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Subject: Rochester ER BRF 0162(18) – Response to Comments – Temporary Shoring Resubmittal

Dear Kevin Ture:

We have reviewed the comments by VTrans submitted in a letter dated May 14, 2014. Below are our responses to comments.

1. Facing Calculations need to be provided.

Facing Calculations are provided with this resubmittal.

2. More detail needs to go into the justification for the surcharge loadings. We could not find the basis for the 500 psf surcharge. Does this accurately represent field conditions?

Typically we design using a surcharge load of 250 psf (similar to the 2-ft equivalent soil discussed in previous VTrans comments). To account for the Construction and potential temporary bridge loads discussed in the April 9, 2014 VTrans Comments Letter we increased the surcharge load. Using the weight and footprint area of typical construction equipment we developed an approximate high pressure of 250 psf. We assumed that doubling this load will safely account for potential loadings for this temporary shoring.

3. From the calculations provided it is not clear what the input for the slide program reflects. Based on the information provided we could not verify that the calculations represent field conditions. We understand that Slide may not easily provide this information, but VTrans needs to have the ability to verify that the Model reflects field conditions. If the Engineer of Record made a listing of design parameters and assumptions, that may suffice.

The geometry for the Slide analysis is based on the project information. The subsurface profile was developed based on the boring information provided to us in the VTrans "Proposed Improvement Bridge Project" document dated September 3, 2013. The subsurface data was also included in the project Details on the "Typical Cross-Section and Elevation" detail (Sheet 5) that included data gained from borings B103, 104, 201, and 204. Below is a summary of our design assumptions.

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Unit	Material (Based on borings provided)	Cohesion (psf)	Friction (°)	Source
Overburden Soil	A-1-a, A-1-b	1	34	Terzaghi, Peck, & Mesri (1996), NAVFAC (1986), Bowles (1996)
Bedrock	Schist	5,000	35	Hoek & Bray (1999 re-print)

Design assumptions included overburden soils characterized generally as AASHTO A-1-a and A-1-b soils (GW, GM, and/or GP) that overlie Quartz-sericite Schist bedrock. The bedrock is visible both at the river level as well as above the roadway level.

The overburden soil strength values (cohesion of 1 psf and friction angle of 34 degrees) was based on a comparison of multiple published empirical relationships including Terzaghi and Peck, NAVFAC, and Bowles (1996) for both the soil type and N-values. Each of these published relationships provides cohesionless values for this material of friction angles equal to or greater than 34 degrees.

Based on the rock type equivalent Mohr-Coulomb values for the schist based on Hoek and Bray (1999 re-print) has friction angles between 30 and 40 degree with cohesion values ranging from 400-800 kips/ft^2. The value used for the bedrock was friction of 35 degrees with cohesion of 5 kips/ft^2.

Thank you for your time.

Respectfully,

Martin Woodard, PhD PE PG
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Soil Nail Wall Properties

Max. Wall Height (ft) = 25 ft
Cut Slope = (0.1H:1V)
Slope Angle= 84.3 °

Nail Properties

Drillhole Diameter (Φ) = 4 in
Nail Type: Self-Drilling SuperNail®
Bar: Williams Form - 38mm
Nail Spacing (6'H x 6'V)
Horizontal (S_H) = 6 ft
Vertical (S_V) = 6 ft
Tensile Capacity = 90.7 kips
FS $_{(Tensile\ Strength)}$ = 1.8
Allowable Capacity = 50.4 kips

T_{max_s} (lbs) = 3500 ⟵ Input from SLIDE Analysis
$T_o = T_{max\_s}$ (0.6 + 0.057 (S_{max} - 3))
T_o = 2.70 kips

Facing Properties

Facing Thickness (h) = 4 in
Compressive Strength of Shotcrete (f'_c) = 4,000 psi
Reinforcement Steel Yield Strength (f_y) = 60 ksi

Facing Mesh Reinforcement -> Welded Wire Mesh Size -> 4x4 - W2.9xW2.9
A_{sm} = 0.087 in²/ft

Facing Waler Reinforcement ->

Horizontal Direction
Bar Size No. 4 Qty. 2
A_{swh} = 0.40 in²

Vertical Direction
Bar Size No. 4 Qty. 2
A_{swv} = 0.40 in²

Bearing Plate -> 3/8"x8"x8"

Headed-Stud -> NONE

Punching Shear

$R_{FP} = C_P$ $C_P = 1$

$V_F = 0.58\ (\sqrt{f'c})\ (\pi)\ (D'c)\ (h_c)$

Facing

$D'_c = L_{BP} + h$ $h = h_C$
L_{BP} = 8 in h = 2 in
D'_c = 10 in

$V_F = R_{FP}$ = 16 kips

$FS_{FP} = R_{FP} / T_o$

FS_{FP} = 5.93 ✓ ***O.K.*** > 1.5 for Permanent Walls

Permanent Facing

D'_c = min of (S_{HS}+h_C & 2h_C) $h_C = L_S - t_S + t_p$

$_{HS}$ =
$_{HS}$ + h_C =
$_C$ =
$_c$ =
$_S$ =
$_S$ =
$_p$ =
$_C$ =

$_F = R_{FP}$ =

$_{FP}$ =

$_{HT} = N_H A_{SH} f_y$ $_H$ =
$_{SH}$ = 2
$_{HT}$ = $_{y\ (Studs)}$ =

$_{HT}$ =

Flexure

a_{vn} = 0.154 in²/ft a_{hn} = 0.154 in²/ft
a_{vm} =0.087 in²/ft a_{hm} =0.087 in²/ft

$R_{FF}\ [kip] = 3.8 \times CF \times (a_{vn} + a_{vm})[in^2/ft] \times (S_H\ h[ft]/S_V\ )$

$R_{FF}\ [kip] = 3.8 \times CF \times (a_{hn} + a_{hm})[in^2/ft] \times (S_V\ h[ft]/S_H\ )$

CF = 2.00 ← Based on Table 5.1 (Circular No.7)

R_{FF} = 36.58 kips

$FS_{FF} = R_{FF}$

FS_{FF} = 13.56 ✓ ***O.K.*** > 1.5 for Permanent Walls

Check Amount of Reinforcement Placed $\rho_{min} \le \rho \le \rho_{max}$ and $\rho_n / \rho_m < 2$

$\rho_{min} = 0.24\sqrt{f'_c}\ [psi]$ 0.25% $\rho_{max} = 0.05 f'_c / f_y\ (90/$ 2.00%

$\rho_{vn} = \frac{a_{vn}}{0.5 * h}$ = 0.64% ✓ $\rho_{hn} = \frac{a_{hn}}{0.5 * h}$ = 0.64% ✓

$\rho_{vm} = \frac{a_{vm}}{0.5 * h}$ = 0.36% ✓ $\rho_{hm} = \frac{a_{hm}}{0.5 * h}$ = 0.36% ✓

$\rho_{vn} /$ 1.77 < 2.5 ✓ $\rho_{hn} /$ 1.77 < 2.5 ✓

Temporary Facing Only ☒

Facing Detail