

**TRANSPORTATION POOLED FUND PROGRAM  
QUARTERLY PROGRESS REPORT  
Q1/2024**

Lead Agency:  
**Washington State Department of Transportation (WSDOT)**

**INSTRUCTIONS:**

*Lead Agency contacts should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <a href="#">TPF-5(491)</a>		<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
<b>TPF Title</b> (follow link to TPF webpage): <a href="#">Super-Elastic Copper-Based and Iron-Based Shape Memory Alloys and Engineered Cementitious Composites for Extreme Events Resiliency</a>			
<b>Lead Agency PM:</b> <a href="#">Mustafa Mohamedali, PE PMP</a>	<b>Lead Agency PM Phone:</b> 360-704-6307	<b>PM E-Mail:</b> <a href="mailto:mohamem@wsdot.wa.gov">mohamem@wsdot.wa.gov</a>	
<b>Lead Agency Technical Lead:</b> <a href="#">Amy Leland, PE SE</a>	<b>Lead Agency Tech Lead Phone:</b> 360-705-7181	<b>Tech Lead E-Mail:</b> <a href="mailto:LelandA@wsdot.wa.gov">LelandA@wsdot.wa.gov</a>	
<b>Principal Investigator(s):</b> <a href="#">Bora Gencturk/USC</a> <a href="#">Saiid Saiidi/UCLA</a>	<b>PI Phone Contact:</b> 213-821-1036	<b>PI Email:</b> <a href="mailto:gencturk@usc.edu">gencturk@usc.edu</a>	
<b>Lead Agency Project ID:</b> <a href="#">UCB 1874</a>	<b>Other Project ID (i.e., contract #):</b> <a href="#">T-1874</a>	<b>Project Start Date:</b> <a href="#">2022-12-01</a>	
<b>Original Project Start Date:</b> <a href="#">2022-12-01</a>	<b>Original Project End Date:</b> <a href="#">Phase 1 - 2023-11-30</a> <a href="#">Phase 2 – 2025-11-30</a>	<b>If Extension has been requested, updated project End Date:</b> <a href="#">N/A</a>	

**Project schedule status:**

On schedule       On revised schedule       Ahead of schedule       Behind schedule

**(A) Overall Project Statistics:**

<b>Commitments to date \$ (3yrs)</b>	<b>Obligations to date \$</b>	<b>% Obligated</b>	<b>Contracted to date \$</b>	<b>Expended to date \$</b>	<b>Expended to date as % of contracted</b>	<b>Completed this quarter \$</b>
400,000	320,000	80%	210,000	195,778	93%	83,814

**(B) Project Description:**

The objective of this research project is to:

1. evaluate and test several innovative columns which have self-centering feature to provide minimum residual displacement after earthquake.
2. improve column serviceability after earthquake by decreasing damage and spalling of concrete within column plastic hinge region; and
3. provide cost comparison among columns having different engineered materials; and
4. develop self-centering column design specifications. Particularly, in this proposed research, the low-cycle fatigue characteristics, corrosion resistance, machinability and coupling mechanisms with traditional steel rebar, and cost of CAM, NiTiCo super-elastic alloy (SEA) bars and Fe-SMA shape memory alloy (SMA) bars are being studied.

Direct comparisons are made with Nickel-Titanium (NiTi) SEAs (and traditional steel reinforcing bars as applicable) to illustrate the advantages/disadvantages of each material. If successfully demonstrated for their suitable characteristics, the NiTiCo SEA and Fe-SMA bars could replace their NiTi counterparts at a significantly lower cost and accelerate their applications in bridges. Therefore, the outcomes of this project are directly relevant to state departments of transportation and bridge and structural engineers and designers. This proposed project will build on the success of previously implemented WSDOT's application of shape memory alloy/engineered cementitious composite (SMA/ECC) in the columns of the SR-99 on-ramp bridge in downtown Seattle while making a direct impact on advancing and securing the national transportation network.

**(C) Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

The NiTiCo and FeSMA materials are selected for column testing. Two columns each will be tested for each material with a total of four columns. In Task 3a, FeSMA columns will be tested while the NiTiCo will be tested in Task 3b. The FeSMA materials have been received in this quarter from the manufacturer (re-fer AG, Switzerland). The column design had been completed for the NiTiCo columns but due to the delays in receiving these materials from the manufacturer, the research team shifted the focus onto the FeSMA columns. The design of FeSMA columns is completed. A test setup has been designed and fabricated to prestrain the FeSMA bars to 10% and 20% strain. Since the bars are 10 ft long, this required a custom setup to be fabricated due to the long stroke under 20% prestrain. The team is currently finalizing the anchors for the FeSMA materials. Once that is completed, the bars will be prestained and placed in the columns. Work is being done in parallel on the column fabrication. The rebar cages have been ordered and the concrete forms have been fabricated. The casting of the columns is anticipated in the next couple of weeks.

**(D) Anticipated work next quarter:**

The two columns will be fabricated. The FeSMA bars will be prestained. The FeSMA bars will be placed in the columns, anchored at the ends, and activated. The test setup for column testing will be readied and the two column tests will be performed.

**(E) Significant Results:**

The significant result in this quarter is the design of the FeSMA columns, the test setup for the prestaining of long FeSMA bars, and the progress made on final testing of the columns in terms of material orders and test preparations.

**(F) Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

The TAC unanimously voted to continue the work and Phase 2 was broken up into smaller tasks. A task proposal was requested from the researchers for Task 3a and adopted after comments by the SMEs and revision by USC for a task order to the value of \$90k. This task includes fabrication and testing of two columns at the end of which, given the funding we will continue with two more columns.

Following further funds being available through recent obligation transfers, the work is being extended to include testing of the remaining two columns under Task 3b and electrochemical testing under Task 4 under a new task order. This work is per the original scope of work as identified in the proposals.

USC has also indicated that there have been significant inflationary factors that are affecting labor rates. This will necessitate increasing the commitments needed to complete the project and WSDOT has been collaborating with the FHWA, TAC partners and USC to address and resolve this.

**(G) Potential Implementation:**

We will have a better idea on the implementation trajectory of the findings during Phase 2, within the scope of this pooled fund, if successful and if adequate funding is committed and obligated to conduct Phase 2. The results of Phase 1 look very promising so far!