of Concrete Slabs with Recycled Aggregates," *ACI Fall 2013 Convention,* Committee 555 Meeting, Phoenix, Arizona, 20-24 October 2013.

"Load Capacity of Slabs with Recycled Aggregates," *2nd International Transportation PhD Student Symposium*, 3-4 September 2013.

"Load Capacity of Concrete Slabs with Recycled Aggregates," *Airfield and Highway Pavement 2013*, Los Angeles, California, 9-12 June 2013.

"Fractionated Reclaimed Asphalt Pavement (FRAP) in Concrete Slabs," *Two-Lift Concrete Pavement Workshop*, University of Texas at Austin, Austin, Texas, 23 May 2013.

"Flexural Capacity of Concrete Slabs with Recycled Aggregates," *ACI Spring 2013 Convention*, Session on Fracture Mechanics Applications in Concrete, Minneapolis, Minnesota, 14-18 April 2013.

"Flexural Capacity of Concrete Slabs with Recycled Aggregates," *Joint ACI Illinois–ACI UIUC Meeting*, University of Illinois at Urbana-Champaign, Urbana, Illinois, 11 April 2013.

"Fracture Properties of Concrete Slabs with Recycled Aggregates," *Kent Weekly Seminar*, Illinois Center for Transportation, Rantoul, Illinois, 4 April 2013.

"Fractionated Reclaimed Asphalt Pavement (FRAP) Aggregate in Concrete: Effect on Material Properties and Slab Capacity," *Harbin Institute of Technology Doctoral Annual Symposium on Transportation Science and Engineering*, Harbin, China, 13 December 2012.

"Coarse Fractionated Reclaimed Asphalt Pavement (FRAP) in a Ternary Blended Concrete," *Kent Weekly Seminar*, Illinois Center for Transportation, Rantoul, Illinois, 19 April 2012.

"Effects of a Nonuniform Subgrade Support on Concrete Slab Responses," *Kent Weekly Seminar*, Illinois Center for Transportation, Rantoul, Illinois, 10 February 2011.

Posters

"Chemical and Expansive Properties of Steel Furnace Slag Reclaimed Asphalt Pavement," *94rd Annual Meeting of the Transportation Research Board*, Washington D.C., 11-15 January 2015.

"Characterization and Expansion of SFS FRAP," *3rd International Transportation PhD Student Conference*, Stockholm, Sweden, 29-30 August 2014.

"Flexural Capacity of Full-Depth and Two-Lift Concrete Slabs with Recycled Aggregates," *93rd Annual Meeting of the Transportation Research Board*, Washington D.C., 12-16 January 2014.

"Concrete with Fractionated Reclaimed Asphalt Pavement: Strength, Durability, Fracture, and Slab Capacity," *2nd International Transportation PhD Student Symposium*, Urbana, Illinois, 3-4 September 2013.

"Fresh and Hardened Properties of Concrete with Fractionated Reclaimed Asphalt Pavement," *10th International Conference on Concrete Pavements*, Québec City, Canada, 8-12 July 2012.

"Durability and Fracture Properties of Concrete with Fractionated Reclaimed Asphalt Pavement," *10th International Conference on Concrete Pavements*, Québec City, Canada, 8-12 July 2012.

PROFESSIONAL AFFILIATIONS

Committee Memberships (Associate Member)

ACI Committee 215 (Fatigue of Concrete)	November 2014-Present
ACI Committee 446 (Fracture Mechanics of Concrete)	May 2013-Present
ACI Committee 555 (Concrete with Recycled Materials)	May 2013-Present

Association Memberships (Student Member)

American Concrete Institute	2010-Present
International Society for Concrete Pavements	2011-Present
American Society of Civil Engineers	2013-Present