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LETTER OF TRANSMITTAL

TO: Steamboat Structures
Denver Metro, CO

DATE: 6/17/2021

FILE NO. 002-01

ATTN: Heather Reed

RE: Forest Lakes Bridges

WE ARE SENDING YOU:

- | | | |
|---|---|----------------------------------|
| <input checked="" type="checkbox"/> Shop Drawings | <input type="checkbox"/> Copy of Letter | <input type="checkbox"/> Samples |
| <input type="checkbox"/> Specifications | <input type="checkbox"/> Reports | <input type="checkbox"/> _____ |
| <input type="checkbox"/> Plans | <input checked="" type="checkbox"/> Submittal Information | |

SUBMITTED BY: Structures

| COPIES | DESCRIPTION | CONTRACTOR |
|--------|--------------------|------------|
| 1 | Piling WEAP Report | Structures |
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THESE ARE TRANSMITTED:

- | | | |
|--|--|---|
| <input checked="" type="checkbox"/> For Approval | <input checked="" type="checkbox"/> For Review and Comment | <input type="checkbox"/> Returned for Corrections |
| <input type="checkbox"/> For Your Use | <input type="checkbox"/> Approved As Submitted | <input type="checkbox"/> _____ |
| <input type="checkbox"/> As Requested | <input type="checkbox"/> Approved As Noted | |

REMARKS:

cc: File

SHOP DRAWING REVIEW

- ☒ NO EXCEPTIONS ☐ REVISE AS NOTED
☐ REVISE AND RESUBMIT ☐ REJECTED

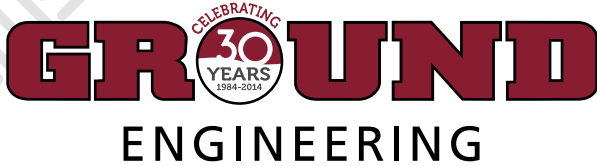
This review is for general conformance with the design intent of the project and general compliance with the information provided in the contract documents. Review, corrections, or comments made concerning the shop drawings during this review do not relieve the contractor from compliance with the requirements of the drawings and specifications, nor relieve the contractor of contractual responsibility for any error or deviation from the contract documents.

The contractor is responsible for, but not limited to: confirming all quantities, dimensions, and structural capabilities, selecting fabrication and construction techniques, coordinating work with that of all other trades, and performing work in a safe and satisfactory manner.

STEAMBOAT STRUCTURES, LLC

By: Heather Reed

DATE: 06/23/21



May 5th, 2021

Job Name: Pile Foundations, WEAP
Analysis: **Forest Lakes Bridges,**
Monument, Colorado

Job Number: 21-8536

Structures Inc.

4 Inverness Court East, Suite 250
Englewood, CO 80112

Attn: Elliot VanStelle

GROUND Engineering was requested to perform a WEAP Analysis (Wave Equation Analysis) for the proposed piles to be driven for the Forest Lakes Bridges (Mesa Top Drive South over North Beaver Creek) located in Monument, Colorado. The contractor proposes to use a D 19 single acting diesel impact hammer to drive the piling.

A Wave Equation Analysis is provided based on the following:

- Hammer Data: provided by Structures Inc. (D19 Diesel Fueled Open-Ended Hammer).
- Pile Data: Forest Lakes Bridges Foundation Layout, Sheet B08, dated 1/21/21.
- Subsurface Forest Lakes Bridges Engineering Geology, Sheet B05, dated 1/21/21

Based on the provided information above, a WEAP Analysis was prepared for the proposed bridge foundations. The soil profile utilized for this wave equation analysis was referenced from the engineering geology identified above. The plans indicate that 12 X 53 H-piles are to be driven to depths ranging from 19 to 26 feet for Abutment #1 and 26 to 30 feet for Abutment #3. Pile penetration depths may be more or less depending on the materials encountered at the specific pile locations.

The plans reference a "MAX LOAD (FACTORED) (KIPS)" of 215 kips for Abutment #1 and 200 kips for Abutment #3. Utilizing typical AASHTO/LRFD design methods the maximum factored design load is to be divided by the resistance factor of 0.65 to compare against maximum capacity resistance measured from the PDA. Utilizing the loads provided and the resistance factor, a resistance value of **331 kips** was calculated for Abutment #1 and **308 kips** for Abutment #3.

As common practice, GROUND requests that the structural engineer verify the load and factor to be used. Per the specification, PDA data records obtained from the end of driving will be analyzed using the CAPWAP computer program for signal matching analysis.

**Forest Lakes Bridges
Monument, Colorado
WEAP Analysis**

Bearing charts (shown in Appendix A) provide increasing capacity values as a function of blow count and include a capacity ranges that encompass the minimum factored (ultimate) load to be compared to with the PDA testing. The bearing charts are prepared assuming the proposed diesel hammer is in good working order.

The bearing charts are produced for fuel setting 4 (maximum fuel setting) of the provided hammer. Based on the available data, the proposed hammer should be adequate to drive the proposed piling to the required capacity within the allowable stresses of the piling (less than 0.9 of the yield strength of steel or less than 45ksi). The following table is provided to estimate blow count at design capacities based on the WEAP data.

| Location | H-Pile Section | Pile Load (kips) | Estimated Blow Count Range (blows/inch) |
|-----------------|-----------------------|-------------------------|--|
| Abutment #1 | 12 x 53 | 331 | 4-6 |
| Abutment #3 | 12 x 53 | 308 | 4-6 |

The attached data and estimations above are based on theoretical models and approximated subsurface modeling. This data should be used as a guide during driving and should not be used to determine final resistance (capacity) versus blow count criteria. Final blow count criteria should be established based on the PDA and CAPWAP results after driving the test piles for the given hammer and established fuel setting. In addition, this does not supersede any applicable minimum tip or minimum penetration requirements as dictated by the project documents.

Please do not hesitate to contact this office with any questions concerning this report.

Sincerely,

GROUND ENGINEERING CONSULTANTS, INC.

Jaro Lepic

Reviewed by Kelsey Van Bommel, P.E.

Appendix A

Bearing Chart Performed at Fuel Setting #4:

➤ Abutment #1

Ground-Eng-Consultants
Forest Lake Bridges Abut #1

06-May-2021
GRLWEAP Version 2010

| Ultimate Capacity kips | Maximum Compression Stress ksi | Maximum Tension Stress ksi | Blow Count blows/in | Stroke ft | Energy kips-ft |
|---------------------------|-----------------------------------|-------------------------------|------------------------|--------------|-------------------|
| 200.0 | 29.49 | 0.55 | 2.1 | 7.13 | 16.93 |
| 250.0 | 33.46 | 0.80 | 2.8 | 7.51 | 17.10 |
| 275.0 | 35.20 | 0.92 | 3.1 | 7.69 | 17.23 |
| 300.0 | 36.79 | 1.69 | 3.5 | 7.88 | 17.39 |
| 325.0 | 38.38 | 1.69 | 3.9 | 8.08 | 17.74 |
| 331.0 | 38.72 | 1.70 | 4.0 | 8.13 | 17.83 |
| 350.0 | 39.84 | 1.97 | 4.3 | 8.29 | 18.13 |
| 375.0 | 41.64 | 2.74 | 4.8 | 8.49 | 18.51 |
| 400.0 | 43.29 | 3.31 | 5.4 | 8.63 | 18.72 |
| 425.0 | 44.81 | 3.66 | 6.0 | 8.84 | 19.05 |

➤ Abutment #3

Ground-Eng-Consultants
Forest Lake Bridges Abut #3

06-May-2021
GRLWEAP Version 2010

| Ultimate Capacity kips | Maximum Compression Stress ksi | Maximum Tension Stress ksi | Blow Count blows/in | Stroke ft | Energy kips-ft |
|---------------------------|-----------------------------------|-------------------------------|------------------------|--------------|-------------------|
| 200.0 | 29.18 | 0.65 | 2.1 | 7.09 | 17.19 |
| 250.0 | 33.18 | 1.08 | 2.7 | 7.48 | 17.39 |
| 275.0 | 34.90 | 1.37 | 3.1 | 7.67 | 17.61 |
| 300.0 | 36.53 | 1.85 | 3.4 | 7.87 | 17.96 |
| 308.0 | 37.09 | 2.04 | 3.6 | 7.95 | 18.09 |
| 325.0 | 38.20 | 2.34 | 3.9 | 8.09 | 18.33 |
| 350.0 | 40.44 | 2.73 | 4.3 | 8.31 | 18.66 |
| 375.0 | 42.53 | 3.05 | 4.8 | 8.52 | 19.08 |
| 400.0 | 44.34 | 3.41 | 5.5 | 8.69 | 19.37 |
| 425.0 | 46.12 | 3.83 | 6.1 | 8.92 | 19.82 |