# Exhibit D

**Research Project Requirement Template**

**Research project name: Optimizing the Planning of Precast Concrete Bridge Construction Methods to Maximize Durability, Safety, and Sustainability**

**Recipient/Grant (Contract) Number:** University of IllinoisUrbana-Champaign / 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):** Khaled El-Rayes and Ernest-John Ignacio

**Project Partners:** None

**Research Project Funding:** $104,888 ($65,000 Federal and $39,888 Non-Federal)

**Project Start and End Date:** 01/01/2024 – 12/31/2024

**Project Description:**

The use of Precast Concrete (PC) bridge construction methods has steadily increased in recent years to improve the durability and sustainability of roadway infrastructure systems. To advance these goals, DOT planners often need to optimize the planning of bridge construction methods to accomplish multiple project objectives including maximizing durability, safety, sustainability, and mobility, while minimizing bridge life-cycle cost. This presents DOT planners with a number of challenges including how to (1) select an optimal bridge construction method during early design phase; (2) identify optimal size and number of bridge PC modules; (3) determine optimal shipping and onsite installation of all prefabricated PC modules; and (4) quantify and optimize the impact of construction planning decisions on bridge durability, safety, sustainability, mobility, and life-cycle cost. To address these challenges confronting DOTs, this research will focus on developing (a) predictive machine learning (ML) models to accurately estimate the construction cost of alternative construction methods during the early bridge design phase, and (b) multi-objective optimization decision support tool for quantifying and optimizing the impact of related construction decisions on durability, safety, sustainability, mobility, and life-cycle cost.

**US DOT Priorities:**

This research optimizes the use of precast bridge elements to advance the USDOT strategic goals of (a) safety by minimizing onsite construction activities and their related serious injuries and fatalities; and (b) climate and sustainability by reducing traffic delays caused by work zones and their greenhouse gas emissions and pollution.

**Outputs:**

This research project will produce the following deliverables that are expected to advance the TRANS-IPIC’s strategic goal of “establishing economic plans for off-site PC manufacturing, shipping, and onsite installation”:

1. ML predictive models that can be used by DOTs to accurately estimate the cost of alternative bridge construction methods and select the most cost-effective method.
2. A practical and user-friendly multi-objective optimization DST that can be used by DOTs to quantify and optimize the impact of construction decisions on the important project objectives of durability, safety, sustainability, mobility, and life-cycle cost.

**Outcomes/Impacts:**

The development of the ML predictive models and the multi-objective optimization DST will be designed as practical and user-friendly tools to facilitate their implementation and use by DOTs to advance the USDOT strategic goals of safety, climate, and sustainability.

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