TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Date: March 31, 2014

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 5-253***	**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: **Evaluation of Member Level Redundancy 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:** 9/1/2011
Original Project End Date: 8/31/2014	**Current Project End Date:** 8/31/2014	**Number of Extensions:** None

Project schedule status:

☐ On schedule X 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
$600,000	**$310,968**	**55%**

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$13,968	**2.3%**	**80%**

Project description:

The objective of this research project is to quantify the redundancy possessed by built-up members. For example, a riveted built-up member will not typically "fail" if one of the components fractures. However, there is very little experimental data which is available to quantify the remaining fatigue life or strength of a member in which one of the components has failed. Furthermore, if built-up members are located in bridges classified as fracture critical, when significant member redundancy can be shown the bridge may not need to be classified as FC. However, doing so would release these members from the more rigorous arms-length inspection currently required. As a result, should a component fail, it may go undetected for an extended interval. Thus, a portion of the project is devoted to setting rational inspection intervals for these members. Lastly, the advantages of using built-up members fabricated with HPS components fastened using HS bolts in new construction will also be explored.

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

- Received repaired actuator valve and reassembled in test fixture.
- Developed method for using brittle welds to produce larger energy release in built-up specimens (see Figure 1).
- Attempted to fracture the bottom cover plate of specimen 36-2 using brittle welds as a fuse element. This attempt did not produce a brittle fracture. Subsequent fatigue cycles produced rapid deterioration of the bottom cover plate at the brittle weld location due to poor welding (intended to propagate fracture). Following the failure of the bottom cover plate, the specimen was tested in fatigue at a stress range of ~6.5ksi and showed no signs of cracking up to 20,000,000 cycles.
- Developed alternate method of increasing stress concentration at crack tips using a combination of brittle welds and a driven wedge (see Figure 2).
- Fractured cover plate of specimen 46-4 using brittle weld/driven wedge method (see Figure 3).
- Initiated fatigue cycles of specimen 46-4.
- Continued work on FE analysis. FE models using built-up riveted plates have been created and are being compared with experimental data.

Anticipated work next quarter:

- Continue reviewing relevant literature.
- Fabrication of additional cover plates using thicker material (1", 1-1/2") to produce larger energy release at fracture event.
- Material testing on recently received flange angle and cover plate material.
- Instrumentation of specimens.
- Place orders for remaining built-up specimens.
- Continue FE analysis.

Significant results:

During the past quarter, the major steps forward included:

1. Two additional specimens have been tested.
2. Developed new methods for producing brittle fracture on built-up steel members.
3. Continue FE analysis.

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 at this time. Too early in the research.

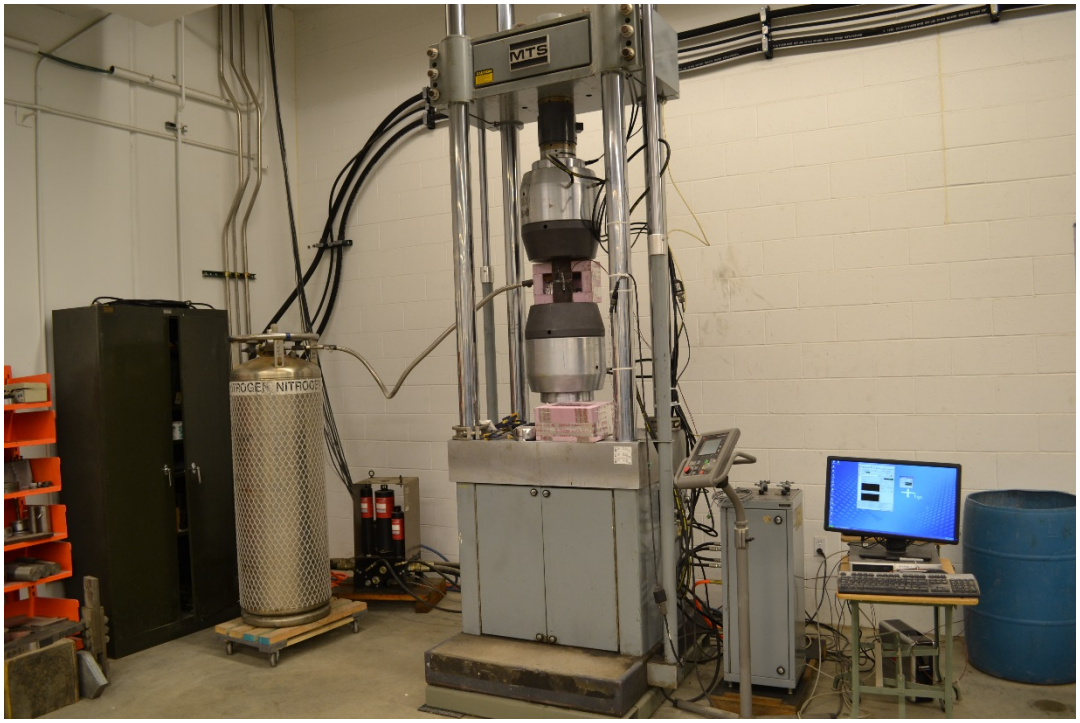

Figure 1: Test setup for evaluating of brittle weld fracture method

Figure 2: Test setup for evaluation of driven wedge method for producing brittle fracture

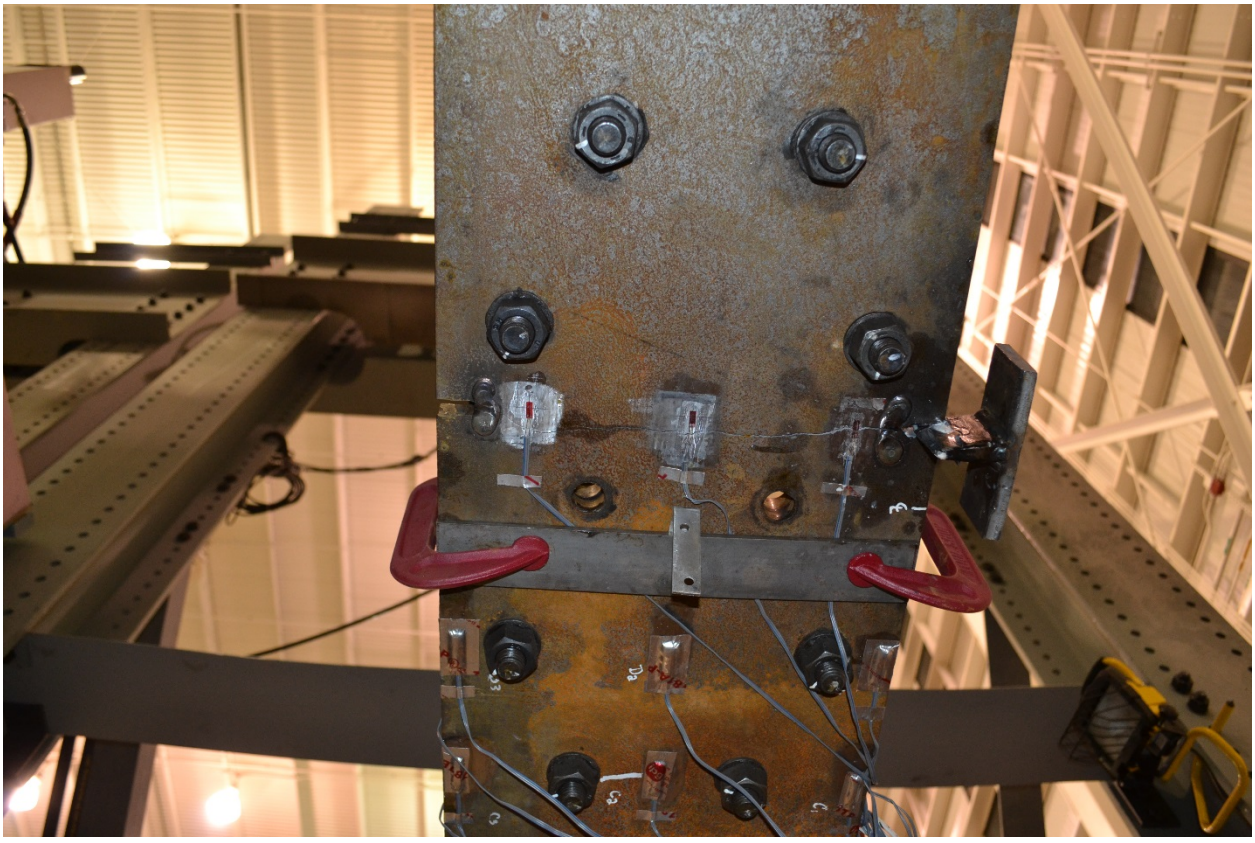

Figure 3: View looking up at fractured cover plate of specimen 46-4