Research is an extremely dynamic process. As time passes, certain areas of research become more salient, while others require less attention. As a tenure-track Assistant Professor at the University of Arkansas, my current research focuses on three primary areas: advanced pavement materials characterization, pavement maintenance and rehabilitation products, and sustainability.

My first area of research, advanced pavement materials characterization, is where I explore fundamental material properties of asphalt concrete and asphalt cement. Tests in the laboratory used to quantify these fundamental properties of asphalt concrete include the Superpave Indirect Tension Test, creep compliance, dynamic modulus, and fracture testing. The pavement materials laboratory at the University of Arkansas is able to run these tests on two MTS load frames with an environmental chamber that is compatible with each load frame. In addition, torsion beam tests on asphalt concrete can be run on a Dynamic Hybrid Rheometer. For asphalt cement, the Dynamic Hybrid Rheometer captures G*, sin δ, and J_{nr}, while the Brookfield Rotational Viscometer measures workability and pumpability. This wide range of testing capabilities allows for a deep understanding of the fundamental material properties of asphalt concrete and asphalt cement.

It is essential to be able to capture these fundamental material properties of pavements as there is a consistent demand for longer lasting roads at lower costs. These goals of improved quality with lower costs are often achieved by introducing new and innovative pavement products. For example, Warm Mix Asphalt is able to reduce production and construction temperatures of asphalt concrete, which in theory reduces energy consumption and fiscal cost. However, the technologies that drive these advancements are unknown. For example, an open question of foamed Warm Mix Asphalt is how long can the asphalt concrete be stored at construction temperatures before the workability benefits due to the foaming is lost? Or, when attempting to understand cracking in asphalt concrete, is tensile strength an adequate measure, or does fracture energy provide a significant improvement in the understanding of the material? These questions, and many more, can be answered by capturing fundamental material properties.

The tests run on the MTS load frame require displacement and load to be recorded. The load is measured by a load cell on the load frame, but while the displacement can be measured by a Linear Variable Differential Transformer (LVDT), it is more accurate to use external displacement gauges to obtain the displacements. These types of external gauges include extensometers, strain gauges, and clip gauges. The disadvantage of using these pieces of equipment is that the data can only be collected at one point on the sample, and that point cannot change during the test. My laboratory is incorporating Digital Image Correlation (DIC) to collect displacement and strain measurements. By using digital images, displacement and strains can be recorded across the entire specimen face. Therefore, bulk displacement, crack propagation, and other displacements or strains at any point on the sample can be captured and analyzed. Through this advanced data collection technique, a deeper understanding of the fundamental material properties of asphalt concrete is possible.

My second area of research, pavement maintenance and rehabilitation, explores performance testing of a wide range of pavement maintenance and rehabilitation products. The pavement network in the United States is highly developed but in a serious state of decline. Compared to research in new-build pavement, research in the area of pavement maintenance and rehabilitation is underdeveloped. Products such as chip seals, slurry seals, micro-surfacing, Full

Depth Reclamation, and Cold In-place Recycling rely heavily on empirical tests developed 10-20, or even more, years ago. There is a significant need to develop new performance tests that accurately predict field performance of these products. With the testing equipment described in the previous section, along with a Wirtgen WL10S foaming machine and a lab-scale Supraton asphalt emulsion mill, and capabilities to perform the raveling test, the wet-track abrasion test, and the sweep test, my lab has the strong ability to develop new performance tests. My research is identifying the areas of greatest need and working with governmental agencies and private companies to develop and implement tests that will be able to increase the success of pavement maintenance products and reduce costs, so that high-quality, cost-effective pavement rehabilitation products can be applied to a great number of roadways.

My third area of research, sustainability, crosses all disciplines of Civil Engineering. Life Cycle Cost Analysis, Life Cycle Analysis, and emission and waste streams of engineering systems are all areas that can be applied in transportation, structural, environmental, and geotechnical areas of Civil Engineering. As I continue to learn and apply more of these sustainable metrics toward transportation applications of Civil Engineering, I dialogue with other faculty in the department in order to share and transfer knowledge of sustainability potential into their disciplines and projects.

The three areas of research I have discussed above, advanced pavement materials characterization, pavement maintenance and rehabilitation, and sustainability, can be made more successful through collaboration with other researchers. As mentioned, I am already reaching out to other faculty in the Civil Engineering department here at the University of Arkansas. Additionally, I am discussing potential research in other engineering disciplines, including Industrial, Mechanical, and Chemical. As the boundaries blur between disciplines, I strive to stay on the leading front of cross-disciplinary research in order to meet the research needs of the local community, the state of Arkansas, the United States, and the global community. In order to achieve this, I am submitting proposals and discussing research possibilities with universities around the United States as well as outside of the country – specifically with Southeast University in Nanjing, China and Universidad de Los Andes in Bogota, Colombia. As the world becomes smaller and more interconnected, international relationships are essential in order to meet the needs of the engineering world.

Research in the laboratory is critical for advancement of knowledge, but equally important is transferring this knowledge to undergraduate and graduate students in the classroom. Students attending college expect to obtain a world class education in Civil Engineering. I believe it is important to weave lab concepts into these classes to let students explore the excitement and possibilities in Civil Engineering, both at the undergraduate and graduate levels. While fundamental equations and theory are always important, real world application brings these problems alive and encourages students to push their boundaries in their educational development.

In summary, as a tenure-track Assistant Professor in Civil Engineering, my three areas of research include advanced pavement materials characterization, pavement maintenance and rehabilitation, and sustainability. My research is enhanced by local to global collaboration with other researchers, and is complimented by the incorporation of real-world applications of engineering research into the undergraduate and graduate classrooms at the University of Arkansas.