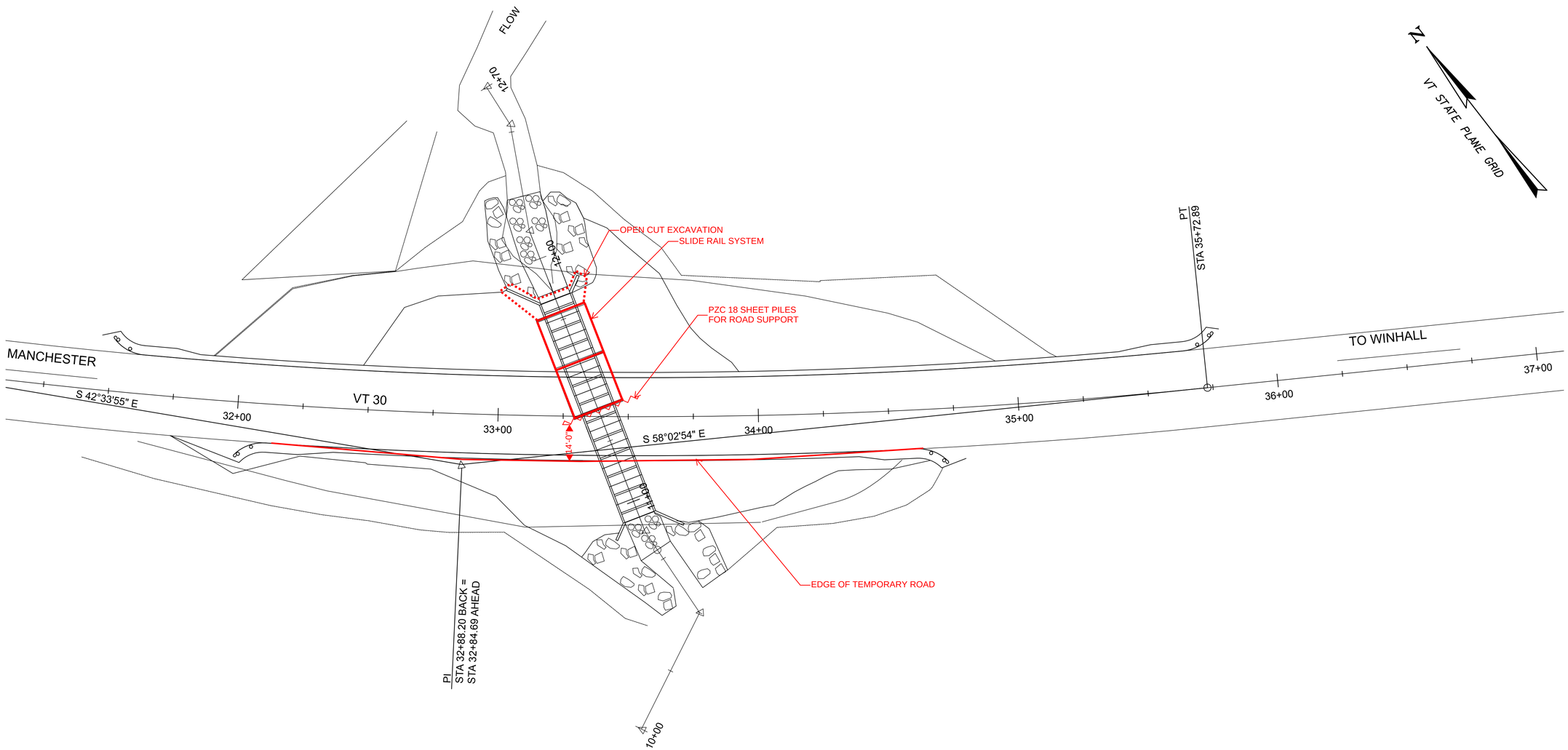


PHASE 1 EXCAVATION SUPPORT PLAN
SCALE: 1" = 20'

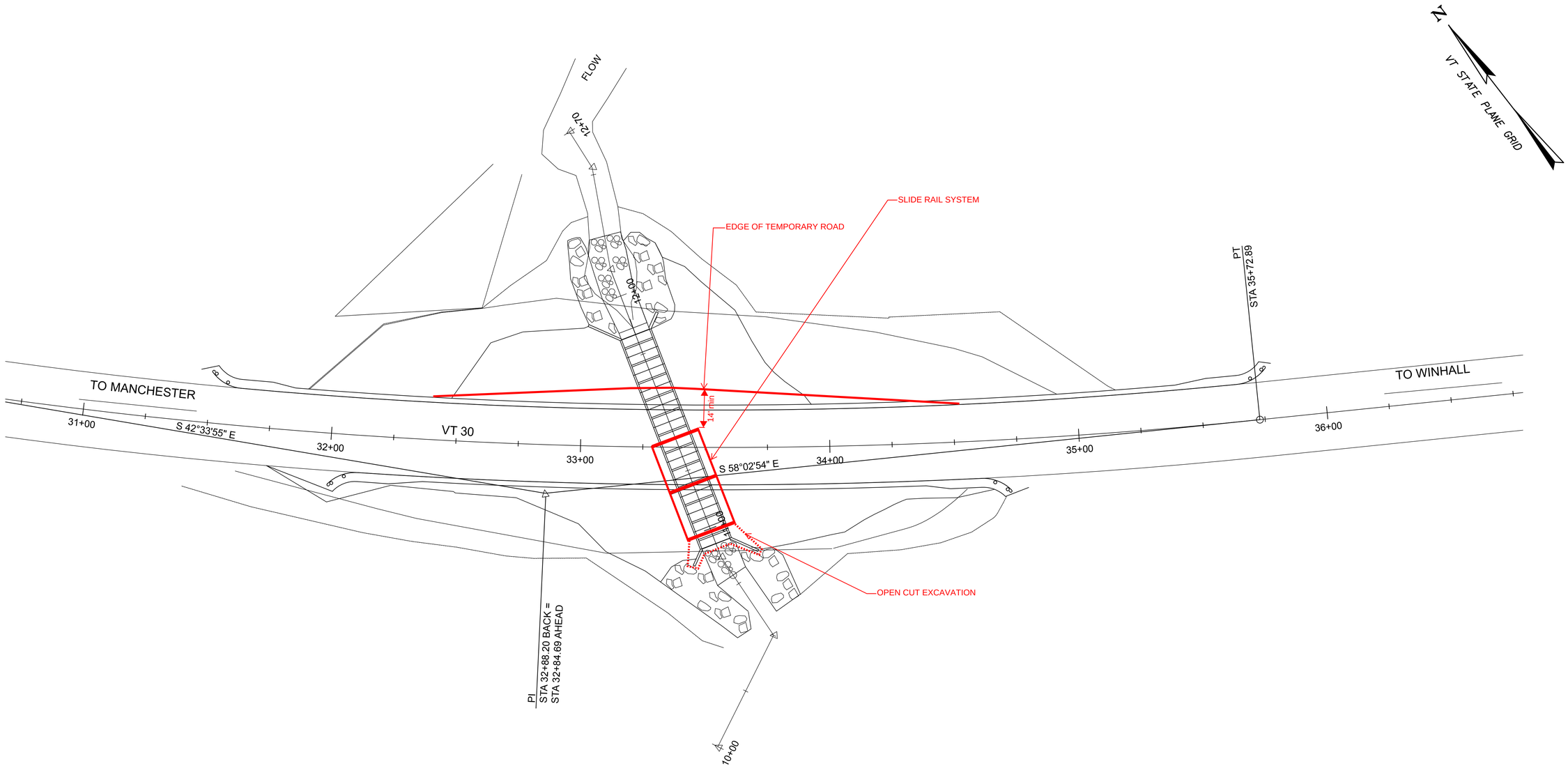
SEQUENCE OF OPERATION

EXCAVATE OUTLET AREA FOR CUT OFF WALLS AND WINGWALL FOOTINGS
INSTALL CUT OFF WALL AND WING WALL FOOTINGS
EXCAVATE AND INSTALL PHASE 1 SLIDE RAIL
INSTALL PHASE 1 BOX CULVERT SECTIONS AND WINGWALLS
BACKFILL PHASE 1 AND REMOVE SLIDE RAIL
PREPARE ROAD AND TRANSFER TRAFFIC
EXCAVATE AND INSTALL PHASE 2 SLIDE RAIL
INSTALL PHASE 2 BOX CULVERT SECTIONS
BACKFILL PHASE 2 AND REMOVE SLIDE RAIL
EXCAVATE INLET AREA FOR CUT OFF WALL AND WING WALL FOOTINGS
INSTALL FOOTINGS AND WING WALLS
BACKFILL INLET AREA

REV. NO.	DATE:

RENAUD BROS. INC.
283 FT. BRIDGMAN RD. VERNON VT., 05354
PH. (802) 257-7383 FAX: (802) 257-7308

SHEET NAME: BRIDGE 47 EXCAVATION SUPPORT PLAN
PROJECT NAME: WINHALL
PROJECT NO: STP CULV (31)
DRAWN BY: CE
CHK'D BY:
DATE: 08/07/2015
SHEET NO. 1 OF 4



PHASE 2 EXCAVATION SUPPORT PLAN
SCALE: 1" = 20'

REV. NO.	DATE:

RENAUD BROS. INC.
283 FT. BRIDGMAN RD. VERNON VT., 05354
PH. (802) 257-7385 FAX. (802) 257-7308

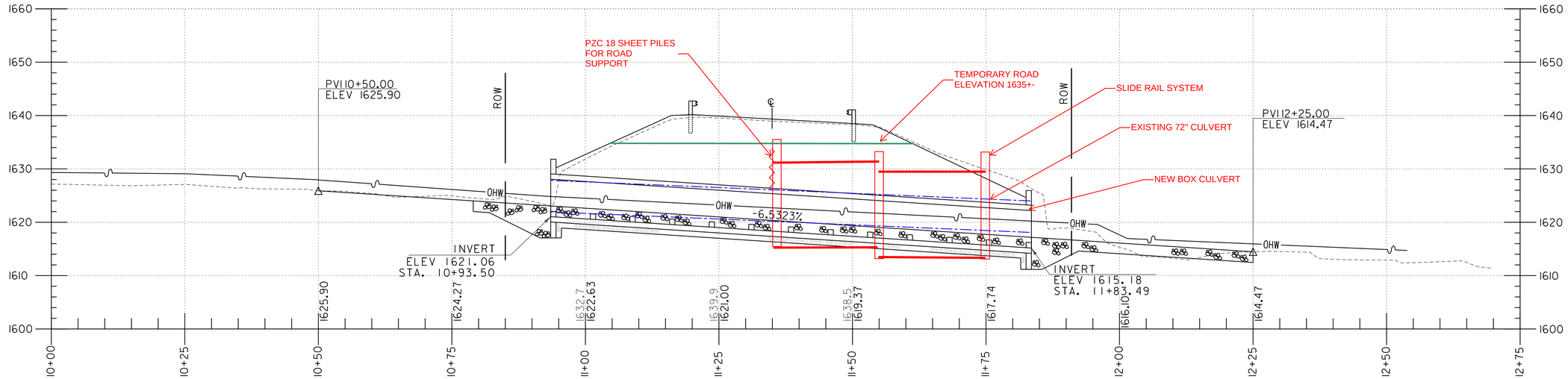
SHEET NAME: BRIDGE 47 EXCAVATION SUPPORT PLAN

PROJECT NAME: WINHALL

PROJECT NO: STP CULV (31)

DRAWN BY:	CHK'D BY:	DATE:
CE		08/07/2015

SHEET NO. 2 OF 4

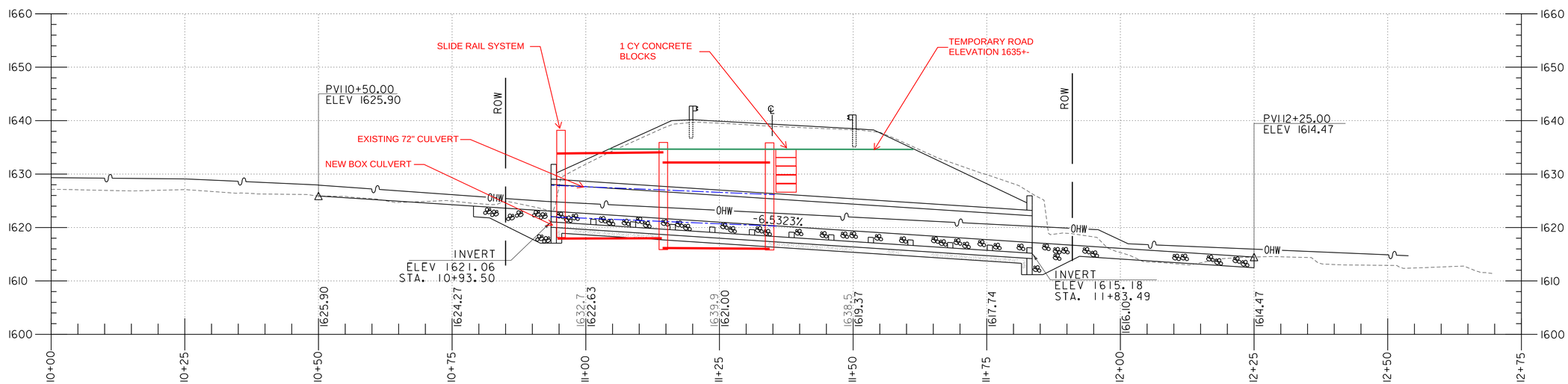


NOTE:
ELEVATIONS SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG PROPOSED CENTERLINE.

ELEVATIONS SHOW TO THE NEAREST HUNDREDTH ARE FINISHED GRADE ALONG PROPOSED CENTERLINE.

PHASE 1 PROFILE

0 10 20
SCALE



NOTE:
ELEVATIONS SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG PROPOSED CENTERLINE.

ELEVATIONS SHOW TO THE NEAREST HUNDREDTH ARE FINISHED GRADE ALONG PROPOSED CENTERLINE.

PHASE 2 PROFILE

0 10 20
SCALE

REV. NO.	DATE:

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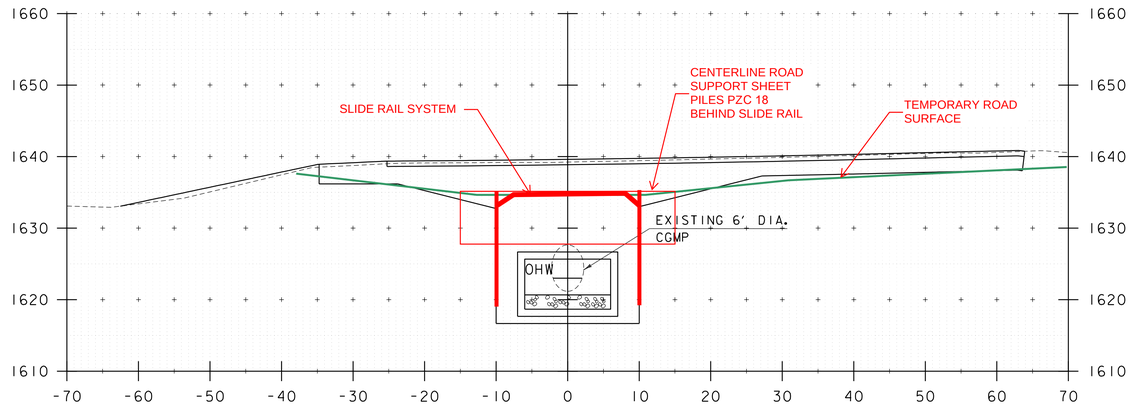
SHEET NAME: BRIDGE 47 EXCAVATION SUPPORT PLAN

PROJECT NAME: WINHALL

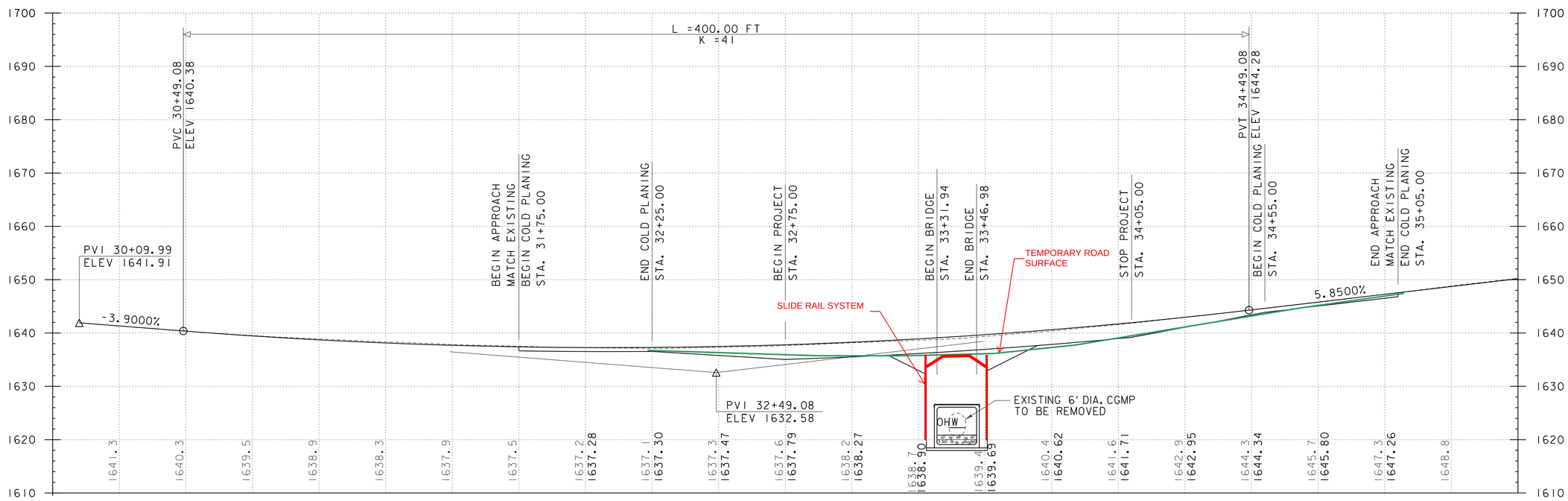
PROJECT NO: STP CULV (31)

DRAWN BY: CE | CHK'D BY: | DATE: 08/07/2015

SHEET NO. 3 OF 4



EXCAVATION SUPPORT AT STREAM STA 11+30



PROFILE ALONG VT ROUTE 30

HORIZONTAL SCALE: 1' = 20' VERTICAL SCALE: 1" = 10'

REV. NO.	DATE:

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283 FT. BRIDGMAN RD. VERNON VT., 05354
PH. (802) 257-7383 FAX. (802) 257-7308

SHEET NAME: BRIDGE 47 EXCAVATION SUPPORT PLAN

PROJECT NAME: WINHALL

PROJECT NO: STP CULV (31)

DRAWN BY: CE | CHK'D BY: | DATE: 08/07/2015

SHEET NO. 4 OF 4

Sheeting structure verification

Input data

Project

Task : BRIDGE 47 SHEET PILE WALL
Descript. : VEHICLE SURCHARGE
Author : RON BELL
Customer : RENAUD BROTHERS
Date : 8/13/2015

Settings

USA - LRFD (2)AASHTO

Materials and standards

Concrete structures : ACI 318-11

Excavations

Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Mazindrani (Rankin)
Earthquake analysis : Mononobe-Okabe
Consider reduction of the modulus of subsoil reaction for a braced sheeting
Verification methodology : according to LRFD

Partial factors on loads (L)			
Permanent design situation			
		Favourable	Unfavourable
Dead load of structural components :	DC =	0.90 [–]	1.25 [–]
Dead load of wearing surfaces :	DW =	0.65 [–]	1.35 [–]
Earth pressure load :	EH =	0.90 [–]	1.50 [–]
Earth surcharge load (permanent) :	ES =	0.75 [–]	1.50 [–]
Vertical pressure of earth fill :	EV =	1.00 [–]	1.35 [–]
Live load surcharge :	LS =	0.00 [–]	1.75 [–]
Water load :	WA =	1.00 [–]	1.00 [–]
Reduction coeff. of internal stability of anchors :	γ_{Ris} =	0.80 [–]	

Geometry of structure

Structure length = 40.00 ft

Type of structure: Arcelor AZ 18-700 700 x 420 x 9.0 mm
Cross-section name : pz 18
Coeff. of press. reduc. in front of wall = 1.00

Area of cross-section A = 4.56E-02 ft^2/ft
Moment of inertia I = 1.33E-02 ft^4/ft
Elastic modulus E = 30000.0 ksi
Shear modulus G = 12000.0 ksi

Modulus of subsoil reaction determined according to the Schmitt theory.

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]	γ_{su} [pcf]	δ [°]
1	Well graded gravel (GW), dense		41.50	0.0	133.00	70.50	41.00

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All soils are considered as cohesionless for at rest pressure analysis.

Parameters of soils to compute modulus of subsoil reaction (Schmitt)

No.	Name	Pattern	ν [–]	E_{oed} [psi]	E_{def} [psi]
1	Well graded gravel (GW), dense		0.20	72222.0	-

Soil parameters

Well graded gravel (GW), dense

Unit weight :	γ	=	133.0 pcf
Stress-state :	effective		
Angle of internal friction :	φ_{ef}	=	41.50 °
Cohesion of soil :	c_{ef}	=	0.0 psf
Angle of friction struc.-soil :	δ	=	41.00 °
Soil :	cohesionless		
Oedometric modulus :	E_{oed}	=	72222.0 psi
Saturated unit weight :	γ_{sat}	=	133.0 pcf

STATE OF VERMONT
RONALD K. BELL
No. 6994
REGISTERED PROFESSIONAL ENGINEER

Geological profile and assigned soils

No.	Layer [ft]	Assigned soil	Pattern
1	40.00	Well graded gravel (GW), dense	
2	-	Well graded gravel (GW), dense	

Excavation

Soil in front of wall is excavated to a depth of 18.00 ft.

Ditch bottom shape

No.	Coordinate x [ft]	Depth z [ft]
1	0.00	0.00
2	-3.00	0.00
3	-6.00	2.00
4	-7.00	2.00

Origin [0,0] is located at the ditch bottom.
Positive coordinate +z has downward direction.

Terrain profile

No.	Coordinate x [ft]	Depth z [ft]
1	0.00	0.00
2	15.00	0.00
3	25.00	10.00
4	26.00	10.00

Origin [0,0] is located in upper right edge of construction.
Positive coordinate +z has downward direction.

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Water influence

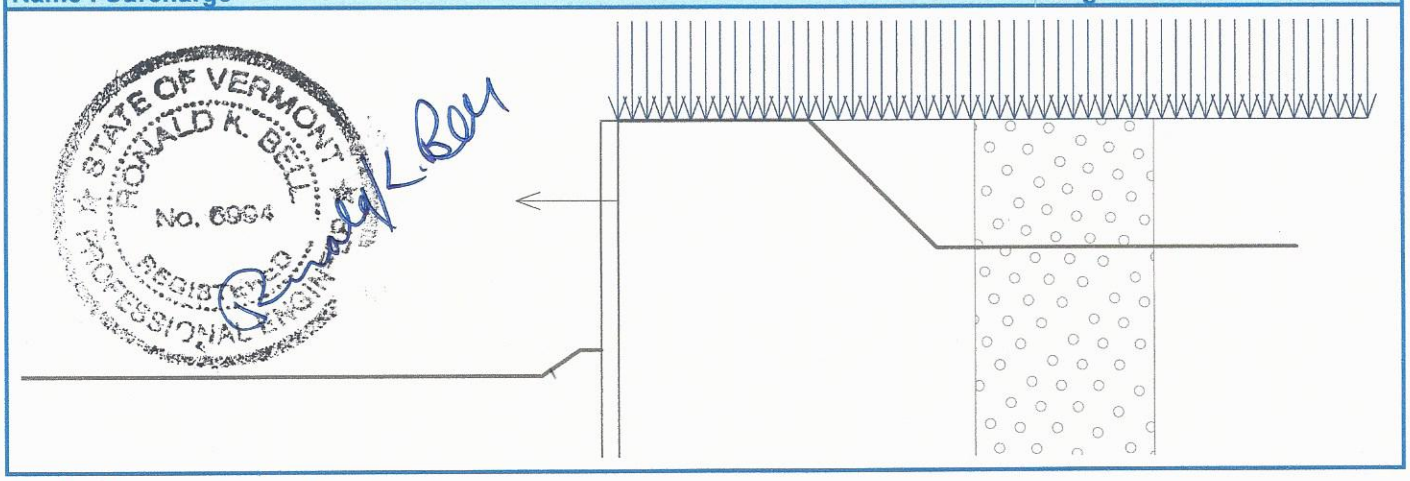
GWT behind the structure lies at a depth of 30.00 ft

Input surface surcharges

No.	Surcharge new	Surcharge change	Action	Mag.1 [lbf/ft²]	Mag.2 [lbf/ft²]	Ord.x x [ft]	Length l [ft]	Depth z [ft]
1	YES		permanent	250.0				on terrain

No.	Name
1	vehicle

Name : Surcharge **Stage : 1**



Applied forces acting on the structure

No.	Force new	Force change	Name	F [lbf/ft]	M [lbfft/ft]	Depth z [ft]
1	YES		FORCE FROM NON TOED SHEETS OVER CULVERT	-1500.00	0.0	6.20

Global settings

Number of FEs to discretize wall = 20
Analysis of depending pressures : do not reduce
Minimum dimensioning pressure is considered as $\sigma_{a,min} = 0.20\sigma_z$

Settings of the stage of construction

Design situation : permanent

Analysis results

Distribution of pressures acting on the structure (in front and behind the wall)

Depth [ft]	Ta,p [psf]	Tk,p [psf]	Tp,p [psf]	Ta,z [psf]	Tk,z [psf]	Tp,z [psf]
0.00	-0.00	-0.00	-0.00	37.53	84.34	1232.01
2.00	-0.00	-0.00	-0.00	83.23	174.09	2542.87
6.76	0.00	0.00	0.00	191.91	387.54	5660.74
6.76	0.00	0.00	0.00	191.93	387.59	2460.79
10.00	0.00	0.00	0.00	266.00	533.06	2798.29

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Depth [ft]	Ta,p [psf]	Tk,p [psf]	Tp,p [psf]	Ta,z [psf]	Tk,z [psf]	Tp,z [psf]
14.72	0.00	0.00	0.00	391.57	744.88	3289.73
14.72	0.00	0.00	0.00	391.57	744.88	4326.05
15.00	0.00	0.00	0.00	399.00	757.42	4509.15
15.00	0.00	0.00	0.00	399.03	757.46	4509.81
18.00	-0.00	-0.00	-0.00	478.80	892.03	6475.44
18.00	-0.01	-0.02	-0.33	478.81	892.06	6475.77
20.13	-42.60	-95.74	-1398.46	535.56	987.77	7873.89
23.93	-118.34	-265.94	-3380.57	636.45	1157.97	10359.95
25.27	-138.39	-326.20	-4082.37	672.17	1218.23	11240.19
28.08	-180.27	-424.93	-5548.54	746.81	1344.13	13079.13
30.00	-209.00	-492.66	-6554.29	798.00	1400.42	14340.58
31.85	-236.67	-557.88	-7769.03	842.73	1544.98	15100.32
33.30	-265.53	-608.75	-8716.39	877.62	1657.73	15692.83
33.30	-265.55	-608.78	-8717.05	844.53	1657.81	15693.24
34.54	-290.30	-652.40	-9529.50	922.91	1754.50	16201.38
40.00	-399.33	-897.43	-13108.57	1268.20	2180.44	18439.84

Distributions of the modulus of subsoil reaction and internal forces on the structure

Depth [ft]	kh,p [pci]	kh,z [pci]	Displacement [in]	Pressure [psf]	Shear Force [lbf/ft]	Moment [lbfft/ft]
0.00	0.00	0.00	-4.41	37.53	0.00	-0.00
2.00	0.00	0.00	-4.00	83.23	-120.76	105.53
4.00	0.00	0.00	-3.59	128.92	-332.90	543.95
6.00	0.00	0.00	-3.19	174.61	-636.43	1498.05
6.00	0.00	0.00	-3.19	174.61	-636.43	1498.05
6.20	0.00	0.00	-3.15	179.18	-671.81	1628.86
6.20	0.00	0.00	-3.15	179.18	-2171.81	1628.86
8.00	0.00	0.00	-2.78	220.31	-2531.35	5850.60
10.00	0.00	0.00	-2.38	266.00	-3017.66	11384.38
12.00	0.00	0.00	-1.99	319.20	-3602.86	17987.16
14.00	0.00	0.00	-1.62	372.40	-4294.46	25866.74
16.00	0.00	0.00	-1.27	425.60	-5092.46	35235.91
17.99	0.00	0.00	-0.94	478.59	-5993.03	46259.53
18.01	0.00	0.00	-0.94	473.77	-6000.66	46355.48
20.00	0.00	0.00	-0.66	-778.86	-5696.80	58420.36
22.00	0.00	0.00	-0.42	-1788.55	-3129.39	67583.11
24.00	0.00	0.00	-0.24	-2780.48	1439.64	69603.50
26.00	102.08	0.00	-0.11	-1344.11	6410.56	59889.28
28.00	102.08	0.00	-0.04	-263.17	7909.95	45212.32
30.00	102.08	0.00	-0.00	264.41	7832.56	29297.90
32.00	102.08	102.08	0.01	993.38	6314.54	14716.63
34.00	102.08	102.08	0.01	1079.01	3644.14	4720.01
36.00	102.08	0.00	0.00	362.46	1958.15	-454.96
38.00	2041.65	2041.65	-0.00	908.87	-680.80	-1692.74
40.00	2041.65	0.00	-0.00	-968.44	0.00	0.00

STATE OF VERMONT
RONALD K. BELL
No. 6[illegible]
REGISTERED PROFESSIONAL ENGINEER

Ronald K. Bell

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Maximum shear force = 7909.95 lbf/ft
Maximum moment = 69603.5 lbfft/ft
Maximum displacement = 4.41 in

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RON BELL

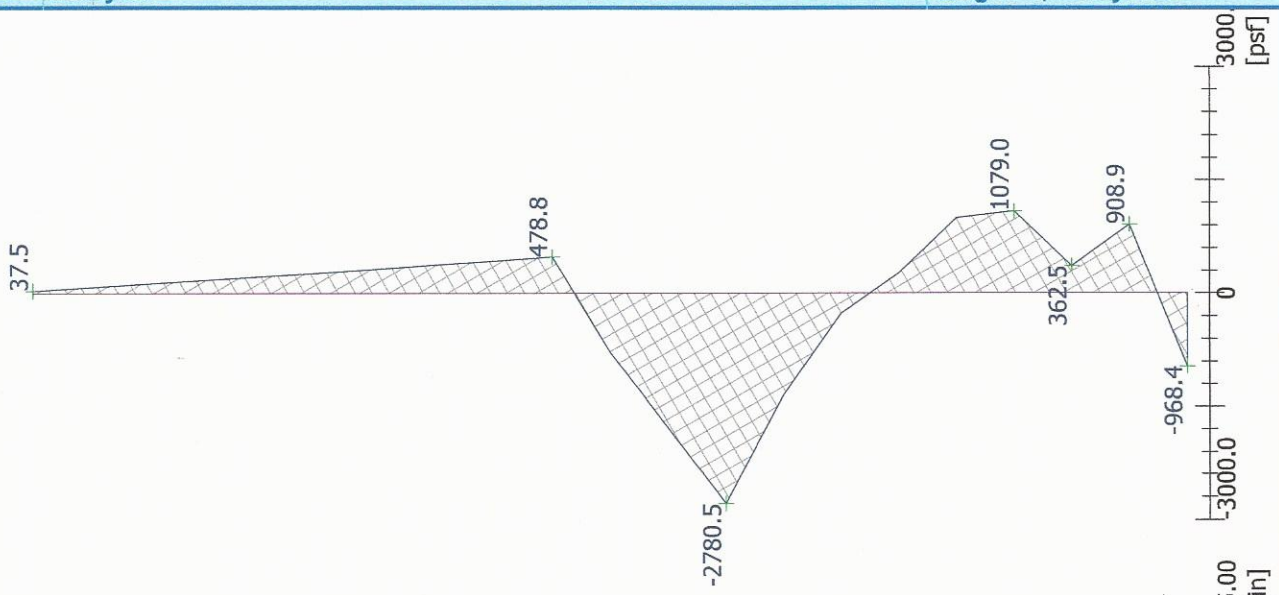
BRIDGE 47 SHEET PILE WALL

Name : Analysis

Stage : 1; Analysis: 1

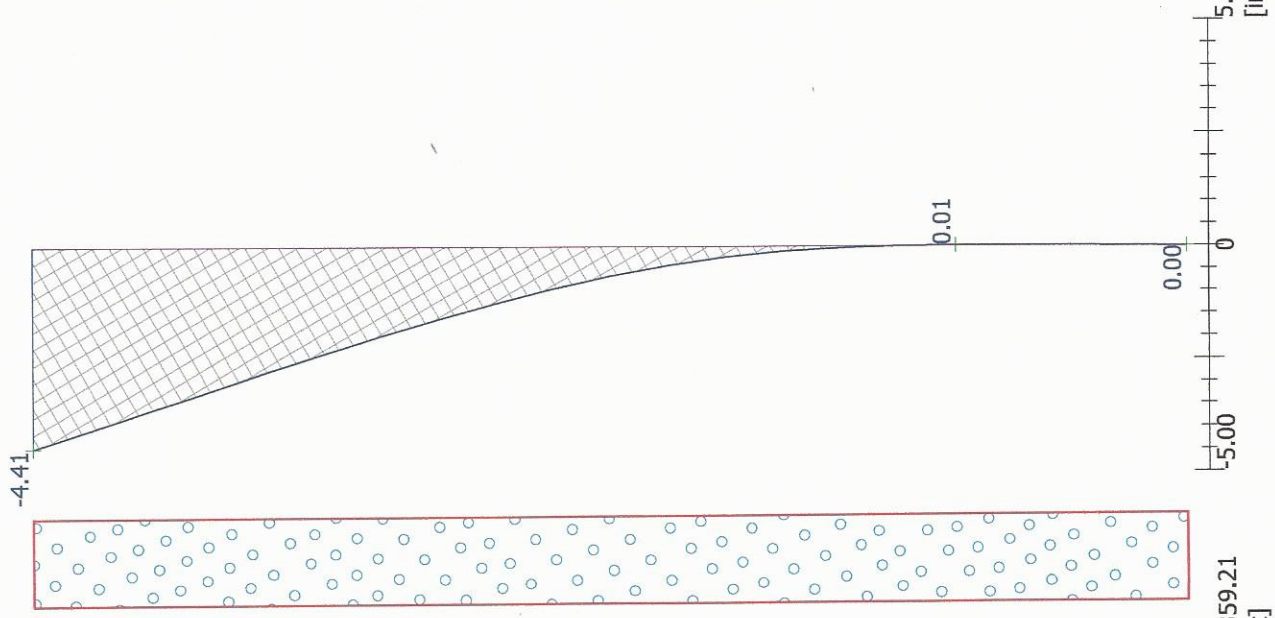
Pressure acting on structure

Max. pressure = 2780.5 psf



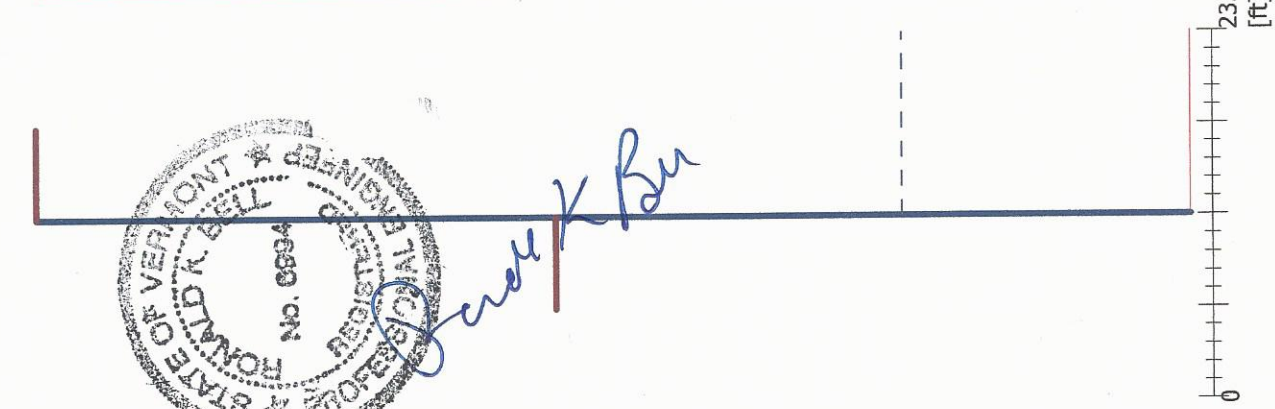
Displacement of structure

Max. disp. = 4.41 in



Geometry of structure

Length of structure = 40.00ft



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RONALD K. BELL
No. 6604
REGISTERED PROFESSIONAL ENGINEER

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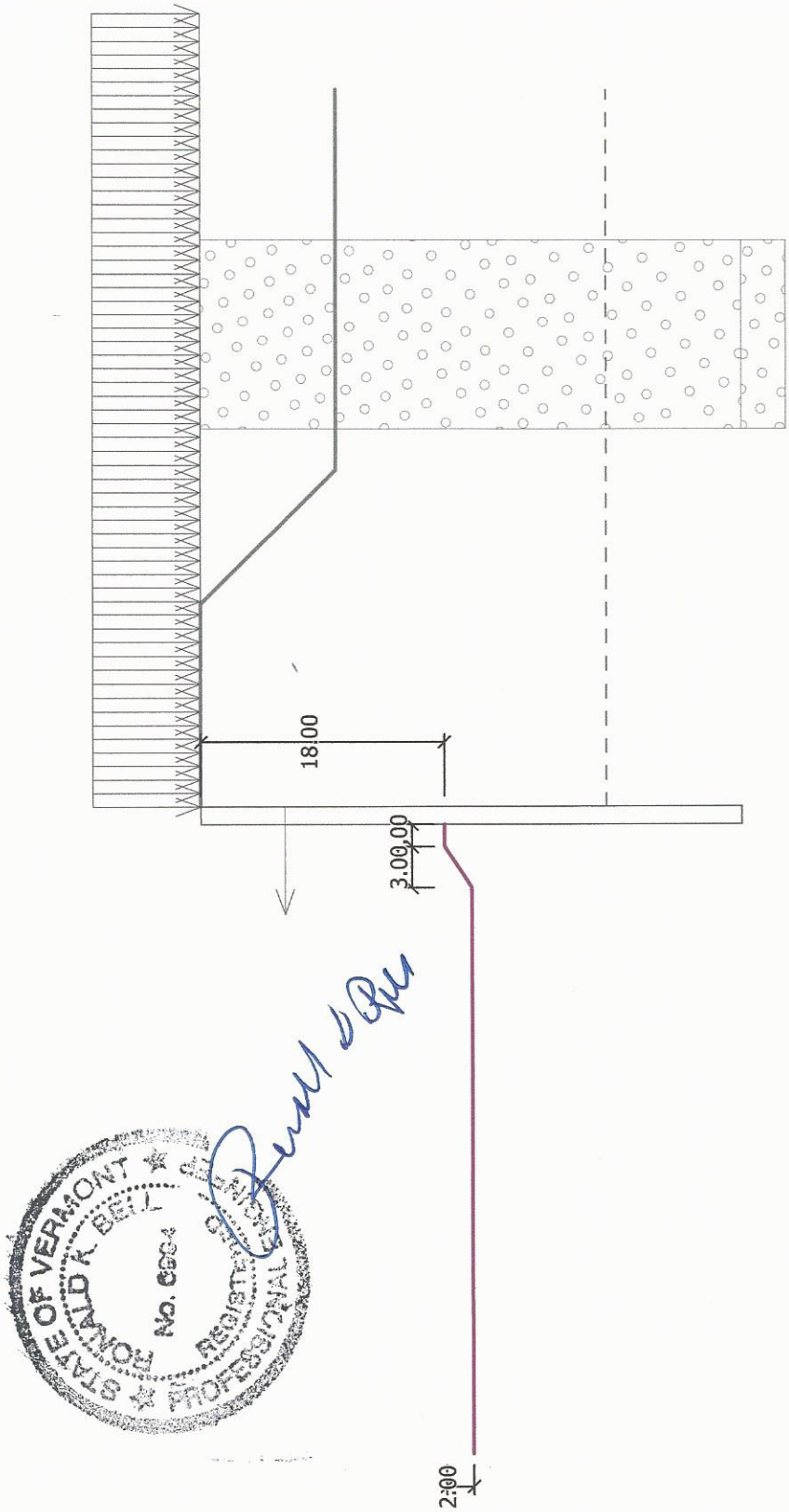
RON BELL

BRIDGE 47 SHEET PILE WALL

Name :	Excavation	Stage : 1



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Tabulated Data For

SLIDE RAIL SYSTEM

American Shoring, Inc.
207 Lake Street Newburgh, NY 12550
800-407-4674
Fax: 800-361-1973

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TABULATED DATA
FOR
SLIDE RAIL SYSTEM

1.0 SCOPE

This Data includes both pit (square & rectangular) and linear (pipeline) Slide Rail applications for excavation depths of 24 feet. For depths greater than 24 feet contact the engineering department at American Shoring, Inc. (ASI).

This Data complies with all United States Federal and individual state O.S.H.A. Regulations.

This Data applies only to ASI and SBH manufactured Slide Rail System.

2.0 TRAINING AND SAFETY

All personnel, competent persons, foremen, equipment operators and superintendents must be trained and/or knowledgeable in the use of Slide Rail systems. ASI can provide on-site instruction at customer request.

All excavation work and installation of the Slide Rail System shall be done following all applicable safety regulations and procedures.

All Slide Rail Panel, Rails and Struts shall be in good working condition.

3.0 APPLICATION

All cables, slings, chains, safety hooks and shackles shall be inspected for damage and shall be sufficient strength to support the loads applied.

Tag lines shall be used to place the individual pieces of the system.

Workers shall not be under Slide Rail Panels, Rails or Struts when they are being moved or placed in the excavation.

No Slide Rail Panel, Rail or Strut shall be allowed to stand unsupported in a position that may allow it to fall on a worker.

The Slide Rail System must be in a stable condition before any worker enters the excavation.

Workers must be protected from falling dirt and rocks at all times.

The bottom of the panels and rails shall be no higher than two feet above the bottom of the excavation while workers are in the excavation.

The excavation should be dug down four feet before the first Panels or Rails are placed in the excavation.

The Panels and Rail Pairs shall be pushed into the excavation after first digging under them with the excavator bucket. The Panels and Rails shall not be pounded on to drive them down into the excavation. Rather a "dig and push" method in small steps will provide the best results.

Workers shall clean out around and under the Panels and Rails with shovels if necessary and only when the Panels and Rails are stable and can not fall on the workers or injure them.

All Panels and Rails shall be installed vertical, plum and square to the other members of the system. It is important that the first rail pair and panels placed in the excavation shall be placed

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3.0 (CONTINUED)

properly (vertical, plum and square) to insure that the remaining panels and rails will go in correctly and easily.

It is necessary to backfill behind the panels and rails to fill any voids that form during placement of the system. This procedure is to maintain stability of the system and to maintain a tight excavation.

Extracting the panels from the slide rails is often the most difficult part of the process. Longer panel lengths contribute to the extraction difficulty and as a general rule shorter length panels should be used in less stable soil.

4.0 INSPECTION

The excavation and Slide Rail System shall be inspected daily by the competent person, who is the superintendent or foreman, to determine that the excavation, work site and Slide Rail System are safe and the work is proceeding properly and safely.

5.0 DEPTH AND CAPACITY TABLES

The tables show the lateral earth capacity of each length of Panel in pounds per square foot. An engineer may calculate the allowable working depth of the System from that lateral earth capacity.

The tables also show a maximum working depth for several types of soil. After determining the type of soil or the Equivalent Weight Effect (sometimes called Equivalent Fluid Pressure), the maximum working depth can be found listed under the column for that type of soil.

The tables do not include a surface surcharge.

The tables are limited to 24 feet deep.

For depths that are not shown in the tables contact the engineering department at American Shoring, Inc.

6.0 SPREADER AND SPREADER FRAMES

Pipe clearances and spreader lengths shown in the table are the maximum for typical conditions. For special conditions contact the engineering department at American Shoring, Inc.

7.0 SOIL TYPES

The soil classifications in the tables of A25, B45, C-1, C-2 and C-3 are described in the OSHA Excavation Regulations as Type A, B and C soils. They have Equivalent Weight Effects of 25 and 45 pounds per cubic feet per foot of depth (sometimes called Equivalent Fluid Pressure and it is in units of pounds per square feet).

Type C60 soil is a soft cohesive or moist granular soil that is not flowing or submerged. This soil can be cut vertically and will stand long enough to safely install the Slide Rail System. The Equivalent Weight Effect for this soil type is 60 pounds per cubic feet per foot of depth.

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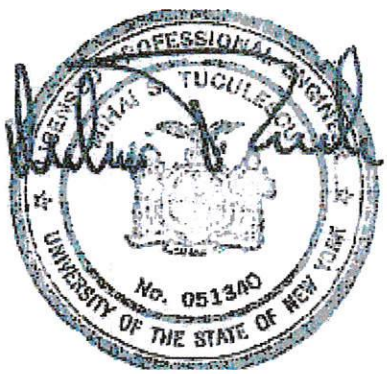
MAXIMUM ALLOWABLE DEPTH TABLE

Panel Length	Capacity	Maximum Allowable Depth* Soil Type					
Feet	With 33% Overstress P.S.F.	A25 feet	B45 feet	C1 (50) feet	C (60) feet	C2 (65) feet	C3 (80) feet
8.202	5595			24'	24'	24'	24'
9.842	3886			24'	24'	24'	24'
11.56	2854			24'	24'	24'	24'
13.123	2185			24'	24'	24'	24'
14.764	1887	74'	41'	38'	34'	29'	24'
16.404	1528	60'	33'	31'	28'	24'	19'
18.044	1448	57'	32'	29'	25'	22'	18'
19.685	1217	48'	27'	24'	24'	19'	15'
21.325	1037	41'	23'	21'	19'	16'	13'
22.966	894	35'	20'	18'	16'	14'	11'
24.606	779	31'	17'	16'	14'	12'	10'
26.246	1133	45'	25'	23'	21'	18'	14'
27.887	1003	40'	22'	20'	18'	16'	13'
30.833	1002	40'	22'	20'	17'	15'	13'
31.401	791	31'	17'	16'	14'	12'	10'

For greater depth requirements than those shown here contact the engineering department at American Shoring, Inc.



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