Exhibit D

Research Project Requirement Template

Next-Generation Permeable Pavement for Enhanced Durability and Functionality

Recipient/Grant (Contract) Number: 69A3552348306 (CY1-LSU-UARK-02)

Center Name: Southern Plains Transportation Center (SPTC)

Research Priority: Improving the Durability and Extending the Life of Transportation

Principal Investigator(s): Mostafa A. Elseifi, Louisiana State University; Kofi S.S. Christie, Louisiana State University; Haitao Liao, University of Arkansas

Project Partners: Louisiana State University and University of Arkansas

Research Project Funding: LSU: $75,000 (Federal) and $75,008 (Match); UARK: $44,553 (Federal) and $44,553 (Match)

Proposed Start and End Date: 10/01/2023 to 9/30/2024

Project Description: The South-Central region of the United States, which is characterized by heavy rainfall conditions and shallow groundwater table, may significantly benefit from the widescale implementation of porous asphalt, especially if similar performance to regular dense-graded asphalt mixtures can be achieved. Yet, there have been some difficulties using porous asphalt as a wearing surface course, largely because of its lower durability when compared to dense-graded asphalt mixtures. The most critical shortcomings of permeable pavement include premature durability problems (raveling and stripping), and clogging of voids by dirt, which result in shorter service life and higher costs.

The goal of this study is to enhance the use of a next-generation permeable pavement in Region 6 by optimizing its mechanical, operational, and environmental characteristics. To this end, the objectives of this study are: (1) Evaluate the failure mechanisms (e.g., cohesive and adhesive mechanisms) in Open-Graded Friction Course (OGFC) mixes and the contribution of modification and additives to the mixture durability; (2) Evaluate the effects of Reclaimed Asphalt Pavement (RAP) on open graded friction course (OGFC) mixture performance and durability; (3) Analyze and quantify bio-remediation processes that may be used to hold and degrade oil and pollutant contaminants into less harmful forms through microbial degradation; (4) Evaluate production, cost, and constructability of OGFC mixes; and (5) Develop an interactive computer tool to facilitate the design of cost-effective and durable OGFC mixes.

These objectives will be achieved through seven research tasks. Task 1 will be led by UARK with the support of LSU and will include the selection of materials and development of the test factorial considering aggregate structure and RAP content, additives and binder modification, and OGFC mixture types. Task 2 will be led by LSU with the support of UARK and include the design and preparation of OGFC mixtures. Task 3 will be led by LSU with the support of UARK and will include evaluation of mechanistic properties and failure mechanisms of OGFC mixtures. Task 4 will be led by LSU and will involve analysis of bioremediation and microbial degradation of hydrocarbon products. Task 5 will be led by LSU with the support of UARK and will consist of an analysis of mixture performance and cost-effectiveness of OGFC mixes. Task 6 will be led by UARK with the support of LSU and will involve the development of a computer tool for the design of OGFC mixes. Task 7 will be led by LSU with the support of UARK and will consist of preparing a final report documenting the entire research effort.

US DOT Priorities: The proposed research will primarily address the USDOT statutory research priority "D: Improving the Durability and Extending the Life of Transportation Infrastructure." Under this statutory priority, the research project will address the USDOT strategic goals "Climate and Sustainability," "Economic Strength and Global Competitiveness," and "Safety." OGFC is considered a public favorite in terms of pavement surface given its safety and societal benefits. Permeable pavement provides enhanced visibility, improved wet skid resistance, and the elimination of the risk of hydroplaning. It is also championed by many state DOTs to address extreme weather events and climate change. It has the potential to reduce the impact of urban heat islands and the degradation of pollutants in stormwater. Addressing durability and constructability challenges will allow state DOTs and the public to fully take advantage of this unique pavement surface.

The proposed research study will address all SPTC goals by optimizing the use of permeable pavement in Region 6, which has the potential to offer a wide range of benefits, especially under extreme weather and climate change. Addressing the durability and constructability challenges of OGFC will support its widespread implementation in Region 6. The implementation of durable porous pavements will also reduce the impact of extreme weather events on vulnerable communities and can enhance economic competitiveness and improve living conditions in these communities.

The proposed research will also provide funding to at least two graduate students. The graduate students, who will pursue their graduate degrees in engineering, will be trained to gain advanced skills and are expected to contribute to the workforce in the transportation sector. The PIs have had great successes in engaging students from underrepresented groups. The project will support these activities and will include opportunities for underrepresented students to engage in hands-on and laboratory testing activities.

Outputs: The following outputs and deliverables are expected from the research activities proposed in the study: (i) Quantify the failure mechanisms in OGFC mixes; (ii) Develop special provision for addressing durability issues in OGFC mixes; (iii) Develop an interactive spreadsheet to assist in the design of durable and cost-effective OGFC mixes; (iv) Quantify processes for the biodegradation of petroleum hydrocarbons in OGFC mixes; (v) Engage underrepresented groups in this study.

Outcomes/Impacts: This study will result in the following outcomes and impacts in Region 6: (1) Enhance durability of OGFC mixes and lifetime extension; (2) Ensure infrastructure performance under all weather conditions; (3) Reduce raveling and retain a smooth OGFC surface for a longer time; (4) Increase cost-effective OGFC mixes while reducing the utilization of virgin resources such as aggregate and asphalt binder; (5) Reduce the amount of pollutants entering the drainage system using biodegradation.

Final Research Report: