TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Date: _March 31, 2020_

Lead Agency (FHWA or State DOT): _____Indiana DOT_____

INSTRUCTIONS:
Project Managers and/or research project investigators 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.

Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)* ***TPF 5-436***	**Transportation Pooled Fund Program - Report Period:** X Quarter 1 (January 1 – March 31) ☐ Quarter 2 (April 1 – June 30) ☐ Quarter 3 (July 1 – September 30) ☐ Quarter 4 (October 1 – December 31)

Project Title: **Development of Criteria to Assess the Effects of Pack-out Corrosion in Built-up Steel Members**		
Name of Project Manager(s): **Tommy E. Nantung**	**Phone Number:** **(765) 463-1521 ext. 248**	**E-Mail** tnantung@indot.in.gov
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:** 9/1/2019
Original Project End Date: **8/31/2022**	**Current Project End Date:** **8/31/2022**	**Number of Extensions:** None

Project schedule status:

X On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget**	Total Cost to Date for Project	Percentage of Work Completed to Date**
$760,000	**$41,490**	**12%**

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$19,035	**2.5%**	**19.4%**

**This total budget is based on funds that are shown as "committed" on the TPF website.

Project Description:
This study proposes to:

1) To develop AASHTO ready specifications for the evaluation of the effects of pack-out corrosion in built-up steel tension, compression, and flexural members.
2) Provide guidance on the need for repairs and corrosion rates that can be expected in various environments in order to assist owners in programming when repairs may need to be made.
3) Identify the most effective methods of repairs and provide suggesting verbiage that could be used when preparing special provisions for repairs.
4) Develop several case-study examples, including calculations that will be used for training users on the methodologies to be developed. It is anticipated that the research team will host a number of webinars or on-site training sessions to ensure technology transfer and implementation.

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

- Considerable progress has been made in the initial finite element studies to evaluate the effects of pack-out on the strength of compression members. These analyses are relying on members obtained from a truss bridge from the state of Minnesota. Hence, at present efforts are also being made to ensure the FE models are calibrated.
- Samples have been removed form the members (fabricated from rolled channels and plates) and the amount of pack-out and section loss measured, as shown in Figure 1. Figure 1 is typical of the damage in this member but on the high end of the level of distortion, which is about 1 inch maximum. The data are then used to develop non-linear (geometry and materials) FE models using material property data from the specimens (see Figure 2). The results are suggesting that shell models, which are much less computationally expensive, may be sufficient for future modeling. However, this has not been fully vetted at this time.
- It is noted that the study is also very useful in estimating the prying forces in the fasteners and the stresses in the individual components. This will be very useful in determining how these forces affect the overall performance of the member for both strength and fatigue.
- Larger FE models are also being developed to examine these effects, as shown in Figure 3. The RT is studying the magnitudes of various pressure distributions exerted by the corrosion product that will achieve the measure deflected shape (see Figure 4). A typical comparison is shown in Figure 4.
- Because the analyses is performed both with and without section loss, the effects of the pack-out forces can be compared at different points in time so to speak. As expected, the forces increase if one assumes the measure deflections occur and there is no section loss. This analysis is useful as it can be used to estimate the additional forces in the fasteners and hopefully, guidance on when there is a likelihood of the faster failing in tension.

Anticipated work next quarter:

- Continue with the finite element studies and begin to tension members.
- Coordinate a project kick-off meeting in early 2020.
- Begin to develop the large-scale experimental program
- Obtain additional members with pack-out corrosions. If a state has such members available or coming out of service in the near future, the RT requests that they contact Robert Connor to discuss the potential for obtaining the members for the research.

Significant Results:

1. None to date

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).

Potential Implementation:

None to date

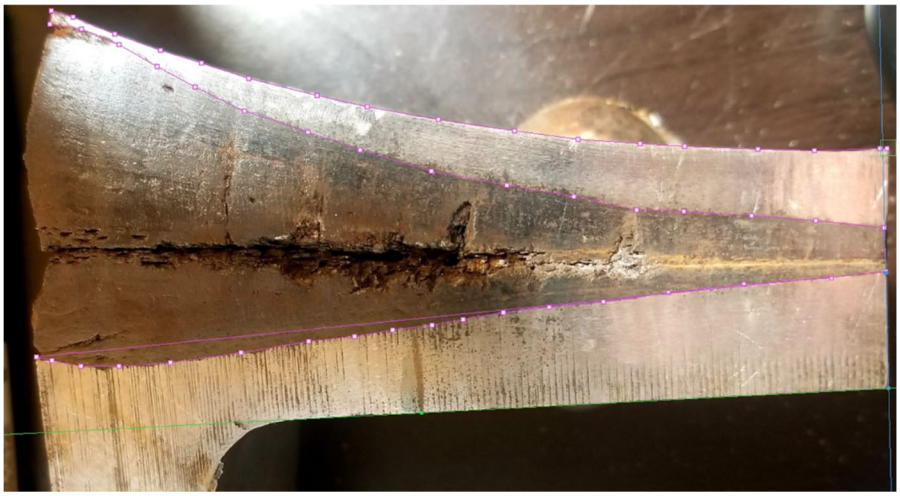

Figure 1 – Mapped corrosion for FE modeling from member obtained from Minnesota

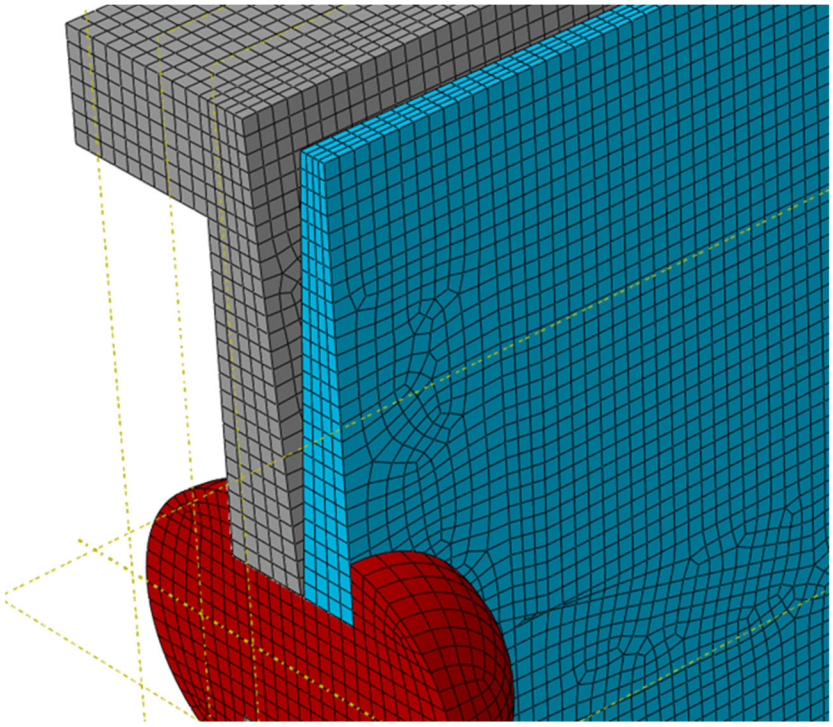

Figure 2 – close-up of FE model used to estimate stresses and forces generated due to pack-out

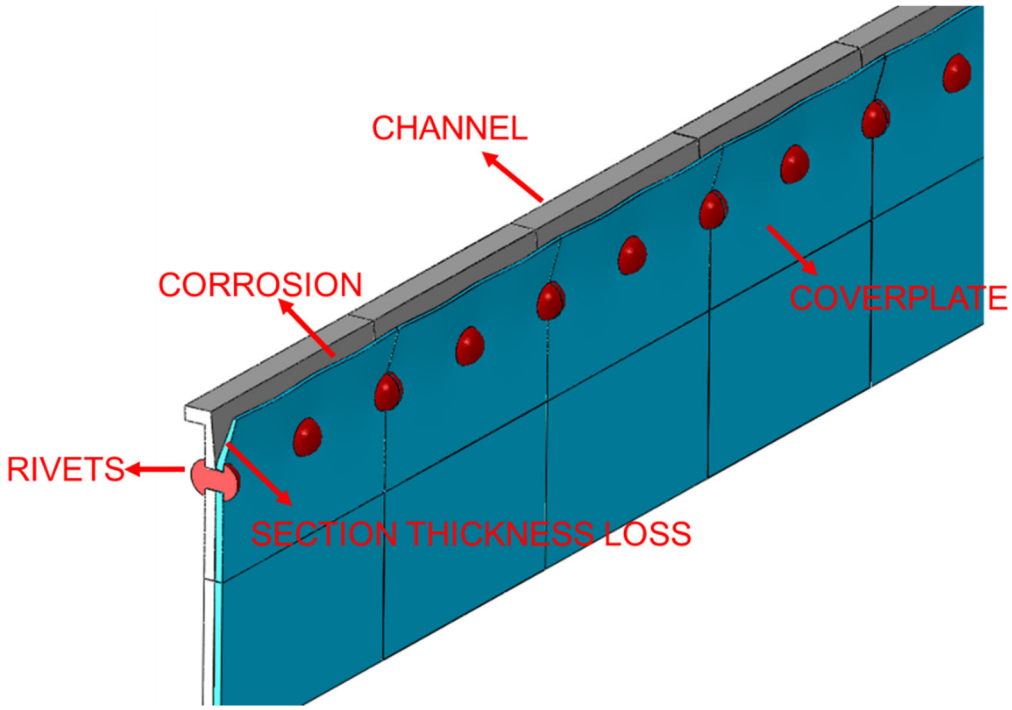

Figure 3 – FE model (solid elements) of portion of member to examine overall state of stress generated at various locations due to pack-out

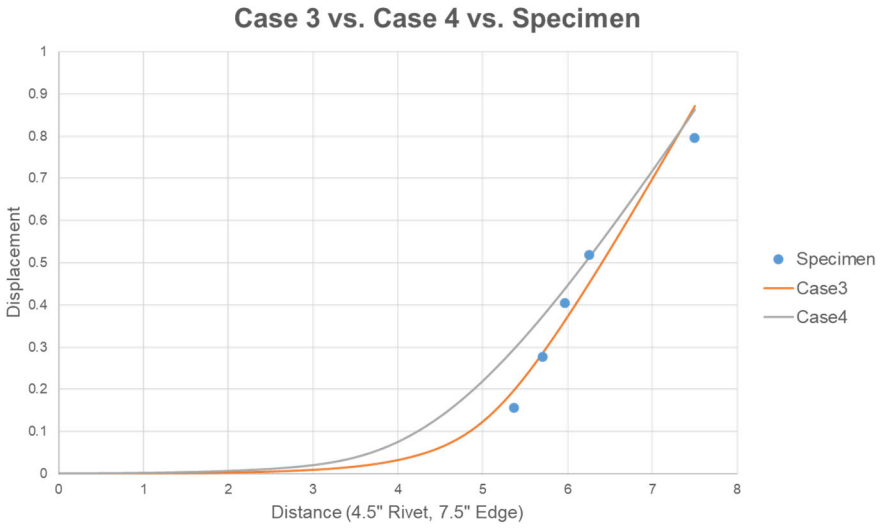

Figure 4 – Predicted and measure displacement using different pressure distributions due to pack-out