# Exhibit D

**Research project name: Bio-Inspired Solutions for Jersey and Road Noise Barriers: Exploring 3D Printing as Alternative Precast Technology**

**Recipient/Grant (Contract) Number:** University of Illinois Urbana-Champaign / Purdue University / Grant Number 69A3552348333

**Center Name:** Transportation Infrastructure Precast Innovation Center (TRANS-IPIC)

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

**Principal Investigator(s):** Jan Olek1(olek@purdue.edu), Jeff Youngblood2(jpyoungb@purdue.edu), Pablo Zavattieri1(zavattie@purdue.edu)

**Project Partners:** None

**Research Project Funding: $**125,803.00 ($67,576.00 Federal and $58,227.00 Non-Federal)

**Project Start and End Date:** 09/01/2023 - 08/31/2024

**Project Description:**

This research project aims to leverage the potential of concrete 3D printing as an alternative precast technology to develop innovative Jersey barriers for impact energy absorption and self-reconfigurable acoustic metamaterials for road noise mitigation. By combining concrete and polymers and exploring the novel approach of printing two materials simultaneously, the project seeks to optimize energy dissipation in Jersey barriers and develop customized acoustic barriers with improved noise reduction capabilities. The research will involve design, comprehensive analysis, fabrication techniques, and rigorous testing to validate the performance and durability of the 3D-printed barriers. The findings from this project have the potential to significantly enhance road safety and noise reduction in transportation infrastructure. By providing novel solutions backed by thorough validation, the project aims to offer sustainable and effective measures for mitigating impact forces and reducing road traffic noise.

**US DOT Priorities:**

Our Phase 1 research project, focusing on leveraging concrete 3D printing for innovative Jersey barriers and acoustic metamaterials, aligns closely with some of the U.S. DOT strategic priorities. First and foremost, it contributes to the DOT's goal of Safety by addressing the critical need for impact-resistant infrastructure materials. Our innovative barriers will have the potential to enhance road safety by dissipating impact forces effectively, reducing accidents, and ultimately eliminating transportation-related serious injuries and fatalities. This project also aligns with the U.S. DOT's research priority regarding automation and emerging technologies. Our work is focused on automation applied to infrastructure development, and therefore, it contributes to the broader goal of leveraging new technologies to improve transportation safety, efficiency, equity, and accessibility. This project also aligns with the U.S. DOT's priority of Sustainable and Resilient Infrastructure by exploring advanced materials to create reconfigurable noise barriers. The innovative combination of polymers and concrete in these 3D-printed elements will result in materials that are likely to be more durable and sustainable than traditional construction materials. The use of these materials will create flexible and adaptable infrastructure, which aligns with resilience goals.

**Outputs:**

We anticipate the following significant outputs: (1) Innovative Materials Solutions and 3D Printing Technologies: The project will yield novel 3D printing processes and materials tailored for transportation infrastructure. This includes advanced printing techniques for concrete and polymers, resulting in cutting-edge architected materials and acoustic metamaterials. (2) Physical prototypes of 3D-printed Jersey barriers and acoustic barriers to showcase the practical application of our innovations in transportation infrastructure. (3) We will also generate valuable research findings, shedding light on the feasibility, and effectiveness of 3D printing and advanced materials in construction. (4) We anticipate establishing partnerships with 3D printing companies, construction firms, governmental agencies, and academic institutions. These collaborations will facilitate knowledge exchange, technology transfer, and the potential implementation of our innovations in broader industry contexts.

**Outcomes/Impacts:**

This project aims to develop a safer, more resilient, cost-effective, and sustainable solution for the transportation system and has the potential to shape policy decisions, improve infrastructure quality, and positively impact various stakeholders, ultimately benefiting the entire transportation ecosystem and the broader economy. For instance, the adoption of 3D-printed Jersey barriers and acoustic metamaterials will significantly improve road safety and infrastructure resilience. It will also lead to cost savings for both, infrastructure developers and taxpayers, by reducing material waste and minimizing disruptions to transportation networks. The cost-effective and efficient construction methods resulting from this research will stimulate economic growth. Reduced infrastructure development costs will create opportunities for related industries and generate jobs. The project's outcomes will contribute to reduced environmental impact through the use of sustainable materials and efficient construction processes. This aligns with sustainability goals as it reduces greenhouse gas emissions and resource consumption. Additionally, research findings from this project could inform federal and state regulations related to 3D printing and advanced materials in transportation construction. Streamlined approval processes may expedite the adoption of these innovations.

**Final Research Report:** URL link to the project's final report will be provided upon the completion of the project.