Sam Page
County Executive

Saint Louis COUNTY
TRANSPORTATION
PUBLIC WORKS

Daniel W. Dreisewerd, P.E., PTOE
Acting Director

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Deputy Director

October 1, 2019

ADDENDUM NO. 5

Notice to All Persons and Firms Proposing
to Submit a Bid or Furnish Materials for
Allen Road Bridge No. 329
St. Louis County Project No. CR-1274
Federal Project No. STP-4900(634)

The construction contract for this project has been revised as follows:

No. 1

The following information is provided as supplemental guidance regarding the MSE wall construction.

Max Wall Height (feet)	Minimum Embedded Depth (feet)	Minimum Strap Length (feet)	Factor Bearing Pressure (psf)	Factor Bearing Resistance (psf)
8	2	8	1,940	2,100
12	2	12	2,760	3,300
16	2	15	3,650	4,000
20	2	18	4,500	4,700
24	2.5	21	5,420	5,500

Additionally, the global stability analysis calculations completed by the engineering firm of record for both the east and west bridge abutments are attached to this Addendum.

No. 2

Note the revisions to the following Job Special Provisions (JSPs):

REMOVE the JSP 100.10.2 COMPLETION OF PROJECT and **REPLACE** with the attached JSP 100.10.2 COMPLETION OF PROJECT

ADD the attached JSP 1200.70.16 BRIDGE CONSTRUCTABILITY ITEMS – ALLEN ROAD BRIDGE NO. 329

No. 3

The following clarification is offered regarding the UPRR's estimate for plan review, inspection, and flagging costs:

- Estimated costs for UPRR plan review & UPRR inspections = $65,000
- Estimated costs for flagging = $1,267 per day

Potential bidders are advised that the above figures are estimates only and are included only as guidance. Actual values will be dependent on the number of submittals and inspections required, as well as on the means and methods utilized by the successful bidder.

No. 4

The following is a list of questions posed as a result of the Pre-Bid Meeting held on September 17, 2019. St. Louis County's response immediately follows each question.

Question #1: Based on information provided by UPRR, it appears that there may not be enough time allotted for this project due in large part to lost production due to the number of daily trains along with the submittal approval process for a project with this complexity. Will you be revising the completion time for this project?

St. Louis County Response #1: Yes, the completion schedule for this project has been revised. Please see the revised JSP 100.10.2 "Completion of Project" attached to this Addendum.

Question #2: You stated that St. Louis County no longer makes the project estimates public. However, what does the County intend to do should the pricing received for this project come in above the County's estimate, which I think we all believe is a very good possibility?

St. Louis County Response #2: St. Louis County has a process for obligating additional funds for this project based on bids received.

Question #3: Jordon [Albers, from the UPRR] stated that all subcontractors will need their own Right of Entry. Having worked on numerous UPRR projects in the past, subs have always worked under the general contractor's ROE. Can you please verify this with Jordon? In addition, will subcontractors have to submit plans for their own work? For instance, if a general contractor uses a subcontractor for the bridge demo, who will be responsible for the demolition plan submittal?

St. Louis County Response #3: Per the UPRR, each Contractor and Subcontractor will be required to pull their own ROE. The UPRR will require one all-inclusive submittal for the project, and only one point of contact for that submittal. The UPRR has no preference as to who completes the submittal, so the Contractor could direct one of their Subcontractors to prepare the submittal to the UPRR if they wish to do so.

Question #4: Please provide a timeline that clarifies the contract process that includes contract award and NTP. The current specs state 3-8 weeks for contract award and 120 days for NTP, but these are estimates only. This is critical in determining when work can begin on the submittal process and when we believe we will actually be able to start work after obtaining approval and ROE. In addition, it should be noted that there are items that are time-sensitive such as select tree removal between 11/1 and 3/31 along with the migratory bird specification, so these items will need to be addressed immediately while waiting for UPRR approval and ROE. I would hope that this would be considered if revisions are made to the contract duration.

St. Louis County Response #4: The project schedule has been revised as noted in response #1 above. Please see the revised JSP 100.10.2 "Completion of Project" attached to this Addendum. St. Louis County believes the revisions to the schedule should allow the appropriate times for the issues such as the tree removal and migratory birds.

Question #5: Due to the close proximity of the Ameren overhead lines, is it possible to de-energize the lines during the bridge deck pour as well as the girder placement? This is due to the pump truck, bridge deck machine, and crews working with concrete finishing tools.

St. Louis County Response #5: St. Louis County has confirmed with the appropriate Ameren representatives that Ameren will de-energize their lines as necessary for the project. Ameren will require as much advance notice as possible from the Contractor for de-energizing these lines.

Question #6: Due to UPRR not allowing any absolute windows, will Ameren de-energize the power lines during the demolition process as this will likely involve numerous cranes?

St. Louis County Response #6: As noted in response #5 above, St. Louis County has confirmed with the appropriate Ameren representatives that Ameren will de-energize their lines as necessary for the project. Ameren will require as much advance notice as possible from the Contractor for de-energizing these lines.

No. 5

Attached to this Addendum, please find the following supplemental documents:

- Summary of the Pre-Bid Meeting notes as captured by St. Louis County (4 pages)
- Example plans of similar projects shared by Acrow Bridge (25 pages)
    - NOTE: St. Louis County does not warrant that the details and construction methods shown in these examples are suitable for this project. These examples are offered only as a service to the potential bidders.
    - St. louis County is not endorsing or requiring the use of any specific product. The examples provided are solely intended to demonstrate successful solutions utilized on similar projects.

ATTENTION BIDDERS: THE FOLLOWING MUST BE COMPLETED:

- **ADDENDUM ACKNOWLEDGEMENT IN THE BID DOCUMENTS MUST BE COMPLETED AND SUBMITTED WITH ALL BID PROPOSALS.**

Joseph W. Kulessa, P.E.
Division Manager, Design

JWK/prt

Attachments: *Global Stability Analysis Calculations; JSP 100.10.2; JSP 1200.70.16; Pre-Bid Meeting Notes; Example Plans*

FHWA-NHI-10-024
Allen Road East Abutment - 4ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road East Abutment - 4ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....nt\MSEW\4ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{equiv.}$	27.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ²

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3948 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 0.00 N_γ= 8.41

SEISMICITY

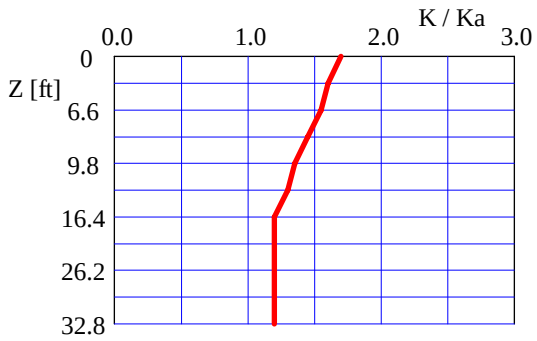
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



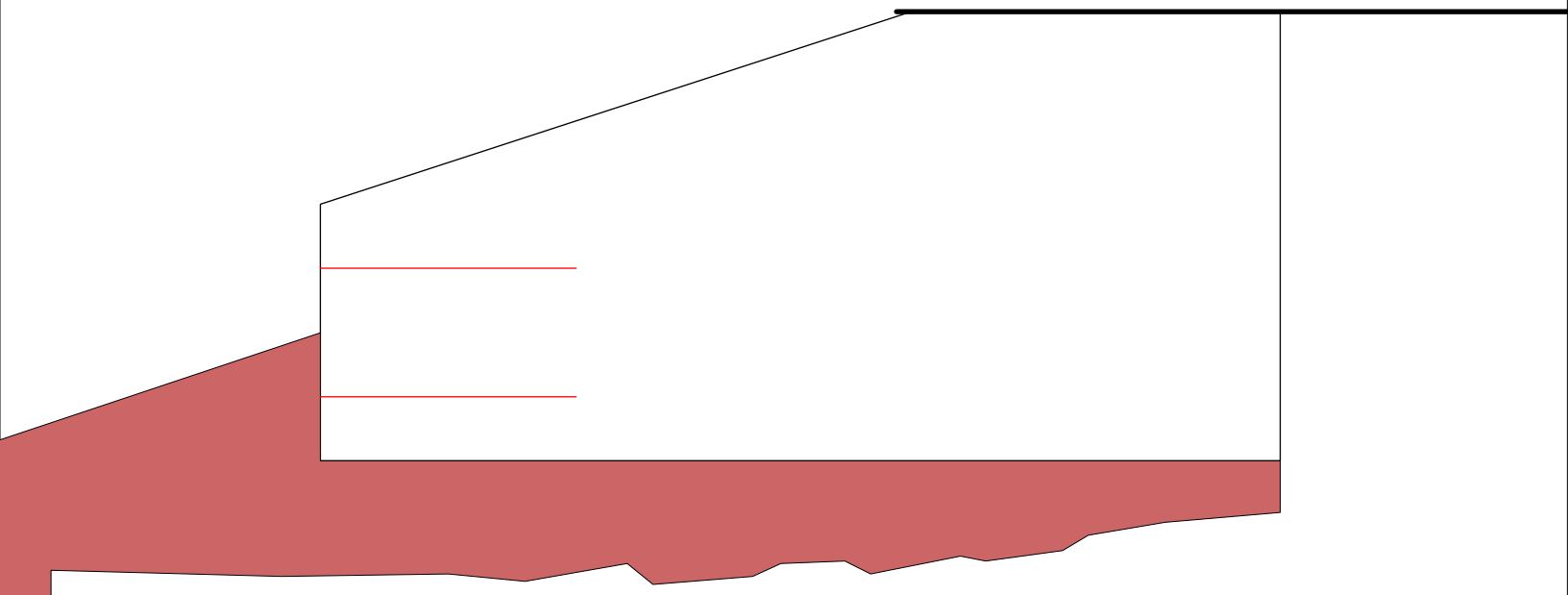
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	4.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 2.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 18.00° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00
Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90		1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:		Static	Combined Static/Seismic
	ϕ_b	0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

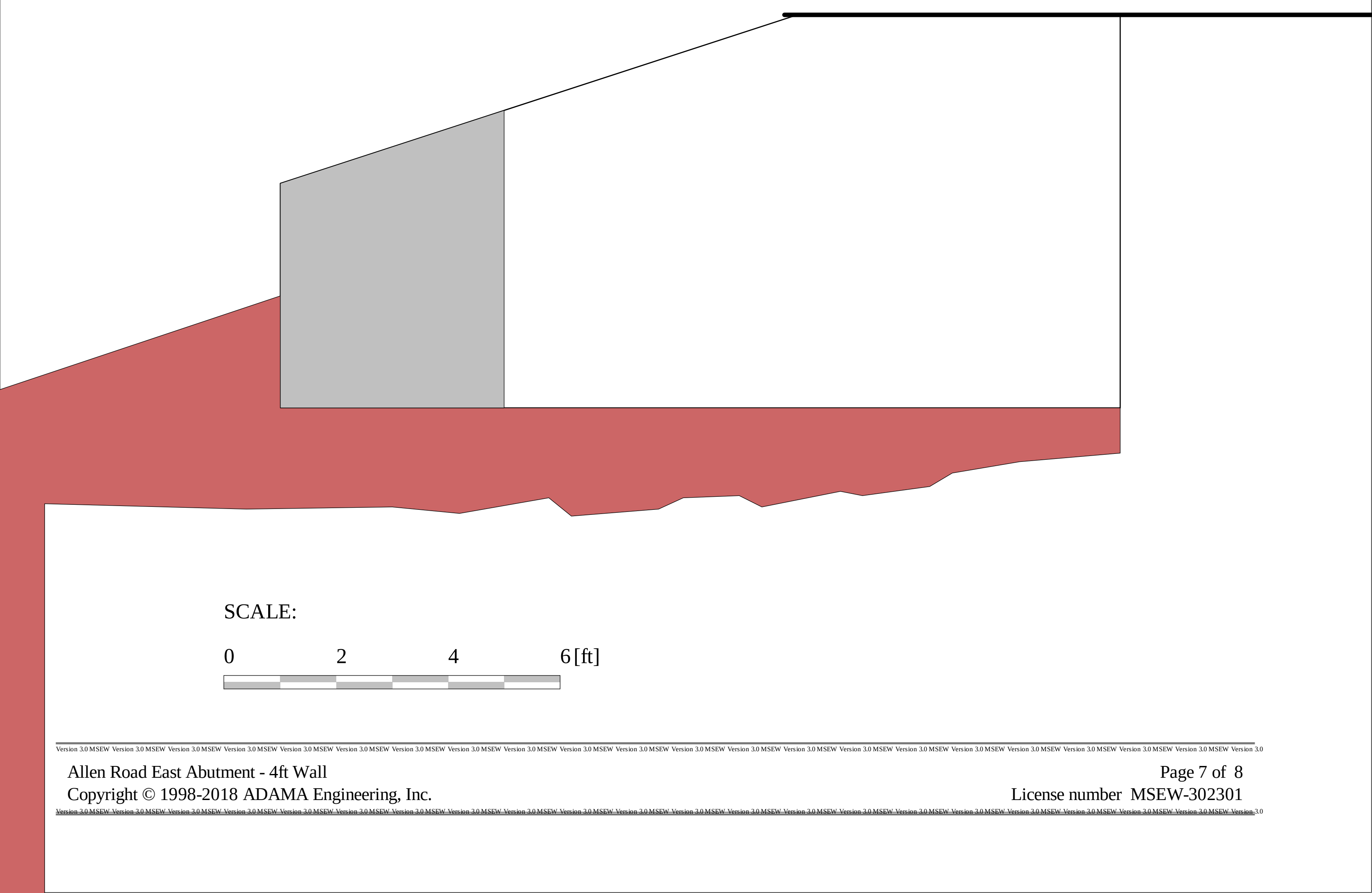
Bearing capacity, CDR = 1.23, factored bearing load = 941 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.364, Eccentricity, e/L = 0.0838, CDR-overturning = 3.52

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	4.00	1	N/A	8.19	9.10	9.098	0.585	2.111	0.0360	---
2	3.00	4.00	1	N/A	18.95	21.06	21.057	0.569	3.208	-0.0550	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	1158	N/A	[lb/ft ²]
Factored bearing load, σ_V	940.7	N/A	[lb/ft ²]
Eccentricity, e	0.23	N/A	[ft]
Eccentricity, e/L	0.059	N/A	
CDR calculated	1.23	N/A	
Base length	4.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 2437.52 [lb/ft], L = 4.00, Unfactored e = 0.20 [ft], and Sigma = 678.82 [lb/ft ²]



SCALE:

0 2 4 6 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.364

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	4.00	2.111	N/A	1	---
2	3.00	4.00	3.208	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.0838; Overturning: CDR-static = 3.52

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	4.00	0.0360	N/A	1	---
2	3.00	4.00	-0.0550	N/A	1	---

FHWA-NHI-10-024
Allen Road East Abutment - 8ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road East Abutment - 8ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....nt\MSEW\8ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{equiv.}$	27.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ²

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3517 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 0.00 N γ= 8.41

SEISMICITY

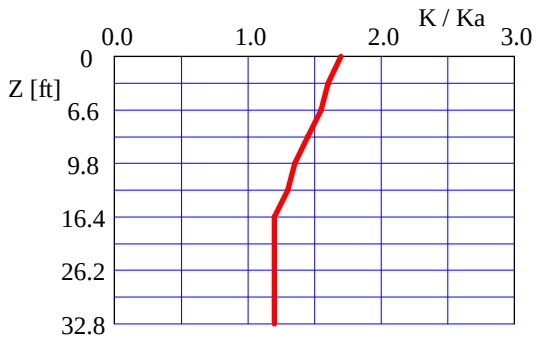
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



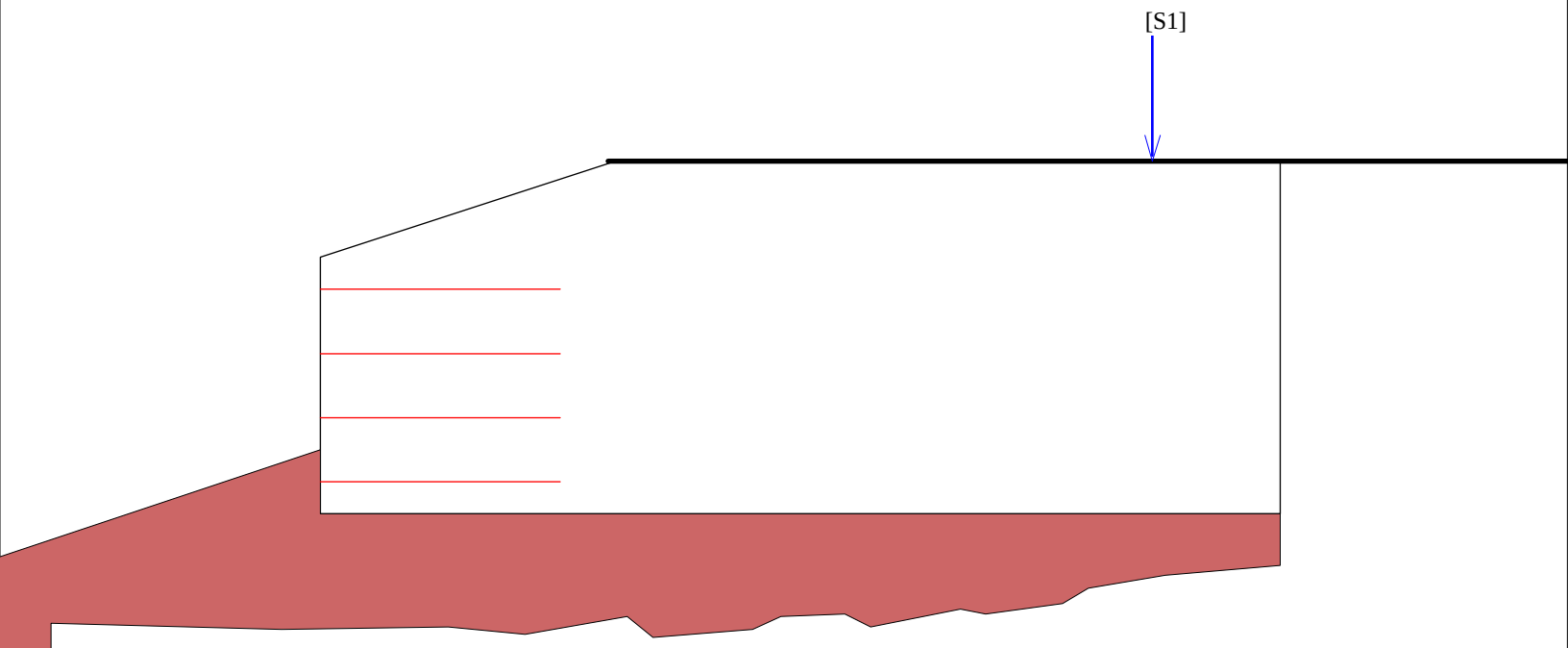
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	8.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 6.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 10.62° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00
Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90		1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:		Static	Combined Static/Seismic
	ϕ_b	0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

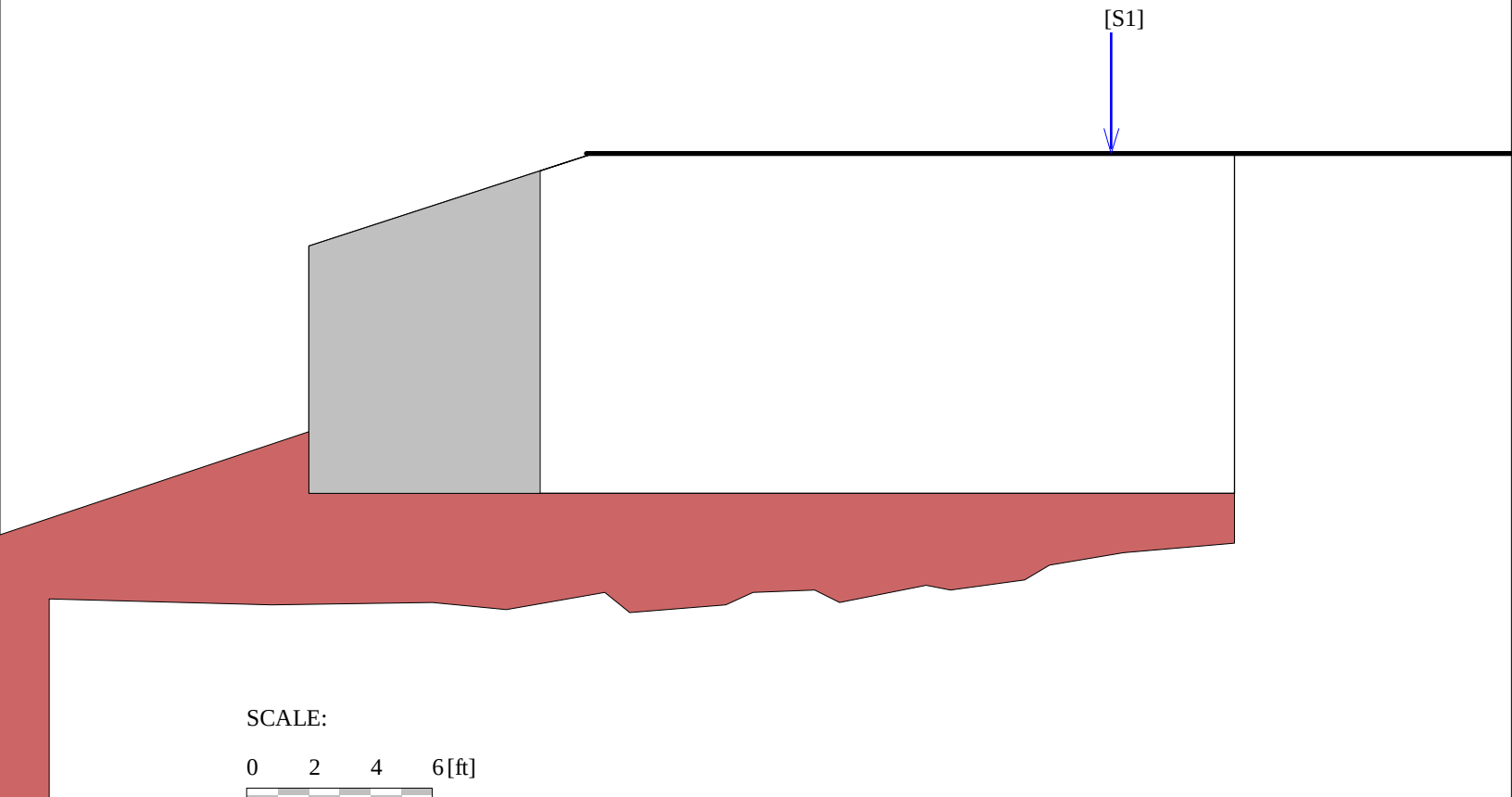
Bearing capacity, CDR = 1.07, factored bearing load = 1909 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.331, Eccentricity, e/L = 0.1216, CDR-overturning = 3.13

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	7.50	1	N/A	3.76	4.18	4.176	1.031	1.909	0.0923	---
2	3.00	7.50	1	N/A	4.90	5.44	5.439	0.944	2.295	0.0389	---
3	5.00	7.50	1	N/A	7.23	8.04	8.035	0.914	2.875	-0.0114	---
4	7.00	7.50	1	N/A	14.39	15.99	15.993	1.113	3.751	-0.0780	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	2034	N/A	[lb/ft ²]
Factored bearing load, σ_V	1908.8	N/A	[lb/ft ²]
Eccentricity, e	0.65	N/A	[ft]
Eccentricity, e/L	0.086	N/A	
CDR calculated	1.07	N/A	
Base length	7.50	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 8723.60 [lb/ft], L = 7.50, Unfactored e = 0.57 [ft], and Sigma = 1371.43 [lb/ft ²]



SCALE:

0 2 4 6 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.331

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	7.50	1.909	N/A	1	---
2	3.00	7.50	2.295	N/A	1	---
3	5.00	7.50	2.875	N/A	1	---
4	7.00	7.50	3.751	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1216; Overturning: CDR-static = 3.13

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	7.50	0.0923	N/A	1	---
2	3.00	7.50	0.0389	N/A	1	---
3	5.00	7.50	-0.0114	N/A	1	---
4	7.00	7.50	-0.0780	N/A	1	---

FHWA-NHI-10-024
Allen Road East Abutment - 12ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road East Abutment - 12ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....t\MSEW\12ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{equiv.}$	27.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ²

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3413 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 0.00 N γ= 8.41

SEISMICITY

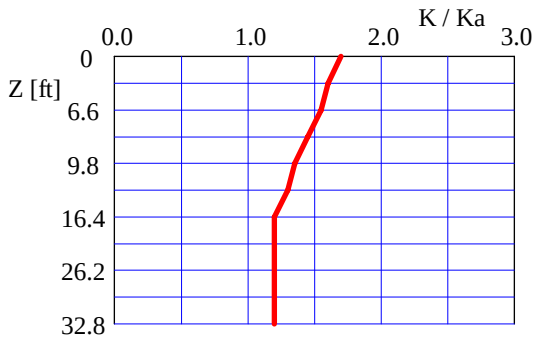
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



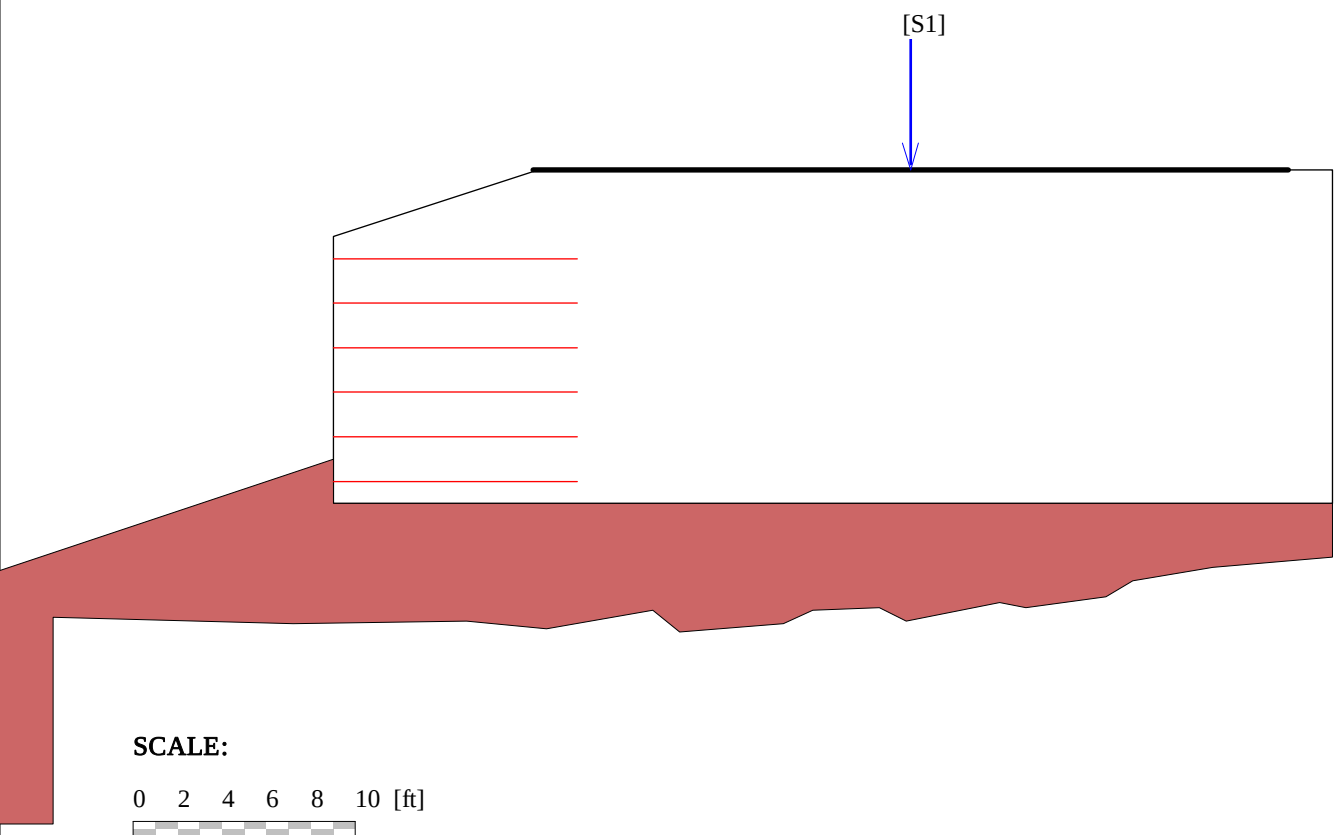
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	12.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 10.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 7.13° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 8 10 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00
Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90		1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:		Static	Combined Static/Seismic	
	ϕ_b	0.65		0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

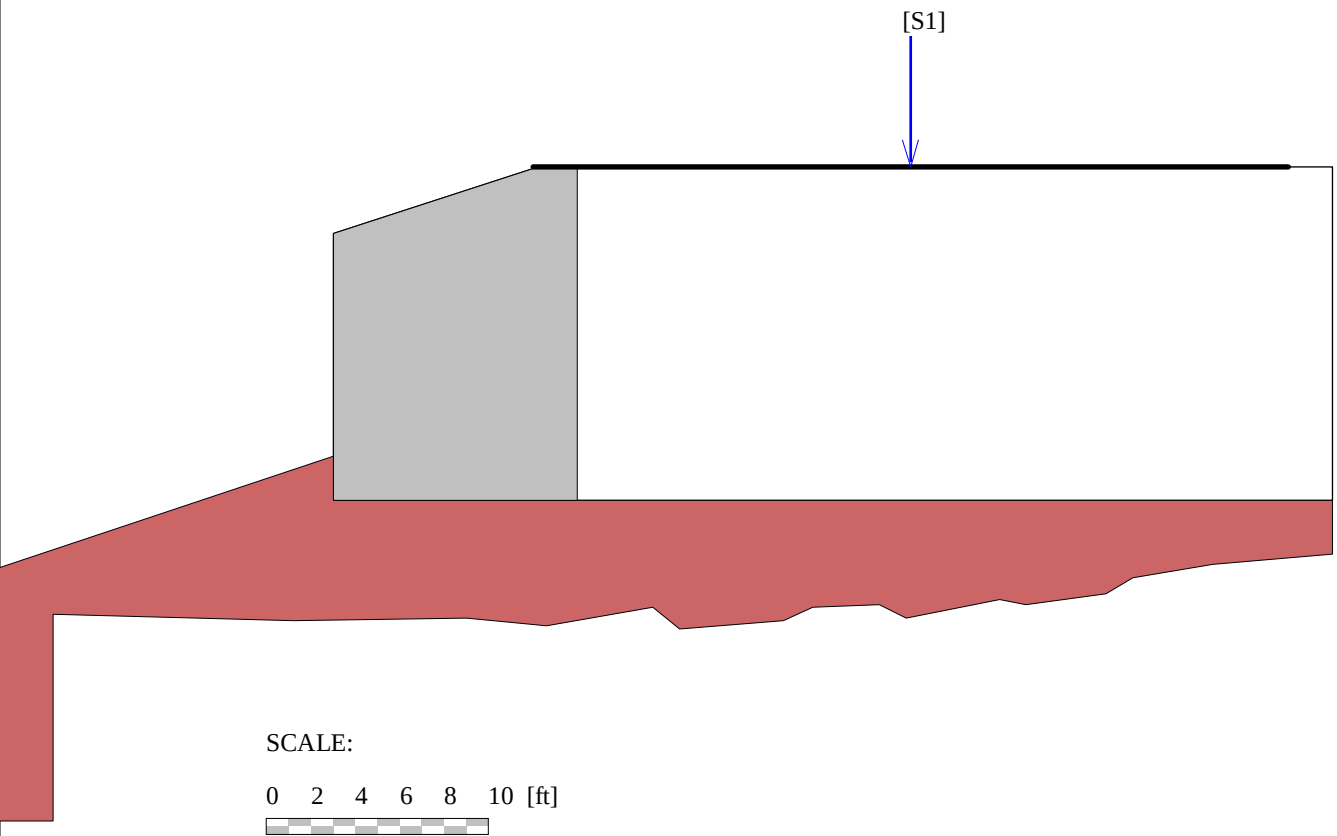
Bearing capacity, CDR = 1.06, factored bearing load = 2798 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.400, Eccentricity, e/L = 0.1245, CDR-overturning = 3.26

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	11.00	1	N/A	2.60	2.89	2.892	1.375	1.966	0.1042	---
2	3.00	11.00	1	N/A	2.98	3.31	3.309	1.320	2.239	0.0667	---
3	5.00	11.00	1	N/A	3.55	3.95	3.948	1.253	2.604	0.0323	---
4	7.00	11.00	1	N/A	4.54	5.05	5.050	1.219	3.110	-0.0004	---
5	9.00	11.00	1	N/A	6.48	7.19	7.195	1.366	3.845	-0.0358	---
6	11.00	11.00	1	N/A	11.60	12.89	12.893	1.648	4.920	-0.0910	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	2974	N/A	[lb/ft ²]
Factored bearing load, σ_V	2797.9	N/A	[lb/ft ²]
Eccentricity, e	0.97	N/A	[ft]
Eccentricity, e/L	0.088	N/A	
CDR calculated	1.06	N/A	
Base length	11.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 18728.49 [lb/ft], L = 11.00, Unfactored e = 0.85 [ft], and Sigma = 2013.15 [lb/ft ²]



SCALE:

0 2 4 6 8 10 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.400

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	11.00	1.966	N/A	1	---
2	3.00	11.00	2.239	N/A	1	---
3	5.00	11.00	2.604	N/A	1	---
4	7.00	11.00	3.110	N/A	1	---
5	9.00	11.00	3.845	N/A	1	---
6	11.00	11.00	4.920	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1245; Overturning: CDR-static = 3.26

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	11.00	0.1042	N/A	1	---
2	3.00	11.00	0.0667	N/A	1	---
3	5.00	11.00	0.0323	N/A	1	---
4	7.00	11.00	-0.0004	N/A	1	---
5	9.00	11.00	-0.0358	N/A	1	---
6	11.00	11.00	-0.0910	N/A	1	---

FHWA-NHI-10-024
Allen Road East Abutment - 16ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road East Abutment - 16ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....t\MSEW\16ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	34.0 °

RETAINED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight,	$\gamma_{equiv.}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction,	$\phi_{equiv.}$	27.0 °
Equivalent cohesion,	$c_{equiv.}$	0.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3378 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 0.00 N γ = 8.41

SEISMICITY

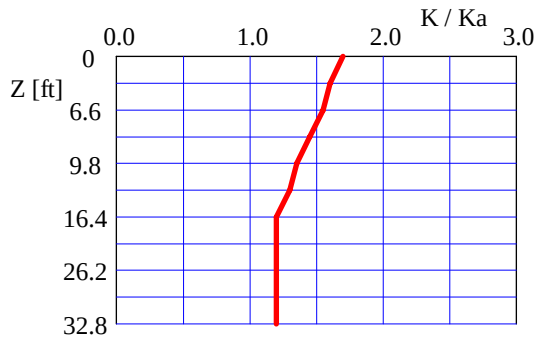
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



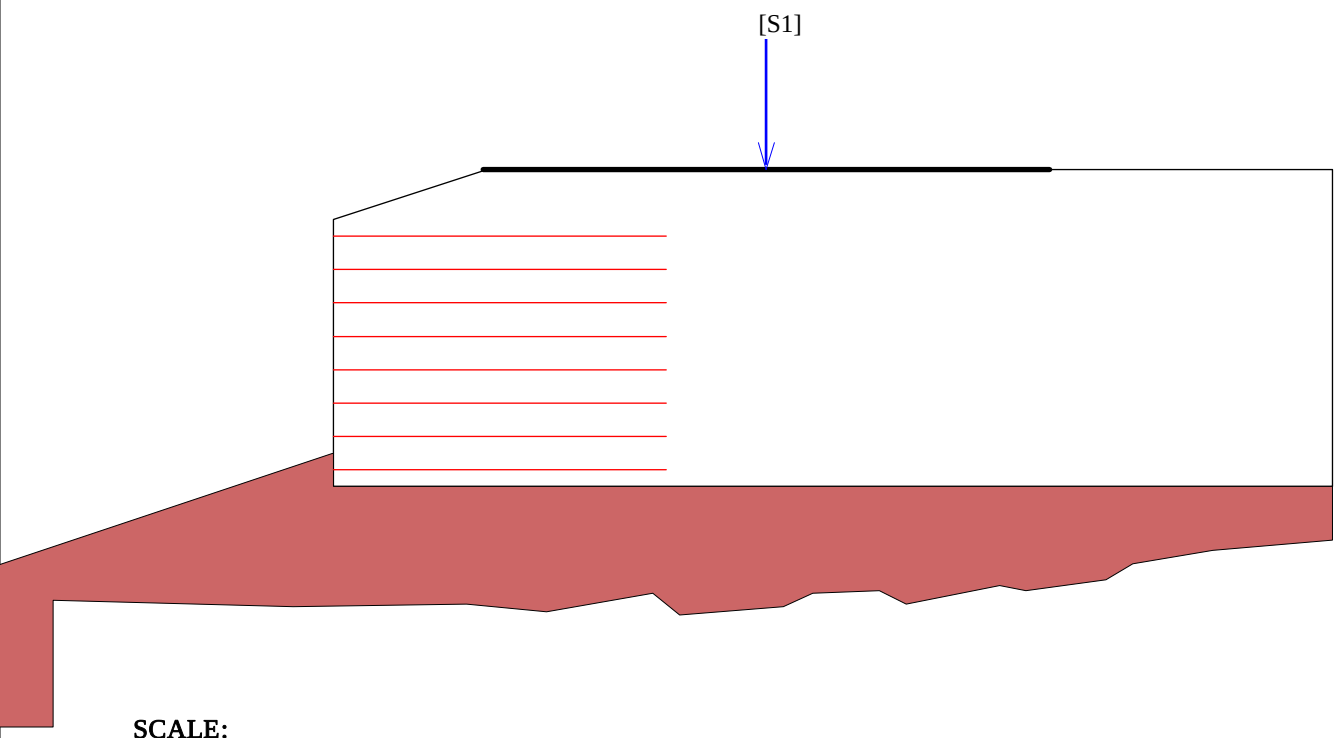
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	16.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 14.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 5.36° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 8 10 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90	1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static		Combined Static/Seismic
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic
Reinforced Soil and Foundation	ϕ_τ	1.00	1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00	1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:	Static	Combined Static/Seismic
ϕ_b	0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

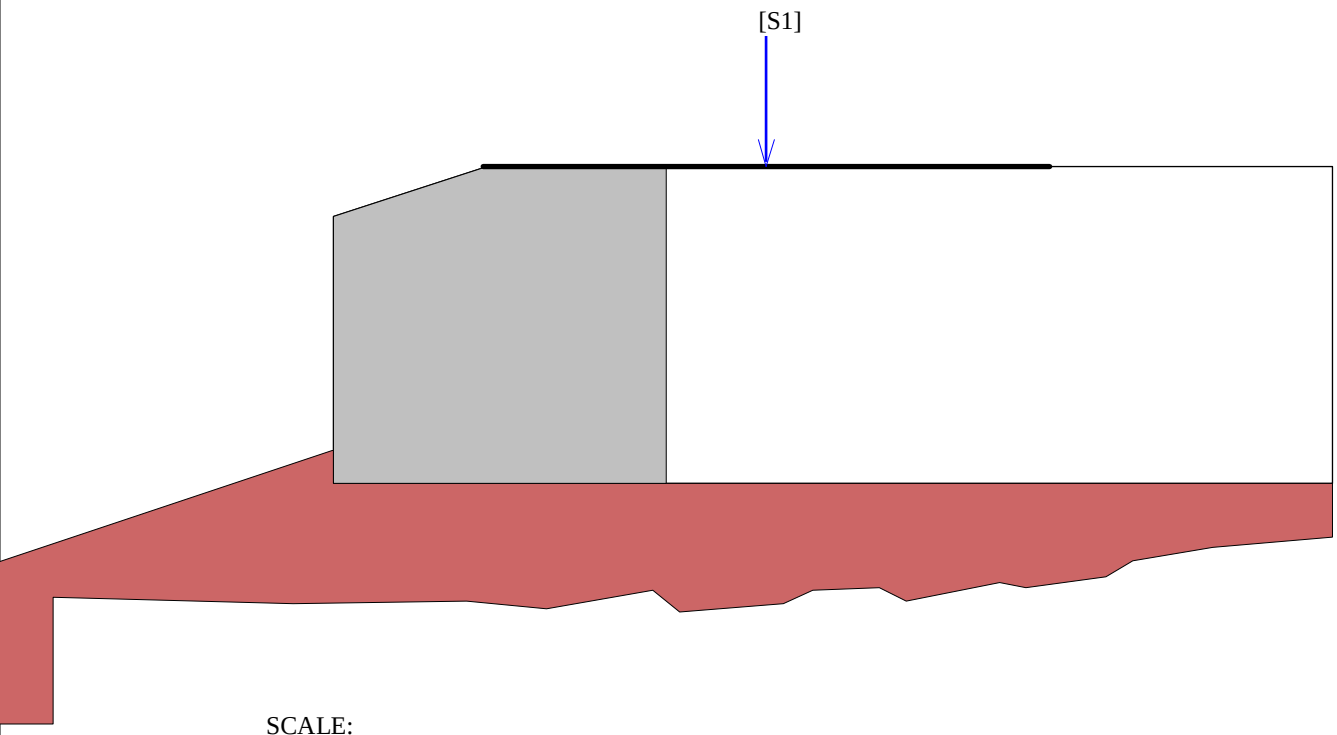
Bearing capacity, CDR = 1.87, factored bearing load = 3259 lb/ft².
Foundation Interface: Direct sliding, CDR = 2.084, Eccentricity, e/L = 0.0535, CDR-overturning = 6.74

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	20.00	1	N/A	2.05	2.27	2.274	2.158	2.901	0.0457	---
2	3.00	20.00	1	N/A	2.26	2.51	2.508	2.256	3.237	0.0308	---
3	5.00	20.00	1	N/A	2.51	2.79	2.789	2.301	3.662	0.0169	---
4	7.00	20.00	1	N/A	2.85	3.17	3.169	2.311	4.219	0.0038	---
5	9.00	20.00	1	N/A	3.37	3.74	3.742	2.325	4.977	-0.0090	---
6	11.00	20.00	1	N/A	4.26	4.73	4.730	2.544	6.070	-0.0227	---
7	13.00	20.00	1	N/A	5.93	6.59	6.590	2.849	7.775	-0.0401	---
8	15.00	20.00	1	N/A	9.92	11.02	11.020	3.361	10.752	-0.0707	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	6087	N/A	[lb/ft ²]
Factored bearing load, σ_V	3258.8	N/A	[lb/ft ²]
Eccentricity, e	0.72	N/A	[ft]
Eccentricity, e/L	0.036	N/A	
CDR calculated	1.87	N/A	
Base length	20.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 44705.56 [lb/ft], L = 20.00, Unfactored e = 0.62 [ft], and Sigma = 2383.72 [lb/ft ²]



SCALE:

0 2 4 6 8 10 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 2.084

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	20.00	2.901	N/A	1	---
2	3.00	20.00	3.237	N/A	1	---
3	5.00	20.00	3.662	N/A	1	---
4	7.00	20.00	4.219	N/A	1	---
5	9.00	20.00	4.977	N/A	1	---
6	11.00	20.00	6.070	N/A	1	---
7	13.00	20.00	7.775	N/A	1	---
8	15.00	20.00	10.752	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.0535; Overturning: CDR-static = 6.74

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	20.00	0.0457	N/A	1	---
2	3.00	20.00	0.0308	N/A	1	---
3	5.00	20.00	0.0169	N/A	1	---
4	7.00	20.00	0.0038	N/A	1	---
5	9.00	20.00	-0.0090	N/A	1	---
6	11.00	20.00	-0.0227	N/A	1	---
7	13.00	20.00	-0.0401	N/A	1	---
8	15.00	20.00	-0.0707	N/A	1	---

FHWA-NHI-10-024
Allen Road East Abutment - 20ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road East Abutment - 20ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....t\MSEW\20ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	0.0 °
Equivalent cohesion, $c_{equiv.}$	2000.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3362 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 5.14 N_γ= 0.00

SEISMICITY

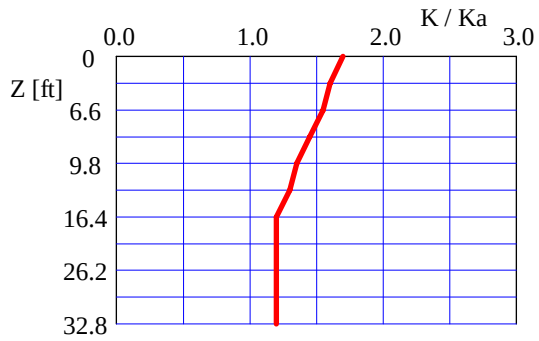
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



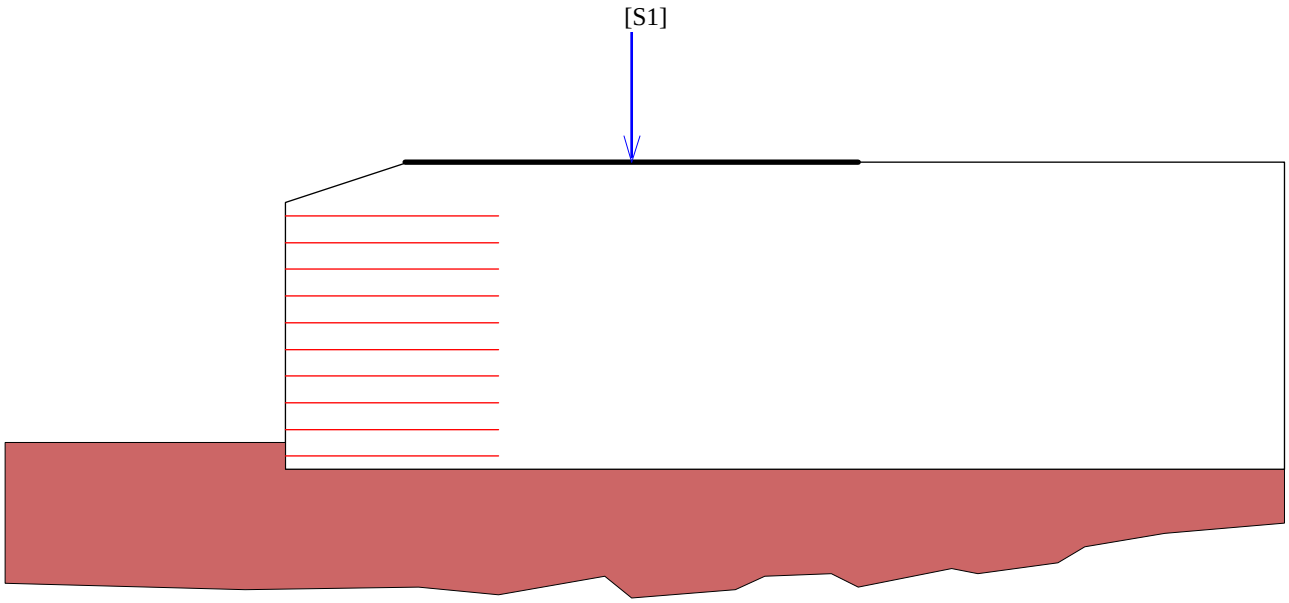
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	20.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 18.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 4.29° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 8 10 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90	1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static		Combined Static/Seismic
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic
Reinforced Soil and Foundation	ϕ_τ	1.00	1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00	1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:	Static	Combined Static/Seismic
	ϕ_b 0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

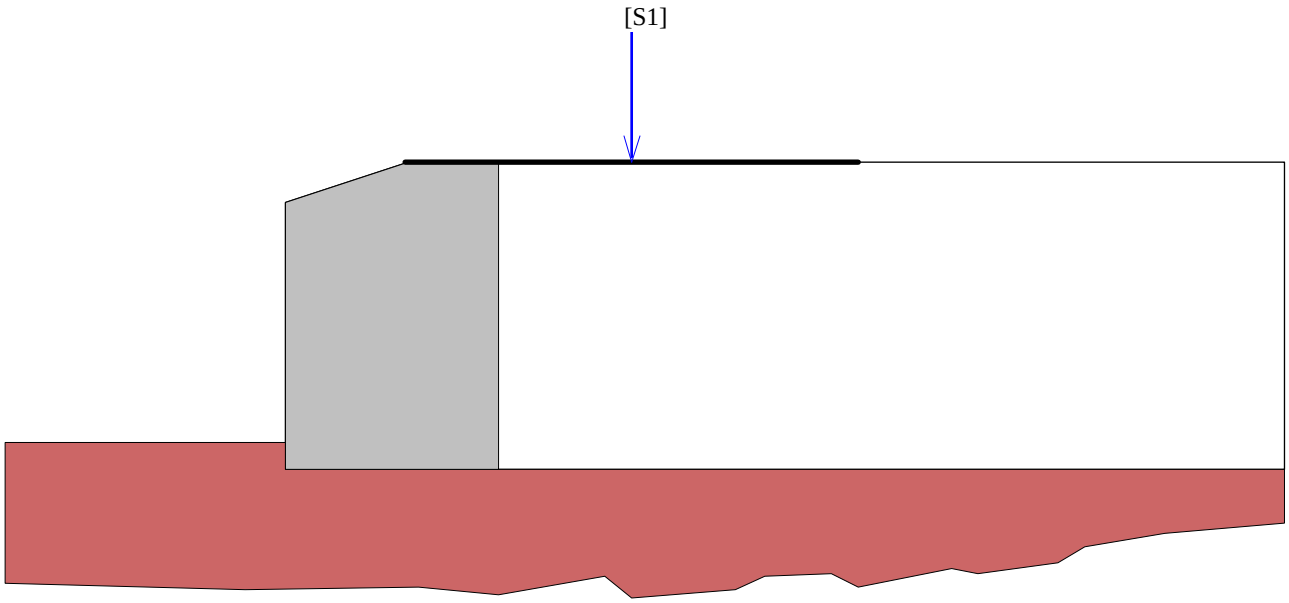
Bearing capacity, CDR = 1.43, factored bearing load = 4690 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.837, Eccentricity, e/L = 0.1511, CDR-overturning = 2.98

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	16.00	1	N/A	1.76	1.96	1.958	1.324	1.910	0.1366	---
2	3.00	16.00	1	N/A	1.87	2.07	2.074	1.393	2.091	0.1093	---
3	5.00	16.00	1	N/A	2.02	2.24	2.241	1.436	2.305	0.0841	---
4	7.00	16.00	1	N/A	2.22	2.47	2.467	1.452	2.568	0.0609	---
5	9.00	16.00	1	N/A	2.46	2.74	2.737	1.422	2.901	0.0396	---
6	11.00	16.00	1	N/A	2.79	3.10	3.098	1.360	3.334	0.0198	---
7	13.00	16.00	1	N/A	3.28	3.64	3.640	1.449	3.920	0.0009	---
8	15.00	16.00	1	N/A	4.09	4.54	4.542	1.567	4.757	-0.0183	---
9	17.00	16.00	1	N/A	5.56	6.18	6.181	1.718	6.037	-0.0414	---
10	19.00	16.00	1	N/A	9.00	10.00	9.995	1.969	8.178	-0.0805	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	6684	N/A	[lb/ft ²]
Factored bearing load, σ_V	4690.0	N/A	[lb/ft ²]
Eccentricity, e	1.75	N/A	[ft]
Eccentricity, e/L	0.109	N/A	
CDR calculated	1.43	N/A	
Base length	16.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 43351.10 [lb/ft], L = 16.00, Unfactored e = 1.55 [ft], and Sigma = 3362.90 [lb/ft ²]



SCALE:

0 2 4 6 8 10 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.837

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	16.00	1.910	N/A	1	---
2	3.00	16.00	2.091	N/A	1	---
3	5.00	16.00	2.305	N/A	1	---
4	7.00	16.00	2.568	N/A	1	---
5	9.00	16.00	2.901	N/A	1	---
6	11.00	16.00	3.334	N/A	1	---
7	13.00	16.00	3.920	N/A	1	---
8	15.00	16.00	4.757	N/A	1	---
9	17.00	16.00	6.037	N/A	1	---
10	19.00	16.00	8.178	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1511; Overturning: CDR-static = 2.98

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	16.00	0.1366	N/A	1	---
2	3.00	16.00	0.1093	N/A	1	---
3	5.00	16.00	0.0841	N/A	1	---
4	7.00	16.00	0.0609	N/A	1	---
5	9.00	16.00	0.0396	N/A	1	---
6	11.00	16.00	0.0198	N/A	1	---
7	13.00	16.00	0.0009	N/A	1	---
8	15.00	16.00	-0.0183	N/A	1	---
9	17.00	16.00	-0.0414	N/A	1	---
10	19.00	16.00	-0.0805	N/A	1	---

FHWA-NHI-10-024
Allen Road East Abutment - 24ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road East Abutment - 24ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....t\MSEW\24ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	27.0 °
Equivalent cohesion, $c_{equiv.}$	30.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3353 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 23.94 N γ= 14.47

SEISMICITY

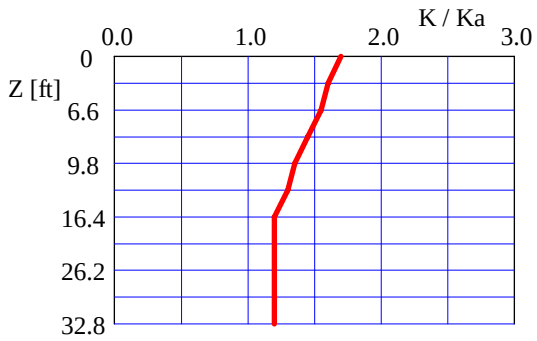
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



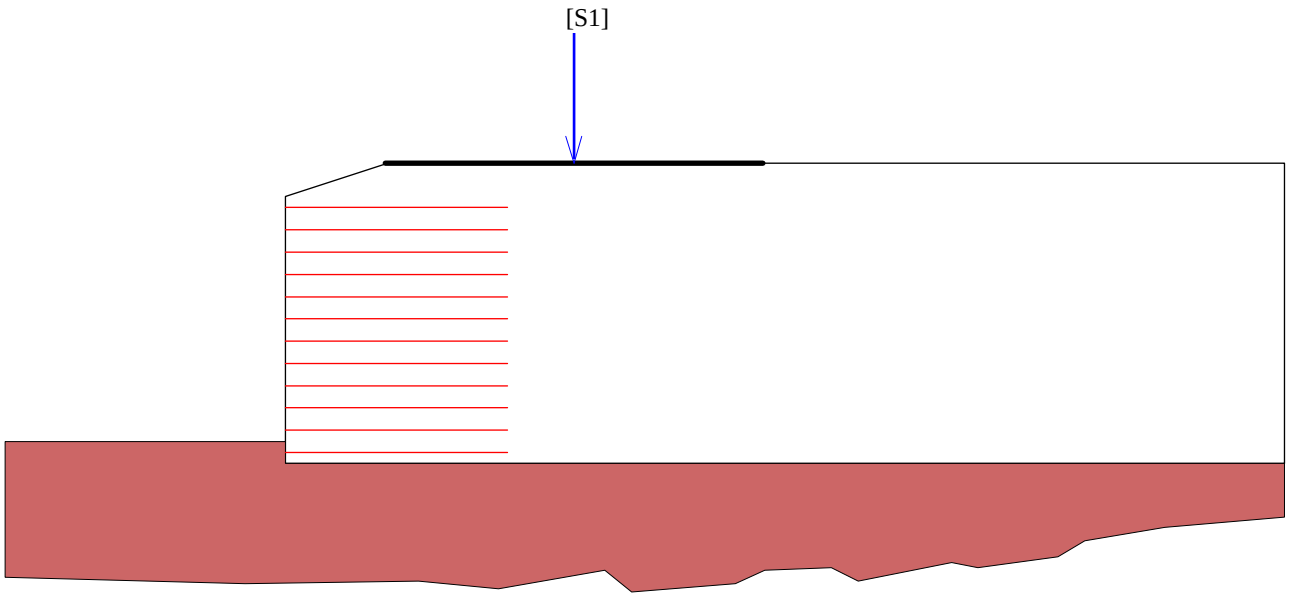
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	24.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 22.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 3.58° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 8 10[ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00
Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90		1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:	Static	Combined Static/Seismic	
	ϕ_b	0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

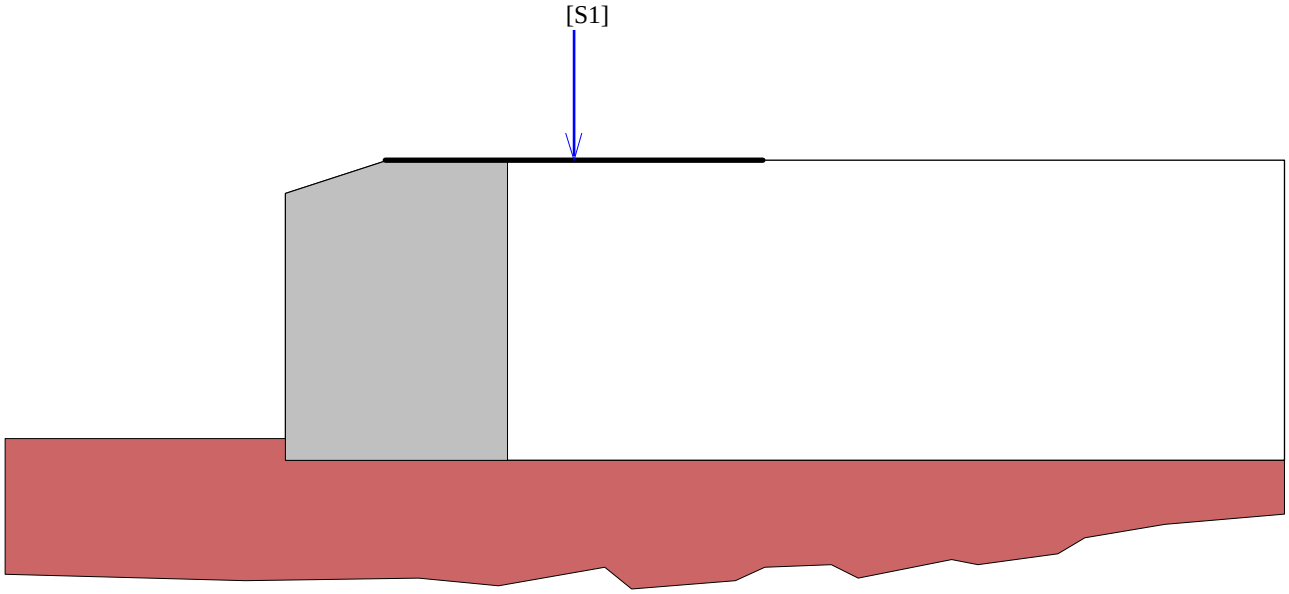
Bearing capacity, CDR = 1.77, factored bearing load = 5388 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.518, Eccentricity, e/L = 0.1347, CDR-overturning = 3.37

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	20.00	1	N/A	1.50	1.67	1.669	1.595	2.035	0.1238	---
2	3.00	20.00	1	N/A	1.63	1.81	1.812	1.506	2.196	0.1031	---
3	5.00	20.00	1	N/A	1.75	1.94	1.943	1.479	2.390	0.0838	---
4	7.00	20.00	1	N/A	1.85	2.06	2.056	1.566	2.621	0.0659	---
5	9.00	20.00	1	N/A	2.00	2.22	2.220	1.627	2.894	0.0493	---
6	11.00	20.00	1	N/A	2.20	2.44	2.440	1.659	3.231	0.0340	---
7	13.00	20.00	1	N/A	2.43	2.70	2.702	1.640	3.659	0.0197	---
8	15.00	20.00	1	N/A	2.75	3.05	3.052	1.728	4.218	0.0062	---
9	17.00	20.00	1	N/A	3.22	3.57	3.575	1.846	4.980	-0.0070	---
10	19.00	20.00	1	N/A	3.99	4.44	4.438	1.991	6.079	-0.0211	---
11	21.00	20.00	1	N/A	5.39	5.99	5.986	2.172	7.792	-0.0388	---
12	23.00	20.00	1	N/A	8.43	9.37	9.370	2.430	10.784	-0.0699	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	9553	N/A	[lb/ft ²]
Factored bearing load, σ_V	5388.3	N/A	[lb/ft ²]
Eccentricity, e	1.95	N/A	[ft]
Eccentricity, e/L	0.097	N/A	
CDR calculated	1.77	N/A	
Base length	20.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 64137.07 [lb/ft], L = 20.00, Unfactored e = 1.74 [ft], and Sigma = 3881.93 [lb/ft ²]



SCALE:

0 2 4 6 8 10[ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.518

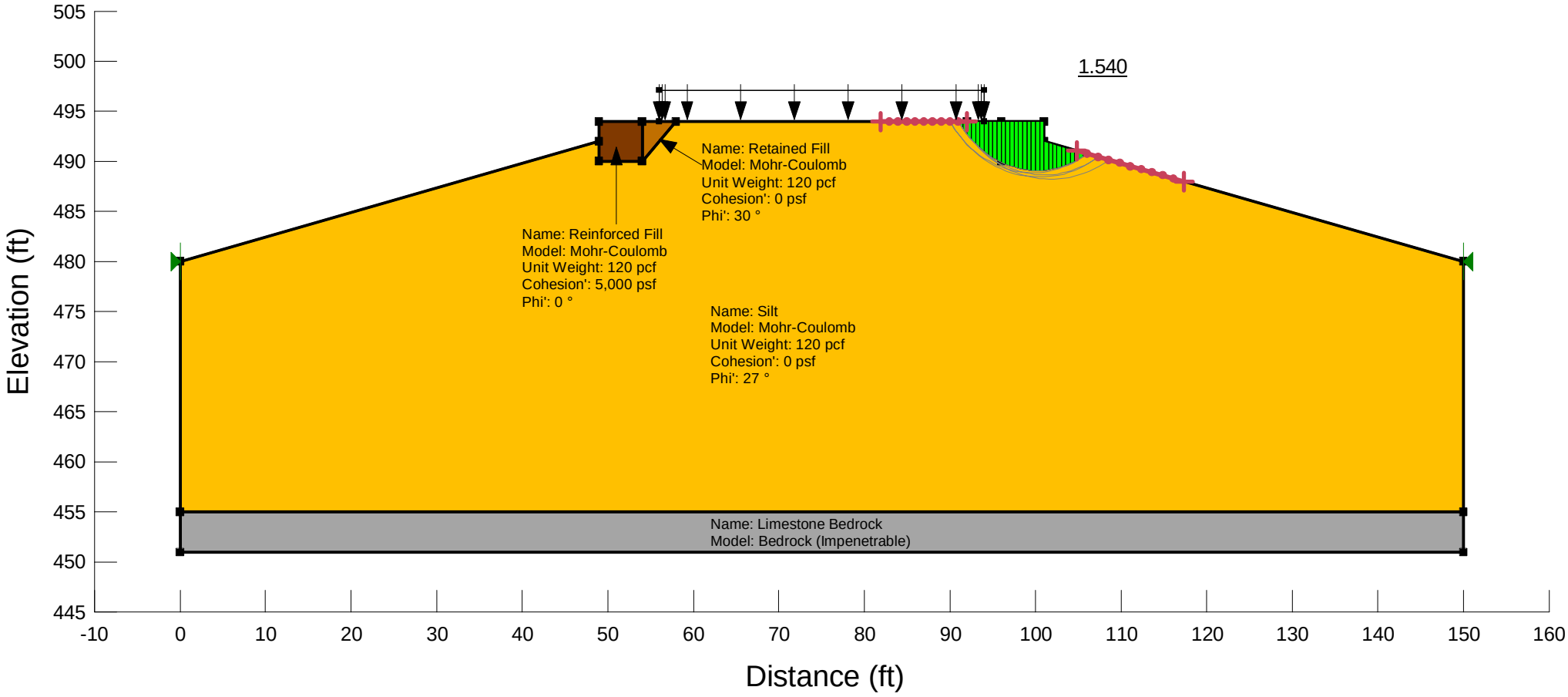
#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	20.00	2.035	N/A	1	---
2	3.00	20.00	2.196	N/A	1	---
3	5.00	20.00	2.390	N/A	1	---
4	7.00	20.00	2.621	N/A	1	---
5	9.00	20.00	2.894	N/A	1	---
6	11.00	20.00	3.231	N/A	1	---
7	13.00	20.00	3.659	N/A	1	---
8	15.00	20.00	4.218	N/A	1	---
9	17.00	20.00	4.980	N/A	1	---
10	19.00	20.00	6.079	N/A	1	---
11	21.00	20.00	7.792	N/A	1	---
12	23.00	20.00	10.784	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1347; Overturning: CDR-static = 3.37

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	20.00	0.1238	N/A	1	---
2	3.00	20.00	0.1031	N/A	1	---
3	5.00	20.00	0.0838	N/A	1	---
4	7.00	20.00	0.0659	N/A	1	---
5	9.00	20.00	0.0493	N/A	1	---
6	11.00	20.00	0.0340	N/A	1	---
7	13.00	20.00	0.0197	N/A	1	---
8	15.00	20.00	0.0062	N/A	1	---
9	17.00	20.00	-0.0070	N/A	1	---
10	19.00	20.00	-0.0211	N/A	1	---
11	21.00	20.00	-0.0388	N/A	1	---
12	23.00	20.00	-0.0699	N/A	1	---

Allen Road East Abutment
4ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 34
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 9/26/2019
Time: 3:24:31 PM
File Name: 4ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\East Abutment\SlopeW\
Last Solved Date: 9/26/2019
Last Solved Time: 3:24:36 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (81.90664, 494) ft
Left-Zone Right Coordinate: (92, 494) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (104.79187, 491.07138) ft
Right-Zone Right Coordinate: (117.38437, 487.9875) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 480) ft
Right Coordinate: (150, 480) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	494
	56	497.10625
	94	497.10625
	94	494

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	455
Point 3	0	480
Point 4	49	490
Point 5	49	492
Point 6	49	494
Point 7	54	494
Point 8	54	490
Point 9	58	494
Point 10	96	494

Point 11	96	490
Point 12	101	494
Point 13	101	490
Point 14	101	492
Point 15	150	480
Point 16	150	455
Point 17	150	451
Point 18	92	494

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	600
Region 2	Silt	2,3,5,4,8,9,18,11,13,14,15,16	5,010
Region 3	Reinforced Fill	6,7,8,4,5	20
Region 4	Retained Fill	7,8,9	8
Region 5	Retained Fill	18,10,11	8
Region 6	Reinforced Fill	10,12,14,13,11	20

Current Slip Surface

Slip Surface: 503
F of S: 1.540
Volume: 44.076369 ft³
Weight: 5,289.1643 lbs
Resisting Moment: 44,389.261 lbs-ft
Activating Moment: 28,827.807 lbs-ft
Resisting Force: 3,501.8634 lbs
Activating Force: 2,275.1242 lbs
F of S Rank: 1
Exit: (106.05112, 490.76299) ft
Entry: (90.990664, 494) ft
Radius: 11.089225 ft
Center: (100.19733, 500.18128) ft

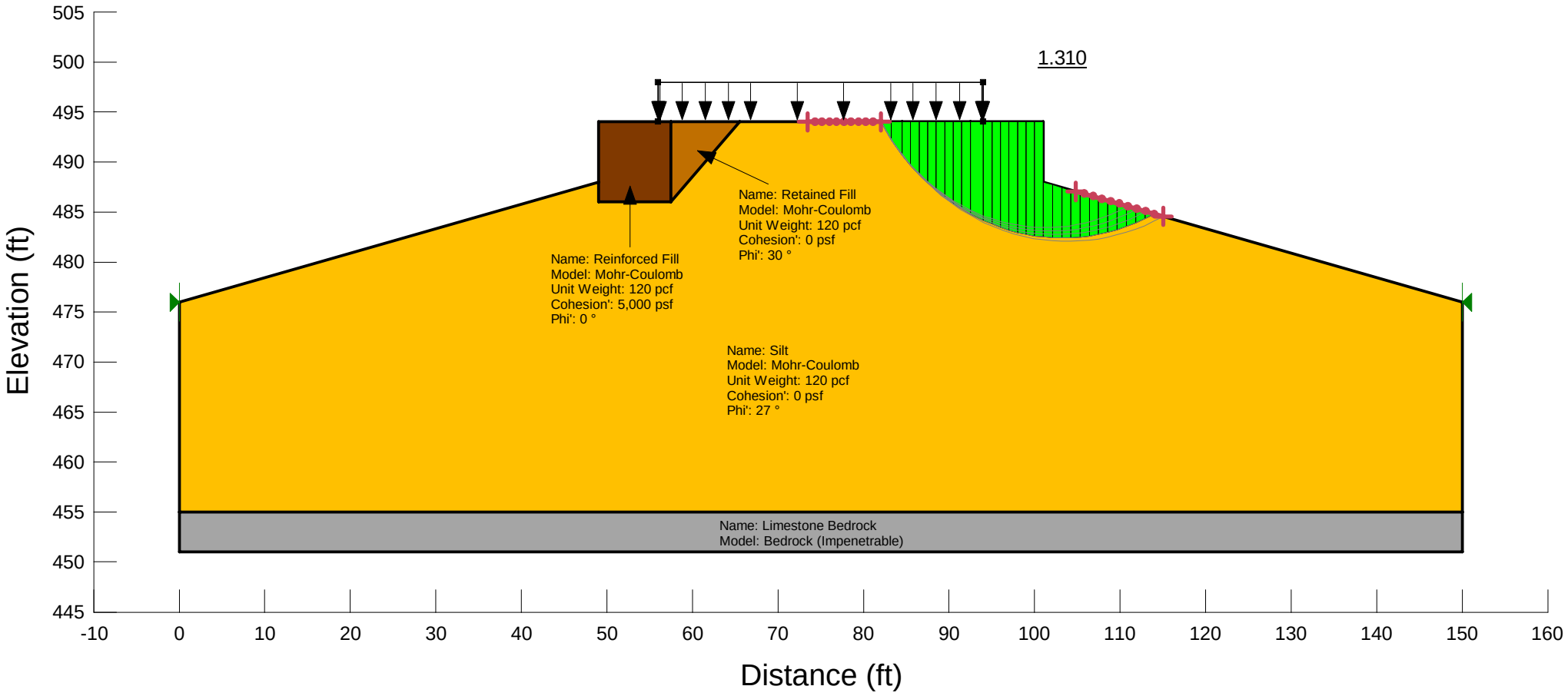
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
	91.242998	493.65385	0	545.7725	278.08498	0

Slice 1						
Slice 2	91.747666	493.01036	0	595.50886	303.42692	0
Slice 3	92.25	492.45585	0	641.67272	326.94858	0
Slice 4	92.75	491.97188	0	686.53024	349.80463	0
Slice 5	93.25	491.544	0	731.86651	372.90461	0
Slice 6	93.75	491.16416	0	778.81736	396.82727	0
Slice 7	94.25	490.82647	0	228.13242	116.23927	0
Slice 8	94.75	490.52648	0	267.7526	136.42676	0
Slice 9	95.25	490.26075	0	307.8064	156.83519	0
Slice 10	95.75	490.02659	0	348.60707	177.62417	0
Slice 11	96.25	489.82184	0	390.31881	198.87737	0
Slice 12	96.75	489.64479	0	432.94243	220.59519	0
Slice 13	97.25	489.49405	0	476.29399	242.68391	0
Slice 14	97.75	489.36852	0	519.97937	264.94272	0
Slice 15	98.25	489.26733	0	563.36877	287.05072	0
Slice 16	98.75	489.1898	0	605.57672	308.55675	0
Slice 17	99.25	489.13544	0	645.45512	328.87581	0
Slice 18	99.75	489.1039	0	681.60802	347.29663	0
Slice 19	100.25	489.09499	0	712.4374	363.00499	0
Slice 20	100.75	489.10866	0	736.22743	375.12661	0
Slice 21	101.25256	489.14529	0	451.76333	230.18491	0
Slice 22	101.75767	489.20534	0	435.62617	221.96262	0
Slice 23	102.26278	489.28913	0	410.41213	209.11542	0
Slice 24	102.76789	489.39723	0	376.07264	191.61858	0

Slice 25	103.273	489.53036	0	333.06666	169.70594	0
Slice 26	103.77812	489.68948	0	282.35266	143.86587	0
Slice 27	104.28323	489.87581	0	225.30676	114.79953	0
Slice 28	104.78834	490.09086	0	163.57463	83.345436	0
Slice 29	105.29345	490.3365	0	98.880842	50.382306	0
Slice 30	105.79856	490.61511	0	32.82956	16.727496	0

Allen Road East Abutment
8ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 30
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 9/26/2019
Time: 4:01:09 PM
File Name: 8ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\East Abutment\SlopeW\
Last Solved Date: 9/26/2019
Last Solved Time: 4:01:14 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (73.48369, 494) ft
Left-Zone Right Coordinate: (82, 494) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (104.79308, 487.07108) ft
Right-Zone Right Coordinate: (115, 484.57143) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 476) ft
Right Coordinate: (150, 476) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	494
	56	497.95938
	94	497.95938
	94	494

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	455
Point 3	0	476
Point 4	49	486
Point 5	49	488
Point 6	49	494
Point 7	57.5	494
Point 8	57.5	486
Point 9	65.5	494
Point 10	92.5	494

Point 11	92.5	486
Point 12	101	494
Point 13	101	486
Point 14	101	488
Point 15	150	476
Point 16	150	455
Point 17	150	451
Point 18	84.5	494

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	600
Region 2	Silt	2,3,5,4,8,9,18,11,13,14,15,16	4,474
Region 3	Reinforced Fill	6,5,4,8,7	68
Region 4	Retained Fill	7,8,9	32
Region 5	Retained Fill	18,10,11	32
Region 6	Reinforced Fill	10,12,14,13,11	68

Current Slip Surface

Slip Surface: 598
F of S: 1.310
Volume: 190.90534 ft³
Weight: 22,908.641 lbs
Resisting Moment: 440,388.97 lbs-ft
Activating Moment: 336,239.4 lbs-ft
Resisting Force: 15,392.341 lbs
Activating Force: 11,760.791 lbs
F of S Rank: 1
Exit: (113.97931, 484.82139) ft
Entry: (82, 494) ft
Radius: 25.214522 ft
Center: (103.21711, 507.62375) ft

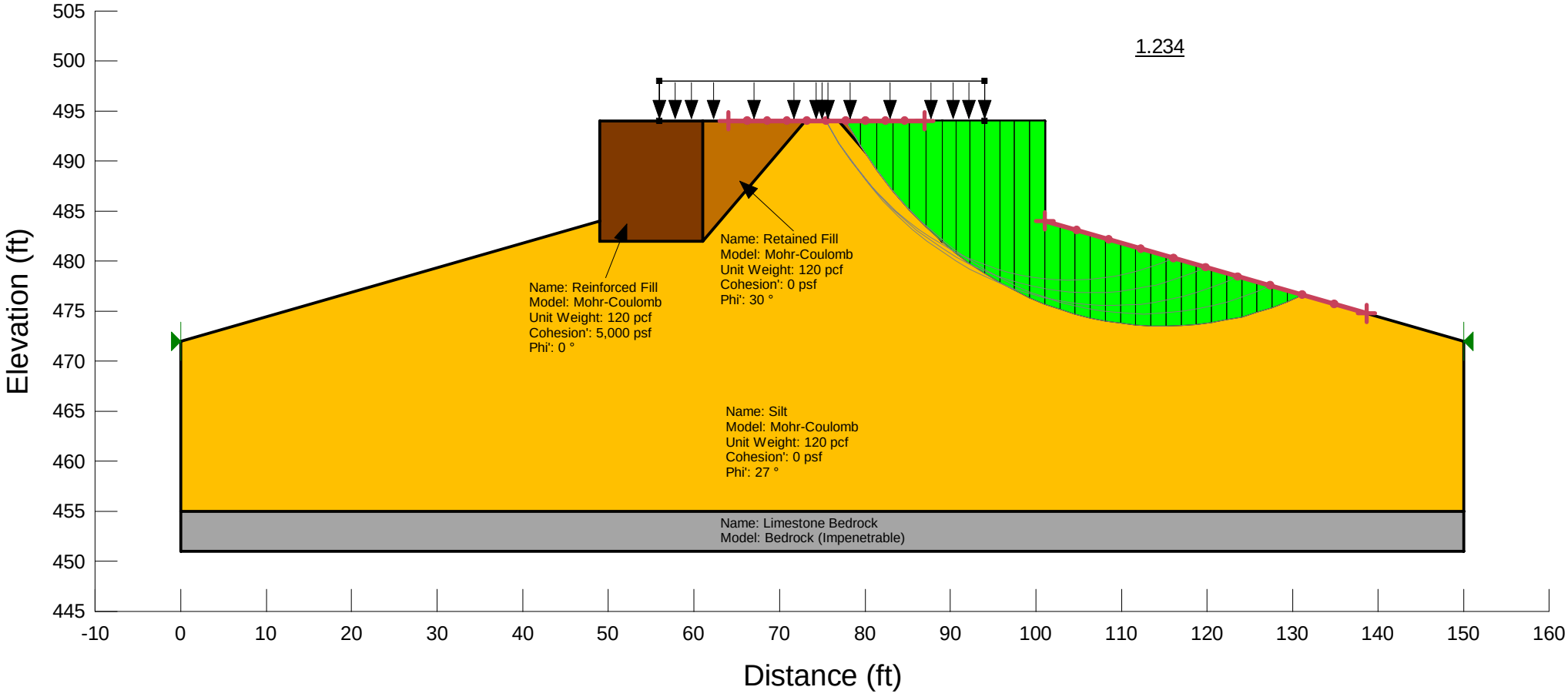
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
	82.625	493.11306	0	681.32604	347.15296	0

Slice 1						
Slice 2	83.875	491.47742	0	806.62064	410.99374	0
Slice 3	85	490.20578	0	911.19497	464.27702	0
Slice 4	86	489.2152	0	1,000.2918	509.67412	0
Slice 5	87	488.32735	0	1,088.9766	554.8613	0
Slice 6	88	487.52851	0	1,179.0687	600.7655	0
Slice 7	89	486.80838	0	1,271.9993	648.116	0
Slice 8	90	486.159	0	1,368.8804	697.47942	0
Slice 9	91	485.57408	0	1,470.5304	749.27265	0
Slice 10	92	485.04861	0	1,577.468	803.76007	0
Slice 11	93.25	484.47721	0	1,718.1381	875.43507	0
Slice 12	94.5	483.96999	0	995.62975	507.2987	0
Slice 13	95.5	483.62494	0	1,088.3859	554.56032	0
Slice 14	96.5	483.32594	0	1,182.3137	602.41893	0
Slice 15	97.5	483.07129	0	1,276.1594	650.23571	0
Slice 16	98.5	482.85962	0	1,368.1917	697.12849	0
Slice 17	99.5	482.68984	0	1,456.1885	741.96511	0
Slice 18	100.5	482.56109	0	1,537.4643	783.37718	0
Slice 19	101.5408	482.47085	0	785.87138	400.42147	0
Slice 20	102.62241	482.42204	0	791.68431	403.3833	0
Slice 21	103.70402	482.41973	0	782.99125	398.95397	0
Slice 22	104.78563	482.46389	0	758.16957	386.30669	0
Slice 23	105.86724	482.55478	0	716.2976	364.97186	0
Slice 24	106.94885	482.6929	0	657.36211	334.94272	0

Slice 25	108.03046	482.87904	0	582.36522	296.7299	0
Slice 26	109.11207	483.11431	0	493.29181	251.34473	0
Slice 27	110.19368	483.40014	0	392.924	200.20478	0
Slice 28	111.27529	483.73835	0	284.5249	144.97268	0
Slice 29	112.35689	484.1312	0	171.44695	87.356582	0
Slice 30	113.4385	484.5815	0	56.741682	28.911331	0

Allen Road East Abutment
12ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 20
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 8/18/2019
Time: 9:35:00 AM
File Name: 12ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\East Abutment\SlopeW\
Last Solved Date: 8/18/2019
Last Solved Time: 9:35:04 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (63.99888, 494) ft
Left-Zone Right Coordinate: (87, 494) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (101, 484) ft
Right-Zone Right Coordinate: (138.67898, 474.77249) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 472) ft
Right Coordinate: (150, 472) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	494
	56	497.95938
	94	497.95938
	94	494

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	455
Point 3	0	472
Point 4	49	482
Point 5	49	484
Point 6	49	494
Point 7	61	494
Point 8	61	482
Point 9	73	494
Point 10	89	494

Point 11	89	482
Point 12	101	494
Point 13	101	482
Point 14	101	484
Point 15	150	472
Point 16	150	455
Point 17	150	451
Point 18	77	494

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	600
Region 2	Silt	2,3,5,4,8,9,18,11,13,14,15,16	3,850
Region 3	Reinforced Fill	6,7,8,4,5	144
Region 4	Retained Fill	7,9,8	72
Region 5	Retained Fill	18,10,11	72
Region 6	Reinforced Fill	10,12,14,13,11	144

Current Slip Surface

Slip Surface: 373
F of S: 1.234
Volume: 441.05271 ft³
Weight: 52,926.325 lbs
Resisting Moment: 1,506,750.8 lbs-ft
Activating Moment: 1,221,282.7 lbs-ft
Resisting Force: 30,036.713 lbs
Activating Force: 24,364.189 lbs
F of S Rank: 1
Exit: (131.14318, 476.618) ft
Entry: (77.799552, 494) ft
Radius: 43.735292 ft
Center: (114.86689, 517.21181) ft

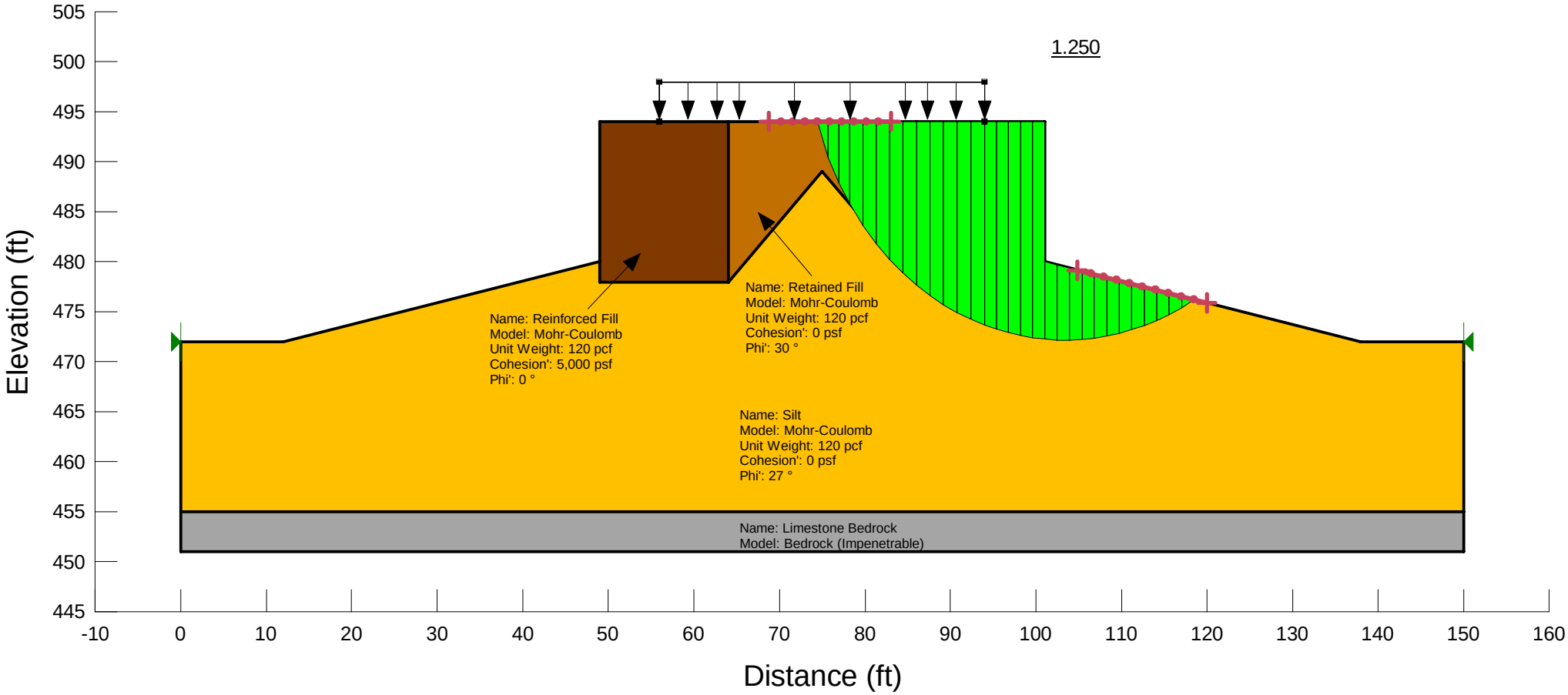
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
	78.627569	492.77221	0	653.81969	377.48298	0

Slice 1						
Slice 2	80.410028	490.32141	0	869.35115	442.95653	0
Slice 3	82.318911	488.03373	0	1,048.7271	534.35315	0
Slice 4	84.227793	486.03119	0	1,217.854	620.52761	0
Slice 5	86.136676	484.26114	0	1,382.5623	704.45066	0
Slice 6	88.045559	482.68746	0	1,547.2663	788.37158	0
Slice 7	89.833333	481.36403	0	1,704.8856	868.6826	0
Slice 8	91.5	480.25519	0	1,856.0467	945.70304	0
Slice 9	93.166667	479.2519	0	2,012.9242	1,025.6361	0
Slice 10	94.875	478.32567	0	1,390.2993	708.39285	0
Slice 11	96.625	477.47414	0	1,542.1061	785.74232	0
Slice 12	98.375	476.71612	0	1,698.1575	865.25449	0
Slice 13	100.125	476.04643	0	1,857.7743	946.58329	0
Slice 14	101.88656	475.45747	0	886.77566	451.83477	0
Slice 15	103.65969	474.94678	0	956.40705	487.31373	0
Slice 16	105.43282	474.5158	0	1,019.0516	519.23272	0
Slice 17	107.20595	474.16213	0	1,072.2281	546.3275	0
Slice 18	108.97908	473.88389	0	1,113.0759	567.1405	0
Slice 19	110.75221	473.67962	0	1,138.5164	580.10307	0
Slice 20	112.52534	473.54827	0	1,145.4913	583.65697	0
Slice 21	114.29846	473.4892	0	1,131.2687	576.41021	0
Slice 22	116.07159	473.50211	0	1,093.7861	557.31188	0
Slice 23	117.84472	473.58706	0	1,031.98	525.82006	0
Slice 24	119.61785	473.74448	0	946.03777	482.03032	0

Slice 25	121.39098	473.97516	0	837.50979	426.73255	0
Slice 26	123.16411	474.28028	0	709.23605	361.37382	0
Slice 27	124.93724	474.66144	0	565.07987	287.92258	0
Slice 28	126.71036	475.12072	0	409.50287	208.65214	0
Slice 29	128.48349	475.66072	0	247.0557	125.88117	0
Slice 30	130.25662	476.28462	0	81.880313	41.720103	0

Allen Road East Abutment
16ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 17
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 8/18/2019
Time: 9:35:42 AM
File Name: 16ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\East Abutment\SlopeW\
Last Solved Date: 8/18/2019
Last Solved Time: 9:35:46 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (68.76828, 494) ft
Left-Zone Right Coordinate: (83, 494) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (104.86724, 479.16384) ft
Right-Zone Right Coordinate: (120, 475.89189) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 472) ft
Right Coordinate: (150, 472) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	494
	56	497.95938
	94	497.95938
	94	494

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	455
Point 3	0	472
Point 4	49	478
Point 5	49	480
Point 6	49	494
Point 7	64	494
Point 8	64	478
Point 9	75	489
Point 10	86	494

Point 11	86	478
Point 12	101	494
Point 13	101	478
Point 14	101	480
Point 15	150	472
Point 16	150	455
Point 17	150	451
Point 18	12	472
Point 19	138	472

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	600
Region 2	Reinforced Fill	6,7,8,4,5	240
Region 3	Retained Fill	7,10,11,9,8	231
Region 4	Reinforced Fill	10,12,14,13,11	240
Region 5	Silt	2,3,18,5,4,8,9,11,13,14,19,15,16	3,279

Current Slip Surface

Slip Surface: 269
F of S: 1.250
Volume: 497.4446 ft³
Weight: 59,693.353 lbs
Resisting Moment: 1,217,812.8 lbs-ft
Activating Moment: 973,940.18 lbs-ft
Resisting Force: 34,546.712 lbs
Activating Force: 27,649.249 lbs
F of S Rank: 1
Exit: (118.48672, 476.21909) ft
Entry: (74.460968, 494) ft
Radius: 30.075687 ft
Center: (103.38857, 502.23048) ft

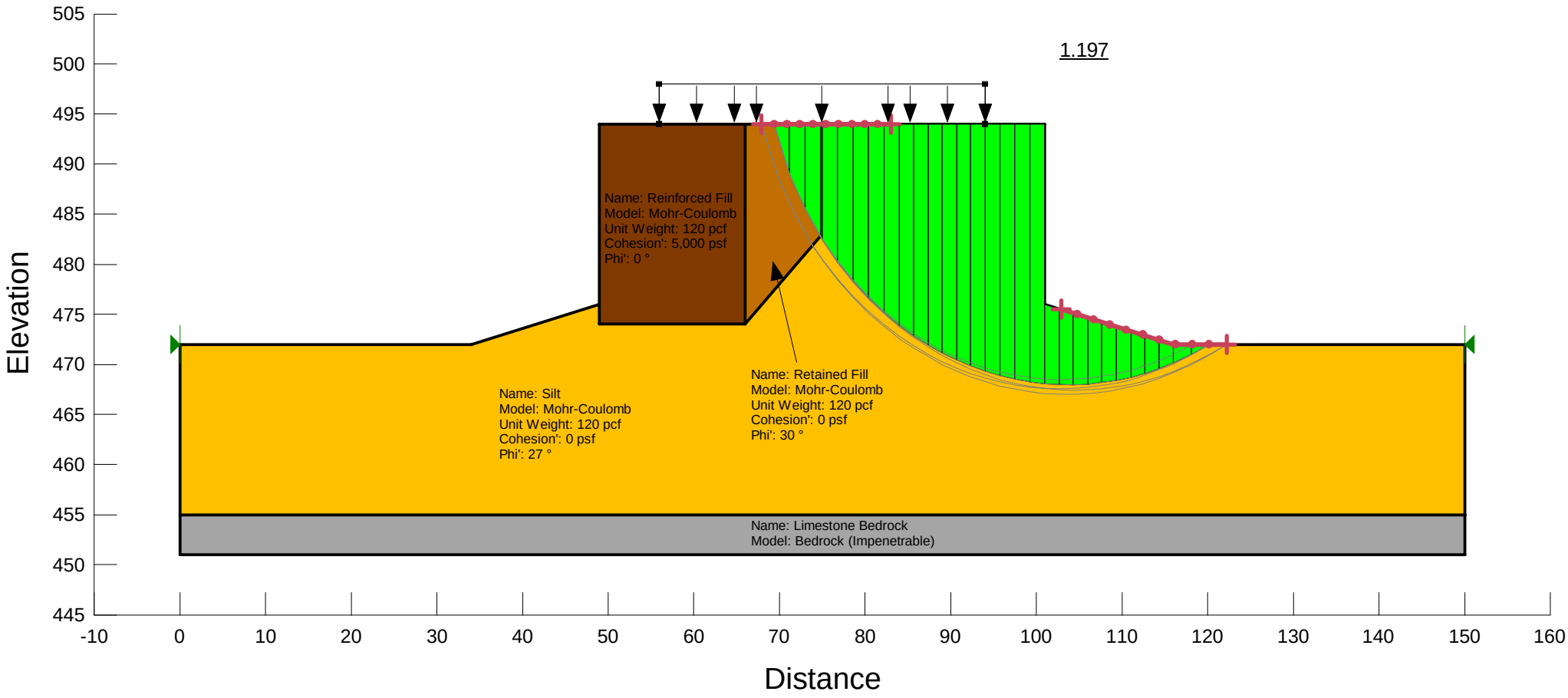
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

Slice 1	75.082978	492.23803	0	495.76285	286.22882	0
Slice 2	76.326998	489.1857	0	715.10318	412.86502	0
Slice 3	77.571019	486.85115	0	891.36861	514.63191	0
Slice 4	78.973726	484.71854	0	1,102.3779	561.68958	0
Slice 5	80.53512	482.71583	0	1,276.1409	650.22628	0
Slice 6	82.096514	481.01794	0	1,444.2071	735.86026	0
Slice 7	83.657909	479.55501	0	1,614.3826	822.56903	0
Slice 8	85.219303	478.28337	0	1,792.1251	913.13337	0
Slice 9	86.8	477.16165	0	1,983.822	1,010.8078	0
Slice 10	88.4	476.17212	0	2,193.1473	1,117.4644	0
Slice 11	90	475.31404	0	2,419.8247	1,232.9622	0
Slice 12	91.6	474.5751	0	2,664.6413	1,357.7025	0
Slice 13	93.2	473.94591	0	2,926.7882	1,491.2731	0
Slice 14	94.7	473.44644	0	2,257.175	1,150.0881	0
Slice 15	96.1	473.06024	0	2,461.0864	1,253.9862	0
Slice 16	97.5	472.74553	0	2,666.3412	1,358.5687	0
Slice 17	98.9	472.50005	0	2,867.1751	1,460.8987	0
Slice 18	100.3	472.32208	0	3,056.1274	1,557.1747	0
Slice 19	101.72861	472.20951	0	1,223.5169	623.41298	0
Slice 20	103.18584	472.16431	0	1,258.6034	641.29047	0
Slice 21	104.64307	472.18982	0	1,267.328	645.73585	0
Slice 22	106.10029	472.28623	0	1,245.2662	634.4948	0
Slice 23	107.55752	472.45422	0	1,189.532	606.09683	0
Slice 24	109.01475	472.69503	0	1,099.459	560.20234	0

Slice 25	110.47198	473.01045	0	977.01101	497.81197	0
Slice 26	111.9292	473.40294	0	826.76243	421.2565	0
Slice 27	113.38643	473.87571	0	655.38264	333.93413	0
Slice 28	114.84366	474.43288	0	470.70116	239.83422	0
Slice 29	116.30088	475.07964	0	280.56567	142.95535	0
Slice 30	117.75811	475.82262	0	91.774018	46.761198	0

Allen Road East Abutment
20ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 9
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 8/18/2019
Time: 9:36:21 AM
File Name: 20ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\East Abutment\SlopeW\
Last Solved Date: 8/18/2019
Last Solved Time: 9:36:24 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (67.86839, 494) ft
Left-Zone Right Coordinate: (83, 494) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (102.86357, 475.50305) ft
Right-Zone Right Coordinate: (122.18535, 472) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 472) ft
Right Coordinate: (150, 472) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	494
	56	497.95938
	94	497.95938
	94	494

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	455
Point 3	0	472
Point 4	49	474
Point 5	49	476
Point 6	49	494
Point 7	66	494
Point 8	66	474
Point 9	75	483
Point 10	84	494

Point 11	84	474
Point 12	101	494
Point 13	101	474
Point 14	101	476
Point 15	150	472
Point 16	150	455
Point 17	150	451
Point 18	34	472
Point 19	116	472

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	600
Region 2	Silt	2,3,18,5,4,8,9,11,13,14,19,15,16	2,795
Region 3	Reinforced Fill	6,7,8,4,5	340
Region 4	Retained Fill	7,10,11,9,8	279
Region 5	Reinforced Fill	10,12,14,13,11	340

Current Slip Surface

Slip Surface: 104
F of S: 1.197
Volume: 673.73975 ft³
Weight: 80,848.77 lbs
Resisting Moment: 1,892,717 lbs-ft
Activating Moment: 1,580,931.5 lbs-ft
Resisting Force: 45,426.966 lbs
Activating Force: 37,944.973 lbs
F of S Rank: 1
Exit: (120.20727, 472) ft
Entry: (69.381551, 494) ft
Radius: 35.669339 ft
Center: (103.72548, 503.63309) ft

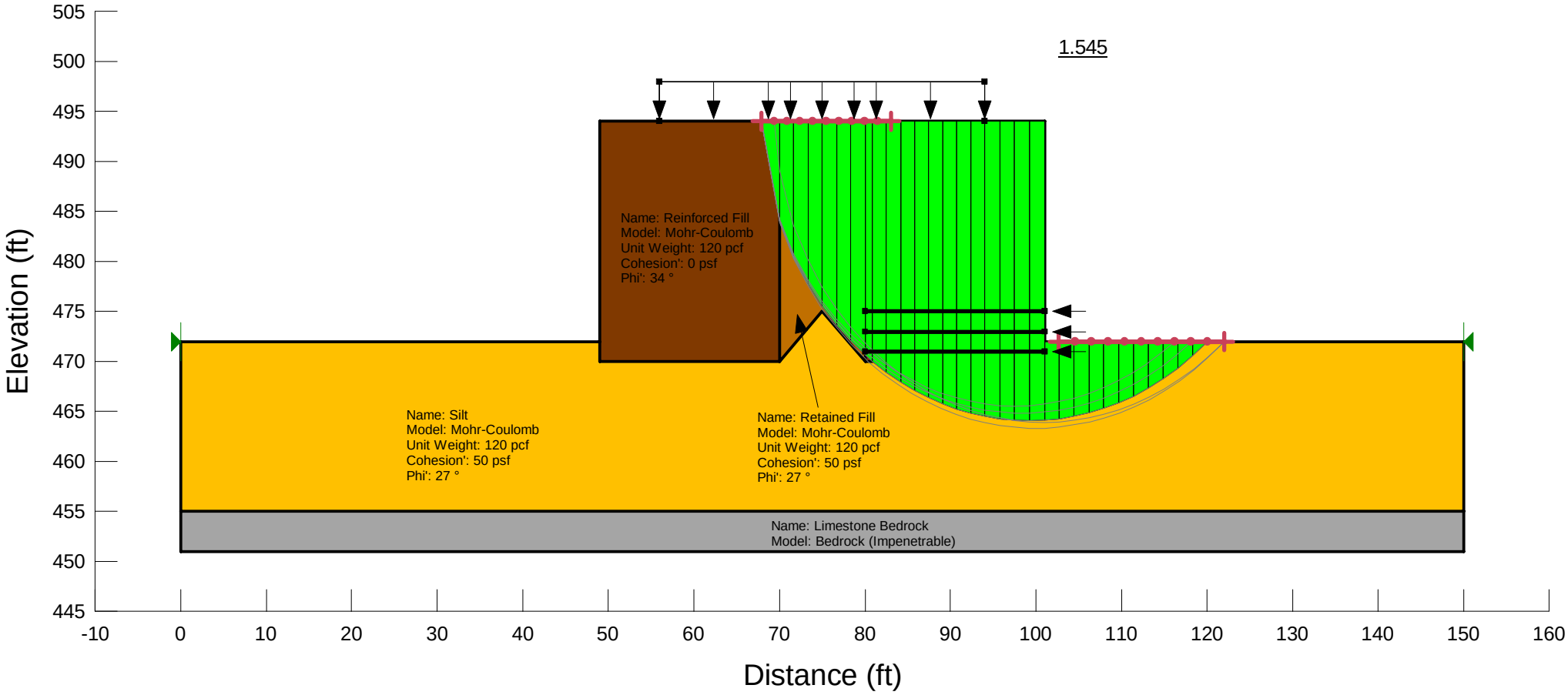
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

Slice 1	70.281946	491.51507	0	518.81434	299.5376	0
Slice 2	72.082735	487.28715	0	808.05207	466.52908	0
Slice 3	73.883525	484.16403	0	1,037.9541	599.26305	0
Slice 4	74.89196	482.63556	0	1,202.2478	612.57585	0
Slice 5	75.9	481.36271	0	1,306.6171	665.75467	0
Slice 6	77.7	479.27654	0	1,495.6817	762.08791	0
Slice 7	79.5	477.48117	0	1,685.8533	858.98514	0
Slice 8	81.3	475.91921	0	1,884.0026	959.94726	0
Slice 9	83.1	474.55262	0	2,095.2739	1,067.5954	0
Slice 10	84.833333	473.39366	0	2,314.9946	1,179.5487	0
Slice 11	86.5	472.41324	0	2,543.3787	1,295.9162	0
Slice 12	88.166667	471.54933	0	2,790.1458	1,421.6503	0
Slice 13	89.833333	470.7927	0	3,055.5864	1,556.899	0
Slice 14	91.5	470.13604	0	3,338.5844	1,701.0937	0
Slice 15	93.166667	469.57355	0	3,636.2071	1,852.74	0
Slice 16	94.875	469.09102	0	2,968.5788	1,512.5664	0
Slice 17	96.625	468.68902	0	3,239.3907	1,650.552	0
Slice 18	98.375	468.37843	0	3,501.1303	1,783.915	0
Slice 19	100.125	468.15683	0	3,740.4516	1,905.8553	0
Slice 20	101.83333	468.02375	0	1,289.0243	656.79071	0
Slice 21	103.5	467.9742	0	1,297.6341	661.17759	0
Slice 22	105.16667	468.00264	0	1,273.6188	648.94121	0
Slice 23	106.83333	468.10925	0	1,213.5695	618.34453	0
Slice 24	108.5	468.29475	0	1,116.5007	568.88554	0

Slice 25	110.16667	468.56038	0	984.3965	501.57507	0
Slice 26	111.83333	468.908	0	822.26444	418.96466	0
Slice 27	113.5	469.34009	0	637.5977	324.87226	0
Slice 28	115.16667	469.85992	0	439.31344	223.84138	0
Slice 29	117.05182	470.56612	0	253.68746	129.26022	0
Slice 30	119.15545	471.49501	0	83.541543	42.566542	0

Allen Road East Abutment
24ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Roth, Nick
Revision Number: 18
File Version: 8.3
Tool Version: 8.13.1.9253
Date: 8/19/2019
Time: 5:42:59 PM
File Name: 24ft Wall - NJR.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\East Abutment\SlopeW\
Last Solved Date: 8/19/2019
Last Solved Time: 5:43:02 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 27 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 27 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (67.86839, 494) ft
Left-Zone Right Coordinate: (83, 494) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (102.64005, 472) ft
Right-Zone Right Coordinate: (122, 472) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 472) ft
Right Coordinate: (150, 472) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	494
	56	497.95938
	94	497.95938
	94	494

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (101, 471) ft
Inside Point: (80, 471) ft
Slip Surface Intersection: () ft
Total Length: 21 ft
Reinforcement Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 34 °
Surface Area Factor: 2

Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 15,172.95 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 15,172.95 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (101, 473) ft
Inside Point: (80, 473) ft
Slip Surface Intersection: () ft
Total Length: 21 ft
Reinforcement Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 34 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 15,172.95 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 15,172.95 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 3

Type: Geosynthetic
Outside Point: (101, 475) ft
Inside Point: (80, 475) ft
Slip Surface Intersection: () ft
Total Length: 21 ft
Reinforcement Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 34 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed

Anchorage: Yes
Tensile Capacity: 15,172.95 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 15,172.95 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	455
Point 3	0	472
Point 4	49	470
Point 5	49	472
Point 6	49	494
Point 7	70	494
Point 8	70	470
Point 9	75	475
Point 10	80	494
Point 11	80	470
Point 12	101	494
Point 13	101	470
Point 14	101	472
Point 15	150	472
Point 16	150	455
Point 17	150	451

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	600
Region 2	Silt	2,3,5,4,8,9,11,13,14,15,16	2,471
Region 3	Reinforced Fill	6,7,8,4,5	504
Region 4	Retained Fill	7,10,11,9,8	215
Region 5	Reinforced Fill	10,12,14,13,11	504

Current Slip Surface

Slip Surface: 50
F of S: 1.545

Volume: 876.32378 ft³
Weight: 105,158.85 lbs
Resisting Moment: 2,317,766.7 lbs-ft
Activating Moment: 1,499,993.8 lbs-ft
Resisting Force: 62,381.124 lbs
Activating Force: 40,478.136 lbs
F of S Rank: 1
Exit: (120.064, 472) ft
Entry: (67.86839, 494) ft
Radius: 31.387218 ft
Center: (99.221269, 495.4678) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	68.934195	489.00514	0	478.45948	322.72499	0
Slice 2	70.833333	482.22403	0	1,152.4341	587.19452	50
Slice 3	72.5	479.07907	0	1,430.975	729.11819	50
Slice 4	74.166667	476.613	0	1,657.803	844.69282	50
Slice 5	75.833333	474.57289	0	1,862.9605	949.22581	50
Slice 6	77.5	472.84017	0	2,061.1413	1,050.204	50
Slice 7	79.166667	471.34736	0	2,261.1817	1,152.1296	50
Slice 8	80.438006	470.32725	0	2,358.9116	1,591.1059	0
Slice 9	81.696261	469.44755	0	2,584.554	1,316.8961	50
Slice 10	83.33676	468.4135	0	2,808.1959	1,430.8473	50
Slice 11	84.977258	467.51395	0	3,047.778	1,552.9204	50
Slice 12	86.617757	466.73617	0	3,304.8746	1,683.9177	50
Slice 13	88.258255	466.07047	0	3,580.0478	1,824.1255	50
Slice 14	89.898754	465.50933	0	3,872.6532	1,973.2153	50
Slice 15	91.539252	465.04695	0	4,180.5587	2,130.1011	50
Slice 16	93.179751	464.67886	0	4,499.8026	2,292.764	50
	94.875	464.39552	0	3,792.616	1,932.4344	50

Slice 17						
Slice 18	96.625	464.20047	0	4,083.7717	2,080.7856	50
Slice 19	98.375	464.10421	0	4,359.1686	2,221.1073	50
Slice 20	100.125	464.10581	0	4,604.2281	2,345.9714	50
Slice 21	101.86655	464.20435	0	1,458.861	743.32678	50
Slice 22	103.59964	464.39979	0	1,513.3771	771.10416	50
Slice 23	105.33273	464.694	0	1,529.889	779.51739	50
Slice 24	107.06582	465.08986	0	1,502.2654	765.44247	50
Slice 25	108.79891	465.59142	0	1,426.7379	726.95928	50
Slice 26	110.532	466.20415	0	1,302.8301	663.8251	50
Slice 27	112.26509	466.93522	0	1,133.8179	577.70908	50
Slice 28	113.99819	467.79408	0	926.49756	472.07409	50
Slice 29	115.73128	468.79312	0	690.21812	351.6837	50
Slice 30	117.46437	469.94895	0	435.35991	221.82695	50
Slice 31	119.19746	471.28421	0	171.60665	87.437957	50

FHWA-NHI-10-024
Allen Road West Abutment - 4ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road West Abutment - 4ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....nt\MSEW\4ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{equiv.}$	27.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ²

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3948 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 0.00 N_γ= 8.41

SEISMICITY

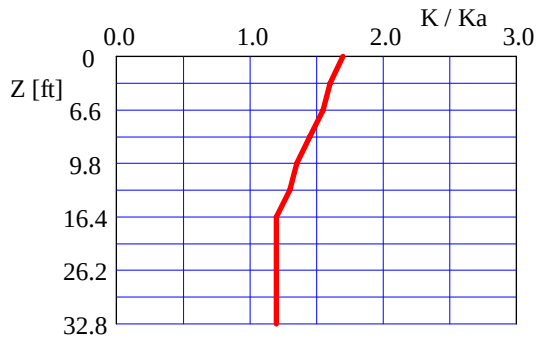
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



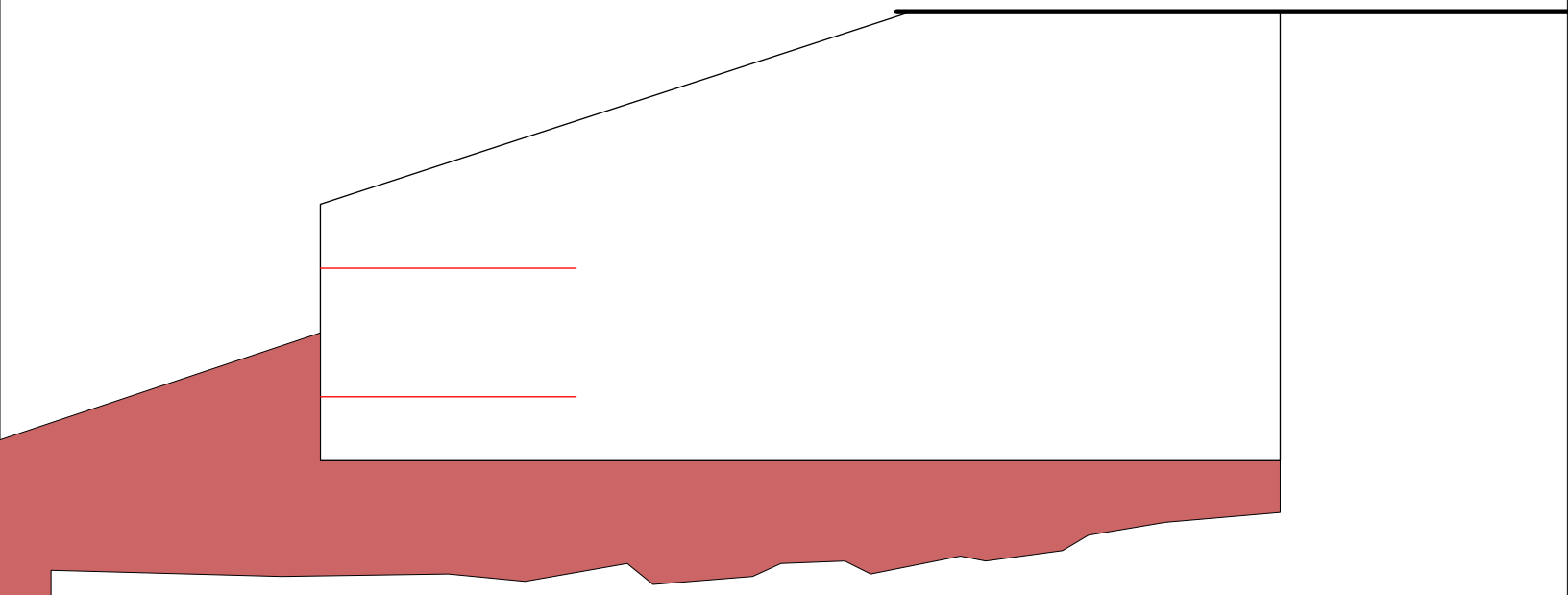
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	4.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 2.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 18.00° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00
Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90		1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:		Static	Combined Static/Seismic	
	ϕ_b	0.65		0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

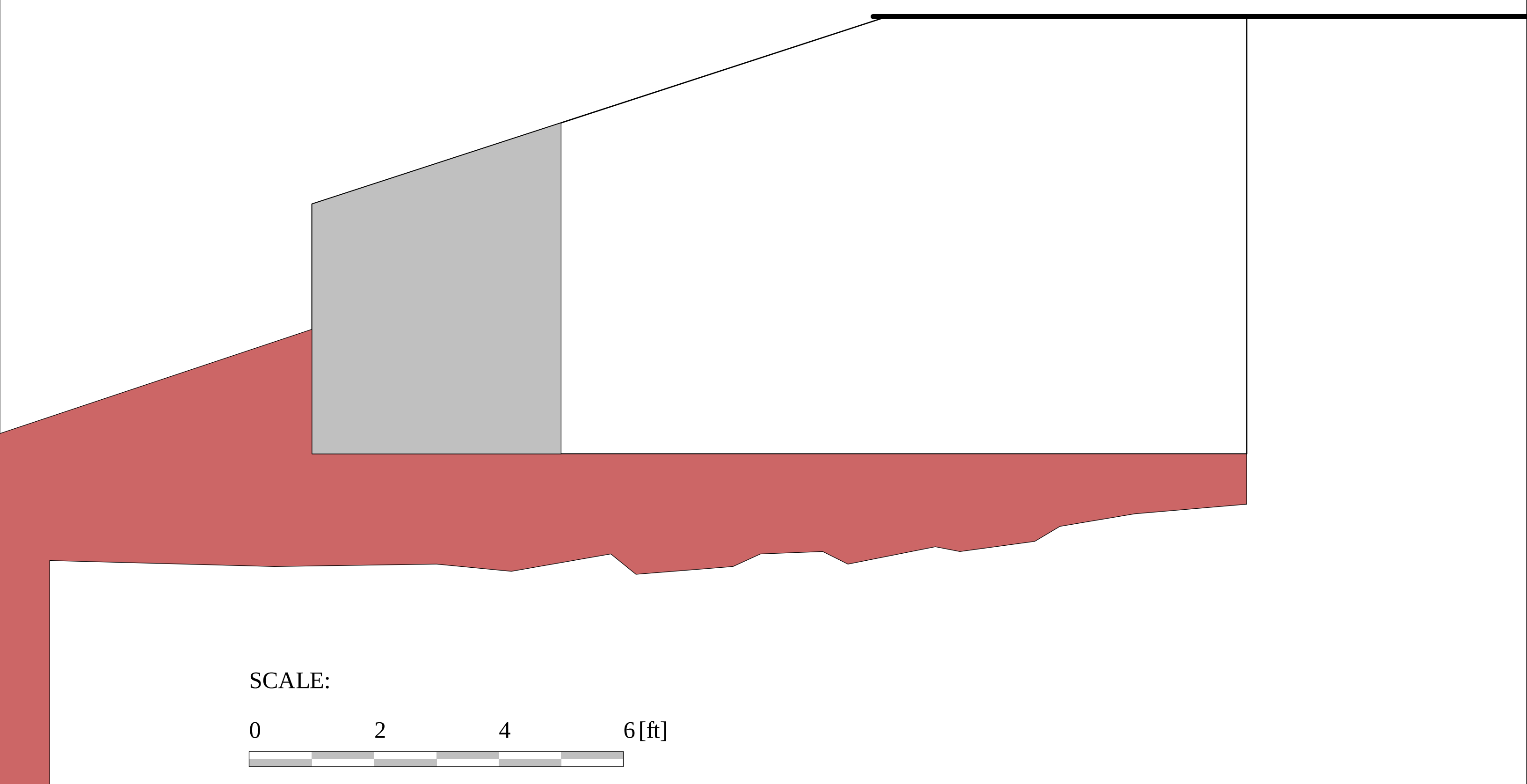
Bearing capacity, CDR = 1.23, factored bearing load = 941 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.364, Eccentricity, e/L = 0.0838, CDR-overturning = 3.52

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	4.00	1	N/A	8.19	9.10	9.098	0.585	2.111	0.0360	---
2	3.00	4.00	1	N/A	18.95	21.06	21.057	0.569	3.208	-0.0550	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	1158	N/A	[lb/ft ²]
Factored bearing load, σ_V	940.7	N/A	[lb/ft ²]
Eccentricity, e	0.23	N/A	[ft]
Eccentricity, e/L	0.059	N/A	
CDR calculated	1.23	N/A	
Base length	4.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 2437.52 [lb/ft], L = 4.00, Unfactored e = 0.20 [ft], and Sigma = 678.82 [lb/ft ²]



DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.364

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	4.00	2.111	N/A	1	---
2	3.00	4.00	3.208	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.0838; Overturning: CDR-static = 3.52

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	4.00	0.0360	N/A	1	---
2	3.00	4.00	-0.0550	N/A	1	---

FHWA-NHI-10-024
Allen Road West Abutment - 8ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road West Abutment - 8ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....nt\MSEW\8ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	34.0 °

RETAINED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight,	$\gamma_{equiv.}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction,	$\phi_{equiv.}$	27.0 °
Equivalent cohesion,	$c_{equiv.}$	0.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3517 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 0.00 N γ = 8.41

SEISMICITY

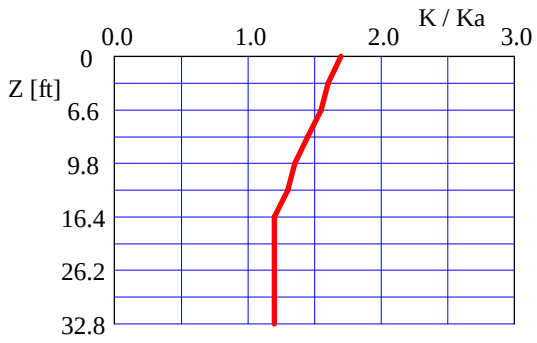
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



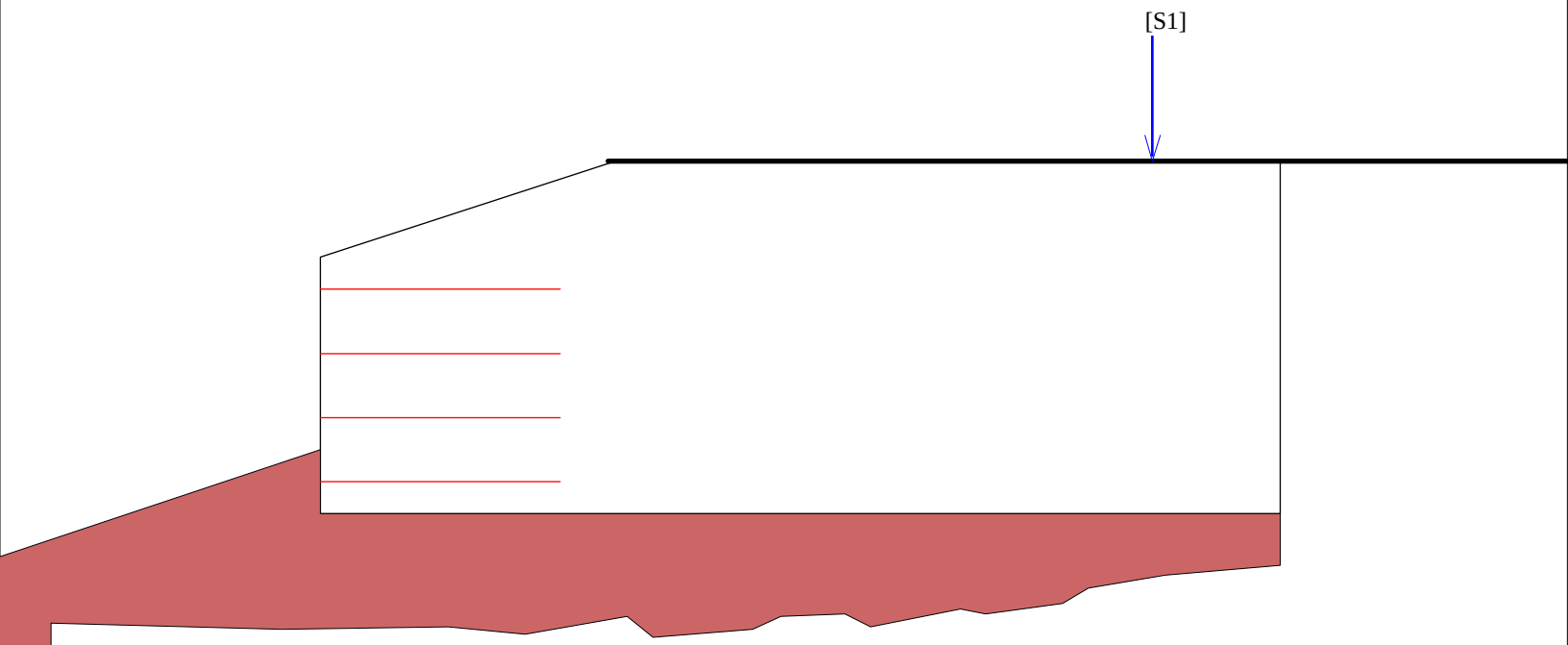
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	8.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 6.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 10.62° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90	1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static		Combined Static/Seismic
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic
Reinforced Soil and Foundation	ϕ_τ	1.00	1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00	1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:	Static	Combined Static/Seismic
ϕ_b	0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

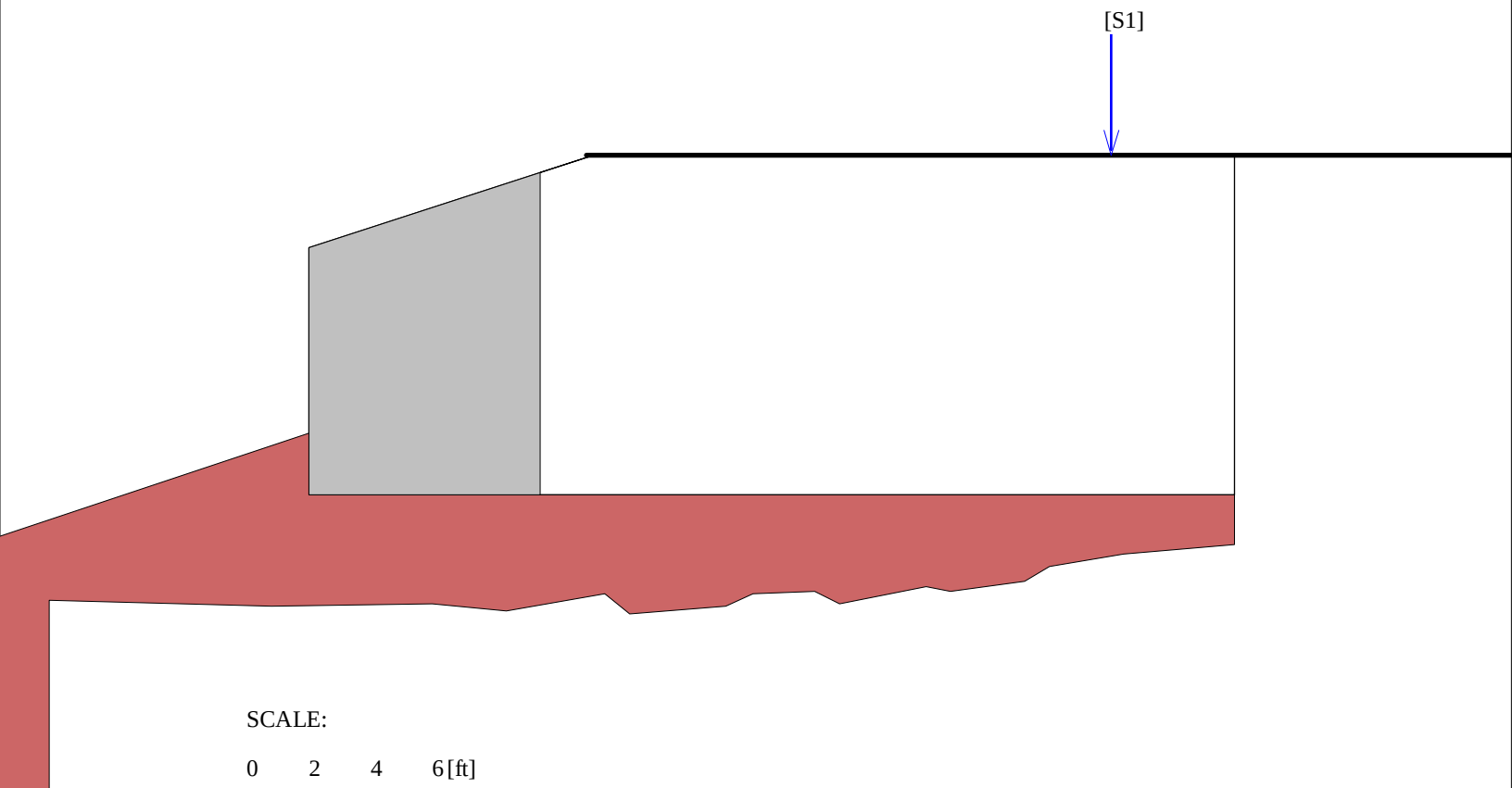
Bearing capacity, CDR = 1.07, factored bearing load = 1909 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.331, Eccentricity, e/L = 0.1216, CDR-overturning = 3.13

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	7.50	1	N/A	3.76	4.18	4.176	1.031	1.909	0.0923	---
2	3.00	7.50	1	N/A	4.90	5.44	5.439	0.944	2.295	0.0389	---
3	5.00	7.50	1	N/A	7.23	8.04	8.035	0.914	2.875	-0.0114	---
4	7.00	7.50	1	N/A	14.39	15.99	15.993	1.113	3.751	-0.0780	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	2034	N/A	[lb/ft ²]
Factored bearing load, σ_V	1908.8	N/A	[lb/ft ²]
Eccentricity, e	0.65	N/A	[ft]
Eccentricity, e/L	0.086	N/A	
CDR calculated	1.07	N/A	
Base length	7.50	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 8723.60 [lb/ft], L = 7.50, Unfactored e = 0.57 [ft], and Sigma = 1371.43 [lb/ft ²]



SCALE:

0 2 4 6 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.331

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	7.50	1.909	N/A	1	---
2	3.00	7.50	2.295	N/A	1	---
3	5.00	7.50	2.875	N/A	1	---
4	7.00	7.50	3.751	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1216; Overturning: CDR-static = 3.13

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	7.50	0.0923	N/A	1	---
2	3.00	7.50	0.0389	N/A	1	---
3	5.00	7.50	-0.0114	N/A	1	---
4	7.00	7.50	-0.0780	N/A	1	---

FHWA-NHI-10-024
Allen Road West Abutment - 12ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road West Abutment - 12ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....t\MSEW\12ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	34.0 °

RETAINED SOIL

Unit weight, γ	120.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{equiv.}$	27.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ²

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3413 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 0.00 N γ= 8.41

SEISMICITY

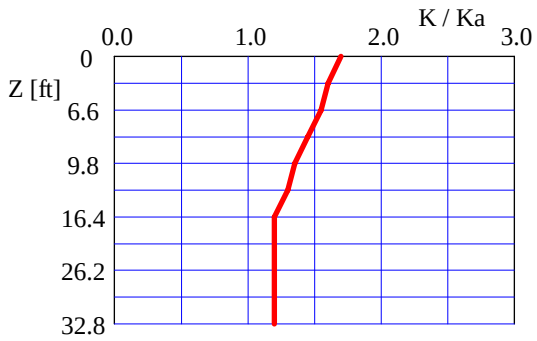
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



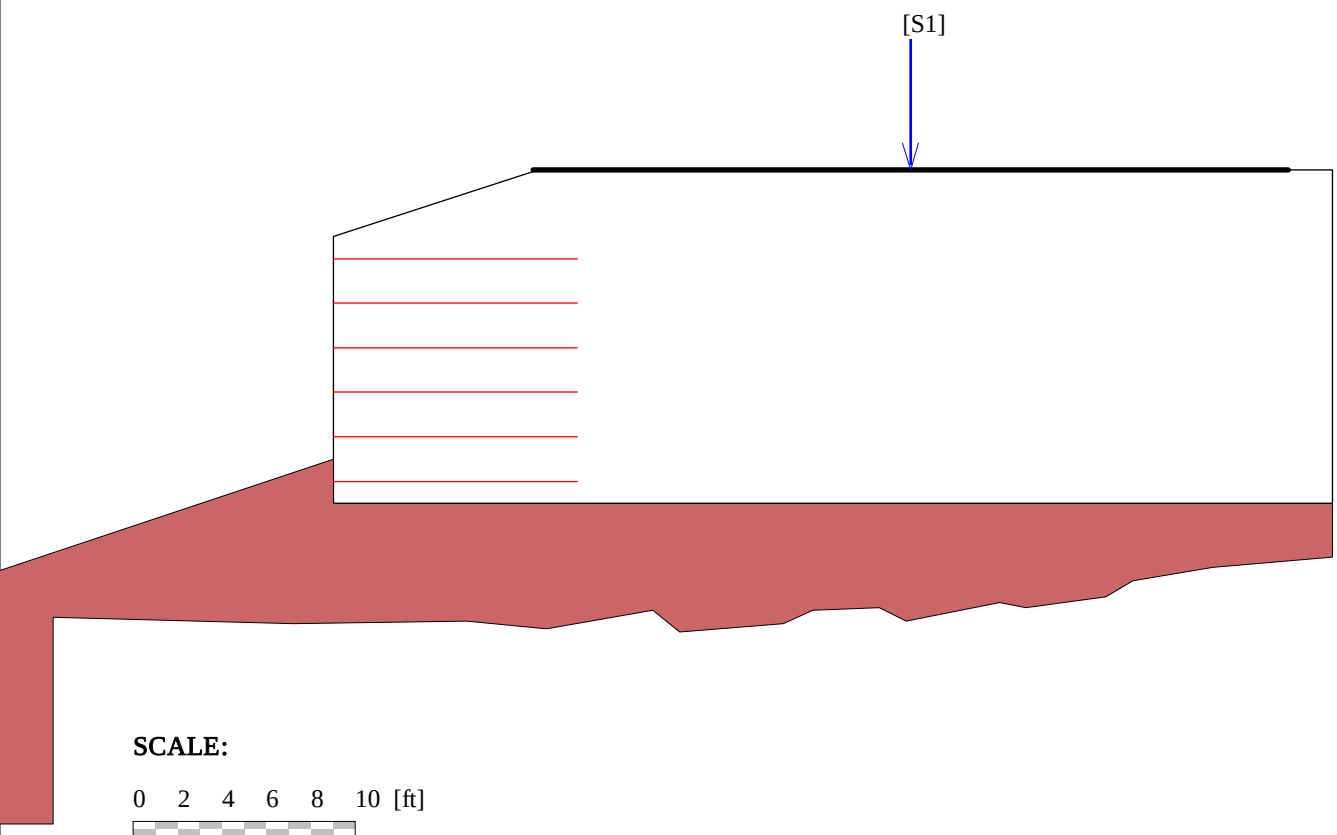
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	12.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 10.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 7.13° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 8 10 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00

Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90		1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:		Static	Combined Static/Seismic	
	ϕ_b	0.65		0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

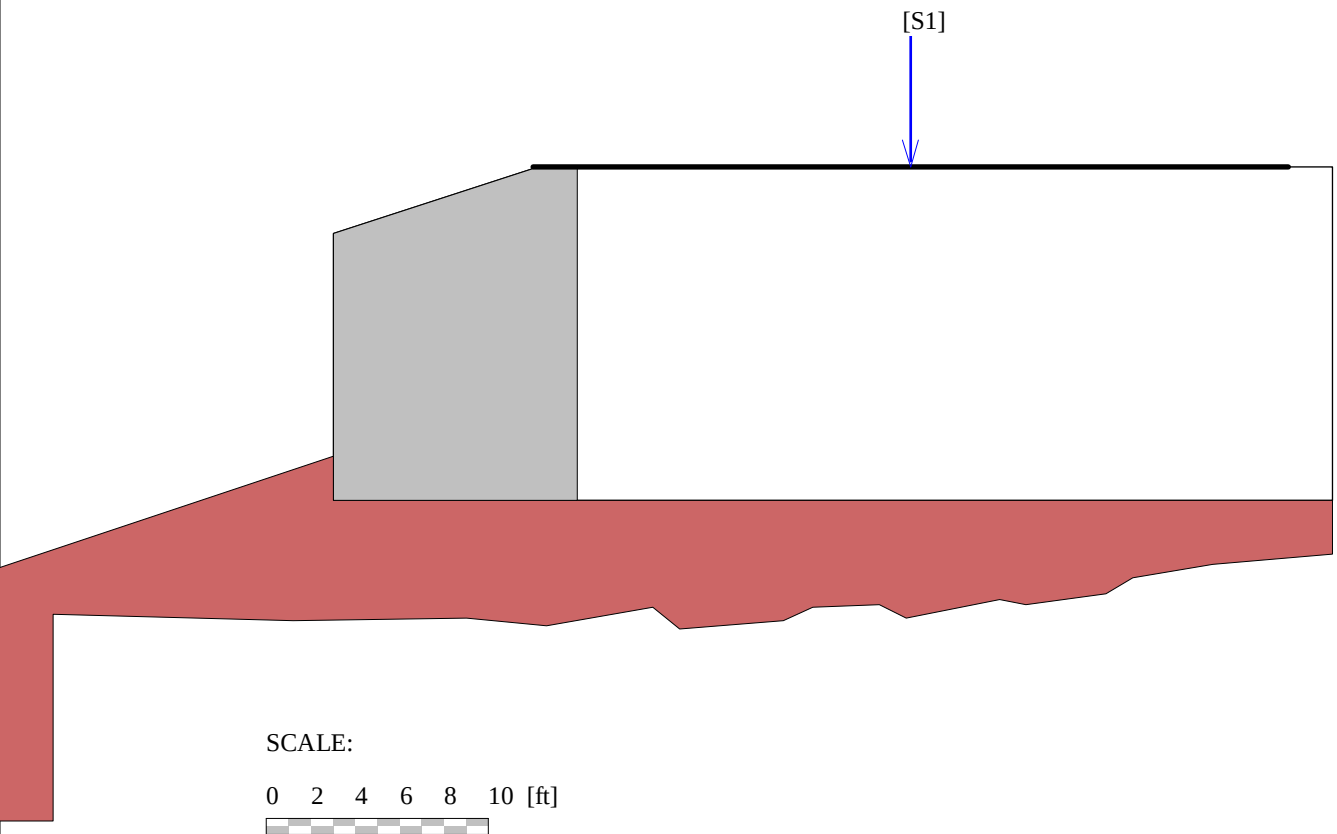
Bearing capacity, CDR = 1.06, factored bearing load = 2798 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.400, Eccentricity, e/L = 0.1245, CDR-overturning = 3.26

#	METAL STRIP Elevation [ft]	Length [ft]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	11.00	1	N/A	2.60	2.89	2.892	1.375	1.966	0.1042	---
2	3.00	11.00	1	N/A	2.98	3.31	3.309	1.320	2.239	0.0667	---
3	5.00	11.00	1	N/A	3.55	3.95	3.948	1.253	2.604	0.0323	---
4	7.00	11.00	1	N/A	4.54	5.05	5.050	1.219	3.110	-0.0004	---
5	9.00	11.00	1	N/A	6.48	7.19	7.195	1.366	3.845	-0.0358	---
6	11.00	11.00	1	N/A	11.60	12.89	12.893	1.648	4.920	-0.0910	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	2974	N/A	[lb/ft ²]
Factored bearing load, σ_V	2797.9	N/A	[lb/ft ²]
Eccentricity, e	0.97	N/A	[ft]
Eccentricity, e/L	0.088	N/A	
CDR calculated	1.06	N/A	
Base length	11.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 18728.49 [lb/ft], L = 11.00, Unfactored e = 0.85 [ft], and Sigma = 2013.15 [lb/ft ²]



SCALE:

0 2 4 6 8 10 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.400

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	11.00	1.966	N/A	1	---
2	3.00	11.00	2.239	N/A	1	---
3	5.00	11.00	2.604	N/A	1	---
4	7.00	11.00	3.110	N/A	1	---
5	9.00	11.00	3.845	N/A	1	---
6	11.00	11.00	4.920	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1245; Overturning: CDR-static = 3.26

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	11.00	0.1042	N/A	1	---
2	3.00	11.00	0.0667	N/A	1	---
3	5.00	11.00	0.0323	N/A	1	---
4	7.00	11.00	-0.0004	N/A	1	---
5	9.00	11.00	-0.0358	N/A	1	---
6	11.00	11.00	-0.0910	N/A	1	---

FHWA-NHI-10-024
Allen Road West Abutment - 16ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road West Abutment - 16ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....t\MSEW\16ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	34.0 °

RETAINED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight,	$\gamma_{equiv.}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction,	$\phi_{equiv.}$	27.0 °
Equivalent cohesion,	$c_{equiv.}$	0.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3378 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 0.00 N γ = 8.41

SEISMICITY

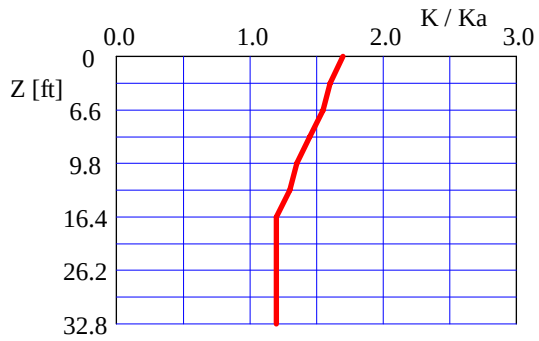
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



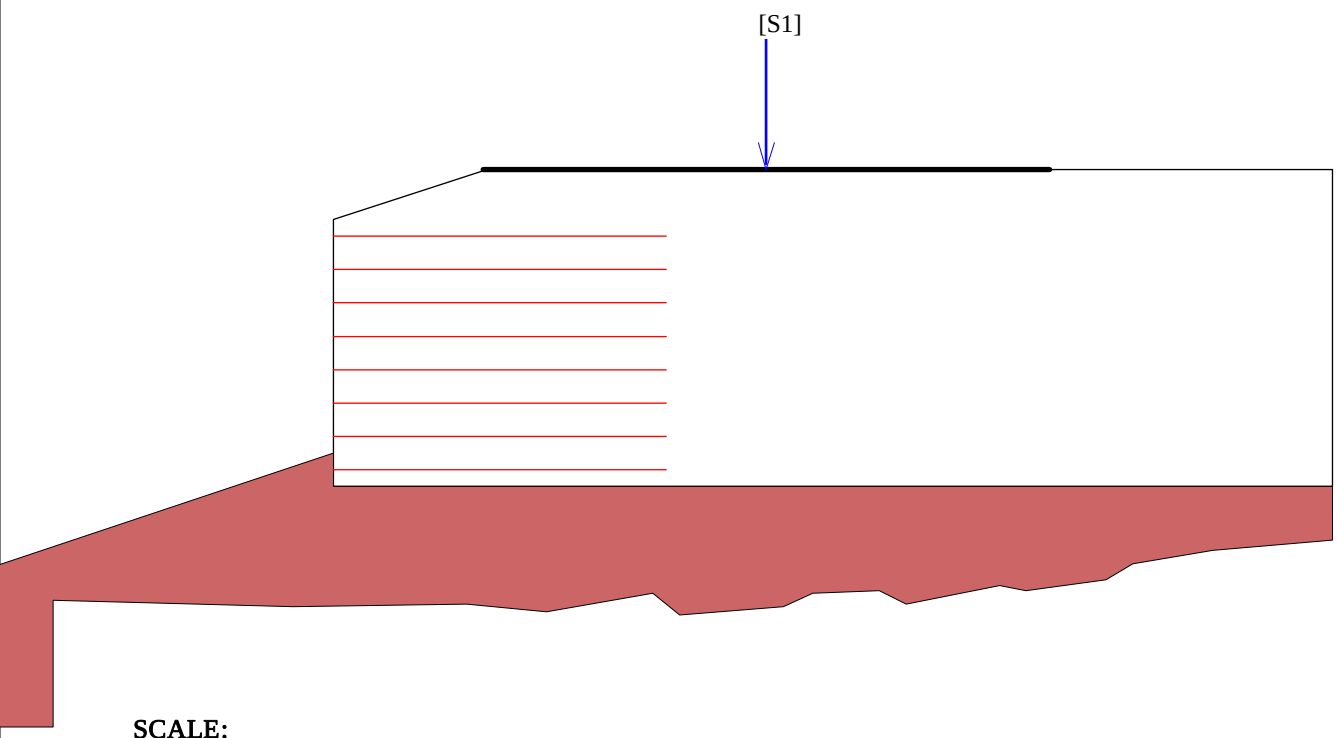
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	16.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 14.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 5.36° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 8 10 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00
Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90		1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:		Static	Combined Static/Seismic
	ϕ_b	0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

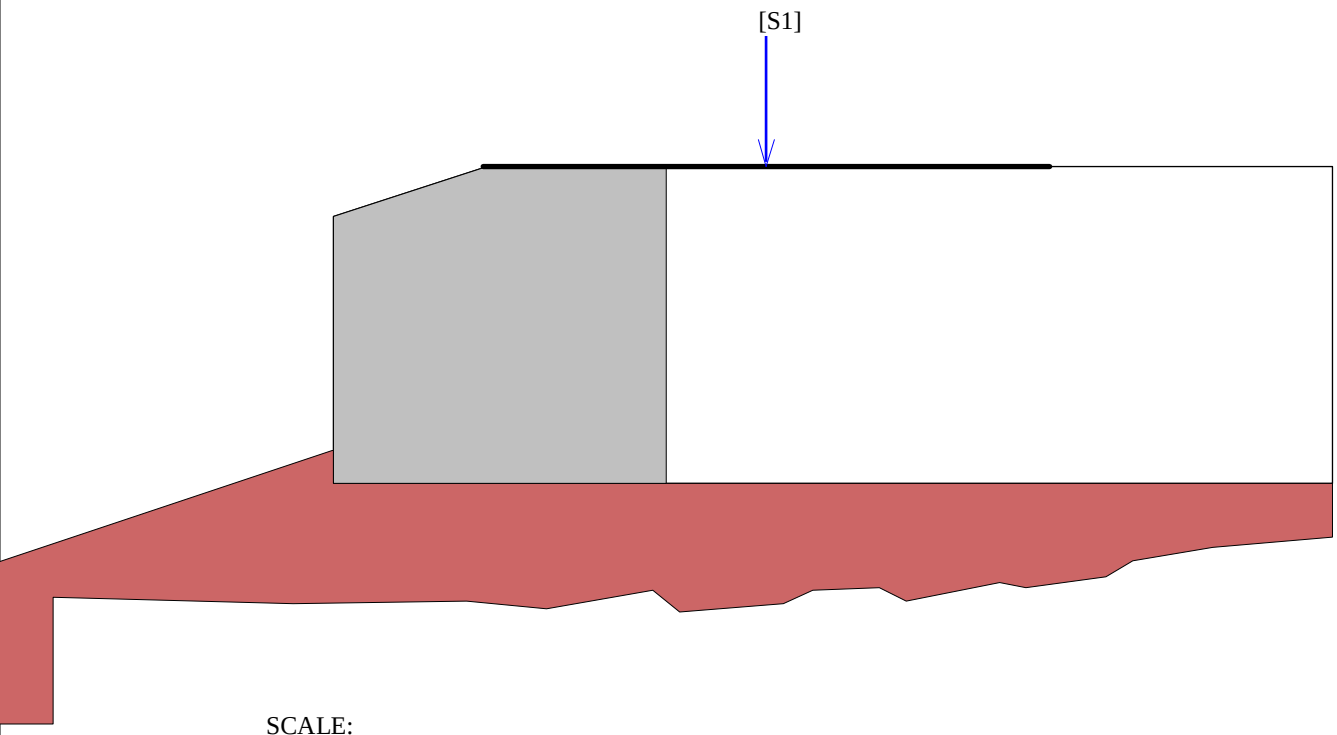
Bearing capacity, CDR = 1.87, factored bearing load = 3259 lb/ft².
Foundation Interface: Direct sliding, CDR = 2.084, Eccentricity, e/L = 0.0535, CDR-overturning = 6.74

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	20.00	1	N/A	2.05	2.27	2.274	2.158	2.901	0.0457	---
2	3.00	20.00	1	N/A	2.26	2.51	2.508	2.256	3.237	0.0308	---
3	5.00	20.00	1	N/A	2.51	2.79	2.789	2.301	3.662	0.0169	---
4	7.00	20.00	1	N/A	2.85	3.17	3.169	2.311	4.219	0.0038	---
5	9.00	20.00	1	N/A	3.37	3.74	3.742	2.325	4.977	-0.0090	---
6	11.00	20.00	1	N/A	4.26	4.73	4.730	2.544	6.070	-0.0227	---
7	13.00	20.00	1	N/A	5.93	6.59	6.590	2.849	7.775	-0.0401	---
8	15.00	20.00	1	N/A	9.92	11.02	11.020	3.361	10.752	-0.0707	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	6087	N/A	[lb/ft ²]
Factored bearing load, σ_V	3258.8	N/A	[lb/ft ²]
Eccentricity, e	0.72	N/A	[ft]
Eccentricity, e/L	0.036	N/A	
CDR calculated	1.87	N/A	
Base length	20.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 44705.56 [lb/ft], L = 20.00, Unfactored e = 0.62 [ft], and Sigma = 2383.72 [lb/ft ²]



SCALE:

0 2 4 6 8 10 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 2.084

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	20.00	2.901	N/A	1	---
2	3.00	20.00	3.237	N/A	1	---
3	5.00	20.00	3.662	N/A	1	---
4	7.00	20.00	4.219	N/A	1	---
5	9.00	20.00	4.977	N/A	1	---
6	11.00	20.00	6.070	N/A	1	---
7	13.00	20.00	7.775	N/A	1	---
8	15.00	20.00	10.752	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.0535; Overturning: CDR-static = 6.74

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	20.00	0.0457	N/A	1	---
2	3.00	20.00	0.0308	N/A	1	---
3	5.00	20.00	0.0169	N/A	1	---
4	7.00	20.00	0.0038	N/A	1	---
5	9.00	20.00	-0.0090	N/A	1	---
6	11.00	20.00	-0.0227	N/A	1	---
7	13.00	20.00	-0.0401	N/A	1	---
8	15.00	20.00	-0.0707	N/A	1	---

FHWA-NHI-10-024
Allen Road West Abutment - 20ft Wall

MSEW(3.0): Update # 14.972

PROJECT IDENTIFICATION

Title: Allen Road West Abutment - 20ft Wall
Project Number: C1X33100
Client: St. Louis County
Designer: James Munson
Station Number:

Description:

Company's information:

Name: Jacobs Engineering
Street:

,
Telephone #:
Fax #:
E-Mail:

Original file path and name: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\.....
.....t\MSEW\20ft Wall.BEN

Original date and time of creating this file: Sun Aug 18 07:42:41 2019

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	34.0 °

RETAINED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight,	$\gamma_{equiv.}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction,	$\phi_{equiv.}$	27.0 °
Equivalent cohesion,	$c_{equiv.}$	0.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3362 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 23.94 N γ= 14.47

SEISMICITY

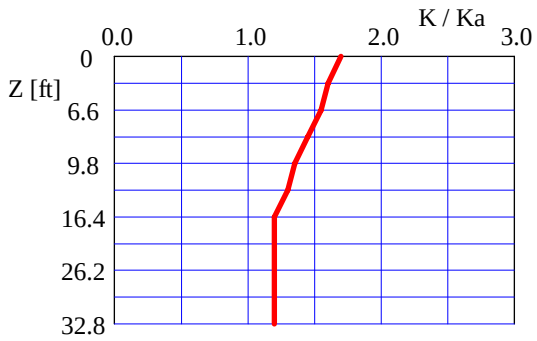
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



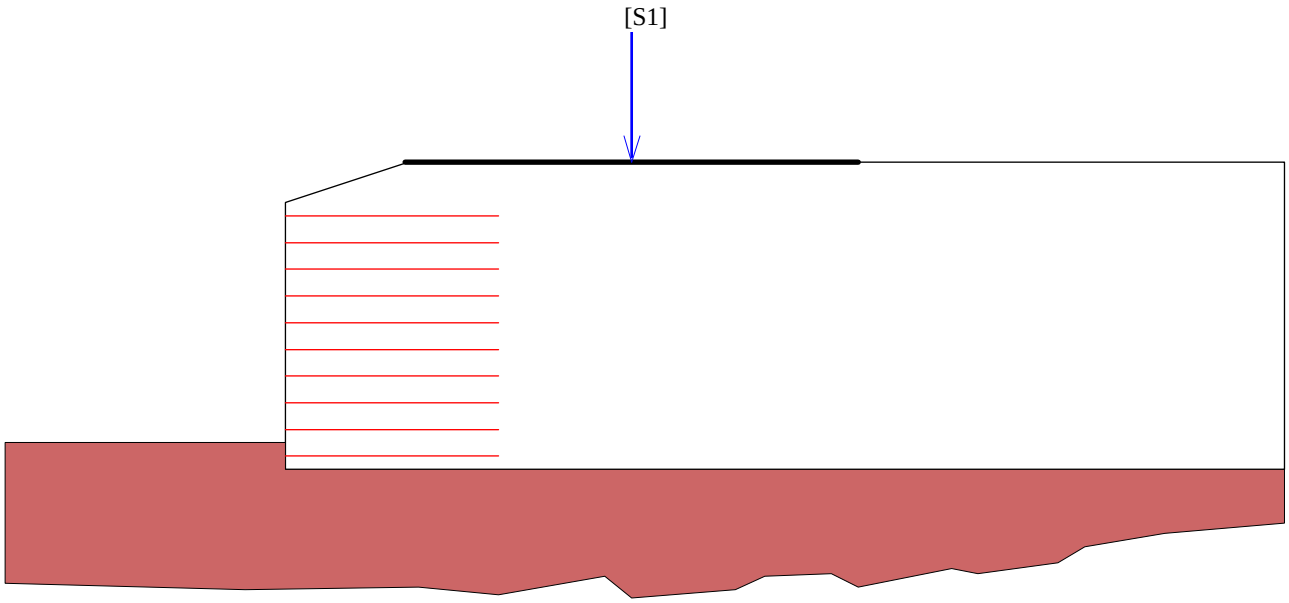
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	20.00	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 18.00 ft }
Batter, ω	0.0	[deg]	
Backslope, β	18.0	[deg]	
Backslope rise	3.0	[ft]	Broken back equivalent angle, I = 4.29° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 0.0 and Pv-l = 250.0 [lb/ft].
Footing width, b=34.0 [ft]. Distance of center of footing from wall face, d = 26.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 8 10 [ft]

AASHTO 2007-2010 (LRFD) Input Data

INTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2:	$\gamma_{p\text{-}EV}$	1.35		
Load factor for earthquake loads, EQ, from Table 3.4.1-1:	$\gamma_{p\text{-}EQ}$	1.00		
Load factor for live load surchrge, LS, from Figure C11.5.5-3(b): (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75		
Load factor for dead load surchrge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50		

Resistance factor for reinforcement tension from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00

Resistance factor for reinforcement tension in connectors from Table 11.5.6-1:	ϕ	Static	Combined static/seismic	
Metal Strips:		0.75		1.00
Resistance factor for reinforcement pullout from Table 11.5.6-1:	ϕ	0.90		1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV, from Table 3.4.1-2 and Figure C11.5.5-2:		Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH, from Table 3.4.1-2 and Figure C11.5.5-2:	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ, from Table 3.4.1-1 (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces from Table 11.5.6-1:		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation from Table 11.5.6-1:		Static	Combined Static/Seismic
	ϕ_b	0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

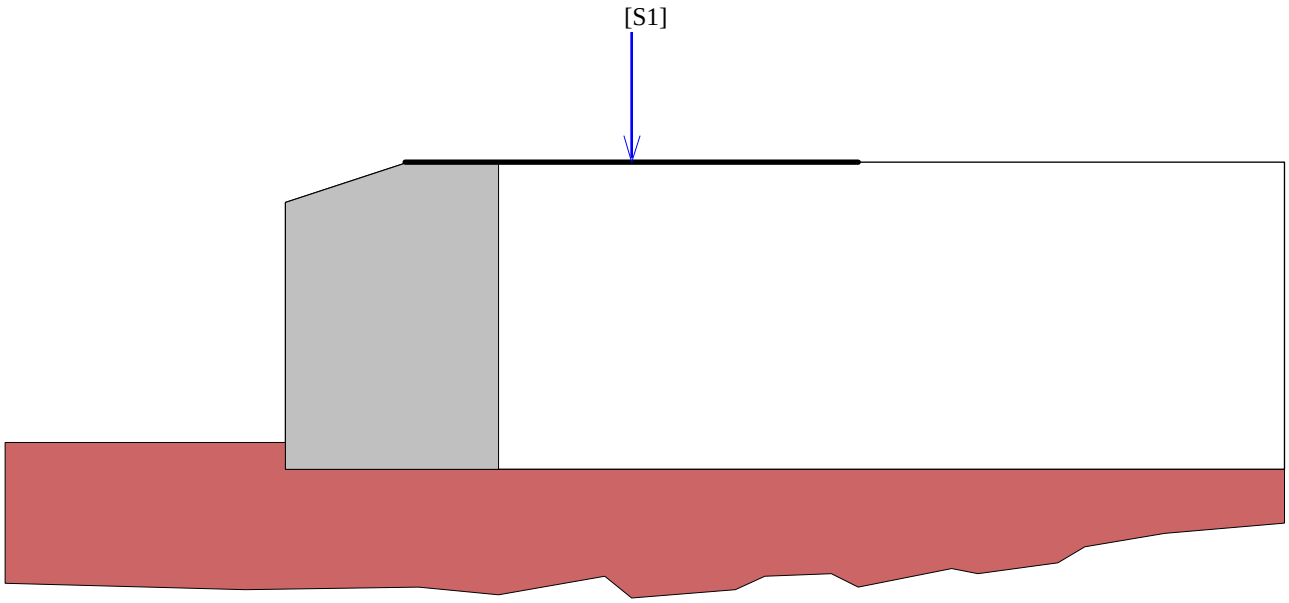
Bearing capacity, CDR = 1.51, factored bearing load = 4690 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.388, Eccentricity, e/L = 0.1511, CDR-overturning = 2.98

	METAL STRIP			CONNECTION							
#	Elevation [ft]	Length [ft]	Type #	CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	16.00	1	N/A	1.76	1.96	1.958	1.324	1.910	0.1366	---
2	3.00	16.00	1	N/A	1.87	2.07	2.074	1.393	2.091	0.1093	---
3	5.00	16.00	1	N/A	2.02	2.24	2.241	1.436	2.305	0.0841	---
4	7.00	16.00	1	N/A	2.22	2.47	2.467	1.452	2.568	0.0609	---
5	9.00	16.00	1	N/A	2.46	2.74	2.737	1.422	2.901	0.0396	---
6	11.00	16.00	1	N/A	2.79	3.10	3.098	1.360	3.334	0.0198	---
7	13.00	16.00	1	N/A	3.28	3.64	3.640	1.449	3.920	0.0009	---
8	15.00	16.00	1	N/A	4.09	4.54	4.542	1.567	4.757	-0.0183	---
9	17.00	16.00	1	N/A	5.56	6.18	6.181	1.718	6.037	-0.0414	---
10	19.00	16.00	1	N/A	9.00	10.00	9.995	1.969	8.178	-0.0805	---

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	7059	N/A	[lb/ft ²]
Factored bearing load, σ_V	4690.0	N/A	[lb/ft ²]
Eccentricity, e	1.75	N/A	[ft]
Eccentricity, e/L	0.109	N/A	
CDR calculated	1.51	N/A	
Base length	16.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 43351.10 [lb/ft], L = 16.00, Unfactored e = 1.55 [ft], and Sigma = 3362.90 [lb/ft ²]



SCALE:

0 2 4 6 8 10 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.388

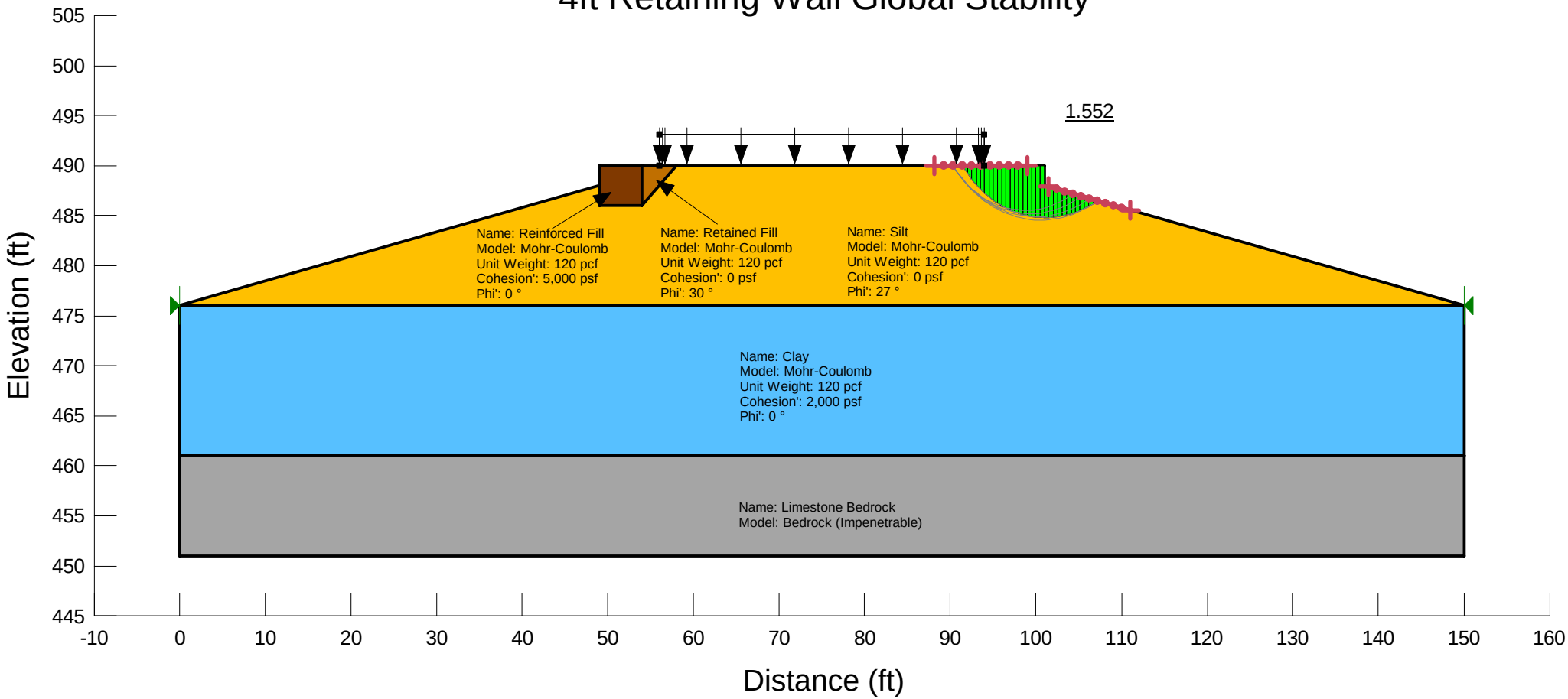
#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	16.00	1.910	N/A	1	---
2	3.00	16.00	2.091	N/A	1	---
3	5.00	16.00	2.305	N/A	1	---
4	7.00	16.00	2.568	N/A	1	---
5	9.00	16.00	2.901	N/A	1	---
6	11.00	16.00	3.334	N/A	1	---
7	13.00	16.00	3.920	N/A	1	---
8	15.00	16.00	4.757	N/A	1	---
9	17.00	16.00	6.037	N/A	1	---
10	19.00	16.00	8.178	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1511; Overturning: CDR-static = 2.98

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	16.00	0.1366	N/A	1	---
2	3.00	16.00	0.1093	N/A	1	---
3	5.00	16.00	0.0841	N/A	1	---
4	7.00	16.00	0.0609	N/A	1	---
5	9.00	16.00	0.0396	N/A	1	---
6	11.00	16.00	0.0198	N/A	1	---
7	13.00	16.00	0.0009	N/A	1	---
8	15.00	16.00	-0.0183	N/A	1	---
9	17.00	16.00	-0.0414	N/A	1	---
10	19.00	16.00	-0.0805	N/A	1	---

Allen Road West Abutment
4ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 23
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 8/18/2019
Time: 8:37:56 AM
File Name: 4ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\West Abutment\SlopeW\
Last Solved Date: 8/18/2019
Last Solved Time: 8:38:02 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (88.1803, 490) ft
Left-Zone Right Coordinate: (99, 490) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (101.47303, 487.88416) ft
Right-Zone Right Coordinate: (111, 485.55102) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 476) ft
Right Coordinate: (150, 476) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	490
	56	493.10625
	94	493.10625
	94	490

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	461
Point 3	0	476
Point 4	49	486

Point 5	49	488
Point 6	49	490
Point 7	54	490
Point 8	54	486
Point 9	58	490
Point 10	96	490
Point 11	96	486
Point 12	101	490
Point 13	101	486
Point 14	101	488
Point 15	150	476
Point 16	150	461
Point 17	150	451
Point 18	92	490

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	1,500
Region 2	Clay	2,3,15,16	2,250
Region 3	Silt	3,5,4,8,9,18,11,13,14,15	1,260
Region 4	Reinforced Fill	6,7,8,4,5	20
Region 5	Retained Fill	7,8,9	8
Region 6	Retained Fill	18,10,11	8
Region 7	Reinforced Fill	10,12,14,13,11	20

Current Slip Surface

Slip Surface: 198
F of S: 1.552
Volume: 46.533348 ft³
Weight: 5,584.0018 lbs
Resisting Moment: 46,580.71 lbs-ft

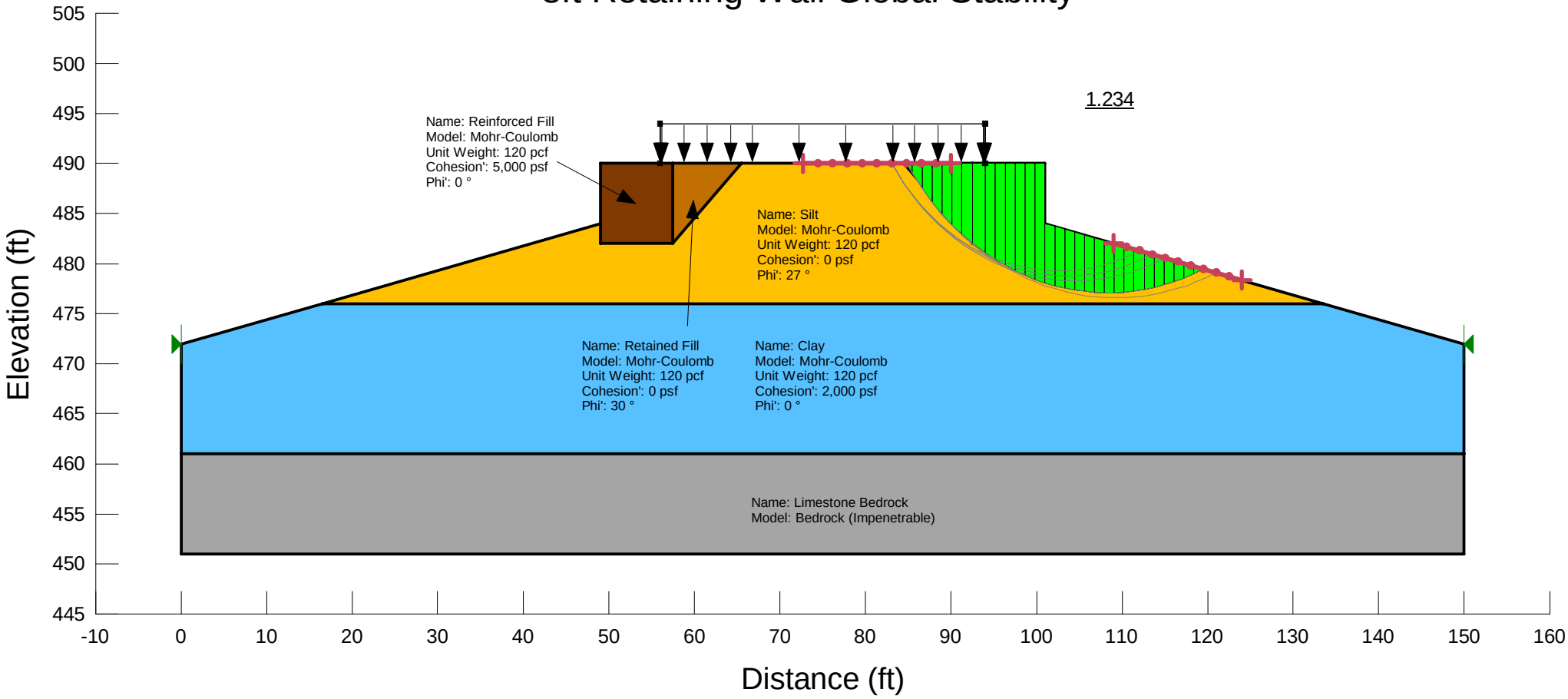
Activating Moment: 30,015.824 lbs-ft
Resisting Force: 3,487.0111 lbs
Activating Force: 2,248.6769 lbs
F of S Rank: 1
Exit: (107.18921, 486.48427) ft
Entry: (91.42621, 490) ft
Radius: 11.692752 ft
Center: (101.14859, 496.49583) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	91.713105	489.60704	0	549.09692	279.77885	0
Slice 2	92.25	488.92042	0	601.16582	306.30928	0
Slice 3	92.75	488.36841	0	646.16047	329.23521	0
Slice 4	93.25	487.88086	0	690.15893	351.65354	0
Slice 5	93.75	487.44724	0	734.56637	374.28026	0
Slice 6	94.25	487.06005	0	200.07477	101.94319	0
Slice 7	94.75	486.71374	0	239.37768	121.96902	0
Slice 8	95.25	486.40409	0	278.54789	141.92724	0
Slice 9	95.75	486.12779	0	318.03786	162.04838	0
Slice 10	96.25	485.88223	0	358.1726	182.49806	0
Slice 11	96.75	485.66532	0	399.14829	203.37621	0
Slice 12	97.25	485.47534	0	441.02243	224.71215	0
Slice 13	97.75	485.31094	0	483.69768	246.45628	0
Slice 14	98.25	485.17099	0	526.90123	268.46958	0
Slice 15	98.75	485.05459	0	570.16251	290.51231	0
Slice 16	99.25	484.96103	0	612.79307	312.23366	0
Slice 17	99.75	484.88976	0	653.87367	333.16527	0
Slice 18	100.25	484.84036	0	692.25516	352.72162	0

Slice 19	100.75	484.81255	0	726.58043	370.21122	0
Slice 20	101.25788	484.80644	0	470.29413	239.62683	0
Slice 21	101.77365	484.82266	0	468.70518	238.81722	0
Slice 22	102.28942	484.86175	0	459.26673	234.00809	0
Slice 23	102.80519	484.92396	0	441.23382	224.81986	0
Slice 24	103.32095	485.00965	0	414.21903	211.05514	0
Slice 25	103.83672	485.11936	0	378.28209	192.74435	0
Slice 26	104.35249	485.25379	0	333.97272	170.1676	0
Slice 27	104.86826	485.41384	0	282.31012	143.84419	0
Slice 28	105.38402	485.60065	0	224.69437	114.4875	0
Slice 29	105.89979	485.81563	0	162.75965	82.930185	0
Slice 30	106.41556	486.06051	0	98.19301	50.031837	0
Slice 31	106.93133	486.33747	0	32.55011	16.585109	0

Allen Road West Abutment
8ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 21
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 8/18/2019
Time: 8:39:39 AM
File Name: 8ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\West Abutment\SlopeW\
Last Solved Date: 8/18/2019
Last Solved Time: 8:39:44 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (72.72778, 490) ft
Left-Zone Right Coordinate: (90, 490) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (109.03387, 482.02243) ft
Right-Zone Right Coordinate: (124, 478.33846) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 472) ft
Right Coordinate: (150, 472) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	490
	56	493.95938
	94	493.95938
	94	490

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	461
Point 3	0	472
Point 4	49	482

Point 5	49	484
Point 6	49	490
Point 7	57.5	490
Point 8	57.5	482
Point 9	65.5	490
Point 10	92.5	490
Point 11	92.5	482
Point 12	101	490
Point 13	101	482
Point 14	101	484
Point 15	150	472
Point 16	150	461
Point 17	150	451
Point 18	16.5	476
Point 19	133.5	476
Point 20	84.5	490

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	1,500
Region 2	Clay	2,3,18,19,15,16	2,184
Region 3	Silt	18,5,4,8,9,20,11,13,14,19	788
Region 4	Reinforced Fill	6,5,4,8,7	68
Region 5	Retained Fill	7,8,9	32
Region 6	Retained Fill	20,10,11	32
Region 7	Reinforced Fill	10,12,14,13,11	68

Current Slip Surface

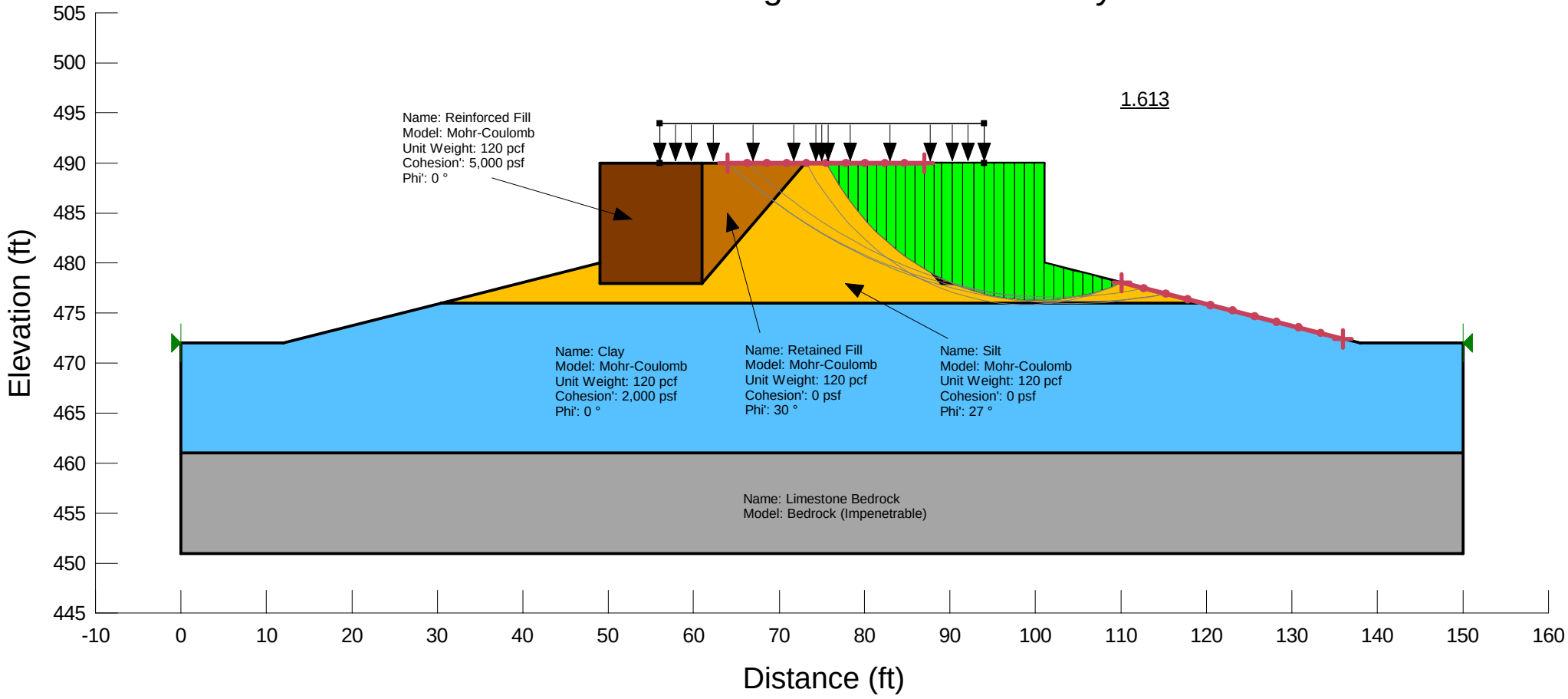
Slip Surface: 423
F of S: 1.234
Volume: 196.4234 ft³
Weight: 23,570.808 lbs
Resisting Moment: 456,204.37 lbs-ft
Activating Moment: 369,763.93 lbs-ft
Resisting Force: 14,221.15 lbs
Activating Force: 11,537.112 lbs
F of S Rank: 1
Exit: (119.51016, 479.44365) ft
Entry: (84.818334, 490) ft
Radius: 27.827848 ft
Center: (108.3097, 504.91793) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	85.133029	489.52614	0	604.35955	348.92715	0
Slice 2	86.030752	488.27195	0	727.9185	370.893	0
Slice 3	87.196805	486.81178	0	841.21277	428.61932	0
Slice 4	88.362859	485.53204	0	948.00397	483.03215	0
Slice 5	89.528913	484.39852	0	1,052.1246	536.08428	0
Slice 6	90.694967	483.38789	0	1,156.4482	589.23978	0
Slice 7	91.888997	482.46406	0	1,265.7178	644.91541	0
Slice 8	93.25	481.53421	0	1,395.3867	710.98505	0
Slice 9	94.583333	480.72028	0	764.4911	389.52767	0
Slice 10	95.75	480.09424	0	863.87525	440.16643	0
Slice 11	96.916667	479.53725	0	966.44365	492.42763	0
Slice 12	98.083333	479.04484	0	1,072.2287	546.32781	0
Slice 13	99.25	478.61336	0	1,180.782	601.63847	0
Slice 14	100.41667	478.23987	0	1,291.0933	657.8449	0
Slice 15	101.57844	477.92305	0	683.28389	348.15053	0
	102.73533	477.66051	0	728.09735	370.98413	0

Slice 16						
Slice 17	103.89221	477.44919	0	766.44142	390.52141	0
Slice 18	105.0491	477.28791	0	796.17187	405.66983	0
Slice 19	106.20598	477.17578	0	814.96842	415.24715	0
Slice 20	107.36287	477.11222	0	820.51458	418.07306	0
Slice 21	108.51975	477.09689	0	810.73206	413.08862	0
Slice 22	109.67664	477.12971	0	784.04674	399.49177	0
Slice 23	110.83352	477.21085	0	739.64589	376.86841	0
Slice 24	111.99041	477.34075	0	677.67592	345.29313	0
Slice 25	113.14729	477.52009	0	599.32959	305.37368	0
Slice 26	114.30418	477.74985	0	506.78735	258.22105	0
Slice 27	115.46106	478.03134	0	403.00538	205.3415	0
Slice 28	116.61795	478.36619	0	291.37884	148.46493	0
Slice 29	117.77483	478.75647	0	175.34092	89.340659	0
Slice 30	118.93172	479.2047	0	57.975899	29.540196	0

Allen Road West Abutment
12ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 16
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 8/18/2019
Time: 8:41:08 AM
File Name: 12ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\West Abutment\SlopeW\
Last Solved Date: 8/18/2019
Last Solved Time: 8:41:14 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (63.99888, 490) ft
Left-Zone Right Coordinate: (87, 490) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (110.08468, 478.03575) ft
Right-Zone Right Coordinate: (136, 472.43243) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 472) ft
Right Coordinate: (150, 472) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	490
	56	493.95938
	94	493.95938
	94	490

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	461
Point 3	0	472
Point 4	49	478

Point 5	49	480
Point 6	49	490
Point 7	61	490
Point 8	61	478
Point 9	73	490
Point 10	89	490
Point 11	89	478
Point 12	101	490
Point 13	101	478
Point 14	101	480
Point 15	150	472
Point 16	150	461
Point 17	150	451
Point 18	12	472
Point 19	138	472
Point 20	30.5	476
Point 21	119.5	476
Point 22	77	490

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	1,500
Region 2	Clay	2,3,18,20,21,19,15,16	2,080
Region 3	Silt	20,5,4,8,9,22,11,13,14,21	370
Region 4	Reinforced Fill	6,7,8,4,5	144
Region 5	Retained Fill	7,9,8	72
Region 6	Retained Fill	22,10,11	72
Region 7	Reinforced Fill	10,12,14,13,11	144

Current Slip Surface

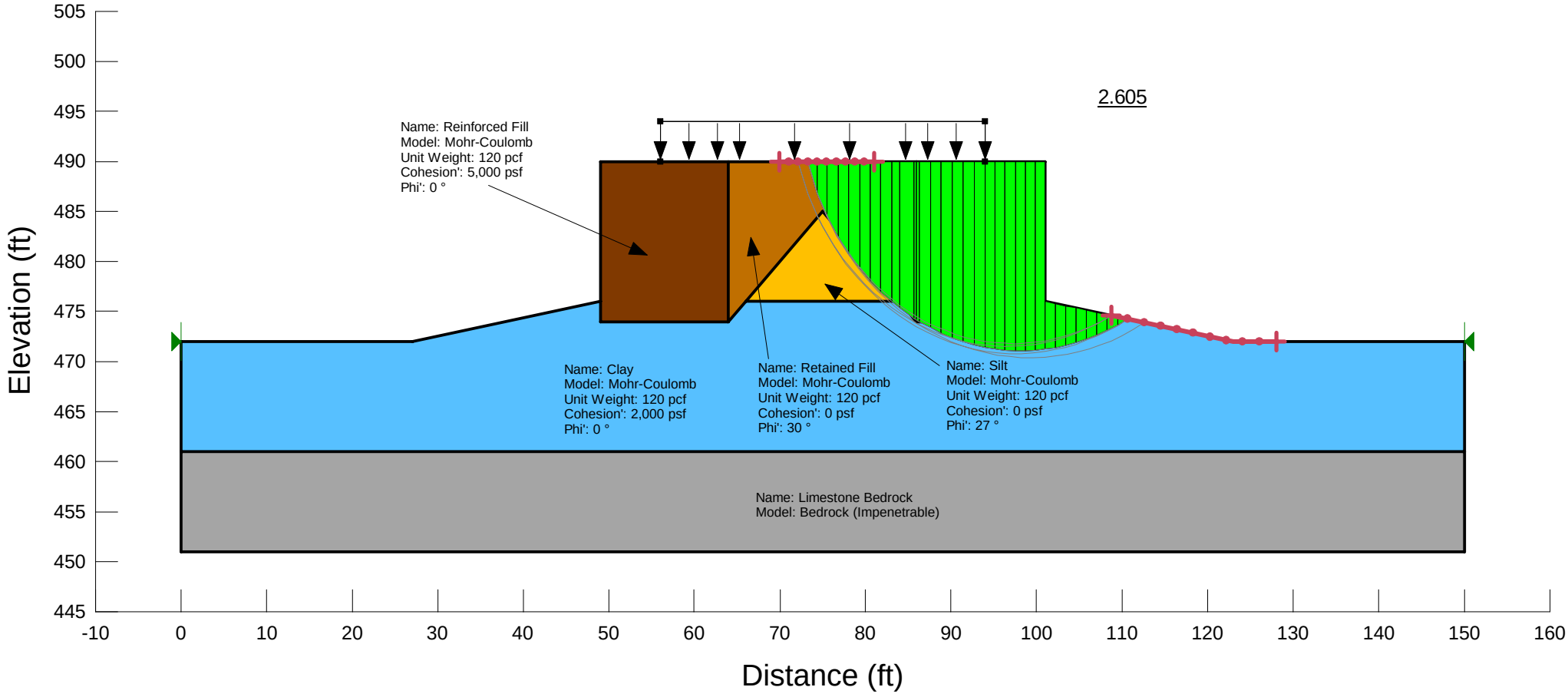
Slip Surface: 278
F of S: 1.613
Volume: 269.82428 ft³
Weight: 32,378.914 lbs
Resisting Moment: 882,434.15 lbs-ft
Activating Moment: 547,040.92 lbs-ft
Resisting Force: 27,420.667 lbs
Activating Force: 16,999.448 lbs
F of S Rank: 1
Exit: (110.08468, 478.03575) ft
Entry: (75.49944, 490) ft
Radius: 28.95003 ft
Center: (100.12632, 505.21911) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	76.24972	488.90212	0	722.07942	367.91784	0
Slice 2	77.556356	487.1108	0	835.71317	425.81713	0
Slice 3	78.669067	485.80254	0	922.674	470.12589	0
Slice 4	79.781778	484.63776	0	1,006.9263	513.05459	0
Slice 5	80.89449	483.59304	0	1,091.5688	556.18207	0
Slice 6	82.007201	482.65159	0	1,178.9765	600.71851	0
Slice 7	83.119912	481.80087	0	1,271.0491	647.63189	0
Slice 8	84.232624	481.03127	0	1,369.3352	697.71113	0
Slice 9	85.345335	480.33522	0	1,475.0808	751.59123	0
Slice 10	86.458046	479.70667	0	1,589.23	809.75314	0
Slice 11	87.570758	479.14075	0	1,712.3868	872.50468	0
Slice 12	88.563557	478.68271	0	1,837.6456	1,060.9652	0
Slice 13	89.633036	478.24627	0	2,332.9374	0	5,000
Slice 14	90.888394	477.7904	0	2,156.9258	1,099.0086	0

Slice 15	92.133036	477.40198	0	2,315.1632	1,179.6346	0
Slice 16	93.377679	477.07394	0	2,476.0025	1,261.5863	0
Slice 17	94.583333	476.8109	0	1,632.3387	831.71809	0
Slice 18	95.75	476.60785	0	1,738.6664	885.89478	0
Slice 19	96.916667	476.45354	0	1,834.5154	934.73228	0
Slice 20	98.083333	476.34718	0	1,914.7949	975.63675	0
Slice 21	99.25	476.28823	0	1,974.2372	1,005.9241	0
Slice 22	100.41667	476.27641	0	2,007.9373	1,023.0951	0
Slice 23	101.56779	476.31058	0	570.74312	290.80815	0
Slice 24	102.70338	476.38964	0	524.14146	267.06342	0
Slice 25	103.83896	476.51383	0	464.33759	236.59182	0
Slice 26	104.97455	476.68374	0	393.03357	200.26061	0
Slice 27	106.11013	476.90019	0	312.61622	159.28592	0
Slice 28	107.24572	477.16425	0	225.88373	115.09351	0
Slice 29	108.3813	477.47729	0	135.71093	69.148171	0
Slice 30	109.51689	477.84099	0	44.722687	22.787347	0

Allen Road West Abutment
16ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 10
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 8/18/2019
Time: 8:42:49 AM
File Name: 16ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\West Abutment\SlopeW\
Last Solved Date: 8/18/2019
Last Solved Time: 8:42:56 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (69.93813, 490) ft
Left-Zone Right Coordinate: (81, 490) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (108.73529, 474.59358) ft
Right-Zone Right Coordinate: (128, 472) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 472) ft
Right Coordinate: (150, 472) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	490
	56	493.95938
	94	493.95938
	94	490

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	461
Point 3	0	472
Point 4	49	474

Point 5	49	476
Point 6	49	490
Point 7	64	490
Point 8	64	474
Point 9	75	485
Point 10	86	490
Point 11	86	474
Point 12	101	490
Point 13	101	474
Point 14	101	476
Point 15	150	472
Point 16	150	461
Point 17	150	451
Point 18	27	472
Point 19	123	472
Point 20	66	476
Point 21	84	476

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	1,500
Region 2	Reinforced Fill	6,7,8,4,5	240
Region 3	Retained Fill	7,10,11,21,9,20,8	231
Region 4	Reinforced Fill	10,12,14,13,11	240
Region 5	Clay	2,3,18,5,4,8,20,21,11,13,14,19,15,16	1,882
Region 6	Silt	20,9,21	81

Current Slip Surface

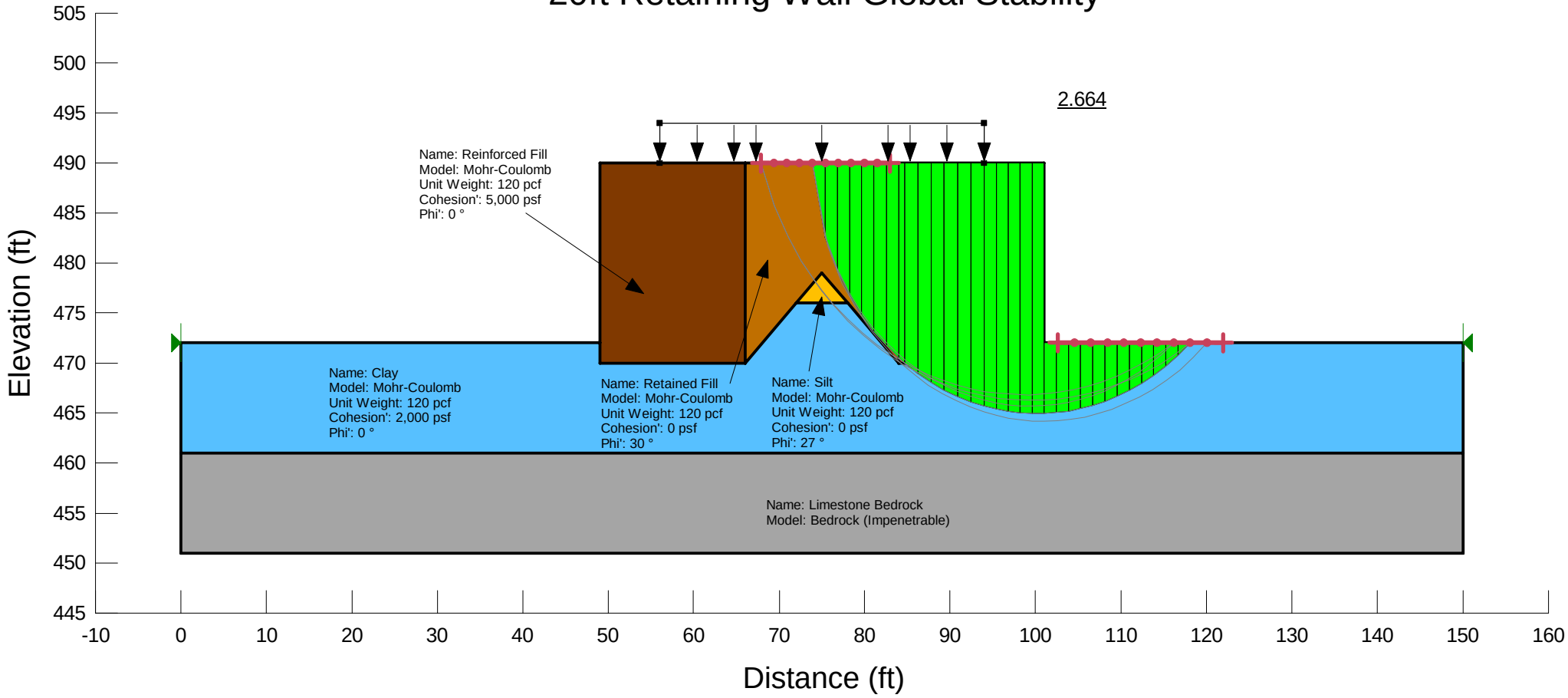
Slip Surface: 174
F of S: 2.605
Volume: 426.533 ft³
Weight: 51,183.959 lbs
Resisting Moment: 1,805,243.2 lbs-ft
Activating Moment: 693,141.98 lbs-ft
Resisting Force: 62,150.376 lbs
Activating Force: 23,873.631 lbs
F of S Rank: 1
Exit: (110.6537, 474.24478) ft
Entry: (73.256691, 490) ft
Radius: 25.962204 ft
Center: (98.243671, 497.04889) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	73.826293	488.39318	0	678.53129	391.75022	0
Slice 2	74.965497	485.62563	0	888.73159	513.10942	0
Slice 3	76.160977	483.44866	0	1,073.9699	547.215	0
Slice 4	77.412733	481.5891	0	1,207.5714	615.28836	0
Slice 5	78.664489	480.02591	0	1,327.9733	676.63621	0
Slice 6	79.916246	478.68153	0	1,444.1356	735.82385	0
Slice 7	81.168002	477.51004	0	1,561.5648	795.657	0
Slice 8	82.419758	476.48153	0	1,684.0063	858.04408	0
Slice 9	83.522818	475.67141	0	1,693.9429	0	2,000
Slice 10	84.829841	474.84156	0	1,890.5964	0	2,000
Slice 11	85.829841	474.24768	0	2,075.315	1,198.1837	0
Slice 12	86.147208	474.07752	0	1,990.3627	0	5,000
Slice 13	86.936548	473.68918	0	2,212.7452	0	2,000
Slice 14	88.220812	473.10951	0	2,407.9534	0	2,000
Slice 15	89.505076	472.61105	0	2,605.3484	0	2,000

Slice 16	90.78934	472.18889	0	2,804.2149	0	2,000
Slice 17	92.073604	471.83918	0	3,002.7757	0	2,000
Slice 18	93.357868	471.55894	0	3,198.1494	0	2,000
Slice 19	94.583333	471.35277	0	2,448.823	0	2,000
Slice 20	95.75	471.21337	0	2,588.0679	0	2,000
Slice 21	96.916667	471.1272	0	2,712.812	0	2,000
Slice 22	98.083333	471.09374	0	2,819.0706	0	2,000
Slice 23	99.25	471.11277	0	2,902.6373	0	2,000
Slice 24	100.41667	471.18441	0	2,959.3681	0	2,000
Slice 25	101.60336	471.31218	0	1,221.2646	0	2,000
Slice 26	102.81007	471.49877	0	1,178.9788	0	2,000
Slice 27	104.01678	471.74426	0	1,111.4308	0	2,000
Slice 28	105.22349	472.05038	0	1,020.1796	0	2,000
Slice 29	106.4302	472.41939	0	908.07827	0	2,000
Slice 30	107.63692	472.85418	0	779.16354	0	2,000
Slice 31	108.84363	473.35838	0	638.39653	0	2,000
Slice 32	110.05034	473.93656	0	491.28889	0	2,000

Allen Road West Abutment
20ft Retaining Wall Global Stability



SLOPE/W Analysis

File Information

Created By: Munson, James
Last Edited By: Munson, James
Revision Number: 4
File Version: 8.1
Tool Version: 8.11.1.7283
Date: 8/18/2019
Time: 8:46:12 AM
File Name: 20ft Wall.gsz
Directory: P:\C1X33100\600DISC\611GEOT\Retaining Walls\Allen Road\West Abutment\SlopeW\
Last Solved Date: 8/18/2019
Last Solved Time: 8:46:18 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6

Lambda 10: 0.8
Lambda 11: 1
PWP Conditions Source: (none)
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Limestone Bedrock

Model: Bedrock (Impenetrable)

Reinforced Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 5,000 psf
Phi': 0 °
Phi-B: 0 °

Retained Fill

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °

Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 27 °

Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (67.86839, 490) ft
Left-Zone Right Coordinate: (83, 490) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (102.64005, 472) ft
Right-Zone Right Coordinate: (122, 472) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 472) ft
Right Coordinate: (150, 472) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	56	490
	56	493.95938
	94	493.95938
	94	490

Points

	X (ft)	Y (ft)
Point 1	0	451
Point 2	0	461
Point 3	0	472
Point 4	49	470

Point 5	49	472
Point 6	49	490
Point 7	66	490
Point 8	66	470
Point 9	75	479
Point 10	84	490
Point 11	84	470
Point 12	101	490
Point 13	101	470
Point 14	101	472
Point 15	150	472
Point 16	150	461
Point 17	150	451
Point 18	72	476
Point 19	78	476

Regions

	Material	Points	Area (ft²)
Region 1	Limestone Bedrock	1,2,16,17	1,500
Region 2	Clay	2,3,5,4,8,18,19,11,13,14,15,16	1,618
Region 3	Reinforced Fill	6,7,8,4,5	340
Region 4	Retained Fill	7,10,11,19,9,18,8	279
Region 5	Reinforced Fill	10,12,14,13,11	340
Region 6	Silt	9,18,19	9

Current Slip Surface

Slip Surface: 265
F of S: 2.664
Volume: 610.2984 ft³
Weight: 73,235.808 lbs

Resisting Moment: 2,456,028.8 lbs-ft
Activating Moment: 921,866.86 lbs-ft
Resisting Force: 79,138.754 lbs
Activating Force: 29,717.428 lbs
F of S Rank: 1
Exit: (118.12801, 472) ft
Entry: (73.921034, 490) ft
Radius: 26.300633 ft
Center: (100.19258, 491.23652) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	74.64096	486.28496	0	617.51453	356.52218	0
Slice 2	76.080812	480.89188	0	1,163.905	671.98088	0
Slice 3	77.520665	477.98237	0	1,419.8784	819.7672	0
Slice 4	78.960517	475.76304	0	1,614.7239	932.2613	0
Slice 5	80.400369	473.95087	0	1,784.4848	1,030.2728	0
Slice 6	81.840222	472.42422	0	1,944.5904	1,122.7098	0
Slice 7	83.280074	471.11674	0	2,103.556	1,214.4886	0
Slice 8	84.338498	470.25579	0	1,681.9745	0	5,000
Slice 9	85.453913	469.47384	0	2,300.6046	0	2,000
Slice 10	87.007747	468.4972	0	2,527.3392	0	2,000
Slice 11	88.561581	467.66339	0	2,754.2933	0	2,000
Slice 12	90.115415	466.95759	0	2,984.2793	0	2,000
Slice 13	91.669249	466.36884	0	3,218.3936	0	2,000
Slice 14	93.223083	465.88894	0	3,456.2266	0	2,000
Slice 15	94.7	465.52578	0	2,774.0394	0	2,000
Slice 16	96.1	465.26592	0	2,969.2896	0	2,000
Slice 17	97.5	465.08355	0	3,157.9527	0	2,000
	98.9	464.97702	0	3,336.3503	0	2,000

Slice 18						
Slice 19	100.3	464.94543	0	3,499.9237	0	2,000
Slice 20	101.71367	464.98964	0	1,437.484	0	2,000
Slice 21	103.141	465.11155	0	1,518.0406	0	2,000
Slice 22	104.56834	465.31255	0	1,573.5917	0	2,000
Slice 23	105.99567	465.59452	0	1,601.0146	0	2,000
Slice 24	107.423	465.96018	0	1,597.7966	0	2,000
Slice 25	108.85034	466.41324	0	1,562.4286	0	2,000
Slice 26	110.27767	466.95861	0	1,494.7682	0	2,000
Slice 27	111.70501	467.60271	0	1,396.3136	0	2,000
Slice 28	113.13234	468.35391	0	1,270.3346	0	2,000
Slice 29	114.55967	469.22326	0	1,121.8324	0	2,000
Slice 30	115.98701	470.22552	0	957.34908	0	2,000
Slice 31	117.41434	471.381	0	784.71298	0	2,000

100.10.2 COMPLETION OF PROJECT

A. The work on this project shall commence on the date specified in the "Notice To Proceed" and completed by December 15, 2022 unless additional time is granted by the Director. Due to seasonal limitations, sodding and crack sealing may be completed after the dates shown on the schedule, if authorized by the Resident Engineer.

   Liquidated damages in the amount of $1,225 per day will be charged after the expiration of the time stipulated for each and every calendar day that all work remains uncompleted.

B. The work on this project shall commence on the date specified in the "Notice To Proceed" and shall be completed as follows, unless additional time is granted by the Director:

   CR-1274 ALLEN ROAD BRIDGE NO. 329 – COMPLETION DATES:

   - Notice to Proceed from St. Louis County – no later than April 1, 2020
   - Entire project completed – no later than December 15, 2022

C. The Contractor is advised that this roadway is the sole access for properties west of Allen Road Bridge No 329 and access must be maintained throughout the duration of the project. An additional $200.00 per hour will be charged for any road closure that exceeds 15 minutes.

D. An additional $200.00 per hour will be charged should temporary striping/marking not begin within the time limits specified in section 621.3.2 of the “St. Louis County Standard Specifications for Road and Bridge Construction”.

1200.70.16 BRIDGE CONSTRUCTABILITY ITEMS – ALLEN ROAD BRIDGE NO. 329

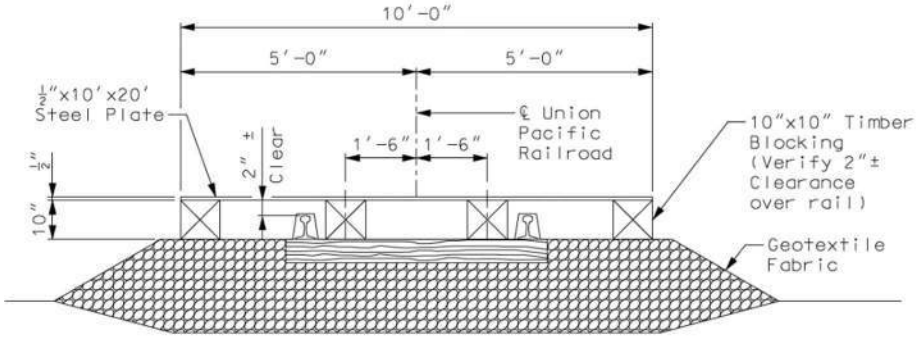
Description: Content under this item consist of the potential means and methods to construct the bridge given the likelihood of severely constrained conditional work windows allowed by UPRR.

St. Louis County does not warrant that the content detailed below is suitable for this project or that this content will be approved by the UPRR, or that if approved by UPRR, these methods will result in a reduced construction duration. This content is offered only as a service to the potential bidders in that these or other means and methods may prove productive to the contractor.

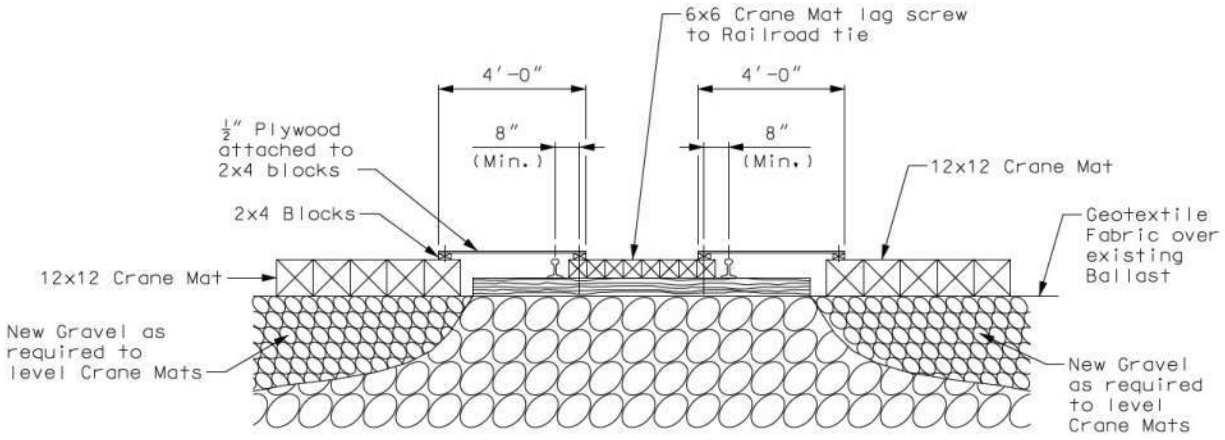
Construction Methods: The Contractor shall prepare and submit the required railroad submittals in an organized manner, detailing the work over and around the UPRR facilities such that the UPRR is able to completely understand and follow the execution of the work and is able to quickly establish the work plans meet the UPRR requirements as set forth in the UPRR agreements, permits, and licenses.

Site Preparation: The contractor shall give due consideration to developing an exit route, within the project limits, and following UPRR requirements that will permit the contractor to mobilize equipment to and from the track back beyond 50 feet of the nearest track centerline in an efficient manner.

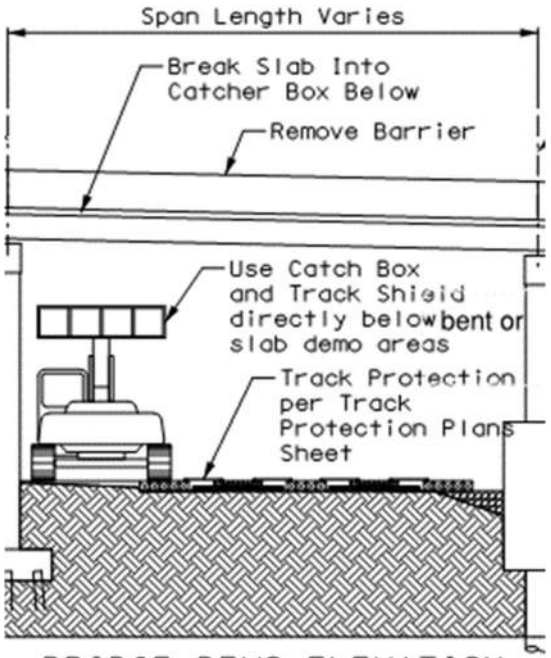
Demolition of the Existing Bridge: The contractor shall give due consideration to using modular track protective means, with hardware readily accessible on the material to allow for lifting so to accelerate placement and removal of the protective means. The figures below represent such arrangements. The contractor shall give due consideration to using smaller, yet effective, equipment as necessary to ensure material demolished from the existing bridge structure does not fall onto the UPRR ROW and can be quickly and easily disposed of, see Bridge Demo Figure below.



TRACK SHIELD DETAIL 1



TRACK SHIELD DETAIL 2



BRIDGE DEMO ELEVATION

Demolition of Existing Bridge Deck and Girders: The contractor shall give due consideration to saw cutting the bridge deck longitudinally at locations approved by the Engineer to reduce the deck to sections small enough to lift by crane. Such saw cuts should be accompanied by demo of the concrete diaphragms over the intermediate bents in line with the deck saw cuts.

Demolition of the Existing Intermediate Bents: The contractor shall give due consideration to installing a tension anchor system (wire rope, shackles, concrete deadman blocks) to the existing bent cap such that the columns and bent cap will fall back toward the existing slope as the bottom of the columns are cut near the base. Once the columns and cap are pulled away as a unit, they can be cut and removed in pieces.

Coordination of Track Clearance: The contractor shall give due consideration to coordinating with the UPRR for schedule of track use. The contractor should maximize time beyond 50 ft of the track to be used rather than both tracks. The contractor shall give due consideration for seeking a variance in the 50 ft clearance wherein work will place the contractor on the protective side of the existing bridge bent but not yet 50 ft from the track in use.

Work Adjacent to the Construction Clearance Envelope: The contractor shall give due consideration to planning work activities for personnel which does not involve equipment adjacent to the minimum construction clearance and 25 ft from the centerline of track in use.

Temporary Bridge: The contractor should give due consideration to coordinating with the supplier of the temporary bridge to ascertain the capacity of the bridge relative to construction equipment that could be situated on the temporary bridge to facilitate construction activities. Such mobilization of equipment on the bridge shall be coordinated with the County to ensure no traffic delays during daytime hours.

Concrete for the proposed rock sockets and abutment wall: The contractor shall give due consideration to a concrete retarder in accordance with AASHTO M 194, Type B may be incorporated into the mix to retard set 4 hours to mitigate a possible horizontal cold joint due to constrained conditional window of construction.

Girder Erection: The contractor shall give due consideration to using an erection beam with a dolly or bogie to allow the proposed concrete prestressed NU girders to be erected by rolling or launching across the RR. Such a beam would allow for potentially smaller cranes to be used to set the girders.

Method of Measurement & Basis of Payment: No additional payment will be issued for any methods used from this provision. The costs for all construction methodologies used for the project shall be considered incidental to other items.

Allen Road Bridge No. 329
Federal Project No. STP-4900(634)
St. Louis County Project No. CR-1274
Pre-Bid Meeting Notes
September 17, 2019

1. Introductions
    a. See attached scan of attendance record sheet

2. General Project Overview
    a. Pam Thebeau (STLCO) gave a high-level overview of the project, but noted that the intent was to get to the RR discussion, as that was the most important information to share at this meeting

3. Discussion of Railroad Permits, Agreements, and Licenses
    a. Jordon Albers (UPRR) directed attention to Exhibit D in the overpass agreement, and noted his new contact phone number: 402-890-4754
    b. Jordon noted that flagging would be coordinated with Jacob Allen but after the meeting Saint Louis was informed that flagging needs would be handled by David Palmertag, UP Manager Track Maintenance. Dave Palmertag's phone number Is 402-269-5734.
    c. Jordon went over work windows that would be allowed by UPRR – section 1.07, subpart C, parts 1 (Conditional Work Window) and 2 (Absolute Work Window)
        - Absolute windows are going to be unlikely, as this track (part of the Jefferson City Subdivision) is very busy.
        - The main line track speed through the project limits is 60MPH and the average number of freight trains is estimated at 23 trains every 24 hours
        - No absolute windows will be guaranteed
        - Conditional windows will most likely be only 1-2 hours
        - No part of the bridge can be 'hanging out' over the rails while a train passes underneath – track area must be totally clear
    d. Jordon discussed Right-of-Entry (ROE) requirements:
        - Each contractor/subcontractor on the project site must have their own ROE permit
        - Each contractor will be required to pay ROE submittal fees
        - Appropriate insurance must be supplied for each contractor/subcontractor on site
    e. Jordon indicated all contractor will need to meet the requirements in both the UP Railroad-BNSF Railway "Guidelines for Railroad Grade Separation Projects" manual and "Public Highway Overpass Agreement".
    f. Jordon indicated that <u>all</u> submittals from the contractor for the project must be submitted <u>at one time</u>
        - UP Railroad-BNSF Railway "Guidelines for Railroad Grade Separation Projects" manual specifies the required submittals and anticipated turnaround review times for submittals.

- The "Guidelines for Railroad Grade Separation Projects" manual and "Public Highway Overpass Agreement" were supplied to all potential bidders in Addendum #3

g. Jordon indicated a revised inspection and flagging estimate will be provided to Saint Louis County.
h. Jordon indicated all construction reports will be provided to UP by the contractor.
i. Jordon discussed project safety, the Federal Railroad Administration requires that each contractor's employee know their job safety requirements. UP will provide the contractor with the job site safety requirements.
    - In person safety review meetings will be required with UP representative.
    - Contractor will prepare emergency response plan for UP.
j. Jordon indicated BNSF may require a wide load permit during construction to bring in oversized bridge beams.

4. Job Special Provisions of note:
    a. Several JSPs from the Bid Proposal were highlighted for special consideration; bidders need to be familiar with all elements of the bid proposal, but these select JSPs may require additional attention when formulating bids

5. Revised Schedule Milestones (per Addendum #3)
    a. Contractors must submit questions to St. Louis County no later than September 24, 2019
    b. St. Louis County will respond to all questions no later than October 1, 2019
    c. Bid Opening will be held at 11:00 a.m. on October 9, 2019

6. Any outstanding issues from this meeting, as well as any questions that are submitted prior to the September 24th deadline, will be addressed in a forthcoming addendum

Allen Road Bridge No. 329
Federal Project No. STP-4900(634)
St. Louis County Project No. CR-1274
September 17, 2019

Pre-Bid Meeting – ATTENDANCE RECORD

COMPANY NAME	REPRESENTATIVE NAME	REPRESENTATIVE E-MAIL	REPRESENTATIVE PHONE	METHOD OF ATTENDANCE (select one)		
				IN-PERSON	WEBEX	PHONE
STLCounty	Pam Thebeau	PThebeau@stlouisco.com	314-615-8579	✓		
STLC	JAMES BROWN	JABROWN@STLOUISCO.	314 615 8199	✓		
STLC	Joe Kulessa	JKulessa@stlouisco.com	314-615-8584	✓		
Jacobs	John Finke	John.Finke@Jacobs	314-335-4059	✓		
Pace	Michael Conner	mconner@paceconstructionstl.com	314 574 6133	✓		
Pace	Jim Schaefer	JSchaefer@PaceConstructionSTL.com	314-220-5698	✓		
JACOBS	CHRIS MOORE	Christopher.Moore2@jacobs.com	314-335-4526	✓		
FLOCHER CONST.	ANDREW WITZ	AWitz@[illegible].com	618-654-9409	✓		
KOBERT-WAGNER, INC	SEAN KILIAN	skilian@koberlywagner.com	314-280-0353	✓		
KCI construction	Jason Sterner	Jsterner@KCIconstruction.com	314 581 0438	✓		
Citer Rising	GERSHENSON	CRISING@GERSHENSON.com	314-574-8035	✓		
UPRR	Jordan Albers	jalbers@upcontractor.up.com	402-890-4754	✓		

Allen Road Bridge No. 329
Federal Project No. STP-4900(634)
St. Louis County Project No. CR-1274
September 17, 2019

Pre-Bid Meeting – ATTENDANCE RECORD

COMPANY NAME	REPRESENTATIVE NAME	REPRESENTATIVE E-MAIL	REPRESENTATIVE PHONE	METHOD OF ATTENDANCE (select one)		
				IN-PERSON	WEBEX	PHONE
St. Louis Co. Construction	Greg Poppitz	gpoppitz@stlouisco.com	314-615-1160	✓		
St. Louis Co Construction	Sotirios Kotikis	skotikis@stlouisco.com	314-615-1670	—		
STLCO	Matt Gruendler				✓	✓
STLCO	Brian Gettinger				✓	
	Juan Banuelas				✓	
RANDALL GLASER	MODOT	RANDALL.GLASER@MODOT.MO.GOV	314-453-5037	—		
MoDOT	Bill Gubler	William.Gubler@modot.mo.gov	314-453-5082	✓		
MoDOT	Russell Klein	Russell.Klein@modot.mo.gov	314-453-5093	✓		

EXAMPLE ONLY
NOT FOR CONSTRUCTION

EXISTING OVERHEAD ALLEGHENY POWER LINES TO BE RELOCATED BY OTHERS (TYP.)

160'-0" ℄ BEARING ABUTMENT TO ℄ BEARING ABUTMENT
TEMPORARY BRIDGE

CSX TRACKS

EXISTING STONE WALL TO BE REMOVED

EXISTING UNDERGROUND ALLEGHENY POWER LINE TO BE RELOCATED BY OTHERS

TO URBANA

CSXT R.O.W. LINE (TYP.)

℄ CONSTRUCTION TEMPORARY BRIDGE

STA. 106+57.43

STA. 108+17.43

65° 00' 00" (TYP.)

+50

107+00

+50

108+00

TO FREDERICK

30'-6"(±) OUT-TO-OUT SUPERSTRUCT. TEMPORARY BRIDGE

2'-9" MIN.

42'-0" ℄ PROPOSED TO ℄ TEMPORARY BRIDGE

WING WALL I

WING WALL III

31'-2"(±) OUT-TO-OUT SUPERSTRUCT. EXISTING BRIDGE

TO URBANA

STA. 6+65.16

STA. 7+95.16

65° 00' 00" (TYP.)

N 40° 39' 48.14" W

7+00

8+00

℄ CONSTRUCTION AND P.G.L. OF MD 355

TO FREDERICK

46'-3" OUT-TO-OUT SUPERSTRUCTURE NEW PERMANENT BRIDGE

16" FREDERICK COUNTY WATER LINE TO BE RELOCATED TO NEW BRIDGE

WING WALL II

WING WALL IV

CSXT R.O.W. LINE (TYP.)

EXISTING R.O.W. LINE (TYP.)

130'-0" ℄ BEARING ABUTMENT TO ℄ BEARING ABUTMENT
NEW PERMANENT BRIDGE

EXISTING EASEMENT LINE (TYP.)

PLAN VIEW BRIDGES
SCALE: 1" = 10'-0"

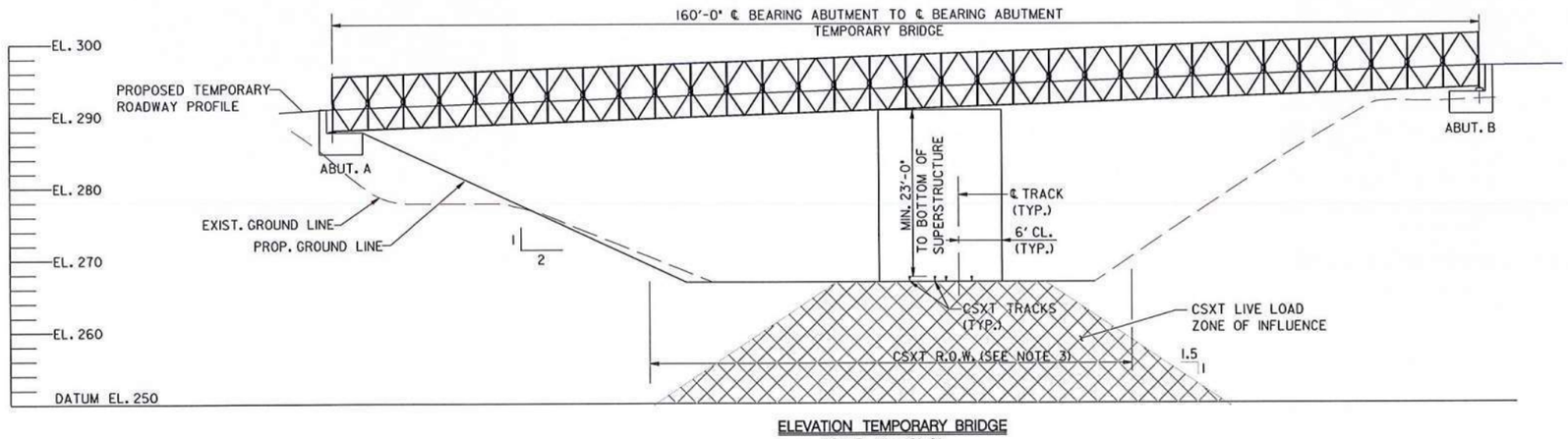
DENOTES EXISTING STRUCTURE TO BE REMOVED

DENOTES TEMPORARY BRIDGE TO BE BE DESIGNED AND BUILT BY CONTRACTOR

DENOTES NEW PERMANENT BRIDGE TO BE CONSTRUCTED

NOTES

1. TEMPORARY BRIDGE WILL BE DESIGNED AND CONSTRUCTED BY CONTRACTOR IN ACCORDANCE WITH STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS.
2. THE NUMBER AND LENGTH OF THE SPANS FOR THE TEMPORARY BRIDGE IS LEFT AT THE DISCRETION OF THE CONTRACTOR.
3. NO ABUTMENT, PIER OR ANY OTHER WORK FOR THE TEMPORARY BRIDGE SHALL BE LOCATED WITHIN THE CSXT RIGHT OF WAY.



ELEVATION TEMPORARY BRIDGE
SCALE: 1" = 10'-0"

S - 2

REVISIONS

STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
OFFICE OF STRUCTURES

BRIDGE REPLACEMENT
STEEL GIRDER BRIDGE NO. 1008400
ON MD 355 (URBANA PIKE)
OVER CSXT
GENERAL PLAN VIEW

SCALE	AS SHOWN	DATE	CONTRACT	FR5595180
DESIGNED BY	R.J.D. & S.F.			
DRAWN BY	J.L.			
CHECKED BY	K.N.			

O.O.S.
12.06.16

SHEET NO. 59 OF 118

OTHER CONTRACTS FOR THIS STRUCTURE

STRUCTURE INVENTORY NO. 1008400

SURVEY BOOK NO. 19782

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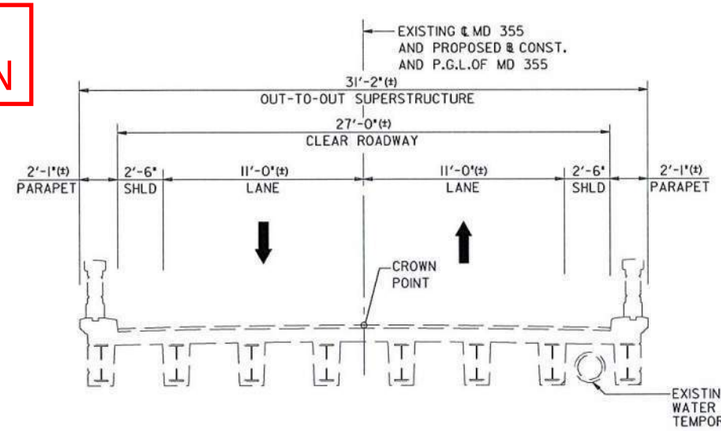
PRINT DATE: Thursday, December 01, 2016 at 7:40:04 AM

INDEXED

EXAMPLE ONLY
NOT FOR CONSTRUCTION



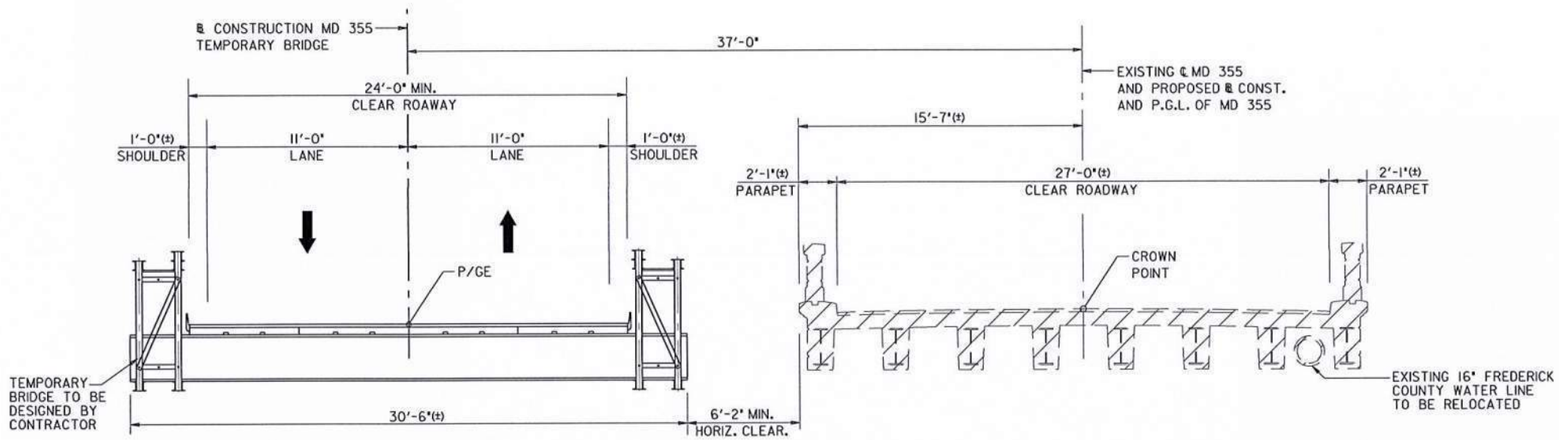
EXISTING TYPICAL SECTION
SCALE: 1/4" = 1'-0"

SEQUENCE OF CONSTRUCTION NOTES:

1. CONSTRUCT TEMPORARY BRIDGE AND ROADWAY AND SHIFT PRESENT TRAFFIC FROM EXISTING BRIDGE TO TEMPORARY BRIDGE.
2. REMOVE ENTIRE EXISTING BRIDGE. REMOVAL OF THE EXISTING STRUCTURE SHALL BE IN ACCORDANCE WITH SECTION 405 OF THE STANDARDS SPECIFICATIONS.

NOTES:

1. FOR DETAILS OF STAGE I AND STAGE 3 CONSTRUCTION, SEE ROADWAY MAINTENANCE OF TRAFFIC SHEETS.
2. BARRIERS ON TEMPORARY BRIDGE SHALL BE DESIGNED TO MEET THE REQUIREMENTS OF TEST LEVEL TL-4 IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.
3. FOR PROPOSED TYPICAL SECTION, SEE SHEET S-24.
4. METAL RIDING SURFACE ON TEMPORARY BRIDGE WILL NOT BE PERMITTED. IF THE TEMPORARY BRIDGE HAS A METAL DECK, A RIDING SURFACE CONSISTING OF A TACK COAT AND HMA OVERLAY SHALL BE PLACED ON THE BRIDGE.



STAGE 2 – REMOVAL
SECTION
SCALE: 1/4" = 1'-0"

S – 4

REVISIONS

STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
OFFICE OF STRUCTURES

BRIDGE REPLACEMENT
STEEL GIRDER BRIDGE NO. 1008400
ON MD 355 (URBANA PIKE)
OVER CSXT
SEQUENCE OF CONSTRUCTION 1

SCALE AS SHOWN DATE CONTRACT FR5595180

DESIGNED BY R.J.D. & SF
DRAWN BY J.L.
CHECKED BY K.N.

O.O.S.
12.06.16

SHEET NO. 61 OF 118

INDEXED

OTHER CONTRACTS FOR THIS STRUCTURE _____ _____

STRUCTURE INVENTORY NO. 1008400

SURVEY BOOK NO. 19782

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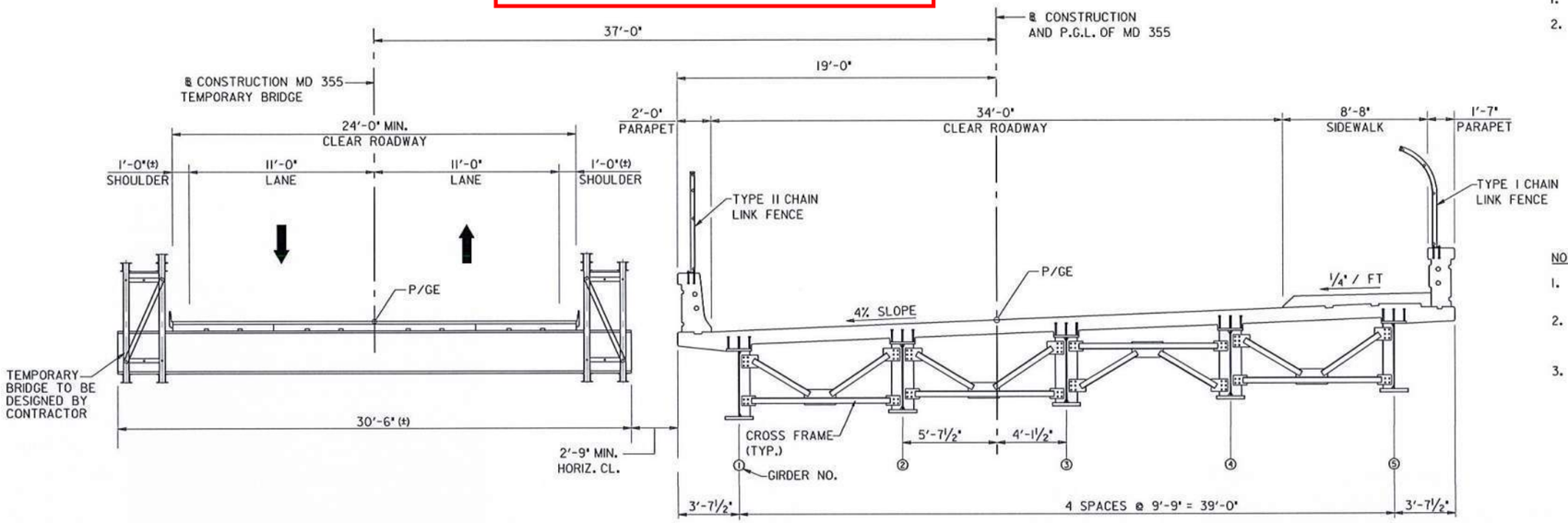
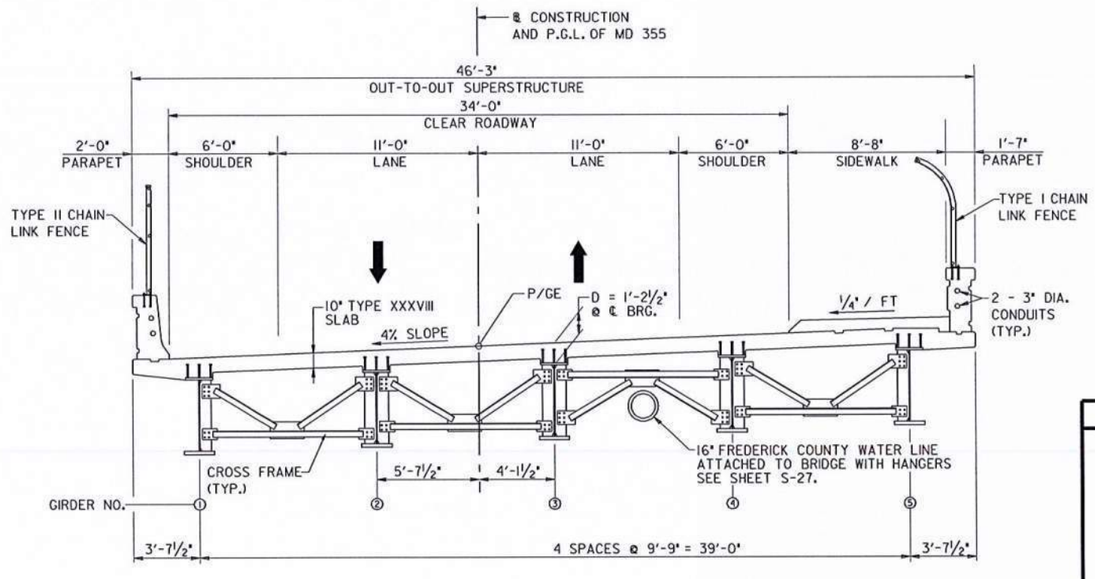
EXAMPLE ONLY
NOT FOR CONSTRUCTION



STAGE 2 – CONSTRUCTION SECTION
SCALE: 1/4" = 1'-0"



PROPOSED TYPICAL SECTION
SCALE: 1/4" = 1'-0"

SEQUENCE OF CONSTRUCTION NOTES:

1. CONSTRUCT THE ENTIRE PROPOSED BRIDGE.
2. SHIFT TRAFFIC FROM TEMPORARY BRIDGE TO THE PROPOSED BRIDGE AND REMOVE TEMPORARY BRIDGE.

NOTES:

1. FOR DETAILS OF STAGE 1 AND STAGE 3 CONSTRUCTION, SEE ROADWAY MAINTENANCE OF TRAFFIC SHEETS.
2. BARRIERS ON TEMPORARY BRIDGE SHALL BE DESIGNED TO MEET THE REQUIREMENTS OF TEST LEVEL TL-4 IN THE AASHTO SPECIFICATIONS.
3. 'D' IS MEASURED FROM TOP OF DECK TO TOP OF GIRDER WEB AT THE CENTERLINE OF BEAM ABD CENTERLINE OF BEARING.

S – 5

REVISIONS

STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
OFFICE OF STRUCTURES
BRIDGE REPLACEMENT
STEEL GIRDER BRIDGE NO. 1008400
ON MD 355 (URBANA PIKE)
OVER CSXT
SEQUENCE OF CONSTRUCTION 2

SCALE AS SHOWN DATE CONTRACT FR5595180

DESIGNED BY R.J.D. & SF
DRAWN BY J.L.
CHECKED BY K.N.

O.O.S.
12.06.16

SHEET NO. 62 OF 118

OTHER CONTRACTS FOR THIS STRUCTURE

STRUCTURE INVENTORY NO. 1008400

SURVEY BOOK NO. 19782

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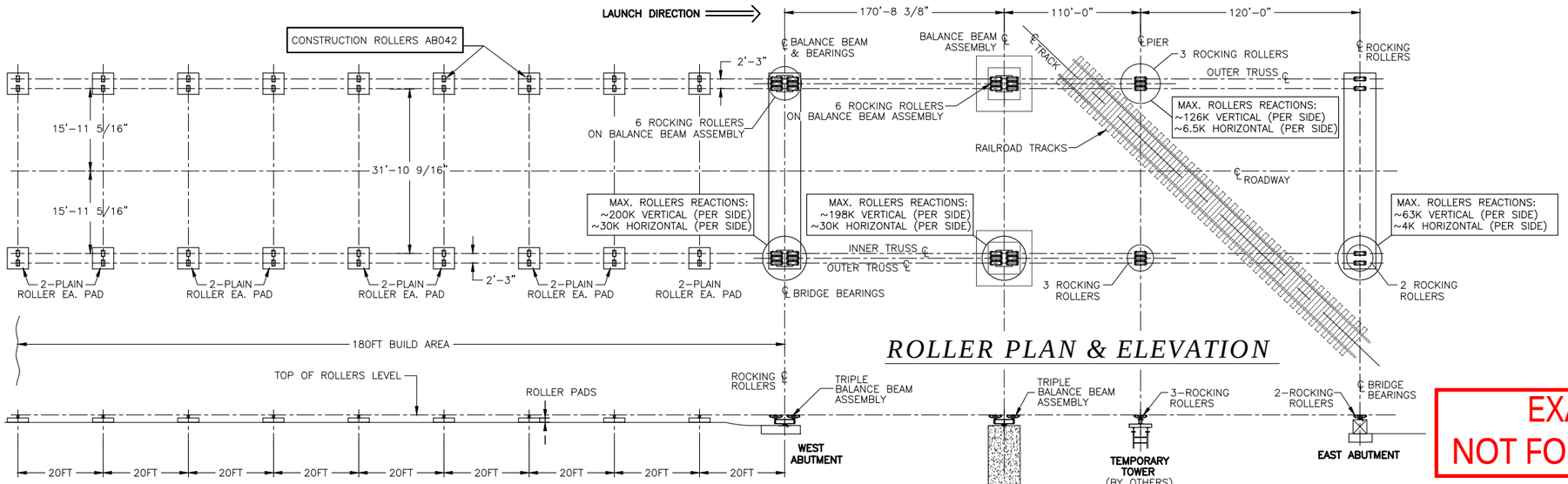


ROLLER PLAN & ELEVATION

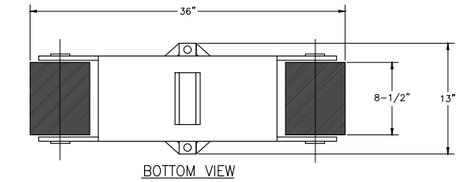
EXAMPLE ONLY
NOT FOR CONSTRUCTION

THE ACROW FIELD REPRESENTATIVE WILL PROVIDE TECHNICAL GUIDANCE DURING ASSEMBLY AND ERECTION.
THE ACTUAL METHOD MAY DEVIATE DUE TO FIELD CONDITIONS

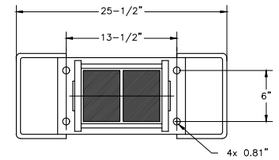
NOTE:
ROLLERS ARE TO BE SUPPORTED ON 5'x5'x1' CONCRETE PADS, TIMBER SWAMP PADS OR TIMBER DUNNAGE CAN ALSO BE USED. ALL PADS ARE BY CONTRACTOR.

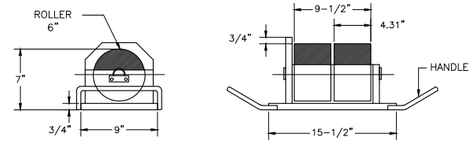
PAD DIMENSIONS TO BE INCREASED AS REQUIRED FOR UNSTABLE GROUND

KEEP TOPS OF ALL ROLLERS LEVEL LONGITUDINALLY & LATERALLY.

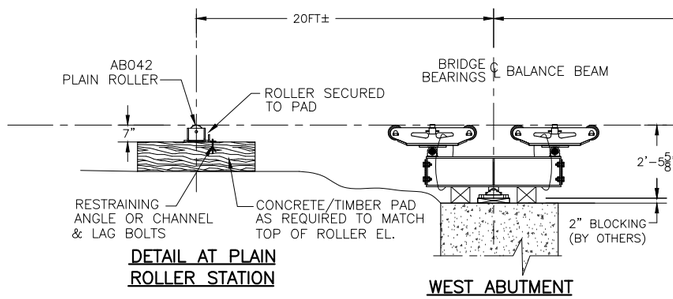


AB043 ROCKING ROLLER



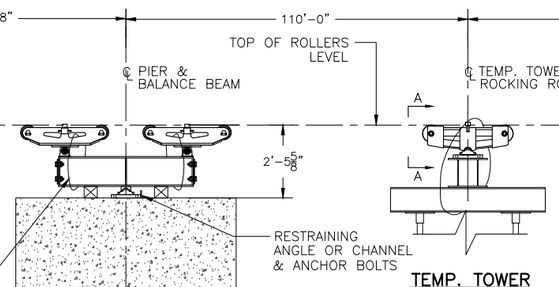


AB042 PLAIN ROLLER



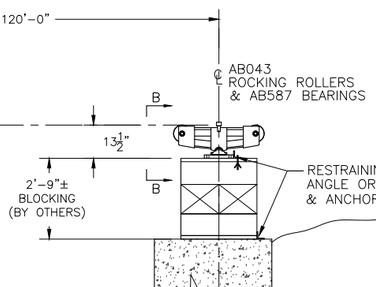
DETAIL AT PLAIN ROLLER STATION

WEST ABUTMENT

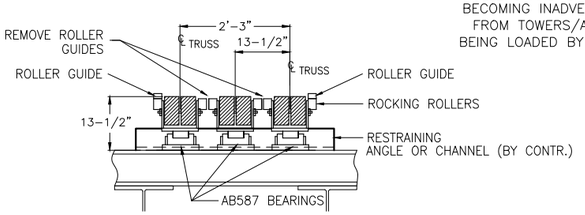


CONCRETE PIER

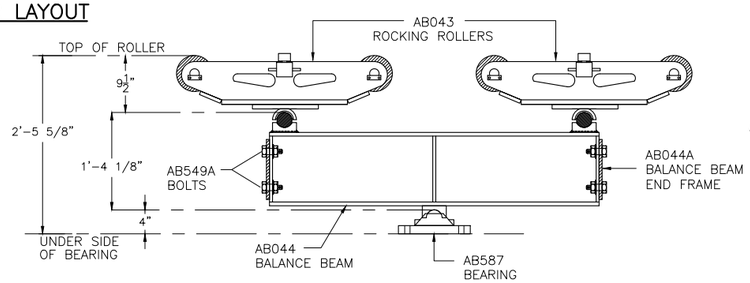
TEMP. TOWER (BY OTHERS)



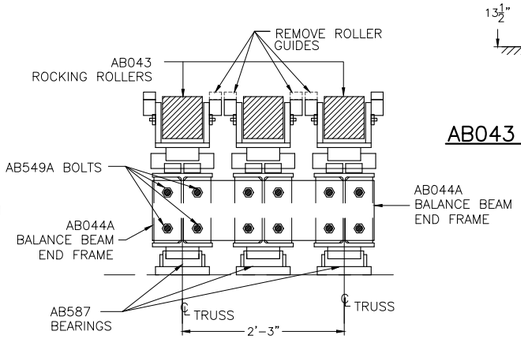
EAST ABUTMENT



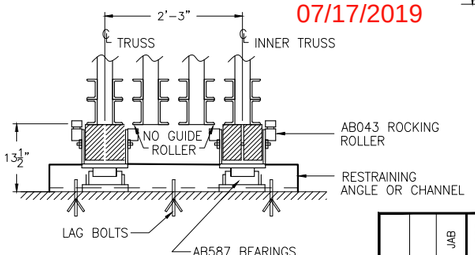
AB043 ROCKING ROLLER LAYOUT SECTION A-A



BALANCE BEAM ASSEMBLY ELEVATION VIEW

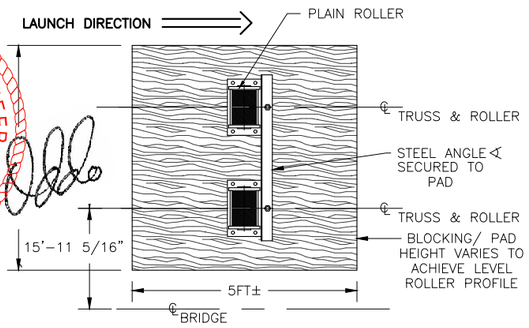


SIDE VIEW



AB043 ROCKING ROLLER LAYOUT SECTION B-B

PROFESSIONAL ENGINEER
No. 5237822
ROBERT ALLEN ODDO
STATE OF UTAH
07/17/2019



PLAN VIEW
TYPICAL ROLLER STATION PAD

PAD DIMENSIONS TO BE INCREASED AS REQUIRED FOR UNSTABLE GROUND

REV.	DATE	DESCRIPTION	BY	APPR.
1	6/27 2019	REVISE ACROW TOWER TO CONCRETE PIER	AC	JAB

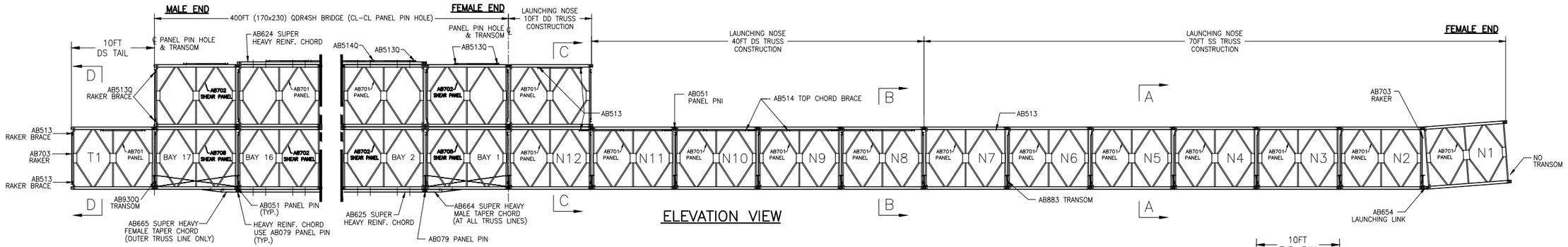
ACROW BRIDGE
Building Bridges. Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

ACROW 700XS PANEL BRIDGE
ROLLER LAYOUT
400FT (2 SPANS 230FT-170FT) QDR4SH TRUSS
2LANE 30FT WIDE BRIDGE
I-80 BLACKROCK CMGC
BLACK ROCK, UT

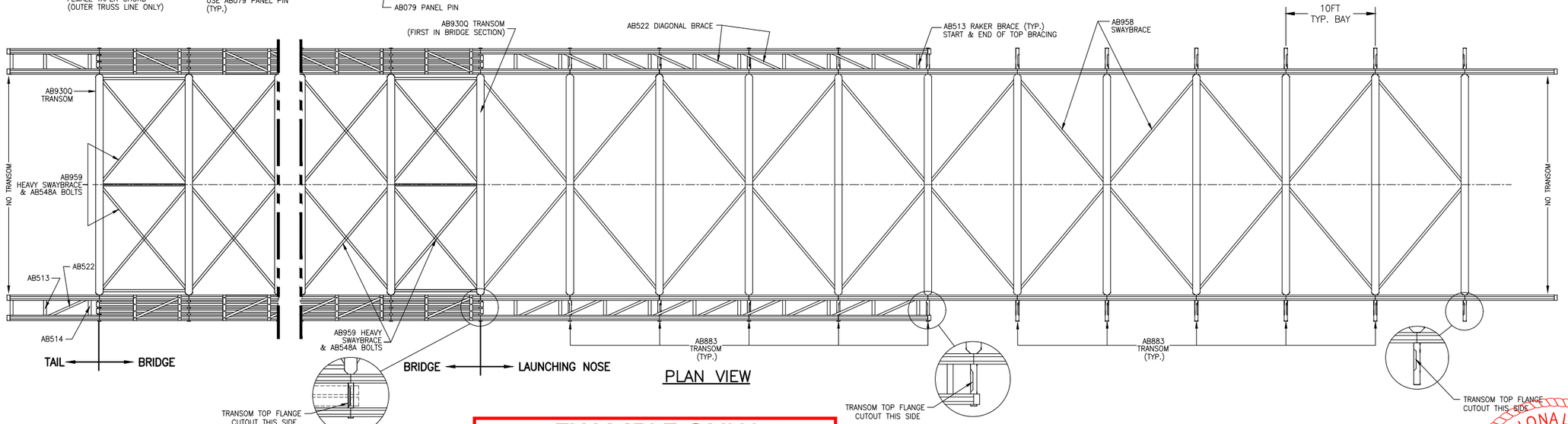
DRAWN BY AC
CHECKED BY JB
APPROVED BY JB
DATE: MARCH 1, 2019
SCALE: AS SHOWN
CONTRACT NO.

GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030_LP
SHT 1 OF 12
REV. 1

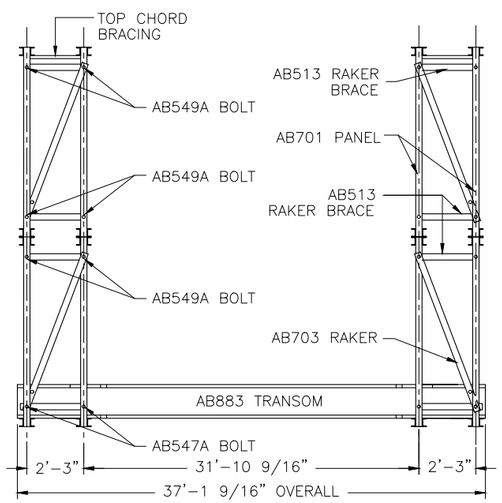


ELEVATION VIEW

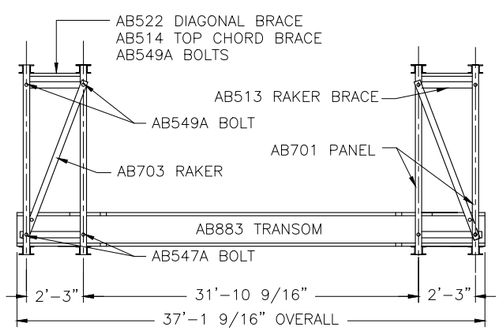


PLAN VIEW

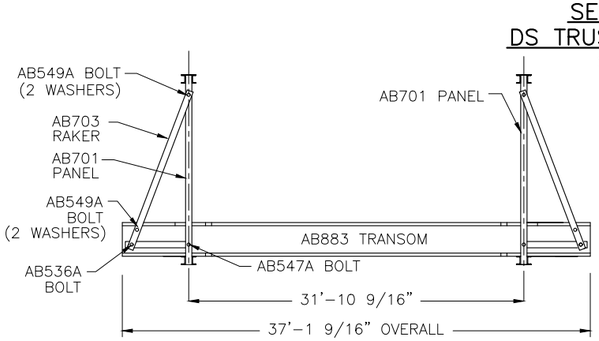
EXAMPLE ONLY
NOT FOR CONSTRUCTION



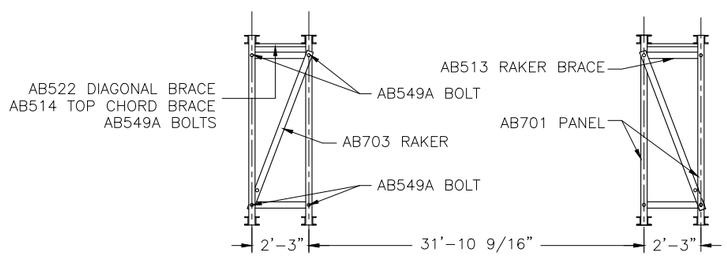
SECTION C–C
DD TRUSS CONSTRUCTION
SCALE: N.T.S.



SECTION B–B
DS TRUSS CONSTRUCTION
SCALE: N.T.S.



SECTION A–A
SS TRUSS CONSTRUCTION
SCALE: N.T.S.



SECTION D–D
DS TRUSS CONSTRUCTION
SCALE: N.T.S.

PROFESSIONAL ENGINEER
No. 5237822
ROBERT ALLEN ODDO
STATE OF UTAH

07/17/2019

REV.	DATE	DESCRIPTION	BY	APPR.
1	6/27 2019	REVISE ACROW TOWER TO CONCRETE PIER	AC	JAB

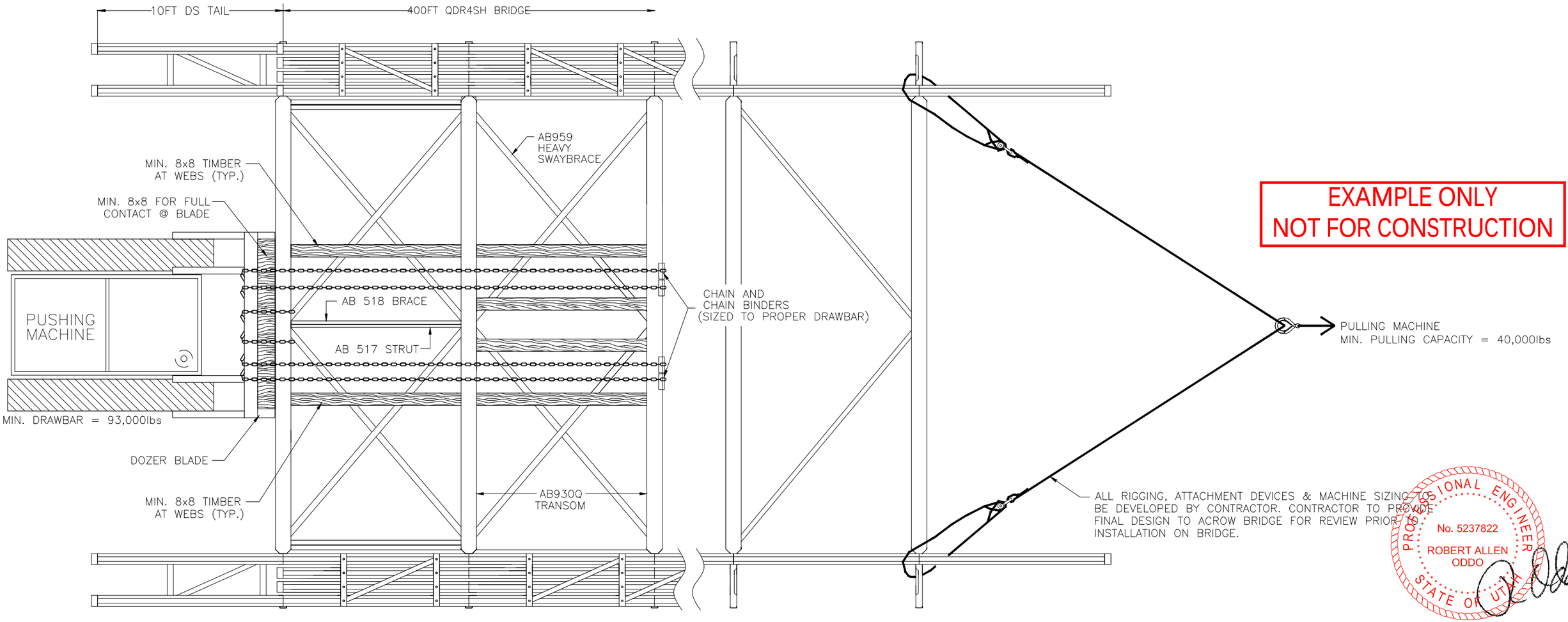
ACROW BRIDGE
Building Bridges. Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

ACROW 700XS PANEL BRIDGE
LAUNCHING NOSE AND TAIL
400FT (2 SPANS 230FT–170FT) QDR4SH TRUSS
2LANE 30FT WIDE BRIDGE
I–80 BLACKROCK CMGC
BLACK ROCK, UT

DRAWN BY AC
CHECKED BY JB
APPROVED BY JB
DATE MARCH 1, 2019
SCALE: AS SHOWN
CONTRACT NO.

GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030_LP
SHT 2 OF 12
REV. 1



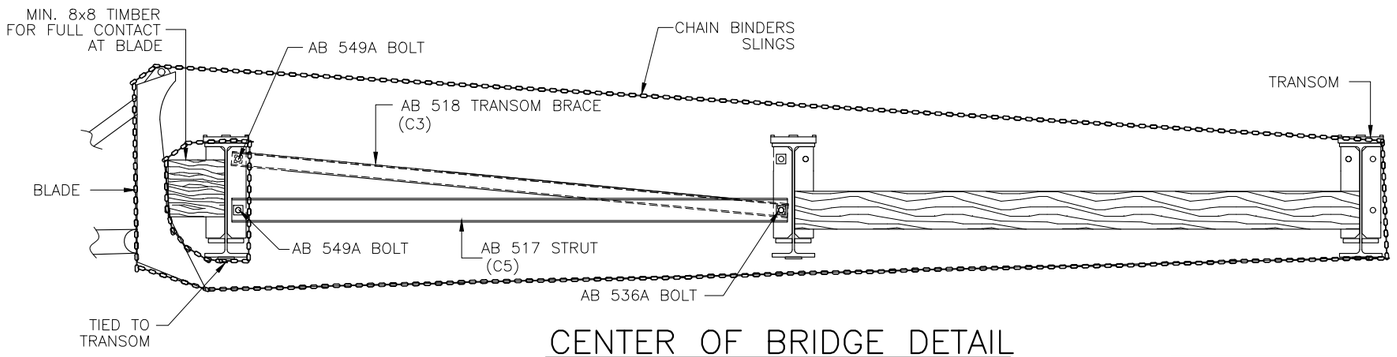
EXAMPLE ONLY
NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER
No. 5237822
ROBERT ALLEN
ODDO
STATE OF UTAH

07/17/2019

NOTE:

INSTALL BLOCKING & TEMPORARY BRACING AS SHOWN FOR ALL PUSHING AND PULLING IN THE LAUNCH SEQUENCE.



CENTER OF BRIDGE DETAIL

8x8 TIMBER STRUT NOT SHOWN FOR CLARITY

REV.	DATE	DESCRIPTION	BY	APPR.
1	6/27 2019	REVISE ACROW TOWER TO CONCRETE PIER	AC	JAB

SEAL

ACROW BRIDGE

Building Bridges.
Connecting People.

Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

ACROW 700XS PANEL BRIDGE
BLOCKING/PUSHING & PULLING DETAIL
400FT (2 SPANS 230FT–170FT) QDR4SH TRUSS
2LANE 30FT WIDE BRIDGE
I–80 BLACKROCK CMGC
BLACK ROCK, UT

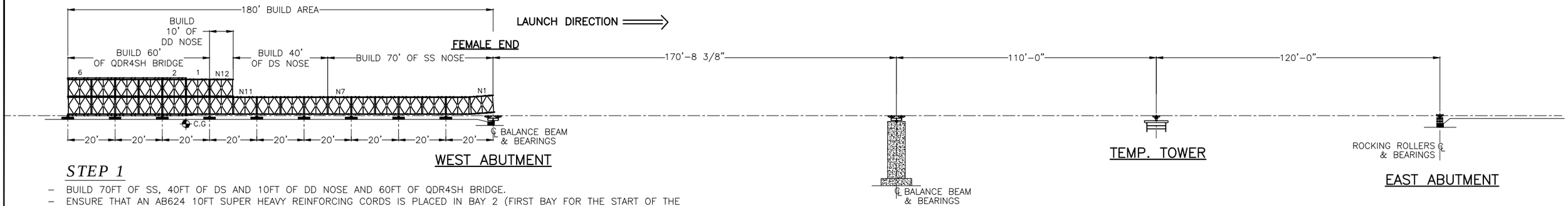
DRAWN BY	AC	DATE MARCH 1, 2019	CONTRACT NO.
CHECKED BY	JB	SCALE: N.T.S.	
APPROVED BY	JB		

GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030_LP

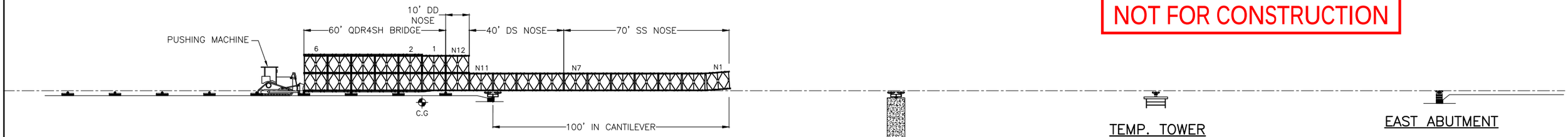
REV. 1

SHT 3 OF 12



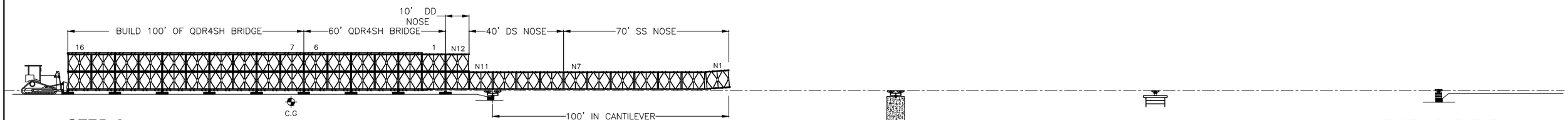
STEP 1

- BUILD 70FT OF SS, 40FT OF DS AND 10FT OF DD NOSE AND 60FT OF QDR4SH BRIDGE.
- ENSURE THAT AN AB624 10FT SUPER HEAVY REINFORCING CORDS IS PLACED IN BAY 2 (FIRST BAY FOR THE START OF THE SUPER HEAVY REINFORCING CHORDS).
- INSTALL TEMPORARY BLOCKING IN THE LAST BAYS OF THE BRIDGE AS SHOWN ON SHEET 3.
- ATTACH A MACHINE CAPABLE OF PUSHING 28,000 LBS. TO THE LAST TRANSOM OF THE BRIDGE.



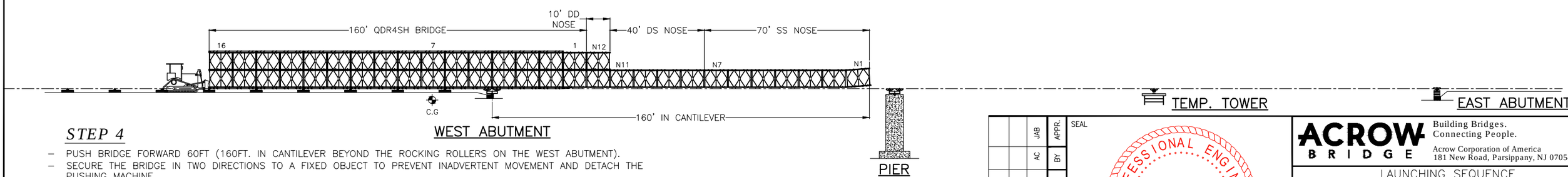
STEP 2

- PUSH BRIDGE FORWARD 100FT (100FT. IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE WEST ABUTMENT).
- SECURE THE BRIDGE IN TWO DIRECTIONS TO A FIXED OBJECT TO PREVENT INADVERTENT MOVEMENT AND DETACH THE PUSHING MACHINE.
- REMOVE THE TEMPORARY BLOCKING FROM THE END OF THE BRIDGE.



STEP 3

- BUILD 100FT OF QDR4SH BRIDGE.
- INSTALL TEMPORARY BLOCKING IN THE END BAYS AS SHOWN ON SHEET 3.
- ATTACH A MACHINE CAPABLE OF PUSHING 62,000 LBS. TO THE LAST TRANSOM OF THE BRIDGE.
- REMOVE THE TEMPORARY RESTRAINTS FROM THE BRIDGE.



STEP 4

- PUSH BRIDGE FORWARD 60FT (160FT. IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE WEST ABUTMENT).
- SECURE THE BRIDGE IN TWO DIRECTIONS TO A FIXED OBJECT TO PREVENT INADVERTENT MOVEMENT AND DETACH THE PUSHING MACHINE.
- REMOVE THE TEMPORARY BLOCKING FROM THE END OF THE BRIDGE.

EXAMPLE ONLY
NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	BY	APPR.
1	6/27 2019	REVISE ACROW TOWER TO CONCRETE PIER	AC	JAB

SEAL

PROFESSIONAL ENGINEER
No. 5237822
ROBERT ALLEN ODDO
STATE OF UTAH

07/17/2019

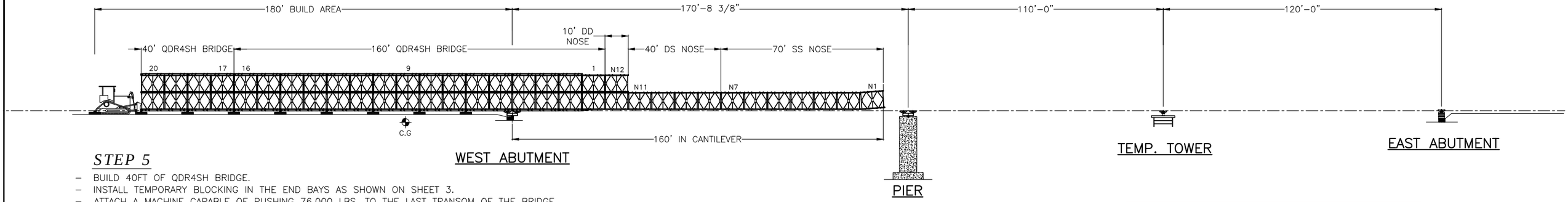
ACROW BRIDGE
Building Bridges. Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

LAUNCHING SEQUENCE
400FT (2 SPANS 230FT-170FT) QDR4SH TRUSS
2LANE 30FT WIDE BRIDGE
I-80 BLACKROCK CMGC
BLACK ROCK, UT

DRAWN BY	AC	DATE MARCH 25, 2019	PROJECT No.
CHECKED BY	JB	SCALE: NTS	18-01-2286
APPROVED BY	JB		

GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

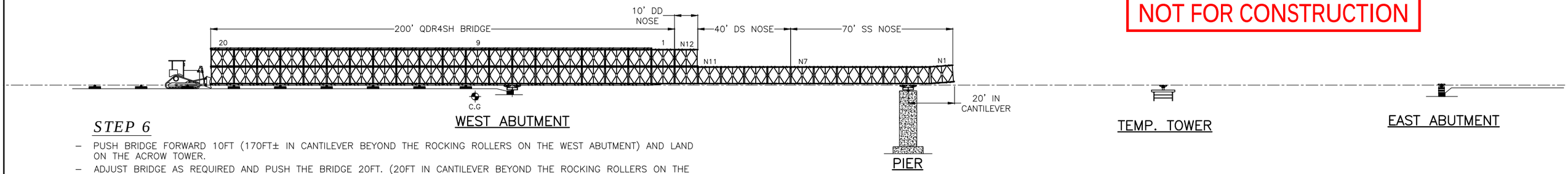
DRAWING NO. AB2030-LP
REV. 1
SHT 4 OF 12



STEP 5

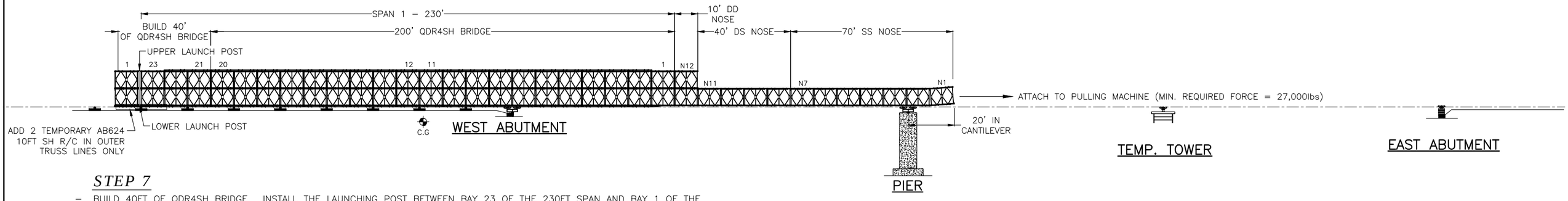
- BUILD 40FT OF QDR4SH BRIDGE.
- INSTALL TEMPORARY BLOCKING IN THE END BAYS AS SHOWN ON SHEET 3.
- ATTACH A MACHINE CAPABLE OF PUSHING 76,000 LBS. TO THE LAST TRANSOM OF THE BRIDGE.
- REMOVE THE TEMPORARY RESTRAINTS FROM THE BRIDGE.

EXAMPLE ONLY
NOT FOR CONSTRUCTION



STEP 6

- PUSH BRIDGE FORWARD 10FT (170FT± IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE WEST ABUTMENT) AND LAND ON THE ACROW TOWER.
- ADJUST BRIDGE AS REQUIRED AND PUSH THE BRIDGE 20FT. (20FT IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE PIER)
- SECURE THE BRIDGE IN TWO DIRECTIONS TO A FIXED OBJECT TO PREVENT INADVERTENT MOVEMENT AND DETACH THE PUSHING MACHINE.
- REMOVE THE TEMPORARY BLOCKING FROM THE END OF THE BRIDGE.



STEP 7

- BUILD 40FT OF QDR4SH BRIDGE. INSTALL THE LAUNCHING POST BETWEEN BAY 23 OF THE 230FT SPAN AND BAY 1 OF THE 170FT SPAN. REFER TO DETAIL A ON SHEET 11 ON HOW TO INSTALL THE LAUNCHING POST INTO BRIDGE.
- IN THE LAST TWO BAYS (BAY 23 OF THE 230FT SPAN AND BAY 1 OF THE 170FT SPAN) INSTALL (2) AB624 10FT SUPER HEAVY REINFORCING CHORDS IN THE BOTTOM OF THE BRIDGE ON THE OUTER TRUSS LINES ONLY. (8) AB624'S TO BE INSTALLED IN TOTAL.
- INSTALL TEMPORARY BLOCKING IN THE END BAYS AS SHOWN ON SHEET 3.
- ATTACH A MACHINE CAPABLE OF PUSHING 65,000 LBS. TO THE LAST TRANSOM OF THE BRIDGE. IN ADDITION ATTACH A PULLING MACHINE TO NOSE BAY N2 TO ASSIST IN KEEP THE BRIDGE IN ALIGNMENT DURING PUSHING.
- REMOVE THE TEMPORARY RESTRAINTS FROM THE BRIDGE.

DO NOT INSTALL GUARDRAIL POSTS AND STRUTS IN BAY 23 (SPAN 1) & BAY 1 (SPAN 2).

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ROBERT ALLEN ODDO
STATE OF UTAH

07/17/2019

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Acrow Corporation of America
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LAUNCHING SEQUENCE
400FT (2 SPANS 230FT-170FT) QDR4SH TRUSS
2LANE 30FT WIDE BRIDGE
I-80 BLACKROCK CMGC
BLACK ROCK, UT

DRAWN BY	AC	DATE MARCH 25, 2019	PROJECT No.
CHECKED BY	JB	SCALE: NTS	18-01-2286
APPROVED BY	JB		

GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030-LP
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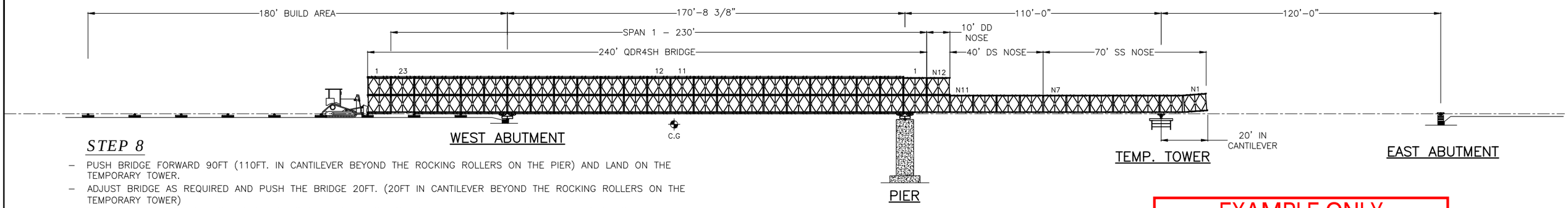
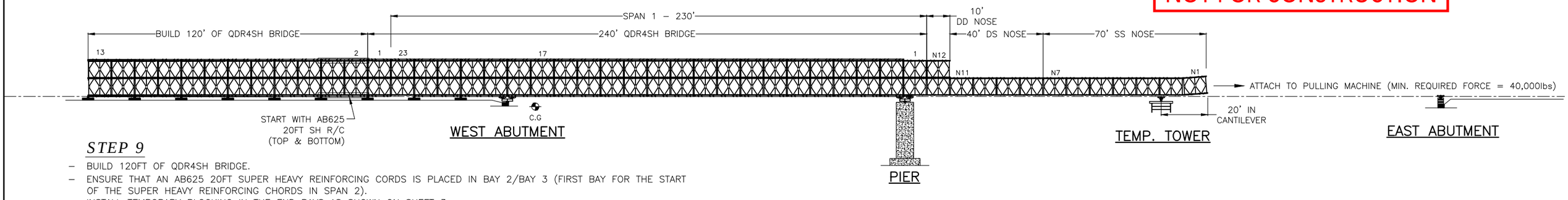
REV. 1



STEP 8

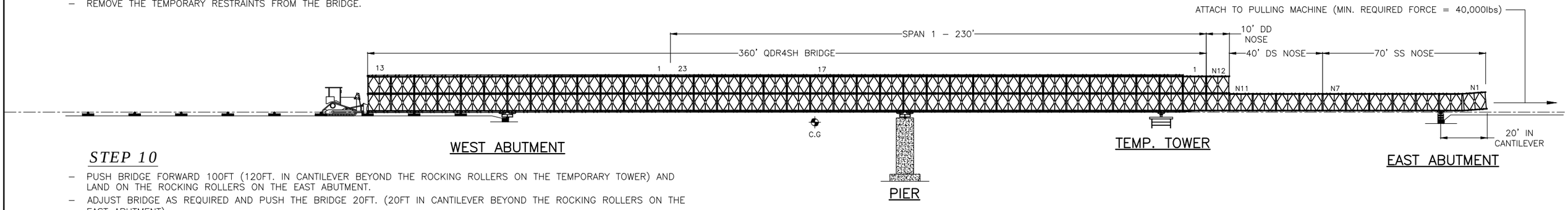
- PUSH BRIDGE FORWARD 90FT (110FT. IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE PIER) AND LAND ON THE TEMPORARY TOWER.
- ADJUST BRIDGE AS REQUIRED AND PUSH THE BRIDGE 20FT. (20FT IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE TEMPORARY TOWER)
- SECURE THE BRIDGE IN TWO DIRECTIONS TO A FIXED OBJECT TO PREVENT INADVERTENT MOVEMENT AND DETACH THE PUSHING MACHINE.
- REMOVE THE TEMPORARY BLOCKING FROM THE END OF THE BRIDGE

EXAMPLE ONLY
NOT FOR CONSTRUCTION



STEP 9

- BUILD 120FT OF QDR4SH BRIDGE.
- ENSURE THAT AN AB625 20FT SUPER HEAVY REINFORCING CORDS IS PLACED IN BAY 2/BAY 3 (FIRST BAY FOR THE START OF THE SUPER HEAVY REINFORCING CHORDS IN SPAN 2).
- INSTALL TEMPORARY BLOCKING IN THE END BAYS AS SHOWN ON SHEET 3.
- ATTACH A MACHINE CAPABLE OF PUSHING 93,000 LBS. TO THE LAST TRANSOM OF THE BRIDGE. IN ADDITION ATTACH A PULLING MACHINE TO NOSE BAY N2 TO ASSIST IN KEEP THE BRIDGE IN ALIGNMENT DURING PUSHING.
- REMOVE THE TEMPORARY RESTRAINTS FROM THE BRIDGE.



STEP 10

- PUSH BRIDGE FORWARD 100FT (120FT. IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE TEMPORARY TOWER) AND LAND ON THE ROCKING ROLLERS ON THE EAST ABUTMENT.
- ADJUST BRIDGE AS REQUIRED AND PUSH THE BRIDGE 20FT. (20FT IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE EAST ABUTMENT).
- SECURE THE BRIDGE IN TWO DIRECTIONS TO A FIXED OBJECT TO PREVENT INADVERTENT MOVEMENT AND DETACH THE PUSHING MACHINE.
- REMOVE THE TEMPORARY BLOCKING FROM THE END OF THE BRIDGE.

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SEAL

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Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

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2LANE 30FT WIDE BRIDGE
I–80 BLACKROCK CMGC
BLACK ROCK, UT

DRAWN BY	AC	DATE MARCH 25, 2019	PROJECT No.
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GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030–LP
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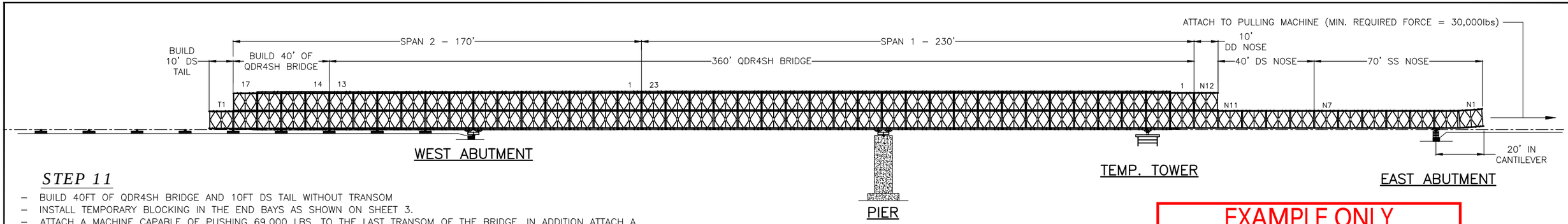
REV. 1



STEP 11

- BUILD 40FT OF QDR4SH BRIDGE AND 10FT DS TAIL WITHOUT TRANSOM
- INSTALL TEMPORARY BLOCKING IN THE END BAYS AS SHOWN ON SHEET 3.
- ATTACH A MACHINE CAPABLE OF PUSHING 69,000 LBS. TO THE LAST TRANSOM OF THE BRIDGE. IN ADDITION ATTACH A PULLING MACHINE TO NOSE BAY N2 TO ASSIST IN KEEP THE BRIDGE IN ALIGNMENT DURING PUSHING.
- REMOVE THE TEMPORARY RESTRAINTS FROM THE BRIDGE.

EXAMPLE ONLY
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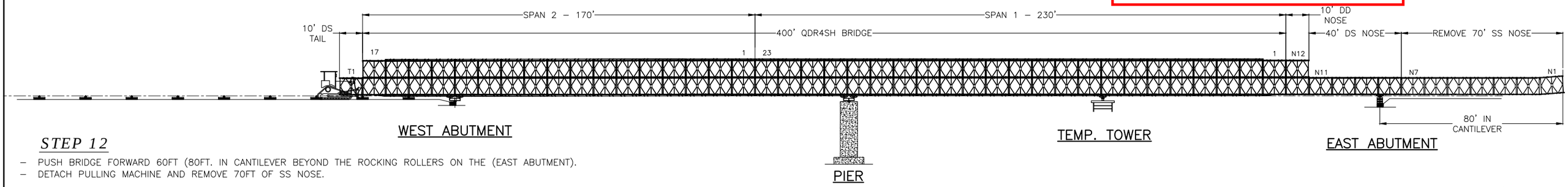
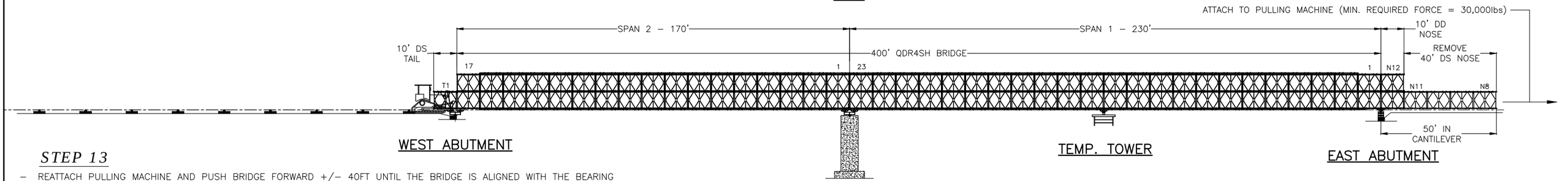


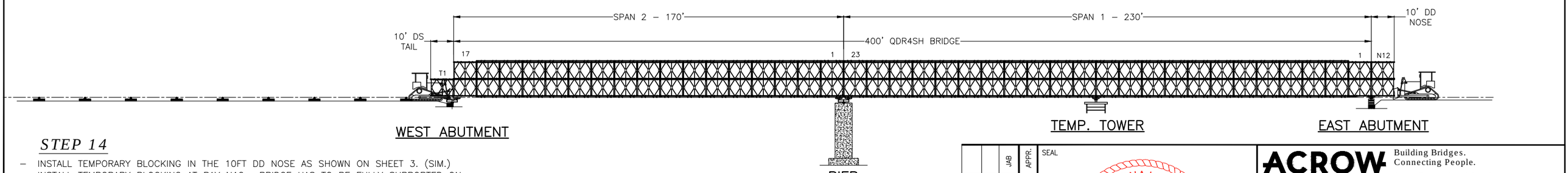
STEP 12

- PUSH BRIDGE FORWARD 60FT (80FT. IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE (EAST ABUTMENT).
- DETACH PULLING MACHINE AND REMOVE 70FT OF SS NOSE.



STEP 13

- REATTACH PULLING MACHINE AND PUSH BRIDGE FORWARD +/– 40FT UNTIL THE BRIDGE IS ALIGNED WITH THE BEARING LOCATIONS. (50FT. IN CANTILEVER BEYOND THE ROCKING ROLLERS ON THE EAST ABUTMENT).
- DETACH PULLING MACHINE AND REMOVE 40FT OF DS NOSE.



STEP 14

- INSTALL TEMPORARY BLOCKING IN THE 10FT DD NOSE AS SHOWN ON SHEET 3. (SIM.)
- INSTALL TEMPORARY BLOCKING AT BAY N12. BRIDGE HAS TO BE FULLY SUPPORTED ON BLOCKING BEFORE MOVING ONTO STEP 15. BLOCKING REQUIRED TO REDUCE LOAD ON ROCKING ROLLERS.
- ATTACH A MACHINE CAPABLE OF PULLING 53,000 LBS. TO THE 10FT DD NOSE AS SHOWN ON SHEET 3. (SIM.)

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SEAL

PROFESSIONAL ENGINEER
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ROBERT ALLEN ODDO
STATE OF UTAH

07/17/2019

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Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

LAUNCHING SEQUENCE
400FT (2 SPANS 230FT–170FT) QDR4SH TRUSS
2LANE 30FT WIDE BRIDGE
I–80 BLACKROCK CMGC
BLACK ROCK, UT

DRAWN BY	AC	DATE MARCH 25, 2019	PROJECT No.
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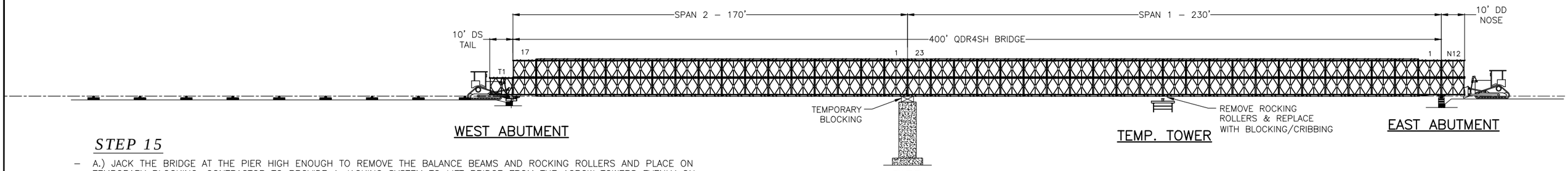
GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030–LP
REV. 1
SHT 7 OF 12

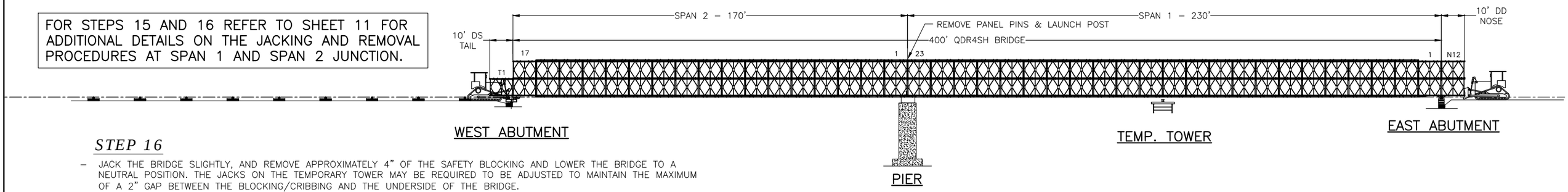


STEP 15

- A.) JACK THE BRIDGE AT THE PIER HIGH ENOUGH TO REMOVE THE BALANCE BEAMS AND ROCKING ROLLERS AND PLACE ON TEMPORARY BLOCKING. CONTRACTOR TO PROVIDE A JACKING SYSTEM TO LIFT BRIDGE FROM THE ACROW TOWERS EVENLY ON BOTH SIDES OF THE BRIDGE MAX. JACKING LOAD = 70 TONS.
- REMOVE THE ROCKING ROLLERS.
- B.) REMOVE THE (8) AB624 SUPER HEAVY REINFORCING CHORDS FROM THE OUTER TRUSS LINES ALONG WITH THE CHORD CONNECTOR CHANNEL. ONCE THE AB624'S ARE REMOVED, INSTALL ADDITIONAL SAFETY BLOCKING.
- LOWER JACKS ON THE TEMPORARY TOWERS, REMOVE THE ROCKING ROLLERS AND REPLACE WITH TEMPORARY BLOCKING/CRIBBING. THE TOP ON THE TEMPORARY BLOCKING TO BE APPROXIMATELY 2" BELOW THE BOTTOM OF THE BRIDGE CHORDS.

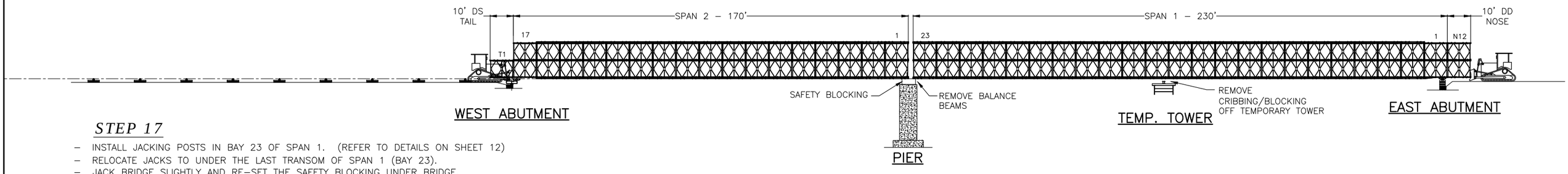
EXAMPLE ONLY
NOT FOR CONSTRUCTION

FOR STEPS 15 AND 16 REFER TO SHEET 11 FOR ADDITIONAL DETAILS ON THE JACKING AND REMOVAL PROCEDURES AT SPAN 1 AND SPAN 2 JUNCTION.



STEP 16

- JACK THE BRIDGE SLIGHTLY, AND REMOVE APPROXIMATELY 4" OF THE SAFETY BLOCKING AND LOWER THE BRIDGE TO A NEUTRAL POSITION. THE JACKS ON THE TEMPORARY TOWER MAY BE REQUIRED TO BE ADJUSTED TO MAINTAIN THE MAXIMUM OF A 2" GAP BETWEEN THE BLOCKING/CRIBBING AND THE UNDERSIDE OF THE BRIDGE.
- ONCE THE BRIDGE IS IN NEUTRAL POSITION, RE–INSTALL THE SAFETY BLOCKING.
- REMOVE THE PANEL PINS CONNECTING THE LAUNCHING POST TO SPAN 1 AND SPAN 2 AND REMOVE LAUNCHING POSTS. THE CONTRACTOR MAYBE REQUIRED TO JACK THE BRIDGE SLIGHTLY TO REMOVE THE LOAD OFF OF THE PINS TO ALLOW FOR THEIR REMOVAL.



STEP 17

- INSTALL JACKING POSTS IN BAY 23 OF SPAN 1. (REFER TO DETAILS ON SHEET 12)
- RELOCATE JACKS TO UNDER THE LAST TRANSOM OF SPAN 1 (BAY 23).
- JACK BRIDGE SLIGHTLY AND RE–SET THE SAFETY BLOCKING UNDER BRIDGE.
- REMOVE THE BALANCE BEAMS.
- LOWER THE SCREW JACKS ON THE TEMPORARY TOWERS, REMOVE THE TEMPORARY BLOCKING/CRIBBING TO PREVENT ANY INTERFERENCE DURING THE LOWERING OF SPAN 1.

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ROBERT ALLEN ODDO
STATE OF UT

07/17/2019

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Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

LAUNCHING SEQUENCE
400FT (2 SPANS 230FT–170FT) QDR4SH TRUSS
2LANE 30FT WIDE BRIDGE
I–80 BLACKROCK CMGC
BLACK ROCK, UT

DRAWN BY	AC	DATE MARCH 25, 2019	PROJECT No.
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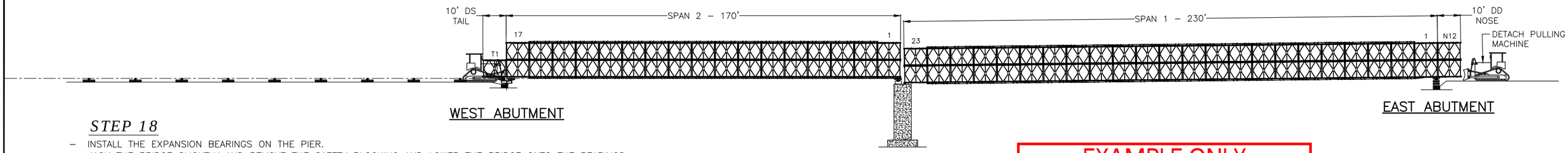
GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030–LP
SHT 8 OF 12
REV. 1



STEP 18

- INSTALL THE EXPANSION BEARINGS ON THE PIER.
- JACK THE BRIDGE SLIGHTLY AND REMOVE THE SAFETY BLOCKING AND LOWER THE BRIDGE ONTO THE BEARINGS.

STEP 19

- SECURE SPAN 1 IN TWO DIRECTIONS TO A FIXED OBJECT TO PREVENT INADVERTENT MOVEMENT AND DETACH THE PULLING MACHINE.

EXAMPLE ONLY
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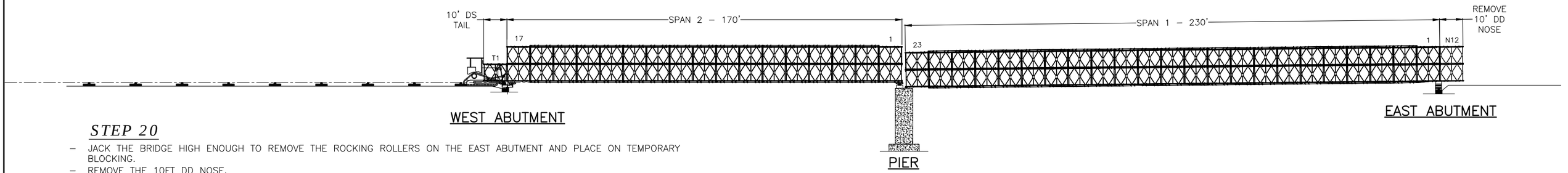
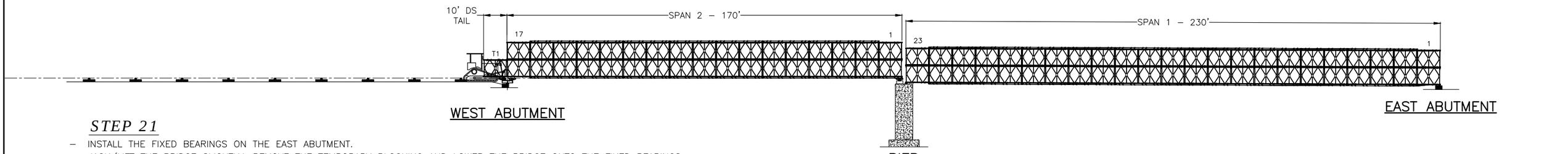


STEP 20

- JACK THE BRIDGE HIGH ENOUGH TO REMOVE THE ROCKING ROLLERS ON THE EAST ABUTMENT AND PLACE ON TEMPORARY BLOCKING.
- REMOVE THE 10FT DD NOSE.
- REMOVE THE ROCKING ROLLERS AND ANY ASSOCIATED CRIBBING/BLOCKING.

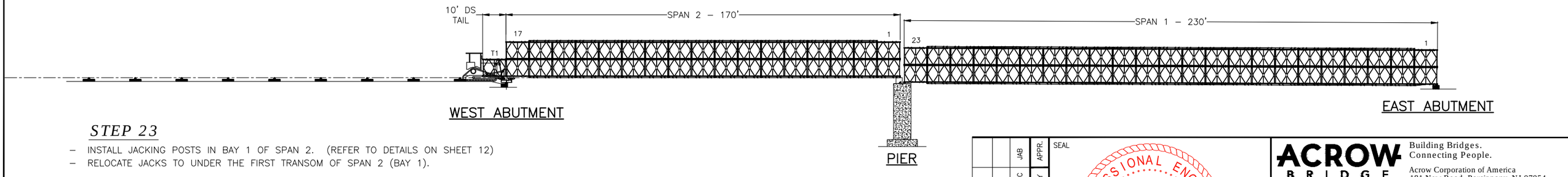


STEP 21

- INSTALL THE FIXED BEARINGS ON THE EAST ABUTMENT.
- JACK/LIFT THE BRIDGE SLIGHTLY, REMOVE THE TEMPORARY BLOCKING AND LOWER THE BRIDGE ONTO THE FIXED BEARINGS.

STEP 22

- INSTALL THE DECK ONTO THE BRIDGE TO ALLOW ACCESS TO INSTALL SPAN 2.
- REMOVE JACKING POSTS FROM BAY 23 AND REINSTALL THE AB703 RAKERS AND AB513 RAKER BRACES.



STEP 23

- INSTALL JACKING POSTS IN BAY 1 OF SPAN 2. (REFER TO DETAILS ON SHEET 12)
- RELOCATE JACKS TO UNDER THE FIRST TRANSOM OF SPAN 2 (BAY 1).

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GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030–LP
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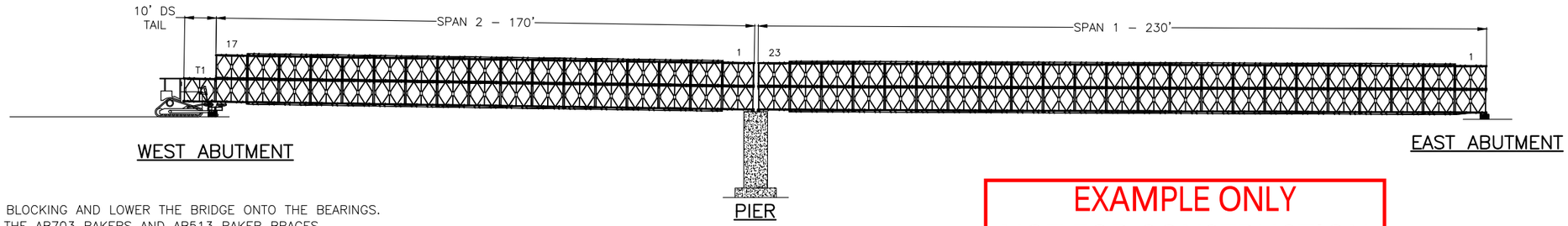
REV. 1



STEP 24

- INSTALL THE EXPANSION BEARINGS ON THE PIER.
- JACK THE BRIDGE SLIGHTLY AND REMOVE THE SAFETY BLOCKING AND LOWER THE BRIDGE ONTO THE BEARINGS.
- REMOVE JACKING POSTS FROM BAY 1 AND REINSTALL THE AB703 RAKERS AND AB513 RAKER BRACES.

EXAMPLE ONLY
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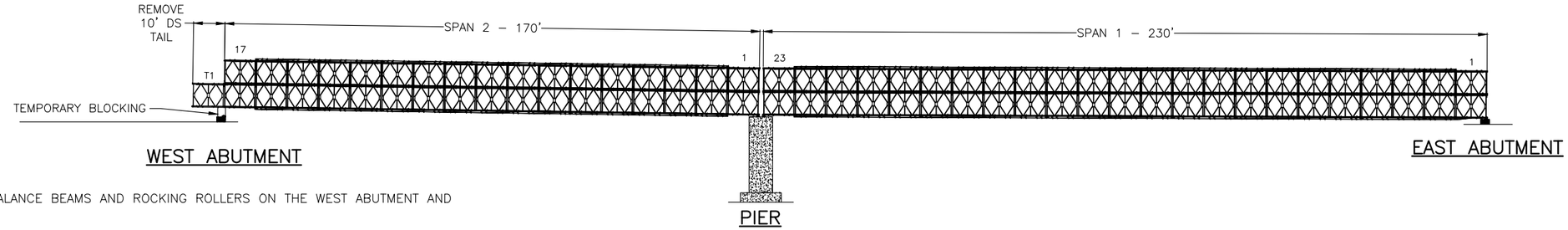
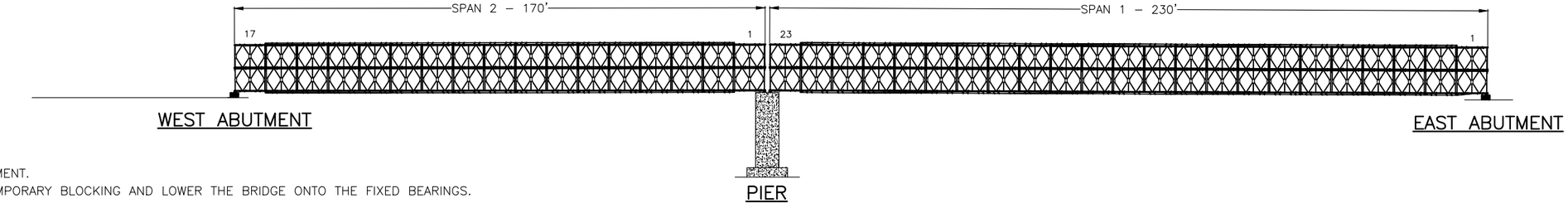
STEP 25

- SECURE SPAN 2 IN TWO DIRECTIONS TO A FIXED OBJECT TO PREVENT INADVERTENT MOVEMENT AND DETACH THE PUSHING MACHINE.



STEP 26

- JACK THE BRIDGE HIGH ENOUGH TO REMOVE THE BALANCE BEAMS AND ROCKING ROLLERS ON THE WEST ABUTMENT AND PLACE ON TEMPORARY BLOCKING.
- REMOVE THE 10FT DS TAIL.
- REMOVE THE BALANCE BEAMS, ROCKING ROLLERS AND ANY ASSOCIATED CRIBBING/BLOCKING.

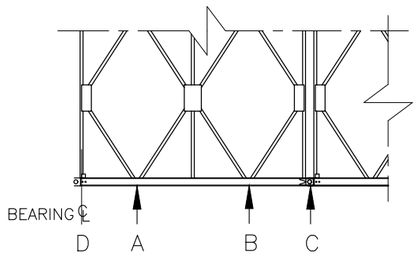


STEP 27

- INSTALL THE FIXED BEARINGS ON THE WEST ABUTMENT.
- JACK/LIFT THE BRIDGE SLIGHTLY, REMOVE THE TEMPORARY BLOCKING AND LOWER THE BRIDGE ONTO THE FIXED BEARINGS.

STEP 28

- INSTALL THE DECK IN SPAN 2
- INSTALL THE GUARDRAIL AND ASPHALT OVERLAY.



ACCEPTABLE JACKING OR BLOCKING POSITIONS
(ONLY AT POSITION A, B, C OR D)

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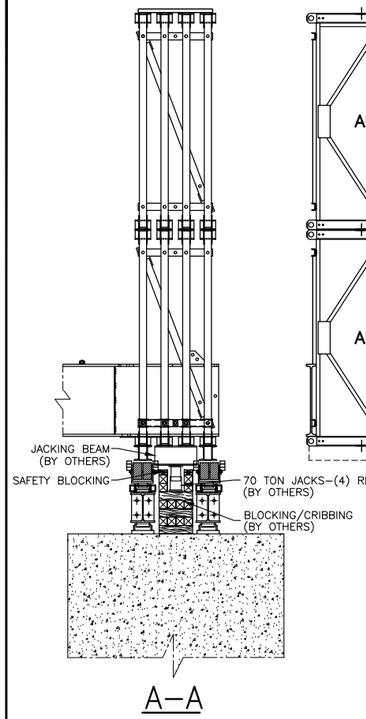
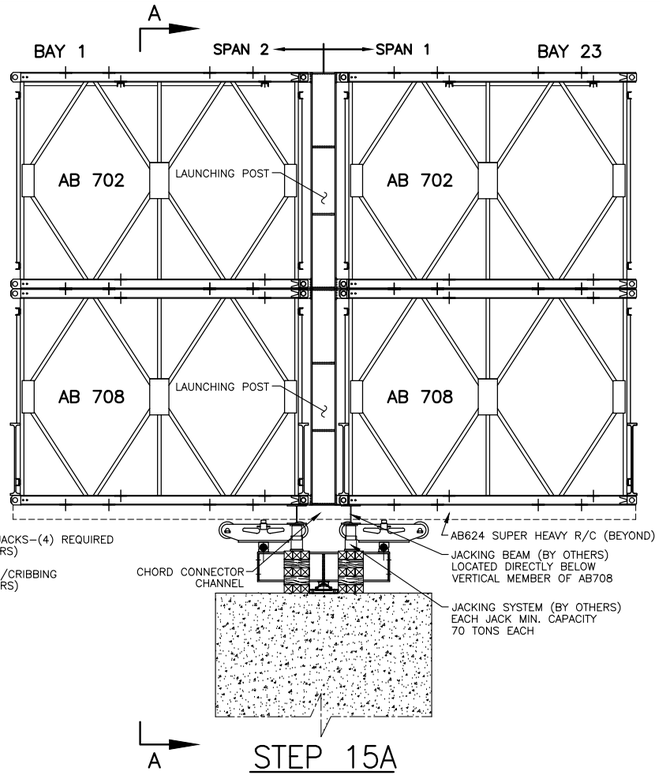
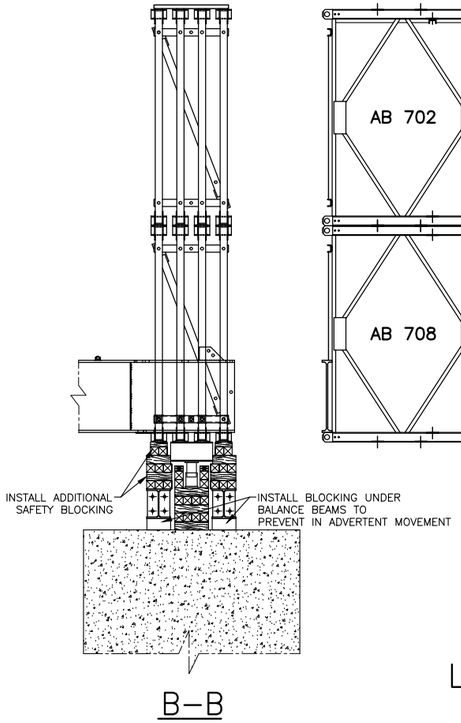
SHT 10 OF 12
REV. 1



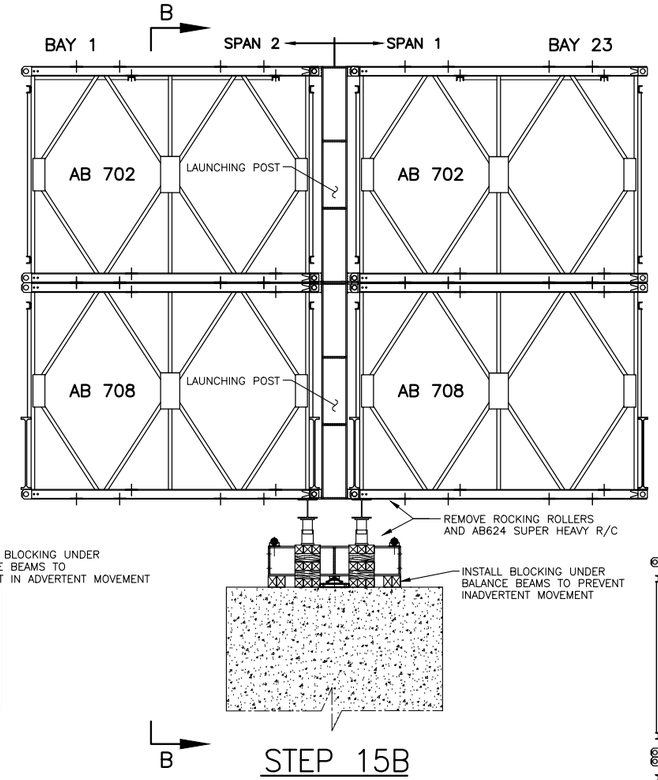
A–A



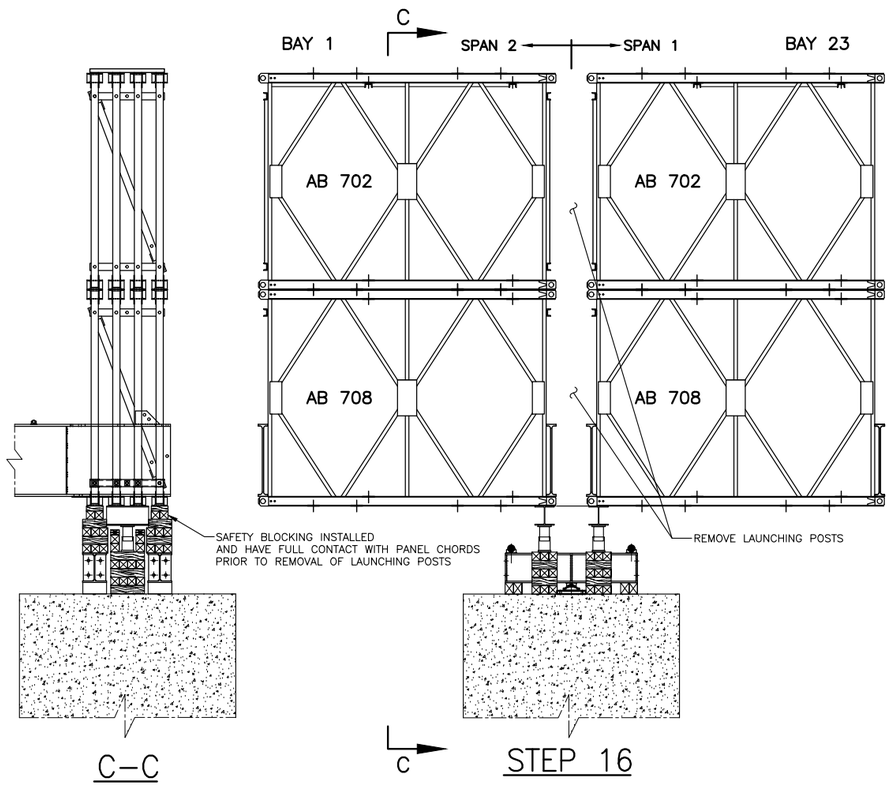
STEP 15A



B–B



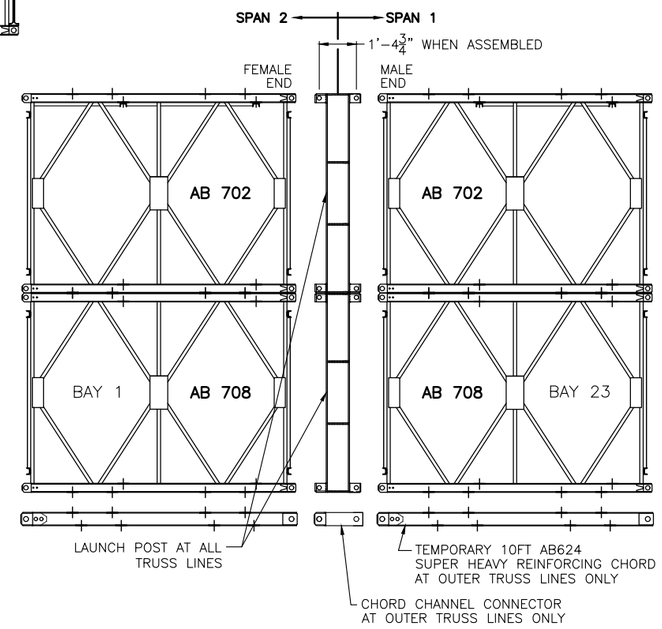
STEP 15B



C–C

STEP 16

EXAMPLE ONLY
NOT FOR CONSTRUCTION



LAUNCHING POST CONNECTION DETAIL

REV.	DATE	DESCRIPTION	BY	APPR.
1	6/27 2019	REVISE ACROW TOWER TO CONCRETE PIER	AC	JAB

SEAL

PROFESSIONAL ENGINEER
No. 5237822
ROBERT ALLEN ODDO
STATE OF UTAH

07/17/2019

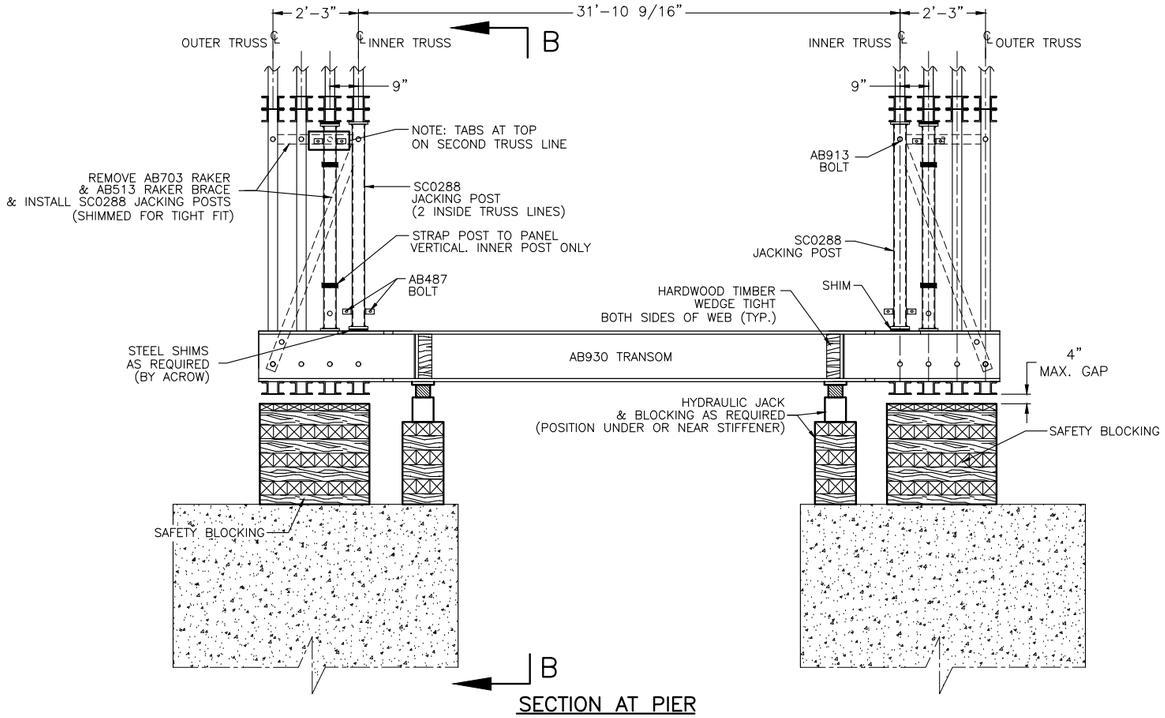
ACROW BRIDGE
Building Bridges. Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

LAUNCHING POST DETAILS
400FT (2 SPANS 230FT–170FT) QDR4SH TRUSS
2LANE 30FT WIDE BRIDGE
I–80 BLACKROCK CMGC
BLACK ROCK, UT

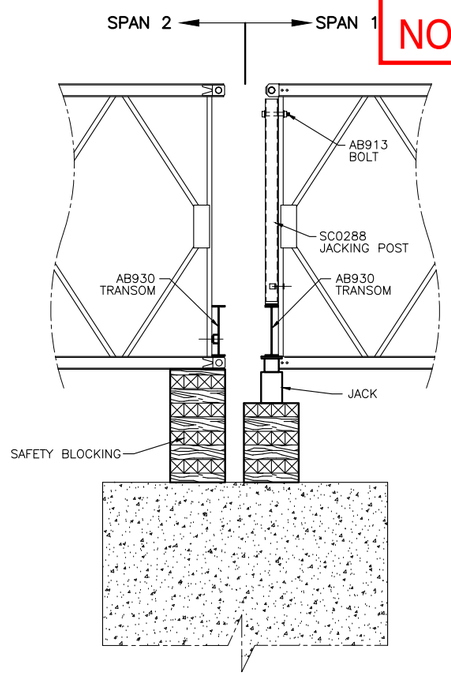
DRAWN BY	AC	DATE MARCH 25, 2019	PROJECT No.
CHECKED BY	JB	SCALE: NTS	18–01–2286
APPROVED BY	JB		

GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030–LP
SHT 11 OF 12
REV. 1



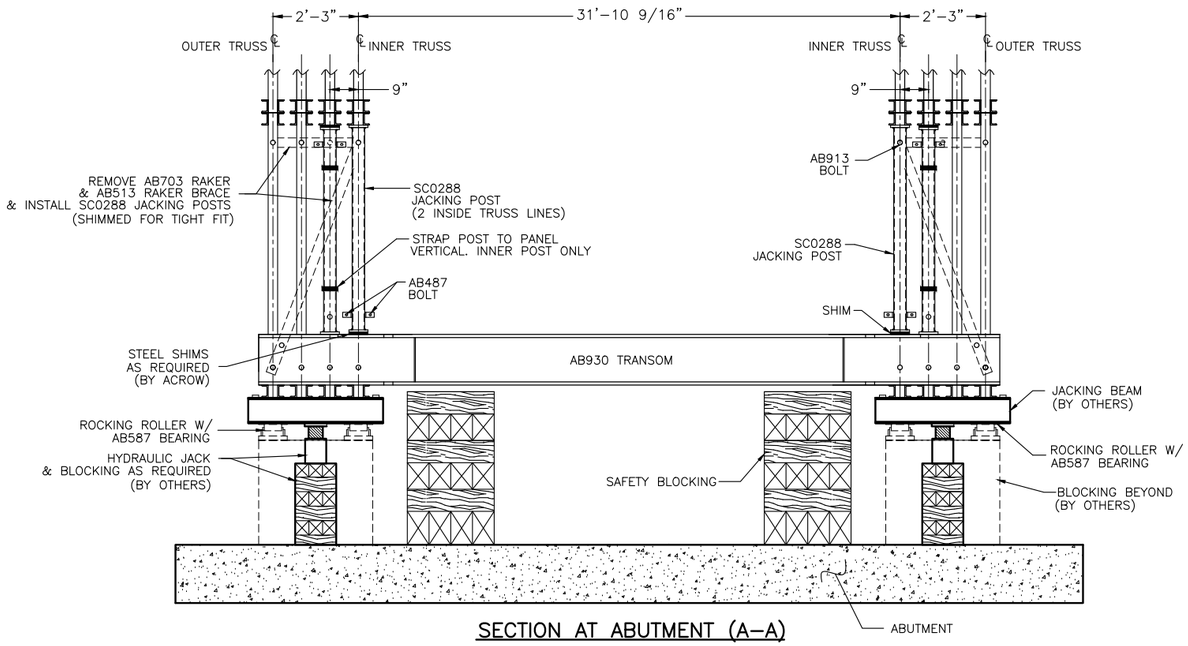
SECTION AT PIER



ELEVATION AT PIER (B–B)

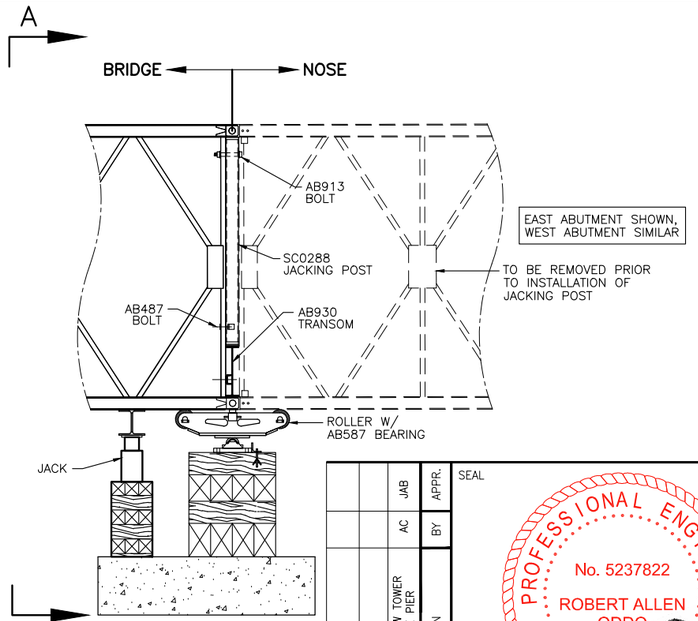
EXAMPLE ONLY
NOT FOR CONSTRUCTION

JACKING LOAD ~ 70 TONS PER CORNER



SECTION AT ABUTMENT (A–A)

JACKING LOAD ~ 70 TONS PER CORNER



A ELEVATION AT ABUTMENT

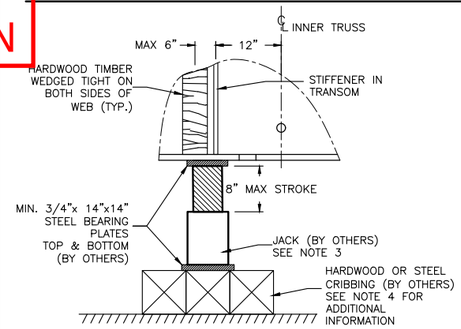
REV.	DATE	DESCRIPTION	BY	APPR.
1	6/27/2019	REVISE ACROW TOWER TO CONCRETE PIER	AC	JAB

SEAL

PROFESSIONAL ENGINEER
No. 5237822
ROBERT ALLEN ODDO
STATE OF UTAH

07/17/2019

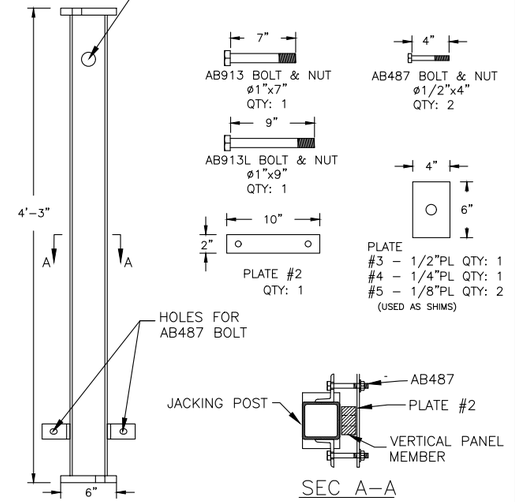
TYPICAL JACK DETAIL



NOTES

1. JACK STROKE NOT TO EXCEED 8"
2. JACKS TO HAVE SWIVEL TYPE HEADS TO ALLOW EVEN LOADING ON THE JACK
3. JACKS TO HAVE THE MINIMUM LIFTING CAPACITY AS INDICATED ON THE DRAWINGS
4. ALL HARDWOOD OR STEEL CRIBBING USED AS PART OF THE JACKING PROCEDURE IS TO BE DESIGNED & PROVIDED BY OTHERS. CRIBBING MUST BE SECURED TO THE CAP BEAM OR ABUTMENT TO PREVENT INADVERTENT MOVEMENT DURING JACKING. MIN. ALLOW. CAPACITY OF CRIBBING IS ⊥625 psi PERPENDICULAR TO GRAIN

JACKING POST DETAIL



SEC A–A

ACROW BRIDGE
Building Bridges. Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

JACKING LOCATION & DETAILS
400FT (2 SPANS 230FT–170FT) QDR4SH TRUSS
2LANE 30FT WIDE BRIDGE
I-80 BLACKROCK CMGC
BLACK ROCK, UT

DRAWN BY	AC	DATE MARCH 25, 2019	PROJECT No.
CHECKED BY	JB	SCALE: NTS	18-01-2286
APPROVED BY	JB		

GRANITE CONSTRUCTION, INC.
SALT LAKE CITY, UT

DRAWING NO. AB2030-LP
SHT 12 OF 12
REV. 1

ACROW 700XS PANEL BRIDGE

190FT (3 SPANS 40-110-40) 2 LANE 30FT BRIDGE
NCDOT PROJECT
US 29 OVER NORFOLK SOUTHERN
RAILROAD BRIDGE REPLACEMENT

EXAMPLE ONLY
NOT FOR CONSTRUCTION

N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
STRUCTURES MANAGEMENT UNIT
✓ ACCEPTED
ACCEPTED AS NOTED
RETURNED FOR CORRECTIONS
SEE EMAIL
BY: SRM
DATE: April 13, 2017

NORTH CAROLINA PROFESSIONAL SEAL 031428 ENGINEER DONALD J. VAN GERVE
4/6/17

TABLE OF CONTENTS

ACROW BRIDGE
Building Bridges.
Connecting People.

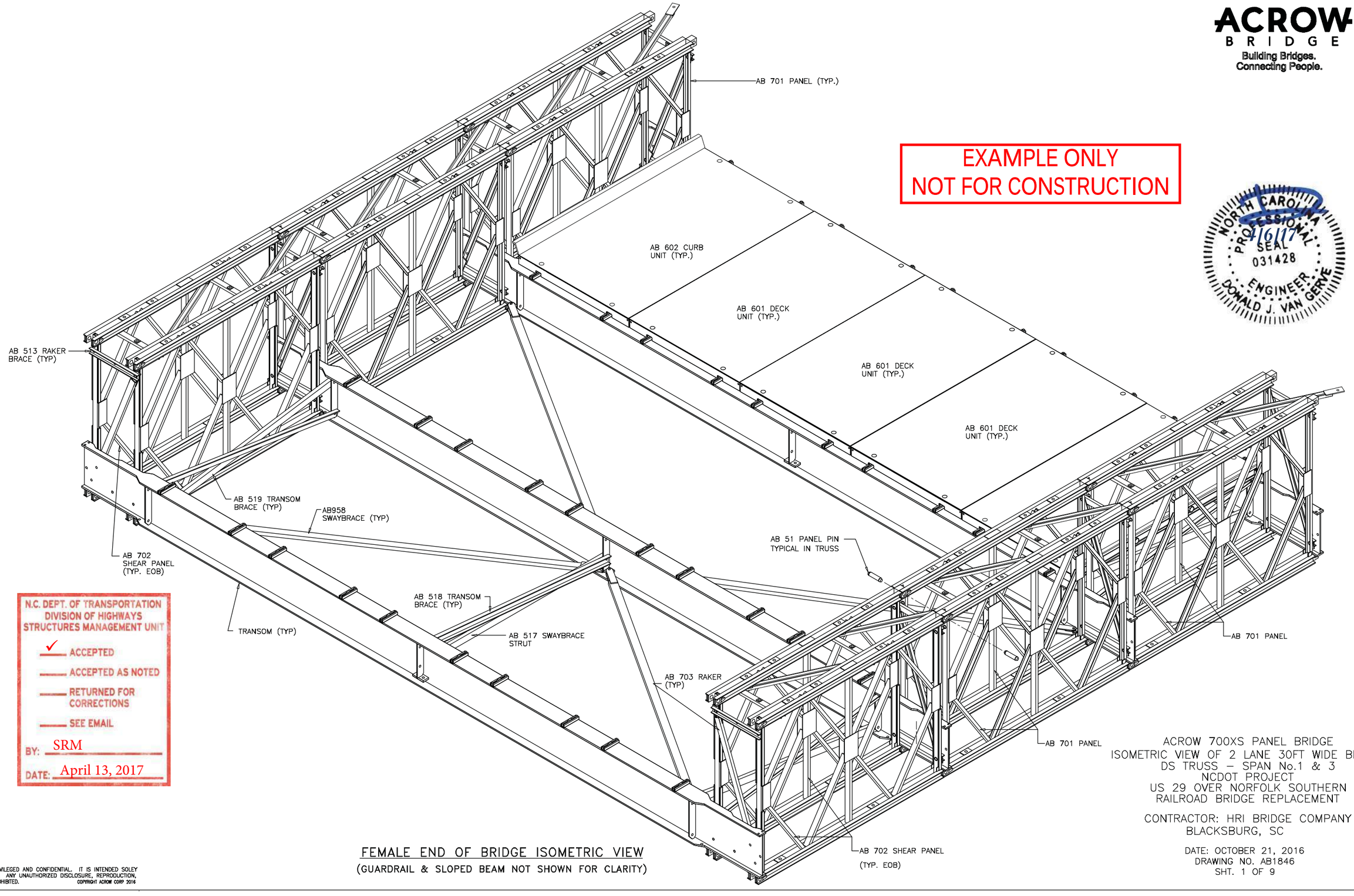
ACROW CORPORATION

DATE: OCTOBER 21, 2014

ACROW BRIDGE
Building Bridges.
Connecting People.

EXAMPLE ONLY
NOT FOR CONSTRUCTION

NORTH CAROLINA PROFESSIONAL SEAL 031428 ENGINEER DONALD J. VAN GERVE 4/6/17



N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
STRUCTURES MANAGEMENT UNIT

✓ ACCEPTED
____ ACCEPTED AS NOTED
____ RETURNED FOR CORRECTIONS
____ SEE EMAIL

BY: SRM
DATE: April 13, 2017

FEMALE END OF BRIDGE ISOMETRIC VIEW
(GUARDRAIL & SLOPED BEAM NOT SHOWN FOR CLARITY)

ACROW 700XS PANEL BRIDGE
ISOMETRIC VIEW OF 2 LANE 30FT WIDE BRIDGE
DS TRUSS – SPAN No.1 & 3
NCDOT PROJECT
US 29 OVER NORFOLK SOUTHERN
RAILROAD BRIDGE REPLACEMENT

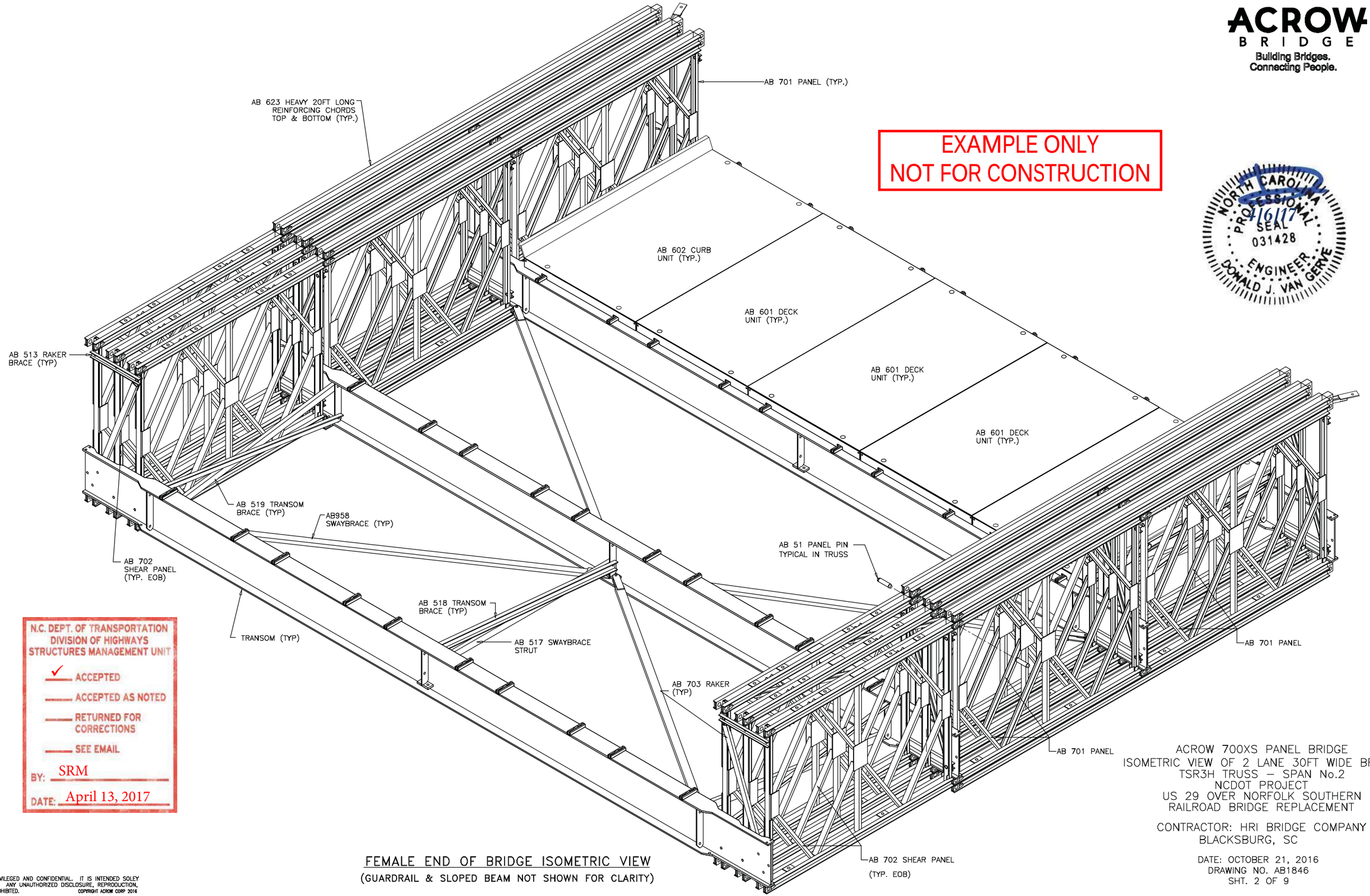
CONTRACTOR: HRI BRIDGE COMPANY
BLACKSBURG, SC

DATE: OCTOBER 21, 2016
DRAWING NO. AB1846
SHT. 1 OF 9

ACROW BRIDGE
Building Bridges.
Connecting People.

EXAMPLE ONLY
NOT FOR CONSTRUCTION

NORTH CAROLINA PROFESSIONAL SEAL 031428 ENGINEER DONALD J. VAN GERVE
4/6/17



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DIVISION OF HIGHWAYS
STRUCTURES MANAGEMENT UNIT

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____ ACCEPTED AS NOTED
____ RETURNED FOR CORRECTIONS
____ SEE EMAIL

BY: SRM
DATE: April 13, 2017

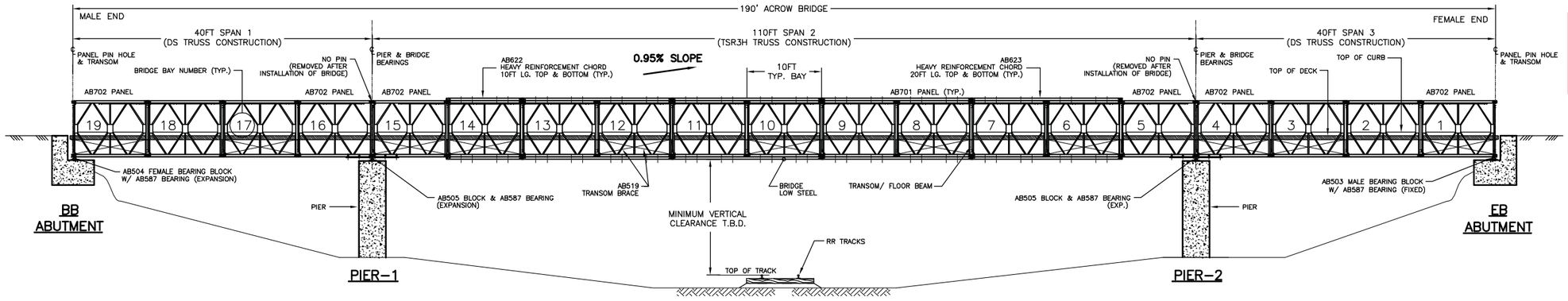
FEMALE END OF BRIDGE ISOMETRIC VIEW
(GUARDRAIL & SLOPED BEAM NOT SHOWN FOR CLARITY)

ACROW 700XS PANEL BRIDGE
ISOMETRIC VIEW OF 2 LANE 30FT WIDE BRIDGE
TSR3H TRUSS – SPAN No.2
NCDOT PROJECT
US 29 OVER NORFOLK SOUTHERN
RAILROAD BRIDGE REPLACEMENT

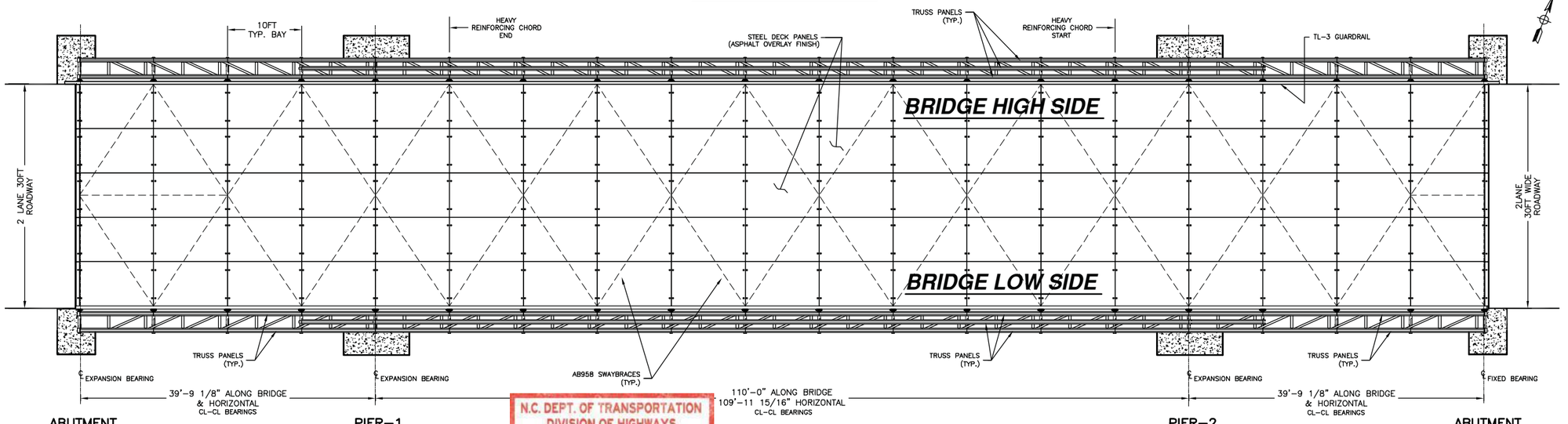
CONTRACTOR: HRI BRIDGE COMPANY
BLACKSBURG, SC

DATE: OCTOBER 21, 2016
DRAWING NO. AB1846
SHT. 2 OF 9

EXAMPLE ONLY
NOT FOR CONSTRUCTION



ELEVATION VIEW



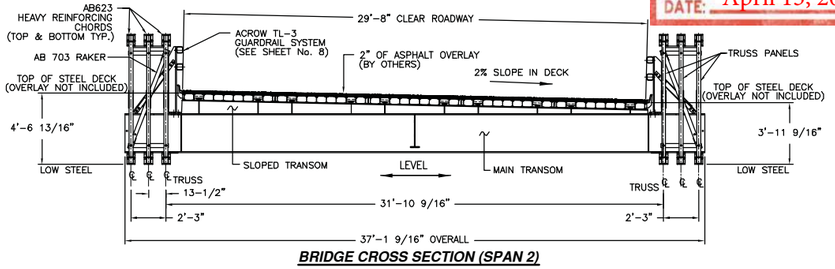
PLAN

SHAPE OF DIAGONALS

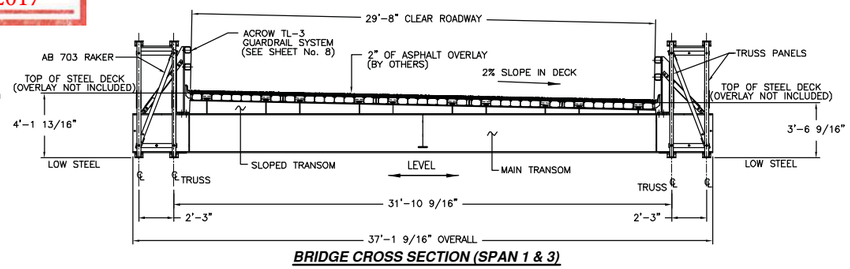
AB701 PANELS – CHANNELS

AB702 PANELS – TUBES

ACROW PANEL



BRIDGE CROSS SECTION (SPAN 2)



BRIDGE CROSS SECTION (SPAN 1 & 3)

N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
STRUCTURES MANAGEMENT UNIT

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ACCEPTED AS NOTED

RETURNED FOR CORRECTIONS

SEE EMAIL

BY: SRM

DATE: April 13, 2017

GENERAL NOTES

AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 7TH EDITION, 2014 WITH 2015 INTERIM REVISIONS

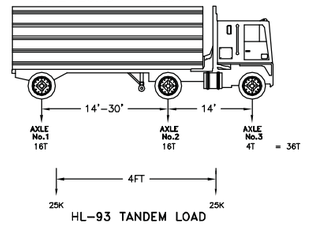
LIVE LOAD
2 LANES HL–93
TRUCK 1, 2, 3, 4 & 5 – SEE TABLE BELOW
TL–3 GUARDRAIL

DEAD LOAD
2" OF ASPHALT OVERLAY (BY OTHERS)
TL–3 GUARDRAIL

BRIDGE
(A) PANEL CHORDS, DIAGONALS & VERTICALS, PANEL PANEL RAKER
AASHTO M223 Gd 65
(B) DECKING, TRANSOM, SWAYBRACE, TRANSOM BRACE, RAKER BRACE, TOP CHORD BRACE, DIAGONAL BRACE
AASHTO M223 Gd 50
(C) PANEL PINS
ASTM A 193 Gd B7
(D) BOLTS
AASHTO M164 – A325

FINISH
ALL MAJOR COMPONENTS GALVANIZED TO AASHTO M111–ASTM A123
ALL BOLTS, ARE HOT DIPPED GALVANIZED.
PINS ARE ELECTRO GALVANIZED.

DIAGRAMS OF DESIGN LIVE LOAD – HL93



LANE LOAD = .64KLF/ LANE

TRUCK No.1			TRUCK No.2			TRUCK No.3			TRUCK No.4			TRUCK No.5		
AXLE	P (k)	DISTANCE (ft)	AXLE	P (k)	DISTANCE (ft)	AXLE	P (k)	DISTANCE (ft)	AXLE	P (k)	DISTANCE (ft)	AXLE	P (k)	DISTANCE (ft)
1	12.00	0.00	1	12.00	0.00	1	4.50	0.00	1	12.00	0.00	1	14.00	0.00
2	20.00	8.08	2	20.00	8.08	2	25.00	8.08	2	20.00	15.00	2	25.00	15.00
3	20.00	4.00	3	20.00	4.00	3	25.00	4.00	3	20.00	4.00	3	25.00	4.00
4	20.00	4.00	4	20.00	4.00	4	20.00	18.00	4	20.00	4.00	4	17.00	20.00
5	16.67	20.00	5	18.00	18.00	5	20.00	4.00	5	20.00	20.00	5	17.00	4.00
6	16.67	4.00	6	18.00	4.00				6	20.00	4.00	6	17.00	4.00
7	16.66	4.00							7	20.00	4.00	7	17.00	4.00

REV.	DATE	DESCRIPTION	BY	APPR.

SEAL

ACROW BRIDGE
Building Bridges. Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

ACROW 700XS PANEL BRIDGE
GENERAL PLAN, ELEVATION & SECTIONS
190FT (3 SPANS 40–110–40) 2LANE 30FT BRIDGE
NCDOT PROJECT
US 29 OVER NORFOLK SOUTHERN
RAILROAD BRIDGE REPLACEMENT

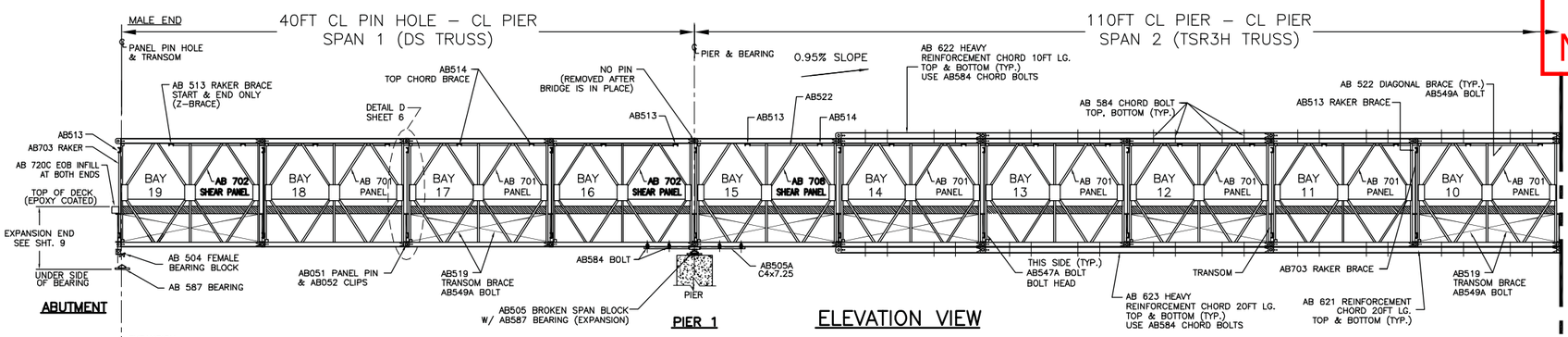
DRAWN BY	RJ	DATE OCTOBER 21, 2016	CONTRACT NO.
CHECKED BY	LP	SCALE: N.T.S.	
APPROVED BY	JAB		

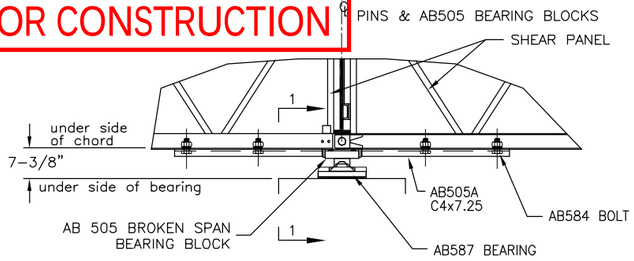
HRI BRIDGE COMPANY
BLACKSBURG, SC

DRAWING NO. AB1846 REV.

SHT 3 OF 9

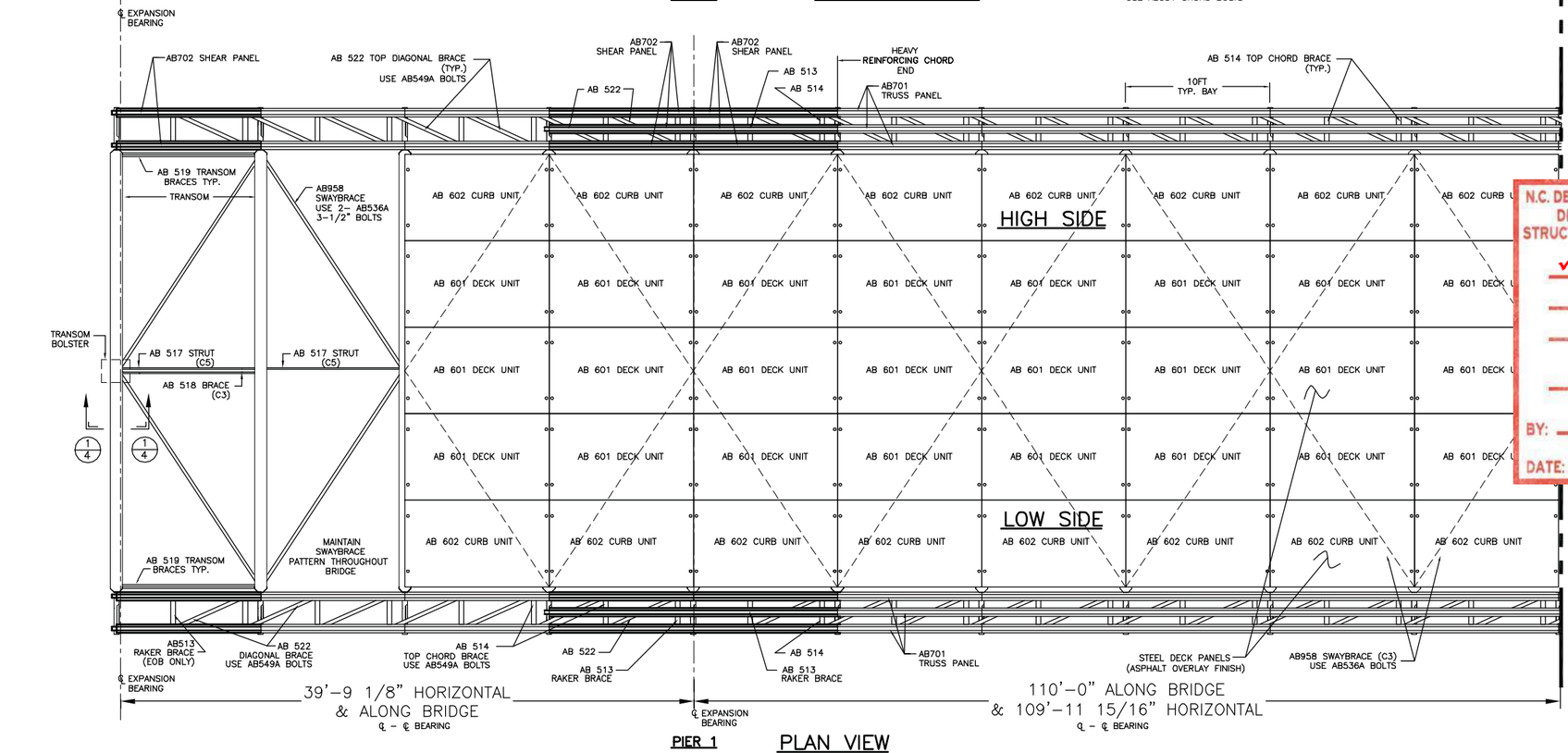
EXAMPLE ONLY
NOT FOR CONSTRUCTION





AB505 CONNECTION DETAIL (PIER 2)
SCALE: N.T.S.
(TYPICAL BOTH SIDES OF BRIDGE)

NOTE:
AB505 & AB587 BEARING ASSEMBLY MUST BE CENTERED UNDER PANEL PIN. POSITION ON PIER MAY VARY.



NORTH

N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
STRUCTURES MANAGEMENT UNIT
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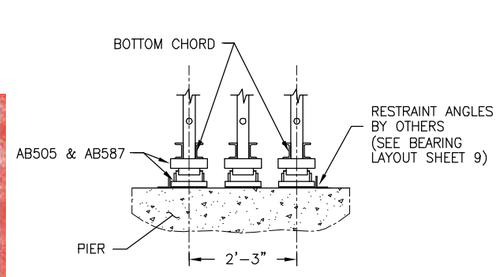
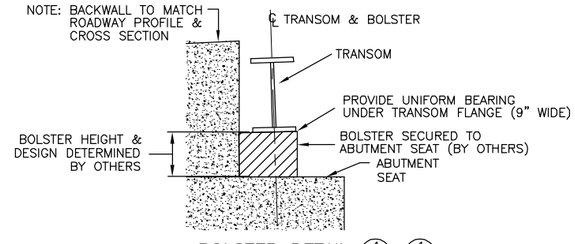
RETURNED FOR CORRECTIONS
SEE EMAIL
BY: SRM
DATE: April 13, 2017



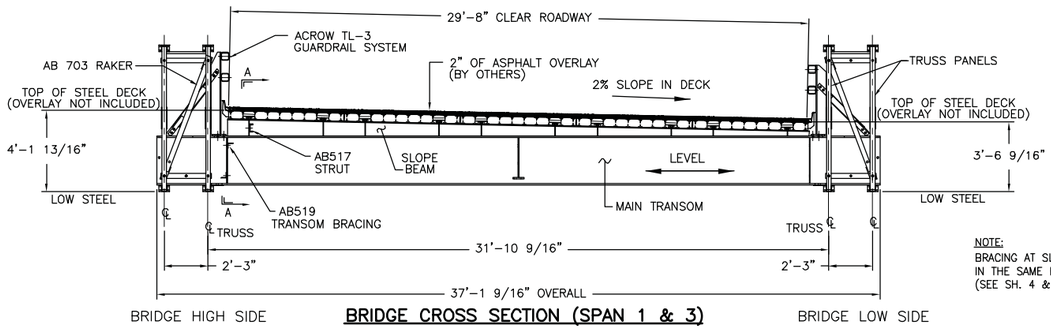
SECTION 1–1
SCALE: N.T.S.

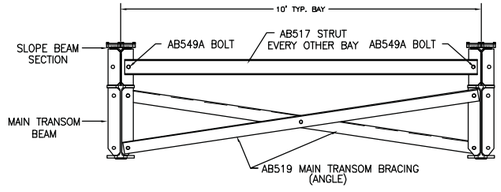
NOTE:
INSTALL BOLSTER AFTER BRIDGE, DECK PANELS & OVERLAY ARE IN PLACE



BOLSTER DETAIL (1/4)-(1/4)
SCALE: N.T.S.

NOTE:
- **BOLSTER TO BE SECURED FROM MOVEMENT AFTER INSTALLATION**
- **BOLSTER TO MATCH SLOPE OF TRANSOM FLANGE**





SECTION A–A
(INSTALLED IN SAME BAYS AS MAIN TRANSOM BRACING)
(DECK NOT SHOWN)

NOTE:
BRACING AT SLOPED BEAM INSTALLED IN THE SAME BAYS AS MAIN TRANSOM BRACING. (SEE SH. 4 & 5 FOR LOCATION)

REV.	DATE	DESCRIPTION	BY	APPR.

SEAL
NORTH CAROLINA PROFESSIONAL SEAL 031428 ENGINEER DONALD J. VAN GERE
4/6/17

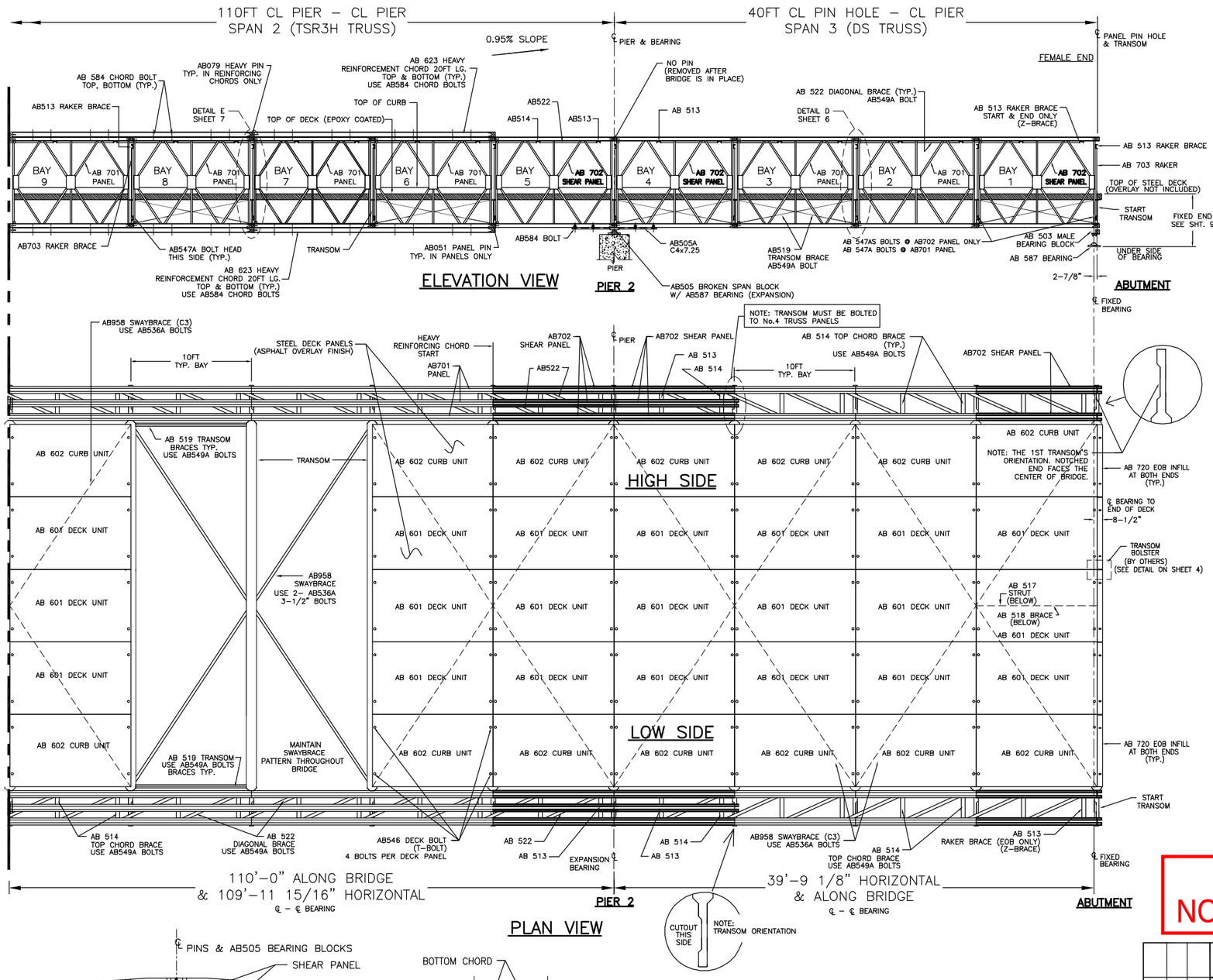
ACROW BRIDGE
Building Bridges. Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

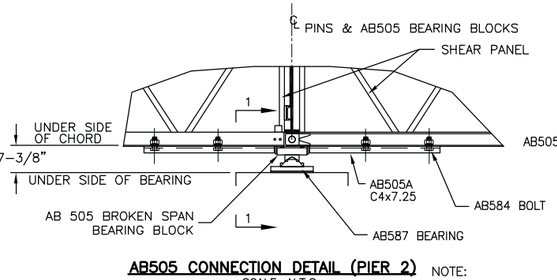
ACROW 700XS PANEL BRIDGE
PLAN & ELEVATION
190FT (3 SPANS 40–110–40) 2LANE 30FT BRIDGE
NCDOT PROJECT
US 29 OVER NORFOLK SOUTHERN
RAILROAD BRIDGE REPLACEMENT

DRAWN BY	RJ	DATE OCTOBER 21, 2016	CONTRACT NO.
CHECKED BY	LP	SCALE: N.T.S.	
APPROVED BY	JAB		

HRI BRIDGE COMPANY
BLACKSBURG, SC

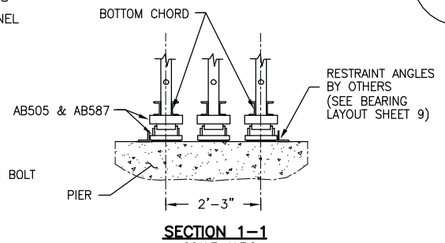
DRAWING NO. AB1846 REV.
SHT 4 OF 9





AB505 CONNECTION DETAIL (PIER 2)
SCALE: N.T.S.
(TYPICAL BOTH SIDES OF BRIDGE)

NOTE:
AB505 & AB587 BEARING ASSEMBLY MUST BE CENTERED UNDER PANEL PIN. POSITION ON PIER MAY VARY.

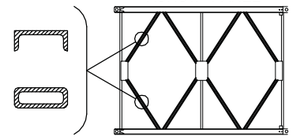


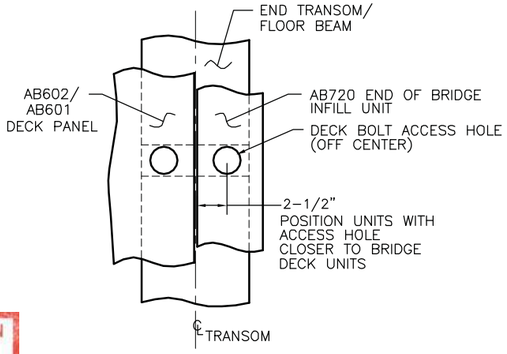
SECTION 1–1
SCALE: N.T.S.

SHAPE OF DIAGONALS

AB701 PANELS – CHANNELS

AB702 PANELS – TUBES





AB720 TYP. END DETAIL
PLAN VIEW
SCALE: N.T.S.

NORTH

N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
STRUCTURES MANAGEMENT UNIT
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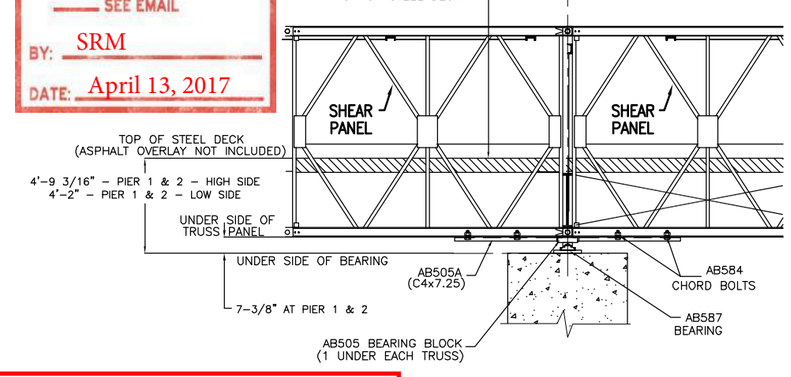

DETAIL AT PIER

EXAMPLE ONLY
NOT FOR CONSTRUCTION

	APPR.	BY	DESCRIPTION	DATE	REV.

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 031428 ENGINEER DONALD J. VAN GERVE 4/6/17

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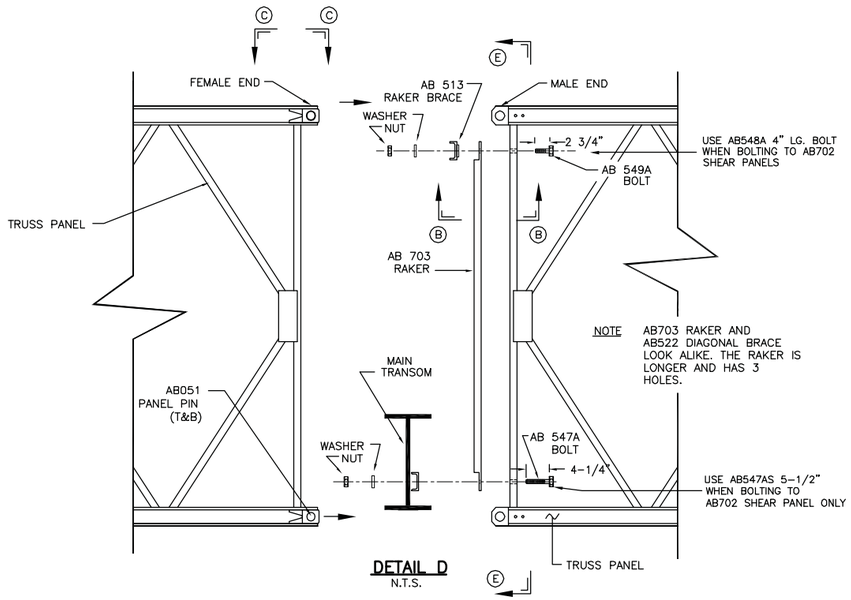
NCDOT PROJECT
US 29 OVER NORFOLK SOUTHERN
RAILROAD BRIDGE REPLACEMENT

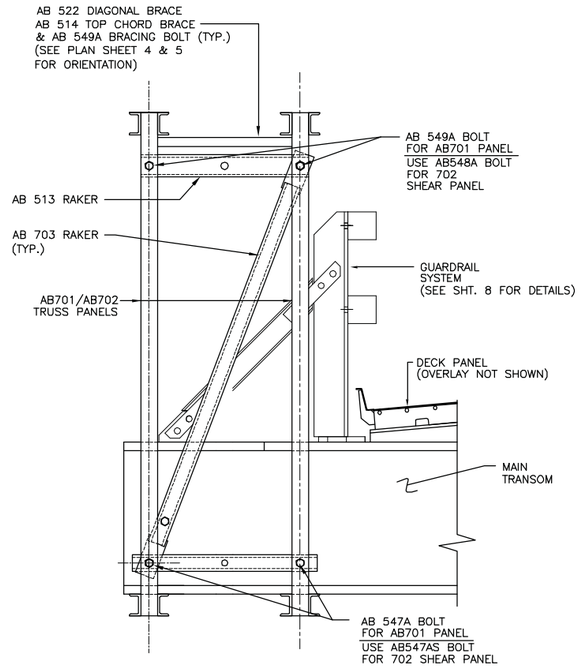
DRAWN BY	RJ	DATE OCTOBER 21, 2016	CONTRACT NO.
CHECKED BY	LP	SCALE: N.T.S.	
APPROVED BY	JAB		

HRI BRIDGE COMPANY
BLACKSBURG, SC

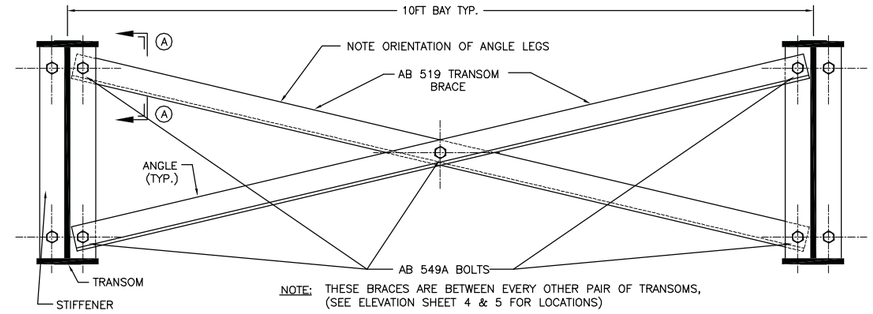
DRAWING NO. AB1846 REV.
SHT 5 OF 9



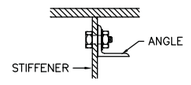
DETAIL D
N.T.S.



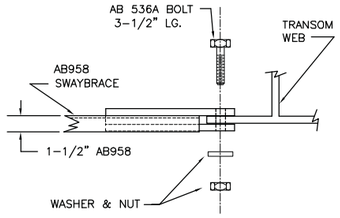
SECTION E–E
BOLT LOCATIONS
N.T.S.



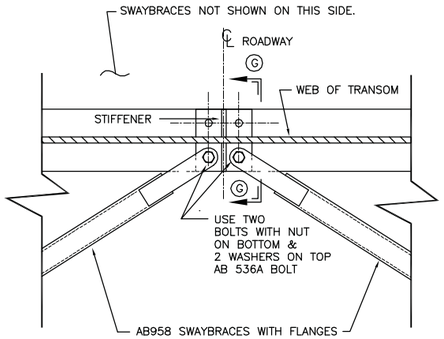
DETAIL – TRANSOM BRACES
N.T.S.



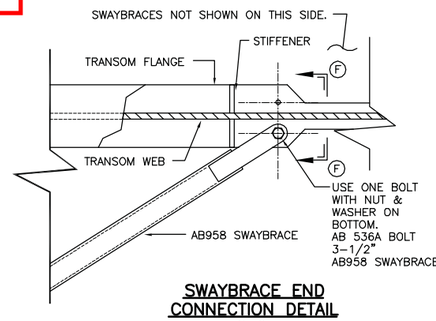
SECTION A–A



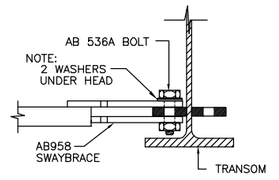
SECTION F–F
N.T.S.



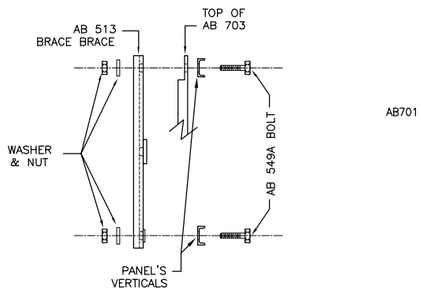
SWAYBRACE CENTER CONNECTION DETAIL
N.T.S.



SWAYBRACE END
CONNECTION DETAIL
N.T.S.



SECTION G–G
SWAYBRACE CONNECTION DETAIL
AT CENTER POINT
N.T.S.



SECTION B–B
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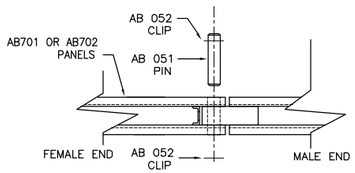
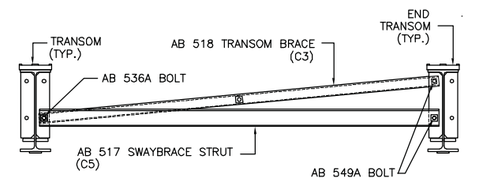
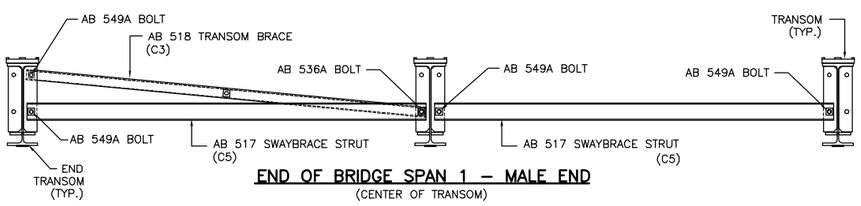


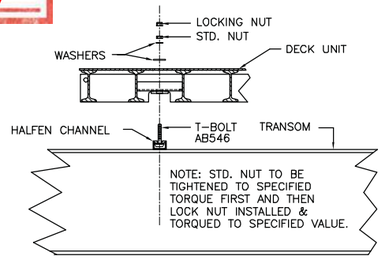
SECTION C–C
N.T.S.



FIRST BAY BRACING DETAIL @ FEMALE END – SPAN 3
(CENTER OF TRANSOM)



END OF BRIDGE SPAN 1 – MALE END
(CENTER OF TRANSOM)



DECK CONNECTION DETAIL
N.T.S.

REV.	DATE	BY	DESCRIPTION	APPR.

SEAL

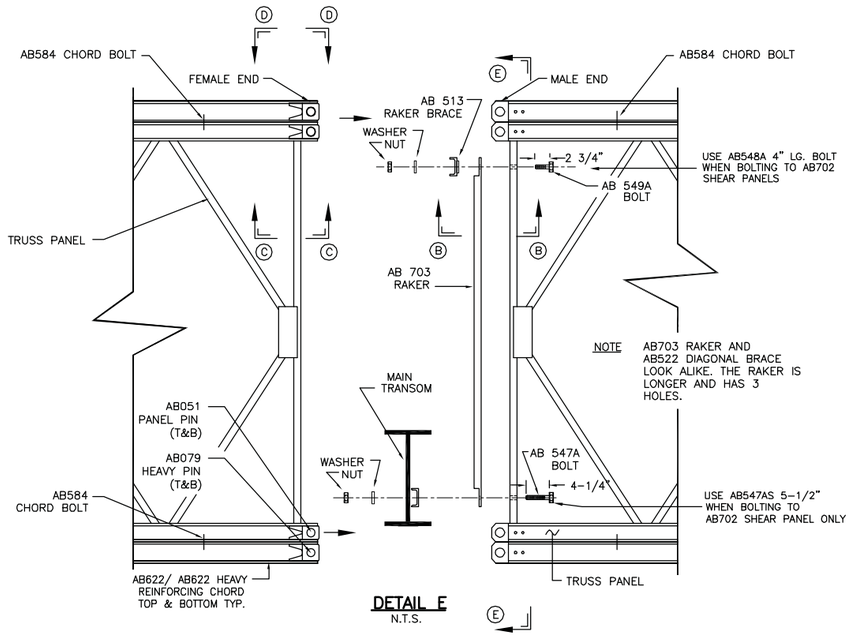
ACROW BRIDGE
Building Bridges.
Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

ACROW 700XS PANEL BRIDGE
TYPICAL BRIDGE CONNECTION DETAILS – SPAN 1 & 3
190FT (3 SPANS 40–110–40) 2LANE 30FT BRIDGE
NCDOT PROJECT
US 29 OVER NORFOLK SOUTHERN
RAILROAD BRIDGE REPLACEMENT

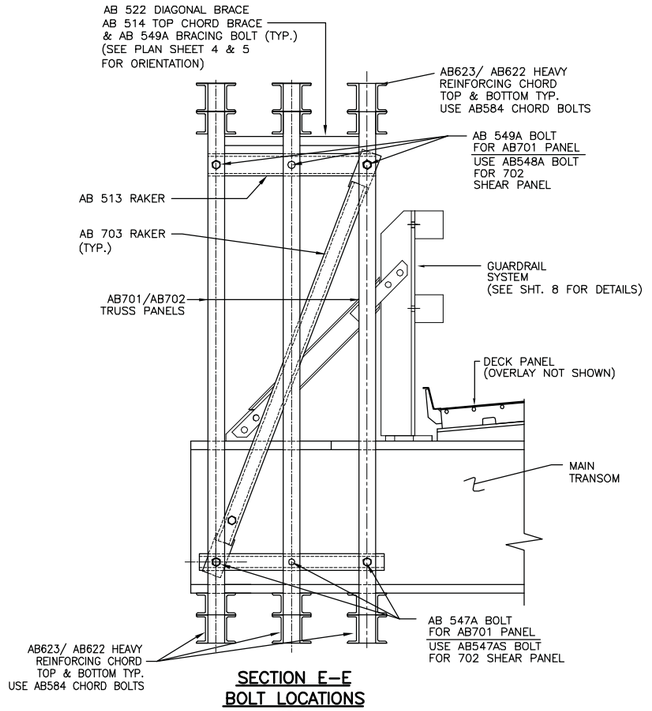
DRAWN BY	RJ	DATE OCTOBER 21, 2016	CONTRACT NO.
CHECKED BY	LP	SCALE: N.T.S.	
APPROVED BY	JAB		

HRI BRIDGE COMPANY
BLACKSBURG, SC

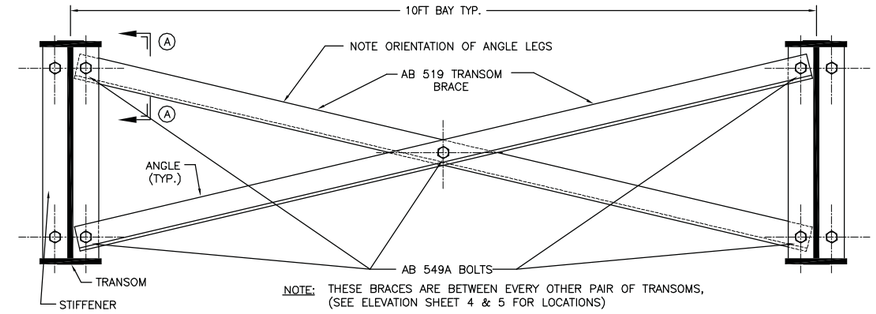
DRAWING NO.	REV.
AB1846	
SHT 6 OF 9	



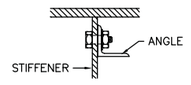
DETAIL E
N.T.S.



SECTION E–E
BOLT LOCATIONS
N.T.S.

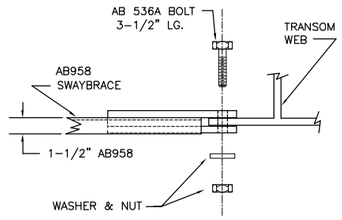


DETAIL – TRANSOM BRACES
N.T.S.

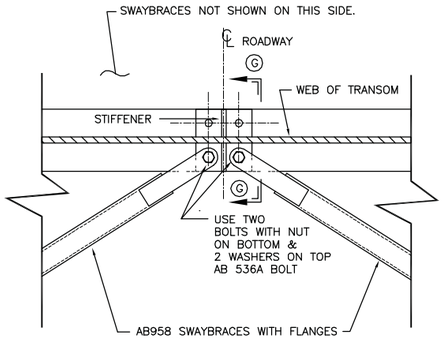


SECTION A–A

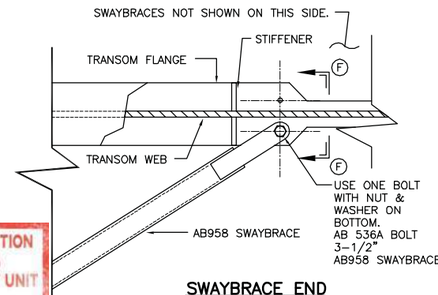
EXAMPLE ONLY
NOT FOR CONSTRUCTION



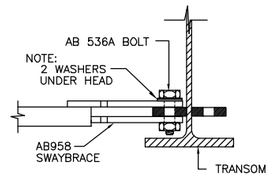
SECTION F–F
N.T.S.



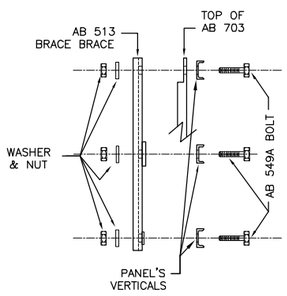
SWAYBRACE CENTER CONNECTION DETAIL
N.T.S.



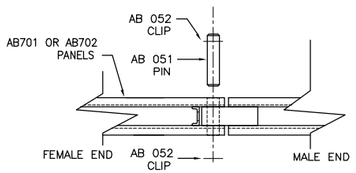
SWAYBRACE END
CONNECTION DETAIL
N.T.S.



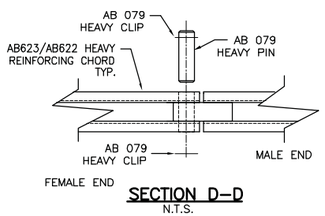
SECTION G–G
SWAYBRACE CONNECTION DETAIL
AT CENTER POINT
N.T.S.



SECTION B–B
N.T.S.

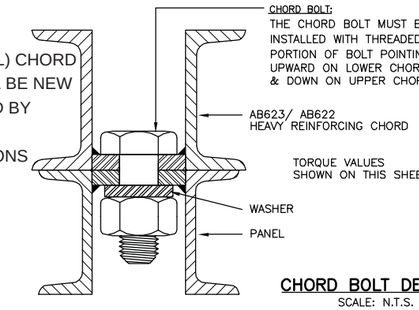


SECTION C–C
N.T.S.

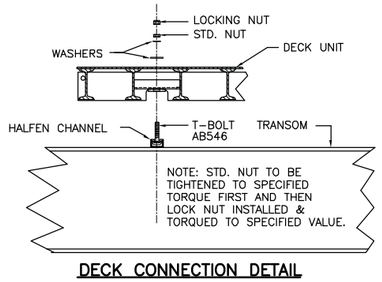


SECTION D–D
N.T.S.

NOTE:
ALL (CRITICAL) CHORD
BOLTS SHALL BE NEW
AS REQUIRED BY
NCDOT
SPECIFICATIONS



CHORD BOLT DETAIL
SCALE: N.T.S.



DECK CONNECTION DETAIL
N.T.S.

BRIDGE BOLTS

BOLT	NAME	DIA ø	UNDER HEAD LENGTH ±1/8"	TORQUE VALUE
AB584	CHORD BOLT	1-1/4"	3-1/2"	650FT/LBS
AB549A	SHORT BRACE BOLT	1"	2-3/4"	450FT/LBS
AB548A	LONG RAKER BOLT	1"	4"	450FT/LBS
AB547AS	TRANSOM SHEAR BOLT	1"	5-1/2"	450FT/LBS
AB547A	TRANSOM BOLT	1"	4-1/4"	450FT/LBS
AB546	DECK T BOLT	3/4"	N/A	110FT/LBS
AB536A	BRACE BOLT	1"	3-1/2"	450FT/LBS

N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
STRUCTURES MANAGEMENT UNIT
✓ ACCEPTED
___ ACCEPTED AS NOTED
___ RETURNED FOR CORRECTIONS
___ SEE EMAIL
BY: SRM
DATE: April 13, 2017

DESCRIPTION	DATE	BY	APPR.
REV.			

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 031428 ENGINEER DONALD J. VAN GERVE 4/6/17

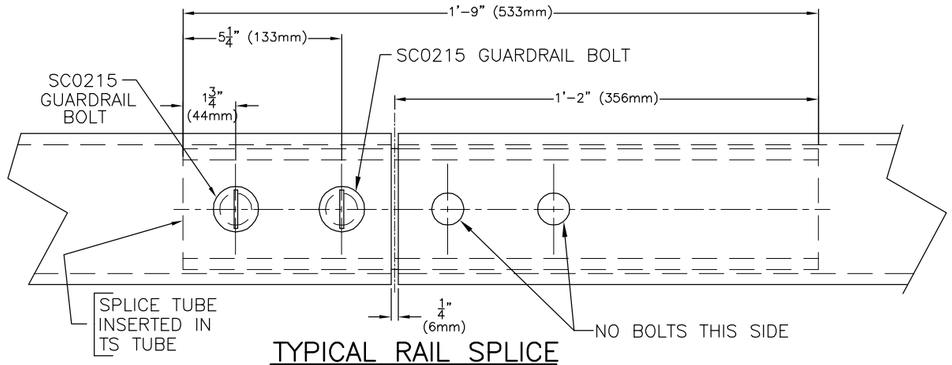
ACROW BRIDGE
Building Bridges.
Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

ACROW 700XS PANEL BRIDGE
TYPICAL BRIDGE CONNECTION DETAILS – SPAN 2
190FT (3 SPANS 40–110–40) 2LANE 30FT BRIDGE
NCDOT PROJECT
US 29 OVER NORFOLK SOUTHERN
RAILROAD BRIDGE REPLACEMENT

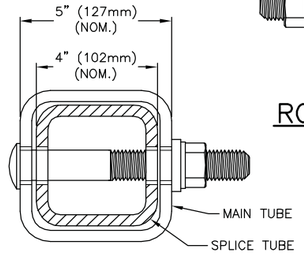
DRAWN BY RJ
CHECKED BY LP
APPROVED BY JAB
DATE OCTOBER 21, 2016
SCALE: N.T.S.
CONTRACT NO.

HRI BRIDGE COMPANY
BLACKSBURG, SC

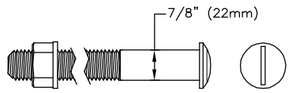
DRAWING NO. AB1846
REV.
SHT 7 OF 9



TYPICAL RAIL SPLICE



SPLICE TUBE DETAILS



SC0215 ROUND HEAD BOLT

N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
STRUCTURES MANAGEMENT UNIT

✓ ACCEPTED

___ ACCEPTED AS NOTED

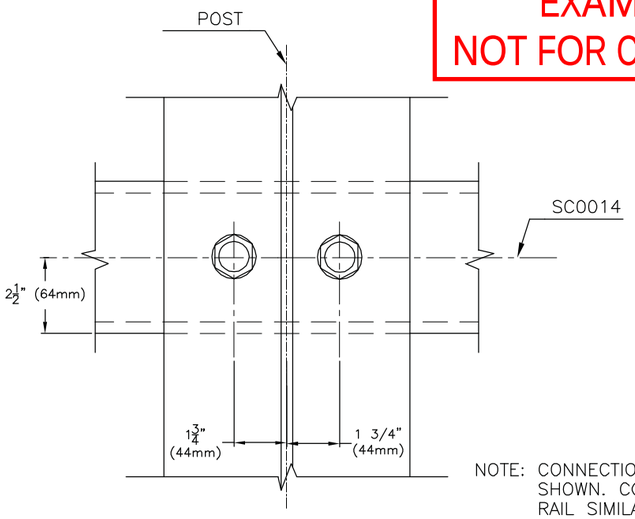
___ RETURNED FOR CORRECTIONS

___ SEE EMAIL

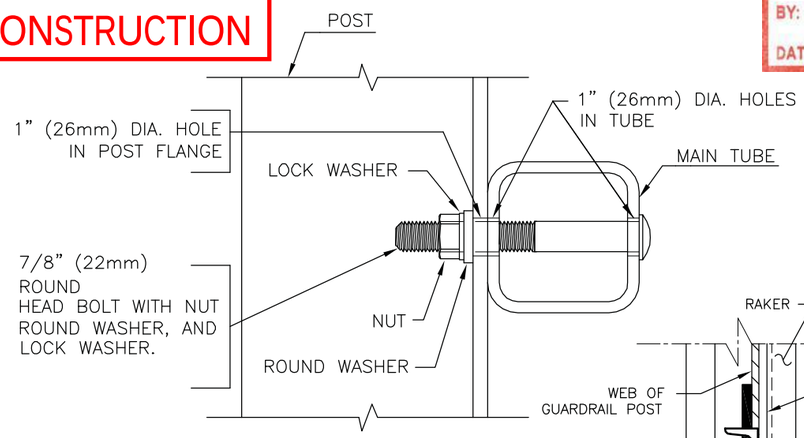
BY: SRM

DATE: April 13, 2017

EXAMPLE ONLY
NOT FOR CONSTRUCTION



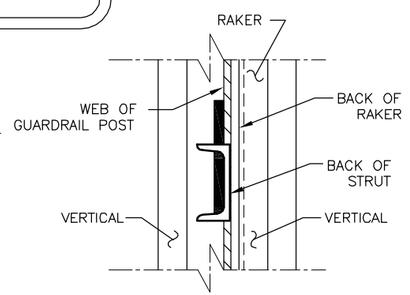
ELEVATION



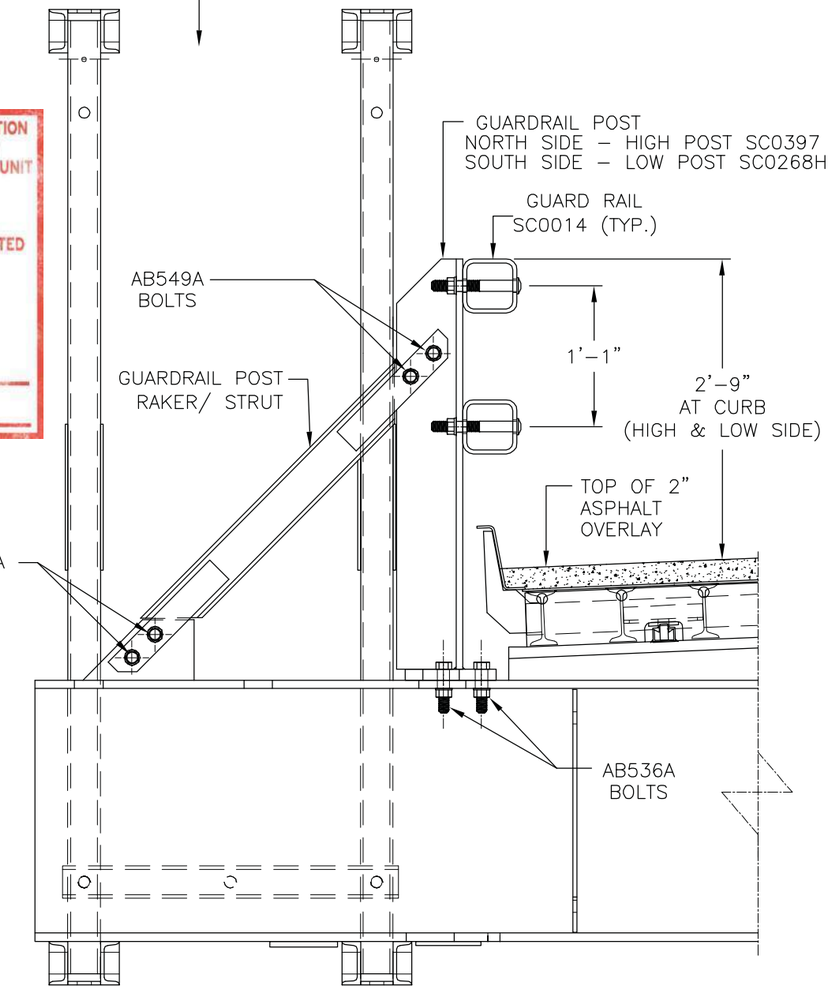
SECTION

NOTE: CONNECTIONS AT LOWER RAILS SHOWN. CONNECTIONS AT TOP RAIL SIMILAR.

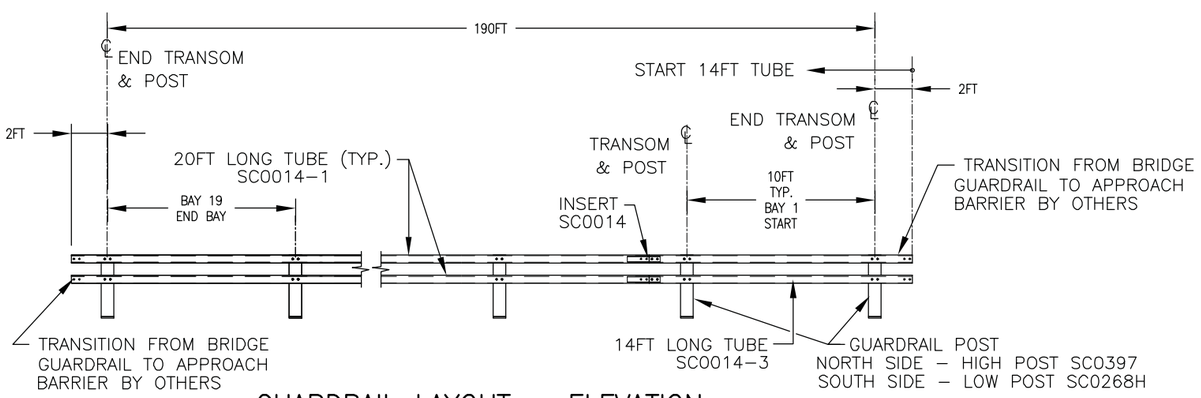
TYPICAL RAIL–TO–POST CONNECTIONS



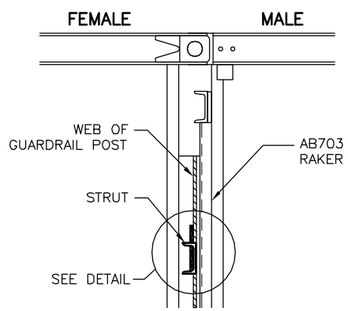
DETAIL



TYPICAL POST CONNECTION DETAIL



GUARDRAIL LAYOUT – ELEVATION



ORIENTATION OF STRUT

APPR.	BY	DESCRIPTION	DATE	REV.

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 031428 ENGINEER DONALD J. VAN GERVE
4/6/17

ACROW BRIDGE
Building Bridges. Connecting People.
Acrow Corporation of America
181 New Road, Parsippany, NJ 07054

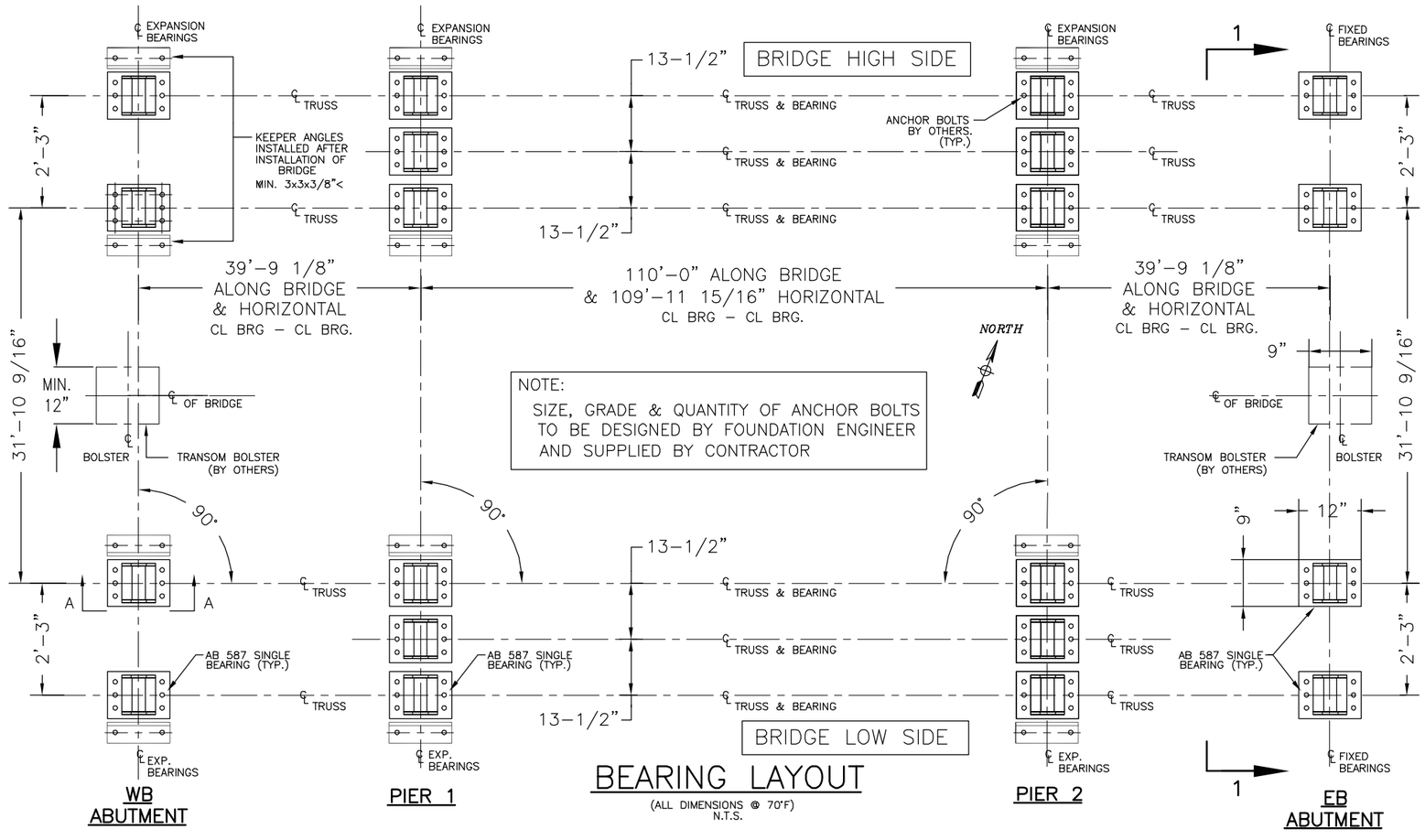
ACROW 700XS PANEL BRIDGE
GUARDRAIL LAYOUT & DETAILS
190FT (3 SPANS 40–110–40) 2LANE 30FT BRIDGE
NCDOT PROJECT
US 29 OVER NORFOLK SOUTHERN
RAILROAD BRIDGE REPLACEMENT

DRAWN BY	RJ	DATE	OCTOBER 21, 2016	CONTRACT NO.
CHECKED BY	LP	SCALE: N.T.S.		
APPROVED BY	JAB			

HRI BRIDGE COMPANY
BLACKSBURG, SC

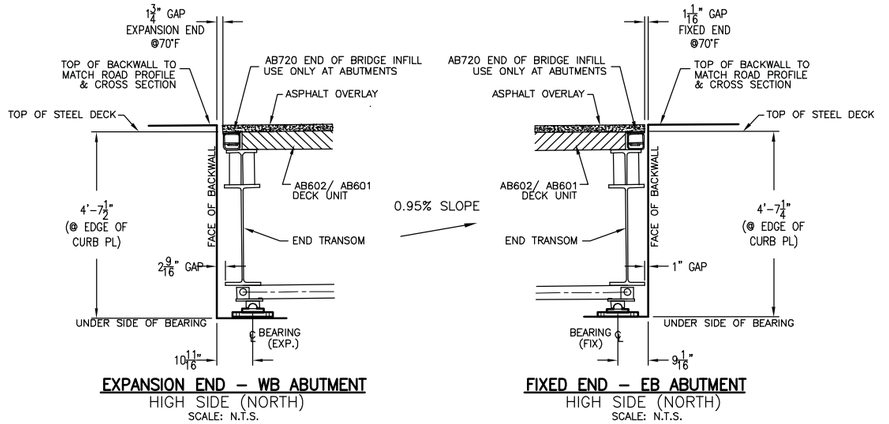
DRAWING NO. AB1846 REV.

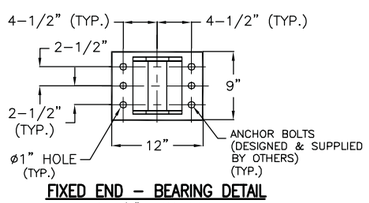
SHT 8 OF 9



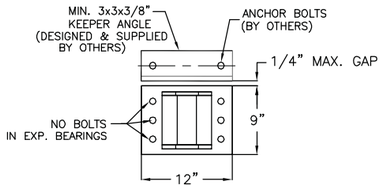
BEARING LAYOUT

(ALL DIMENSIONS @ 70°F) N.T.S.

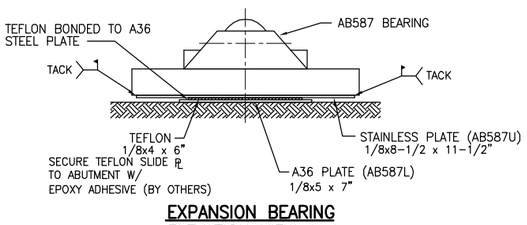




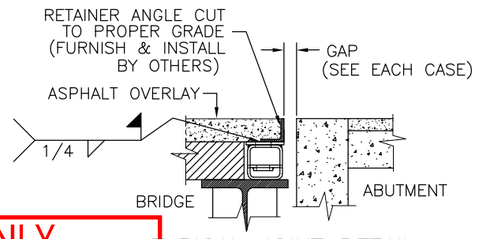
FIXED END – BEARING DETAIL
1–3/8" THICK PLATE
SCALE: N.T.S.



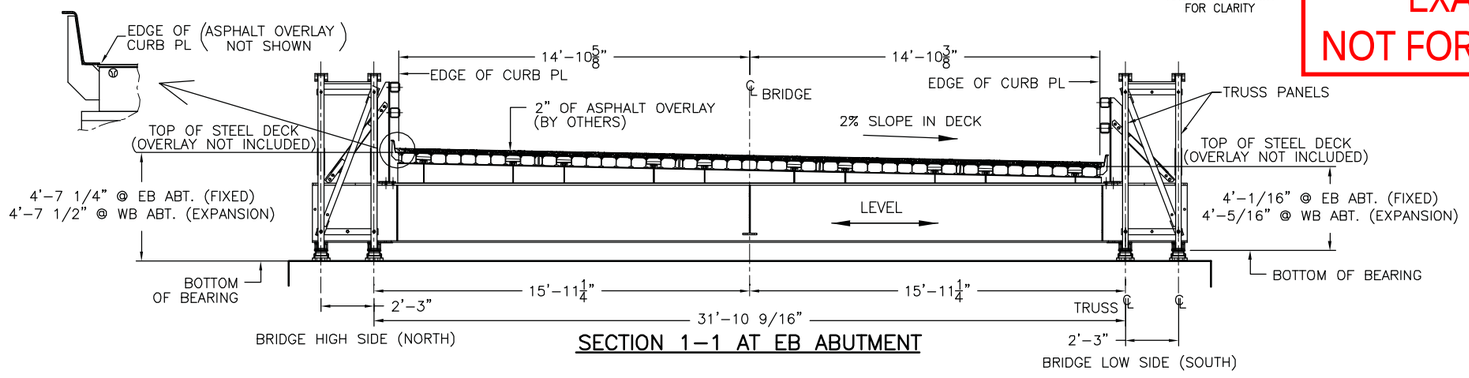
EXPANSION END – BEARING DETAIL
SCALE: N.T.S.



EXPANSION BEARING ELEVATION VIEW A–A
ANGLE NOT SHOWN FOR CLARITY



TYPICAL JOINT DETAIL



SECTION 1–1 AT EB ABUTMENT

EXAMPLE ONLY
NOT FOR CONSTRUCTION

N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
STRUCTURES MANAGEMENT UNIT
✓ ACCEPTED
ACCEPTED AS NOTED
RETURNED FOR CORRECTIONS
SEE EMAIL
BY: SRM
DATE: April 13, 2017

REV.	DATE	DESCRIPTION	BY	APPR

SEAL
NORTH CAROLINA PROFESSIONAL SEAL 031428 ENGINEER DONALD J. VAN GERVE
4/6/17

ACROW BRIDGE
Building Bridges. Connecting People.
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181 New Road, Parsippany, NJ 07054

ACROW 700XS PANEL BRIDGE
BEARING LAYOUT & DETAILS
190FT (3 SPANS 40–110–40) 2LANE 30FT BRIDGE
NCDOT PROJECT
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DRAWN BY	RJ	DATE OCTOBER 21, 2016	CONTRACT NO.
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HRI BRIDGE COMPANY
BLACKSBURG, SC

DRAWING NO. AB1846 REV.
SHT 9 OF 9