Request for Research Funding for FY 2021-2022			
Requesting Office	CO Office of Maintenance	**Priority**	2 of 2 (projects may not have the same ranking – no ties)
Proposed Title	Effects of cracks in stiffener welds on miscellaneous structures and their structural capacity		
Justification	Districts 2 and 4 have found cracks in the stiffener to upright weld in multiple galvanized steel overhead sign structures, a few of which are cantilever structures but most of which are dual upright structures. The cracks (see figure below) were first noticed during an inspection after Hurricane Irma and targeted inspections have found additional cracks. The cracks were first identified visually and then examined with ultrasonic inspection. Some cracks were found to extend only into the galvanizing and some extended into the base metal. The State Materials Office (SMO) has completed an investigation and determined that the crack was formed either during the fabrication or galvanizing process, because the cracks investigated were filled with zinc. Fatigue loading could cause the existing defect to grow. Research is proposed to determine the long-term effects of these cracks. Research should determine the fatigue category for these defects and, along with the stress range predicted by design, the remaining fatigue life which can be reasonably predicted. In addition, research should examine the feasibility of replacing upright members of dual upright sign structures without replacing the entire structure.		
Impact	To date, District 2 Structures Maintenance Office has identified 13 structures with these types of weld cracks and has removed 2. The replacement cost for each structure ranges from $100,000 to $400,000 with the total replacement cost of all 13 totaling approximately $3.2M. The problem is known to exist in at least district 4 as well, with replacement costs assumed to be similar. Replacement requires replacing the entire structure. Not doing the research would lead the Districts to put all the sign structures, with cracks in the base material, for replacement when a capital improvement project is scheduled in the corridor or when other funding sources are available.		
Affected Offices	The affected offices are the Office of Maintenance who oversees the maintenance and funding of the sign structures, and who also sets the policy for how these deficiencies are to be inspected, repair, and replaced. The District Maintenance Offices are responsible for maintaining all their sign structures. The Work Program Office programs the funding for projects including the repair and replacement of sign structures. Finally, some criteria may be recommended that would require changes to the design standards, which would affect the Structures Design Office.		
Existing Work	Initial Analytical Investigation of Overhead Sign Trusses with Respect to Remaining Fatigue Life and Predictive Methods for Inspection: https://trid.trb.org/View/1605934 Structural Assessment for MD Sign Structures Project based on AASHTO LTS-6 Strength and Fatigue Criteria: https://trid.trb.org/View/1743204 Inspection, Repair, and Rehabilitation of Ancillary Highway Structures to Enhance Fatigue Performance: https://trid.trb.org/View/801591		
Keywords Used In Existing Work Search **(Cannot leave blank)**	sign structure, steel crack, repair sign structure		
Related Contracts (Give contract numbers)	BDV31-977-121 Use of Infrared Thermography for the Inspection of Welds in the Shop and Field - Phase II		
Funding Request	$200,000	**Anticipated Duration**	24 months
Project Manager	Felix Padilla	**Contracting Method**	RFP

Urgency	Score 1	Since we have already begun to identify these deficiencies, the sooner we can determine alternative options to replacing every sign structure with cracks in the base material, the more comfortable we can be with the status of our inventory.
Implementability	Score 1	We are already in the process of inspecting and identifying these cracks in all our sign structures statewide. The results from this research project will help us identify which structures would need to be replaced immediately and which structures would only need monitoring.

Project Benefits (Succinct, complete explanation)

The current process requires structures with cracks in the base material to be replaced when funding is available. The urgency of the replacement is currently driven by the depth of the cracks, with 50% of the thickness of the base material as the threshold, or by documenting crack growth in subsequent inspections. We don't have a handle on how critical these cracks are to the performance of the structure or how they are affected by fatigue loading conditions. The main benefit of this project is that it would give us a clear indication on how to handle these structures when various levels of deficiencies (cracks) are discovered. It would give the Department direction on how to prioritize the replacements to minimize the funding need and maintain the safety of the traveling public.

Project Benefits **(Select all that apply and explain)**	**Quantifiable Benefits (units, dollars, etc…if applicable)**	**Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits**
o Materials Enhancement		
o Materials Savings	Horizontal truss members, foundations, sign panels.	If we don't need to replace the entire structure, we will save the materials needed for the horizontal members, the foundations, and the sign panels.
o Time Savings	Fabrication of extra members, pouring concrete for foundations.	Lead time required for fabrication and delivery of the members saved above would be saved.
o Lives Saved/Injuries Prevented	Preventing the loss of any sign structure.	Better understanding of the criticality of these cracks will lead to better maintenance operations and prioritization for these sign structures.
o Other (Explain)		

*Comments should explain and support urgency, financial benefit, and implementability scores