

## Texas Transportation Pooled Fund Project – Progress Report

<b>Project Title:</b> Investigation of the Fatigue Life of Steel Base Plate to Pole Connections for Traffic Structures	
<b>Project Number:</b> TPF-5(116) / 9-1526	<b>Project Manager – Name &amp; Contact Info:</b> Tim Bradberry, Bridge Division, TxDOT tbradber@dot.state.tx.us
<b>Term of Contract:</b> 11/4/05 – 8/31/08	
<b>Reporting Period:</b> 03/01/08 – 05/31/08	
<b>Work Performed and Progress:</b>	
<b>A. Progress to Date, by Task</b>	
<p>1) <b>Literature Review-</b> We have reviewed all the work that has been completed. We are exchanging data with Sougata Roy at ATLSS and await the results of Professor Connor’s work at Purdue on high mast towers.</p>	
<p>2) <b>Development of Test Plan-</b> - The test plan for the first and second phases were developed in previous reporting periods. The second phase specimens arrived in August, with testing of these specimens being completed.</p>	
<p>We have contacted other fabricators to supply mast arm specimens. We have received one set of specimens from Pelco which have been tested and received a set of specimens from Union Metal. Pelco supplied the test specimens free of charge.</p>	
<p>Another round of high mast specimens is needed to develop details than can improve fatigue performance and to look at the effect of pole diameter upon the results. TxDOT has solicited participating states for additional funding to perform this work.</p>	
<p>3) <b>Fatigue Testing-</b> The testing of the first set of specimens was completed last year. We prepared the test fixtures to accept the new end plate hole patterns used in the second phase mast arm specimens. We have completed tests of 8 pairs of mast arm specimens. The test results are given in the table under heading ‘Other Information’ at the end of this report. The specimens produced excellent fatigue performance. Many of the specimens did not fail at a stress range of 12 ksi. The stress ranges on the later specimens were increased to 18 and then 24 ksi to produce a failure. The latest specimens with a peened weld did not fail at a stress range of 24 ksi after 10 million cycles. The testing of these mast arm specimens should be completed the spring of 2008</p>	
<p>The high mast specimen testing has been much slower. These large specimens are tested at lower testing frequency. The first</p>	

set of high mast specimens with the Texas ground collar connection and a 3 in. base plate went to 4,034,441 cycles at a stress range of 12 ksi without failure. The test was stopped and the specimens flipped over testing restarted at a 18 ksi stress range. The specimen failed on the bottom side after 68,923 cycles. The short additional life was attributed to an undetected crack during the first part of the test.

The second pair of high mast specimens was cycled at the 18ksi stress range. During the testing of these specimens the rod eye end fixtures fatigued. After two failures the testing was stopped and new larger rod eyes and mating pins and clevises were ordered. This equipment came in just before the end of the year. The fabrication of new support fixtures to match these new pieces is underway. We expect to begin testing of the high mast specimens before the end of January.

4) **Analytical Studies-** The analytical studies were begun. However, due to the effort spent in designing the new specimens and analyzing the fatigue results, the finite element study was not started. A study of the relationship between connection stiffness and fatigue performance was investigated and has shown some interesting trends. The stiffness-fatigue life relationship is included in the second master thesis which will be completed this summer. The thesis, which also includes presentation of the mast arm results, will be distributed to the sponsors. In addition the relationship between tip deflection and connection fatigue stress range has been studied for signal mast arms.

5) **Summary of Results-** Master's thesis describing the first phase test results was sent out to the sponsors. An update of the second phase mast arms test was sent out in the Fall of 2007.

B. **Meetings/Conferences-** A progress meeting was held on May 1, 2008 at Ferguson Laboratory, and the scope of additional testing was developed. Each participating state has been asked to contribute an additional \$25,000.

**C. Other Information**

Testing Sequence Mast Arms

Testing Sequence	Specimen Code	Base Plate Thickness and Arm Diameter (in)	Base Plate Dimensions (in)	Base Plate Hole Pattern (in.)	Weld Detail	Galvanized	Manufacturer	Stress Range (ksi)	Fatigue Life Spec. A	Fatigue Life Spec. B	Comments
1	10-3S-WY-PB-A,B	3-10	15.25x15.25	12.50x12.50	WY Full Pen.	No	Pelco	12	6,734,487	5,219,304	
2	10-2S-WY-VG-A,B	2-10	15.25x15.25	12.50x12.50	WY Full Pen.	Yes	Valmont	12	<b>12,602,940</b>	<b>12,602,940</b>	Runout
3	8-2S-WY-VG-A,B	2-8	15.25x15.25	12.50x12.50	WY Full Pen.	Yes	Valmont	24	856,122	1,603,632	Runout Spec. B
3 cont.								24	747,510		Failed at A twice
4	8-2S-S-VG-A,B	2-8	15.25x15.25	12.50x12.50	Socket Fillet Weld	Yes	Valmont	18	512,860	653,208	
5	12-2S-WY-VG-A,B	2-12	15.25x15.25	12.50x12.50	WY Full Pen.	Yes	Valmont	18	1,053,554	880,807	
6	12-2S-EC-VG-A,B	2-12	15.25x15.25	12.50x12.50	External Collar	Yes	Valmont	18	<b>805,991</b>	468,601	Runout Spec. A
6 cont.										337,390	Failed at B twice
7	10-3R-WY-VG-A,B	3-10	12x18	9x15	WY Full Pen.	Yes	Valmont	18	<b>8,037,420</b>	<b>8,037,420</b>	Runout
7 cont.								24	439,511	342,175	Retest
8	10-3R-WY-VP-A,B	3-10	12x18	9x15	WY Full Pen.	Yes and Peened	Valmont	24	<b>10,055,123</b>	<b>10,055,123</b>	Runout
9	10-3R-WY-VB-A,B	3-10	12x18	9x15	WY Full Pen.	No	Valmont				
10	10-2SR-WY-VG-A,B	2-10	15.25x15.25	9x12	WY Full Pen.	Yes	Valmont				
11	10-2SR-EC-VG-A,B	2-10	15.25x15.25	9x12	External Collar	Yes	Valmont				
12							Union Metal				

**Expenditures Life-to-date: \$ 409,753**

