AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

To: Christopher D. Williams, Construction Resident Engineer

END CEE

From: Eric Denardo, Geotechnical Engineer, via Callie Ewald, P.E., Senior Geotechnical Engineer

Date: May 23, 2014

Subject: Rochester ER BRF 0162 (18) Wave Equation Analysis Review

The following summarizes our review of the wave equation analysis conducted for the piles proposed for the Rochester ER BRF 0162 (18) project. We received a copy of the wave equation analysis provided to Kevin Ture of W.M. Schultz Construction Inc. that was conducted by John Linscott IV of HB Fleming Inc. Mr. Linscott performed wave equation analyses for the pile and hammer proposed for use at the abutments. The MKT DE-42 single-acting diesel hammer was requested for analysis with a maximum rated energy of 42,000 ft-lbs. This hammer was evaluated for the pile-soil system for the Rochester ER BRF 0162 (18) site only.

The characteristics of the proposed pile, hammer, and hammer cushion data were reviewed with the WEAP analysis to ensure the analysis was conducted per the submitted pile and driving equipment data form. Some discrepancies were found in the provided equipment form and analyses output. An APE D19-42 hammer was specified on the submitted cover sheet but the hammer modeled was the MKT DE-42. Also, the stiffness of the hammer cushion differed between the one used in the analysis and the one calculated using the modulus of elasticity provided. Analyzing the stiffness based on the pile driving equipment data form, the driving criterion changed from 6 blows per inch to 5 blows per inch. These discrepancies have been noted in red on the original submittal and are attached to this memo.

For the pile-hammer system, H.B. Fleming modeled the resistance during driving encountered by the pile as 78% end bearing and 22% skin friction triangularly distributed along the pile. The MKT DE-42 only has one fuel setting. Constant capacity analysis was conducted to determine an approximate ram stroke length of 10 feet. Variable capacity analysis was then performed to confirm that the blow count fell in an acceptable range for a stroke length of 10 feet. We are comfortable with the chosen analysis with respect to the subsurface information presented in the boring logs and previous geotechnical reports

Based on a review of the material submitted, we recommend a driving criterion of 5 blows per inch for three consecutive inches with a 10 foot stroke. Mr. Linscott recommends 6 consecutive inches in their report, however based on our Standard Specifications for Construction, we recommend using 3 inches. At these blow counts, the stresses in the pile are expected to remain below 45 ksi per HB Fleming's analysis. A saximeter is required to be on site to monitor the driving process at each substructure. We recommend using a refusal criterion of 10 blows per half inch.

The 2011 VTrans Standard Specifications for Construction, Section 504.02(b), states the pile driving equipment must be capable of driving the pile to the required ultimate capacity at blow counts between 3 and 15 BPI. **Based upon this information and the WEAP analysis, the MKT DE-42 hammer should be able to drive the steel HP 12x84 piles to the desired resistance and stay within the specifications.**

The serial number of the hammer should be recorded and kept in the pile driving records. Also, it is important to note that the thickness and condition of the prescribed Monocast cushion should be inspected prior to driving any piles. **If the thickness of the hammer cushion has decreased by 25%, then the cushion should be replaced, per Agency Specifications.** Generally, the best time to inspect the hammer cushion is when the hammer first arrives on the job, and is placed in the leads.

Attachments: H.B. Fleming's Submittal Cover Sheets – M&R Review

cc: Jennifer Fitch, Project Manager
Project File/CEE

END

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H.B. FLEMING, INC.

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PILE DRIVING BRIDGES SUBMARINE PIPELINES

SUBMITTAL

Submitted To:
Client: W.M. Schults Construction
Attention: Kevin Ture

Date: 4/30/14
Project: Rt. 73 bridge 19
Location: Rochester, VT

Subject: Pile Driving Criteria

H.B. Fleming Proposes to use the following driving criteria for the piles to be installed at the above location.

Hammer MKT DE-42

- An ~~APE D19-42~~ single acting open ended diesel pile hammer will be used to drive the piles. The ~~D19~~ DE-42 has a ram weight of 4,200 Lbs, a max stroke of ~~10'-6"~~ 10'-0", and a rated energy of 42,000 ft-lbs
- The ~~D19~~ DE-42 uses a Monocast MC 901 pile cushions.

Pile

- HP 12x84 ASTM A572 Gr. 50 pile
- The Ultimate capacity is 205 tons.
- Piles will be fitted with cast steel points

Results

- Piles will be driven until a blow count of 6 blows per inch for six consecutive inches is obtained. 5 Blows per inch for three consecutive inches
- These criteria are based upon the output generated from the WEAP analysis that follows.

Signed: _____

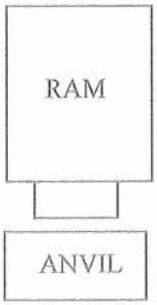
John Linscott IV "Scotty"

H.B. FLEMING PILE EQUIPMENT DATA SHEET

Project: Rt. 73, Bridge 19
Location: Rochester, VT

Date: 5/2/2014
Client: W.M. Schultz

HAMMER

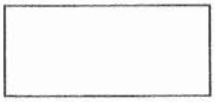


Manufacturer:	MKT
Model:	DE-42
Type:	Single Acting Diesel
Length of Stroke:	10' - 6"
Rated Energy at Given Stroke:	42,000 ft-lb
Modifications:	None

HAMMER CUSHION

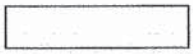
Material:	Monocast MC901
Thickness:	2"
Area:	283.5 in^2
Modulus of Elasticity:	285 psi 285 ksi
Coefficient of Restitution:	0.8

DRIVE HEAD



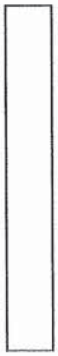
Weight:	1200 lb

PILE CUSHION



Cushion Material:	N/A
Thickness:	N/A
Modulus of Elasticity:	N/A
Coefficient of Restitution:	N/A

PILE



Pile Type:	HP 12x84
Length in Leads:	Up to 65'
Weight/LF:	84 lb
Wall Thickness:	.685"
Taper:	N/A
Cross Sectional Area:	25.5 in^2
Ultimate Capacity	205 tons
Splice Description:	Full Penetration Butt Weld
Tip Treatment Description:	Cast Steel Point