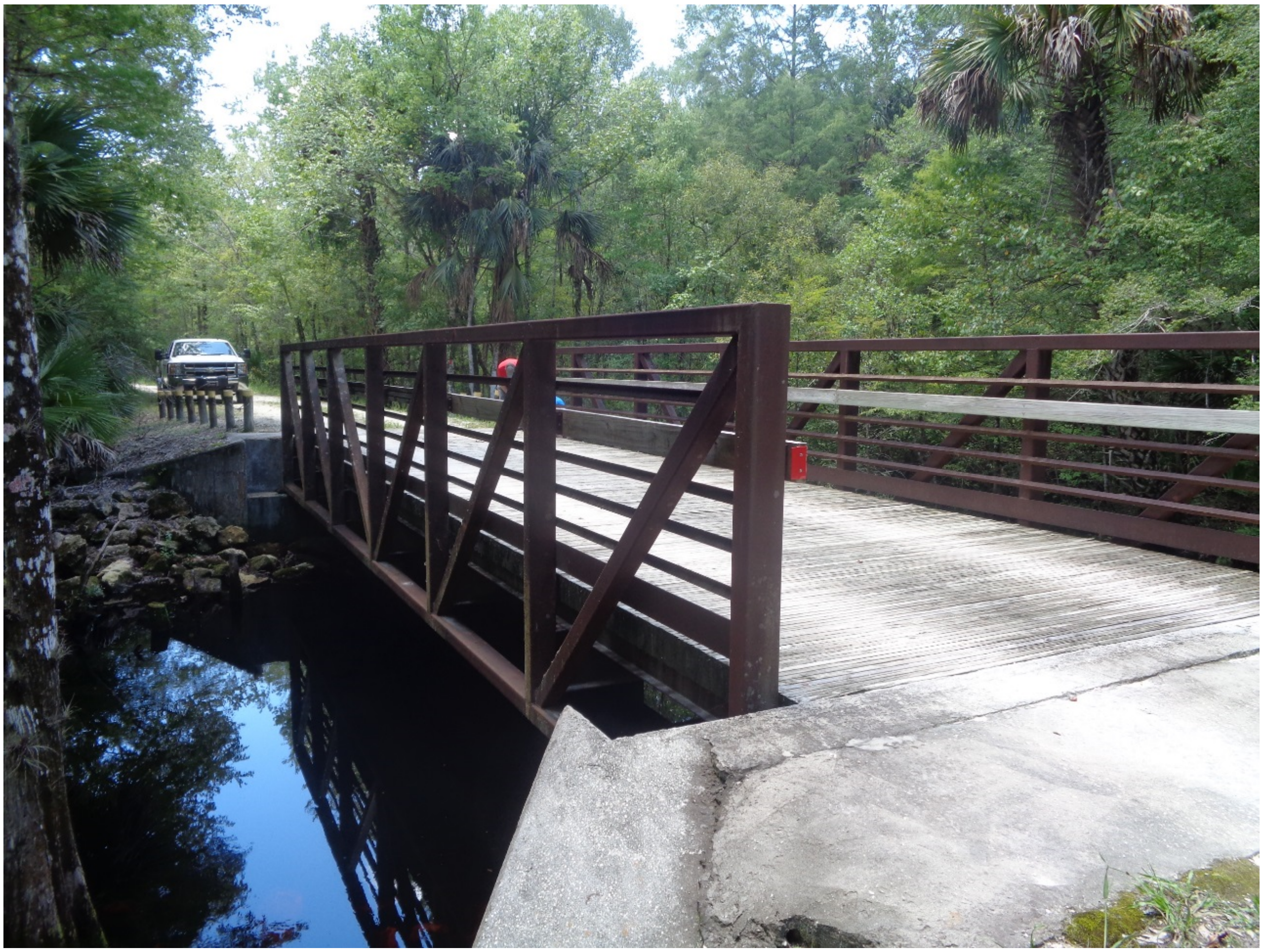
MAIN GRADE ROAD BRIDGE NO. 3
SPECIAL COATINGS REPORT – OCTOBER 2017



PREPARED FOR THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
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Southwest Florida
Water Management District

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INTRODUCTION

Greenman-Pedersen, Inc. has completed a preliminary field survey of the weathering steel on Main Grade Road Bridge No. 3 located in the East Tract of the Green Swamp Wildlife Management Area in Polk County, Florida. The purpose of this evaluation was to determine the condition of the existing weathering steel and to recommend alternatives for mitigating current and inhibiting future corrosion.

The field survey was performed on July 11, 2017 by Mr. Frank Rea, NACE certified Protective Coatings Specialist (PCS). Access to the structural steel on the bridge was on foot. Messrs. Jeff O-Connor, P.E., UESI, Inspection Team Leader and Juan Ortega-Rosales, P.E., GPI Senior Structural Engineer, were also present at the time conducting a bridge element ultrasonic thickness investigation.

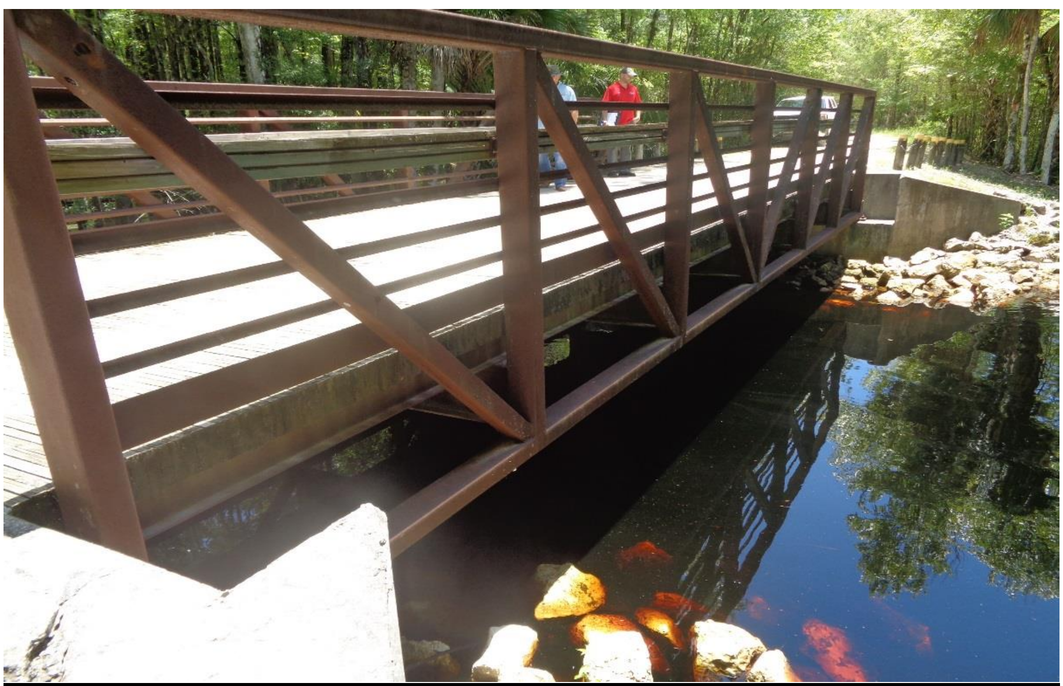
The field survey consisted of the following:

Visual Observations - Visual determination of the type and distribution of corrosion. The surrounding environment was also noted as this may be important when selecting a coatings maintenance alternative.

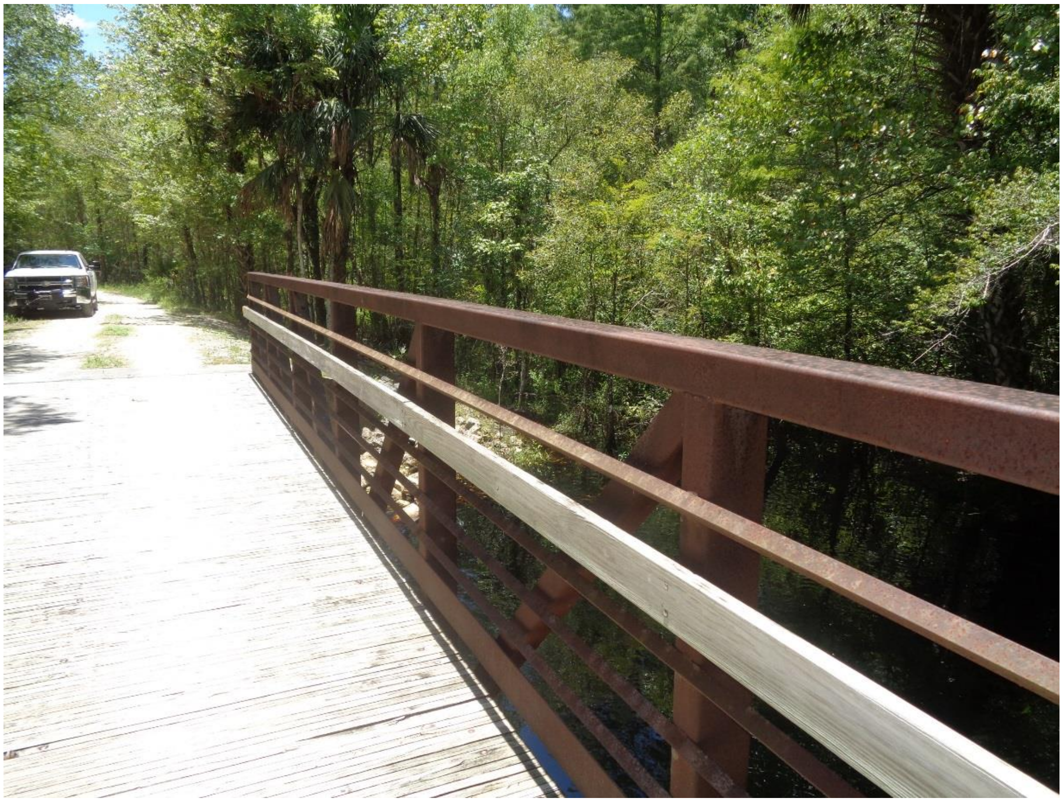
Photographs - Pictures of unique and typical conditions found throughout the field survey were taken and included as part of this submission. These illustrate the conditions described and documented in the test results.

FIELD SURVEY

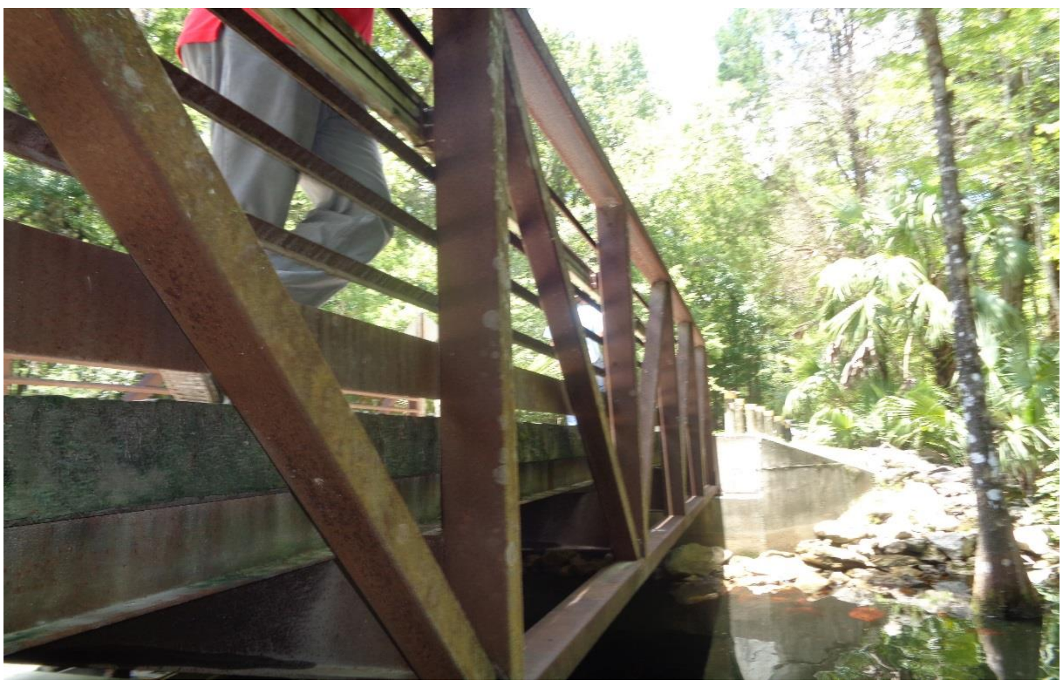
The structure is located in an area described as Environmental Zone 2A by the Society for Protective Coatings (SSPC) Steel Structure Painting Manual, Volume 2. Environmental Zone 2A is defined as frequently wet by fresh water where surface may be subject to condensation, splash, spray or frequent immersion. The lowest point of the structure, the bottom chord, was less than 4 feet above the water level underneath. For this survey, two areas with differing conditions were observed: (1) trusses and (2) floor system. The trusses which are exposed to sunlight and some air movement exhibited spot corrosion varying from 65% to 90% of weathering steel surfaces. The remainder of truss surfaces were covered with light, general rusting. General, pitting rust was present on approximately 75% of floor beam and stringer weathering steel surfaces and the remainder of surfaces exhibited spot corrosion. Rust nodules and scaling rust were observed on nearly all of the bottom surface of the bottom flanges. Although the structure was surveyed in the mid-afternoon in 90°F and partly cloudy conditions, moisture was still evident on weathering steel surfaces beneath the bridge. The photos below represent the present conditions during this survey.



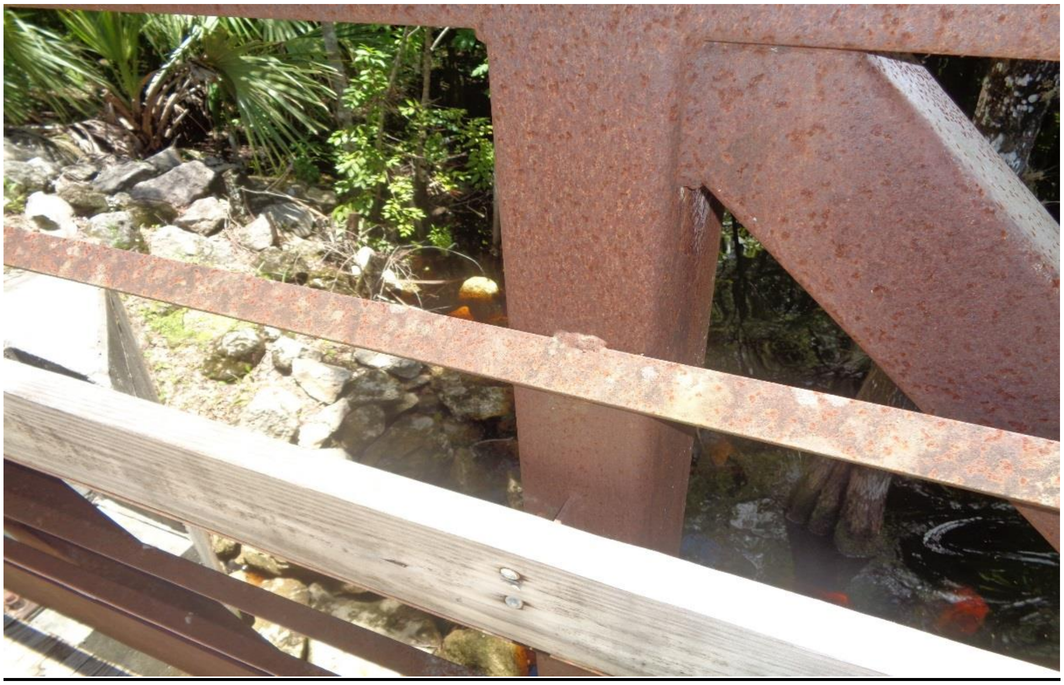
Photograph No. 1 – General View from Southwest



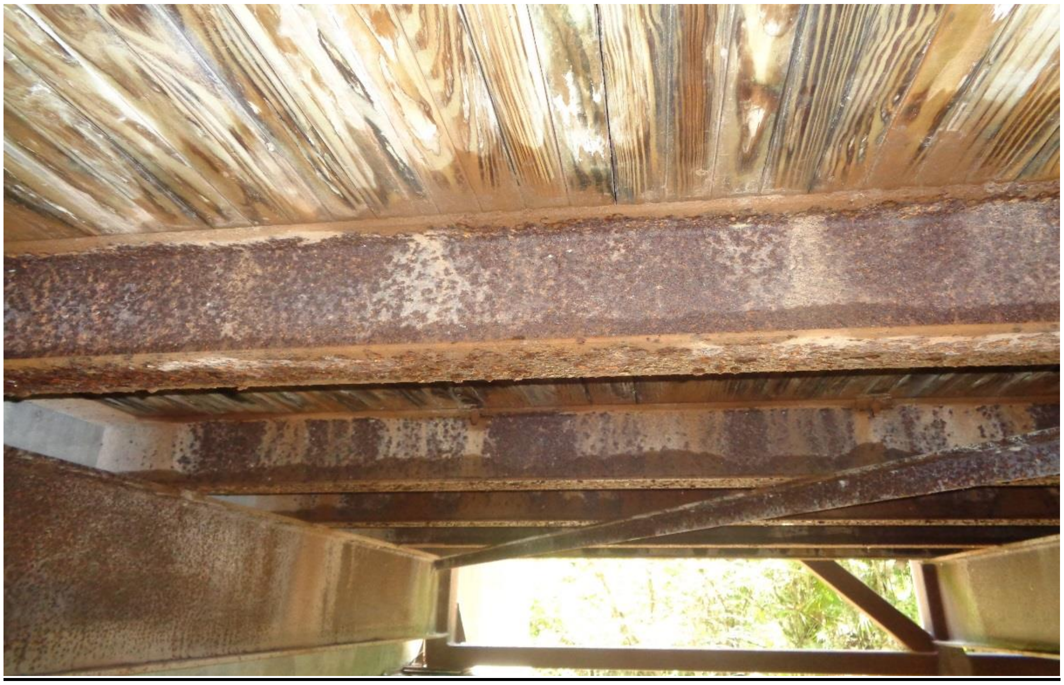
Photograph No. 2 – General View of South Truss



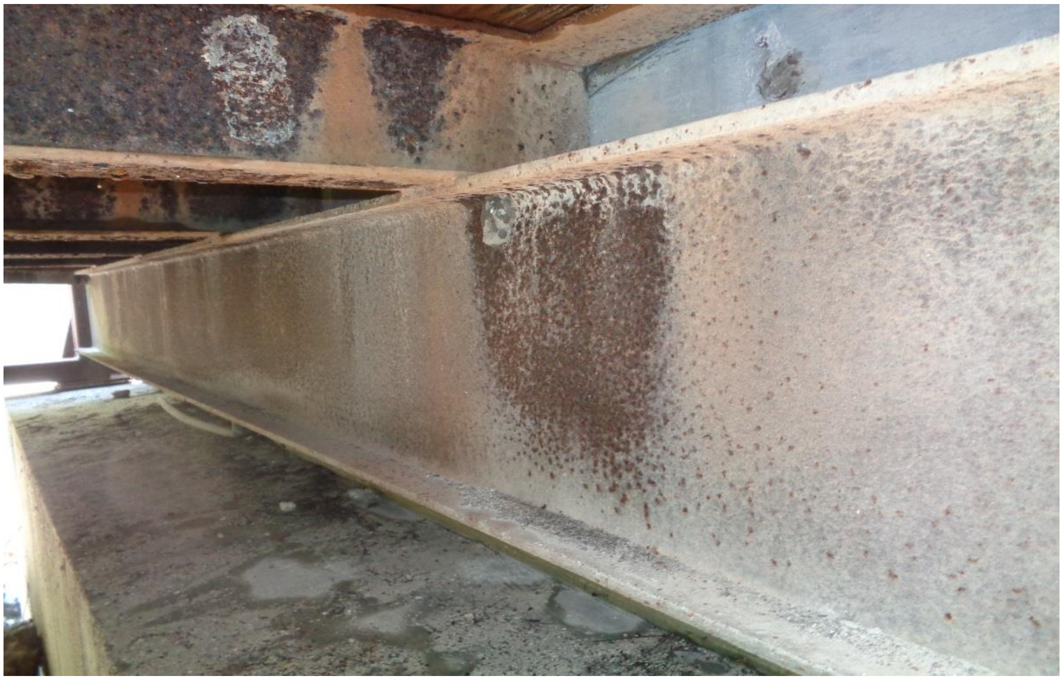
Photograph No. 3 – General View North Truss



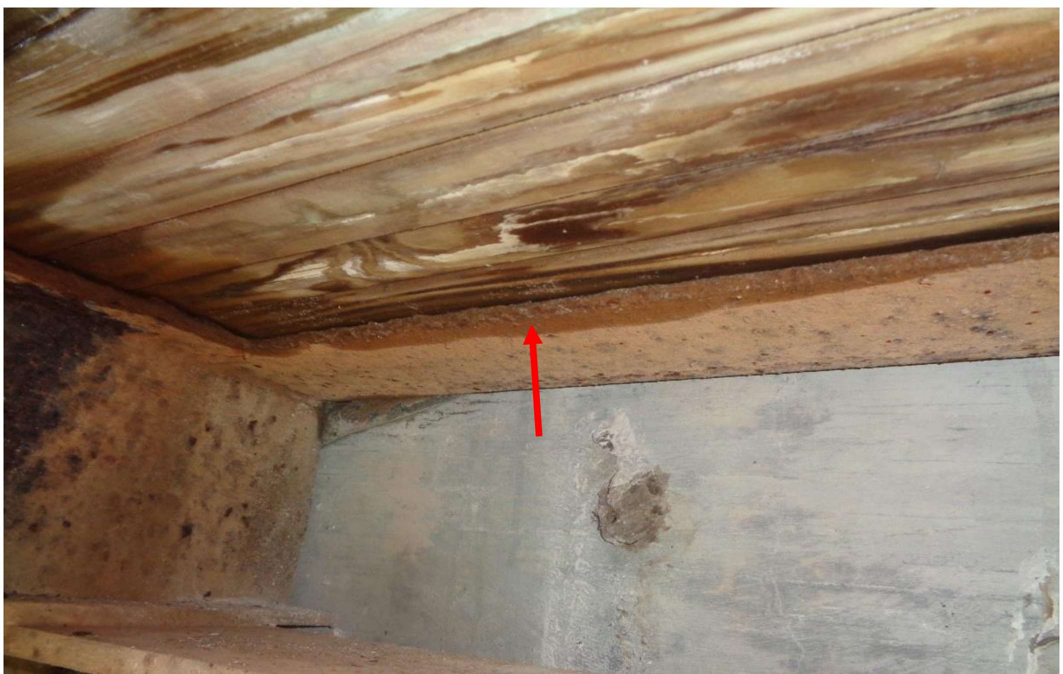
Photograph No. 4 – Chord Vertical/Diagonal/Safety Rail



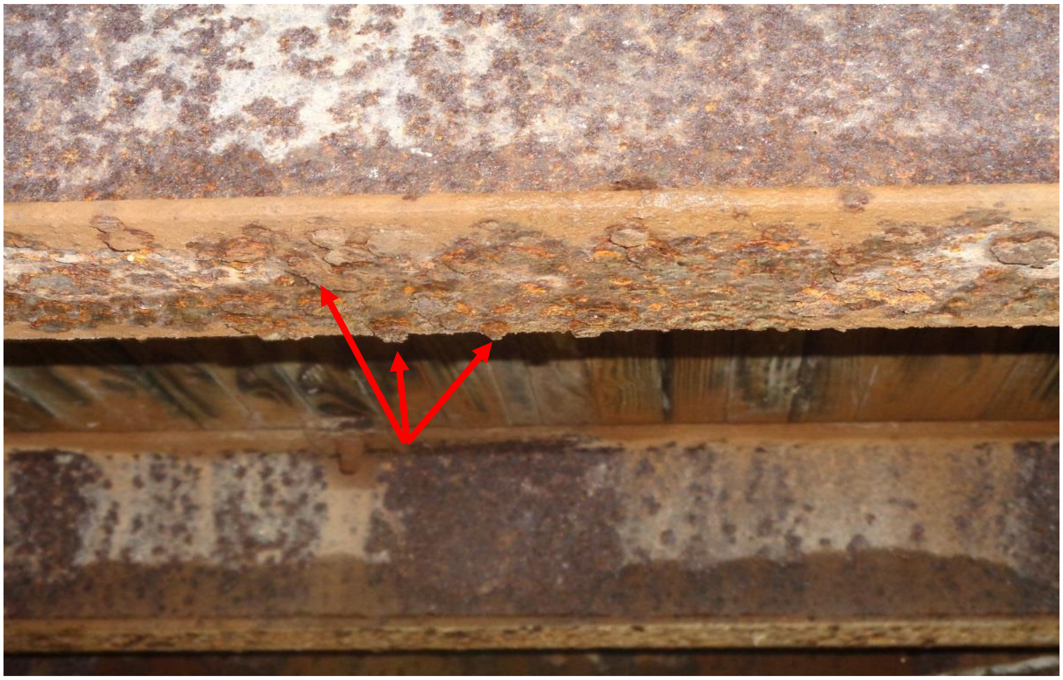
Photograph No. 5 – General View from Underneath
Extensive Pitting



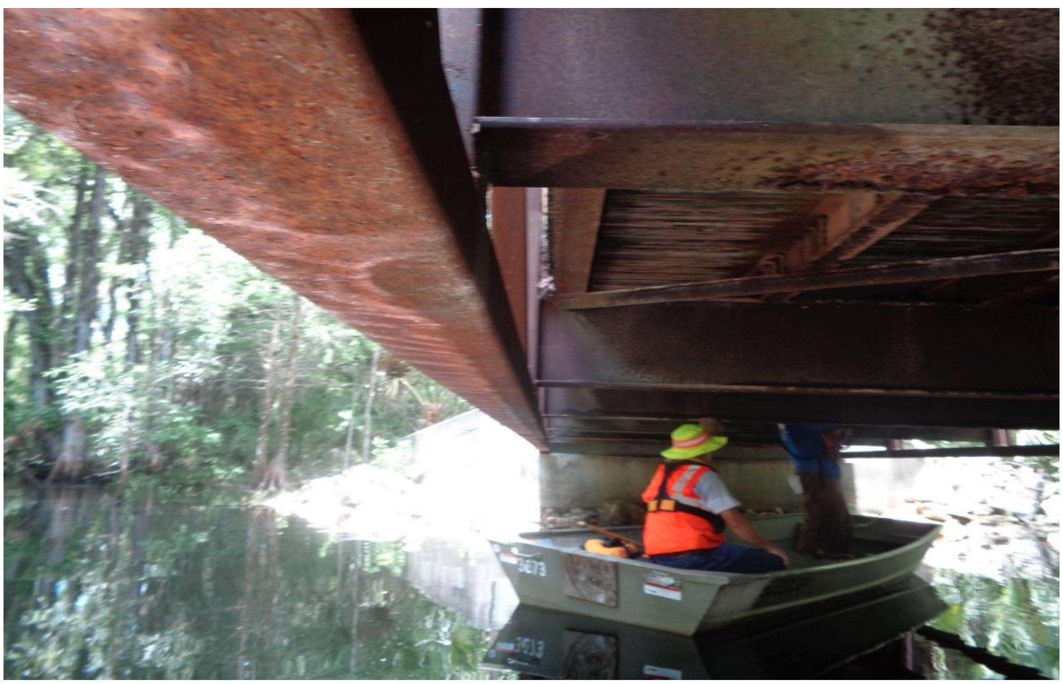
Photograph No. 6 – Floor Beam



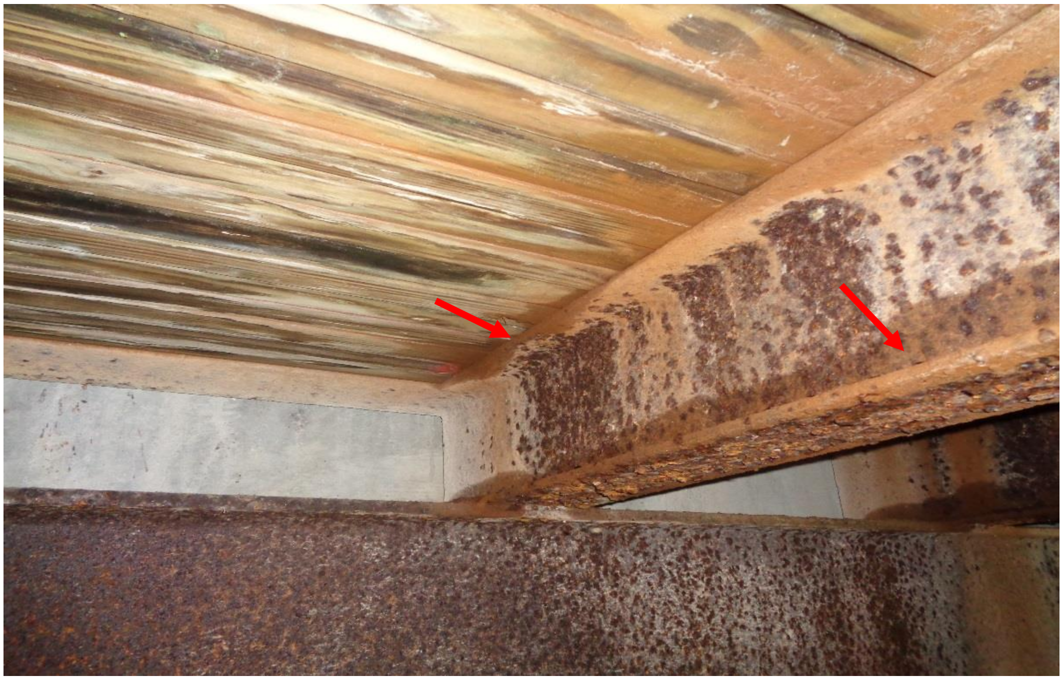
Photograph No. 7 – Corrosion of Top Flange Caused by Entrapment/Holding of Moisture by the Wooden Deck



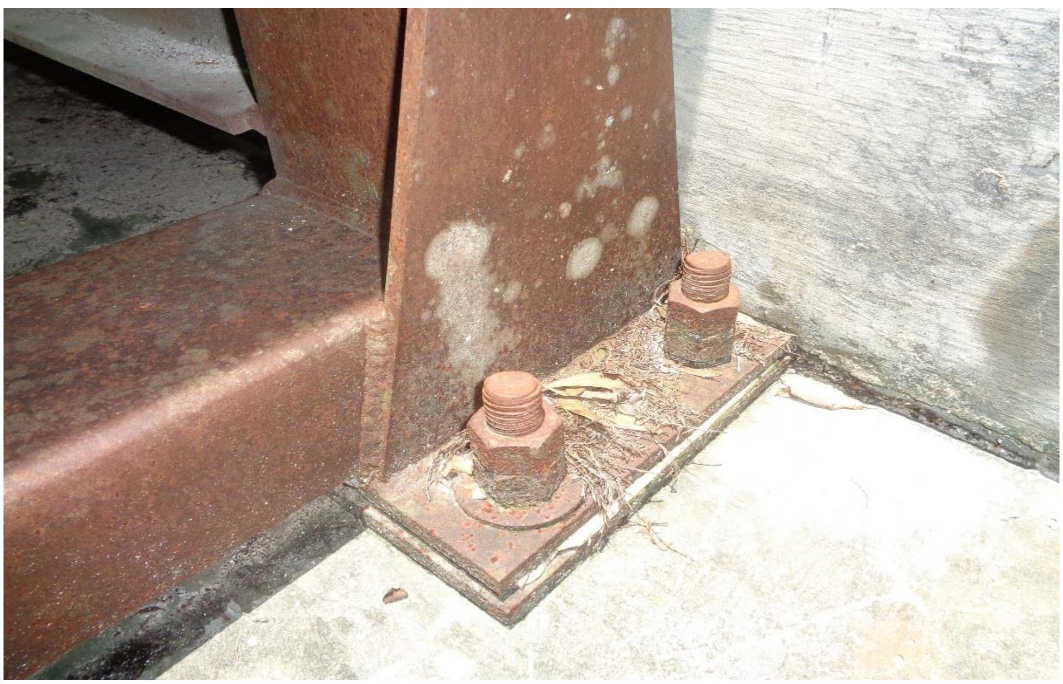
Photograph No. 8 – Rust Nodules on Bottom Flange Caused by Condensate



Photograph No. 9 – General View from Underneath



Photograph No. 10 – Moisture is Still Present Even Though Photo was Taken at the Peak of the Day Heat, approximately 2:00 pm



Photograph No. 11 – Typical Condition of Fasteners

DISCUSSION/RECOMMENDATION

The development of a protective layer (patina) on weathering steel can take years to form and is dependent upon the environmental conditions present at the location where the weathering steel is located. For optimum formation of a dense, tightly adhered patina, wet and dry cycles are necessary. In this case, the vertical clearance over the water is less than the recommended minimum of 7-8 feet. Further, a continuously humid environment with little air movement all but eliminates dry cycles. Therefore, a complete patina has not formed over most surfaces of the weathering steel on this structure. The location of pitting rust on stringers and in areas where the wooden deck traps moisture against the weathering steel confirms this conclusion. Although the structure was surveyed in the mid-afternoon in 90ºF and partly cloudy conditions, moisture was still evident on weathering steel surfaces beneath the bridge.

GPI has gathered sufficient information and test results to discuss the available coating rehabilitative options for consideration on the subject bridge structure. This discussion is based on accepted industry standards and proven techniques. Prior to beginning this investigation, the available options for any steel structure included the following;

1. Do Nothing: This option is viable when the inspection indicates very little corrosion or light, general corrosion and the corrosion rate does not suggest section loss before the next coatings maintenance.

2. Spot Repair: This option is chosen when spot or pitting corrosion is less than 25% of the total surface area and distribution of the rust allow for economical surface preparation and coatings application of the affected areas.

3. Spot Repair with an Overcoat: This option is selected when the conditions for spot repair exist. A spot repair is done followed by application of a full coat or coats of paint for additional protection and for aesthetic purposes (uniform appearance).

4. Zone Painting: This option is preferable when discrete areas with differing conditions are present or when budget only allows for maintenance painting of a portion of the structure.

5. Ultra-high Pressure (UHP) Water Jetting and Surface Tolerant Coating System: This option consists of UHP Water Jetting down to tight rust and application of a surface tolerant 100% solids epoxy penetrant sealer, an aluminum epoxy mastic primer and an aliphatic polyurethane finish coat. A surface tolerant calcium sulfonate alkyd coating system could also be used, but unfortunately this system either never cure to or takes a very long time (sometime months) to cure to a tack-free, hard finish. A significant amount of insects (especially love bugs in Florida) exist in this environment and could get stuck in the calcium sulfonate alkyd finish, resulting in an unacceptable appearance.

6. Abrasive Blasting and Complete Coating System: This option minimizes risk of premature failure of maintenance coatings because it does not rely on adhesion to and performance of coatings applied over marginally prepared surfaces or existing coatings. Two coating system alternatives exist for Option 6, namely (A) abrasive blast | metallizing | sealer | aliphatic polyurethane finish coat and (B) abrasive blast | organic zinc rich epoxy primer | epoxy intermediate coat | aliphatic polyurethane finish coat.

When choosing an option one must consider the technical feasibility and the life cycle cost. The current amount, type and distribution of the corrosion is much greater than 25%, consists of considerable pitting and scaling rust and is not located in isolated, discrete areas, respectively. Anything less than aggressive, comprehensive surface preparation will result in a temporary solution. Therefore, from a technical feasibility standpoint Options 1 through 4 are not recommended.

The cost of mobilization/demobilization, rigging and containment will be a constant, sunken cost regardless of whether the structure is abrasive blasted or water jetted. It is also the most expensive cost of a coating project, up to 65% of the total cost. Moreover, the life cycle costs for the three alternatives remaining would be: Option 5, UHP water jetting/liquid coatings: $12/ft^2 divided by a 15 year life expectancy = $0.80. Adjusted to a 50 year life cycle the result would be $2.66/ft^2/year; Option 6(A): abrasive blast | metallizing | aliphatic polyurethane finish coat: $45/ft^2 divided by a 50 year life expectancy = $0.90/ft^2/year; and Option (6B) abrasive blast | organic zinc rich epoxy primer | epoxy intermediate coat | aliphatic polyurethane finish coat: $11/ft^2 divided by a 20 year life expectancy = $0.55/ft^2/year. However, the bridge would have to be cleaned and painted 2.5 times to achieve the 50 year life expectancy of Option 6(A) so the overall total life cycle cost would be 2.5 X $0.55/ft^2/year = $1.38/ft^2/year. The life cost for Option 6(B) would be less if the second cleaning and painting could be effectively achieved by spot touch-up and overcoating. Also, of consideration is the schedule. Since Option 6(A) would require blasting, metallizing, adhesion testing and sealing in the same day, the production rate would be approximately 120 square foot per day. Assuming one blaster, the production rate for Option 6(B) would be approximately 900 square foot per day for blasting and priming. An additional blaster would essentially double the production rate of Option 6(B) but not Option 6(A). Although the life cycle cost is estimated as higher than Option 6(A); considering the initial cost, possibility of a lower life cycle cost for Option 6(B) if partial maintenance painting is effective, and schedule, GPI recommends Option 6(B).

The values used for the cost estimates are approximate and relative. Although actual cost may vary, the relative costs are constant. Also, the life expectancies are based on practical life expectancy (corrosion protection) not ideal life expectancy (corrosion protection and new or close to new appearance). Minor touch-up and/or an aesthetic coat of finish paint to re-fresh color and gloss are not included in the cost estimates.