
TECHNICAL MEMORANDUM

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From: Andrew LeCheminant, PE (WY)
Zachary Farnsworth

Reviewed by: Brian Garrett, PE
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Date: July 10, 2025

Job Number: 22-1474

Subject: Soldier Pile Design Submittal – Permanent Walls 2, 3, 4, 7, and
Temporary Walls North & South – **REVISION C**
14600 South Railroad Crossing
14600 South Roadway Improvement Project



INTRODUCTION AND BACKGROUND

This Technical Memorandum (TM) serves as a design narrative for the permanent and temporary soldier pile walls that will be constructed by Ralph L. Wadsworth Construction (RLW) to facilitate the realignment of 14600 South as part of the 14600 S Roadway Improvement Project in Bluffdale, Utah. Included as appendices to this TM are working drawings and supporting design calculations.

The following details our understanding of Permanent Walls 2, 3, 4, 7, and Temporary Walls North and South:

1. Soldier pile retaining walls are RLW's preferred system for both the temporary and permanent retaining walls.
 2. Walls 2, 3 (Verizon Wall), 4, & 7 (SW Wingwall) will be permanent soldier pile walls and the North and South temporary walls will be temporary soldier pile walls.
 3. Two box culverts will be constructed in an open excavation supported in part by Walls 3 and 4 Wingwall.
 - a. Petrucco and RLW will excavate under the existing Union Pacific Railroad (UPRR) and Utah Transit Authority (UTA) tracks and jack the prefabricated box culverts into place under the tracks.
 4. Temporary Walls North and South will be constructed on the west end of Walls 3 and 4, respectively and will temporarily support the excavation necessary for the placement of the box culverts as well as the crane equipment that will be used to place and remove temporary UPRR tracks (the Petrucco Verona System). The maximum retained height will be 27.5 feet.
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5. The temporary excavation will be backfilled approximately 5 feet to its finished grade and where 14600 South will be realigned to go through the box culverts.
 6. Wall 2 will be constructed adjacent to Wingwall 1 (northwest corner of the north box culvert) and will permanently support a portion of the existing MSE wall that is supporting the grade to the west of the existing and future UTA tracks. The maximum retained height will be 23.5 feet.
 - a. An approximate 20-foot section of the southernmost portion of the existing MSE wall will be excavated and removed during the north box culvert placement.
 - b. Wall 2 will be constructed prior to the MSE wall removal and box culvert placement. Wall 2 will be constructed in front of the existing wall and will be supported by tieback anchors that will be installed through the face of the MSE wall.
 7. Wall 3 will permanently remain in place and support the grade separation to the north of the realigned 14600 South, east of the box culverts.
 8. Wall 7 will serve as a wingwall to the southwest corner of the south box culvert and is located west of and will be perpendicular to the existing and future UTA tracks. The maximum retained height will be 20 feet, considering that the existing grade behind Wall 7 will be raised as part of the construction of the future UTA track.
 9. Wall 4 will serve as a wingwall to the southeast corner of the south box culvert. Wall 4 will tie directly into Temporary Wall South and will have a maximum temporary retained height of 27.5 feet. The maximum permanent retained height will be 15.5 feet.

DESIGN BASIS

The depth of the excavation as well as the location and extent of the proposed soldier pile walls were based on the information provided in the CAD files “14600 S_Design” and “14600 S_Wall Alignments” dated September 4, 2024, and additional CAD files with the same names dated October 17, 2024 and May 15, 2025, as well as PDF files “14600 S-Wall Profiles” dated September 4, 2024, “14600S_Wall2 Profile” dated February 20, 2025, “14600S_Pit Wall Profiles” dated May 15, 2025, and “14600S_Verizon Wall Profile” dated May 16, 2025, , all provided by HDR. Based on this information, Wall 3 was designed for a temporary retained height of up to 30 feet and a permanent retained height of up to 25 feet. The temporary walls were designed to support an unsupported backslope as steep as 1.5H:1V (horizontal to vertical) beginning 40 feet back from the face of wall. A portion of Wall 3 at the east end of the wall that slopes down to the bottom of the excavation was designed to support a temporary unsupported backslope as steep as 1.5H:1V and a permanent unsupported backslope as steep as 2H:1V.

Gerhart Cole submitted a 100% Geotechnical Design Services memorandum dated May 13, 2024 for the railroad undercrossing box culverts for this project. In June and July of 2024, two additional test holes were drilled within the footprint of the planned box culverts, one on each side of the UPRR/UTA tracks. Test hole logs and information related to these test holes were included in the final Geotechnical Design Services memorandum dated May 21, 2025. Subsurface soil conditions have been interpreted based on information provided in the

100% geotechnical design memorandum and the additional field studies. Based on this information, we anticipate that the subsurface soils generally consist of interbedded silty sand, sand with silt, and sandy clay layers.

Several temporary piezometers and a temporary pumping well were installed during field studies east of the railroad tracks in the vicinity of the area that will be supported by Wall 3. Groundwater was measured as high as elevation 4451 feet. A CPT sounding was also performed near the planned excavation with pore pressure dissipation (PPD) tests indicating a static groundwater level as high as elevation 4448 feet. Based on this information, a ground water elevation of 4451 feet was used in the retaining wall design for the permanent long-term conditions of the soldier pile walls east of the railroad tracks.

Groundwater was found during drilling of the two additional test holes (one on the east side of the UPRR tracks and the other on the west side of the UTA tracks) at a depth of approximately 17 feet and 18 feet below the existing ground surface, which corresponds to a groundwater elevation of approximately 4440 and 4441 feet. A temporary piezometer was installed in the test hole on the east side of the tracks and groundwater was measured several weeks after drilling at a depth of approximately 12 feet below the existing ground surface (elevation 4446 feet). During our field studies, water in the existing canal located west of the existing MSE wall was observed to be at approximately elevation 4431 feet, which is below the elevation of the bottom of Wall 2. A CPT sounding was also performed in the roadway adjacent to the existing canal with PPD tests indicating a static groundwater level as high as elevation 4418 feet. The static groundwater level drops in elevation from the east to west side of the existing MSE wall and it was assumed that the groundwater level at the face of Wall 2 will be below the base of wall. Based on the measured groundwater levels and this assumption, Wall 2 was not designed to include hydrostatic pressures above the base of the wall.

We understand that dewatering will take place to facilitate the excavation and construction of the box culverts with the groundwater to be drawn down to the bottom of excavation (bottom of wall) elevation or lower. As such, the soldier pile walls were not designed to include hydrostatic pressures above the base of the walls for the temporary construction cases. Any water or localized wet zones located within the retained soils may result in both hydrostatic forces and decreased soil strength, resulting in poor performance of the wall systems. If such conditions are found during construction, Gerhart Cole should immediately be informed to evaluate the adequacy of the designs and make modifications if needed.

Seismic forces were considered based on a horizontal coefficient (k_h) value of 0.24g. This value was calculated as one-half of the A_s value of 0.47g provided in the Railroad Undercrossing Box Culverts Geotechnical Design Services memorandum for the 1150 year return period event.

SOLDIER PILE WALL DESIGN

In coordination with RLW, the soldier pile retaining walls were designed with solid bar tieback anchors. The design of the permanent soldier pile walls was performed in general accordance with:

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- Project special provisions
 - FHWA Geotechnical Engineering Circular No. 4 – Ground Anchors and Anchored Systems (GEC 4)
 - PTI Recommendations for Prestressed Rock and Soil Anchors
 - UPRR & BNSF Guidelines for Temporary Shoring (UPRR 2021)
 - American Railway Engineering and Maintenance-of-Way Association (AREMA 2024)
 - UDOT Geotechnical Manual of Instruction (GMOI) (2022)

The computer software ShoringSuite (version 8.12) was used to calculate the required pile size, minimum pile length, tieback anchor loads, and estimated wall deflection for various design sections. Consistent with guidance from AREMA (2024), the following design considerations were used in the wall designs:

- The passive resistance of the embedded piles was reduced by a factor of safety of 1.5 for temporary cases, Wall 3, and Wall 4
- The passive resistance of the embedded piles was reduced by a factor of safety of 2 for permanent cases for Walls 2 and 7
- The active earth pressure was modeled with a triangular distribution for cantilever and single tieback supported walls
- The active earth pressure was modeled with apparent earth pressures for walls supported with two or more rows of tieback anchors
- The pile section was analyzed considering an allowable bending stress equal to 55 percent of the yield strength of the pile ($0.55 \times F_y$; $F_y = 50$ ksi)

The global stability of the design sections was evaluated using the computer software Slope/W version 2022.1 and the Morgenstern-Price method of slices. The factor of safety was greater than 1.3 in all temporary cases, 1.5 in all long-term static cases, and 1.1 in all pseudo-static (seismic) cases, all of which satisfy the requirements for global stability in AREMA (2024).

In coordination with RLW and HDR, the following summarizes the surcharge loading used in the wall designs:

- Wall 3 was designed for a maximum surcharge load of 2.4 ksf located no closer than 10 feet from back of wall in the temporary condition only.
- Temporary Wall North has been designed considering a maximum surcharge load of 3.21 ksf located no closer than 10 feet from back of wall and 16' x 32' in plan dimensions.
- Temporary Wall South and Wall 4 (in the temporary condition only) have been designed considering a maximum surcharge load of 5.50 ksf located no closer than 20 feet from back of wall and 4' x 16' in plan dimension.
- In addition to the E80 Cooper live load and associated ballast and rail loading for the existing and future UTA tracks, Wall 7 has been designed with a maximum surcharge pressure of 250 psf located no closer than 3 feet from the back of wall.
- In addition to the associated ballast and rail loadings for the existing and future UTA tracks, Wall 2 has been designed for live loads of 1265 psf from a maintenance train

car for the future UTA track and 926 psf from a commuter rail car for the existing UTA track.

Gerhart Cole should be provided information on the planned ground bearing pressures from large construction equipment like cranes and planned distance from back of walls before being used behind the earth shoring walls.

The tieback anchors were designed in general accordance with the Post-Tensioning Institute (2014) and AREMA (2024) and with a factor of safety against pullout of 2 for the temporary, long-term static, and pseudo-static (seismic) cases. A nominal/ultimate pullout resistance (bond strength) of 3.0 kips/ft (10 psi bond stress) was used in all design cases for Walls 2, 3, 4, and the temporary walls. A nominal/ultimate pullout resistance (bond strength) of 3.6 kips/ft (12 psi bond stress) was used in all design cases for Wall 7. These values are based on the recommendations provided in PTI and our previous pull testing experience in similar soils. The actual pullout resistance will be assessed by testing as described in the working drawings. The tieback anchors were also designed with a minimum drilled hole diameter of 9-5/8 inches for Walls 2 & 7 and 8 inches for all other walls. The minimum drilled hole diameter was selected to reduce the length of the tiebacks such that they do not extend within the UPRR Right of Way. Consistent with guidance in AREMA (2024), the size of the solid bar tieback anchors was also analyzed considering an allowable yield strength equal to half the yield strength of the bars ($0.5F_y$; $F_y = 75$ ksi). The unbonded tieback anchor lengths were sized such that the bond zone begins beyond the critical failure surface. The unbonded length and critical failure surfaces are detailed in calculations presented in Appendix B.

The temporary timber lagging was designed following guidance provided in AREMA Chapter 7. The permanent shotcrete lagging was sized following guidance from the American Concrete Institute (ACI) Code 318-19(22) (2019). An arching reduction of 33 percent was used for both the timber and shotcrete lagging consistent with guidance in AREMA (2024).

In coordination with RLW, corrosion protection for the permanent tieback anchors will be provided by epoxy coating for solid bar anchors installed to support Wall 3 and Wall 4 and by Class I (double corrosion protection) for strand anchors installed to support Walls 2 and 7. Corrosion protection for the soldier piles will be provided by sacrificial steel. The loss of steel was calculated using a 75-year design life and Equation 4 as provided by Decker, Rollins and Ellsworth (2008), which is referenced by the UDOT GMOI to estimate the corrosion thickness loss of steel piles. The section modulus for the selected soldier pile beam sizes was calculated considering the estimated corrosion loss and this value was checked against the required minimum section modulus from the analyses performed for each soldier pile design section.

SUMMARY AND RECOMMENDATIONS

The working drawings and supporting calculations presented in Appendices A and B detail the design of the proposed temporary and permanent soldier pile walls. The locations and extents of the soldier pile walls are based on the information provided by HDR. The relocation of several utilities and the location of all remaining utilities should all be field verified before installing the soldier piles and tieback anchors. The existing

Verizon cellular tower is located a distance of at least 20 feet from the back of Wall 3 and it is our understanding that it is supported on relatively shallow foundations. Considering the distance away from the back of wall, the loading from the existing tower was not considered in the design of Wall 3; however, the locations and depths of the tower foundations should also be field verified prior to the tieback anchor installation. If the tower foundations extend greater than 5 feet below the ground surface, Gerhart Cole should be notified to evaluate the compatibility of the current design and allowed to revise the soldier pile wall design if necessary.

Walls 2, 3, 4, and the Temporary Walls will be constructed to facilitate the excavation, construction, and placement of the box culverts. We recommend that Wall 7 also be constructed and in-place prior to jacking the box culverts.

As stated above, Gerhart Cole should be provided information on the planned ground bearing pressures from large construction equipment like cranes and planned distance from back of walls before being used behind the earth shoring walls.

In addition to the track monitoring plan submitted by the project team, we recommend the soldier pile walls be frequently monitored for movement during construction and while the temporary excavation is in place. We also recommend that the permanent soldier pile walls be frequently monitored for movement for at least 2 months after the final wall facing is constructed and the permanent unsupported slopes are backfilled to finished grade. We also recommend that the permanent walls also be monitored for movement and the wall and roadway drainage systems be inspected periodically thereafter on a long-term basis. We can provide a wall monitoring plan if requested.

LIMITATIONS

The assessments and recommendations presented in this document are based on our limited field studies, and on limited field studies and laboratory testing performed by others, as well as our understanding of the project's design and manner of construction. If the project's design or manner of construction changes, or if conditions are found that are different from those described, we should be notified immediately so that we can make revisions as necessary.

This document was prepared solely for the use of the addressee (our Client) for the specified project and may not contain sufficient information for other parties or uses.

We represent that our services are performed within the limitations prescribed by our Client, in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation, expressed or implied, and no warranty or guarantee is included or intended. We do not assume responsibility for the accuracy of information provided by others.

APPENDICES

Appendix A – Earth Shoring Working Drawings

Appendix B – Earth Shoring Design Calculations

REFERENCES

American Concrete Institute [ACI], (2019), Building Code Requirements for Structural Concrete ACI Code 318-19(22).

American Railway Engineering and Maintenance-of-Way Association [AREMA], (2024), Manual for Railway Engineering.

Decker, J.B., Rollins, K.M., and Ellsworth, J.C., 2008, Corrosion Rate Evaluation and Prediction for Piles Based on Long-Term Field Performance, Journal of Geotechnical and Geoenvironmental Engineering. Volume 134, Issue 3. ASCE.

Federal Highway Administration [FHWA], (1999). Geotechnical Engineering Circular No. 4 – Ground Anchors and Anchored Systems, FJWA-IF-99-015, Sabatini, P.J., Pass, D.G., Bachas, R.C.

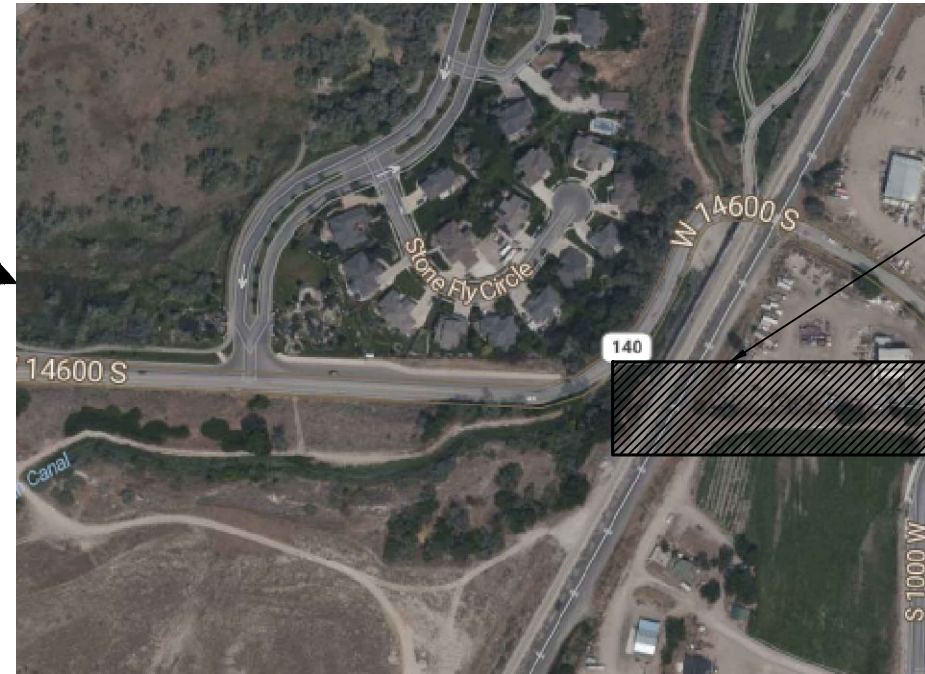
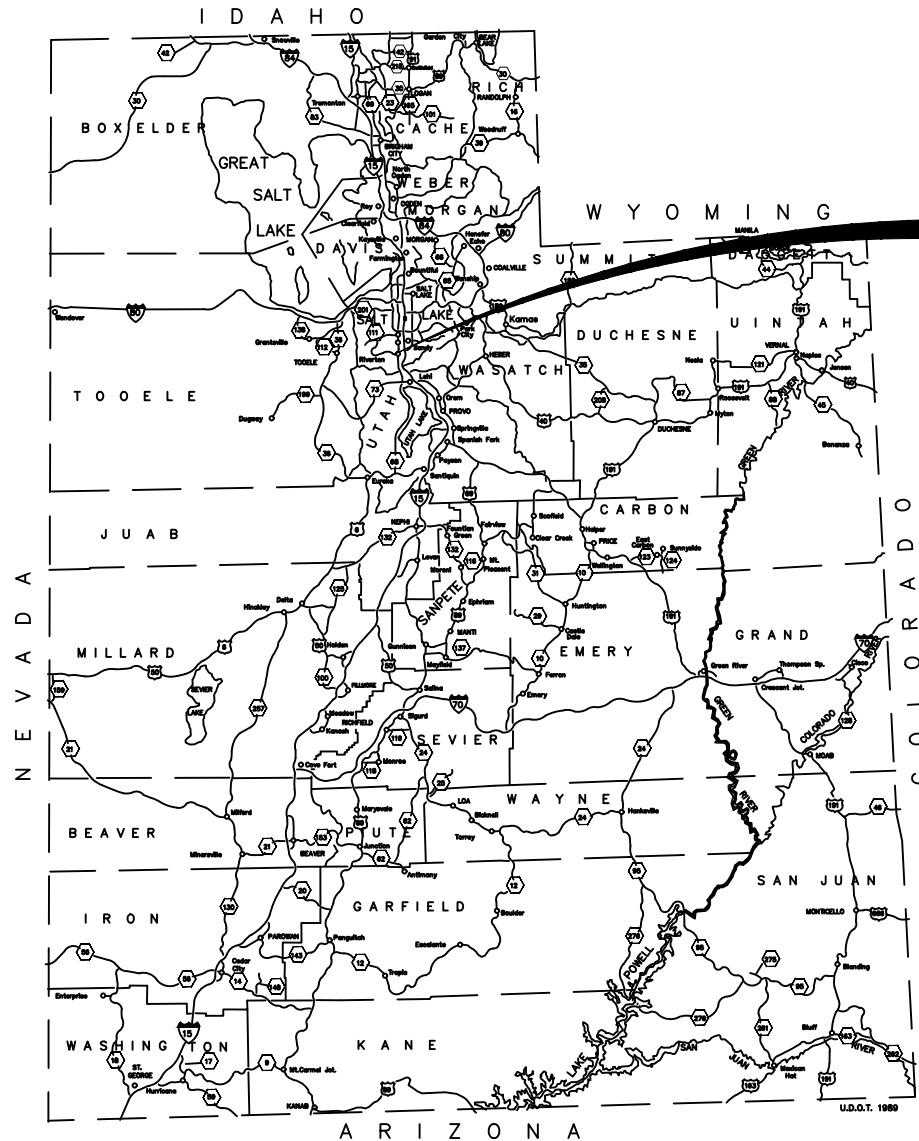
Post-Tensioning Institute [PTI], 2014, Recommendations for Prestressed Rock and Soil Anchors, PTI DC35.1-14.

Utah Department of Transportation [UDOT]. (2022). Geotechnical Manual of Instruction.

Union Pacific Railroad and BNSF Railway, (2021). Guidelines for Temporary Shoring.

APPENDIX A

14600 SOUTH RAILROAD CROSSING PROJECT WALL DESIGN - PERMANENT WALLS 2, 3, 4, 7 WALL & TEMPORARY WALL NORTH AND TEMPORARY WALL SOUTH BLUFFDALE, UTAH



VICINITY MAP
NTS

PROJECT LOCATION

DRAWING INDEX

SHEET NO.	DRAWING TITLE
SHEET 1	DRAWING INDEX
SHEET 2	GENERAL NOTES
SHEET 3	OVERALL SITE PLAN
SHEET 4	SITE PLAN - WALLS 3 & TEMPORARY WALL NORTH
SHEET 5	SITE PLAN - WALLS 7, TEMPORARY WALL SOUTH, & WALL 4
SHEET 6	SITE PLAN - WALL 2
SHEET 7	ELEVATION VIEW - WALL 7
SHEET 8	ELEVATION VIEW - WALL 3 & TEMPORARY WALL NORTH
SHEET 9	ELEVATION VIEW - WALL 4 & TEMPORARY WALL SOUTH
SHEET 10	ELEVATION VIEW - WALL 2
SHEETS 11 TO 13	SECTION VIEWS
SHEETS 14 TO 16	DETAILS
SHEET 17	SECTION & DETAILS

CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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14600 SOUTH RAILROAD CROSSING PROJECT
 BLUFFDALE, UTAH
 TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN
 DRAWING INDEX

REVISION	DATE	DRAWN	DESCRIPTION
A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC



DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 1 of 17	CHECKED: BHG
	APPROVED: BHG




REVISIONS

1. GENERAL
 - 1.1. The scope of work is outlined by these general notes as defined below and includes the construction of the permanent soldier pile Walls 2, 3, 4, and 7 and temporary soldier pile walls Temporary Wall North and Temporary Wall South to facilitate the 146th South Railroad crossing.
 - 1.2. The walls should be constructed in accordance with project special provisions, contract documents and these working drawings.
 - 1.3. The wall contractor is responsible for field locating all utilities and buried structures.
 - 1.4. Any signs of instability of the retaining walls shall be immediately brought to Gerhart Cole's attention at 801-849-0055. If observed, all work below the wall shall be halted.
 - 1.5. Wall 3 has been designed considering a maximum surcharge load of 2.40 ksf located no closer than 10 feet from back of wall. Temporary Wall North has been designed considering a maximum surcharge load of 3.21 ksf located no closer than 10 feet from back of wall and 16' x 32' in plan dimension. Temporary Wall South and Wall 4 (in the temporary condition only) have been designed considering a maximum surcharge load of 5.50 ksf located no closer than 20 feet from back of wall and 4' x 16' in plan dimensions. In addition to the E80 Cooper live load and associated ballast and rail loading, Wall 7 has been designed with a maximum surcharge pressure of 250 psf located no closer than 3 feet from back of wall. In addition to the associated ballast and rail loadings for the existing and future UTA tracks, Wall 2 has been designed for live loads of 1265 psf from a maintenance train car for the future UTA track and 926 psf from a commuter rail car for the existing UTA track. Gerhart Cole should be provided information on the planned ground bearing pressures from large construction equipment like cranes before being used behind the earth shoring walls.
 - 1.6. Soldier pile walls should be constructed prior to the box culverts being pushed into place.
2. EXCAVATION
 - 2.1. Excavation shall be carried out carefully without damaging soldier piles, lagging, or tieback anchors.
 - 2.2. Excavation shall be in lifts of no more than 5 feet vertically.
 - 2.3. Excavated face shall not be left unsupported and exposed for longer than 24 hours or as directed by Gerhart Cole.
 - 2.4. If excessive raveling or sloughing of the excavated face occurs, temporary berms or other stabilization methods may be necessary as approved by Gerhart Cole.
 - 2.5. Excavation spoils are not permitted behind the excavation.
 - 2.6. Unshored excavations shall comply with OSHA standards for temporary excavations.
3. STRUCTURAL STEEL
 - 3.1. All soldier piles shall be ASTM A572 Grade 50 beams or better, as specified in these drawings.
 - 3.2. Plate steel shall conform to AASHTO M270 (36 ksi min.) or better.
 - 3.3. All welds shall conform with the latest version of AWS D1.1.
 - 3.4. Headed studs shall consist of Type B studs conforming to ASTM A108 (51 ksi min.) and have a full penetration weld to the pile flange using either arc welded or hand welding techniques. Prior to welding, flange of beams is to be free of shotcrete, dirt, excessive rust or mill scale, moisture and all foreign material.
 - 3.5. Headed stud installation shall be observed full-time by onsite inspector. Prior to production welding of headed studs, at least 2 studs should be bent in any direction to a 30 degree angle from weld position by striking with a hammer. If failure occurs, adjust welding settings or techniques and repeat test. During production installation, perform at least two tests at the beginning of each day or after change in operator by bending studs to a 15 degree angle from weld position. If failure does not occur, the welds should be considered good. If welds fail then the studs should be replaced.
 - 3.6. Soldier piles shall not be spliced.
4. LAGGING AND WALL DRAINAGE
 - 4.1. Timber lagging for the temporary walls shall consist of full sawn 4"x12" Douglas Fir No. 2 or better grade timber.
 - 4.2. Timber lagging for the permanent walls shall consist of full sawn 3"x12" pressure treated Douglas Fir-Larch No. 1 or better grade timber. Treat according to AWPA Standard U1 to the requirements of Use Category 4C (UC4B). Timber lagging to be left in place.
 - 4.3. Permanent lagging shall consist of reinforced shotcrete attached to the soldier piles as detailed using headed studs.
 - 4.4. Shotcrete lagging shall consist of Portland Type II or 1L cement having 8 to 10 percent air entrainment at the pump with a minimum 28-day compressive strength of 4000 psi.
 - 4.5. Shotcrete reinforcement shall be epoxy coated rebar conforming to AASHTO M31 grade 60. Overlap #4 rebar 30 inch minimum for all lap splices.
 - 4.6. Pre-fabricated vertical geocomposite drain strips shall be a minimum of 18" wide and consist of SiteDrain Sheet 180 or approved equivalent. Equivalent drain strips will be approved by Gerhart Cole.
 - 4.7. Place vertical drain strips in between soldier piles, with the geotextile side against the ground, spaced between each column of soldier piles (1 per bay). Vertical drain strips shall extend to 12 inches below the top of wall.
 - 4.8. Splice drain strips with a minimum 12" of overlap.
5. TIEBACKS INCLUDING HARDWARE
 - 5.1. Tieback anchors shall consist of Grade 75 solid threaded bars in accordance with ASTM A615, or approved equivalent.
 - 5.2. All bars shall be straight and undamaged.
 - 5.3. Strand anchors shall be produced from 0.6" diameter, 7-wire strands with $F_{pu} = 270$ ksi conforming to AASHTO M203, or approved equivalent, and contain PTI Class I corrosion protection.
 - 5.4. All anchors shall be new and undamaged.
 - 5.5. Provide tremie grout tubes and post grout tubes as detailed on Sheet 16.
 - 5.6. All bars/anchors shall be sized as specified in the Tieback Anchor Schedule provided in these drawings.
 - 5.7. All nuts and couplers shall be manufactured by the anchor tendon manufacturer.
 - 5.8. All bars, couplers, and hex nuts for the permanent tieback anchors shall be fusion-bonded epoxy coated with a minimum thickness of 7 to 12 mils and in accordance with ASTM A775.
 - 5.9. Minimum drilled hole diameter shall be 9 5/8 inches for Walls 2 & 7 and 8 inches for all other walls.
 - 5.10. Unbonded portion of the threaded solid bar tiebacks may be obtained using a PVC pipe that is taped on both ends to prevent grout from entering. PVC pipe should consist of 6-inch schedule 40 PVC pipe.
 - 5.11. Develop unbonded length of strand anchors with corrosion inhibiting grease filled extruded high density polyethylene sheathing installed by strand manufacturer over each anchor strand.
 - 5.12. Tiebacks shall be grouted with neat Portland Type II or 1L cement with a specific gravity between 1.80 and 1.90 and have a minimum 28-day compressive strength of 4000 psi, per AASHTO T 106.
 - 5.13. All plate steel shall conform to AASHTO M270 mild steel (36 ksi min) or better.
 - 5.14. Construct unbonded and bonded lengths as specified in the tieback anchor schedule.
 - 5.15. PVC centralizers shall be spaced no more than 8' O.C. beginning no more than 1.5' from either end of the tendons. Centralizers shall be schedule 40 PVC and 1" smaller in outside diameter than the bore hole diameter to allow free grout flow. Centralizers shall be securely attached with coated wire.


- 5.16. Provide steel bearing plates conforming to AASHTO M270 mild steel (36 ksi min.) or better and (trumpets and beveled washers consisting of Schedule 80 steel pipe or better. Hot dip galvanize bearing plates, beveled washers, and trumpets in accordance with ASTM A123 for permanent tieback anchors.
- 5.17. Provide anchor head and wedges that conform to the strand anchor manufacturer's specifications. Anchor head shall be electro zinc plated in accordance with ASTM B633 and the manufacturer's specifications.
6. INSTALLATION PROCEDURE
 - 6.1. Visually locate buried structures and utilities.
 - 6.2. Install soldier piles with driven methods at the specified locations and depths based on field verification of the proposed wall locations.
 - 6.3. Provide access restriction, notice, and/or warning behind top of shoring or OSHA approved railing as necessary (by others).
 - 6.4. Excavate down to no more than 2 feet below the tieback anchor. Install timber lagging and drain strips in lifts no more than 5 feet. Smaller lifts may be necessary if excavated face becomes unstable.
 - 6.5. Install tieback anchors as detailed using the open hole installation method. If holes will not remain open, temporary casing may be required to stabilize drill holes and to facilitate anchor tendon installation. Minimum drill hole size shall be 8 inches.
 - 6.6. Grout tiebacks using a tremmie pipe or grout tube beginning from the bottom of the hole. Re-grout as necessary to completely fill hole.
 - 6.7. Place anchor head and test and lock-off the tiebacks following the procedure detailed in Section 7 after the grout has a minimum compressive strength of 1500 psi. Post-grout anchor and re-test if initial load test results do not meet the specified acceptance criteria.
 - 6.8. Perform performance and proof tests as specified and lock-off each tieback anchor. Do not advance the excavation past 2 feet below tieback anchor elevation until tiebacks have been successfully tested and locked off.
 - 6.9. Weld steel bearing plates to soldier piles as detailed.
 - 6.10. Continue excavation, temporary lagging, and vertical drain strip installation to the specified bottom of wall elevations, repeating steps 6.5 to 6.7 as needed.
 - 6.11. Tie in wall drainage to site drainage system, as designed by others.
 - 6.12. Install headed studs and shotcrete reinforcement.
 - 6.13. For strand anchor tiebacks:
 - 6.13.1. Completely fill trumpet with corrosion inhibiting grease or grout.
 - 6.13.2. After the anchors, bearing plates, and grease filled trumpets are installed to final conditions, completely fill anchor sleeve with grout.
 - 6.14. Place expansion joints and shotcrete lagging.
 - 6.15. Saw cut construction joints.
 - 6.16. Backfill temporary excavation to finished grade following the requirements of the project plans and specifications.
 - 6.17. After temporary excavation is backfilled to finished grade, backfill crane pad to finished grade. Use hand held or walk behind equipment to compact soil fill within 3 feet from back of earth shoring walls.
 - 6.18. Acceptable Tolerances are as follows:
 - 6.18.1. Soldier Pile Plan Location: + or - 6 inches.
 - 6.18.2. Anchor Position: + or - 6 inches vertically.
 - 6.18.3. Anchor Length: No less than specified length.
 - 6.18.4. Anchor Inclination: + or - 3°
 - 6.18.5. Anchor splay: up to 10° horizontally, U.N.O. (unless noted otherwise).
 - 6.18.6. Shotcrete Thickness: No less than shown.
7. TIEBACK ANCHOR TESTING & LOCK OFF
 - 7.1. Perform a performance test on the tieback anchors specified on the elevation views, following the Performance Test Schedule on Sheet 16.
 - 7.2. Proof test remaining production anchors following the Proof Test Schedule on Sheet 16.
 - 7.3. Lock-off each successfully tested anchors at 100 percent of the design load (see Tieback Anchor Schedule for design load (DL)). After locking off the anchors and prior to removing the jack, conduct a lift-off test to assess the magnitude of the load in the anchor tendon. Perform the lift-off test by re-applying load to the tendon and recording the load at which point the anchor wedges become loose. This load is defined as the lift off load. If the initial lift off load is less than 95 percent of the design lock-off load then adjust the lock-off load accordingly and repeat the lift off test.
 - 7.4. Test Anchor Acceptance Criteria:
 - 7.4.1. The total creep movement is less than 0.04 in. during the 10 minute hold period or less than 0.08 in. during the 60 minute hold period, if applicable, and the creep rate is linear or decreasing throughout the test hold period.
 - 7.4.2. The total measured movement exceeds 80% of the theoretical elastic elongation of the unbonded length of the anchor tendon.
 - 7.4.3. Pullout failure does not occur before max test load. Failure is defined as the inability to further increase the test load while there is continued pullout movement of the test anchor.

△ MOVED TEST SCHEDULES TO SHEET 16

CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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CONTRACTOR:
WADSWORTH CONTRACTOR
Draper, Utah
(801)553-1661




DESIGNER:
GERHART COLE
Midvale, Utah
(801)849-0055

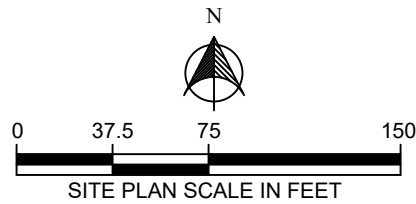
14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

GENERAL NOTES

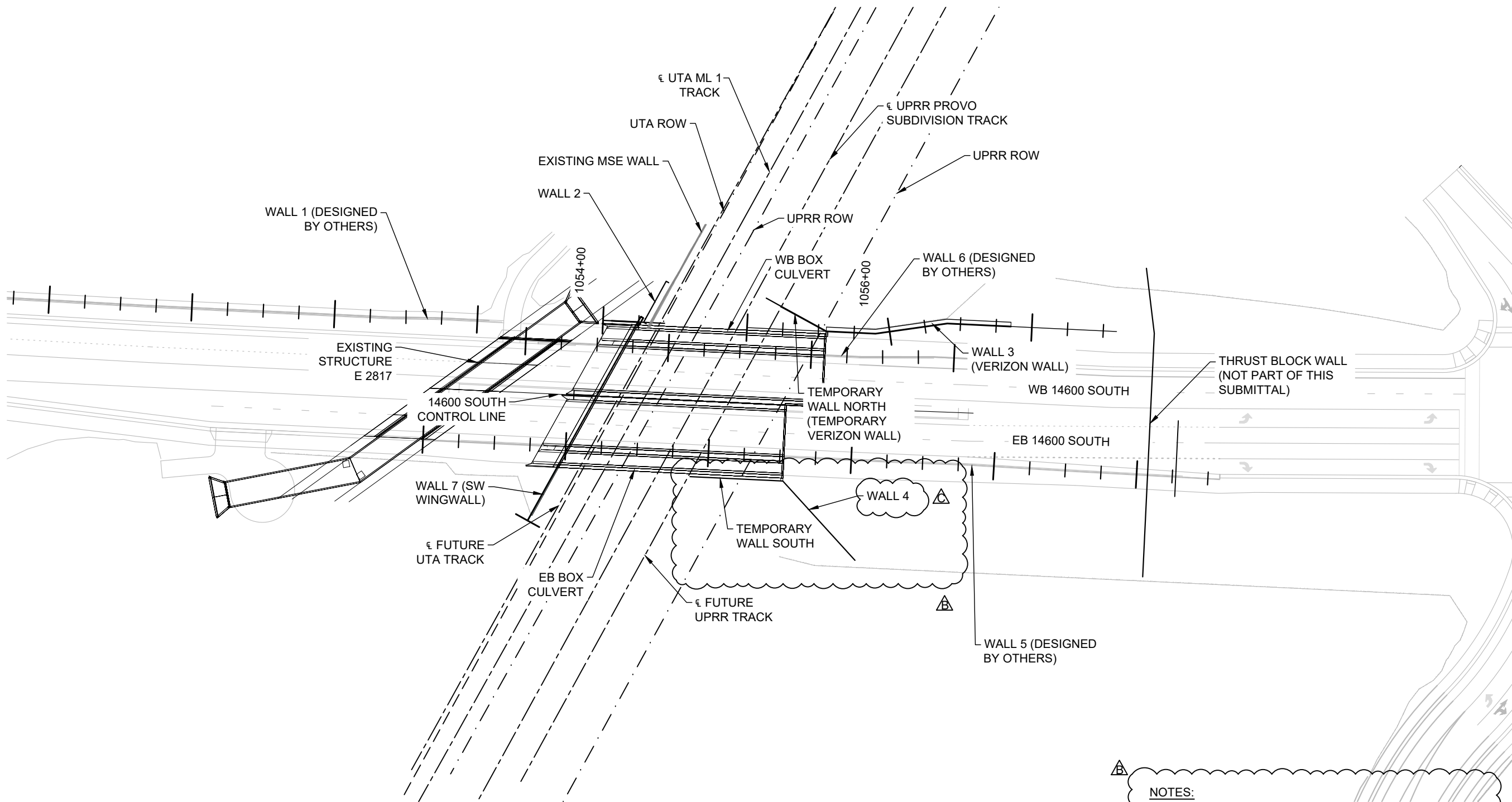
REVISION:	DATE:	DRAWN:	DESCRIPTION:
△	1/29/25	AWL	RESPONSE TO DRC
△	5/23/25	AWL	RESPONSE TO DRC
△	7/10/25	ZPF	RESPONSE TO DRC



DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 2 of 17	CHECKED: BHG
	APPROVED: BHG



CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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CONTRACTOR: **WADSWORTH**
DESIGNER: **GERHART COLE**

14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

OVERALL SITE PLAN

REVISION:	DATE:	DRAWN:	DESCRIPTION:
A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC

REVISIONS

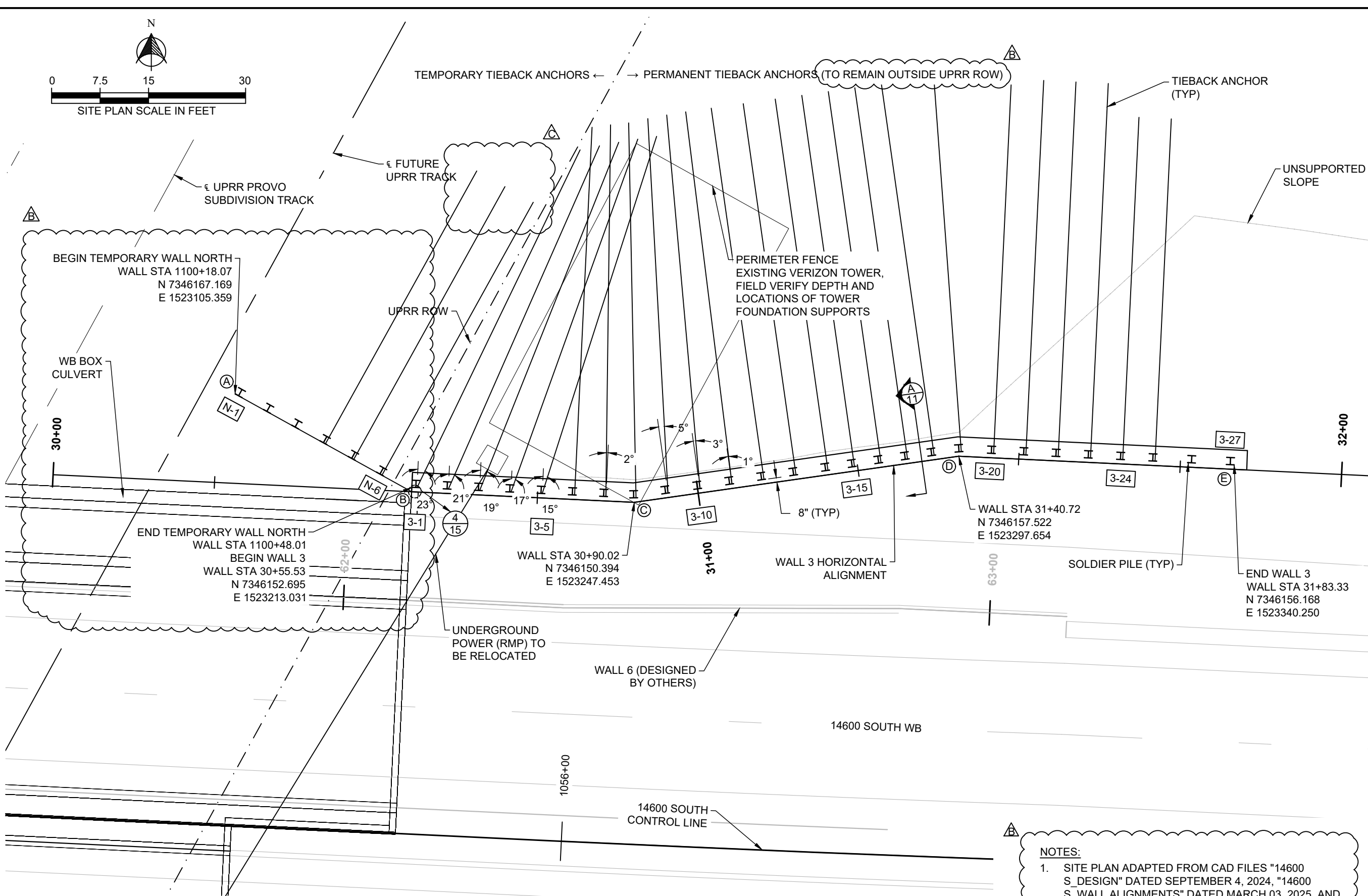
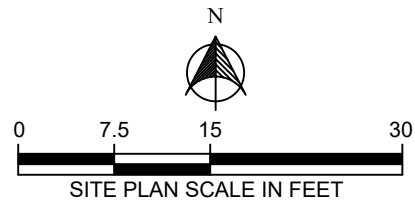


DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 3 of 17	CHECKED: BHG APPROVED: BHG

- NOTES:**
- SITE PLAN ADAPTED FROM CAD FILES "14600 S_WALL DESIGN" DATED SEPTEMBER 4, 2024, "14600 S_WALL ALIGNMENTS" DATED MARCH 03, 2025, AND PIT GRADING WALL ALIGNMENTS DATED MAY 15, 2025, ALL PROVIDED BY HDR.
 - FIELD VERIFY PROPOSED STRUCTURE AND WALL LOCATIONS PRIOR TO SOLDIER PILE INSTALLATION.
 - FIELD VERIFY EXISTING UTILITIES AND BURIED STRUCTURES PRIOR TO SOLDIER PILE INSTALLATION AND EXCAVATION.



OVERALL SITE PLAN
SCALE: 1" = 75'



CONTRACTOR: **WADSWORTH**
 REGISTERED PROFESSIONAL ENGINEER
 Draper, Utah
 (801)553-1661

DESIGNER: **GERHART COLE**
 MICHAEL COLE
 Draper, Utah
 (801)848-0055

14600 SOUTH RAILROAD CROSSING PROJECT
 BLUFFDALE, UTAH
 TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

SITE PLAN - WALLS 3 & TEMPORARY WALL NORTH

REVISION:	DATE:	DRAWN:	DESCRIPTION:
A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC



CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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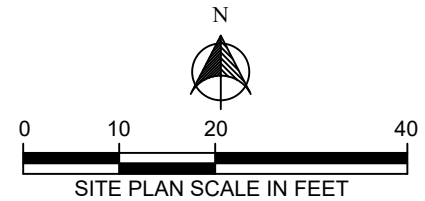
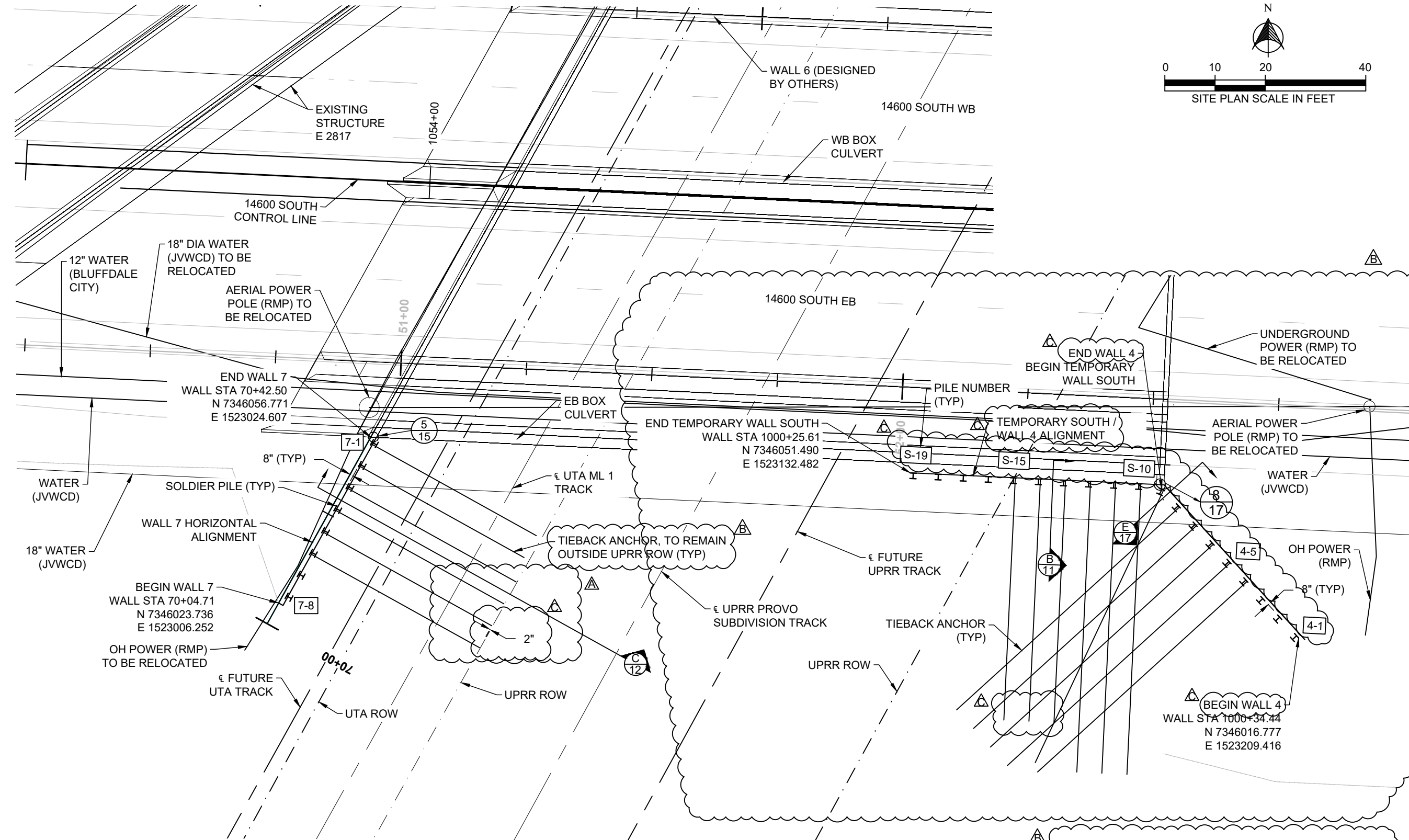
SITE PLAN - WALL 3 & TEMPORARY WALL NORTH
 SCALE: 1" = 15'

- NOTES:**
- SITE PLAN ADAPTED FROM CAD FILES "14600 S DESIGN" DATED SEPTEMBER 4, 2024, "14600 S_WALL ALIGNMENTS" DATED MARCH 03, 2025, AND PIT GRADING WALL ALIGNMENTS DATED MAY 15, 2025, ALL PROVIDED BY HDR.
 - FIELD VERIFY PROPOSED STRUCTURE AND WALL LOCATIONS PRIOR TO SOLDIER PILE INSTALLATION.
 - FIELD VERIFY EXISTING UTILITIES AND BURIED STRUCTURES PRIOR TO SOLDIER PILE INSTALLATION AND EXCAVATION.



REVISIONS

DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER:	CHECKED: BHG
	APPROVED: BHG



CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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SITE PLAN - WALLS 7, TEMPORARY WALL SOUTH, & WALL 4
SCALE: 1" = 20'

- NOTES:**
- SITE PLAN ADAPTED FROM CAD FILES "14600 S DESIGN" DATED SEPTEMBER 4, 2024, "14600 S_WALL ALIGNMENTS" DATED MARCH 03, 2025, AND PIT GRADING_WALL ALIGNMENTS DATED MAY 15, 2025, ALL PROVIDED BY HDR.
 - FIELD VERIFY PROPOSED STRUCTURE AND WALL LOCATIONS PRIOR TO SOLDIER PILE INSTALLATION.
 - FIELD VERIFY EXISTING UTILITIES AND BURIED STRUCTURES PRIOR TO SOLDIER PILE INSTALLATION AND EXCAVATION.



CONTRACTOR: WADSWORTH ENGINEERS
DESIGNER: GERHART COLE ENGINEERS
14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN
SITE PLAN - WALLS 7, TEMPORARY WALL SOUTH, & WALL 4

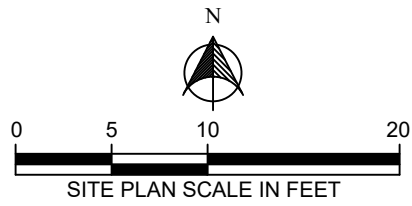
REVISION:	DATE:	DRAWN:	DESCRIPTION:
A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC



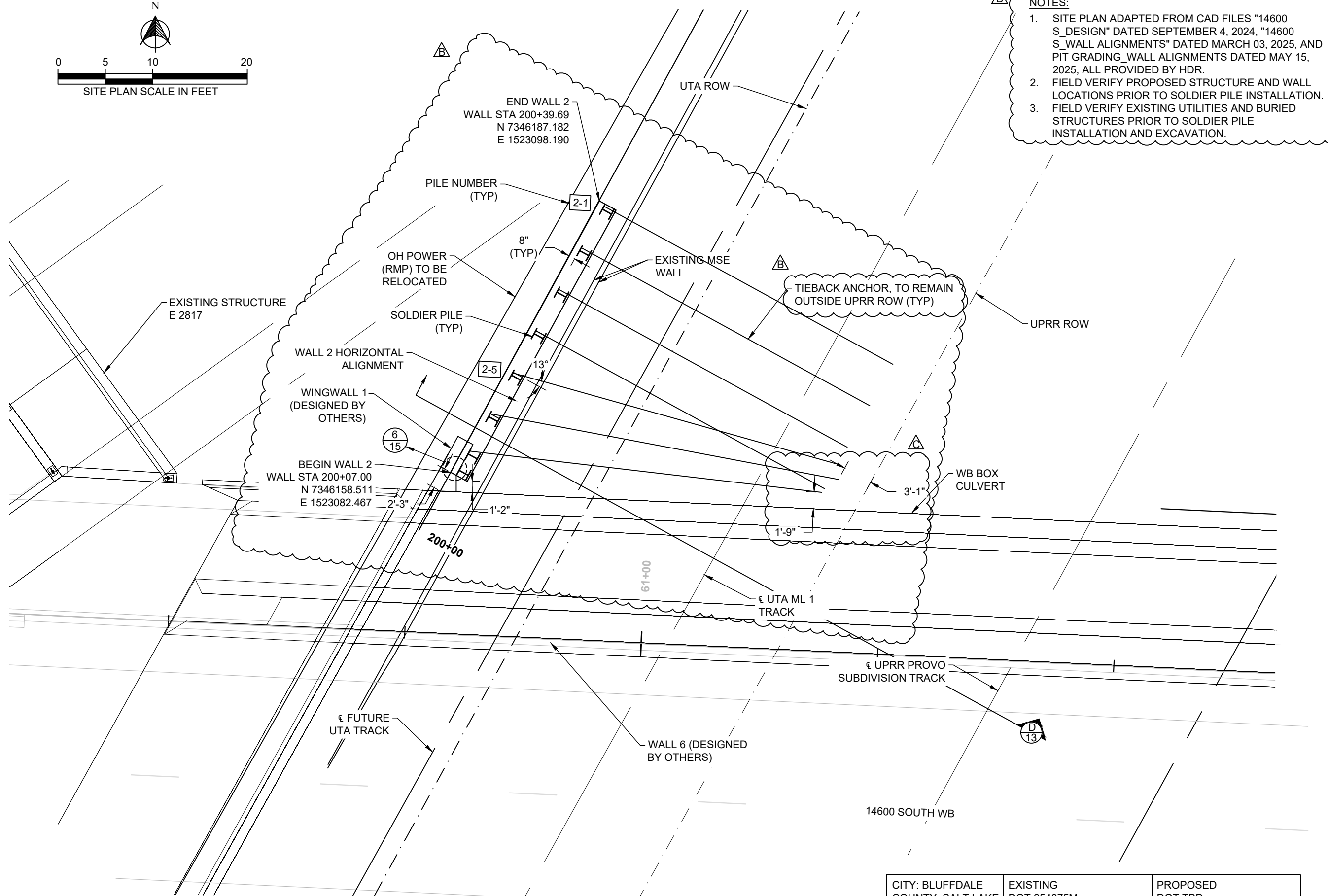
DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 5 of 17	CHECKED: BHG
	APPROVED: BHG



REVISIONS



- NOTES:**
1. SITE PLAN ADAPTED FROM CAD FILES "14600 S DESIGN" DATED SEPTEMBER 4, 2024, "14600 S_WALL ALIGNMENTS" DATED MARCH 03, 2025, AND "PIT GRADING_WALL ALIGNMENTS" DATED MAY 15, 2025, ALL PROVIDED BY HDR.
 2. FIELD VERIFY PROPOSED STRUCTURE AND WALL LOCATIONS PRIOR TO SOLDIER PILE INSTALLATION.
 3. FIELD VERIFY EXISTING UTILITIES AND BURIED STRUCTURES PRIOR TO SOLDIER PILE INSTALLATION AND EXCAVATION.



14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN
SITE PLAN - WALL 2

REVISION:	DATE:	DRAWN:	DESCRIPTION:
A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC



DATE:	10/25/2024	DESIGNED:	AWL
PROJECT NUMBER:	22-1474	DRAWN:	AWL
SHEET NUMBER:	6 of 17	CHECKED:	BHG
		APPROVED:	BHG

CITY: BLUFFDALE	EXISTING DOT 254875M	PROPOSED DOT TBD
COUNTY: SALT LAKE	UP MP 725.66, PROVO SUB	UP MP 725.58, PROVO SUB
STATE: UTAH	UTA MP S19.37	UTA MP S19.45
DATE: 10/17/2024	LATITUDE: 40.487195	LATITUDE: 40.486180
	LONGITUDE: -111.920975	LONGITUDE: -111.921686

SITE PLAN - WALL 2
SCALE: 1" = 10'



REVISIONS

NOTES:

- ELEVATION VIEWS ADAPTED FROM PDF FILES "14600S_WALL2 PROFILE" DATED FEBRUARY 20, 2025, "14600S_PIT WALL PROFILES" DATED MAY 15, 2025, AND "14600S_VERIZON WALL PROFILE" DATED MAY 16, 2025, ALL PROVIDED BY HDR.
- FIELD VERIFY PROPOSED STRUCTURE AND WALL LOCATIONS PRIOR TO SOLDIER PILE INSTALLATION.
- EXISTING UTILITIES MUST BE FIELD VERIFIED PRIOR TO SOLDIER PILE AND TIEBACK ANCHOR INSTALLATION.
- CRANES, PUMP TRUCKS, AND SIMILAR LARGE CONSTRUCTION EQUIPMENT MAY NOT BE PLACED BEHIND WALLS 2 AND 7.
- CRANES AND CRANE MATS SHALL BE A MINIMUM OF 10 FEET BACK FROM THE FACE OF WALL 3 AND TEMPORARY WALL NORTH AND A MINIMUM OF 20 FEET BACK FROM THE FACE OF WALL FOR TEMPORARY WALL SOUTH AND WALL 4. SEE GENERAL NOTES FOR MAXIMUM GROUND BEARING PRESSURES THAT WERE CONSIDERED IN THE WALL DESIGNS.

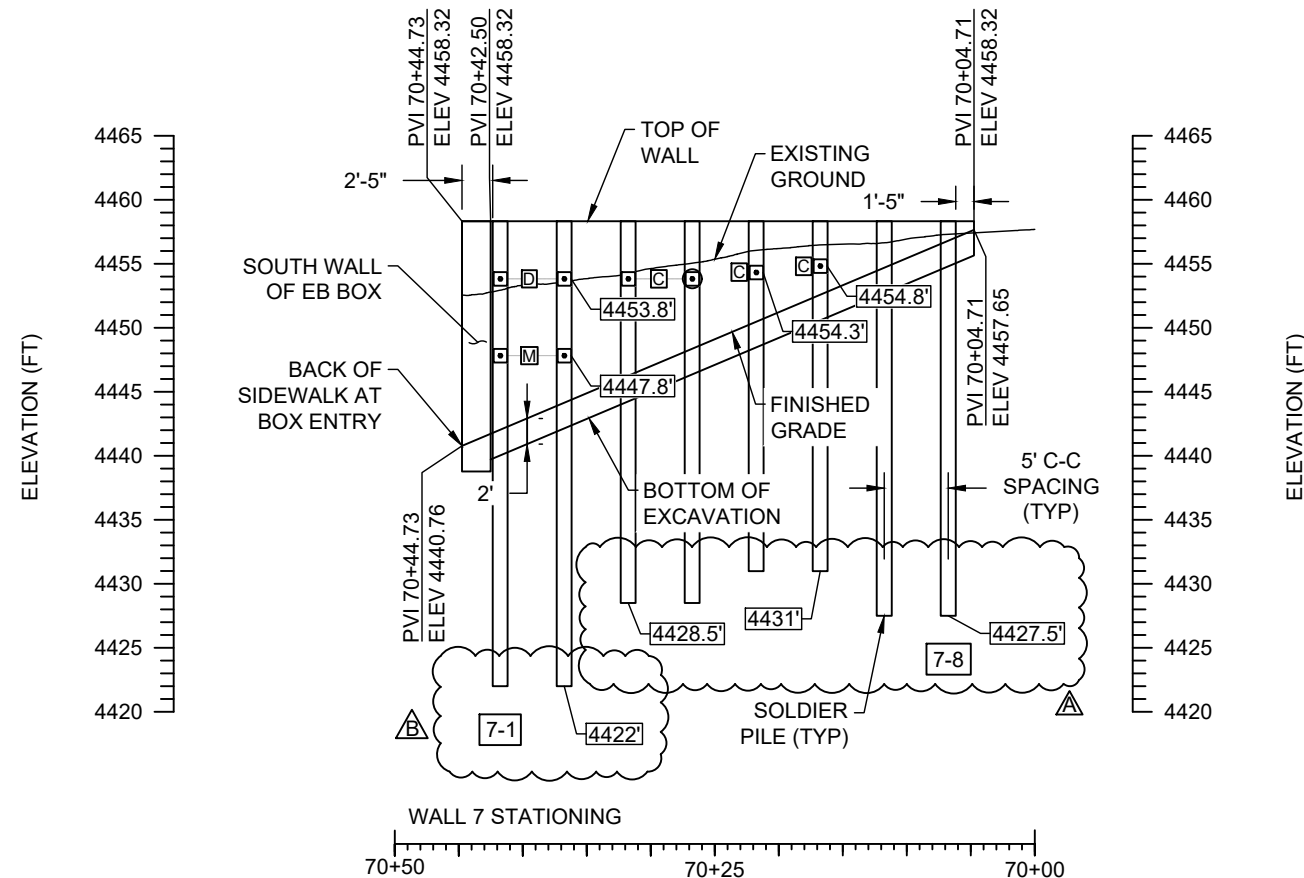
LEGEND

- TIEBACK ANCHOR SYMBOL
- A TIEBACK ANCHOR TYPE
- #### ELEVATION MARKER
- ⊙ PERFORMANCE TEST ANCHOR
- ### SOLDIER PILE NUMBER
- CJ CONTRACTION JOINT

SOLDIER PILE SCHEDULE		
WALL	PILE NUMBER	MIN. PILE SIZE
2	2-1 TO 2-8	HP 14X117
3	3-1 TO 3-27	HP14X89
7	7-1 TO 7-8	HP14X117
4	4-1 TO 4-9	HP14X117
TEMPORARY	N-1 TO N-6 S-10 TO S-19	HP14X117

TIEBACK ANCHOR SCHEDULE						
TYPE	SIZE	MIN. DRILLED HOLE LENGTH (FT)	MIN. BONDED LENGTH (FT)	MIN. UNBONDED LENGTH (FT)	INSTALLATION ANGLE (DEG)	DESIGN LOAD (KIPS)
A	#14	58	51	7	15 (U.N.O.)	69
B	#11	53	48	5	15	49
C	2 STRAND	40	29	11	15	64
D	2 STRAND	40	27	13	15	58
E	#14	60	50	10	15 (U.N.O.)	68
F	#10	50	40	10	15 (U.N.O.)	47
G	#14	60	55	5	15 (U.N.O.)	68
H	2 STRAND	36	26	10	15 (U.N.O.)	48
I	2 STRAND	37	24	13	15 (U.N.O.)	43
J	2 STRAND	37	23	14	10	42
K	2 STRAND	38	22	16	10	40
L	2 STRAND	34	24	10	15 (U.N.O.)	43
M	2 STRAND	38	28	10	15	61

NOTE: TYPES E & F ARE TEMPORARY TIEBACK ANCHORS



CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN
ELEVATION VIEW - WALL 7

CONTRACTOR:	DESIGNER:	DATE:	DESCRIPTION:
WADSWORTH ENGINEERS	GERHART COLE	1/29/25	RESPONSE TO DRC
		5/23/25	RESPONSE TO DRC
		7/10/25	RESPONSE TO DRC



DATE:	DESIGNED:
10/25/2024	AWL
PROJECT NUMBER:	DRAWN:
22-1474	AWL
SHEET NUMBER:	CHECKED:
7 of 17	BHG
	APPROVED:
	BHG

- NOTES:**
- ELEVATION VIEWS ADAPTED FROM PDF FILES "14600S_WALL2 PROFILE" DATED FEBRUARY 20, 2025, "14600 S_PIT WALL PROFILES" DATED MAY 15, 2025, AND "14600S_VERIZON WALL PROFILE" DATED MAY 16, 2025, ALL PROVIDED BY HDR.
 - FIELD VERIFY PROPOSED STRUCTURE AND WALL LOCATIONS PRIOR TO SOLDIER PILE INSTALLATION.
 - EXISTING UTILITIES MUST BE FIELD VERIFIED PRIOR TO SOLDIER PILE AND TIEBACK ANCHOR INSTALLATION.
 - CRANES, PUMP TRUCKS, AND SIMILAR LARGE CONSTRUCTION EQUIPMENT MAY NOT BE PLACED BEHIND WALLS 2 AND 7.
 - CRANES AND CRANE MATS SHALL BE A MINIMUM OF 10 FEET BACK FROM THE FACE OF WALL 3 AND TEMPORARY WALL NORTH AND A MINIMUM OF 20 FEET BACK FROM THE FACE OF WALL FOR TEMPORARY WALL SOUTH AND WALL 4. SEE GENERAL NOTES FOR MAXIMUM GROUND BEARING PRESSURES THAT WERE CONSIDERED IN THE WALL DESIGNS.

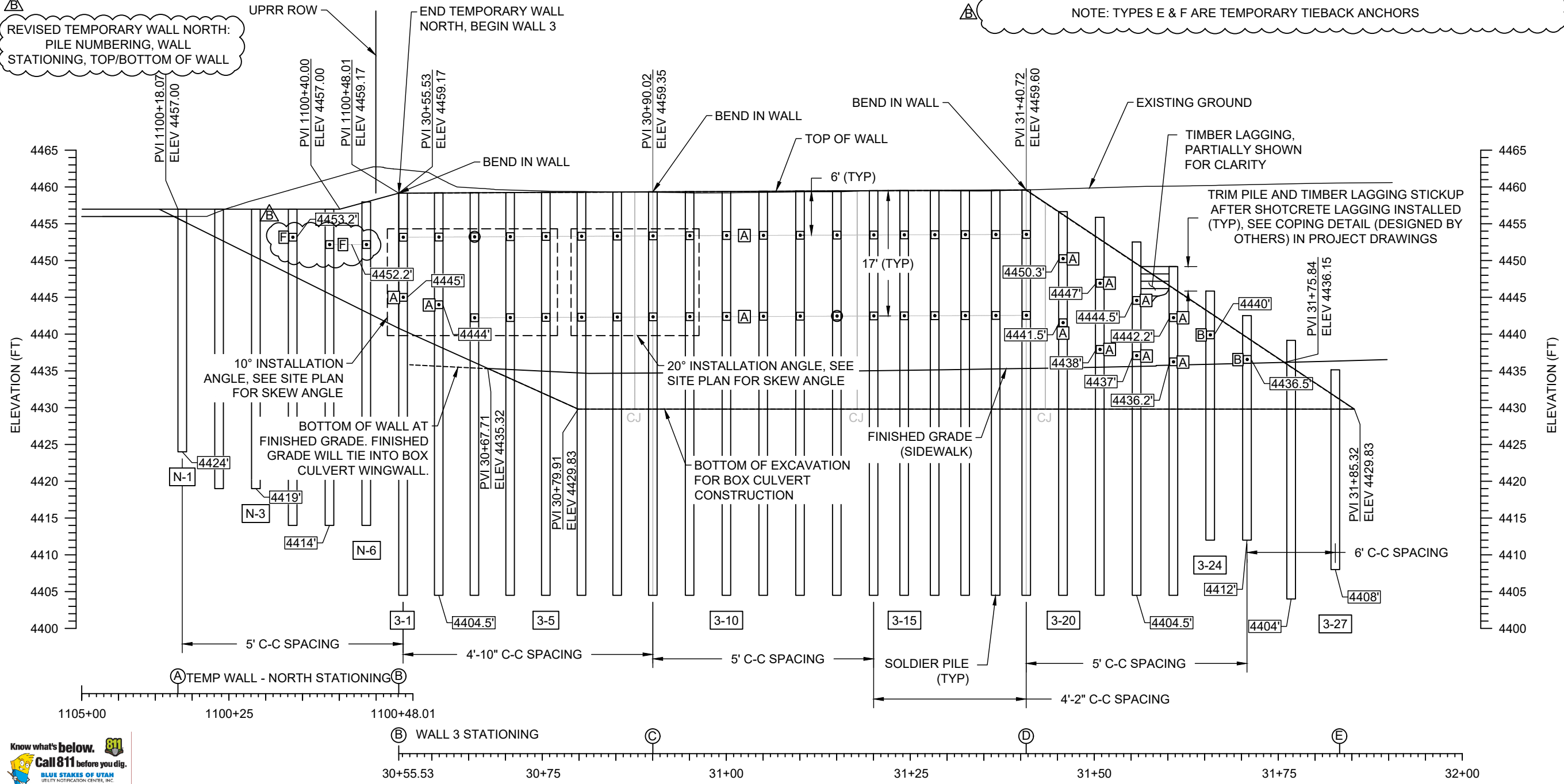
LEGEND


- TIEBACK ANCHOR SYMBOL
- △ TIEBACK ANCHOR TYPE
- #### ELEVATION MARKER
- ⊙ PERFORMANCE TEST ANCHOR
- ### SOLDIER PILE NUMBER
- CJ CONTRACTION JOINT

SOLDIER PILE SCHEDULE		
WALL	PILE NUMBER	MIN. PILE SIZE
2	2-1 TO 2-8	HP 14X117
3	3-1 TO 3-27	HP14X89
7	7-1 TO 7-8	HP14X117
4	4-1 TO 4-9	HP14X117
TEMPORARY	N-1 TO N-6 S-10 TO S-19	HP14X117


TIEBACK ANCHOR SCHEDULE						
TYPE	SIZE	MIN. DRILLED HOLE LENGTH (FT)	MIN. BONDED LENGTH (FT)	MIN. UNBONDED LENGTH (FT)	INSTALLATION ANGLE (DEG)	DESIGN LOAD (KIPS)
A	#14	58	51	7	15 (U.N.O.)	69
B	#11	53	48	5	15	49
C	2 STRAND	40	29	11	15	64
D	2 STRAND	40	27	13	15	58
E	#14	60	50	10	15 (U.N.O.)	68
F	#10	50	40	10	15 (U.N.O.)	47
G	#14	60	55	5	15 (U.N.O.)	68

NOTE: TYPES E & F ARE TEMPORARY TIEBACK ANCHORS





CONTRACTOR:
WADSWORTH




DESIGNER:
GERHART COLE

14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

ELEVATION VIEW - WALL 3 & TEMPORARY WALL NORTH

REVISION:	DATE:	DRAWN:	DESCRIPTION:
△	1/29/25	AWL	RESPONSE TO DRC
△	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
△	7/10/25	ZPF	RESPONSE TO DRC



BRIAN H. GARRETT
LICENSED PROFESSIONAL ENGINEER
STATE OF UTAH
4939562

DATE:	DESIGNED:
10/25/2024	AWL
PROJECT NUMBER:	DRAWN:
22-1474	AWL
SHEET NUMBER:	CHECKED:
8 of 17	BHG
	APPROVED:
	BHG



NOTES:

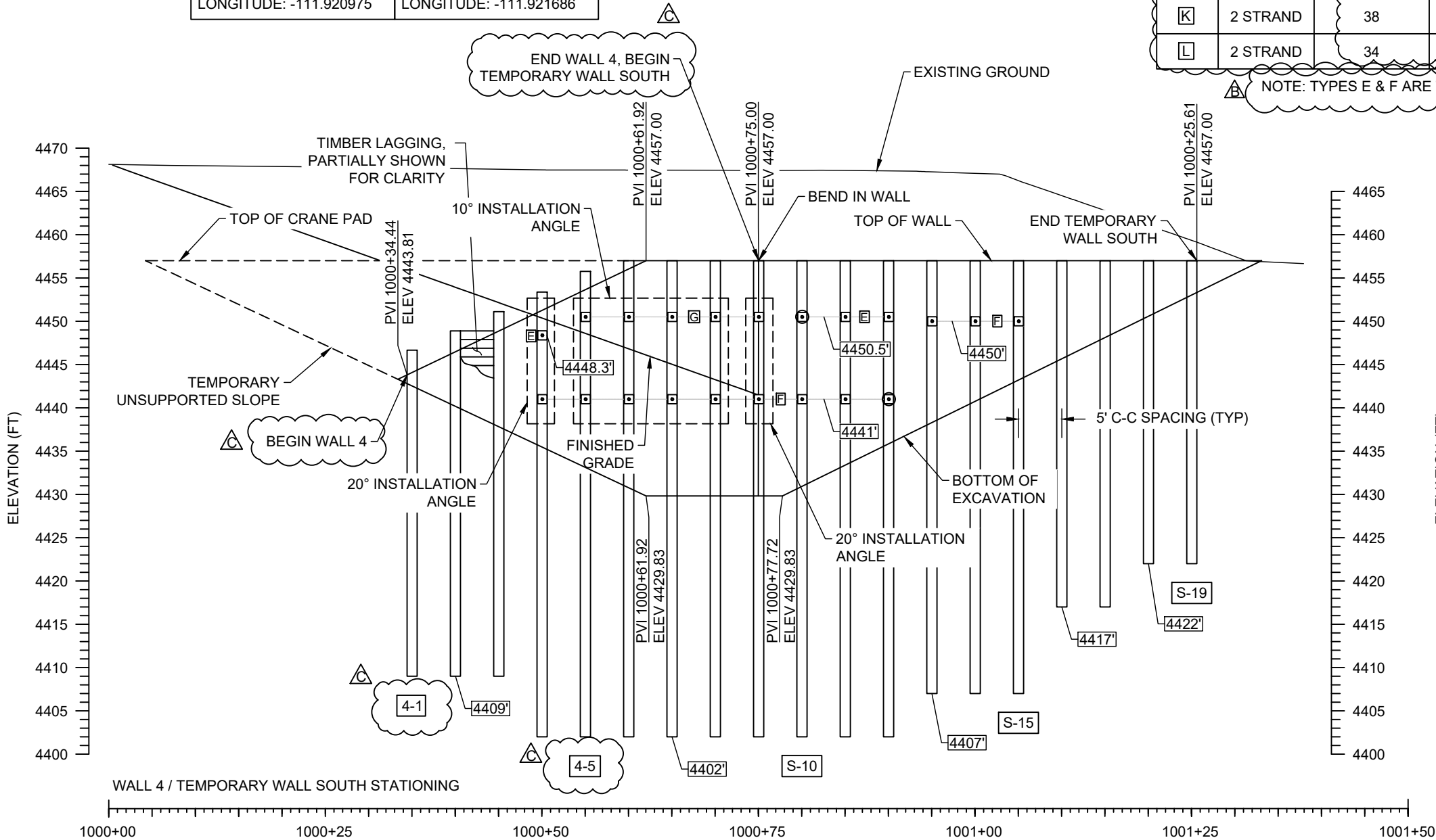
- ELEVATION VIEWS ADAPTED FROM PDF FILES "14600S_WALL2 PROFILE" DATED FEBRUARY 20, 2025, "14600 S_PIT WALL PROFILES" DATED MAY 15, 2025, AND "14600S_VERIZON WALL PROFILE" DATED MAY 16, 2025, ALL PROVIDED BY HDR.
- FIELD VERIFY PROPOSED STRUCTURE AND WALL LOCATIONS PRIOR TO SOLDIER PILE INSTALLATION.
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- CRANES AND CRANE MATS SHALL BE A MINIMUM OF 10 FEET BACK FROM THE FACE OF WALL 3 AND TEMPORARY WALL NORTH AND A MINIMUM OF 20 FEET BACK FROM THE FACE OF WALL FOR TEMPORARY WALL SOUTH AND WALL 4. SEE GENERAL NOTES FOR MAXIMUM GROUND BEARING PRESSURES THAT WERE CONSIDERED IN THE WALL DESIGNS.

CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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SOLDIER PILE SCHEDULE		
WALL	PILE NUMBER	MIN. PILE SIZE
2	2-1 TO 2-8	HP 14X117
3	3-1 TO 3-27	HP14X89
7	7-1 TO 7-8	HP14X117
4	4-1 TO 4-9	HP14X117
TEMPORARY	N-1 TO N-6 S-10 TO S-19	HP14X117

TIEBACK ANCHOR SCHEDULE						
TYPE	SIZE	MIN. DRILLED HOLE LENGTH (FT)	MIN. BONDED LENGTH (FT)	MIN. UNBONDED LENGTH (FT)	INSTALLATION ANGLE (DEG)	DESIGN LOAD (KIPS)
A	#14	58	51	7	15 (U.N.O.)	69
B	#11	53	48	5	15	49
C	2 STRAND	40	29	11	15	64
D	2 STRAND	40	27	13	15	58
E	#14	60	50	10	15 (U.N.O.)	68
F	#10	50	40	10	15 (U.N.O.)	47
G	#14	60	55	5	15 (U.N.O.)	68
H	2 STRAND	36	26	10	15 (U.N.O.)	48
I	2 STRAND	37	24	13	15 (U.N.O.)	43
J	2 STRAND	37	23	14	10	42
K	2 STRAND	38	22	16	10	40
L	2 STRAND	34	24	10	15 (U.N.O.)	43

NOTE: TYPES E & F ARE TEMPORARY TIEBACK ANCHORS



LEGEND

- ☐ TIEBACK ANCHOR SYMBOL
- Ⓐ TIEBACK ANCHOR TYPE
- #### ELEVATION MARKER
- ⊙ PERFORMANCE TEST ANCHOR
- ### SOLDIER PILE NUMBER
- CJ CONTRACTION JOINT

REVISED ELEVATION VIEW



14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN
ELEVATION VIEW WALL 4 & TEMPORARY WALL SOUTH

REVISION:	DATE:	DRAWN:	DESCRIPTION:
Ⓐ	1/29/25	AWL	RESPONSE TO DRC
Ⓑ	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
Ⓒ	7/10/25	ZPF	RESPONSE TO DRC



DATE:	DESIGNED:
10/25/2024	AWL
PROJECT NUMBER:	DRAWN:
22-1474	AWL
SHEET NUMBER:	CHECKED:
9 of 17	BHG
	APPROVED:
	BHG

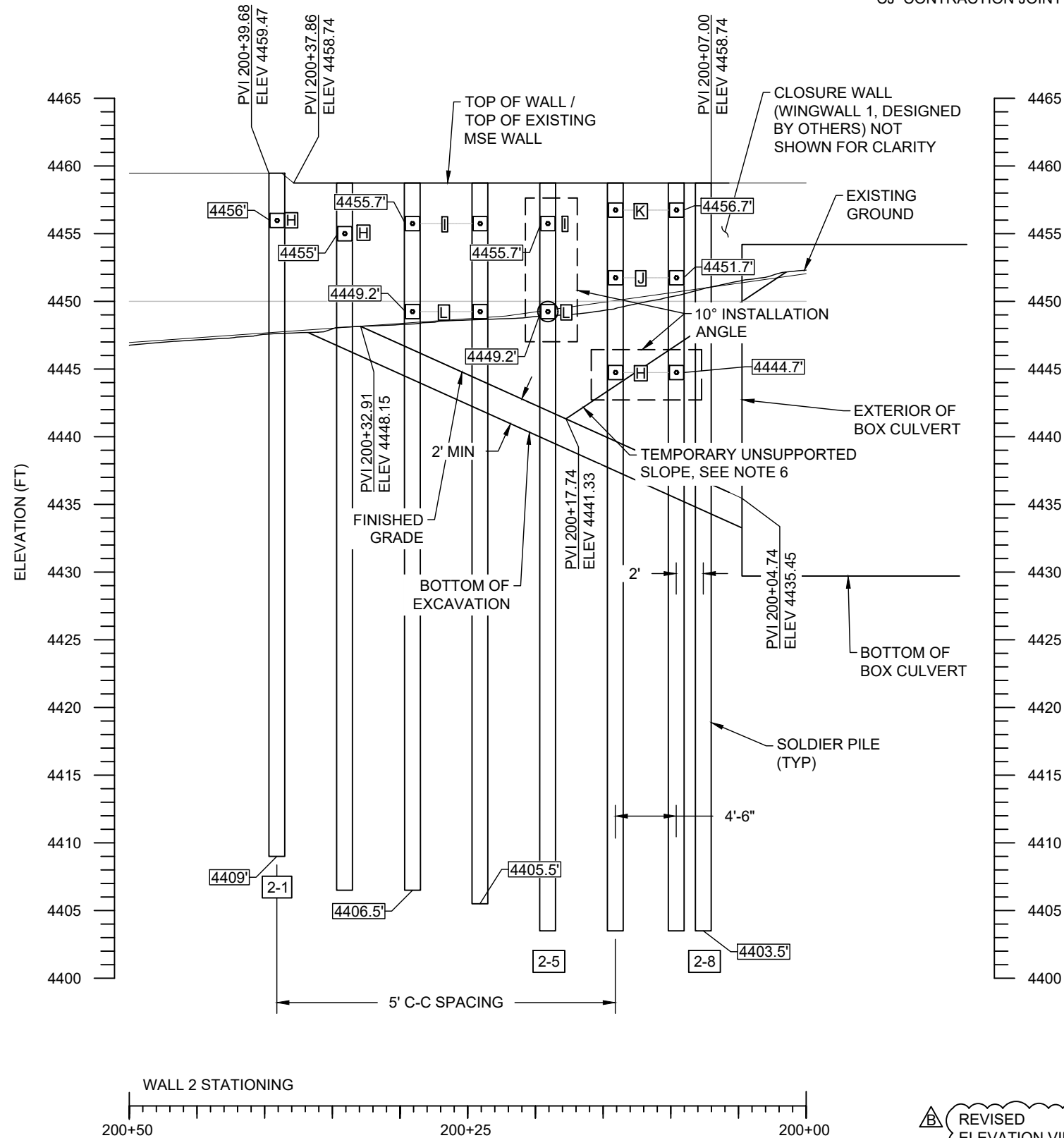


REVISIONS

CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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LEGEND

- TIEBACK ANCHOR SYMBOL
- △ TIEBACK ANCHOR TYPE
- #### ELEVATION MARKER
- ⊙ PERFORMANCE TEST ANCHOR
- ### SOLDIER PILE NUMBER
- CJ CONTRACTION JOINT



ELEVATION (FT)

TYPE	SIZE	MIN. DRILLED HOLE LENGTH (FT)	MIN. BONDED LENGTH (FT)	MIN. UNBONDED LENGTH (FT)	INSTALLATION ANGLE (DEG)	DESIGN LOAD (KIPS)
A	#14	58	51	7	15 (U.N.O.)	69
B	#11	53	48	5	15	49
C	2 STRAND	40	29	11	15	64
D	2 STRAND	40	27	13	15	58
E	#14	60	50	10	15 (U.N.O.)	68
F	#10	50	40	10	15 (U.N.O.)	47
G	#14	60	55	5	15 (U.N.O.)	68
H	2 STRAND	36	26	10	15 (U.N.O.)	48
I	2 STRAND	37	24	13	15 (U.N.O.)	43
J	2 STRAND	37	23	14	10	42
K	2 STRAND	38	22	16	10	40
L	2 STRAND	34	24	10	15 (U.N.O.)	43
M	2 STRAND	38	28	10	15	61

NOTE: TYPES E & F ARE TEMPORARY TIEBACK ANCHORS

WALL	PILE NUMBER	MIN. PILE SIZE
2	2-1 TO 2-8	HP 14X117
3	3-1 TO 3-27	HP14X89
7	7-1 TO 7-8	HP14X117
4	4-1 TO 4-9	HP14X117
TEMPORARY	N-1 TO N-6 S-10 TO S-19	HP14X117

- NOTES:**
- ELEVATION VIEWS ADAPTED FROM PDF FILES "14600S_WALL2 PROFILE" DATED FEBRUARY 20, 2025, "14600 S_PIT WALL PROFILES" DATED MAY 15, 2025, AND "14600S_VERIZON WALL PROFILE" DATED MAY 16, 2025, ALL PROVIDED BY HDR.
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 - CRANES, PUMP TRUCKS, AND SIMILAR LARGE CONSTRUCTION EQUIPMENT MAY NOT BE PLACED BEHIND WALLS 2 AND 7.
 - CRANES AND CRANE MATS SHALL BE A MINIMUM OF 10 FEET BACK FROM THE FACE OF WALL 3 AND TEMPORARY WALL NORTH AND A MINIMUM OF 20 FEET BACK FROM THE FACE OF WALL FOR TEMPORARY WALL SOUTH AND WALL 4. SEE GENERAL NOTES FOR MAXIMUM GROUND BEARING PRESSURES THAT WERE CONSIDERED IN THE WALL DESIGNS.
 - 1.5H:1V TEMPORARY UNSUPPORTED SLOPE. DO NOT EXCAVATE BELOW THIS LINE UNTIL BOX CULVERT IS INSTALLED.

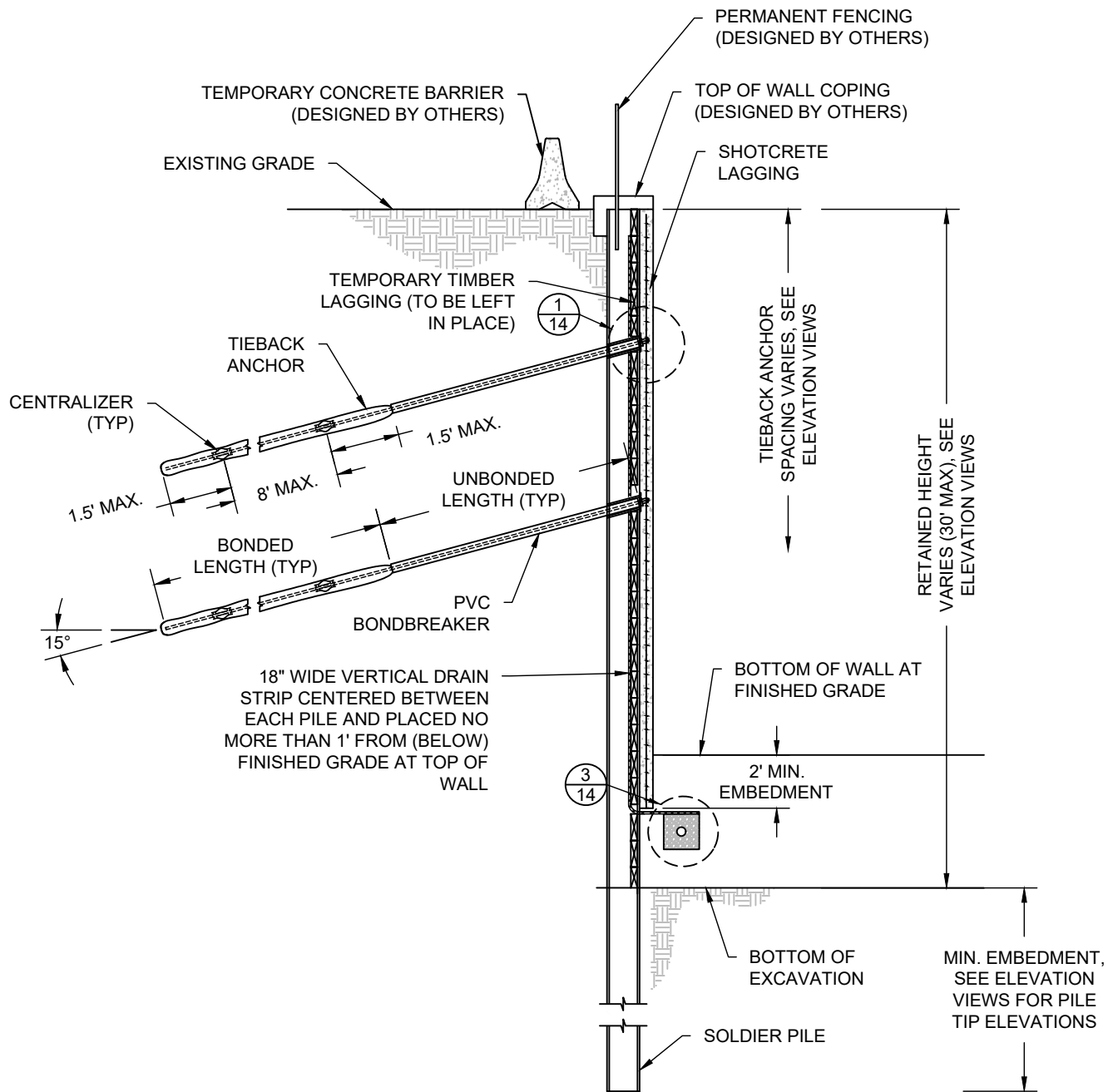


CONTRACTOR: WADSWORTH
 DESIGNER: GERHART COLE
 14600 SOUTH RAILROAD CROSSING PROJECT
 BLUFFDALE, UTAH
 TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN
 ELEVATION VIEW - WALL 2

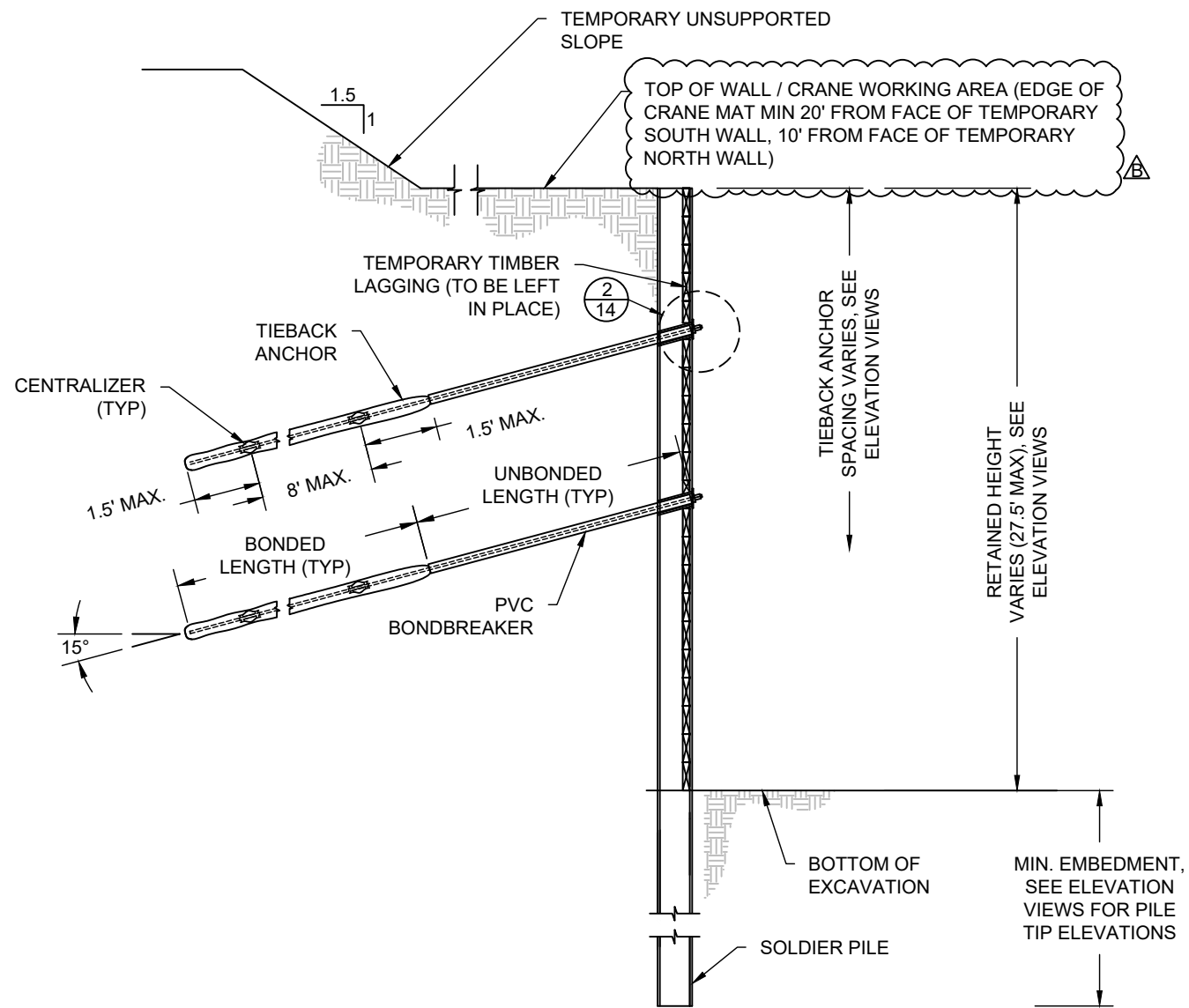


DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 10 of 17	CHECKED: BHG APPROVED: BHG

REVISIONS



A
 11
 TYPICAL SECTION VIEW - WALL 3
 NTS



B
 11
 TYPICAL SECTION VIEW - TEMPORARY WALLS
 NTS

A ADDED CENTRALIZERS

CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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14600 SOUTH RAILROAD CROSSING PROJECT
 BLUFFDALE, UTAH
 TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

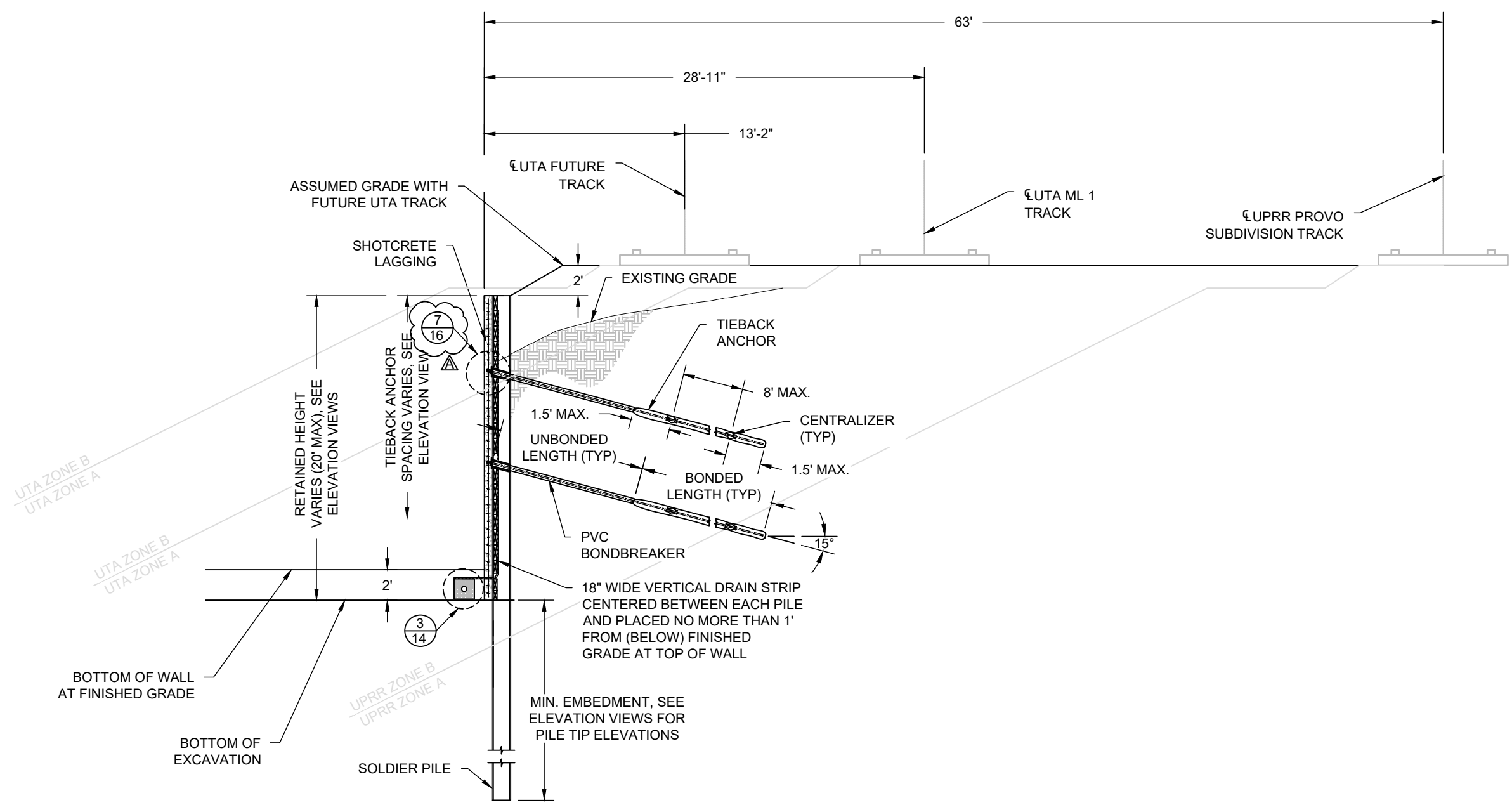
SECTION VIEWS

REVISION:	DATE:	DRAWN:	DESCRIPTION:
A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC




DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 11 of 17	CHECKED: BHG
	APPROVED: BHG

REVISIONS



C/12 TYPICAL SECTION VIEW - WALL 7
NTS

CONTRACTOR:

 WADSWORTH
 ENGINEERS
 Draper, Utah
 (801)553-1661


DESIGNER:

 GERHART COLE
 Draper, Utah
 (801)849-0055

14600 SOUTH RAILROAD CROSSING PROJECT
 BLUFFDALE, UTAH
 TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

SECTION VIEW

REVISION:	DATE:	DRAWN:	DESCRIPTION:
A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC



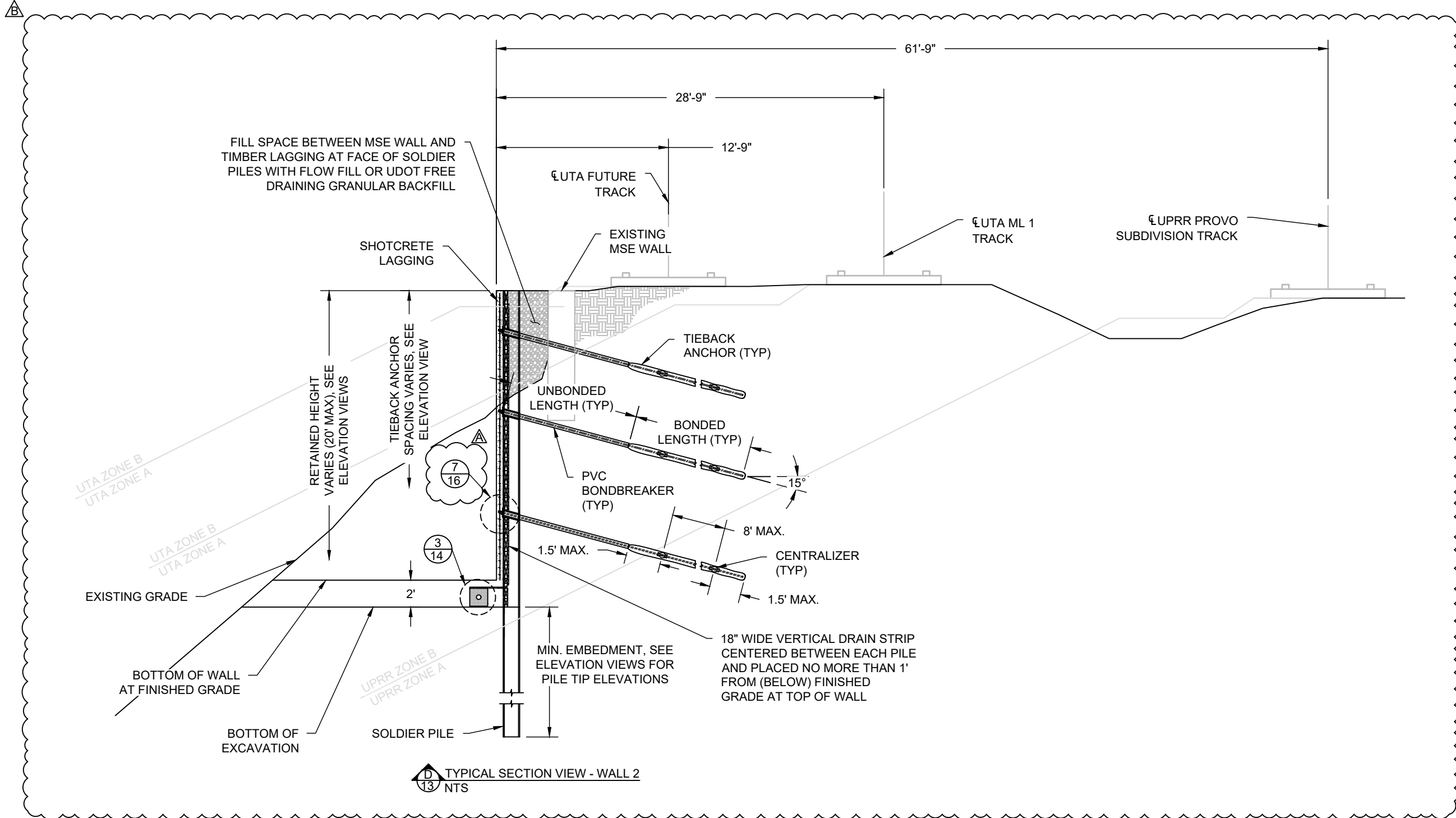
DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 12 of 17	CHECKED: BHG
	APPROVED: BHG

CITY:	EXISTING	PROPOSED
BLUFFDALE	DOT 254875M	DOT TBD
COUNTY: SALT LAKE	UP MP 725.66, PROVO SUB	UP MP 725.58, PROVO SUB
STATE: UTAH	UTA MP S19.37	UTA MP S19.45
DATE: 10/17/2024	LATITUDE: 40.487195	LATITUDE: 40.486180
	LONGITUDE: -111.920975	LONGITUDE: -111.921686

ADDED CENTRALIZERS



REVISIONS



CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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⚠️ ADDED CENTRALIZERS



CONTRACTOR: WADSWORTH CONTRACTORS
DESIGNER: GERHART COLE

14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

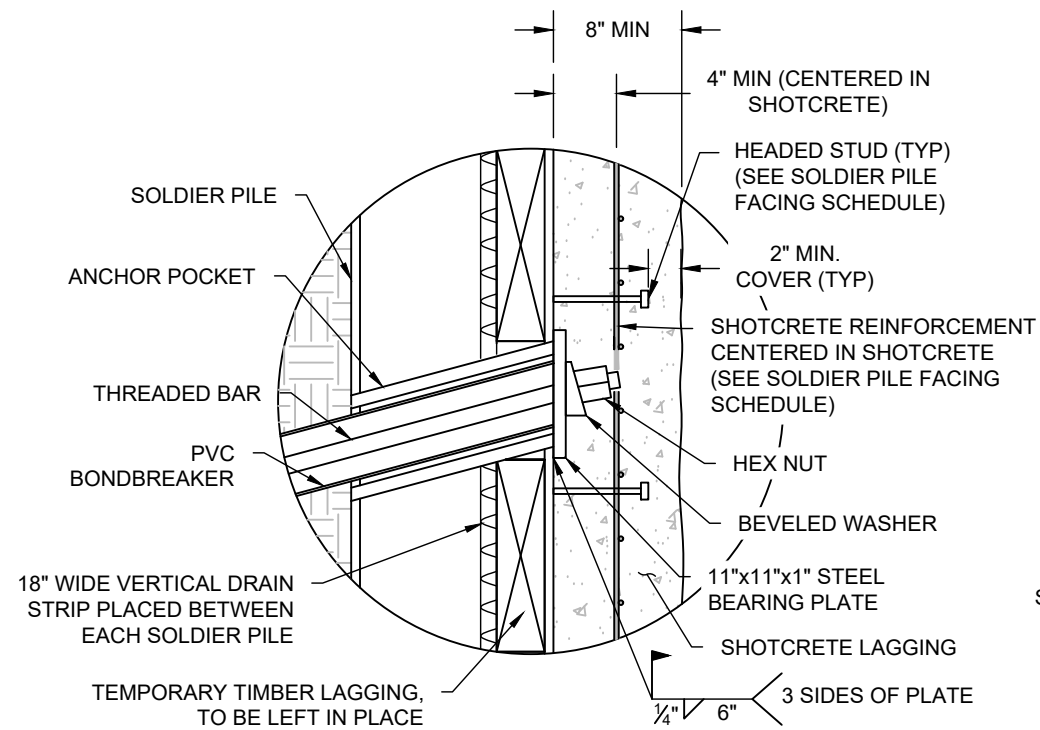
SECTION VIEW	
REVISION:	DESCRIPTION:
⚠️ A	1/29/25 AWL RESPONSE TO DRC
⚠️ B	5/23/25 AWL RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
⚠️ C	7/10/25 ZPF RESPONSE TO DRC



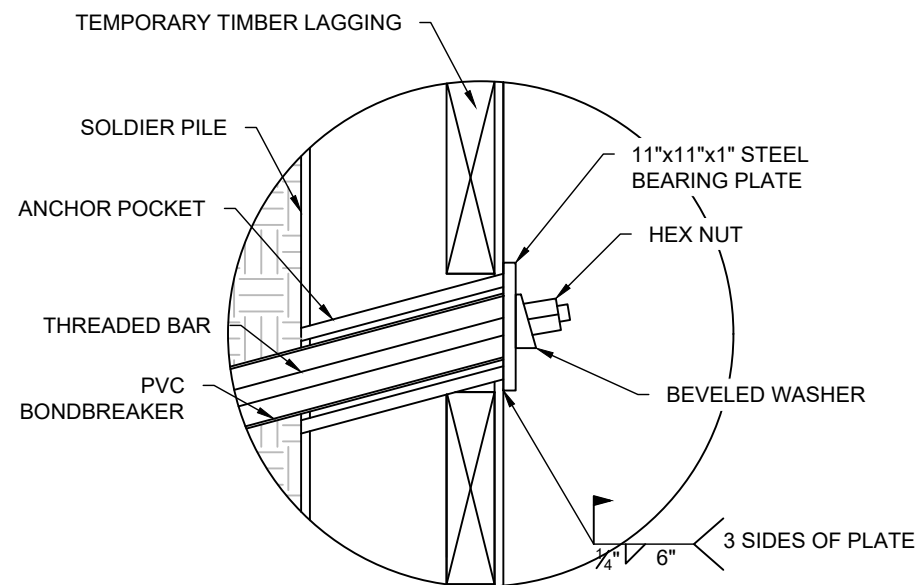
DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 13 of 17	CHECKED: BHG
	APPROVED: BHG



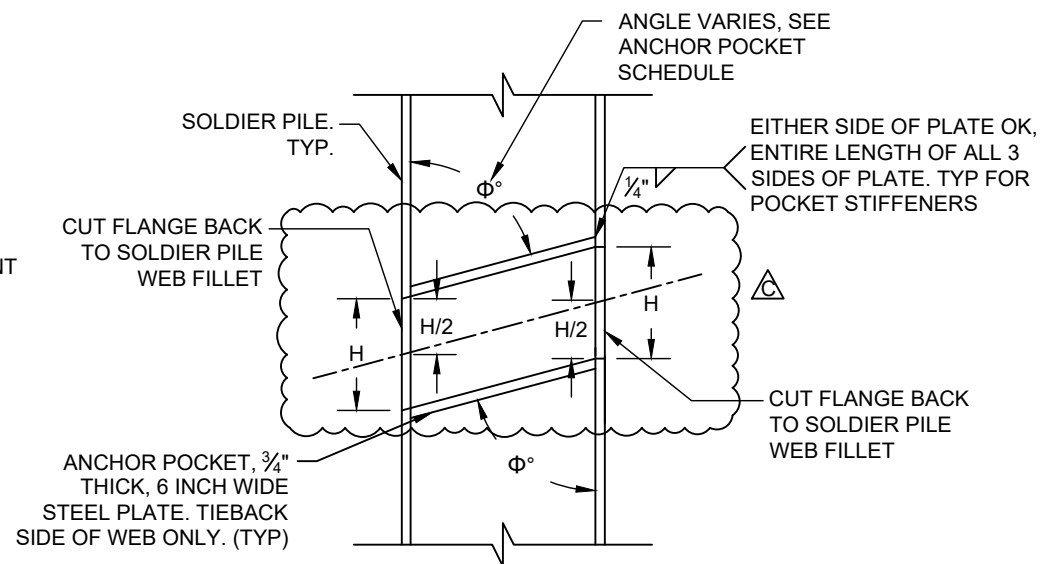
REVISIONS



1 TYPICAL ANCHOR HEAD DETAIL
14 NTS



2 TYPICAL ANCHOR HEAD DETAIL - TEMPORARY WALLS
14 NTS

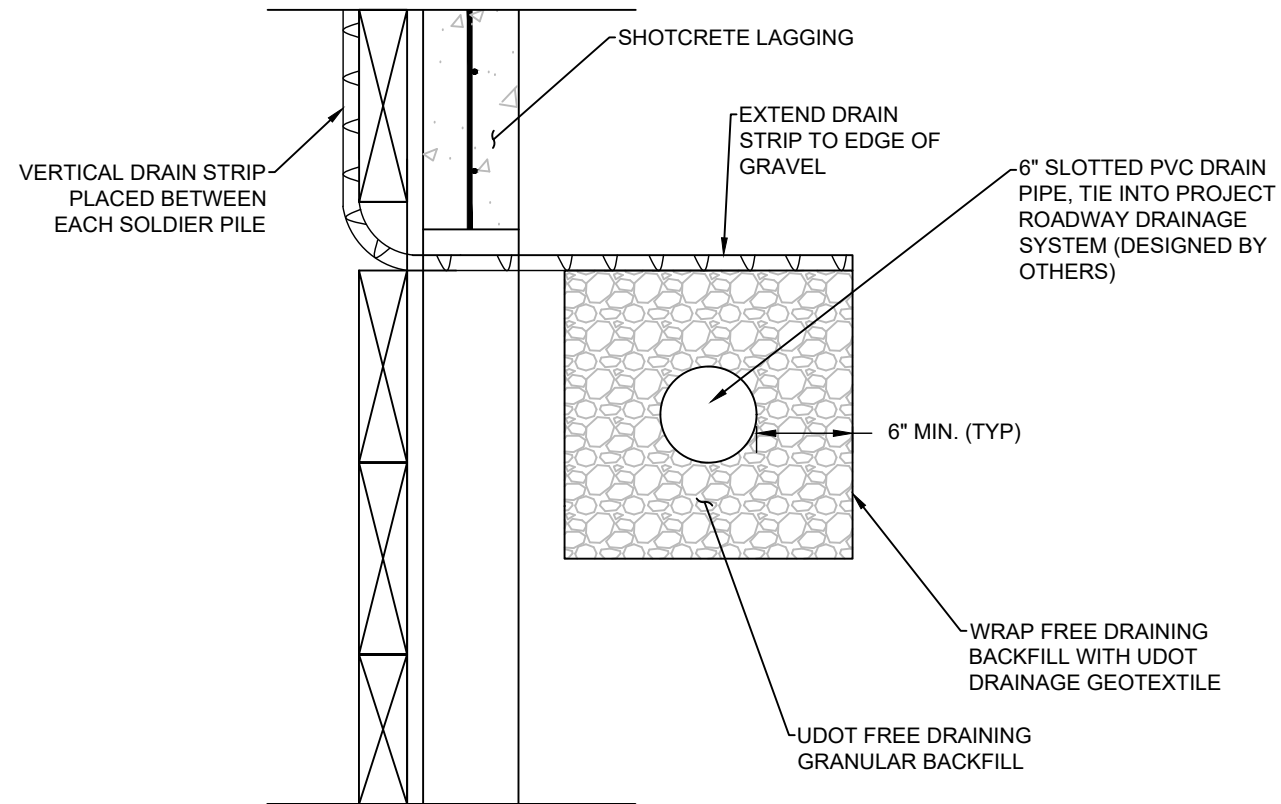


TYPICAL DETAIL - ANCHOR POCKET-PROFILE VIEW
NTS

ANCHOR POCKET SCHEDULE	
TIEBACK ANCHOR INSTALLATION ANGLE (DEG)	Φ (DEG)
10	80
15	75
20	70
25	65

NOTES:

- 'H' EQUALS 9.625 INCHES FOR WALLS 2 AND 7.
- FOR ALL OTHER WALLS 'H' EQUALS 8 INCHES.

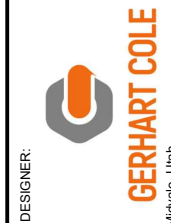


3 TYPICAL DRAINAGE DETAIL
14 NTS

SOLDIER PILE FACING SCHEDULE

WALL	FACING REINFORCMENT	HEADED STUD LENGTH, L (IN)	HEADED STUD DIAMETER (IN)	HEADED STUD SPACING (IN)	MIN SHOTCRETE THICKNESS (IN)
2	#5 BAR @ 12" O.C.	5-5/16	1/2	18	8
3, 4, & 7	#4 BAR @ 12" O.C.	5-5/16	1/2	18	8

CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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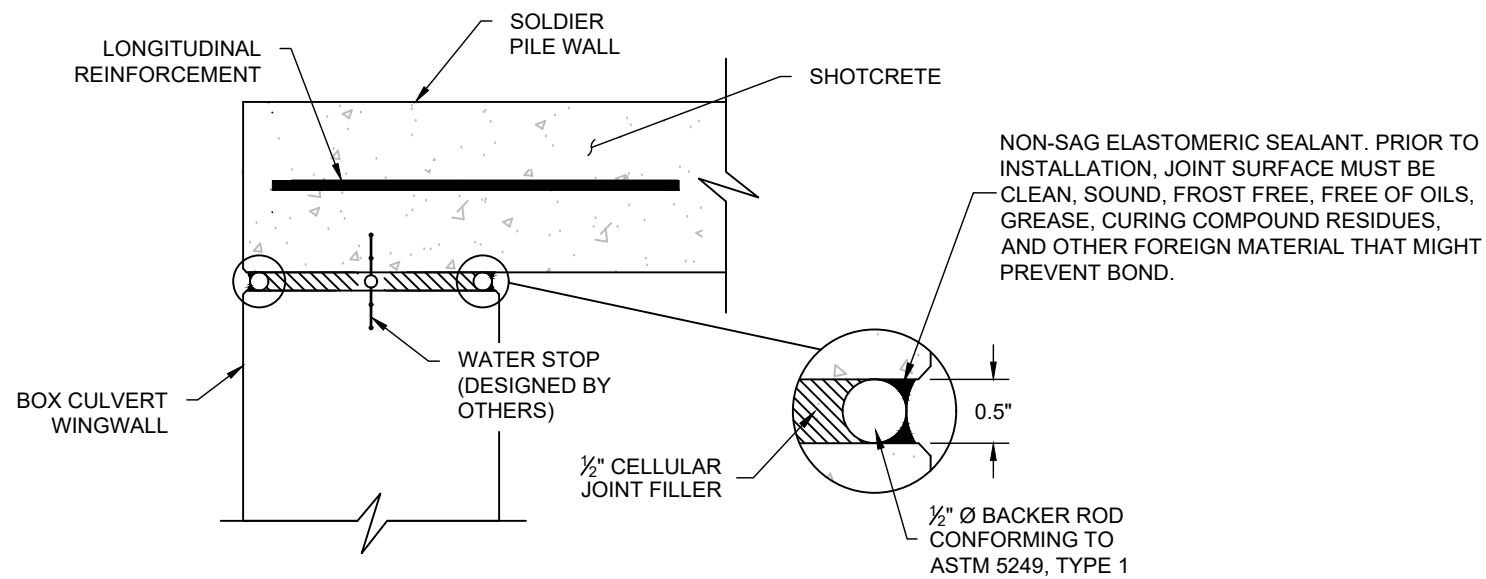
CONTRACTOR: WADSWORTH ENGINEERS
DESIGNER: GERHART COLE
14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

REVISION	DATE	DRAWN	DESCRIPTION
A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC

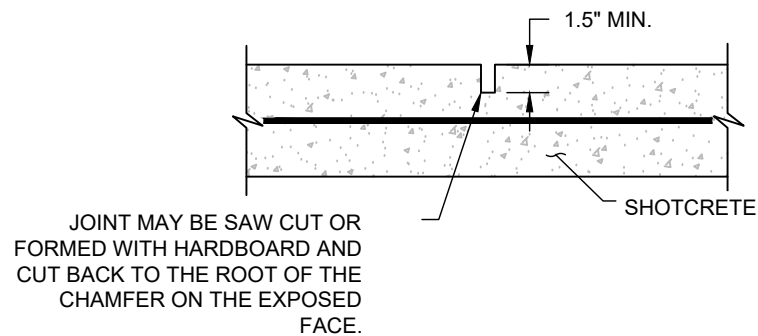


DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 14 of 17	CHECKED: BHG
	APPROVED: BHG





4 EXPANSION JOINT DETAIL - WALL 3 (PLAN VIEW)
15 NTS

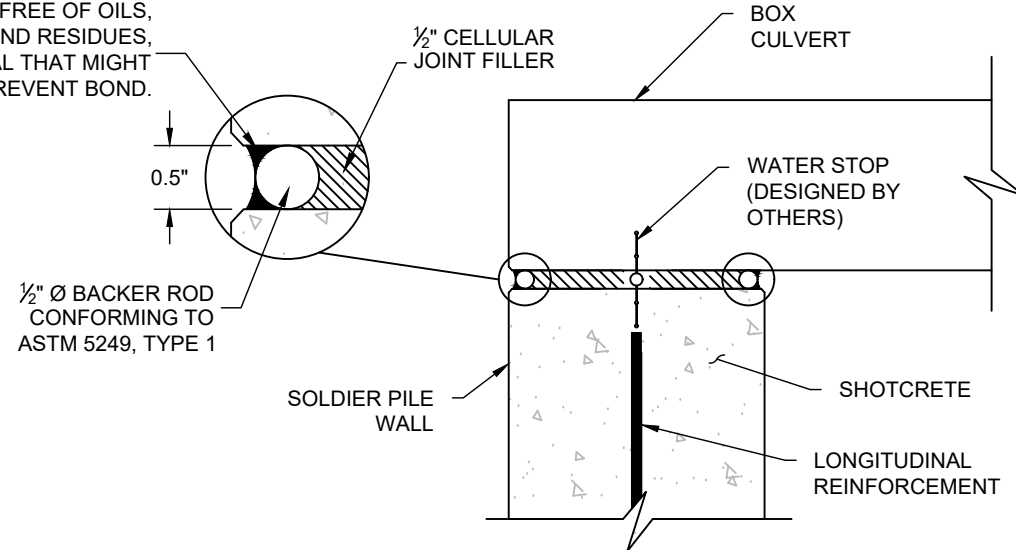


CONTRACTION JOINT DETAIL (PLAN VIEW)
NTS

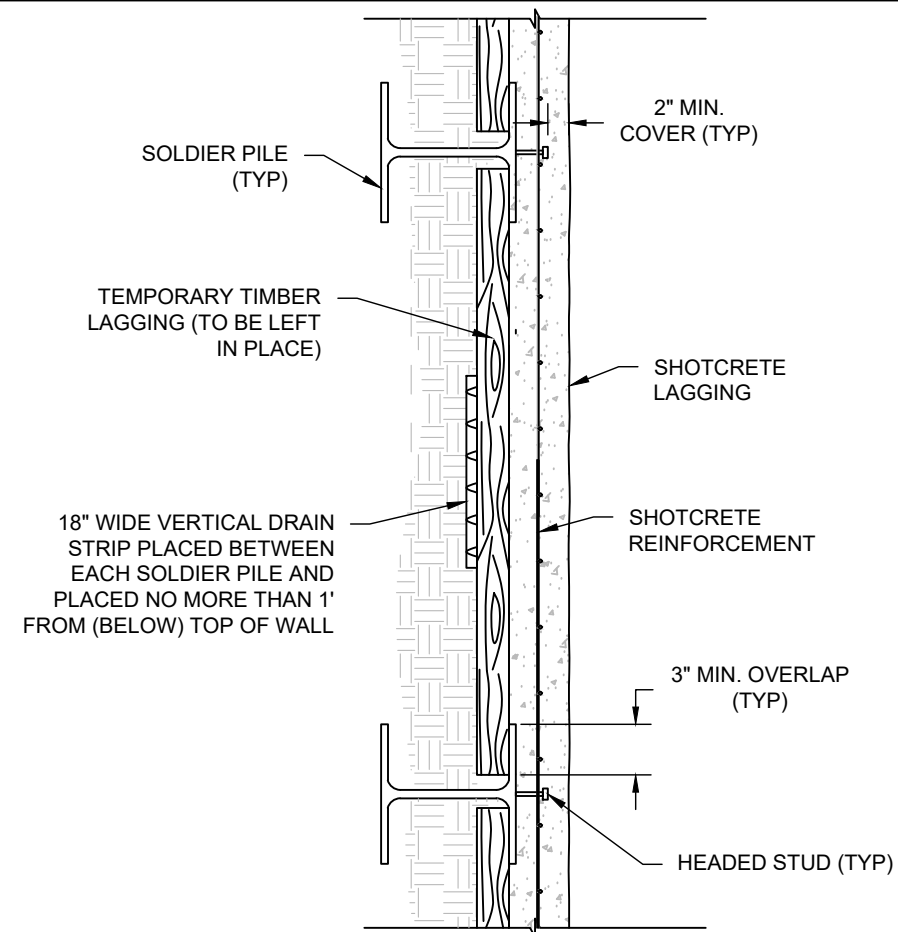
JOINT SCHEDULE	
FREQUENCY	JOINT TYPE
EVERY 30' OR LESS	CONTRACTION JOINT (CJ)

NOTE:
RELOCATE JOINT LOCATION WITHIN 2' LEFT OR RIGHT OF SPECIFIED LOCATION ON ELEVATION VIEWS TO AVOID CONFLICTS WITH SOLDIER PILES, IF NECESSARY.

NON-SAG ELASTOMERIC SEALANT. PRIOR TO INSTALLATION, JOINT SURFACE MUST BE CLEAN, SOUND, FROST FREE, FREE OF OILS, GREASE, CURING COMPOUND RESIDUES, AND OTHER FOREIGN MATERIAL THAT MIGHT PREVENT BOND.

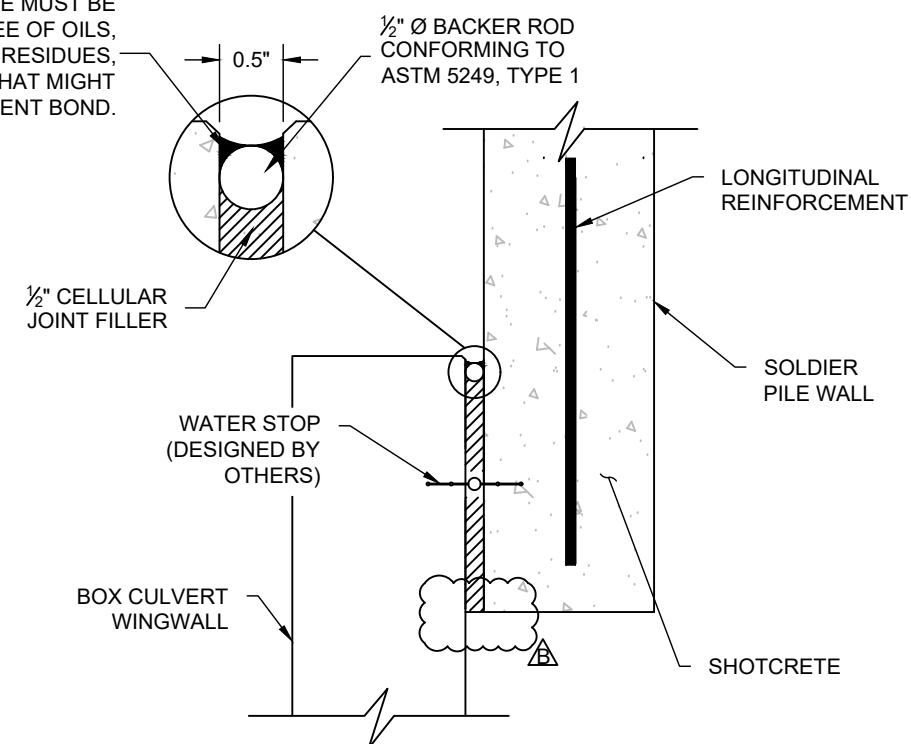


5 EXPANSION JOINT DETAIL - WALL 7 (PLAN VIEW)
15 NTS



TYPICAL DETAIL - LAGGING CONNECTION (PLAN VIEW)
NTS

NON-SAG ELASTOMERIC SEALANT. PRIOR TO INSTALLATION, JOINT SURFACE MUST BE CLEAN, SOUND, FROST FREE, FREE OF OILS, GREASE, CURING COMPOUND RESIDUES, AND OTHER FOREIGN MATERIAL THAT MIGHT PREVENT BOND.



6 EXPANSION JOINT DETAIL - WALL 2 (PLAN VIEW)
15 NTS



14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

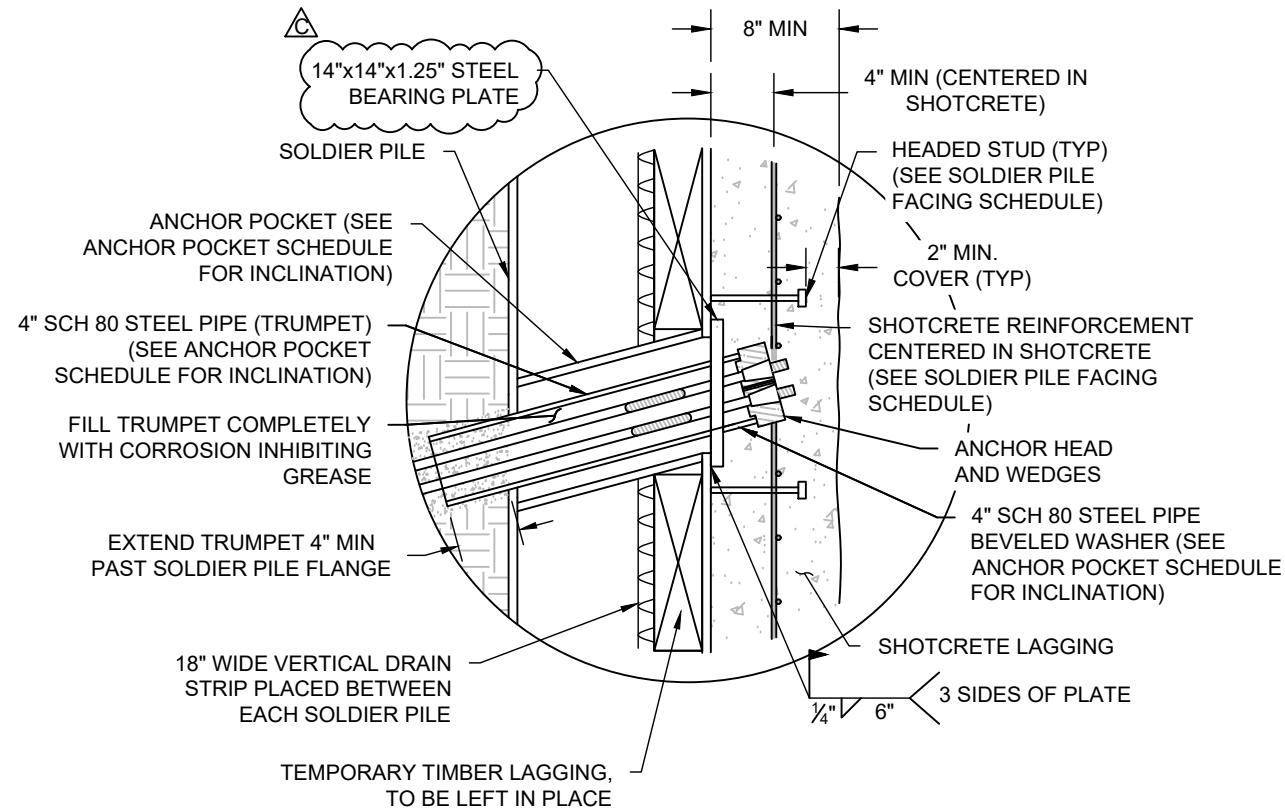
DETAILS

REVISION	DATE	DRAWN	DESCRIPTION
A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC

REVISIONS



DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 15 of 17	CHECKED: BHG
	APPROVED: BHG



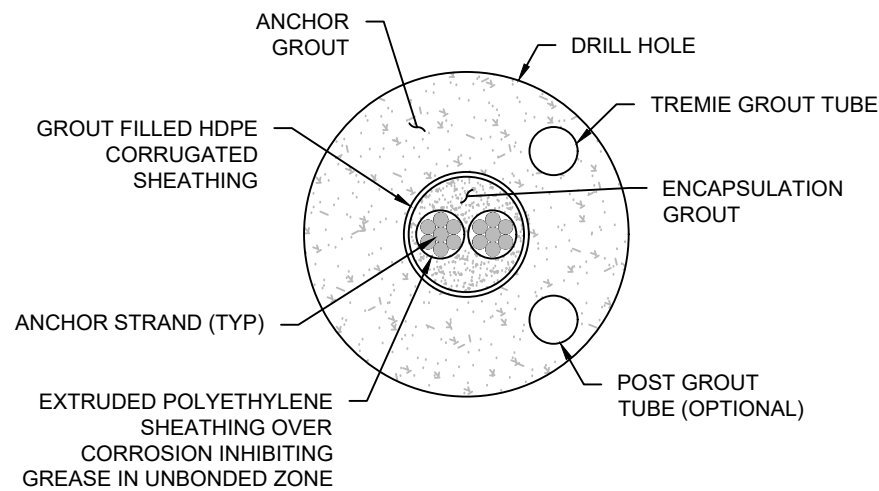
7
16 TYPICAL STRAND ANCHOR HEAD DETAIL
NTS

PERFORMANCE TEST SCHEDULE		
LOADING	APPLIED LOAD	HOLD TIME (MIN)
CYCLE 1	*AL	UNTIL STABLE
	0.25DL	UNTIL STABLE
CYCLE 2	AL	UNTIL STABLE
	0.25DL	UNTIL STABLE
	0.50DL	UNTIL STABLE
CYCLE 3	AL	UNTIL STABLE
	0.25DL	UNTIL STABLE
	0.50DL	UNTIL STABLE
	0.75DL	UNTIL STABLE
CYCLE 4	AL	UNTIL STABLE
	0.25DL	UNTIL STABLE
	0.50DL	UNTIL STABLE
	0.75DL	UNTIL STABLE
	1.00DL	UNTIL STABLE
CYCLE 5	AL	UNTIL STABLE
	0.25DL	UNTIL STABLE
	0.50DL	UNTIL STABLE
	0.75DL	UNTIL STABLE
	1.00DL	UNTIL STABLE
	1.20DL	UNTIL STABLE
CYCLE 6	AL	UNTIL STABLE
	0.25DL	UNTIL STABLE
	0.50DL	UNTIL STABLE
	0.75DL	UNTIL STABLE
	1.00DL	UNTIL STABLE
	1.20DL	UNTIL STABLE
CYCLE 7	AL	UNTIL STABLE
	1.33DL	10 MIN**
ADJUST TO LOCK OFF LOAD = DL		

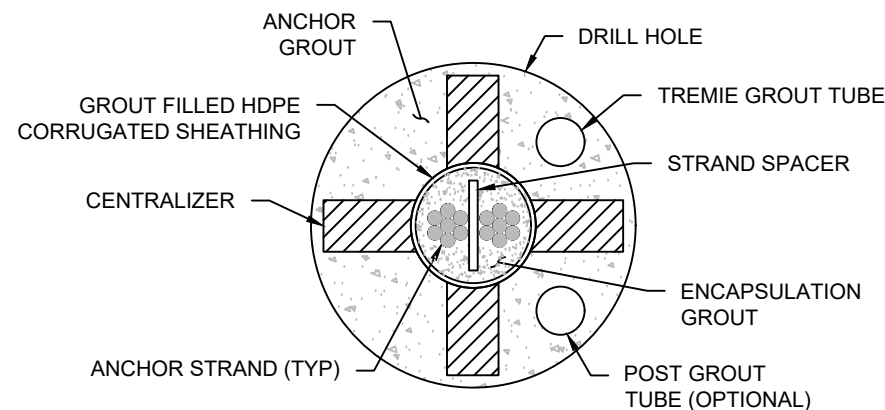
PROOF TEST SCHEDULE	
LOAD INCREMENT	HOLD TIME
*AL (0.05 DL MAXIMUM)	UNTIL STABLE
0.25DL	UNTIL STABLE
0.50DL	UNTIL STABLE
0.75DL	UNTIL STABLE
1.00DL	UNTIL STABLE
1.20DL	UNTIL STABLE
1.33DL CREEP TEST	10 MIN**
ADJUST TO LOCK-OFF LOAD = DL	

*ALIGNMENT LOAD (AL) SHALL BE NO MORE THAN 0.05% OF MAXIMUM DL.
 **CREEP TEST, 10 MIN. HOLD. RECORD ANCHOR HEAD MOVEMENT AT 1, 2, 5, AND 10 MINUTES. IF THE ANCHOR MOVES MORE THAN 0.040 IN. DURING THE 10 MINUTE HOLD, MAINTAIN LOAD FOR AN ADDITIONAL 50 MINUTES AND RECORD ANCHOR HEAD MOVEMENT AT 20, 30, 50, AND 60 MINUTES.

CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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TYPICAL GROUND ANCHOR UN-BONDED ZONE SECTION
NTS




TYPICAL GROUND ANCHOR BONDED ZONE SECTION
NTS

NEW SHEET



CONTRACTOR:
WADSWORTH
RAPHAEL WADSWORTH
ENGINEER
Drapers, Utah
(801)553-1661




DESIGNER:
GERHART COLE
Mikvaale, Utah
(801)848-0055

14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

REVISION: DATE: DRAWN: DESCRIPTION:

A	1/29/25	AWL	RESPONSE TO DRC
B	5/23/25	AWL	RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C	7/10/25	ZPF	RESPONSE TO DRC

DETAILS



DATE: 10/25/2024

PROJECT NUMBER: 22-1474

SHEET NUMBER: 16 of 17

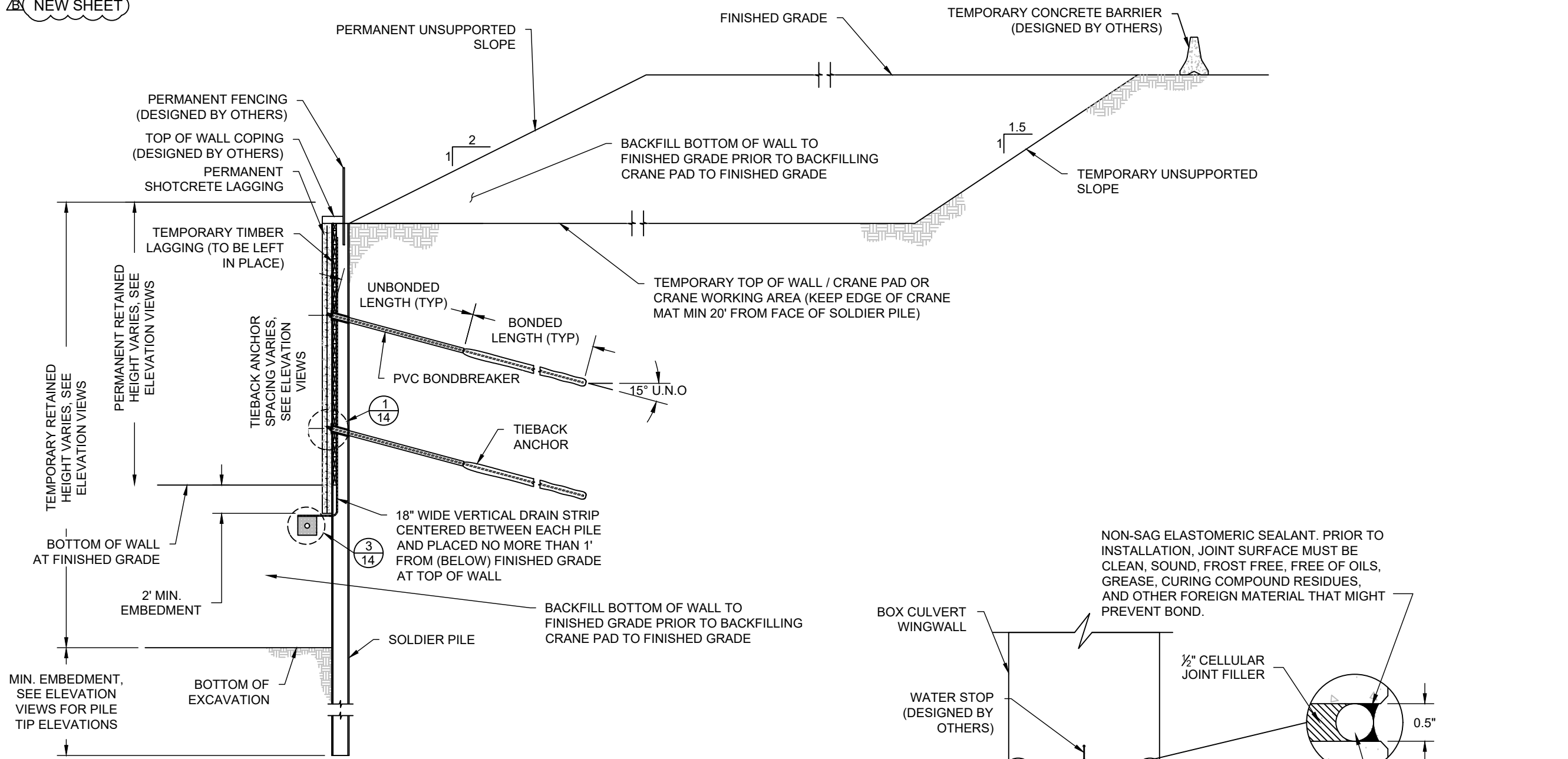
DESIGNED: AWL

DRAWN: AWL

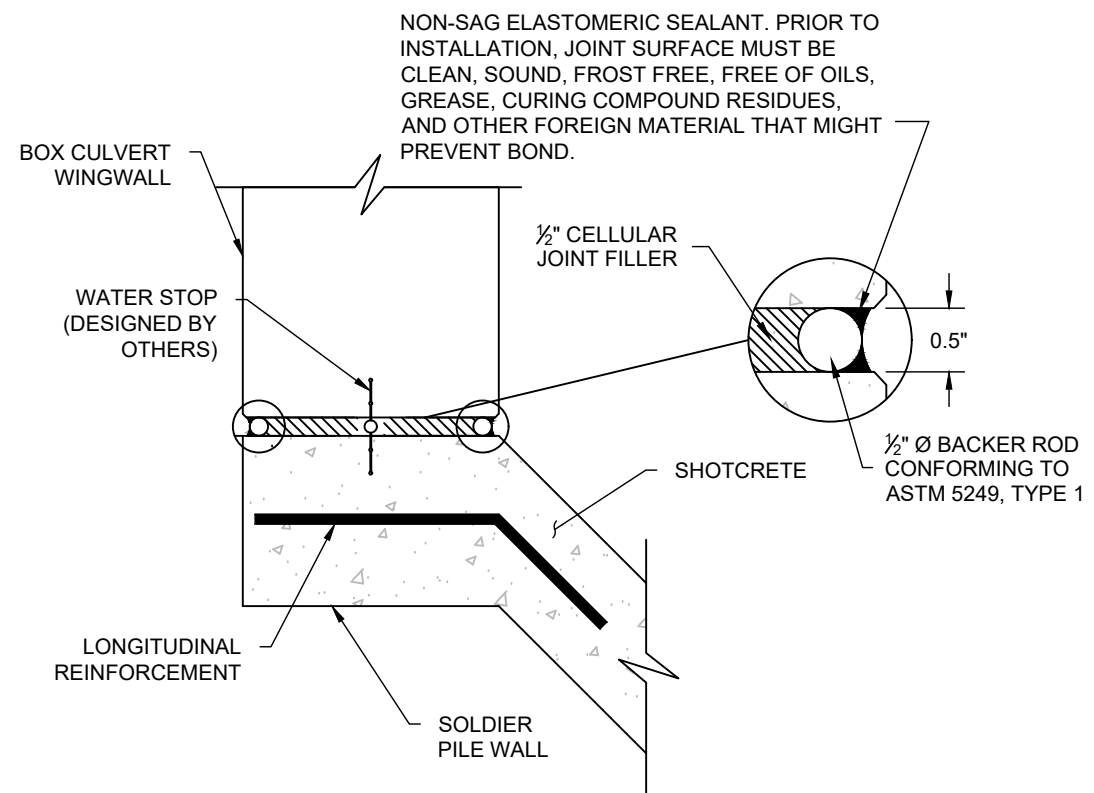
CHECKED: BHG

APPROVED: BHG

NEW SHEET



17 TYPICAL SECTION VIEW - WALL 4
NTS



17 EXPANSION JOINT DETAIL - WALL 4 (PLAN VIEW)
NTS

CITY: BLUFFDALE COUNTY: SALT LAKE STATE: UTAH DATE: 10/17/2024	EXISTING DOT 254875M UP MP 725.66, PROVO SUB UTA MP S19.37 LATITUDE: 40.487195 LONGITUDE: -111.920975	PROPOSED DOT TBD UP MP 725.58, PROVO SUB UTA MP S19.45 LATITUDE: 40.486180 LONGITUDE: -111.921686
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CONTRACTOR: WADSWORTH
DESIGNER: GERHART COLE
14600 SOUTH RAILROAD CROSSING PROJECT
BLUFFDALE, UTAH
TEMPORARY & PERMANENT SOLDIER PILE WALL DESIGN

SECTION & DETAIL	
REVISION: DATE:	DESCRIPTION:
A 1/29/25	AWL RESPONSE TO DRC
B 5/23/25	AWL RESPONSE TO DRC, REVISED WALL 2 / TEMPORARY SOUTH, SE WW
C 7/10/25	ZPF RESPONSE TO DRC



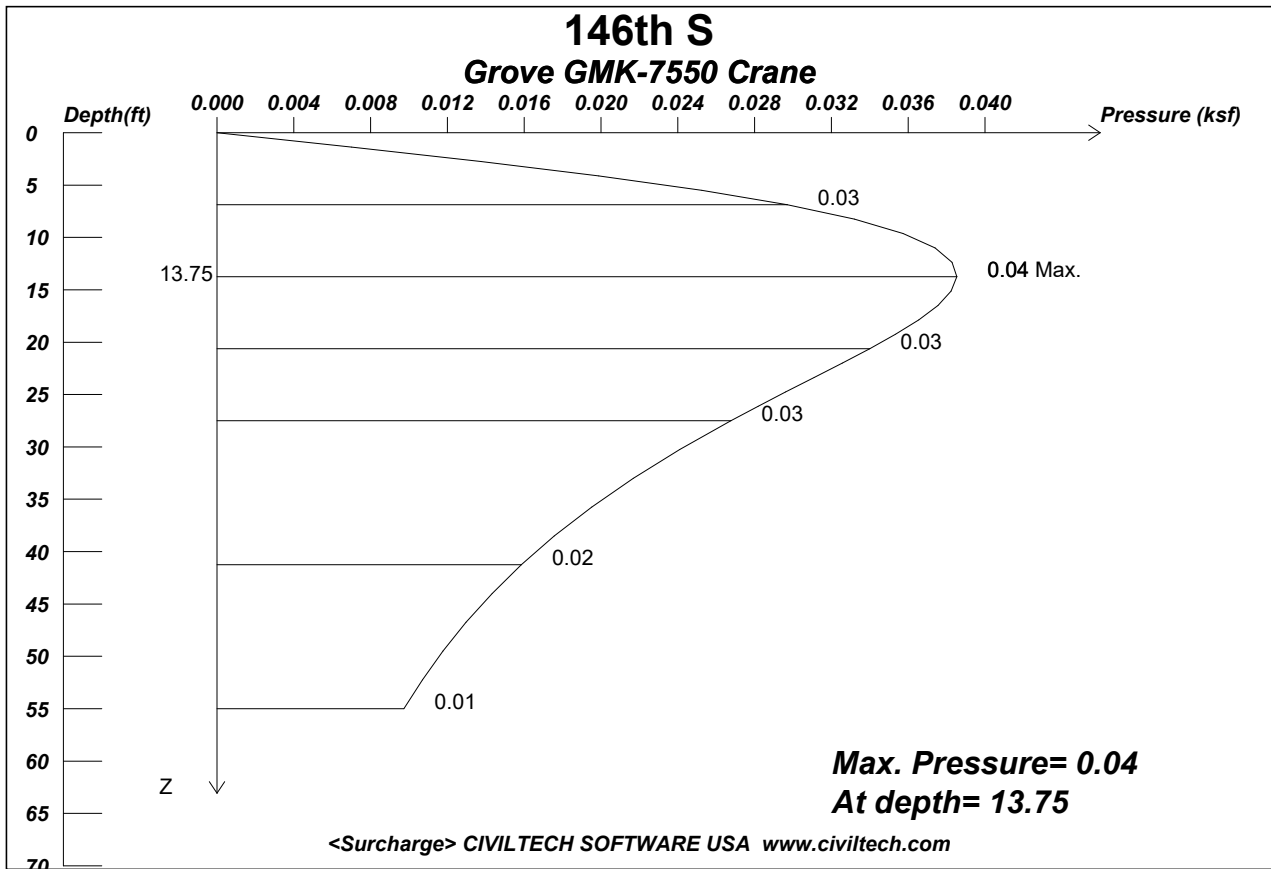
DATE: 10/25/2024	DESIGNED: AWL
PROJECT NUMBER: 22-1474	DRAWN: AWL
SHEET NUMBER: 17 of 17	CHECKED: BHG
	APPROVED: BHG



REVISIONS

APPENDIX B

Temporary Wall Calculations



Licensed to 4324324234 3424343

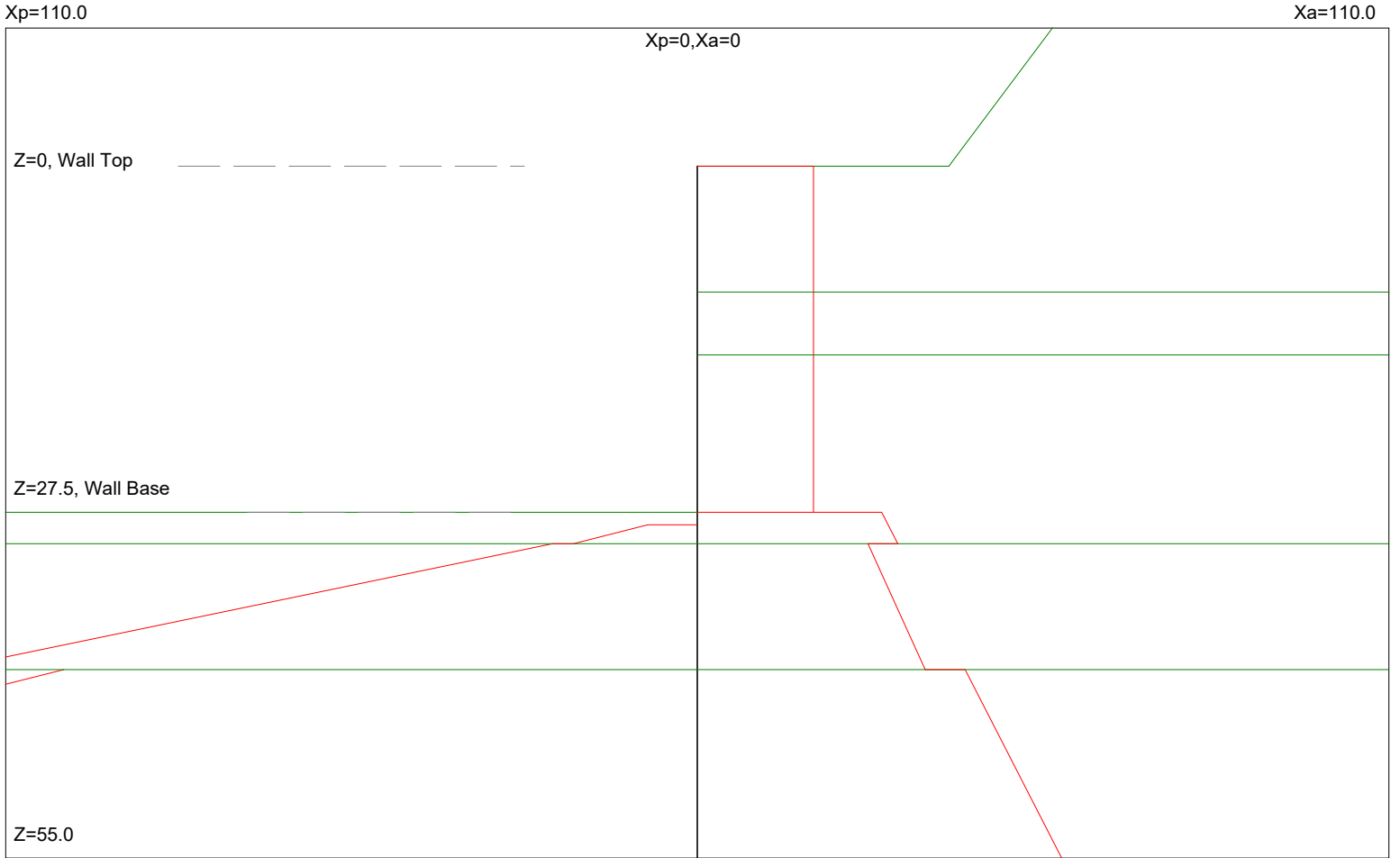
Date: 5/13/2025 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Grove 7550 Crane.lp8

Wall Height, H= 27.5 Load Depth, D= 0
 Load Factor of Surcharge Loading = 1
 Flexible Wall Condition -- Movement or deflection are allowed.
 Max. Pressure = 0.039 at depth = 13.75

X	Width	Length	Area Load
20.0	4.0	16.0	5.50
46.0	4.0	16.0	5.50

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 27.5' Temporary



<EarthPres> CIVILTECH SOFTWARE www.civiltech.com * Licensed to 4324324234 3424343

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/12/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Wall 1\27.5 Temporary.ep8

* INPUT DATA *

Wall Height=27.5 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	40.0	1	SM
2	0.0	40.0	-11.0	56.5	1	SM
3	-11.0	56.5	-11.0	800.0	1	SM
4	10.0	0.0	10.0	800.0	2	ML
5	15.0	0.0	15.0	800.0	3	CL
6	30.0	0.0	30.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	27.5	0.0	27.5	800.0	3	CL
2	30.0	0.0	30.0	800.0	2	ML
3	40.0	0.0	40.0	800.0	3	CL

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 15.80 per one linear foot (or meter) width along wall height

Total Static Force above Base= 15.80. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.75	27.50	0.75	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
27.50	1.19	30.00	1.29	0.0415	0.3608
30.00	1.10	40.00	1.47	0.0368	0.3070
40.00	1.72	55.00	2.34	0.0415	0.3608

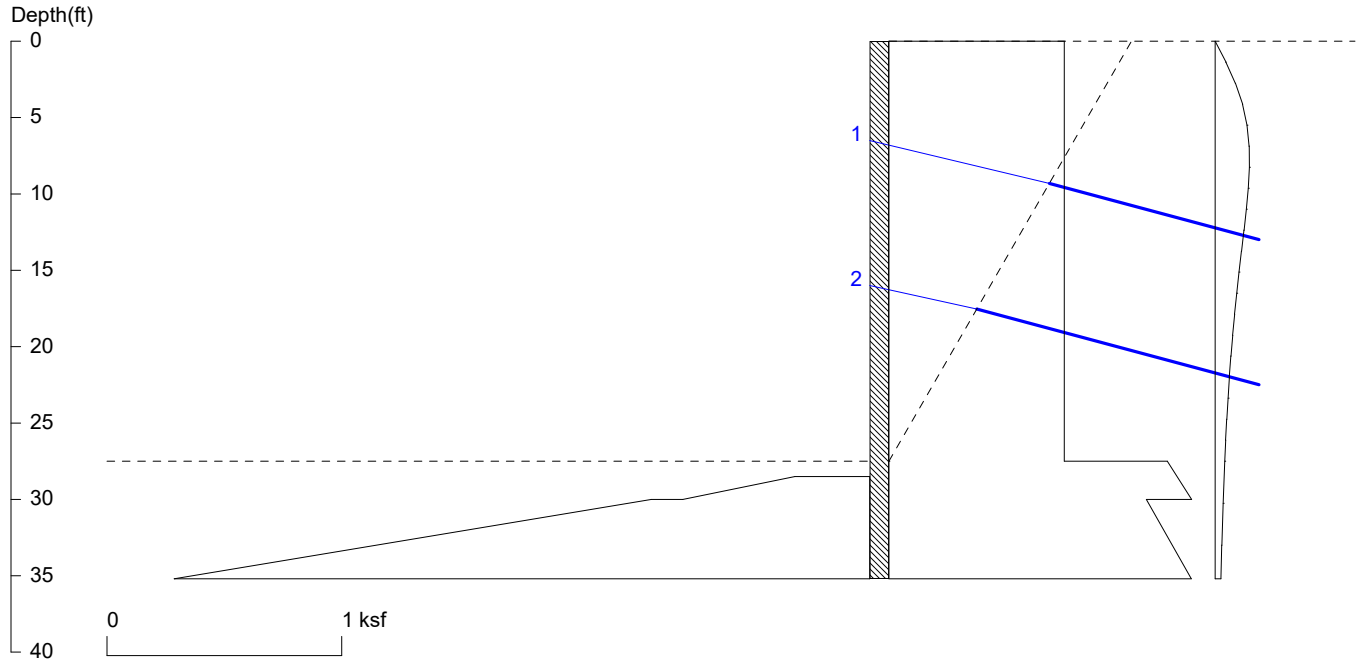
Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
28.50	0.32	30.00	0.80	0.319	2.7698
30.00	0.93	40.00	4.84	0.391	3.2592
40.00	4.07	55.00	8.90	0.322	2.7983

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/12/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Wall 1\27.5 Temporary.ep8

146th South 27.5' Temporary



<ShoringSuite> CIVILTECH SOFTWARE USA www.civiltech.com

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Date: 9/14/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Walls\27.5' Temporary.sh8

Wall Height=27.5 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=7.70 Min. Pile Length=35.20

MOMENT IN PILE: Max. Moment=98.33 per Pile Spacing=5.0 at Depth=24.28

PILE SELECTION:

Request Min. Section Modulus = 42.9 in³/pile=703.10 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	6.5	15.0	5.0	68.1*	65.7	17.6	10.9	44.9
2. Tieback	16.0	15.0	5.0	44.8	43.3	11.6	6.0	29.6

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.747	27.50	0.747	0.000000
*	Below	Base		
27.50	1.186	30.00	1.290	0.041488
30.00	1.097	40.00	1.466	0.036838
*	Sur-	charg		
0.000	0.000	1.375	0.046	0.033706
1.375	0.046	2.750	0.087	0.029319
2.750	0.087	4.125	0.117	0.022010
4.125	0.117	5.500	0.136	0.013819
5.500	0.136	6.875	0.145	0.006400

6.875	0.145	8.250	0.146	0.000603
8.250	0.146	9.625	0.141	-0.00341
9.625	0.141	11.00	0.133	-0.00587
11.00	0.133	12.37	0.123	-0.00716
12.37	0.123	13.75	0.112	-0.00762
13.75	0.112	15.12	0.102	-0.00756
15.12	0.102	16.50	0.092	-0.00719
16.50	0.092	17.87	0.083	-0.00665
17.87	0.083	19.25	0.075	-0.00605
19.25	0.075	20.62	0.067	-0.00544
20.62	0.067	22.00	0.061	-0.00485
22.00	0.061	23.37	0.055	-0.00431
23.37	0.055	24.75	0.049	-0.00382
24.75	0.049	26.12	0.045	-0.00338
26.12	0.045	27.50	0.041	-0.00299
27.50	0.041	30.25	0.034	-0.00250
30.25	0.034	33.00	0.028	-0.00197
33.00	0.028	35.75	0.024	-0.00157

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
28.50	0.319	30.00	0.796	0.318530
30.00	0.931	40.00	4.842	0.391104

ACTIVE SPACING:

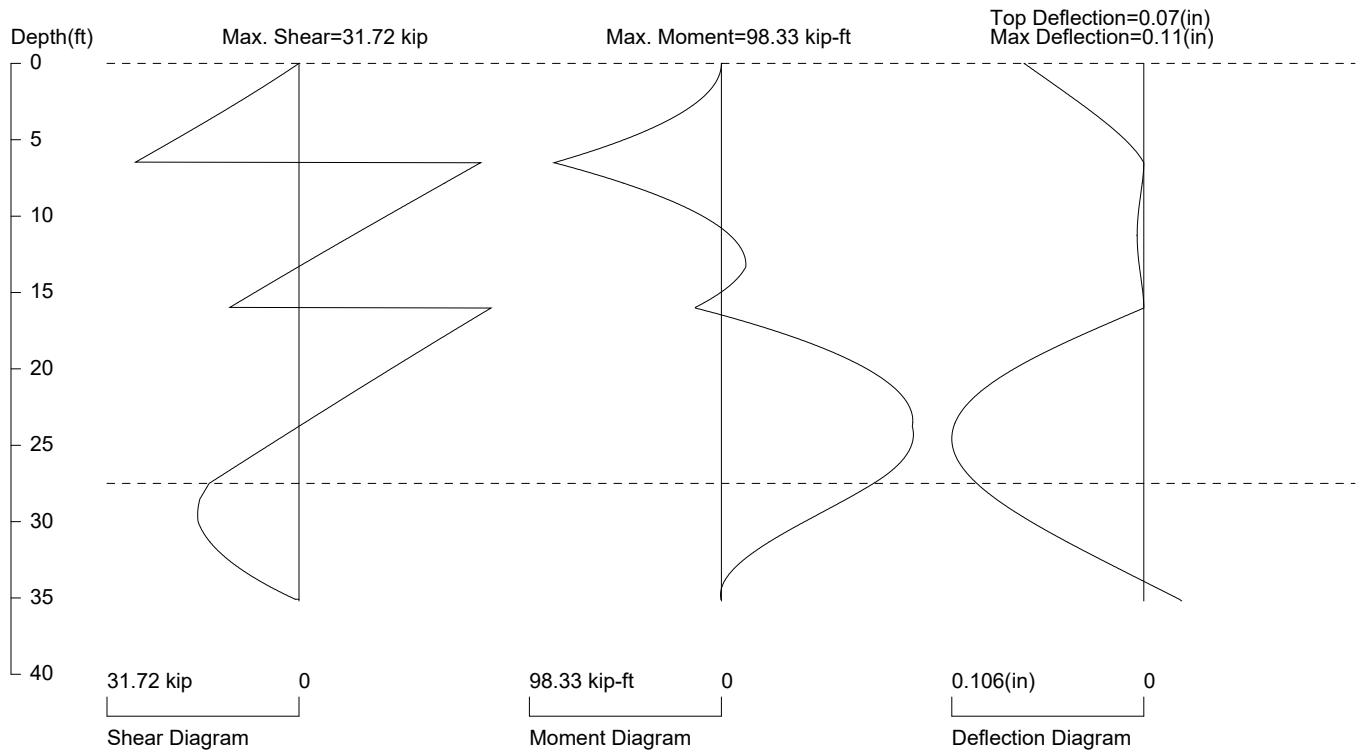
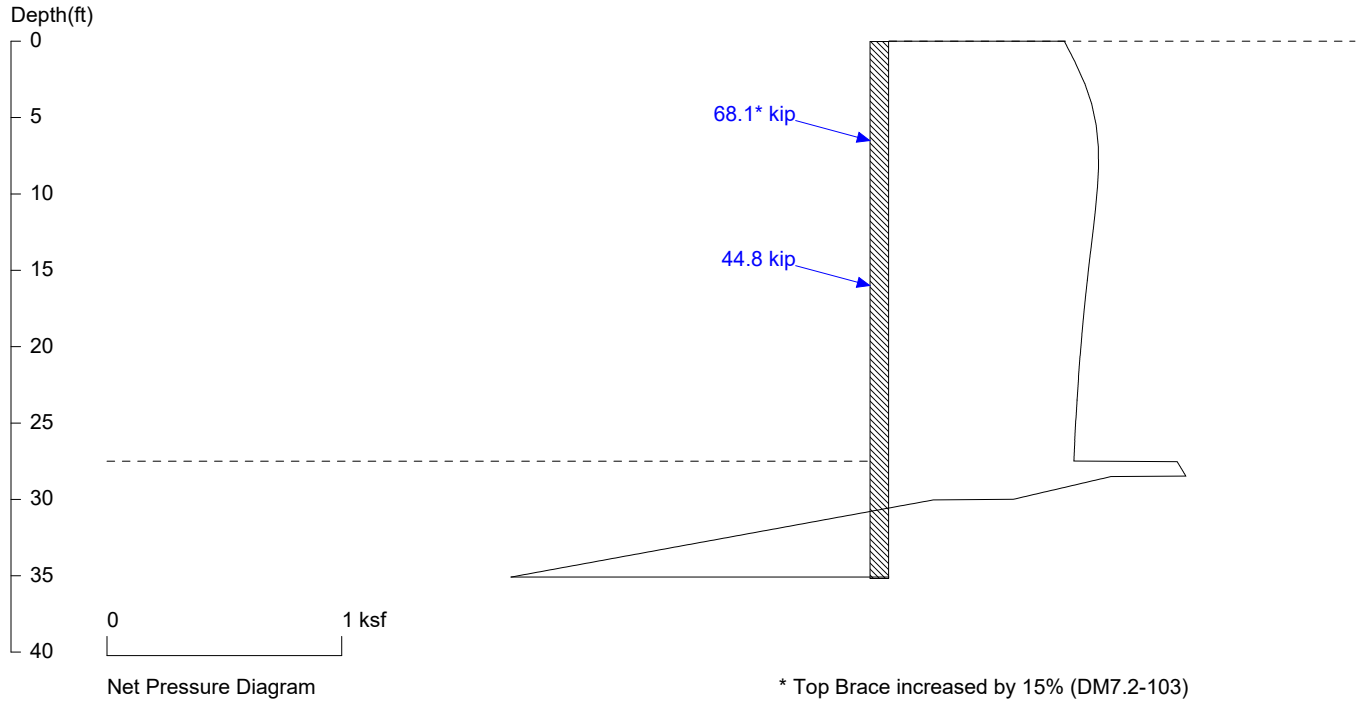
No.	Z depth	Spacing
1	0.00	5.00
2	27.50	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	27.50	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 27.5' Temporary

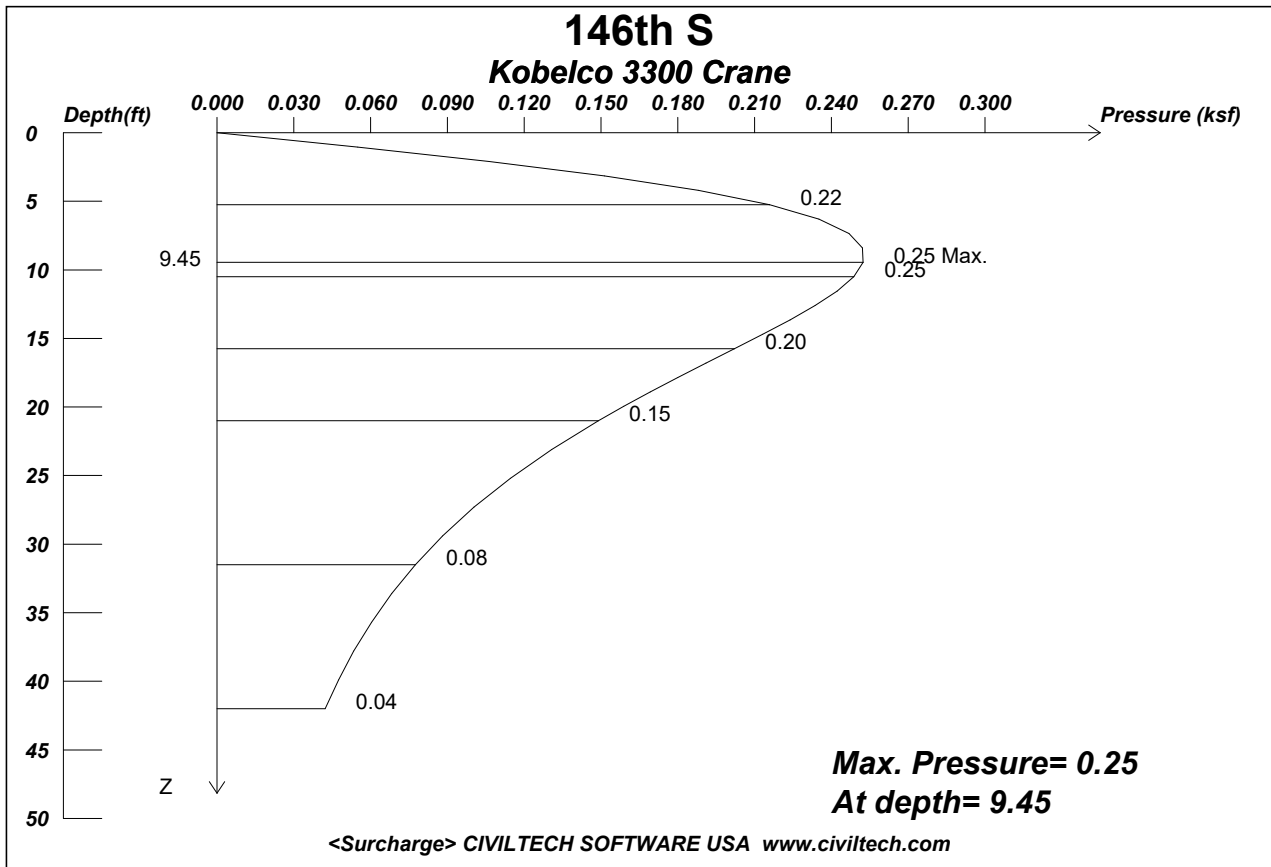


PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Walls\27.5' Temporary.sh8



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Wall Height, H= 21 Load Depth, D= 0
 Load Factor of Surcharge Loading = 1
 Flexible Wall Condition -- Movement or deflection are allowed.
 Max. Pressure = 0.252 at depth = 9.45

X	Width	Length	Area Load
10.0	16.0	32.0	3.21

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 21' Temporary

Xp=84.0

Xa=84.0

Xp=0, Xa=0

Z=0, Wall Top

Z=21.0, Wall Base

Z=42.0

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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/12/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Wall 1\21' Temporary.ep8

* INPUT DATA *

Wall Height=21.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	40.0	1	SM
2	0.0	40.0	-11.0	56.5	1	SM
3	-11.0	56.5	-11.0	800.0	1	SM
4	10.0	0.0	10.0	800.0	2	ML
5	15.0	0.0	15.0	800.0	3	CL
6	30.0	0.0	30.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	21.0	0.0	21.0	800.0	3	CL
2	30.0	0.0	30.0	800.0	2	ML
3	40.0	0.0	40.0	800.0	3	CL

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 8.97 per one linear foot (or meter) width along wall height

Total Static Force above Base= 8.97

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	10.00	0.37	0.0368	0.2947
10.00	0.38	15.00	0.57	0.0369	0.3073
15.00	0.67	21.00	0.92	0.0419	0.3647

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
21.00	0.92	30.00	1.29	0.0415	0.3608
30.00	1.10	40.00	1.47	0.0368	0.3070
40.00	1.72	42.00	1.81	0.0415	0.3608

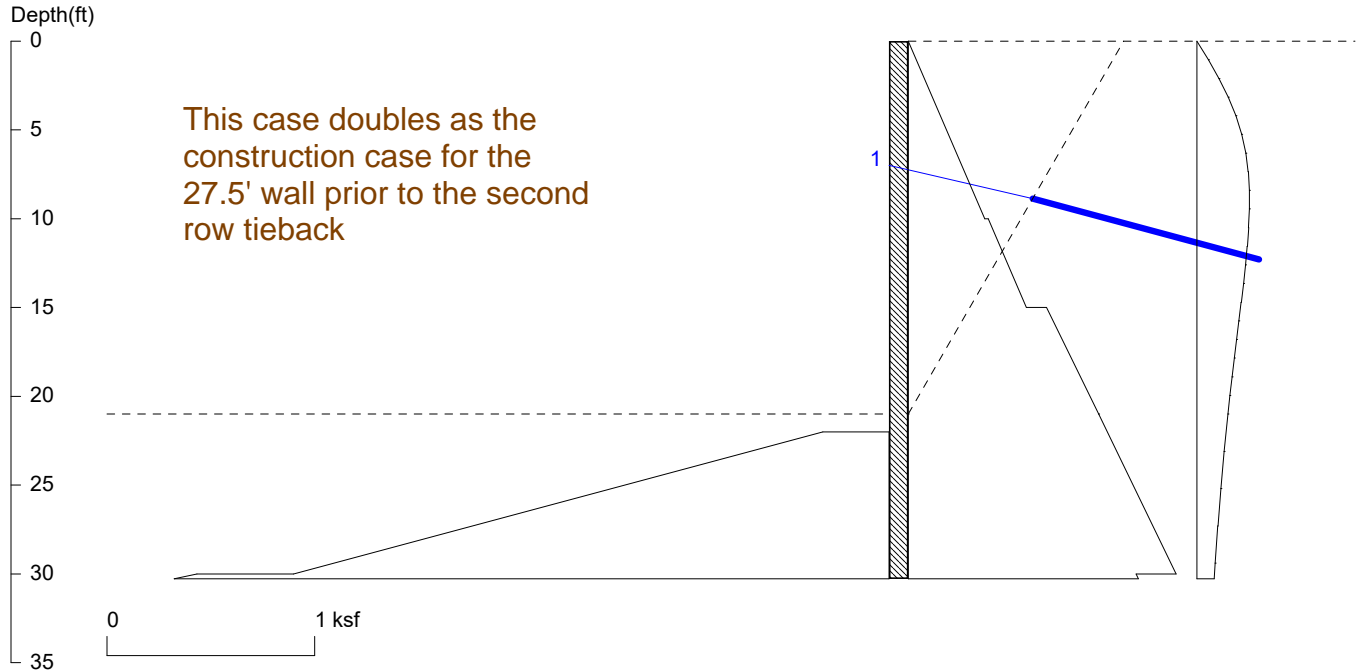
Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
22.00	0.32	30.00	2.87	0.319	2.7698
30.00	3.33	40.00	7.28	0.395	3.2881
40.00	6.12	42.00	6.77	0.326	2.8354

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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146th South 21' Temporary



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Wall Height=21.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=9.28 Min. Pile Length=30.28

MOMENT IN PILE: Max. Moment=177.32 per Pile Spacing=5.0 at Depth=17.15

PILE SELECTION:

Request Min. Section Modulus = 77.4 in³/pile=1267.93 cm³/pile, F_y= 50 ksi = 345 MPa, F_b/F_y=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.38(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	7.0	15.0	5.0	47.3	45.7	12.2	7.2	31.2

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	10.00	0.368	0.036841
10.00	0.384	15.00	0.568	0.036871
15.00	0.665	21.00	0.917	0.041937
*	Below	Base		
21.00	0.916	30.00	1.290	0.041488
30.00	1.097	40.00	1.466	0.036838
*	Sur-	charge		
0.000	0.000	1.050	0.055	0.052360
1.050	0.055	2.100	0.106	0.048960
2.100	0.106	3.150	0.151	0.042808
3.150	0.151	4.200	0.188	0.034952
4.200	0.188	5.250	0.216	0.026505

5.250	0.216	6.300	0.235	0.018371
6.300	0.235	7.350	0.247	0.011132
7.350	0.247	8.400	0.252	0.005066
8.400	0.252	9.450	0.252	0.000222
9.450	0.252	10.500	0.249	-0.003487
10.500	0.249	11.550	0.242	-0.006212
11.550	0.242	12.600	0.234	-0.008125
12.600	0.234	13.650	0.224	-0.009389
13.650	0.224	14.700	0.213	-0.010148
14.700	0.213	15.750	0.202	-0.010524
15.750	0.202	16.800	0.191	-0.010612
16.800	0.191	17.850	0.180	-0.010491
17.850	0.180	18.900	0.169	-0.010222
18.900	0.169	19.950	0.159	-0.009851
19.950	0.159	21.000	0.149	-0.009414
21.000	0.149	23.100	0.131	-0.008691
23.100	0.131	25.200	0.115	-0.007696
25.200	0.115	27.300	0.100	-0.006737
27.300	0.100	29.400	0.088	-0.005857
29.400	0.088	31.500	0.077	-0.005073

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
22.00	0.319	30.00	2.867	0.318530
30.00	3.332	40.00	7.277	0.394574

ACTIVE SPACING:

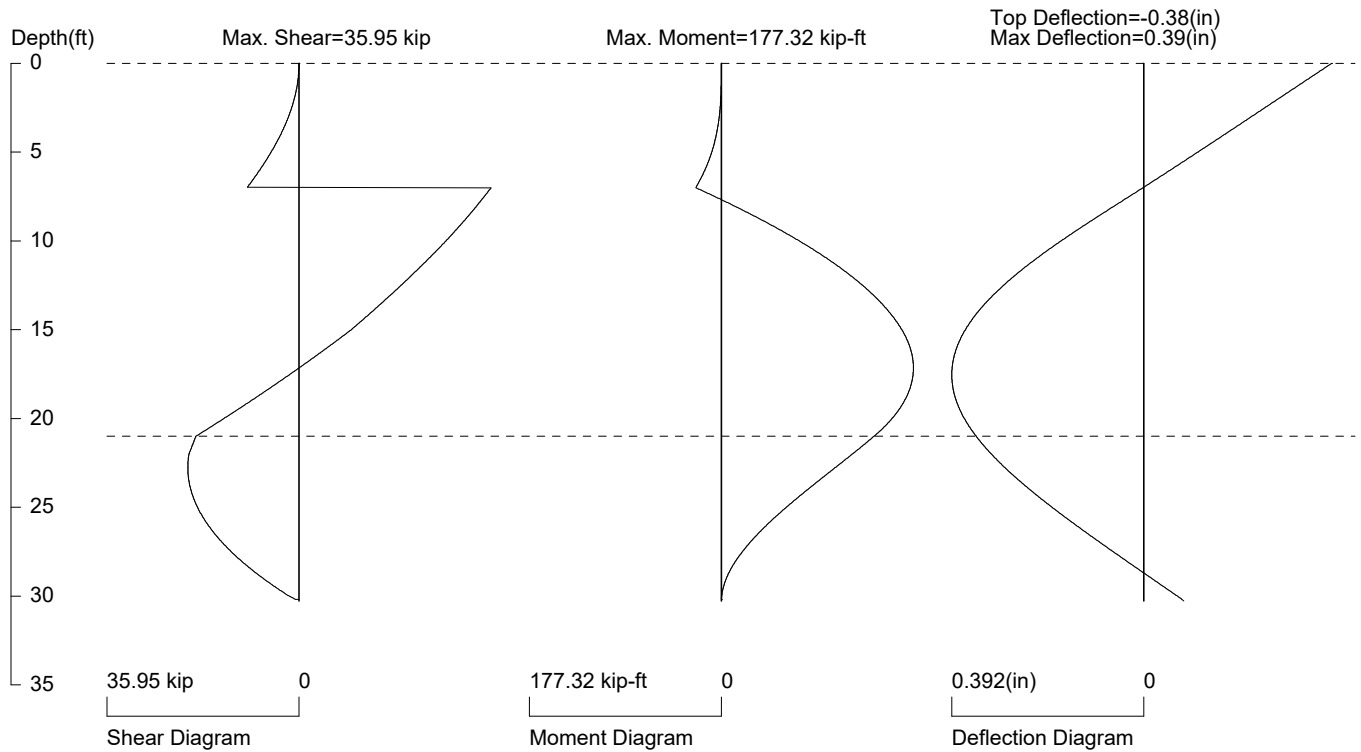
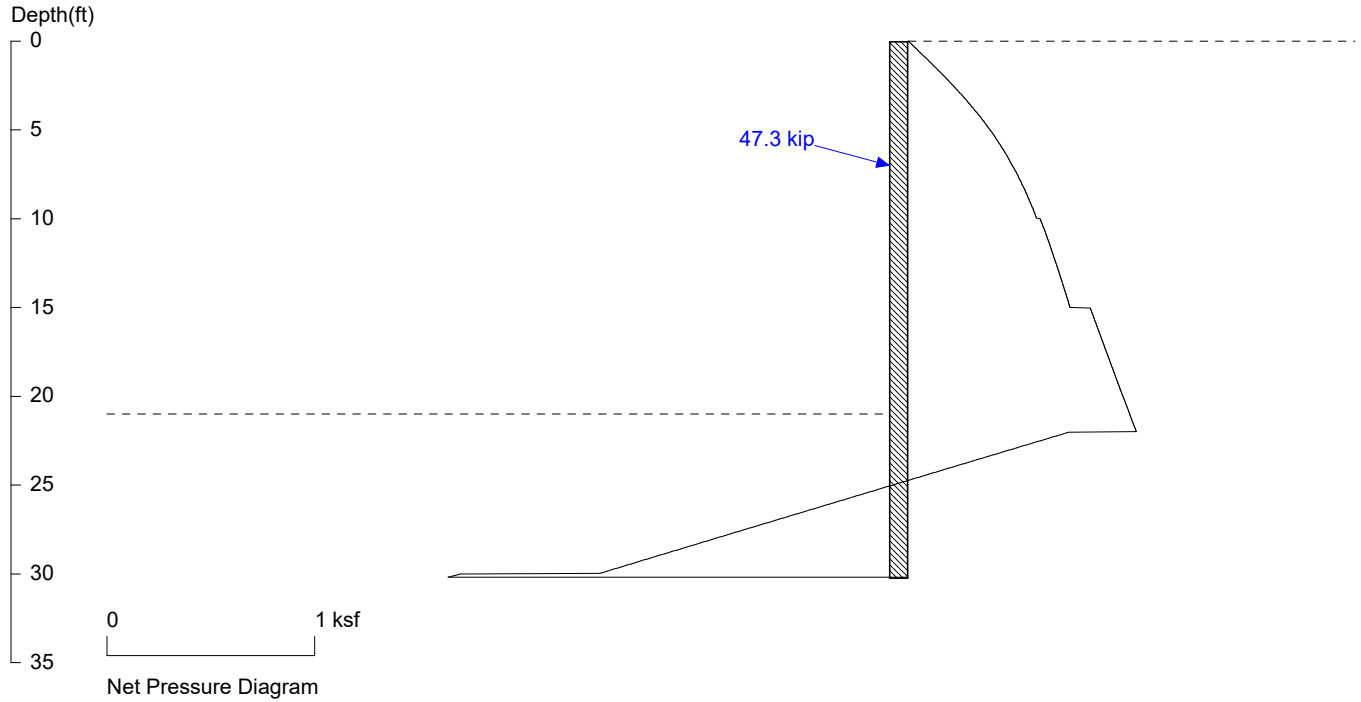
No.	Z depth	Spacing
1	0.00	5.00
2	21.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	21.00	3.60

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 21' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

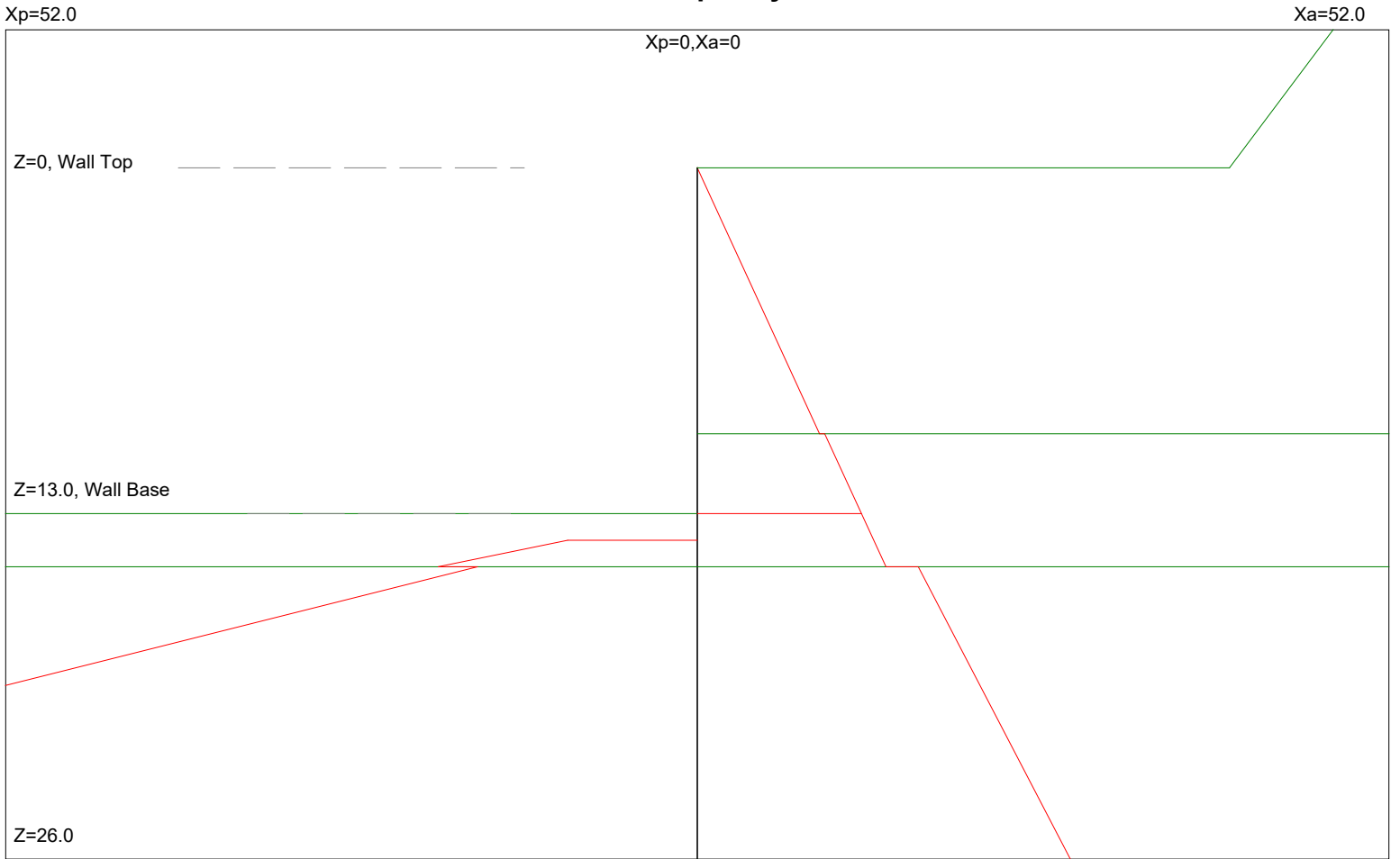
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Calculation Sheet #14

146th South 13' Temporary



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/12/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Wall 1\13' Temporary.ep8

* INPUT DATA *

Wall Height=13.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	40.0	1	SM
2	0.0	40.0	-11.0	56.5	1	SM
3	-11.0	56.5	-11.0	800.0	1	SM
4	10.0	0.0	10.0	800.0	2	ML
5	15.0	0.0	15.0	800.0	3	CL
6	30.0	0.0	30.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	13.0	0.0	13.0	800.0	2	ML
2	15.0	0.0	15.0	800.0	3	CL
3	30.0	0.0	30.0	800.0	2	ML
4	40.0	0.0	40.0	800.0	3	CL

Wall Friction Options: 1.* No wall friction
 Wall Batter Angle = 0
 Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*
 Water Density = 62.4
 Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 3.16 per one linear foot (or meter) width along wall height
 Total Static Force above Base= 3.16

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	10.00	0.37	0.0368	0.2947
10.00	0.38	13.00	0.49	0.0369	0.3073

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
13.00	0.49	15.00	0.57	0.0369	0.3073
15.00	0.67	26.00	1.12	0.0417	0.3624

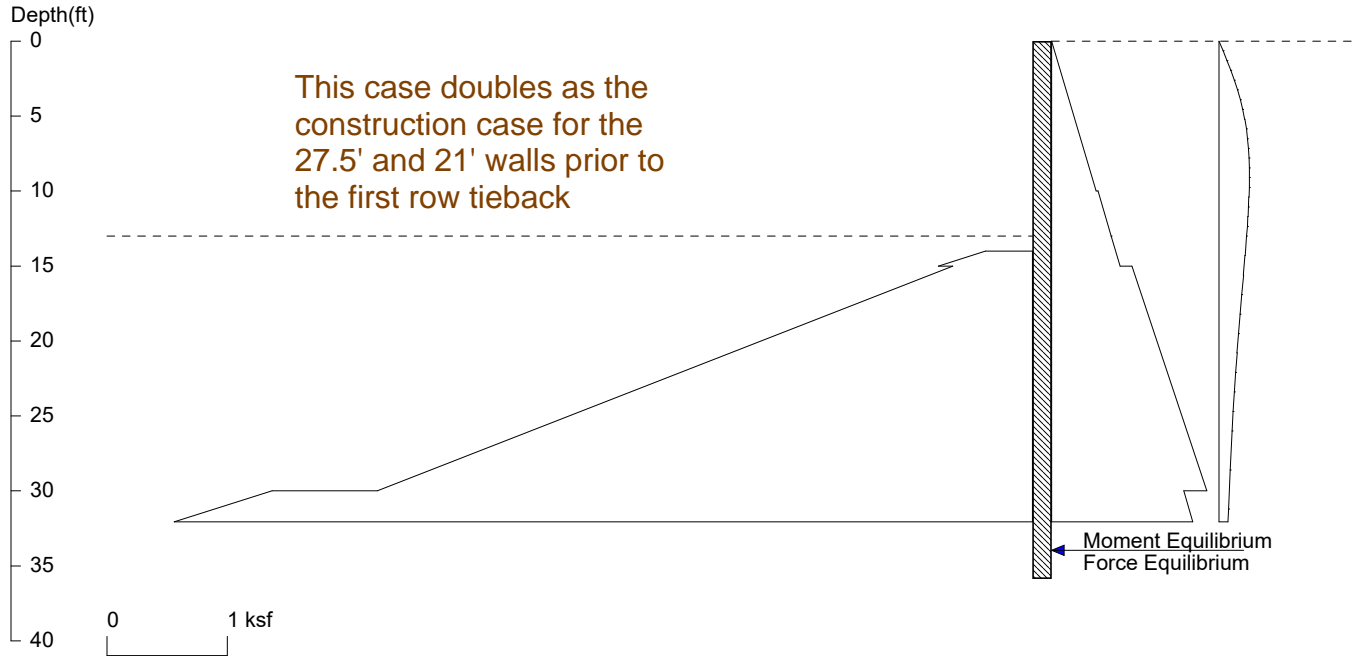
Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
14.00	0.39	15.00	0.78	0.391	3.2546
15.00	0.66	26.00	4.17	0.319	2.7727

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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146th South 13' Temporary



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Wall Height=13.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=22.86 Min. Pile Length=35.86

MOMENT IN PILE: Max. Moment=344.02 per Pile Spacing=5.0 at Depth=23.18

PILE SELECTION:

Request Min. Section Modulus = 150.1 in³/pile=2460.00 cm³/pile, F_y= 50 ksi = 345 MPa, F_b/F_y=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 1.51(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	10.00	0.368	0.036841
10.00	0.384	13.00	0.495	0.036871
*	Below	Base		
13.00	0.495	15.00	0.568	0.036871
15.00	0.666	30.00	1.290	0.041588
30.00	1.097	40.00	1.466	0.036838
*	Sur-	charge		
0.000	0.000	0.650	0.034	0.052723
0.650	0.034	1.300	0.068	0.051378
1.300	0.068	1.950	0.099	0.048793
1.950	0.099	2.600	0.129	0.045158
2.600	0.129	3.250	0.155	0.040722
3.250	0.155	3.900	0.178	0.035760
3.900	0.178	4.550	0.198	0.030539
4.550	0.198	5.200	0.215	0.025295
5.200	0.215	5.850	0.228	0.020222
5.850	0.228	6.500	0.238	0.015459

6.500	0.238	7.150	0.245	0.011101
7.150	0.245	7.800	0.250	0.007199
7.800	0.250	8.450	0.252	0.003772
8.450	0.252	9.100	0.253	0.000811
9.100	0.253	9.750	0.252	-0.001705
9.750	0.252	10.400	0.249	-0.003811
10.400	0.249	11.050	0.246	-0.005546
11.050	0.246	11.700	0.241	-0.006951
11.700	0.241	12.350	0.236	-0.008066
12.350	0.236	13.000	0.230	-0.008931
13.000	0.230	14.300	0.217	-0.009814
14.300	0.217	15.600	0.204	-0.010450
15.600	0.204	16.900	0.190	-0.010608
16.900	0.190	18.200	0.176	-0.010441
18.200	0.176	19.500	0.163	-0.010063
19.500	0.163	20.800	0.151	-0.009554
20.800	0.151	22.100	0.139	-0.008973
22.100	0.139	23.400	0.128	-0.008360
23.400	0.128	24.700	0.118	-0.007742
24.700	0.118	26.000	0.109	-0.007138
26.000	0.109	28.600	0.093	-0.006288
28.600	0.093	31.200	0.079	-0.005271
31.200	0.079	33.800	0.067	-0.004402
33.800	0.067	36.400	0.058	-0.003674

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
14.00	0.391	15.00	0.781	0.390551
15.00	0.663	30.00	5.443	0.318716
30.00	6.317	40.00	10.28	0.396690

ACTIVE SPACING:

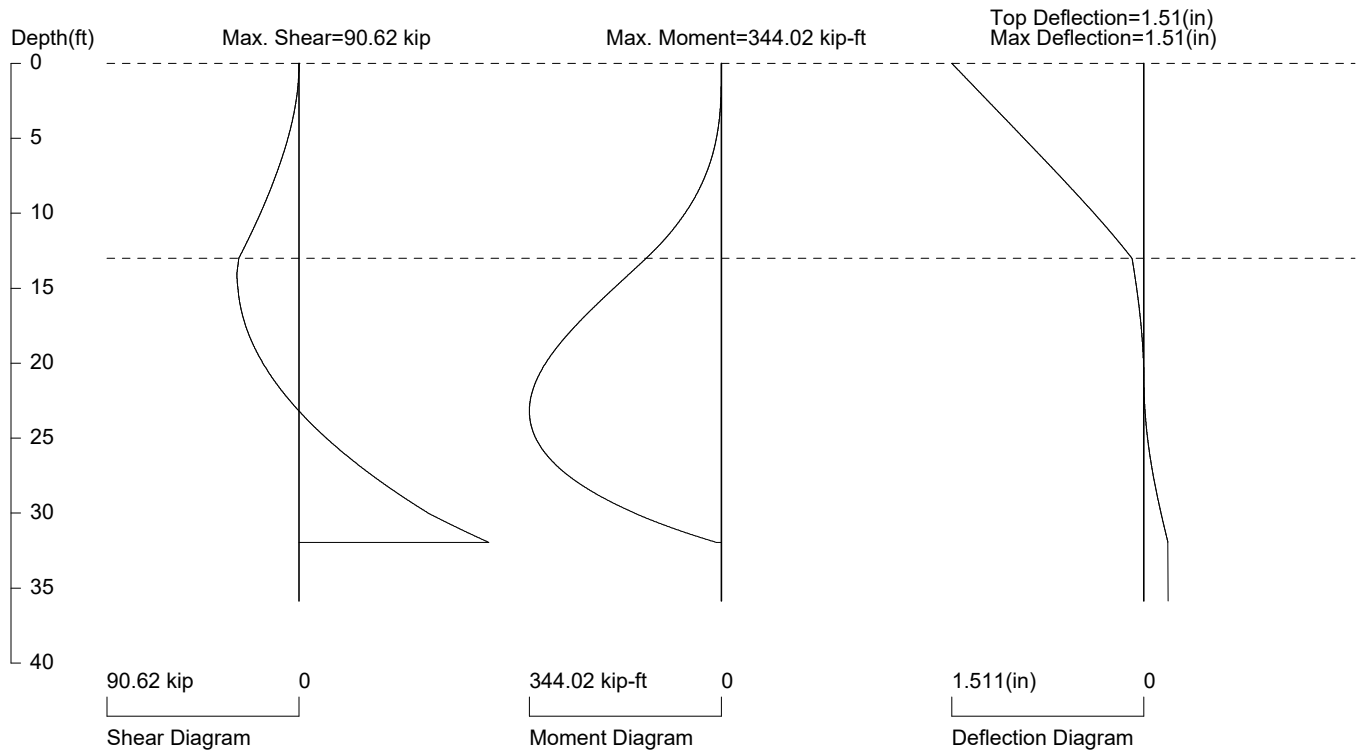
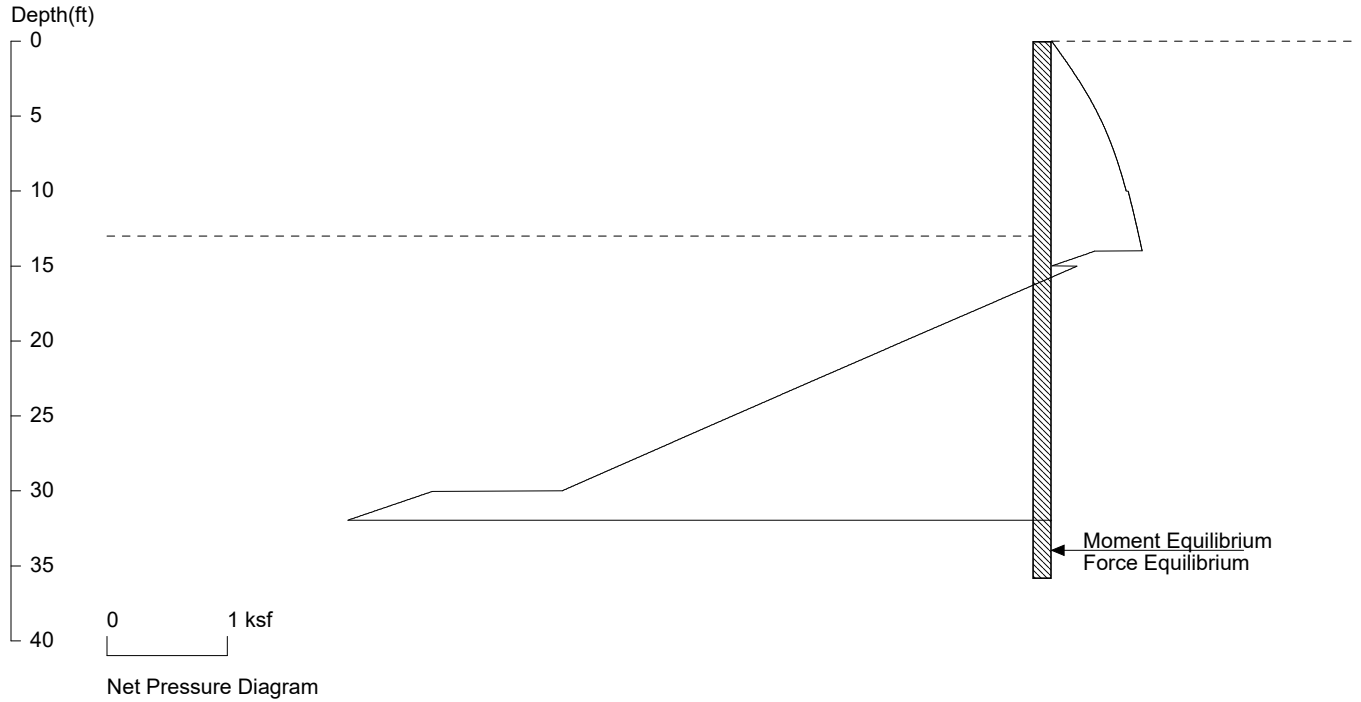
No.	Z depth	Spacing
1	0.00	5.00
2	13.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	13.00	3.60

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 13' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

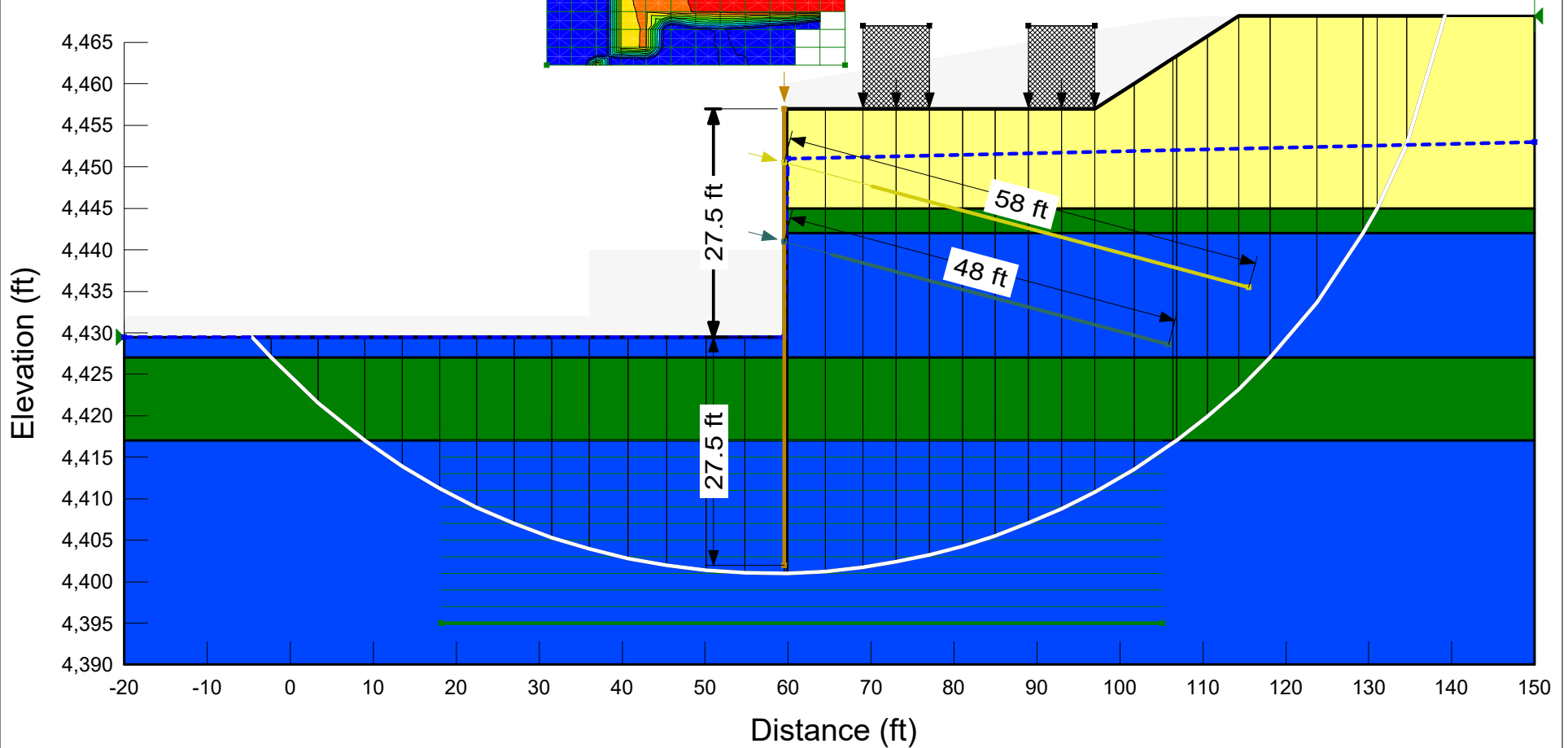
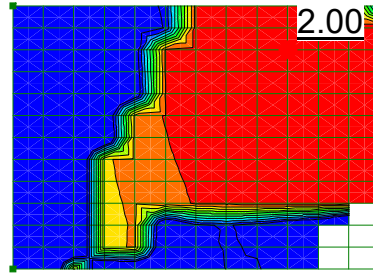
Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Walls\13' Temporary 3300 Crane.sh8

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Brown	Pile (Temporary Walls)	Pile			5
Light Green	Tieback (Temporary Walls)	Anchor	47	0.67	5
Dark Green	Tieback (Temporary Walls) (2)	Anchor	42	0.67	5

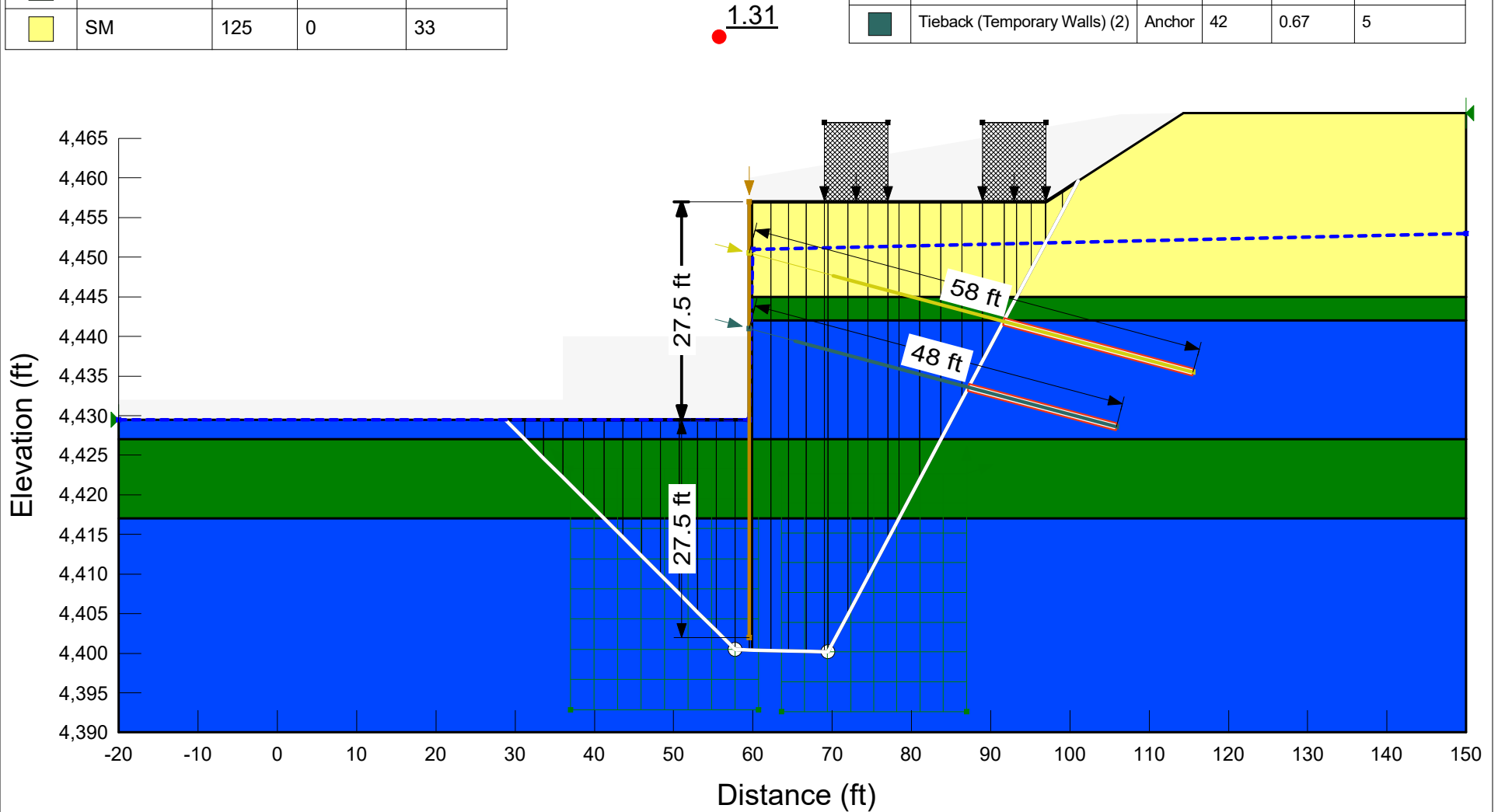


Temporary Walls - 27.5' Temporary

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Brown	Pile (Temporary Walls)	Pile			5
Light Green	Tieback (Temporary Walls)	Anchor	47	0.67	5
Dark Green	Tieback (Temporary Walls) (2)	Anchor	42	0.67	5

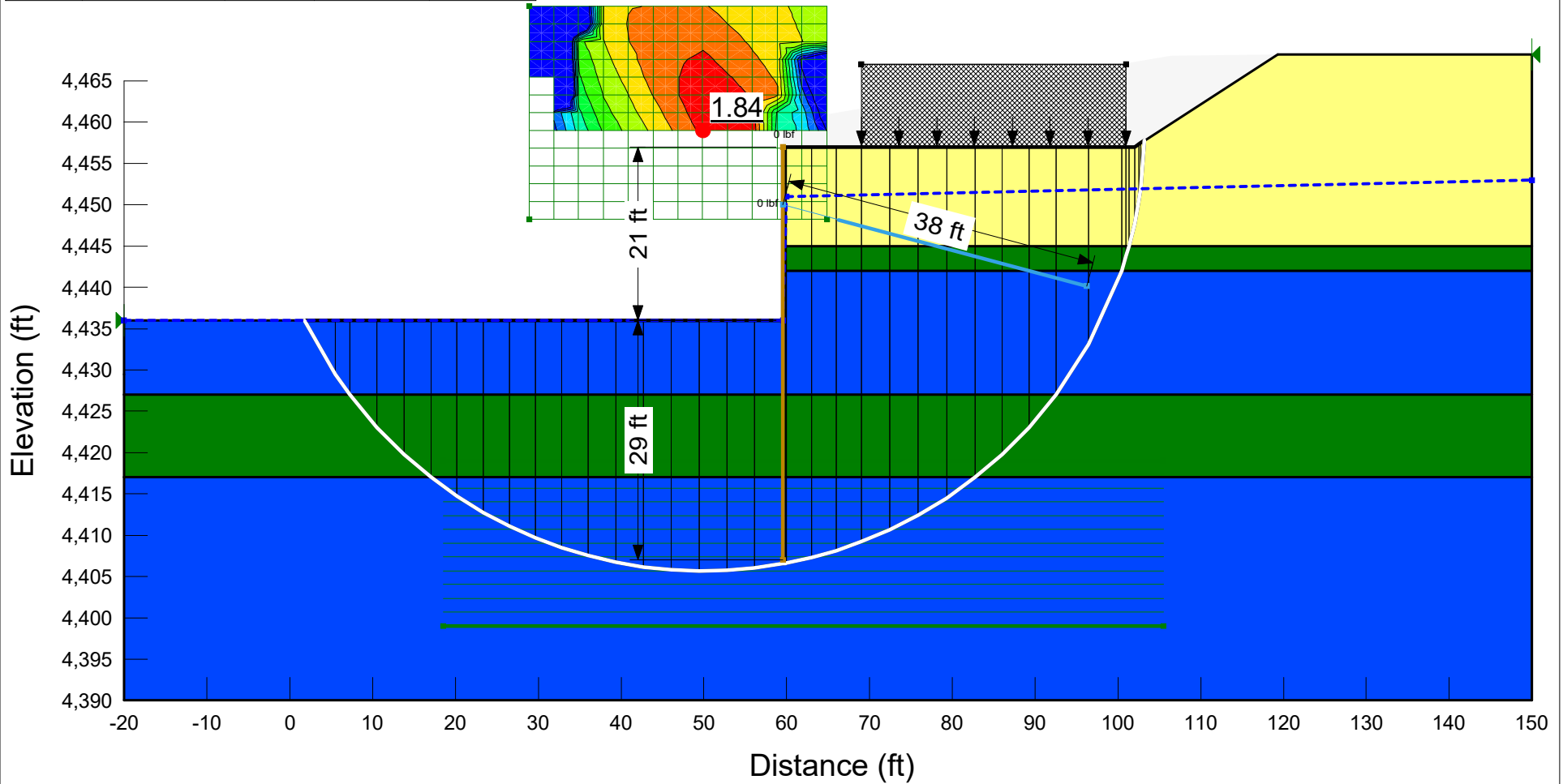


Temporary Walls - 27.5' Temporary Non-Circular

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Out-of-Plane Spacing (ft)	Bond Length (ft)	Bond Diameter (ft)
Brown	Pile (Temporary Walls)	Pile	5		
Light Blue	Tieback (Temporary Walls) (3)	Anchor	5	31	0.67

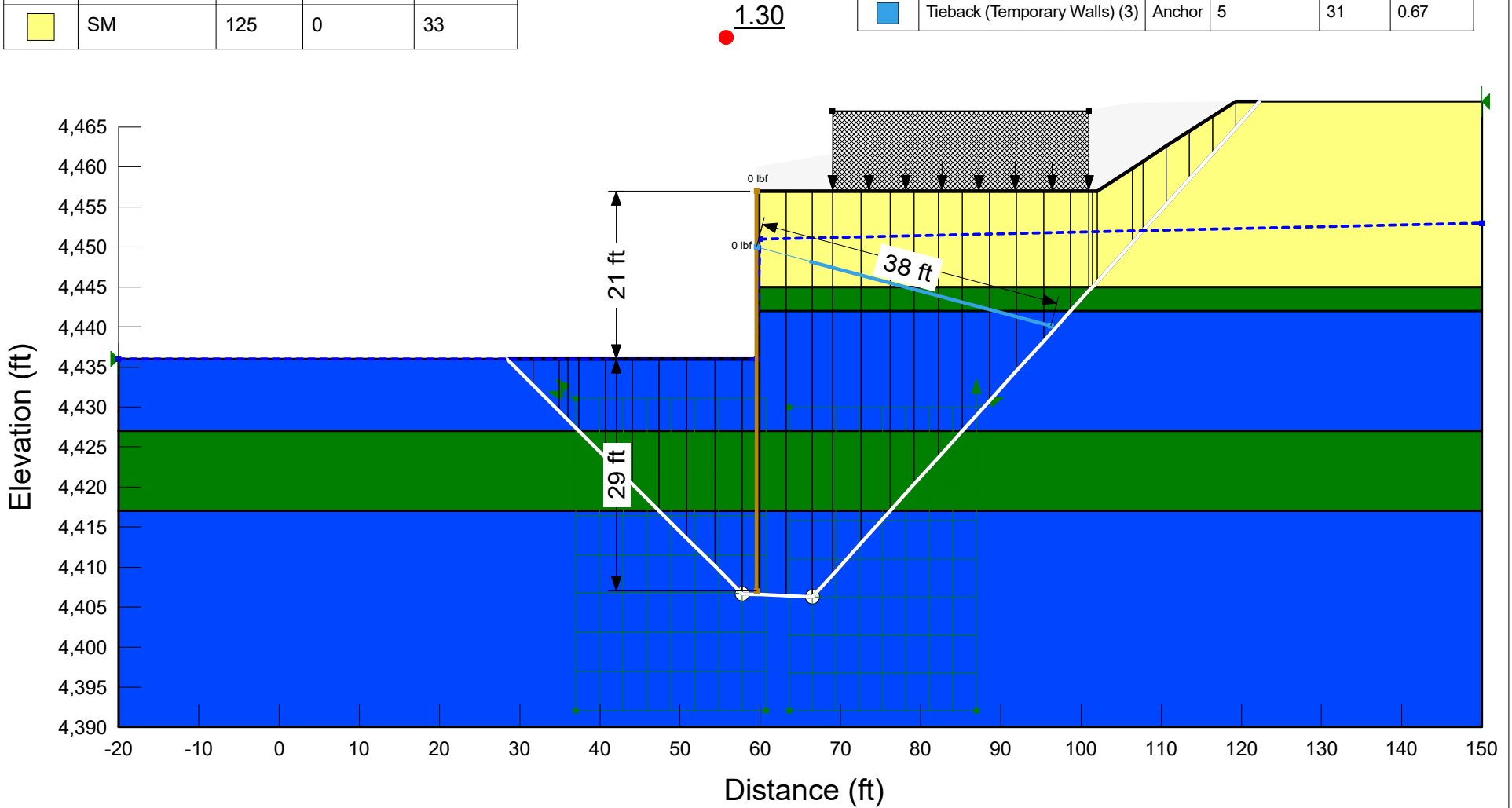


Temporary Walls - 21' Temporary

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Out-of-Plane Spacing (ft)	Bond Length (ft)	Bond Diameter (ft)
Brown	Pile (Temporary Walls)	Pile	5		
Light Blue	Tieback (Temporary Walls) (3)	Anchor	5	31	0.67

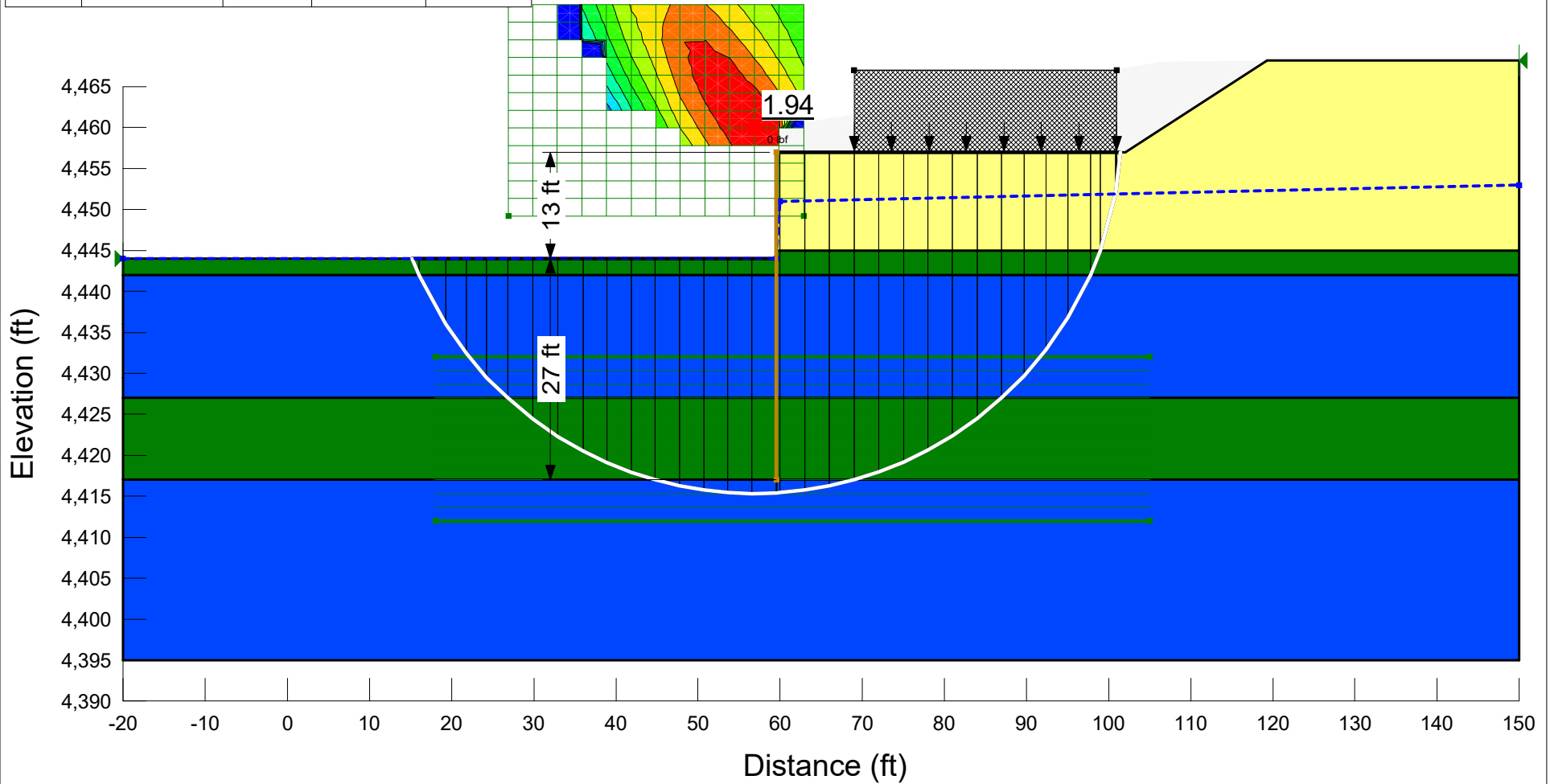


Temporary Walls - 21' Temporary Non-Circular

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

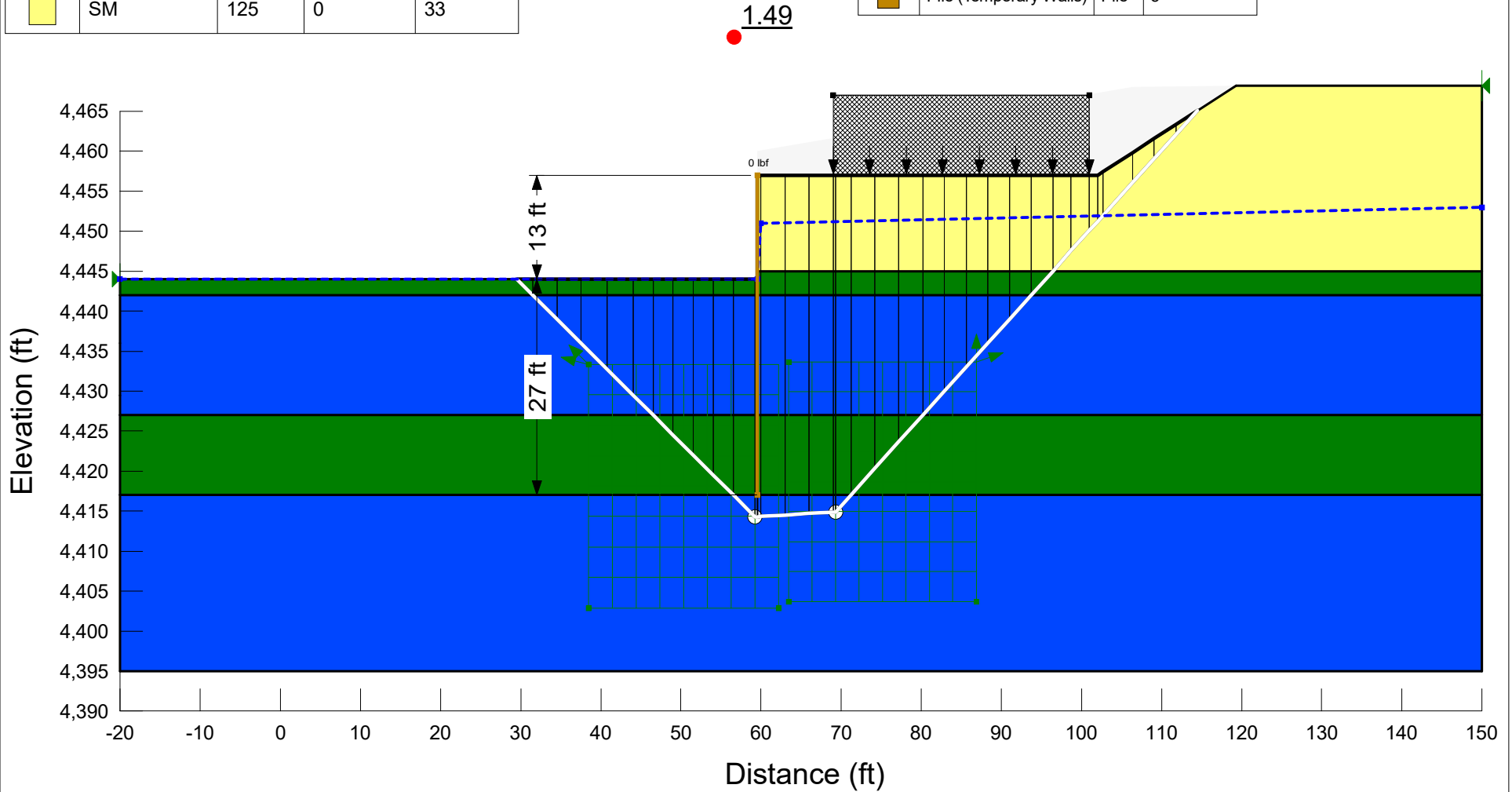
Color	Name	Type	Out-of-Plane Spacing (ft)
Brown	Pile (Temporary Walls)	Pile	5



Temporary Walls - 13' Temporary
14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Out-of-Plane Spacing (ft)
Brown	Pile (Temporary Walls)	Pile	5



Temporary Walls - 13' Temporary Non-Circular

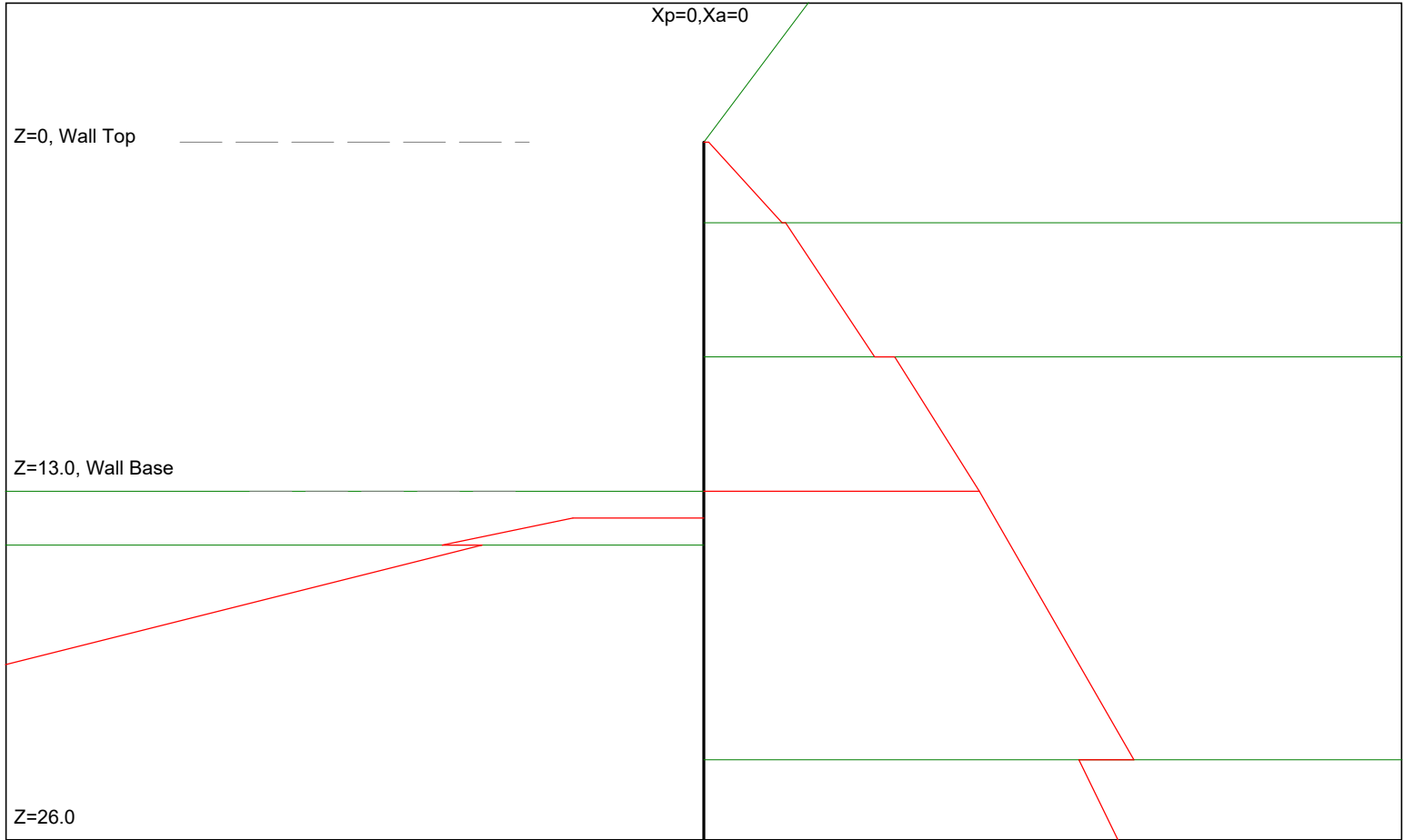
14600 South Railroad Crossing

Wall 4 Calculations

146th South 13' Temporary

Xp=52.0

Xa=52.0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 5/13/2025

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Walls\13' Temporary SE WW EP.ep8

* INPUT DATA *

Wall Height=13.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-7.0	10.5	1	SM
2	-7.0	10.5	-7.0	50.0	1	SM
3	-7.0	50.0	-20.0	70.0	1	SM
4	-20.0	70.0	-20.0	800.0	1	SM
5	3.0	0.0	3.0	800.0	2	ML
6	8.0	0.0	8.0	800.0	3	CL
7	23.0	0.0	23.0	800.0	2	ML
8	33.0	0.0	33.0	800.0	3	CL

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	13.0	0.0	13.0	800.0	2	ML
2	15.0	0.0	15.0	800.0	3	CL
3	30.0	0.0	30.0	800.0	2	ML

4 40.0 0.0 40.0 800.0 3 CL

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 5.74 per one linear foot (or meter) width along wall height

Total Static Force above Base= 5.74

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.01	3.00	0.23	0.0730	0.5842
3.00	0.24	8.00	0.51	0.0531	0.4427
8.00	0.57	13.00	0.82	0.0505	0.4392

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
13.00	0.82	23.00	1.28	0.0461	0.4010
23.00	1.12	26.00	1.24	0.0390	0.3248

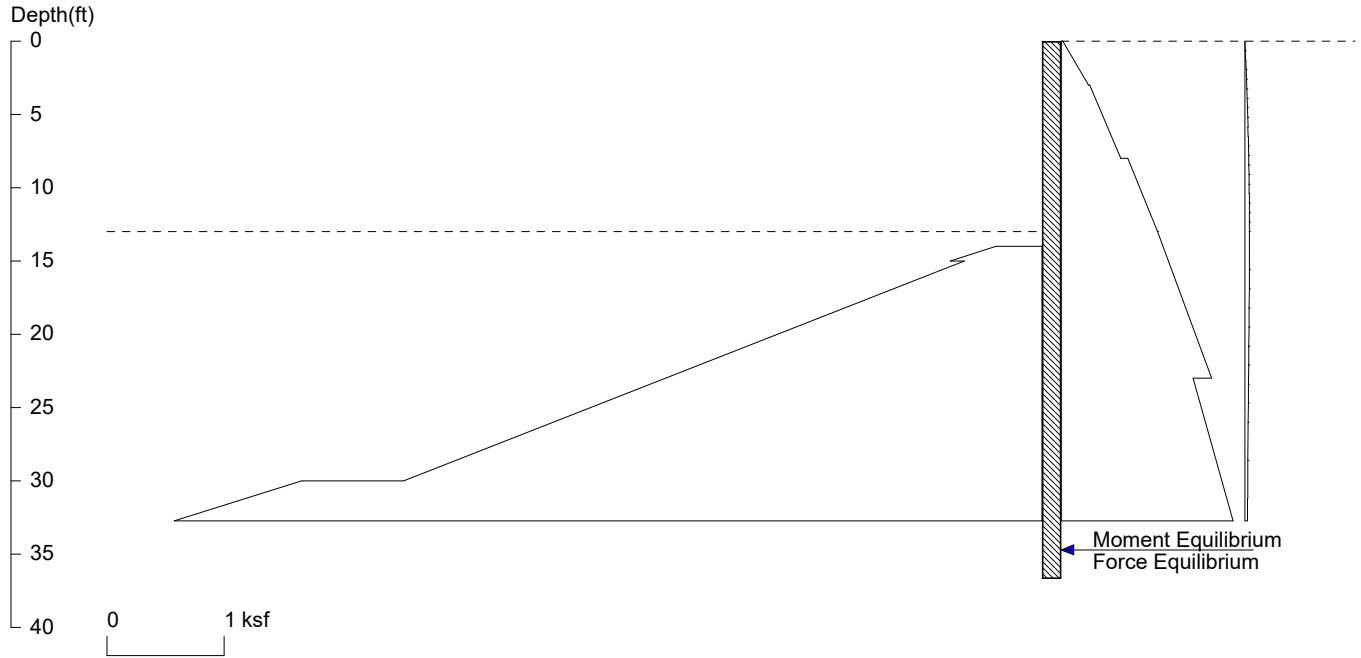
Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
14.00	0.39	15.00	0.78	0.391	3.2546
15.00	0.66	26.00	4.17	0.319	2.7727

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 5/13/2025 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Walls\13' Temporary SE WW EP.ep8

146th South 13' Temporary



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Date: 5/13/2025

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Walls\13' Temporary 7550 Crane SE WW

Wall Height=13.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=23.68 Min. Pile Length=36.68

MOMENT IN PILE: Max. Moment=374.83 per Pile Spacing=5.0 at Depth=23.71

PILE SELECTION:

Request Min. Section Modulus = 163.6 in³/pile=2680.29 cm³/pile, F_y= 50 ksi = 345 MPa, F_b/F_y=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 1.64(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.014	3.000	0.233	0.073022
3.000	0.244	8.000	0.510	0.053123
8.000	0.570	13.000	0.822	0.050503
*	Below	Base		
13.000	0.822	23.000	1.283	0.046117
23.000	1.125	33.000	1.477	0.035197
33.000	1.497	117.000	5.889	0.052281
*	Sur-	charge		
0.000	0.000	0.650	0.003	0.005138
0.650	0.003	1.300	0.007	0.005087
1.300	0.007	1.950	0.010	0.004987
1.950	0.010	2.600	0.013	0.004841
2.600	0.013	3.250	0.016	0.004651
3.250	0.016	3.900	0.019	0.004424
3.900	0.019	4.550	0.022	0.004163
4.550	0.022	5.200	0.024	0.003876
5.200	0.024	5.850	0.026	0.003568

5.850	0.026	6.500	0.029	0.003245
6.500	0.029	7.150	0.030	0.002914
7.150	0.030	7.800	0.032	0.002580
7.800	0.032	8.450	0.034	0.002249
8.450	0.034	9.100	0.035	0.001925
9.100	0.035	9.750	0.036	0.001612
9.750	0.036	10.400	0.037	0.001312
10.400	0.037	11.050	0.037	0.001029
11.050	0.037	11.700	0.038	0.000765
11.700	0.038	12.350	0.038	0.000520
12.350	0.038	13.000	0.038	0.000296
13.000	0.038	14.300	0.038	0.000000
14.300	0.038	15.600	0.038	-0.000328
15.600	0.038	16.900	0.037	-0.000583
16.900	0.037	18.200	0.036	-0.000771
18.200	0.036	19.500	0.035	-0.000905
19.500	0.035	20.800	0.034	-0.000993
20.800	0.034	22.100	0.032	-0.001045
22.100	0.032	23.400	0.031	-0.001068
23.400	0.031	24.700	0.030	-0.001069
24.700	0.030	26.000	0.028	-0.001055
26.000	0.028	28.600	0.026	-0.001013
28.600	0.026	31.200	0.023	-0.000937
31.200	0.023	33.800	0.021	-0.000852
33.800	0.021	36.400	0.019	-0.000767
36.400	0.019	39.000	0.017	-0.000687

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
14.000	0.391	15.000	0.781	0.390551
15.000	0.663	30.000	5.443	0.318716
30.000	6.317	40.000	10.283	0.396690

ACTIVE SPACING:

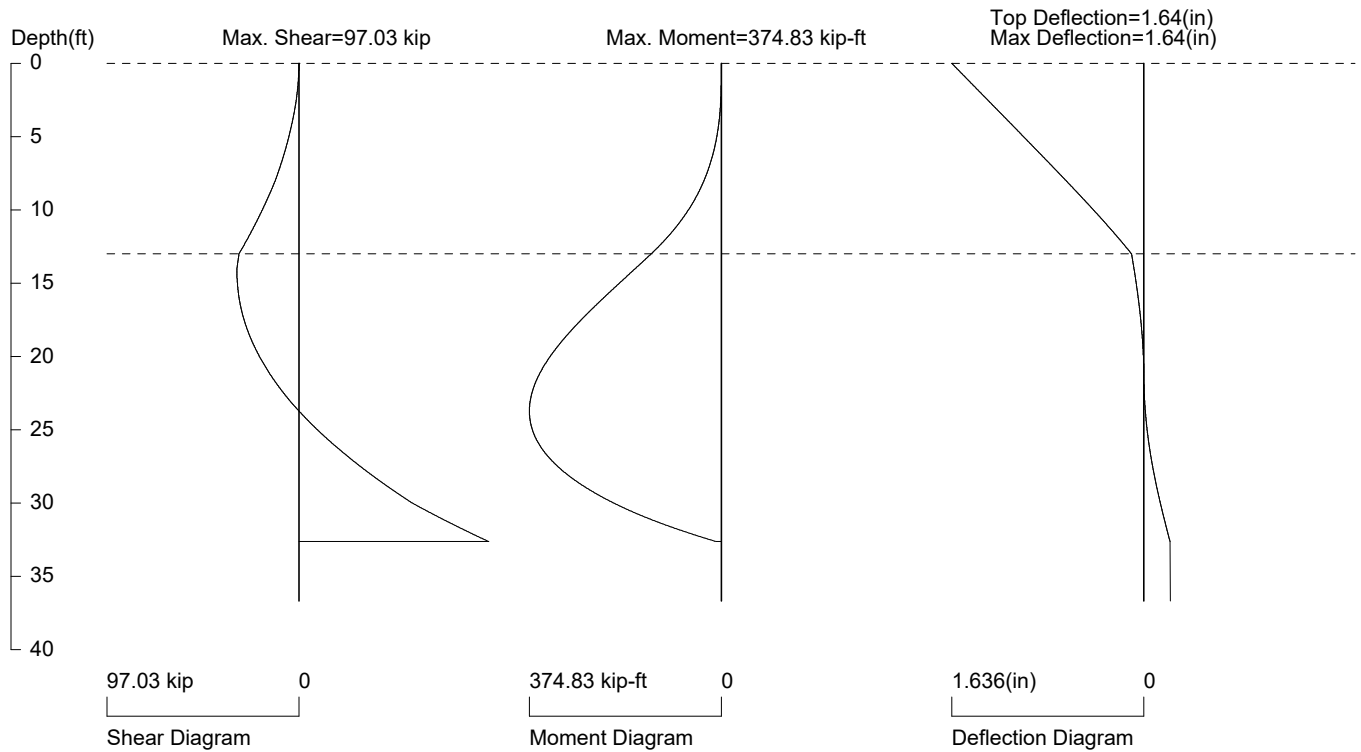
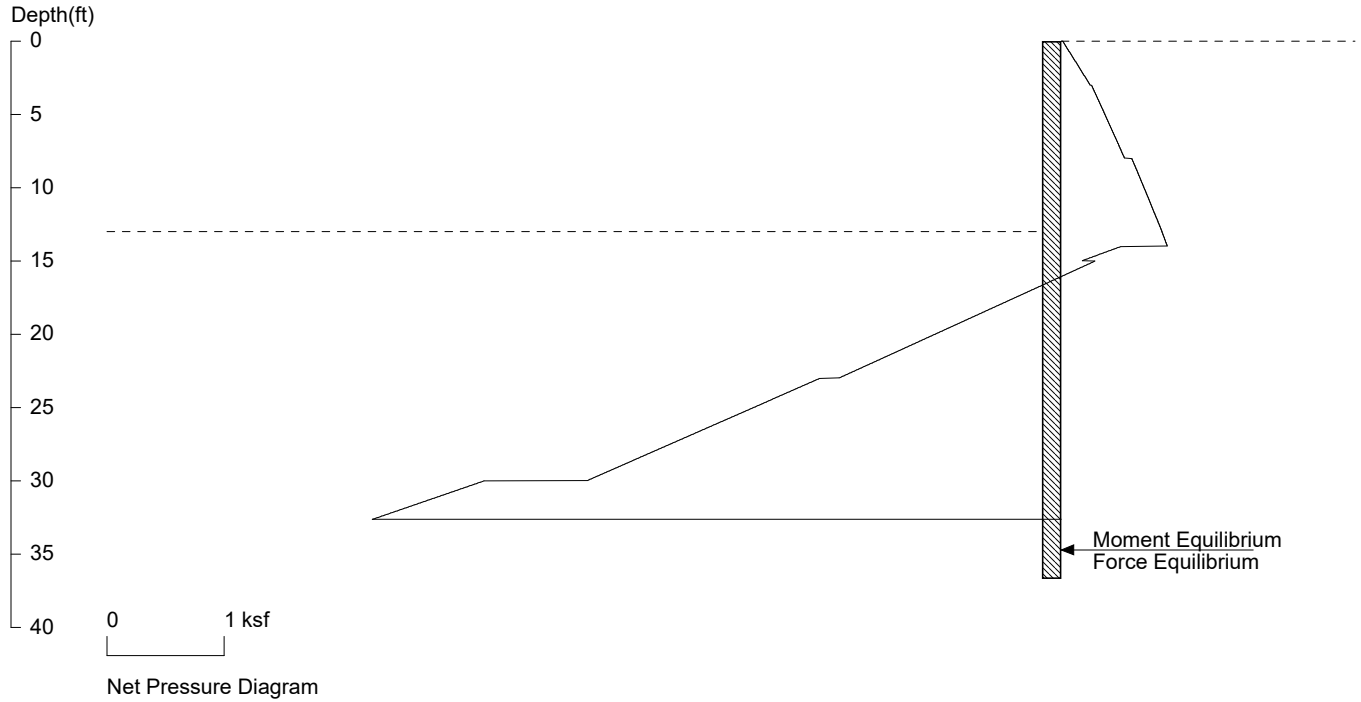
No.	Z depth	Spacing
1	0.00	5.00
2	13.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	13.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 13' Temporary



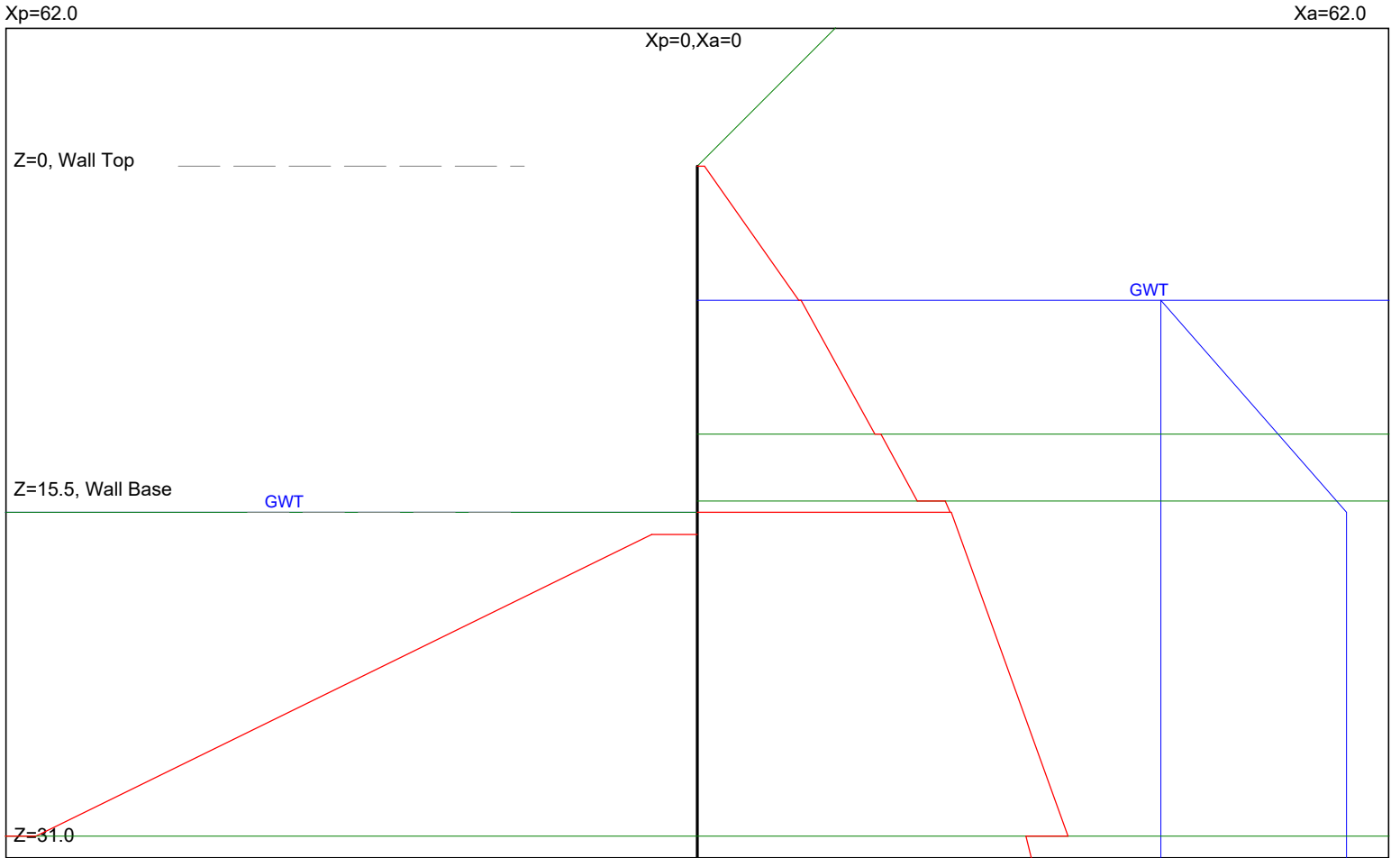
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Temp Walls\13' Temporary 7550 Crane SE WW.sh8

146th South 15.5' Permanent



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 UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 5/15/2025 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 4\15.5' Permanent SE WW.ep8

* INPUT DATA *

Wall Height=15.5 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-11.0	22.0	1	SM
2	-11.0	22.0	-11.0	800.0	1	SM
3	12.0	0.0	12.0	800.0	2	ML
4	15.0	0.0	15.0	800.0	3	CL
5	30.0	0.0	30.0	800.0	2	ML
6	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	6.0	0.0
2	6.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	15.5	0.0	15.5	800.0	3	CL

2	30.0	0.0	30.0	800.0	2	ML
3	40.0	0.0	40.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	15.5	0.0
2	15.5	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 6.07 per one linear foot (or meter) width along wall height

Total Static Force above Base= 6.07

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.02	6.00	0.32	0.0501	0.4006
6.00	0.33	12.00	0.57	0.0393	0.6275
12.00	0.59	15.00	0.70	0.0385	0.6680
15.00	0.79	15.50	0.81	0.0310	0.5897

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
15.50	0.81	30.00	1.18	0.0257	0.4883
30.00	1.05	31.00	1.07	0.0176	0.3051

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
16.50	0.15	30.00	2.11	0.146	2.7698
30.00	2.45	31.00	2.64	0.195	3.3855

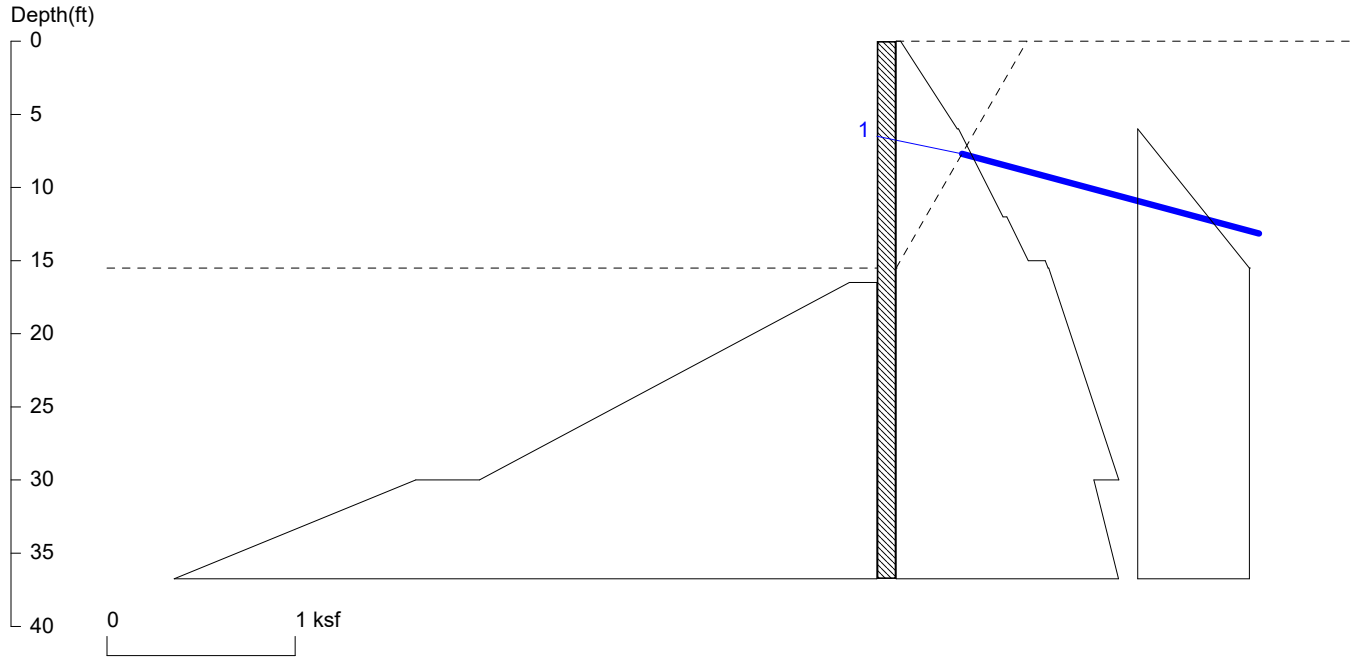
Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	6.00	0.00	15.50	0.59	0.06
1	15.50	0.59	31.00	0.59	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 5/15/2025 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 4\15.5' Permanent SE WW.ep8

146th South 15.5' Permanent



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Date: 5/15/2025

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Wall Height=15.5 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=21.25 Min. Pile Length=36.75

MOMENT IN PILE: Max. Moment=175.01 per Pile Spacing=5.0 at Depth=15.25

PILE SELECTION:

Request Min. Section Modulus = 76.4 in³/pile=1251.44 cm³/pile, F_y= 50 ksi = 345 MPa, F_b/F_y=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.48(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	6.5	15.0	5.0	44.1	42.6	11.4	4.7	21.8

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.023	6.000	0.324	0.050076
6.000	0.331	12.000	0.567	0.039279
12.000	0.587	15.000	0.702	0.038475
15.000	0.792	15.500	0.808	0.031017
*	Below	Base		
15.500	0.811	30.000	1.184	0.025687
30.000	1.051	40.000	1.243	0.019219
*	Water	Pres.		
6.000	0.000	15.500	0.593	0.062400
15.500	0.593	139.500	0.593	0.000000

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		

16.500	0.146	30.000	2.113	0.145693
30.000	2.451	40.000	4.353	0.190145

ACTIVE SPACING:

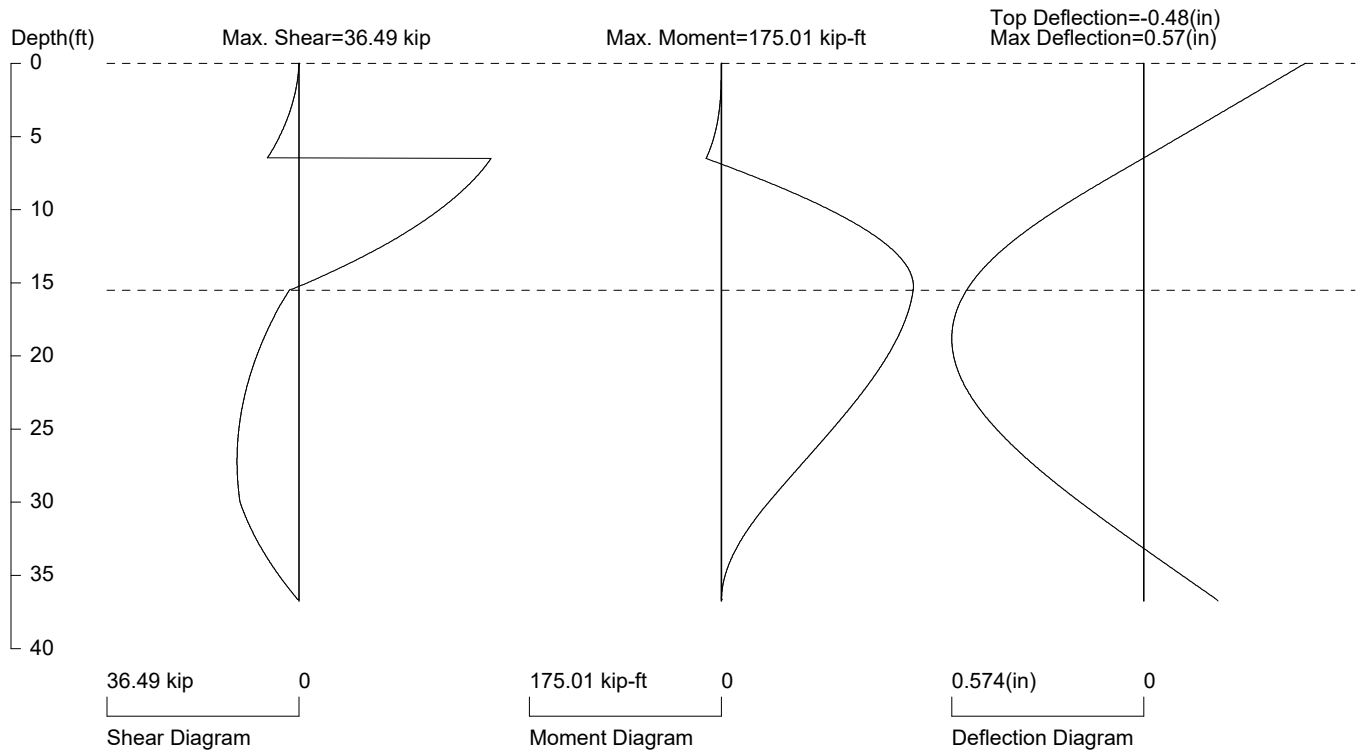
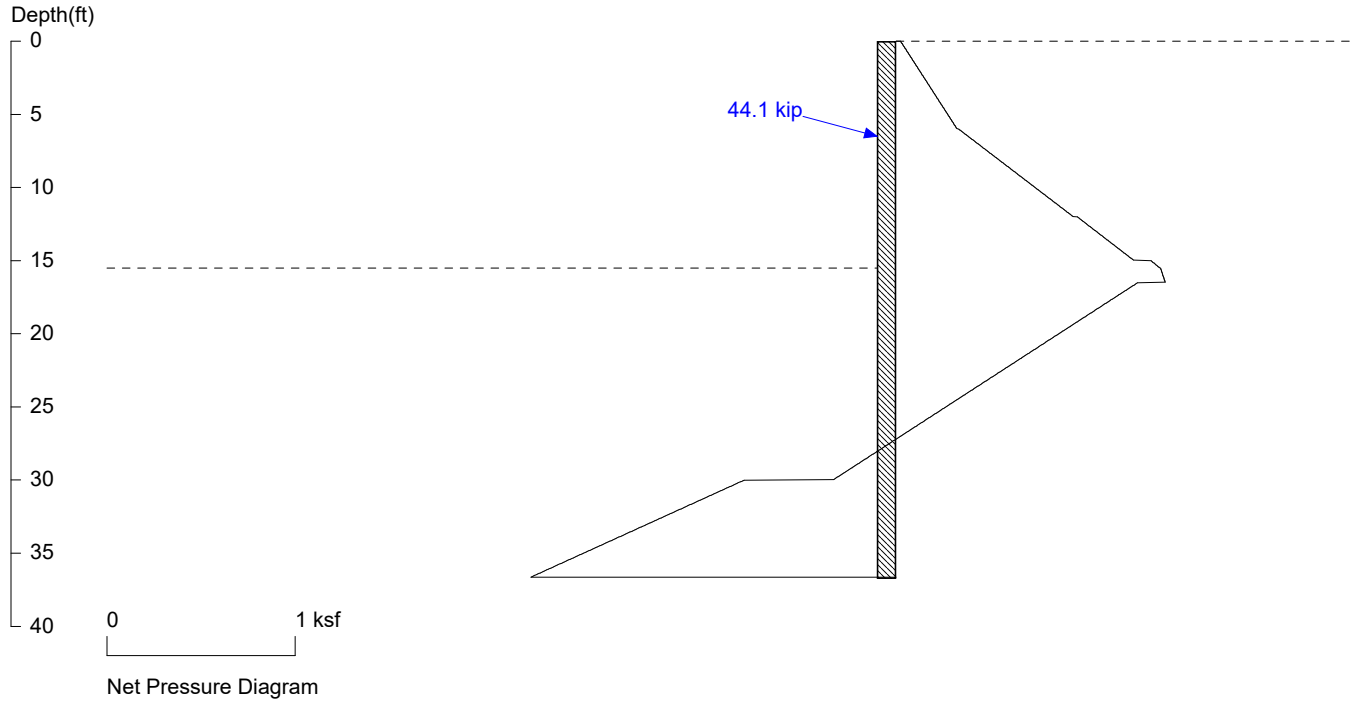
No.	Z depth	Spacing
1	0.00	5.00
2	15.50	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	15.50	2.40

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 15.5' Permanent



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

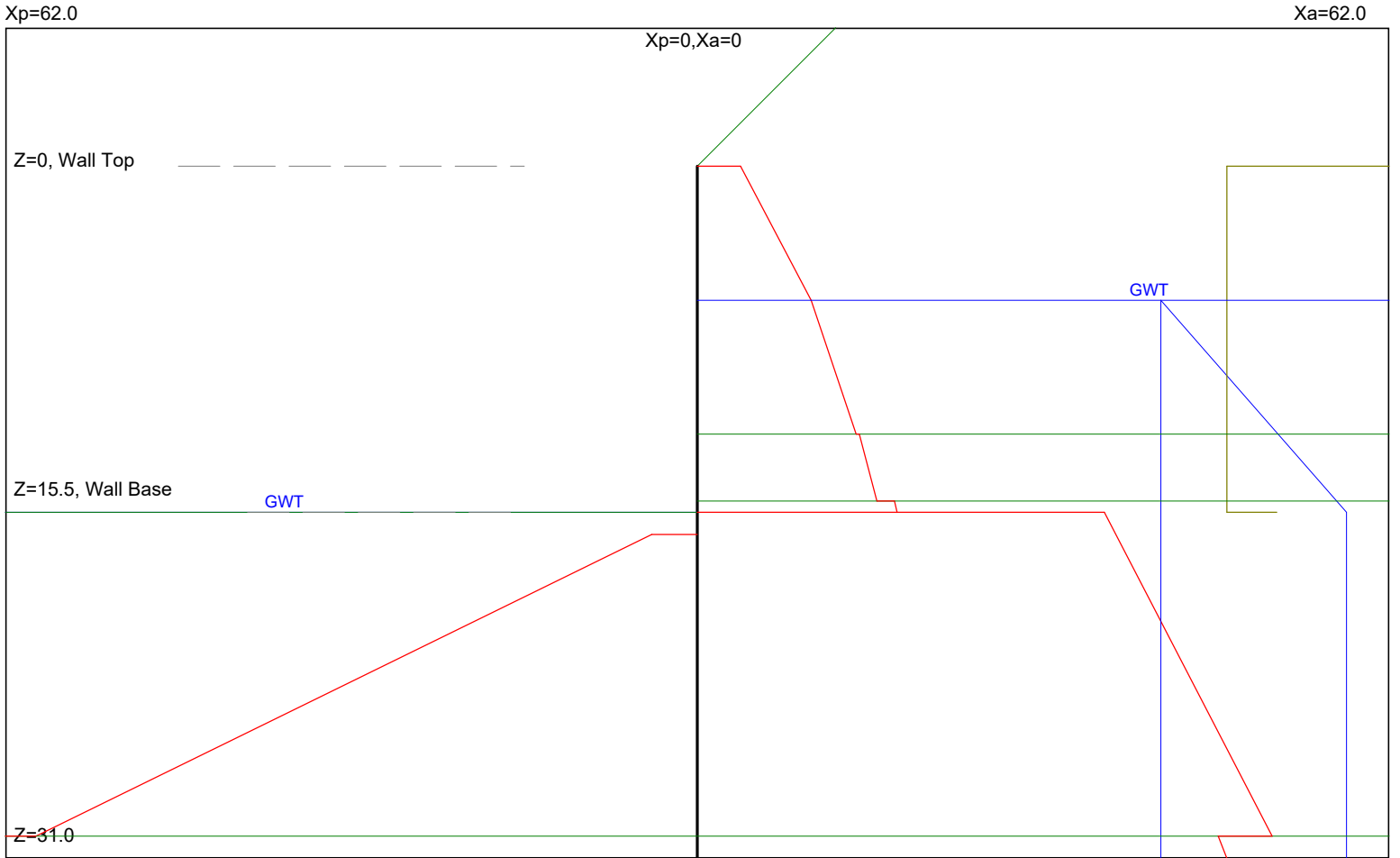
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Calculation Sheet #36

146th South 15.5' Seismic



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 UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 5/15/2025 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 4\15.5' Seismic SE WW.ep8

* INPUT DATA *

Wall Height=15.5 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-11.0	22.0	1	SM
2	-11.0	22.0	-11.0	800.0	1	SM
3	12.0	0.0	12.0	800.0	2	ML
4	15.0	0.0	15.0	800.0	3	CL
5	30.0	0.0	30.0	800.0	2	ML
6	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	6.0	0.0
2	6.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	15.5	0.0	15.5	800.0	3	CL

2	30.0	0.0	30.0	800.0	2	ML
3	40.0	0.0	40.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	15.5	0.0
2	15.5	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 12.26 per one linear foot (or meter) width along wall height

Total Static Force above Base= 6.07

Total Earthquake Force above Base= 6.19. Distributed in trapezoid. Total earthquake force acting at 0.4H below wall top.

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.14	6.00	0.36	0.0376	0.3005
6.00	0.36	12.00	0.51	0.0240	0.3840
12.00	0.52	15.00	0.57	0.0185	0.3220
15.00	0.63	15.50	0.64	0.0180	0.3427

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
15.50	1.30	30.00	1.84	0.0370	0.7032
30.00	1.66	31.00	1.69	0.0277	0.4808

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
16.50	0.15	30.00	2.11	0.146	2.7698
30.00	2.45	31.00	2.64	0.195	3.3855

Output Earthquake Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Total Earthq. Force, Ee = 6.19

No	Zq1	Pq1	Zq2	Pq2	Slope
0	0.00	0.639	15.50	0.160	-0.031

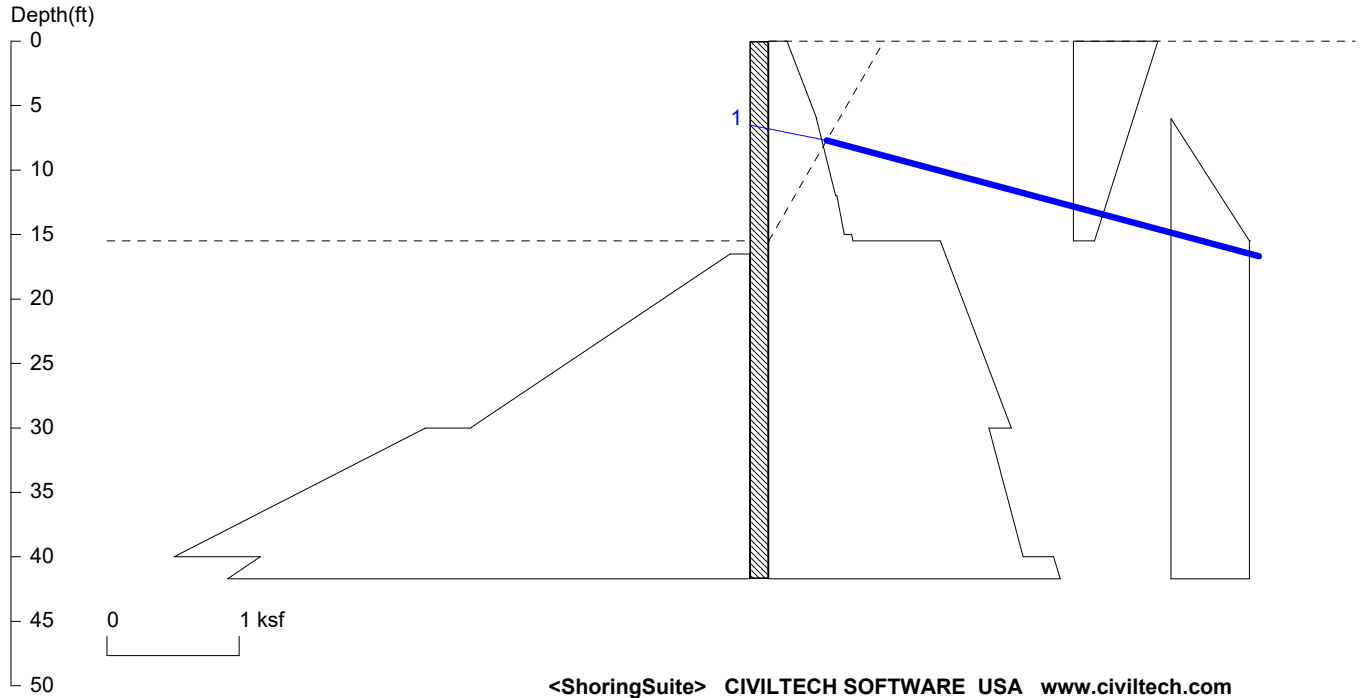
Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	6.00	0.00	15.50	0.59	0.06
1	15.50	0.59	31.00	0.59	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 5/15/2025 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 4\15.5' Seismic SE WW.ep8

146th South 15.5' Seismic



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Date: 5/15/2025

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 4\15.5' Seismic SE WW.sh8

Wall Height=15.5 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=26.20 Min. Pile Length=41.70

MOMENT IN PILE: Max. Moment=206.98 per Pile Spacing=5.0 at Depth=17.81

PILE SELECTION:

Request Min. Section Modulus = 90.3 in³/pile=1480.07 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.58(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	6.5	15.0	5.0	83.2	80.4	21.5	4.7	41.2

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.138	6.000	0.363	0.037559
6.000	0.363	12.000	0.508	0.024039
12.000	0.518	15.000	0.573	0.018546
15.000	0.629	15.500	0.638	0.018026
*	Below	Base		
15.500	1.300	30.000	1.836	0.036988
30.000	1.667	40.000	1.927	0.025987
40.000	2.157	139.500	5.023	0.028797
*	Earth	Queck		
0.000	0.639	15.500	0.160	-0.030902
*	Water	Pres.		
6.000	0.000	15.500	0.593	0.062400

15.500 0.593 139.500 0.593 0.000000

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
16.500	0.146	30.000	2.113	0.145693
30.000	2.451	40.000	4.353	0.190145
40.000	3.700	139.500	18.207	0.145798

ACTIVE SPACING:

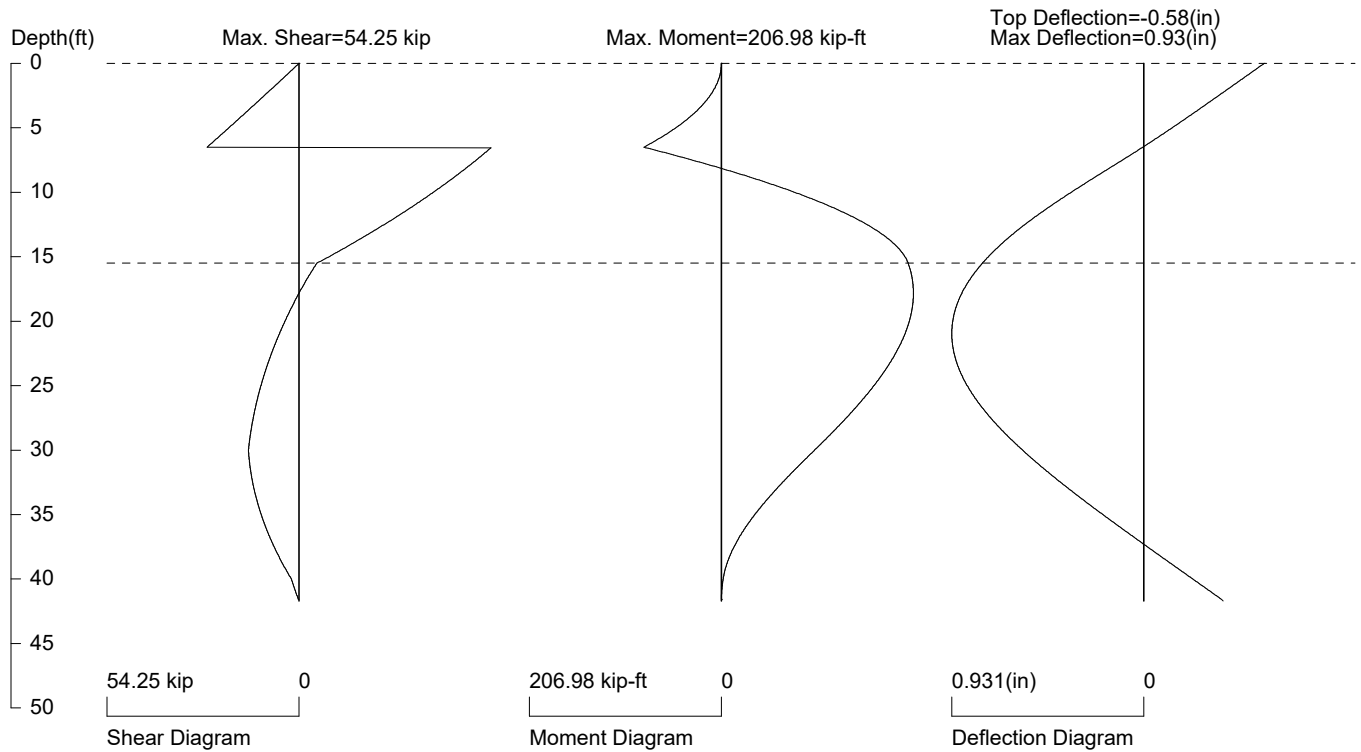
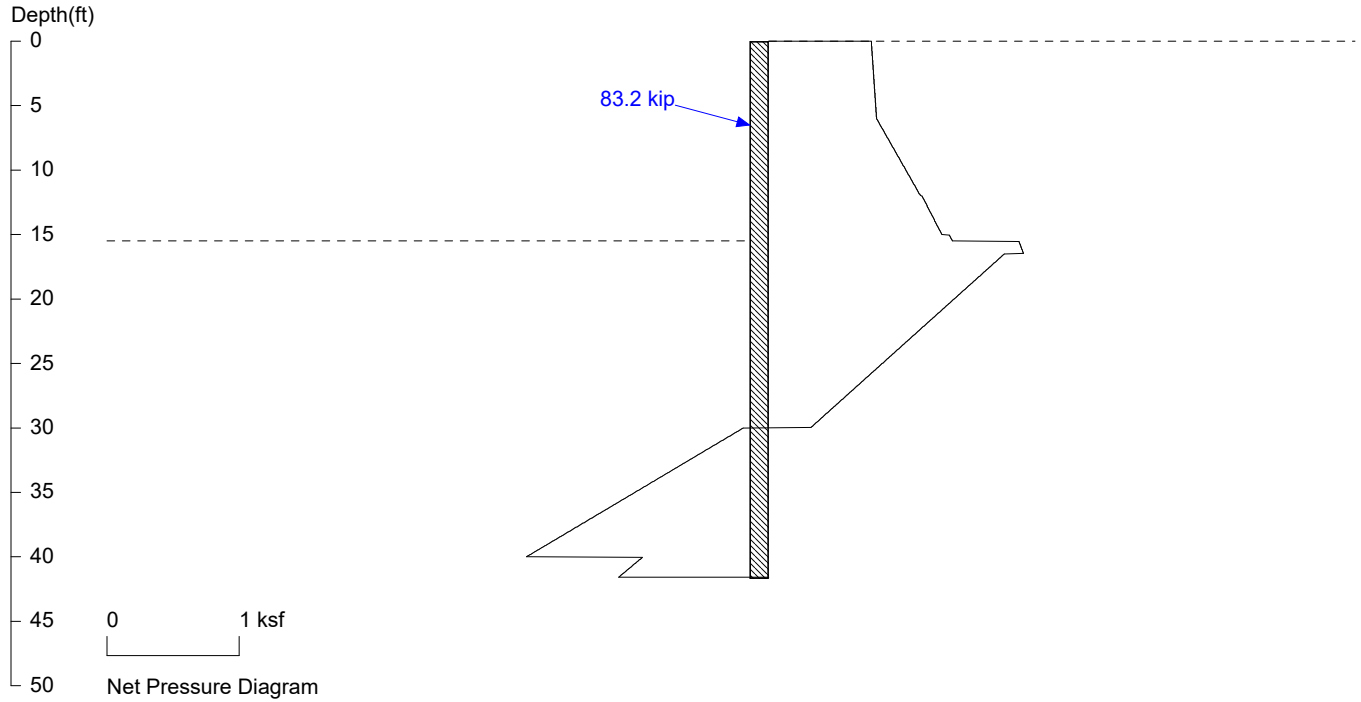
No.	Z depth	Spacing
1	0.00	5.00
2	15.50	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	15.50	2.40

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 15.5' Seismic



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 4\15.5' Seismic SE WW.sh8

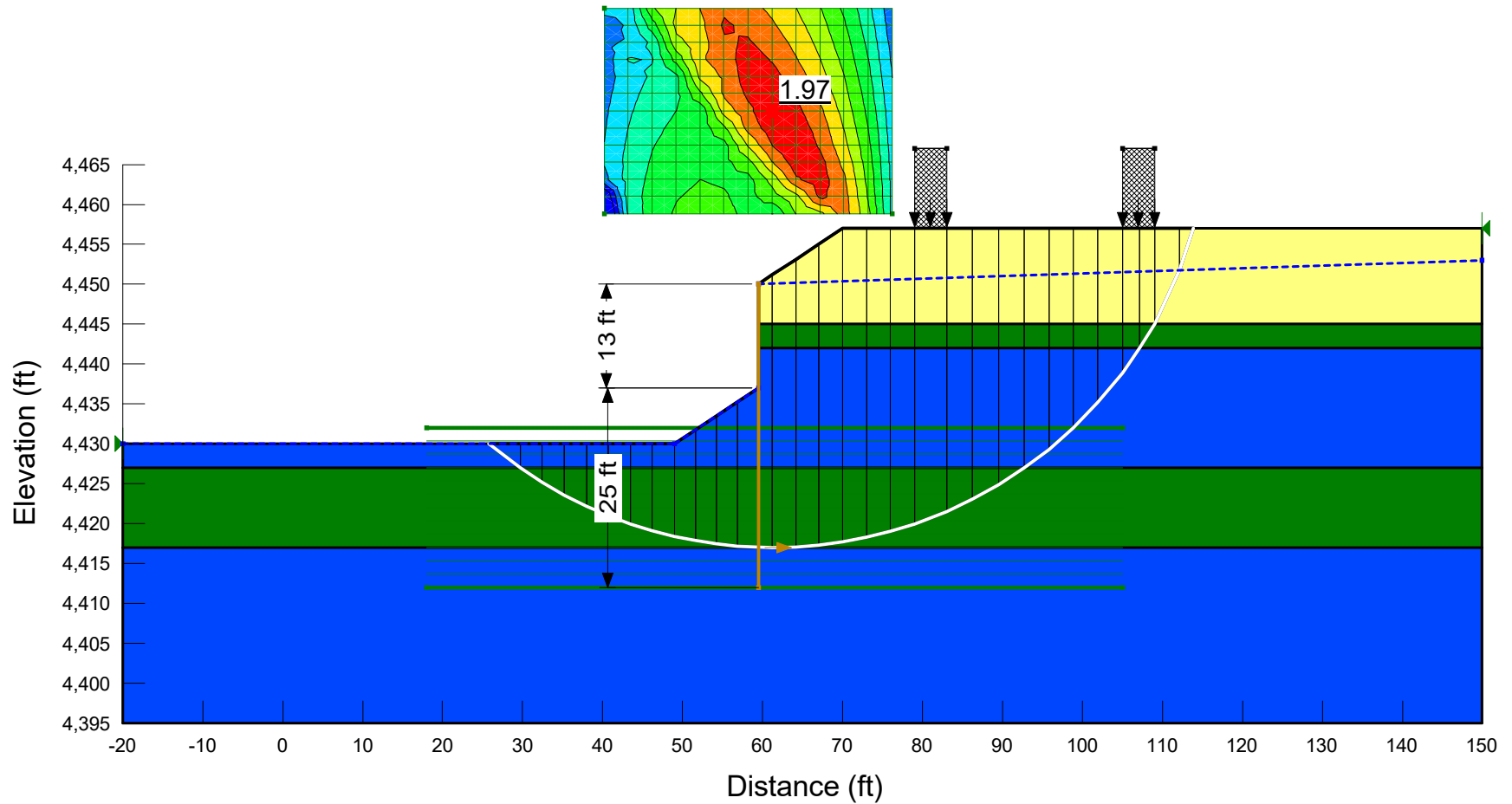
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Calculation Sheet #41

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Out-of-Plane Spacing (ft)
Brown	Pile (Wall 4)	Pile	5

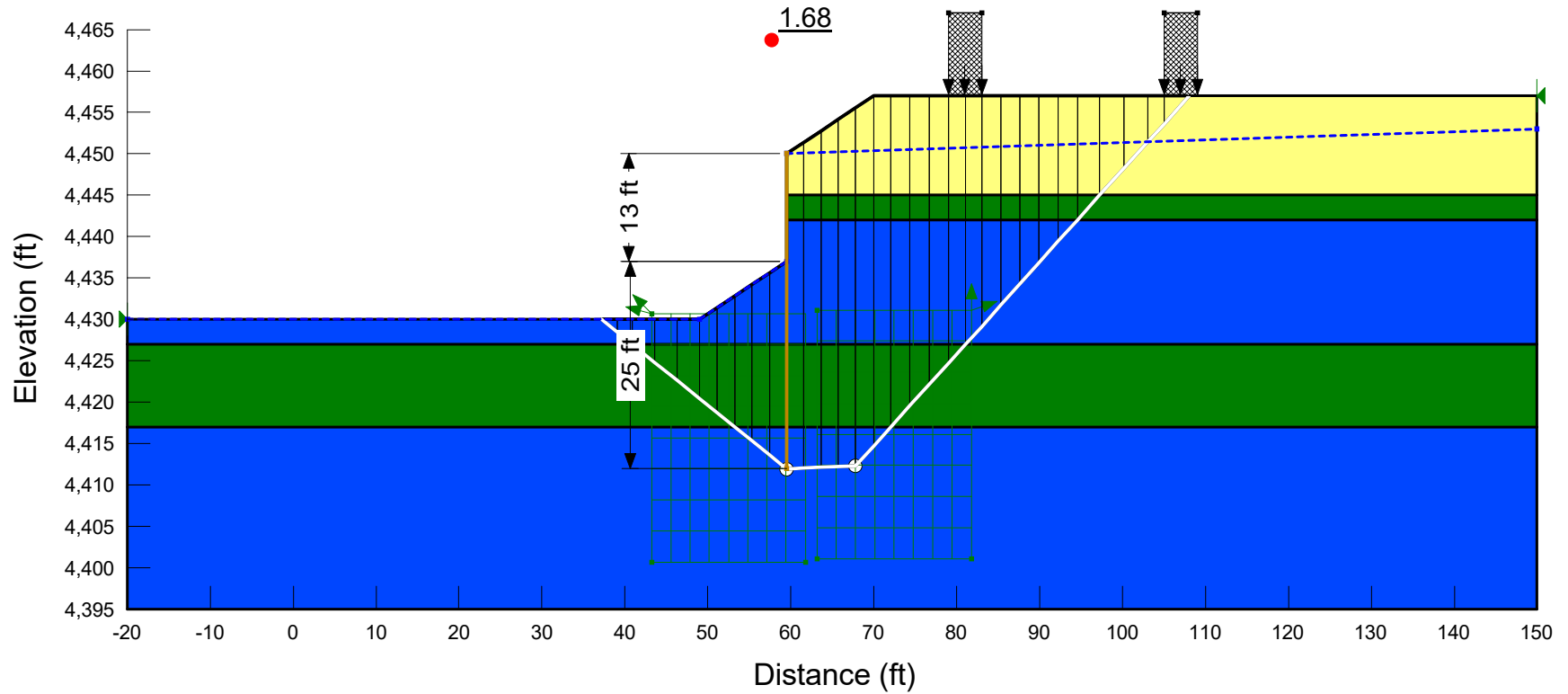


Wall 4 - 13' Temporary Case

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Out-of-Plane Spacing (ft)
Orange	Pile (Wall 4)	Pile	5

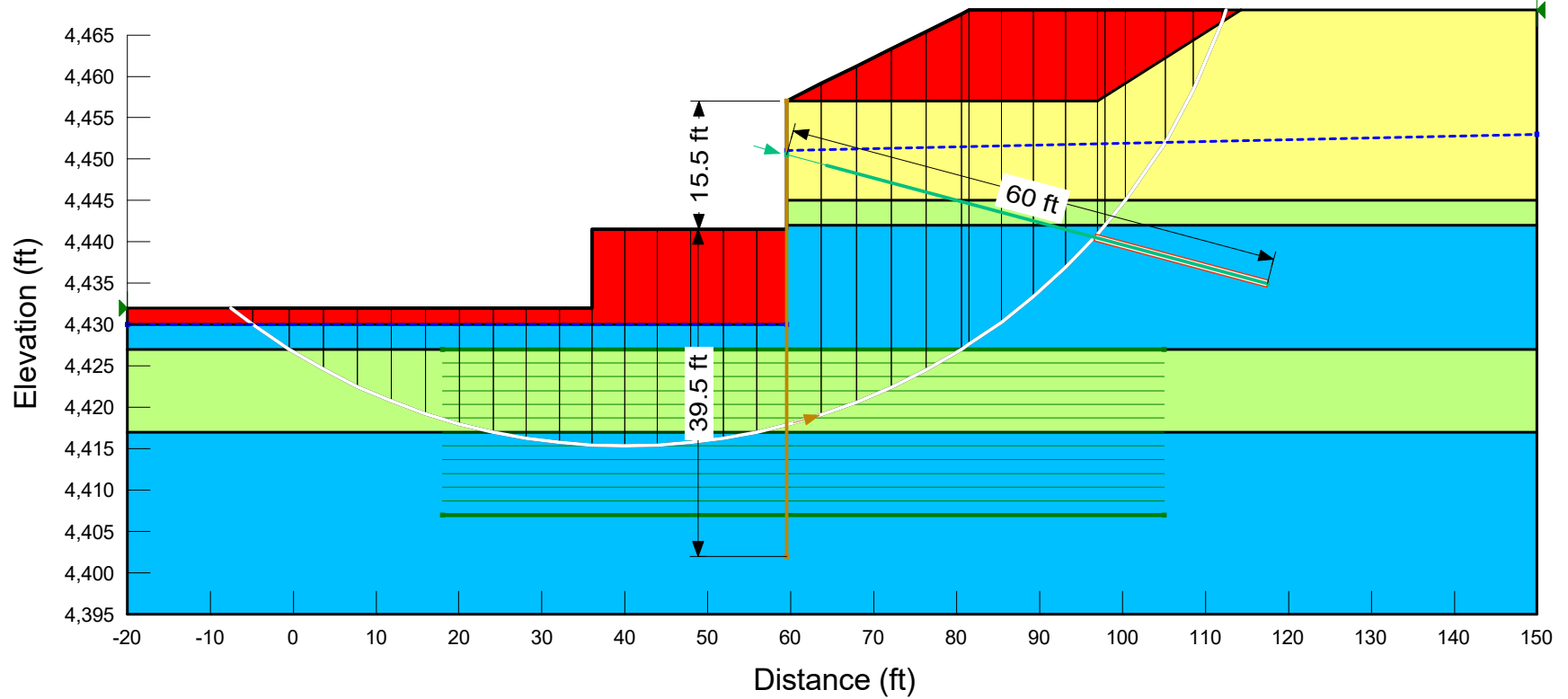
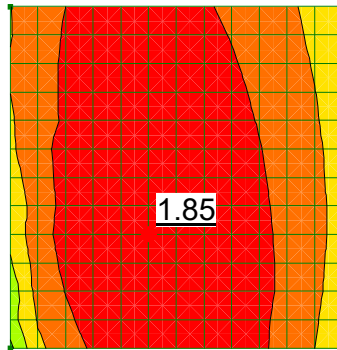


Wall 4 - 13' Temporary Case - Non Circular

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Red	Backfill	135	0	34
Blue	CL Drained	115	150	28
Light Green	ML Drained	120	100	32
Yellow	SM	125	0	33

Color	Name	Type	Out-of-Plane Spacing (ft)	Bond Length (ft)	Bond Diameter (ft)
Brown	Pile (Wall 4)	Pile	5		
Green	Tieback (Wall 4) (2)	Anchor	5	55	0.67

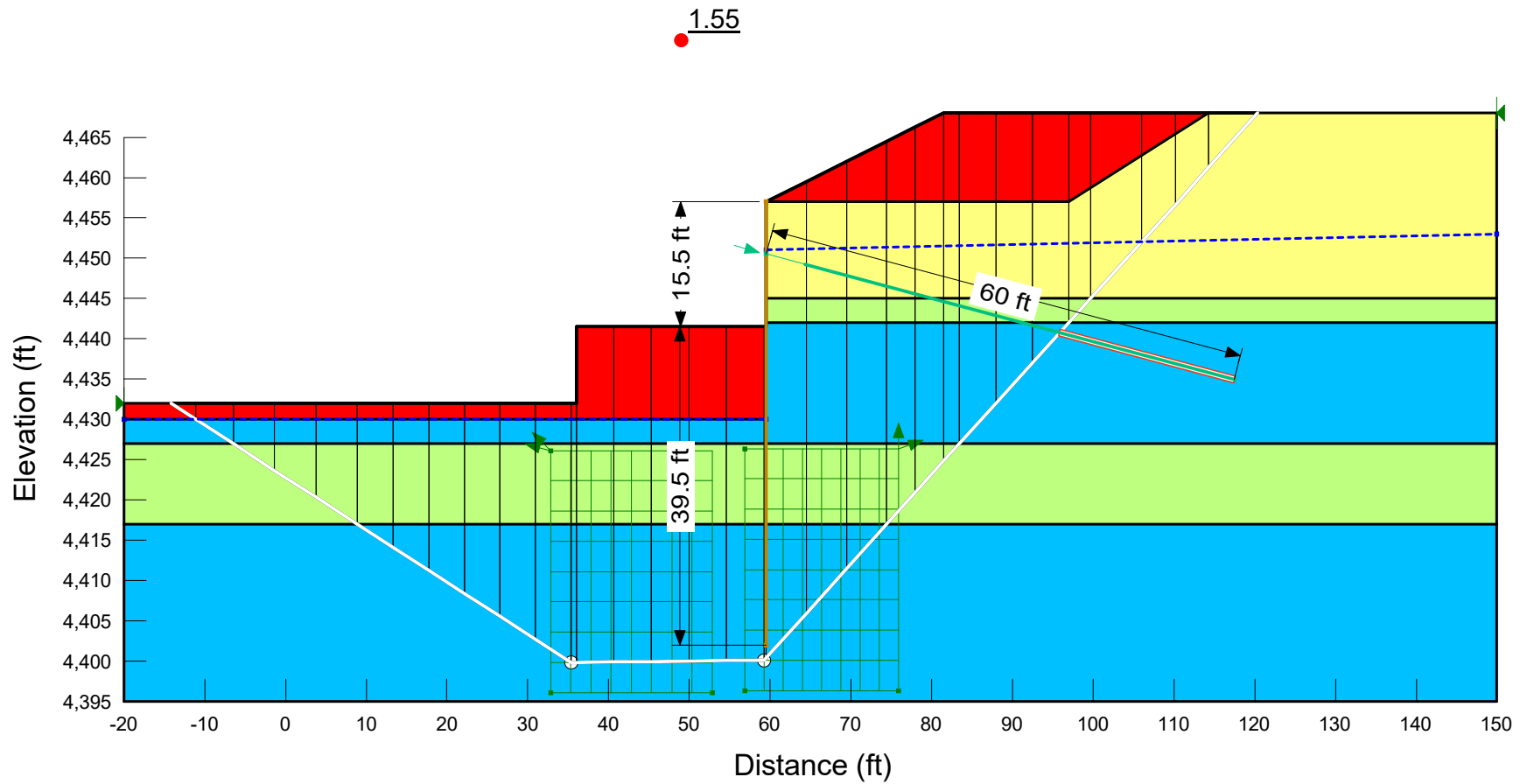


Wall 4 - 15.5' Long Term Case

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Red	Backfill	135	0	34
Blue	CL Drained	115	150	28
Light Green	ML Drained	120	100	32
Yellow	SM	125	0	33

Color	Name	Type	Out-of-Plane Spacing (ft)	Bond Length (ft)	Bond Diameter (ft)
Brown	Pile (Wall 4)	Pile	5		
Green	Tieback (Wall 4) (2)	Anchor	5	55	0.67



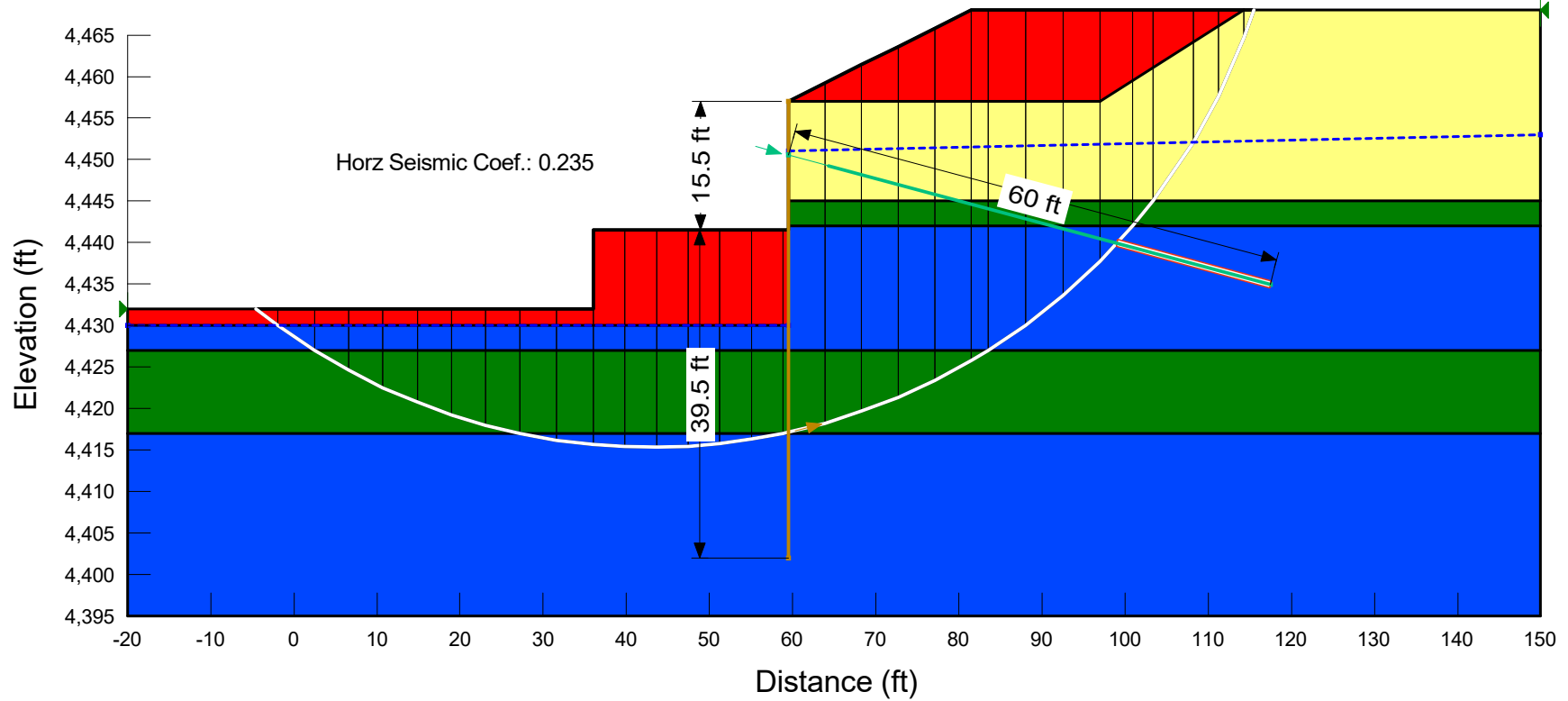
Wall 4 - 15.5' Long Term Case - Non Circular

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Red	Backfill	135	0	34
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Out-of-Plane Spacing (ft)	Bond Length (ft)	Bond Diameter (ft)
Brown	Pile (Wall 4)	Pile	5		
Teal	Tieback (Wall 4) (2)	Anchor	5	55	0.67

1.44

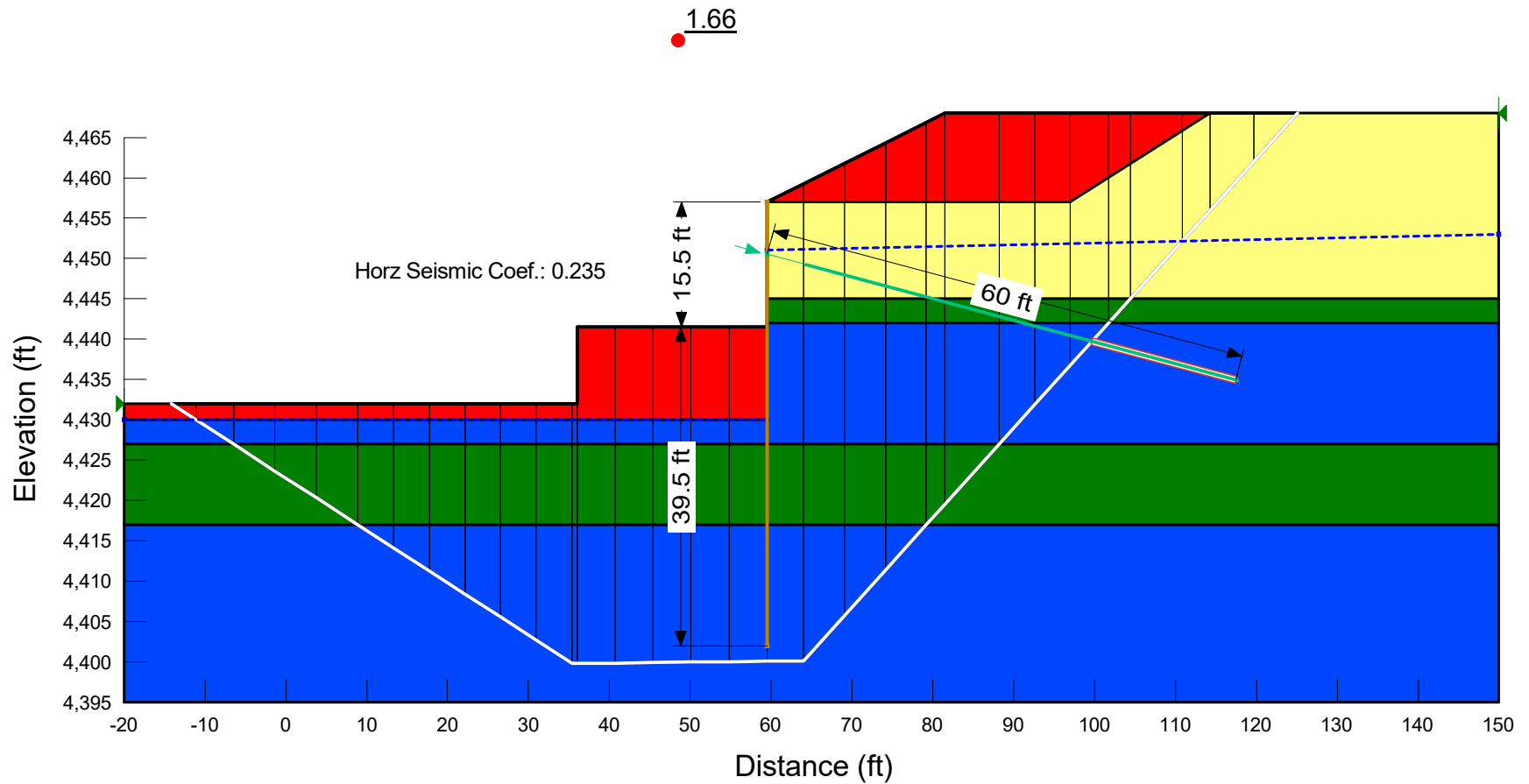


Wall 4 - 15.5' Psuedo Static

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Red	Backfill	135	0	34
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Out-of-Plane Spacing (ft)	Bond Length (ft)	Bond Diameter (ft)
Brown	Pile (Wall 4)	Pile	5		
Teal	Tieback (Wall 4) (2)	Anchor	5	55	0.67



Wall 4 - 15.5' Psuedo Static - Non Circular

14600 South Railroad Crossing

Wall 3 Calculations

146th South 30' Temporary

Xp=120.0

Xa=120.0

Xp=0, Xa=0

Z=0, Wall Top

Z=30.0, Wall Base

Z=60.0

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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/23/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\30' Temporary.ep8

* INPUT DATA *

Wall Height=30.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	13.0	0.0	13.0	800.0	2	ML
3	18.0	0.0	18.0	800.0	3	CL
4	33.0	0.0	33.0	800.0	2	ML
5	43.0	0.0	43.0	800.0	3	CL

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	30.0	0.0	30.0	800.0	3	CL
2	33.0	0.0	33.0	800.0	2	ML
3	43.0	0.0	43.0	800.0	3	CL

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 18.68 per one linear foot (or meter) width along wall height

Total Static Force above Base= 18.68. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.81	30.00	0.81	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

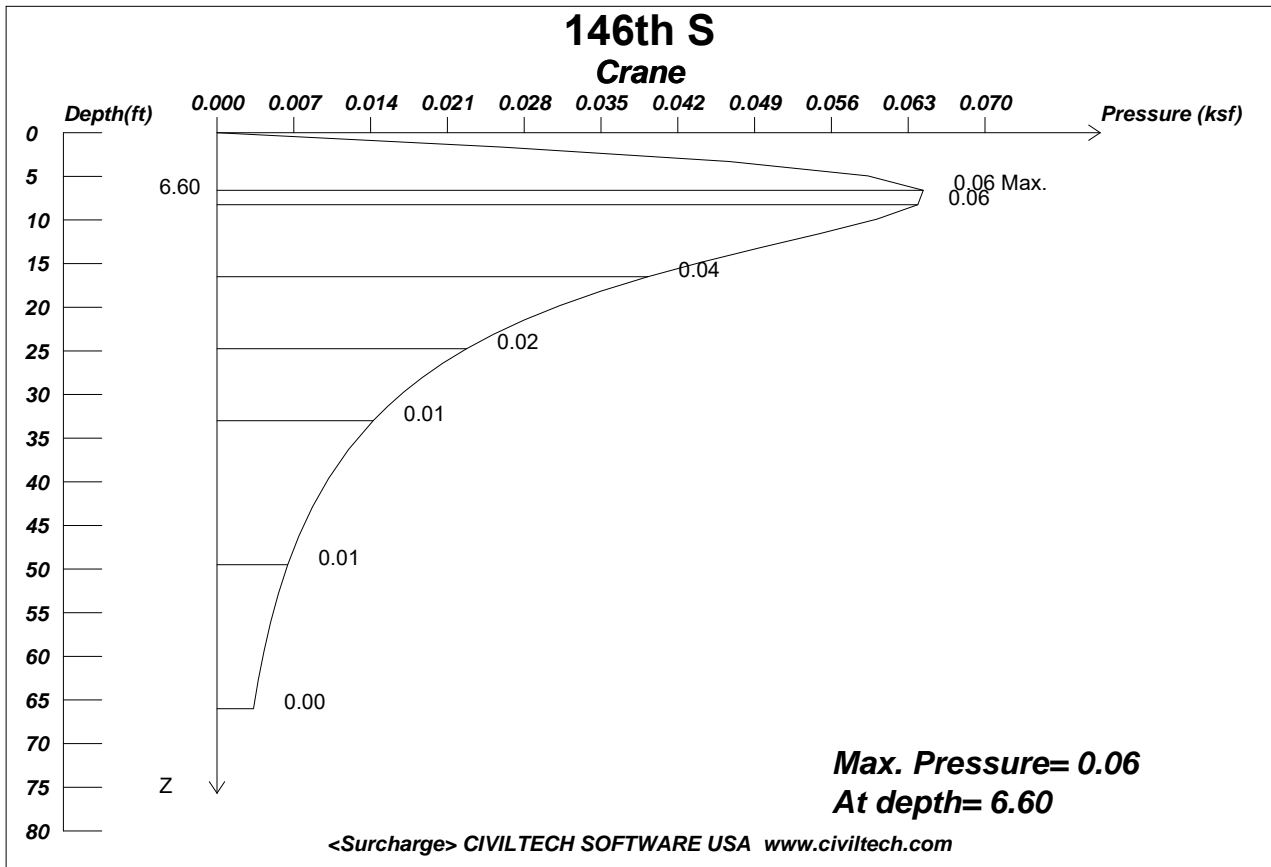
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
30.00	1.30	33.00	1.43	0.0415	0.3608
33.00	1.21	43.00	1.58	0.0368	0.3070
43.00	1.86	60.00	2.56	0.0415	0.3608

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
31.00	0.32	33.00	0.96	0.319	2.7698
33.00	1.12	43.00	5.03	0.391	3.2607
43.00	4.24	60.00	9.70	0.321	2.7939

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/23/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\30' Temporary.ep8



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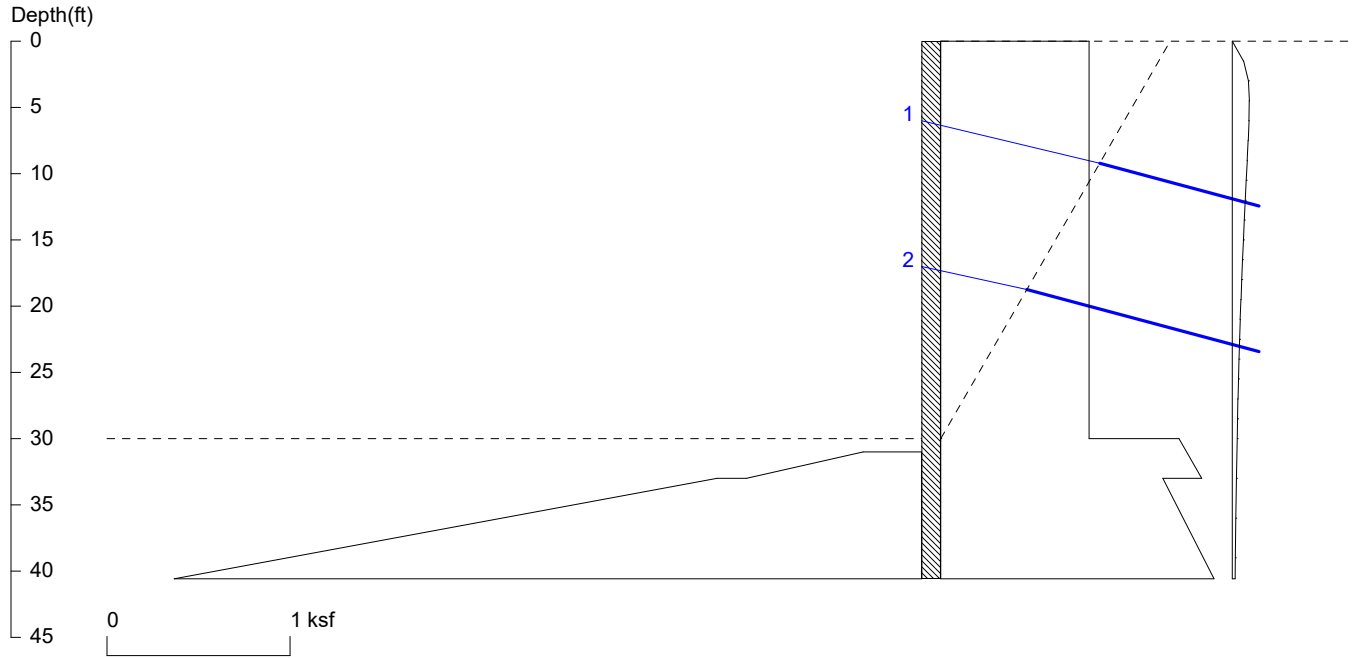
Date: 8/23/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\14000 Crane Surcharge.

Wall Height, H= 33 Load Depth, D= 0
 Load Factor of Surcharge Loading = 1
 Flexible Wall Condition -- Movement or deflection are allowed.
 Max. Pressure = 0.064 at depth = 6.60

X	Width	Length	Area Load
10.0	4.0	24.0	2.40
30.0	4.0	24.0	2.40

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 30' Temporary



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Date: 9/14/2024

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Wall Height=30.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=10.58 Min. Pile Length=40.58

MOMENT IN PILE: Max. Moment=143.31 per Pile Spacing=5.0 at Depth=26.77

PILE SELECTION:

Request Min. Section Modulus = 62.5 in³/pile=1024.74 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has Section Modulus = 131.0 in³/pile=2146.70 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.06(in) based on E (ksi)=29000.00 and I (in⁴)/pile=904.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	6.0	15.0	5.0	69.1*	66.7	17.9	12.4	45.6
2. Tieback	17.0	15.0	5.0	58.1	56.1	15.0	6.7	38.3

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.810	30.00	0.810	0.000000
*	Below	Base		
30.00	1.301	33.00	1.425	0.041488
33.00	1.213	43.00	1.581	0.036838
*	Sur-	charg		
0.000	0.000	1.500	0.062	0.041002
1.500	0.062	3.000	0.088	0.017598
3.000	0.088	4.500	0.093	0.003733
4.500	0.093	6.000	0.092	-0.00125
6.000	0.092	7.500	0.087	-0.00295

7.50	0.087	9.00	0.082	-0.00353
9.00	0.082	10.50	0.076	-0.00367
10.50	0.076	12.00	0.071	-0.00363
12.00	0.071	13.50	0.066	-0.00350
13.50	0.066	15.00	0.061	-0.00333
15.00	0.061	16.50	0.056	-0.00313
16.50	0.056	18.00	0.052	-0.00292
18.00	0.052	19.50	0.047	-0.00272
19.50	0.047	21.00	0.044	-0.00252
21.00	0.044	22.50	0.040	-0.00232
22.50	0.040	24.00	0.037	-0.00214
24.00	0.037	25.50	0.034	-0.00196
25.50	0.034	27.00	0.031	-0.00180
27.00	0.031	28.50	0.029	-0.00164
28.50	0.029	30.00	0.027	-0.00150
30.00	0.027	33.00	0.023	-0.00131
33.00	0.023	36.00	0.019	-0.00110
36.00	0.019	39.00	0.017	-0.00091
39.00	0.017	42.00	0.014	-0.00076

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
31.00	0.319	33.00	0.956	0.318530
33.00	1.117	43.00	5.030	0.391288

ACTIVE SPACING:

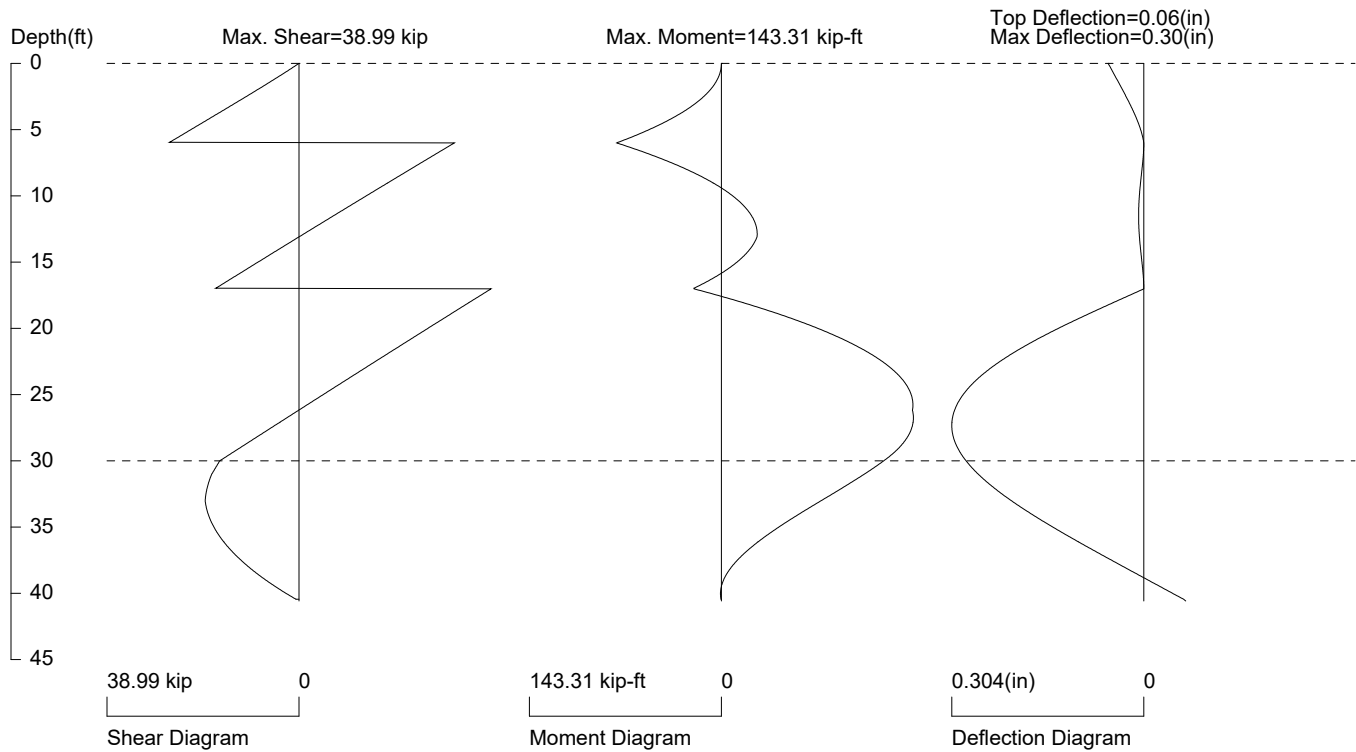
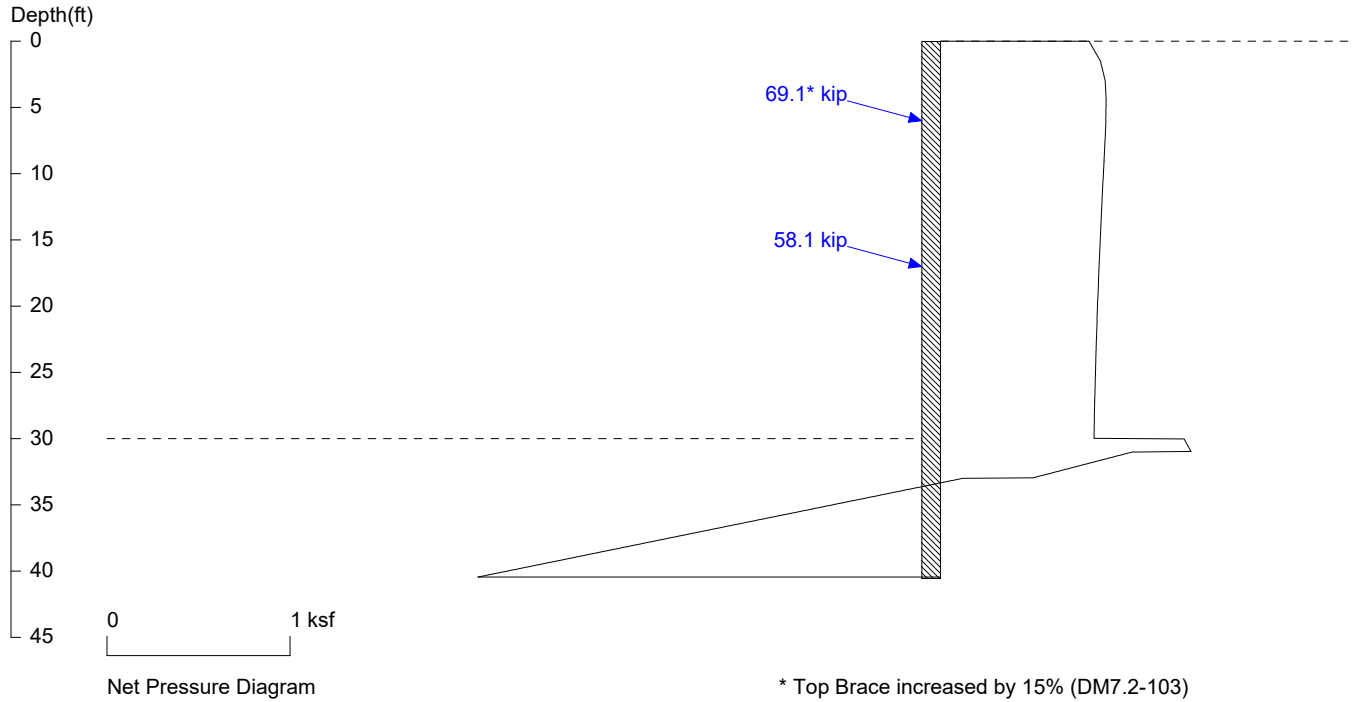
No.	Z depth	Spacing
1	0.00	5.00
2	30.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	30.00	2.40

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 30' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X89: E (ksi)=29000.0, I (in⁴)/pile=904.0

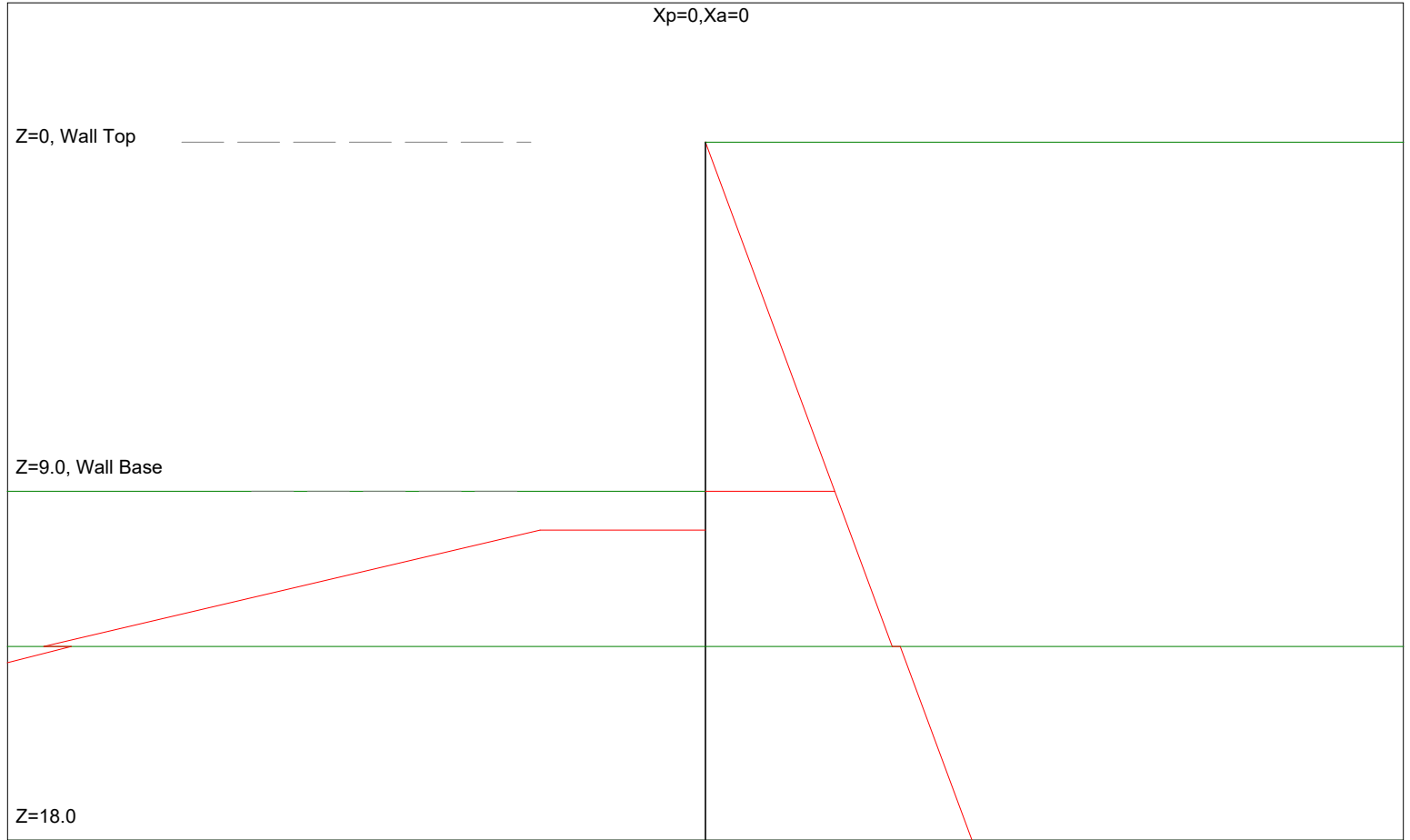
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146th South 9' Temporary

Xp=36.0

Xa=36.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\9' Temporary.ep8

* INPUT DATA *

Wall Height=9.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	13.0	0.0	13.0	800.0	2	ML
3	18.0	0.0	18.0	800.0	3	CL
4	33.0	0.0	33.0	800.0	2	ML
5	43.0	0.0	43.0	800.0	3	CL

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	9.0	0.0	9.0	800.0	1	SM
2	13.0	0.0	13.0	800.0	2	ML
3	18.0	0.0	18.0	800.0	3	CL
4	33.0	0.0	33.0	800.0	2	ML
5	43.0	0.0	43.0	800.0	3	CL

Wall Friction Options: 1.* No wall friction

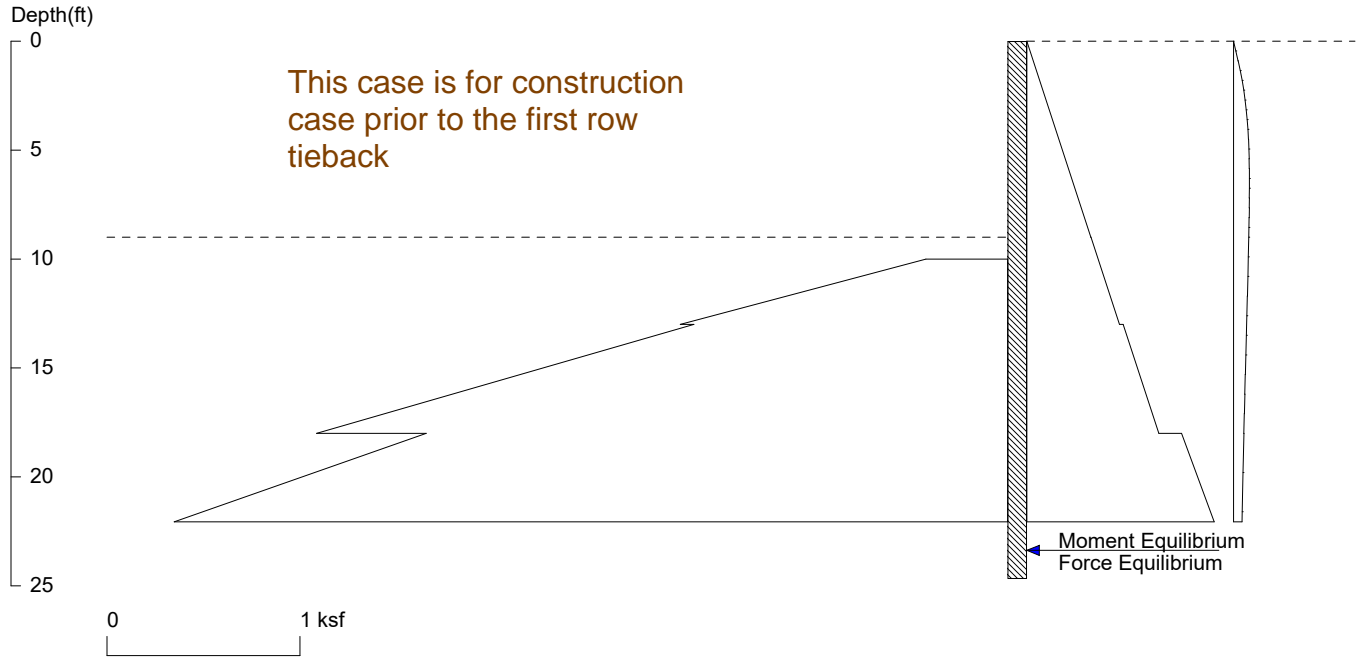
Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

146th South 9' Temporary



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Wall Height=9.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=15.68 Min. Pile Length=24.68

MOMENT IN PILE: Max. Moment=84.40 per Pile Spacing=5.0 at Depth=15.79

PILE SELECTION:

Request Min. Section Modulus = 36.8 in³/pile=603.49 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has Section Modulus = 131.0 in³/pile=2146.70 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.25(in) based on E (ksi)=29000.00 and I (in⁴)/pile=904.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	9.000	0.332	0.036841
*	Below	Base		
9.000	0.332	13.000	0.479	0.036841
13.000	0.499	18.000	0.684	0.036871
18.000	0.801	33.000	1.426	0.041640
*	Sur-	charg		
0.000	0.000	0.450	0.012	0.027114
0.450	0.012	0.900	0.024	0.026122
0.900	0.024	1.350	0.035	0.024273
1.350	0.035	1.800	0.045	0.021800
1.800	0.045	2.250	0.053	0.018971
2.250	0.053	2.700	0.060	0.016037
2.700	0.060	3.150	0.066	0.013194
3.150	0.066	3.600	0.071	0.010571
3.600	0.071	4.050	0.075	0.008239
4.050	0.075	4.500	0.078	0.006221
4.500	0.078	4.950	0.080	0.004508

4.950	0.080	5.400	0.081	0.003075
5.400	0.081	5.850	0.082	0.001889
5.850	0.082	6.300	0.082	0.000913
6.300	0.082	6.750	0.082	0.000116
6.750	0.082	7.200	0.082	-0.00053
7.200	0.082	7.650	0.082	-0.00106
7.650	0.082	8.100	0.081	-0.00148
8.100	0.081	8.550	0.080	-0.00183
8.550	0.080	9.000	0.079	-0.00211
9.000	0.079	9.900	0.077	-0.00242
9.900	0.077	10.80	0.075	-0.00270
10.80	0.075	11.70	0.072	-0.00286
11.70	0.072	12.60	0.069	-0.00295
12.60	0.069	13.50	0.067	-0.00298
13.50	0.067	14.40	0.064	-0.00297
14.40	0.064	15.30	0.061	-0.00293
15.30	0.061	16.20	0.059	-0.00287
16.20	0.059	17.10	0.056	-0.00280
17.10	0.056	18.00	0.054	-0.00272
18.00	0.054	19.80	0.049	-0.00258
19.80	0.049	21.60	0.045	-0.00239
21.60	0.045	23.40	0.041	-0.00220
23.40	0.041	25.20	0.037	-0.00201

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
10.00	0.424	13.00	1.696	0.424115
13.00	1.626	18.00	3.580	0.390854
18.00	3.013	33.00	7.829	0.321034

ACTIVE SPACING:

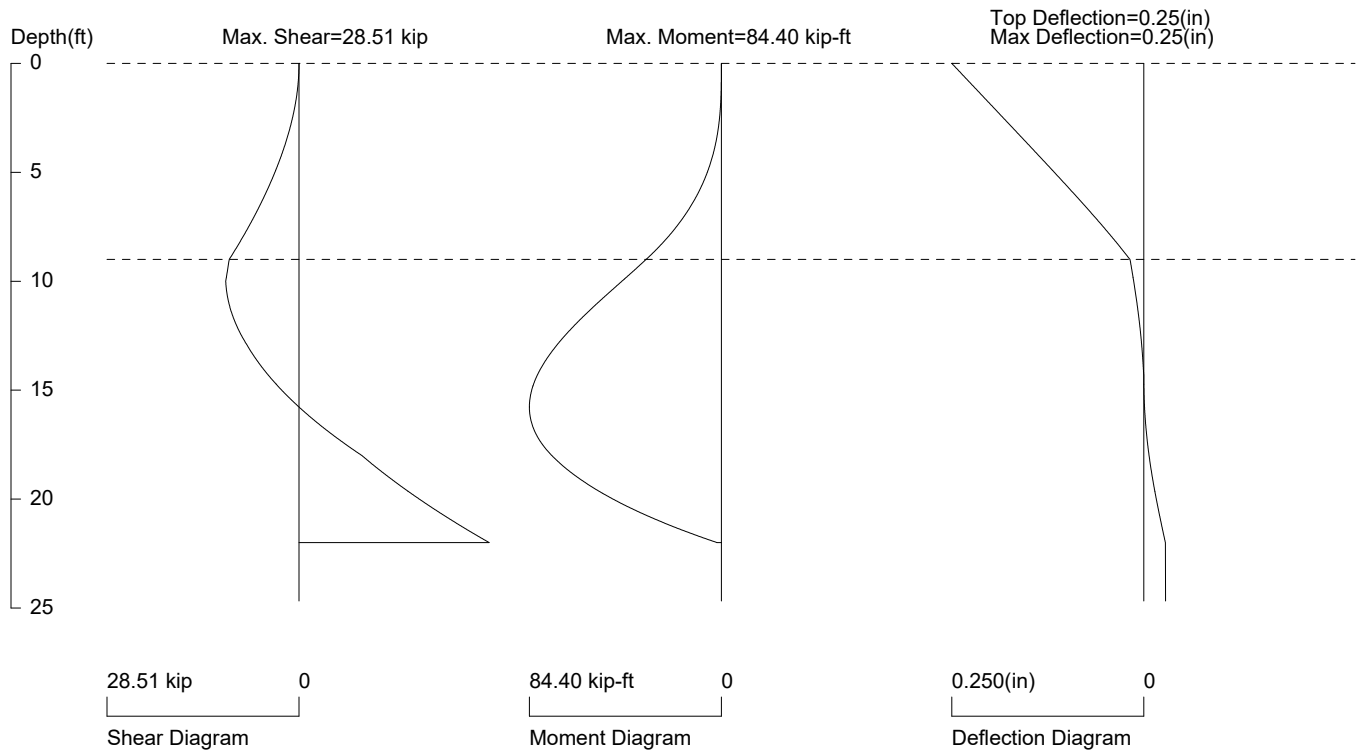
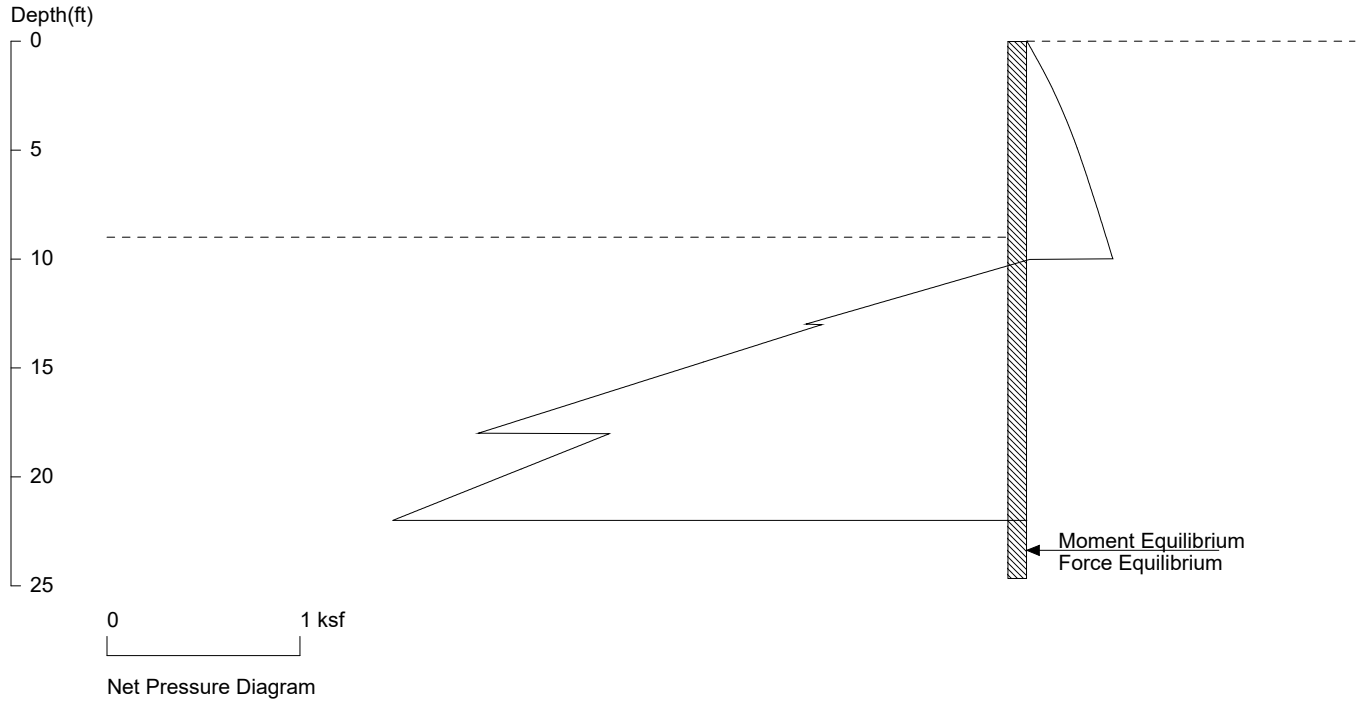
No.	Z depth	Spacing
1	0.00	5.00
2	9.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	9.00	2.40

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 9' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X89: E (ksi)=29000.0, I (in⁴)/pile=904.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\9' Temporary.sh8

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Calculation Sheet #58

146th South 19' Temporary

Xp=76.0

Xa=76.0

Xp=0, Xa=0

Z=0, Wall Top

Z=19.0, Wall Base

Z=38.0

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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\19' Temporary.ep8

* INPUT DATA *

Wall Height=19.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	13.0	0.0	13.0	800.0	2	ML
3	18.0	0.0	18.0	800.0	3	CL
4	33.0	0.0	33.0	800.0	2	ML
5	43.0	0.0	43.0	800.0	3	CL

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	19.0	0.0	19.0	800.0	3	CL
2	33.0	0.0	33.0	800.0	2	ML
3	43.0	0.0	43.0	800.0	3	CL

Wall Friction Options: 1.* No wall friction

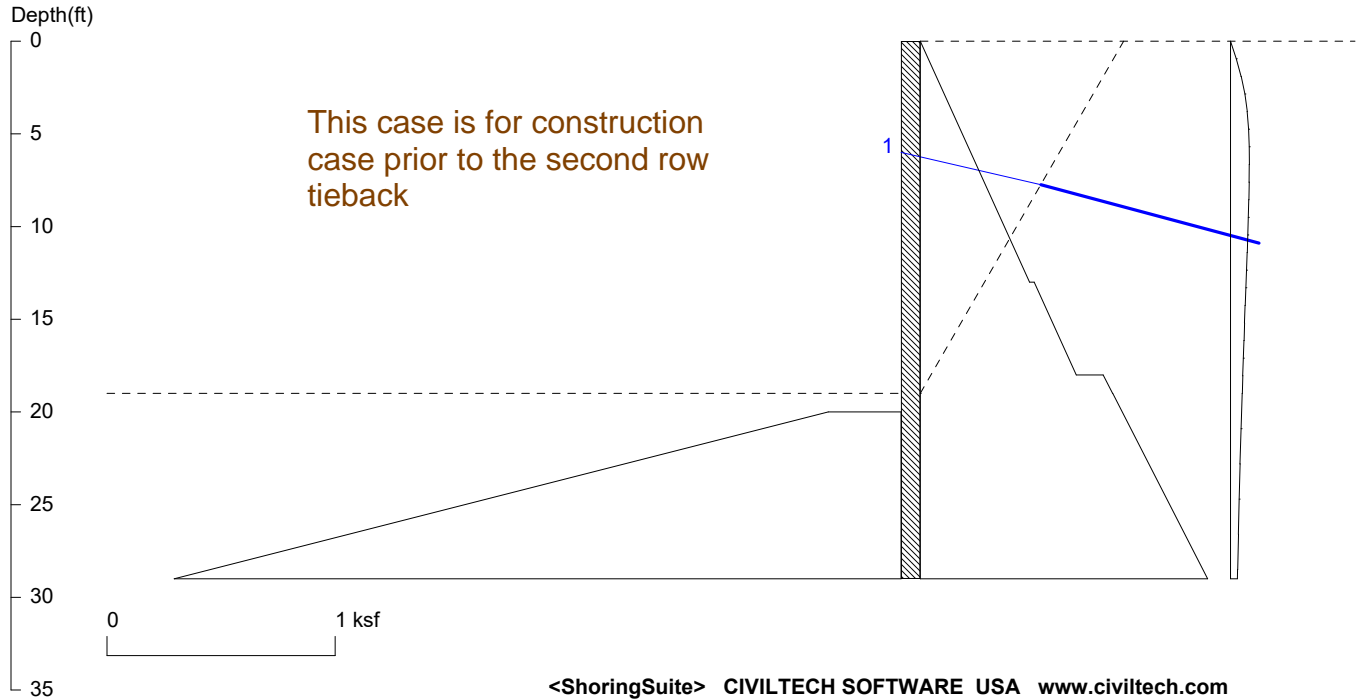
Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

146th South 19' Temporary



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Date: 9/24/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\19' Temporary.sh8

Wall Height=19.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=10.00 Min. Pile Length=29.00

MOMENT IN PILE: Max. Moment=118.71 per Pile Spacing=5.0 at Depth=15.78

PILE SELECTION:

Request Min. Section Modulus = 51.8 in³/pile=848.84 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has Section Modulus = 131.0 in³/pile=2146.70 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.30(in) based on E (ksi)=29000.00 and I (in⁴)/pile=904.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	6.0	15.0	5.0	29.5	28.5	7.6	6.7	19.5

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	13.00	0.479	0.036841
13.00	0.499	18.00	0.684	0.036871
18.00	0.801	19.00	0.842	0.041397
*	Below	Base		
19.00	0.843	33.00	1.426	0.041626
*	Sur-	charg		
0.000	0.000	0.950	0.025	0.026544
0.950	0.025	1.900	0.047	0.022613
1.900	0.047	2.850	0.063	0.016695
2.850	0.063	3.800	0.073	0.010891
3.800	0.073	4.750	0.079	0.006265
4.750	0.079	5.700	0.082	0.002967

5.700	0.082	6.650	0.082	0.000747
6.650	0.082	7.600	0.082	-0.00070
7.600	0.082	8.550	0.080	-0.00164
8.550	0.080	9.500	0.078	-0.00223
9.500	0.078	10.45	0.076	-0.00260
10.45	0.076	11.40	0.073	-0.00281
11.40	0.073	12.35	0.070	-0.00293
12.35	0.070	13.30	0.067	-0.00297
13.30	0.067	14.25	0.064	-0.00297
14.25	0.064	15.20	0.062	-0.00294
15.20	0.062	16.15	0.059	-0.00288
16.15	0.059	17.10	0.056	-0.00280
17.10	0.056	18.05	0.054	-0.00272
18.05	0.054	19.00	0.051	-0.00262
19.00	0.051	20.90	0.046	-0.00247
20.90	0.046	22.80	0.042	-0.00227
22.80	0.042	24.70	0.038	-0.00207
24.70	0.038	26.60	0.035	-0.00188
26.60	0.035	28.50	0.031	-0.00170
28.50	0.031	30.40	0.028	-0.00153

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
20.00	0.319	33.00	4.459	0.318530

ACTIVE SPACING:

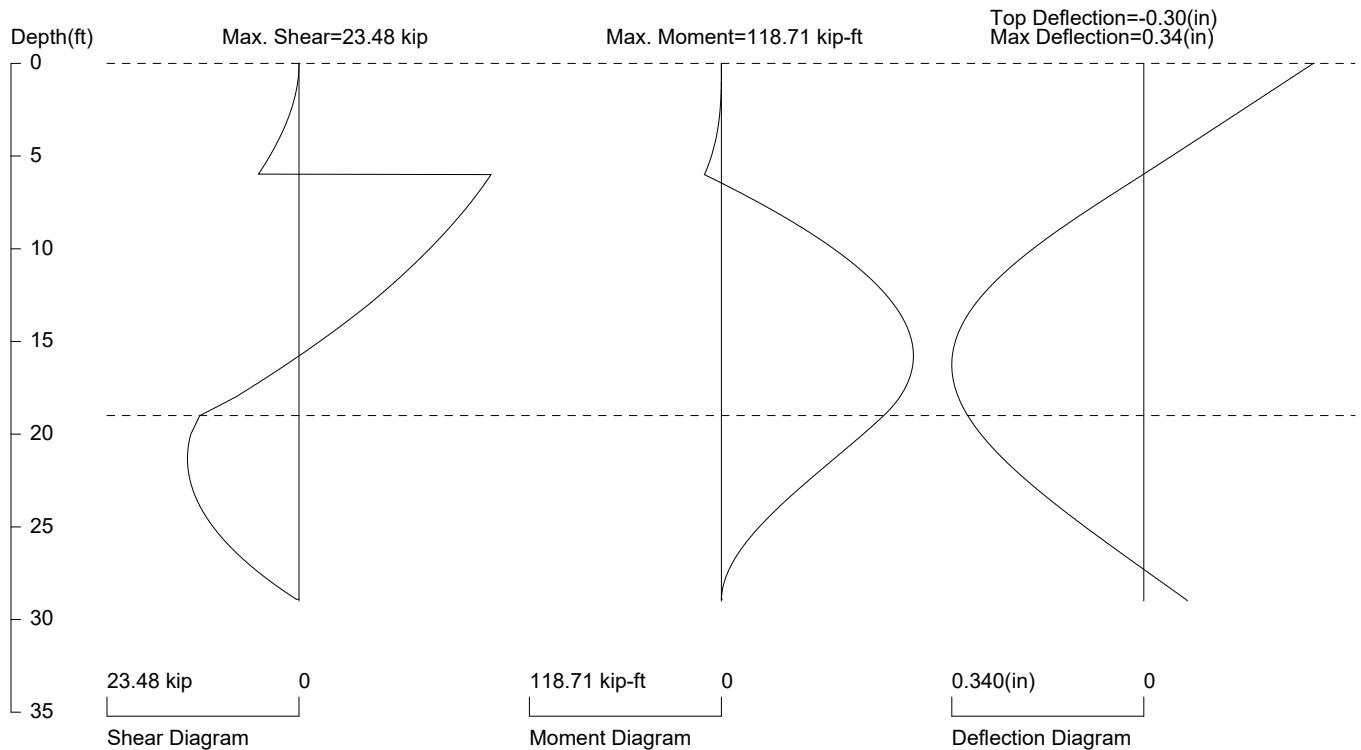
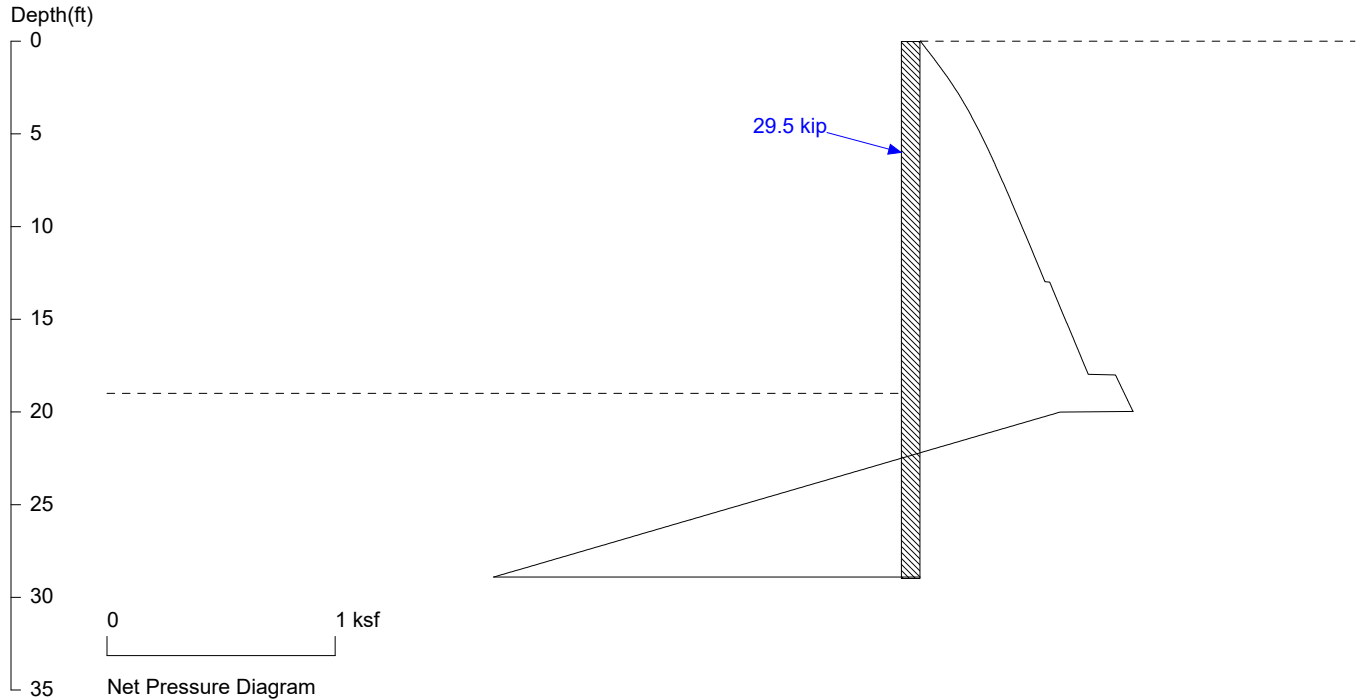
No.	Z depth	Spacing
1	0.00	5.00
2	19.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	19.00	2.40

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 19' Temporary



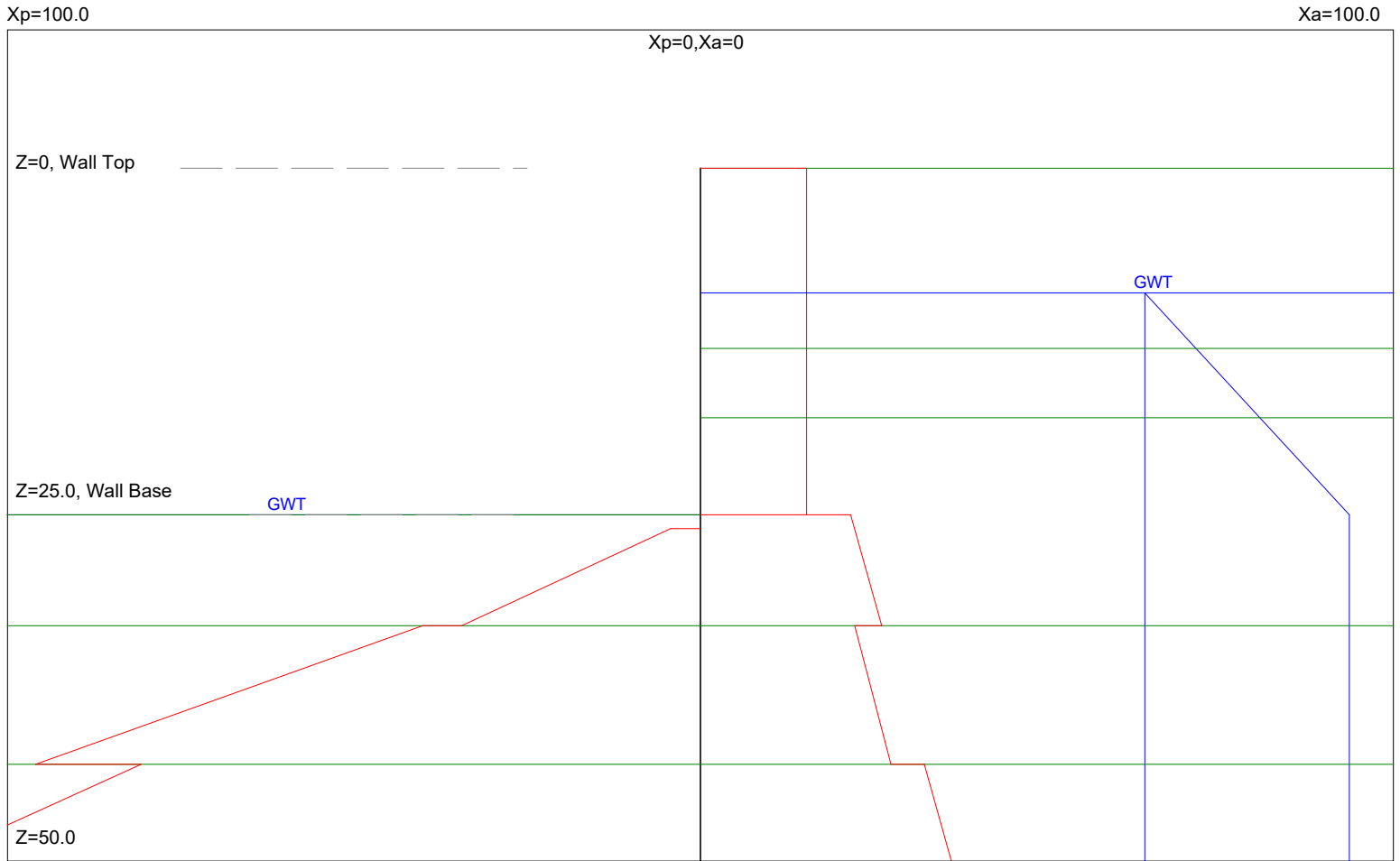
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X89: E (ksi)=29000.0, I (in⁴)/pile=904.0

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146th South 25' Permanent



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\LRFD\25' Permanent.ep8

* INPUT DATA *

Wall Height=25.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	13.0	0.0	13.0	800.0	2	ML
3	18.0	0.0	18.0	800.0	3	CL
4	33.0	0.0	33.0	800.0	2	ML
5	43.0	0.0	43.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	9.0	0.0
2	9.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	25.0	0.0	25.0	800.0	3	CL

2	33.0	0.0	33.0	800.0	2	ML
3	43.0	0.0	43.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	25.0	0.0
2	25.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 9.96 per one linear foot (or meter) width along wall height

Total Static Force above Base= 9.96. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.52	25.00	0.52	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
25.00	0.73	33.00	0.88	0.0190	0.3608
33.00	0.75	43.00	0.93	0.0177	0.3070
43.00	1.09	50.00	1.23	0.0190	0.3608

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
26.00	0.15	33.00	1.17	0.146	2.7698
33.00	1.36	43.00	3.25	0.189	3.2816
43.00	2.73	50.00	3.77	0.149	2.8309

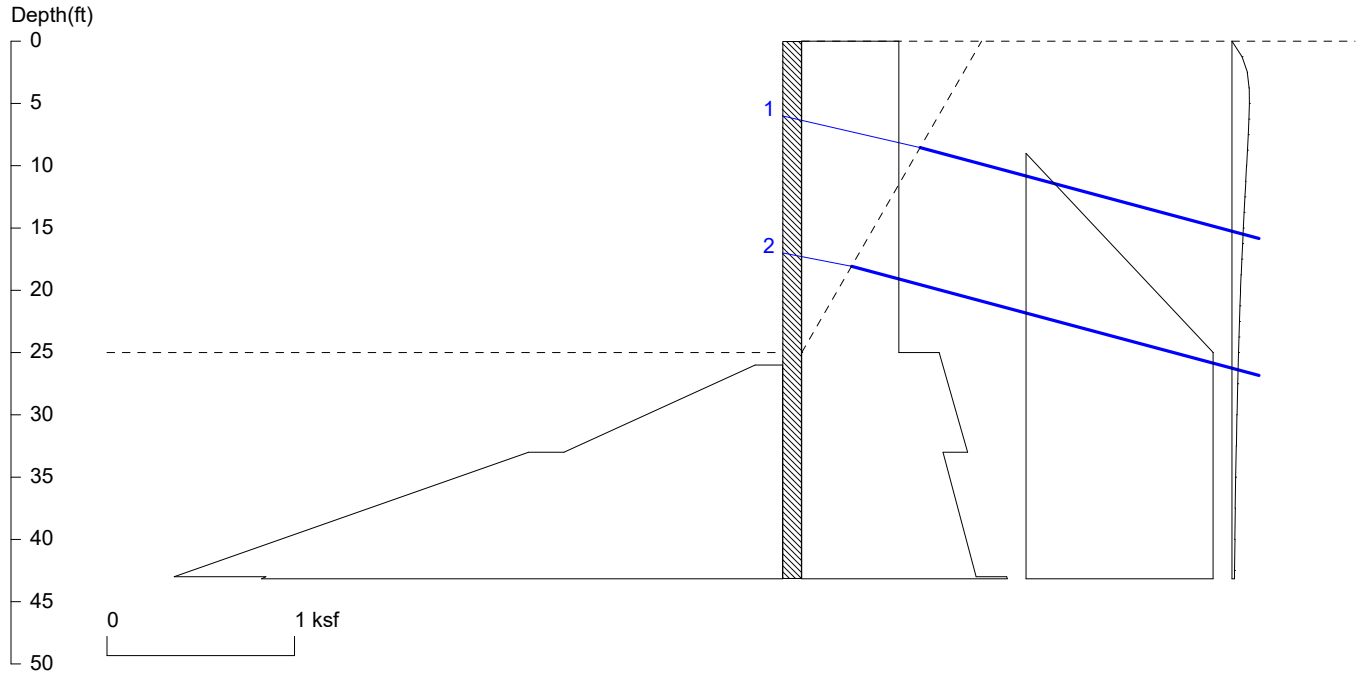
Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	9.00	0.00	25.00	1.00	0.06
1	25.00	1.00	50.00	1.00	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\LRFD\25' Permanent.ep8

146th South 25' Permanent



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Date: 9/14/2024

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Wall Height=25.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=18.16 Min. Pile Length=43.16

MOMENT IN PILE: Max. Moment=150.28 per Pile Spacing=5.0 at Depth=24.68

PILE SELECTION:

Request Min. Section Modulus = 65.6 in³/pile=1074.57 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has Section Modulus = 131.0 in³/pile=2146.70 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.03(in) based on E (ksi)=29000.00 and I (in⁴)/pile=904.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	6.0	15.0	5.0	49.2*	47.5	12.7	9.8	32.4
2. Tieback	17.0	15.0	5.0	69.2	66.8	17.9	4.1	45.6

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.518	25.00	0.518	0.000000
*	Below	Base		
25.00	0.733	33.00	0.885	0.018976
33.00	0.753	43.00	0.930	0.017682
43.00	1.093	200.0	4.075	0.018996
*	Water	Pres.		
9.000	0.000	25.00	0.998	0.062400
25.00	0.998	200.0	0.998	0.000000
*	Sur-	charg		
0.000	0.000	1.250	0.054	0.042917

1.250	0.054	2.500	0.082	0.023012
2.500	0.082	3.750	0.092	0.007825
3.750	0.092	5.000	0.093	0.000926
5.000	0.093	6.250	0.091	-0.00189
6.250	0.091	7.500	0.087	-0.00304
7.500	0.087	8.750	0.083	-0.00351
8.750	0.083	10.00	0.078	-0.00366
10.00	0.078	11.25	0.074	-0.00366
11.25	0.074	12.50	0.069	-0.00358
12.50	0.069	13.75	0.065	-0.00346
13.75	0.065	15.00	0.061	-0.00331
15.00	0.061	16.25	0.057	-0.00315
16.25	0.057	17.50	0.053	-0.00298
17.50	0.053	18.75	0.049	-0.00280
18.75	0.049	20.00	0.046	-0.00263
20.00	0.046	21.25	0.043	-0.00247
21.25	0.043	22.50	0.040	-0.00231
22.50	0.040	23.75	0.038	-0.00215
23.75	0.038	25.00	0.035	-0.00200
25.00	0.035	27.50	0.031	-0.00180
27.50	0.031	30.00	0.027	-0.00155
30.00	0.027	32.50	0.023	-0.00133
32.50	0.023	35.00	0.020	-0.00115
35.00	0.020	37.50	0.018	-0.00098
37.50	0.018	40.00	0.016	-0.00085
40.00	0.016	42.50	0.014	-0.00073
42.50	0.014	45.00	0.012	-0.00063

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
26.00	0.146	33.00	1.166	0.145693
33.00	1.355	43.00	3.246	0.189021
43.00	2.756	200.0	25.63	0.145734

ACTIVE SPACING:

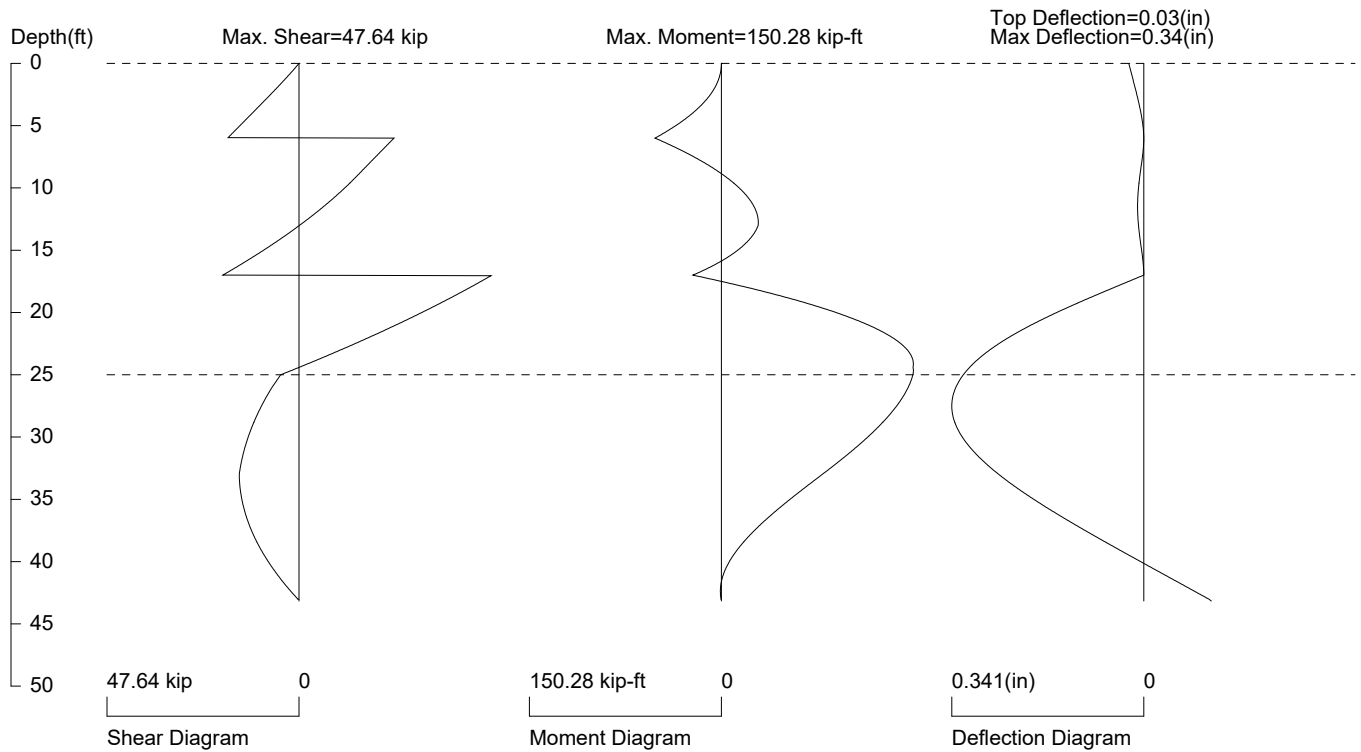
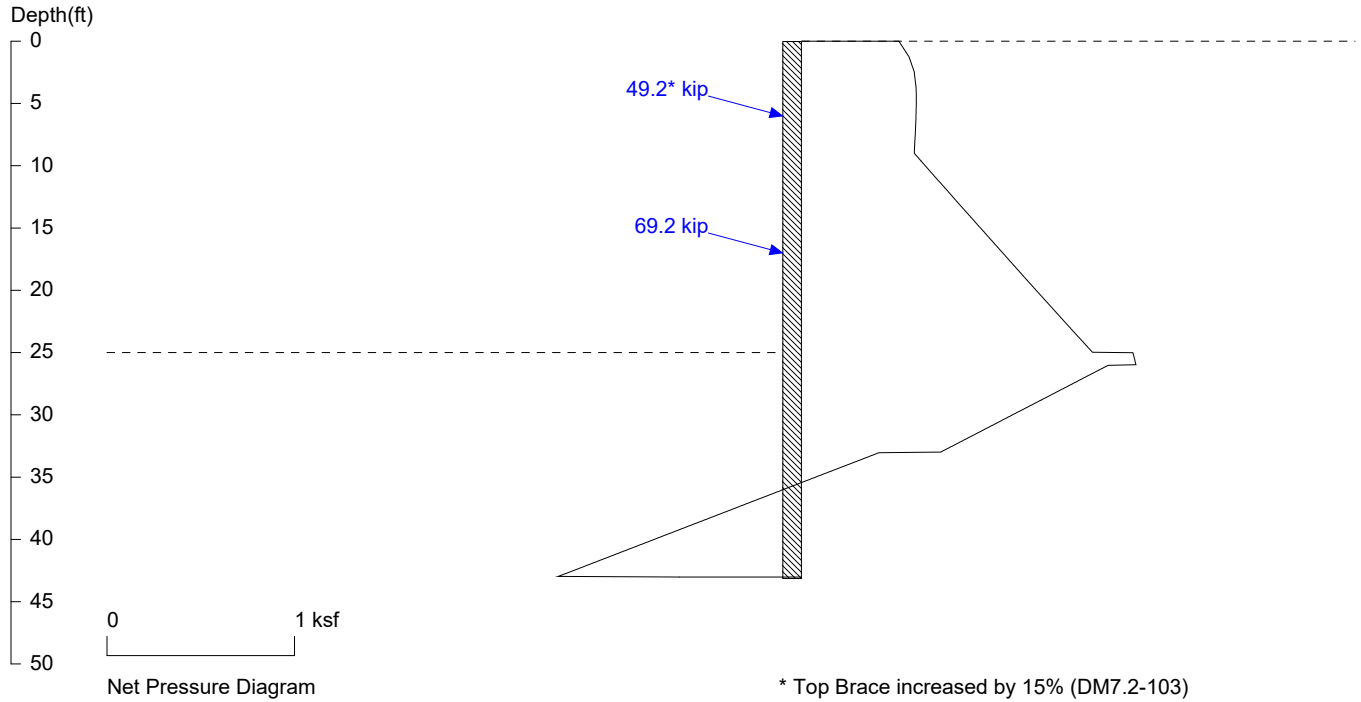
No.	Z depth	Spacing
1	0.00	5.00
2	25.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	25.00	2.40

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 25' Permanent



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X89: E (ksi)=29000.0, I (in⁴)/pile=904.0

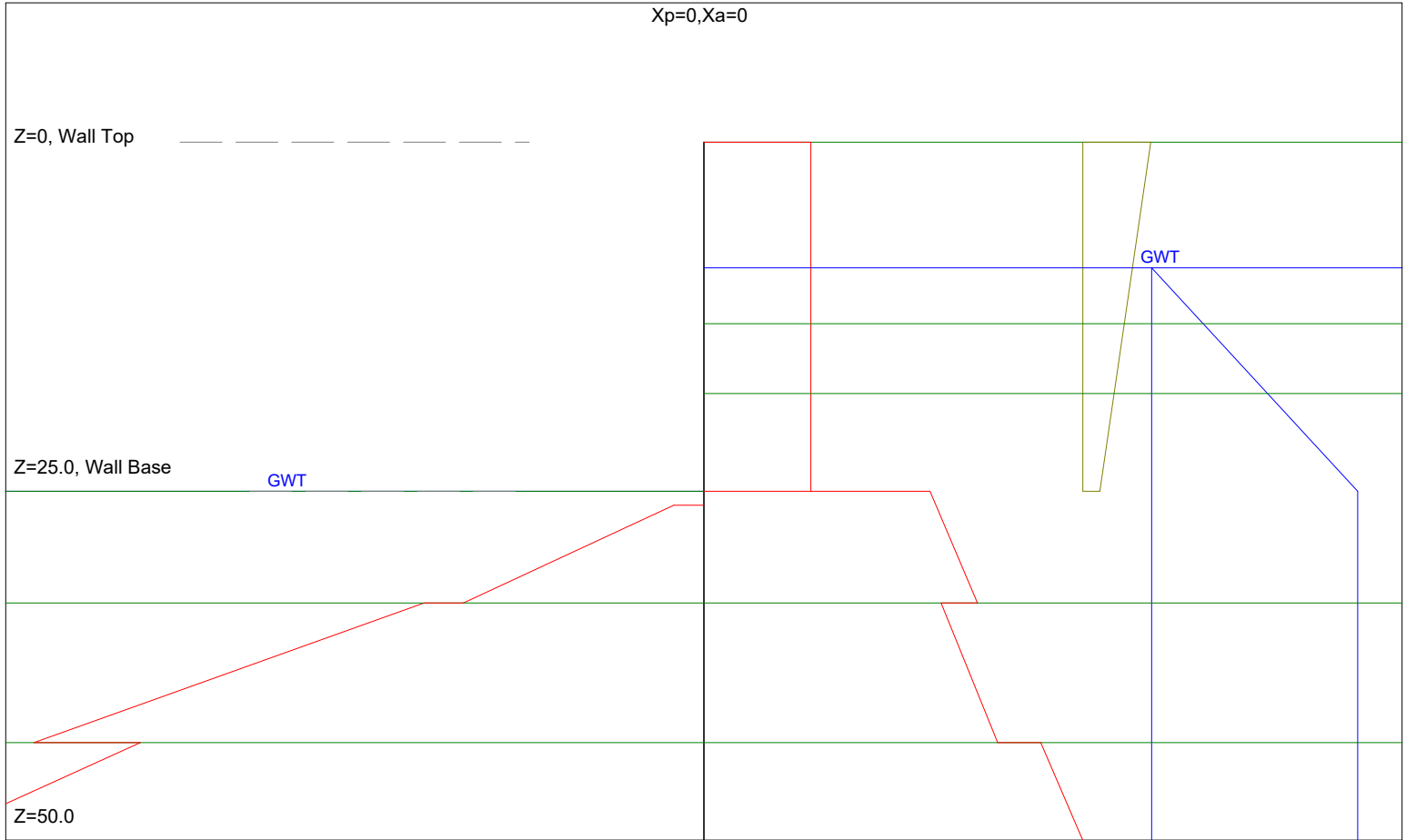
File: J:\PROJECTS\HDMI22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\25' Permanent.sh8

146th South 25' Seismic

Xp=100.0

Xa=100.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\25' Seismic.ep8

* INPUT DATA *

Wall Height=25.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	13.0	0.0	13.0	800.0	2	ML
3	18.0	0.0	18.0	800.0	3	CL
4	33.0	0.0	33.0	800.0	2	ML
5	43.0	0.0	43.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	9.0	0.0
2	9.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	25.0	0.0	25.0	800.0	3	CL

2	33.0	0.0	33.0	800.0	2	ML
3	43.0	0.0	43.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	25.0	0.0
2	25.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 15.10 per one linear foot (or meter) width along wall height

Total Static Force above Base= 9.96. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Total Earthquake Force above Base= 5.14. Distributed in trapezoid. Total earthquake force acting at 0.4H below wall top.

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.52	25.00	0.52	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
25.00	1.10	33.00	1.33	0.0288	0.5477
33.00	1.15	43.00	1.42	0.0275	0.4767
43.00	1.63	50.00	1.84	0.0292	0.5542

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
26.00	0.15	33.00	1.17	0.146	2.7698
33.00	1.36	43.00	3.25	0.189	3.2816
43.00	2.73	50.00	3.77	0.149	2.8309

Output Earthquake Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Total Earthq. Force, Ee = 5.14

No	Zq1	Pq1	Zq2	Pq2	Slope
0	0.00	0.329	25.00	0.082	-0.010

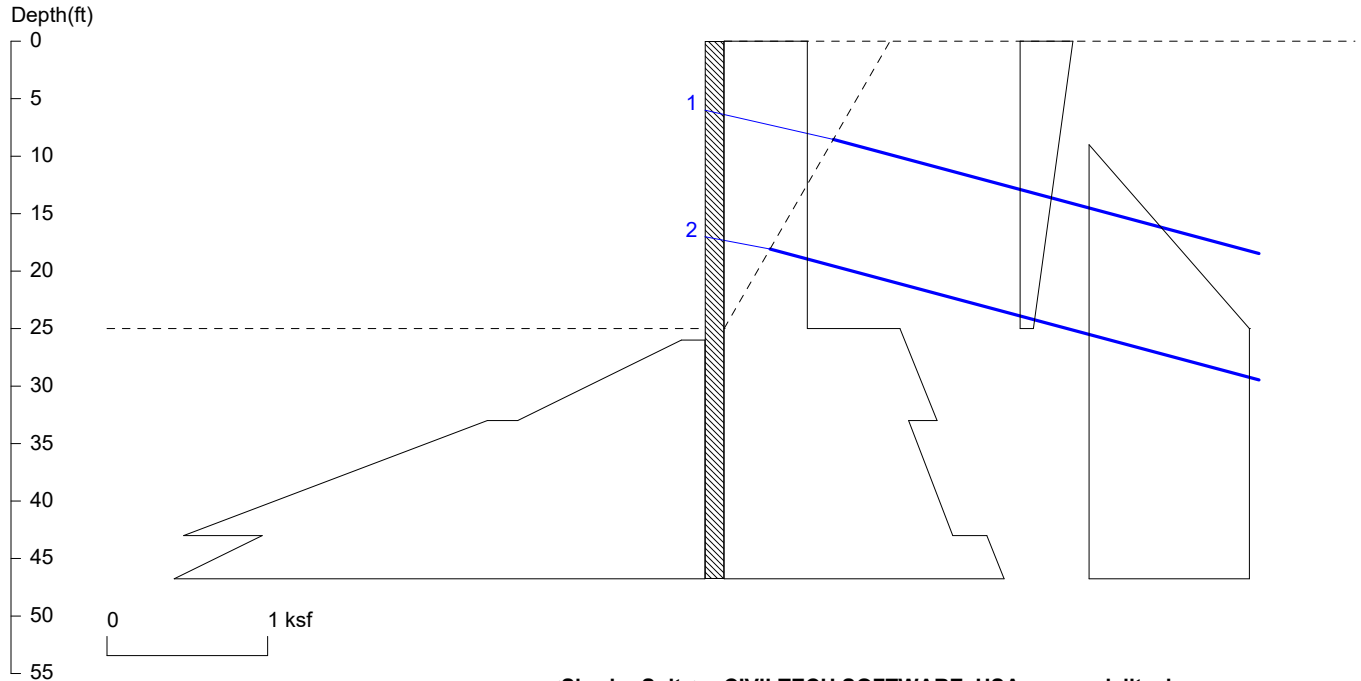
Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	9.00	0.00	25.00	1.00	0.06
1	25.00	1.00	50.00	1.00	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\25' Seismic.ep8

146th South 25' Seismic



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Date: 9/14/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\25' Seismic.sh8

Wall Height=25.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=21.76 Min. Pile Length=46.76

MOMENT IN PILE: Max. Moment=176.71 per Pile Spacing=5.0 at Depth=24.50

PILE SELECTION:

Request Min. Section Modulus = 77.1 in³/pile=1263.61 cm³/pile, Fy = 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has Section Modulus = 131.0 in³/pile=2146.70 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.05(in) based on E (ksi)=29000.00 and I (in⁴)/pile=904.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	6.0	15.0	5.0	64.7*	62.5	16.8	9.8	42.7
2. Tieback	17.0	15.0	5.0	77.0	74.4	19.9	4.1	50.8

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.518	25.00	0.518	0.000000
*	Below	Base		
25.00	1.095	33.00	1.326	0.028807
33.00	1.149	43.00	1.424	0.027456
43.00	1.636	200.0	6.103	0.028451
*	Earth	Queck		
0.000	0.329	25.00	0.082	-0.00987
*	Water	Pres.		
9.000	0.000	25.00	0.998	0.062400
25.00	0.998	200.0	0.998	0.000000

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
26.00	0.146	33.00	1.166	0.145693
33.00	1.355	43.00	3.246	0.189021
43.00	2.756	200.0	25.63	0.145734

ACTIVE SPACING:

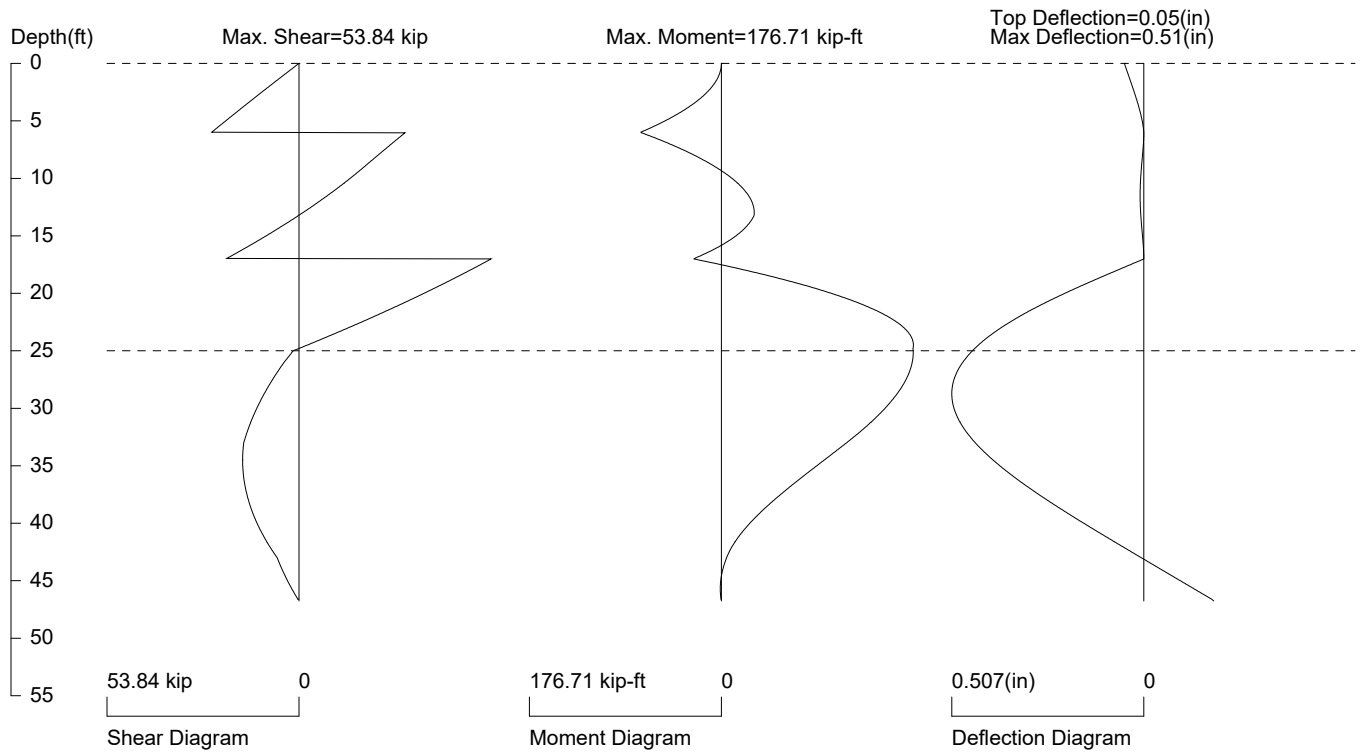
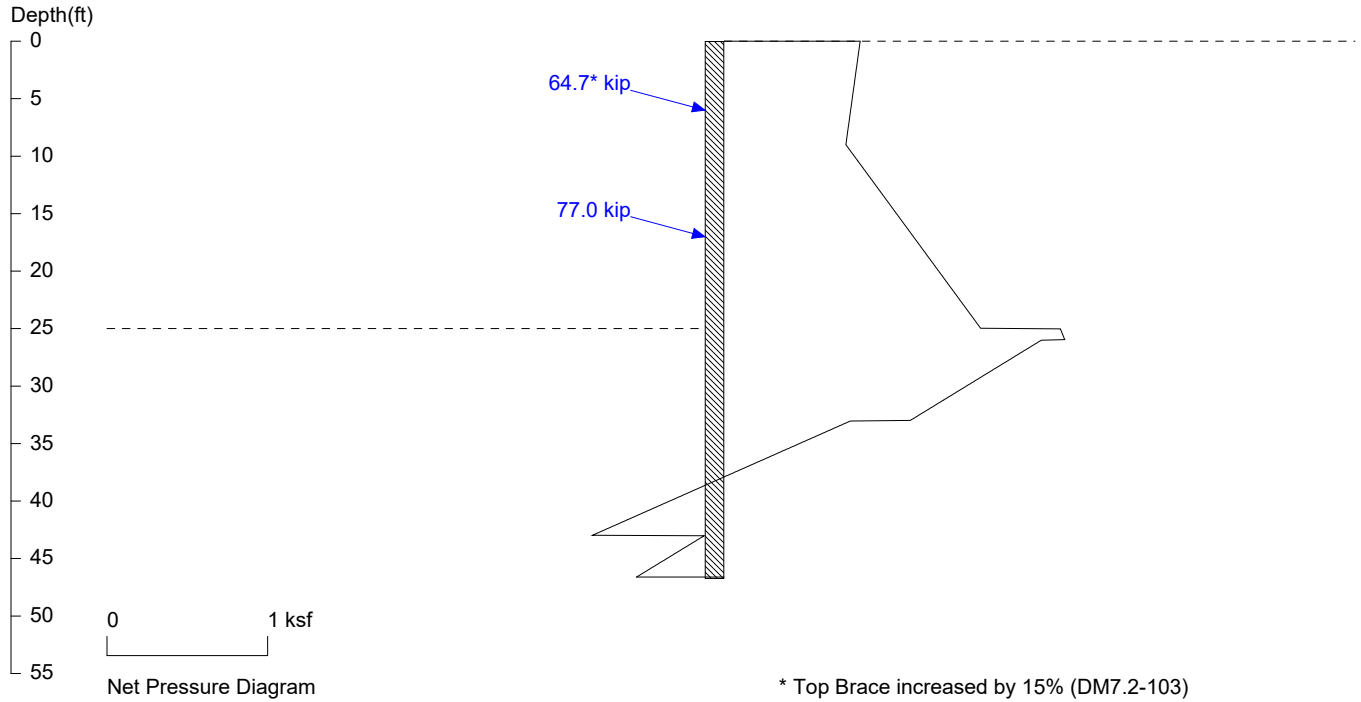
No.	Z depth	Spacing
1	0.00	5.00
2	25.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	25.00	2.40

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 25' Seismic



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

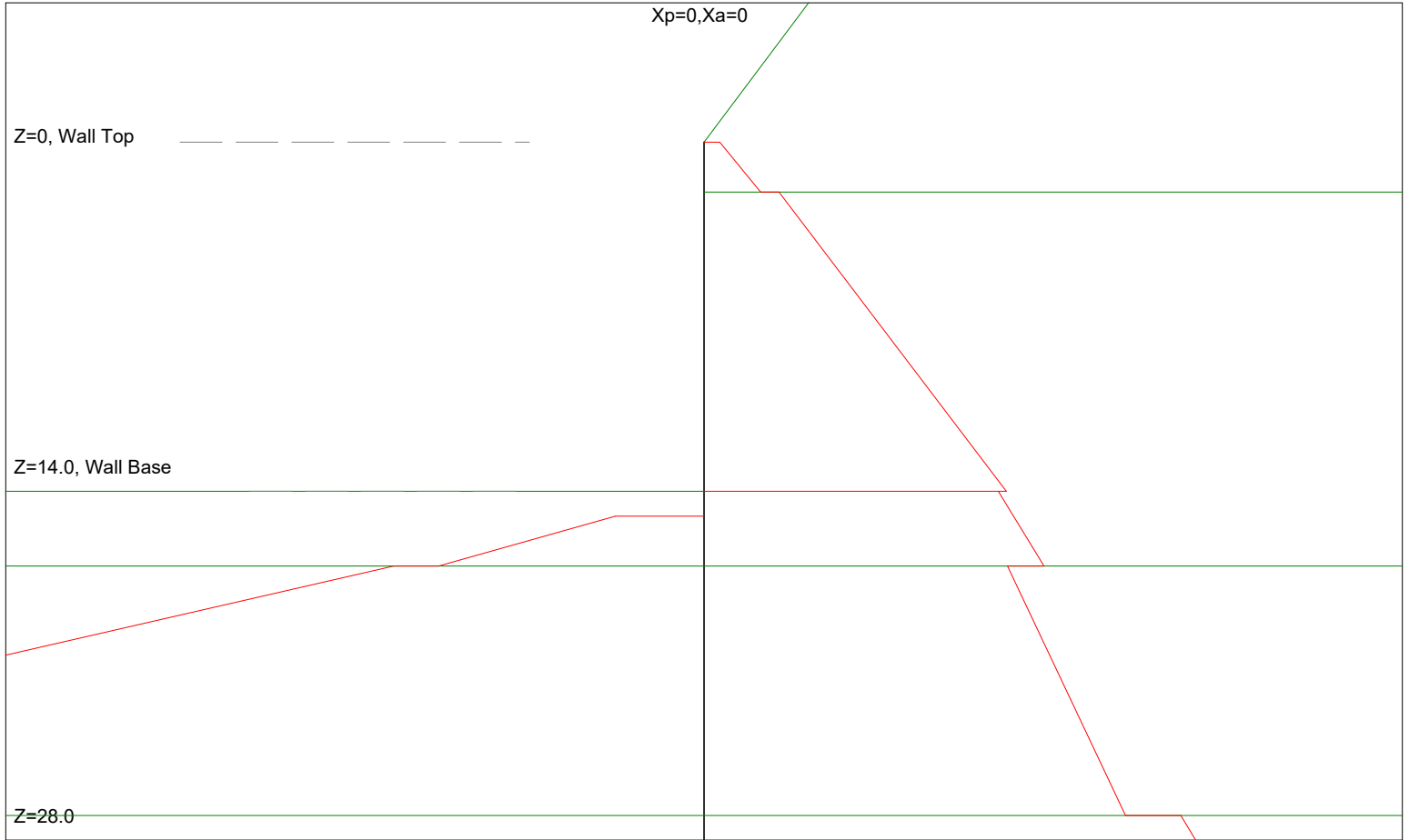
User Input Pile, HP14X89: E (ksi)=29000.0, I (in⁴)/pile=904.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\25' Seismic.sh8

146th South 14' Temporary

Xp=56.0

Xa=56.0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\14' Temporary.ep8

* INPUT DATA *

Wall Height=14.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-16.0	24.0	2	ML
2	-16.0	24.0	-16.0	800.0	2	ML
3	2.0	0.0	2.0	800.0	3	CL
4	17.0	0.0	17.0	800.0	2	ML
5	27.0	0.0	27.0	800.0	3	CL

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	14.0	0.0	14.0	800.0	3	CL
2	17.0	0.0	17.0	800.0	2	ML
3	27.0	0.0	27.0	800.0	3	CL

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 8.41 per one linear foot (or meter) width along wall height

Total Static Force above Base= 8.41

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.06	2.00	0.20	0.0736	0.6133
2.00	0.27	14.00	1.09	0.0682	0.5932

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
14.00	1.06	17.00	1.22	0.0550	0.4779
17.00	1.09	27.00	1.52	0.0425	0.3539
27.00	1.72	28.00	1.77	0.0539	0.4688

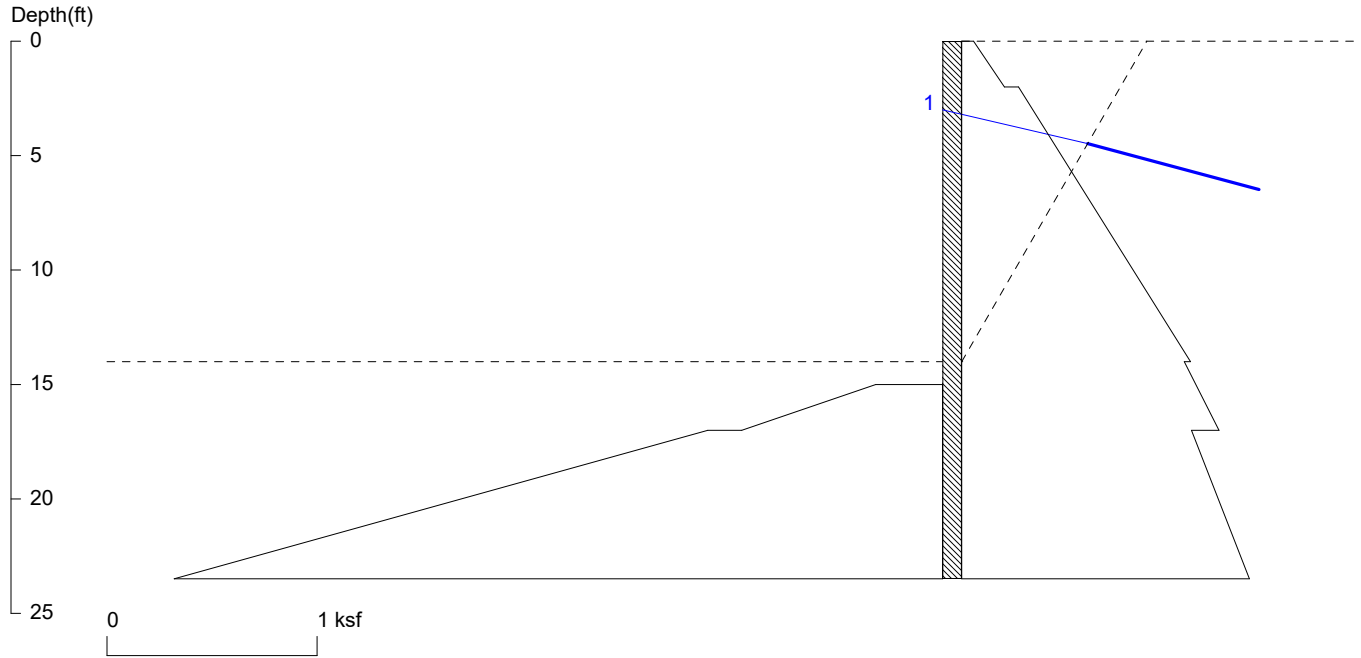
Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
15.00	0.32	17.00	0.96	0.319	2.7698
17.00	1.12	27.00	5.03	0.391	3.2607
27.00	4.21	28.00	4.55	0.338	2.9352

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\14' Temporary.ep8

146th South 14' Temporary



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Wall Height=14.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=9.49 Min. Pile Length=23.49

MOMENT IN PILE: Max. Moment=122.87 per Pile Spacing=5.0 at Depth=11.37

PILE SELECTION:

Request Min. Section Modulus = 53.6 in³/pile=878.63 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has Section Modulus = 131.0 in³/pile=2146.70 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.14(in) based on E (ksi)=29000.00 and I (in⁴)/pile=904.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	3.0	15.0	5.0	29.9	28.9	7.8	5.7	19.8

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.056	2.000	0.204	0.073599
2.000	0.270	14.00	1.088	0.068218
*	Below	Base		
14.00	1.059	17.00	1.224	0.054956
17.00	1.093	27.00	1.517	0.042462

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
15.00	0.319	17.00	0.956	0.318530
17.00	1.117	27.00	5.030	0.391288

ACTIVE SPACING:

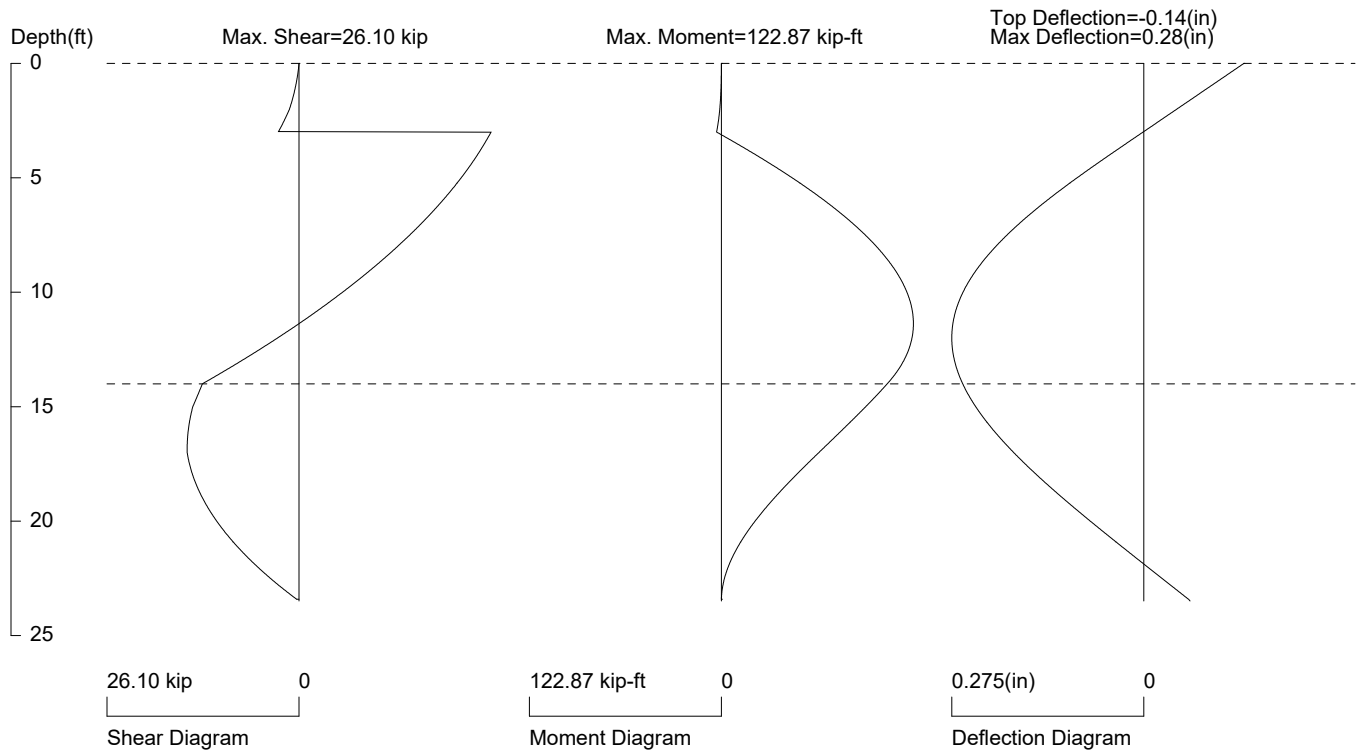
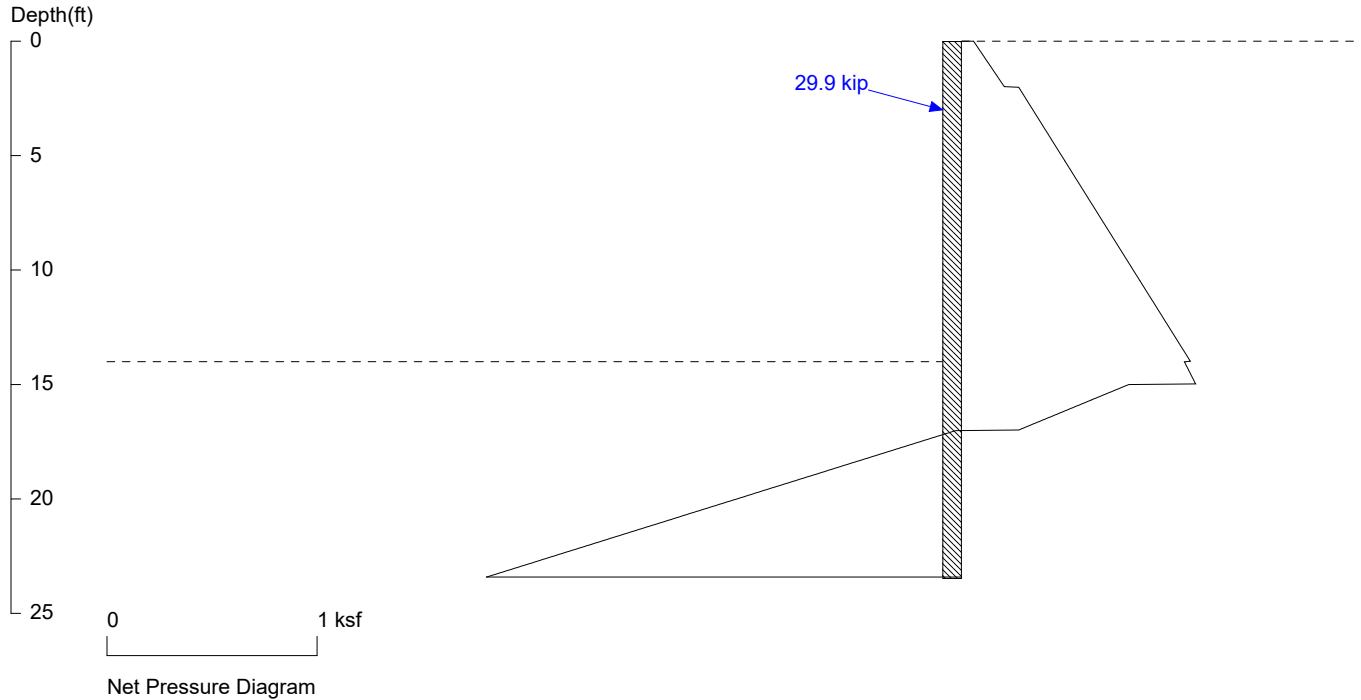
No.	Z depth	Spacing
1	0.00	5.00
2	14.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	14.00	2.40

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 14' Temporary



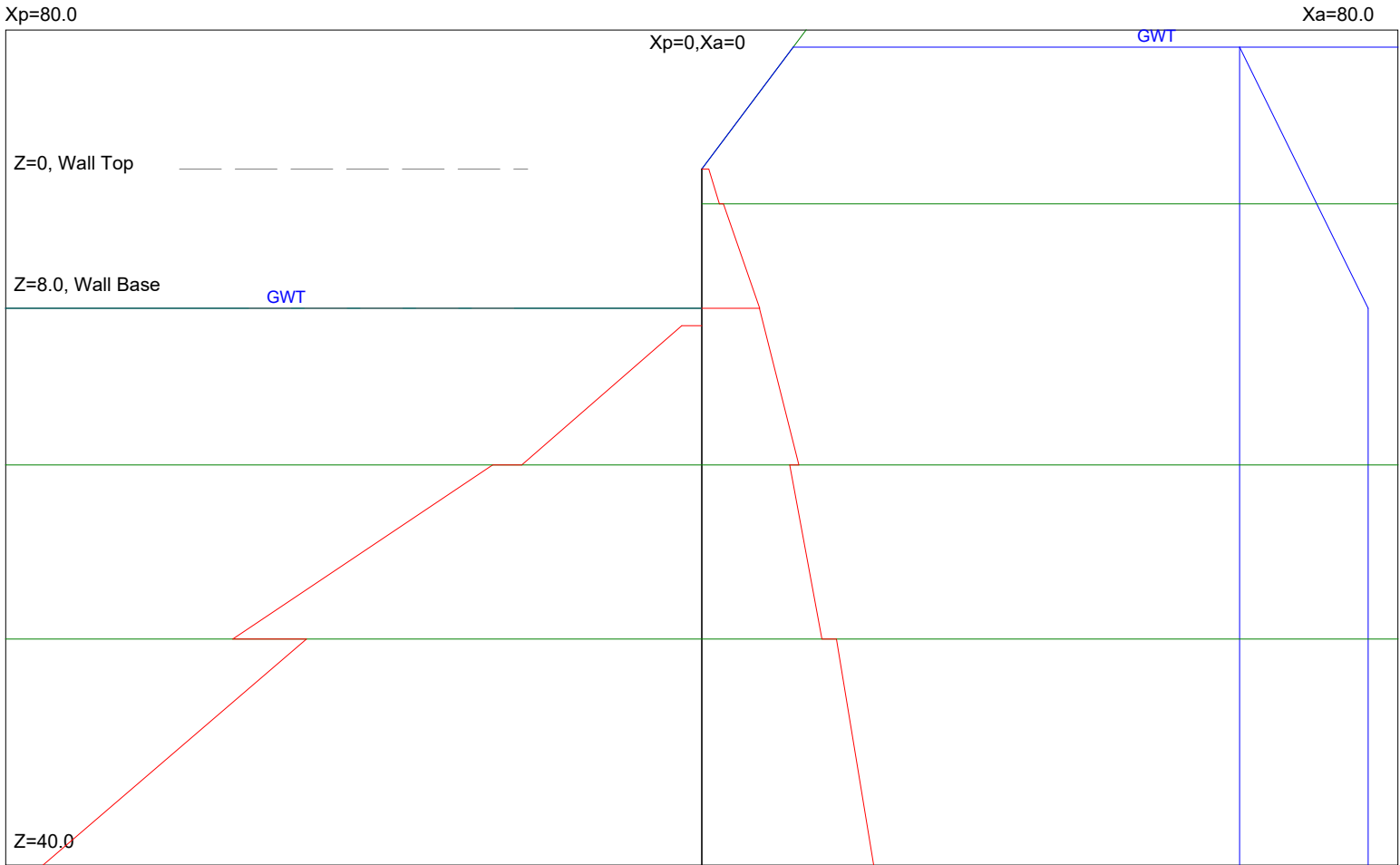
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X89: E (ksi)=29000.0, I (in⁴)/pile=904.0

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146th South 8' Permanent



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\8' Permanent.ep8

* INPUT DATA *

Wall Height=8.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-16.0	24.0	2	ML
2	-16.0	24.0	-16.0	800.0	2	ML
3	2.0	0.0	2.0	800.0	3	CL
4	17.0	0.0	17.0	800.0	2	ML
5	27.0	0.0	27.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	-7.0	10.5
2	-7.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	8.0	0.0	8.0	800.0	3	CL

2	17.0	0.0	17.0	800.0	2	ML
3	27.0	0.0	27.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	8.0	0.0
2	8.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 1.92 per one linear foot (or meter) width along wall height

Total Static Force above Base= 1.92

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.05	2.00	0.13	0.0388	0.6745
2.00	0.16	8.00	0.42	0.0440	0.8368

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
8.00	0.42	17.00	0.71	0.0319	0.6069
17.00	0.64	27.00	0.88	0.0235	0.4078
27.00	0.98	40.00	1.25	0.0209	0.3980

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
9.00	0.15	17.00	1.31	0.146	2.7698
17.00	1.52	27.00	3.42	0.189	3.2866
27.00	2.88	40.00	4.80	0.148	2.8102

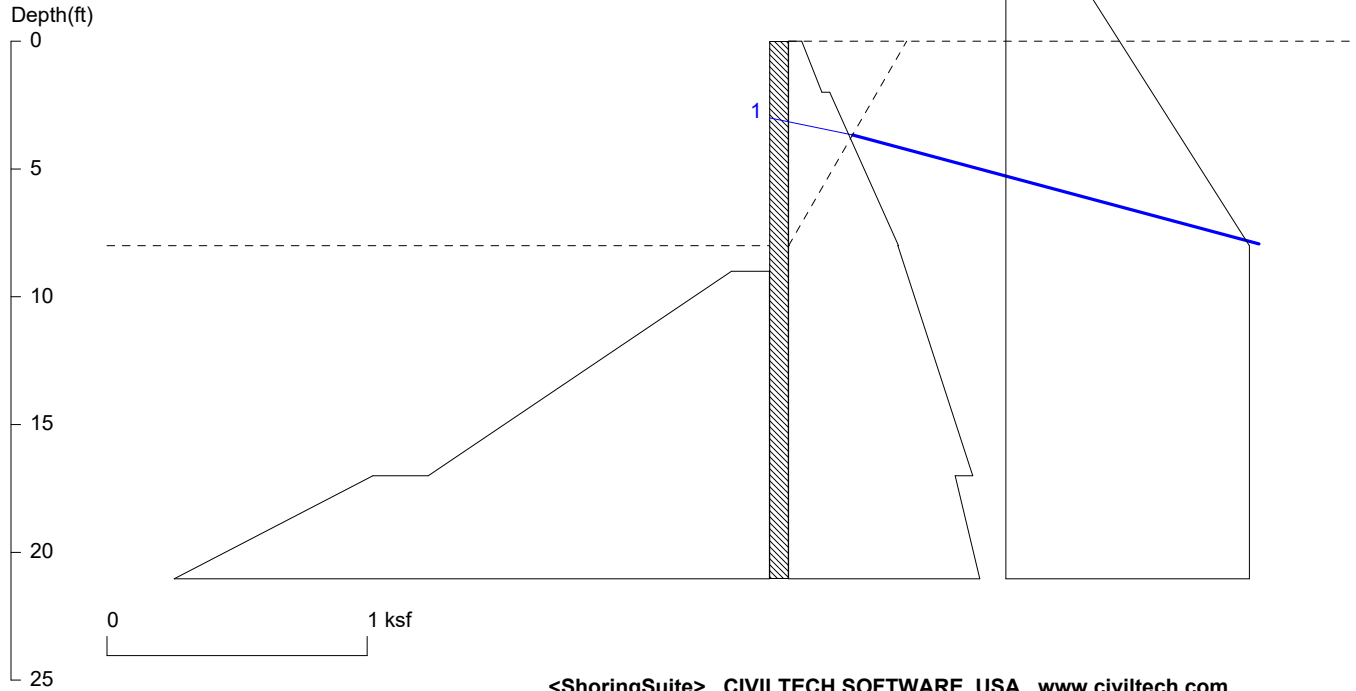
Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	-7.00	0.00	8.00	0.94	0.06
1	8.00	0.94	40.00	0.94	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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146th South 8' Permanent



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Wall Height=8.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=13.03 Min. Pile Length=21.03

MOMENT IN PILE: Max. Moment=54.00 per Pile Spacing=5.0 at Depth=3.00

PILE SELECTION:

Request Min. Section Modulus = 23.6 in³/pile=386.16 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has Section Modulus = 131.0 in³/pile=2146.70 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.01(in) based on E (ksi)=29000.00 and I (in⁴)/pile=904.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	3.0	15.0	5.0	48.8	47.1	12.6	2.6	32.2

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.050	2.000	0.128	0.038850
2.000	0.158	8.000	0.422	0.044018
*	Below	Base		
8.000	0.420	17.00	0.707	0.031925
17.00	0.640	27.00	0.875	0.023487
*	Water	Pres.		
-7.00	0.000	8.000	0.936	0.062400
8.000	0.936	72.00	0.936	0.000000

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		

9.000	0.146	17.00	1.311	0.145693
17.00	1.524	27.00	3.417	0.189309

ACTIVE SPACING:

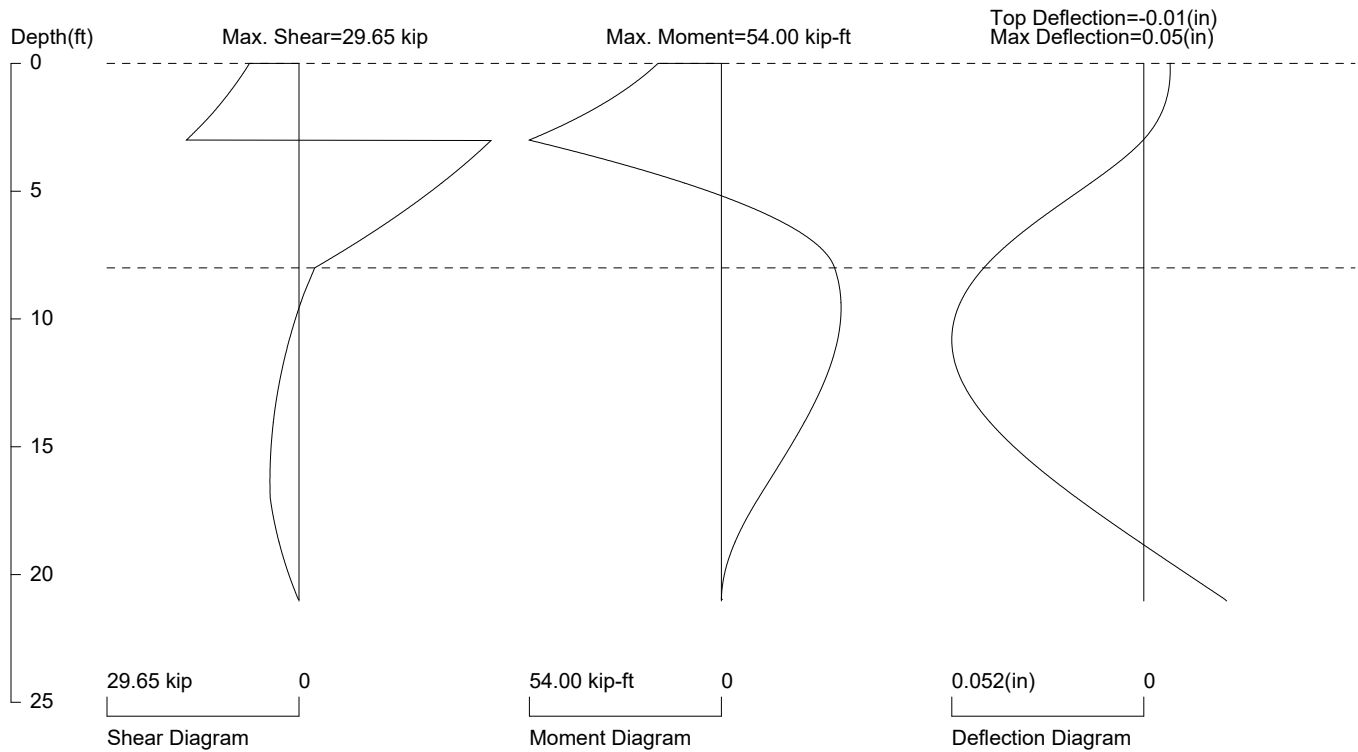
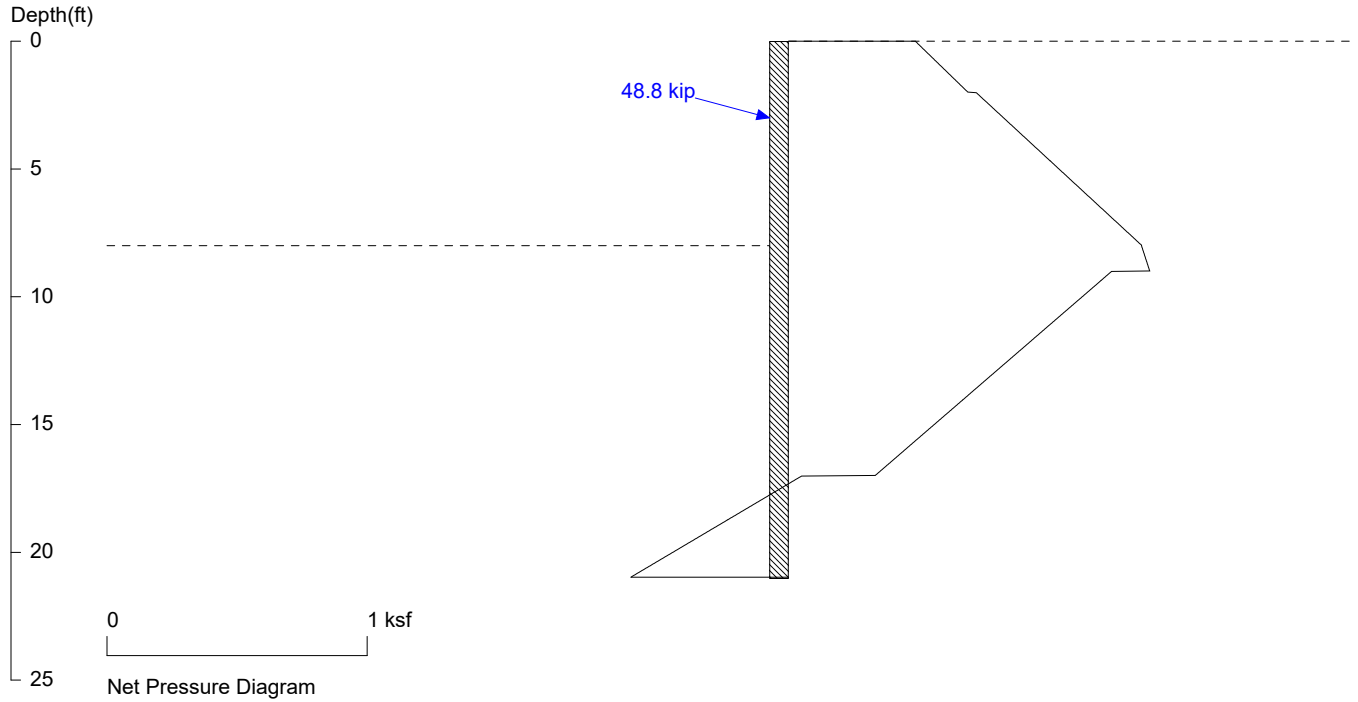
No.	Z depth	Spacing
1	-7.00	5.00
2	8.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	8.00	2.40

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 8' Permanent



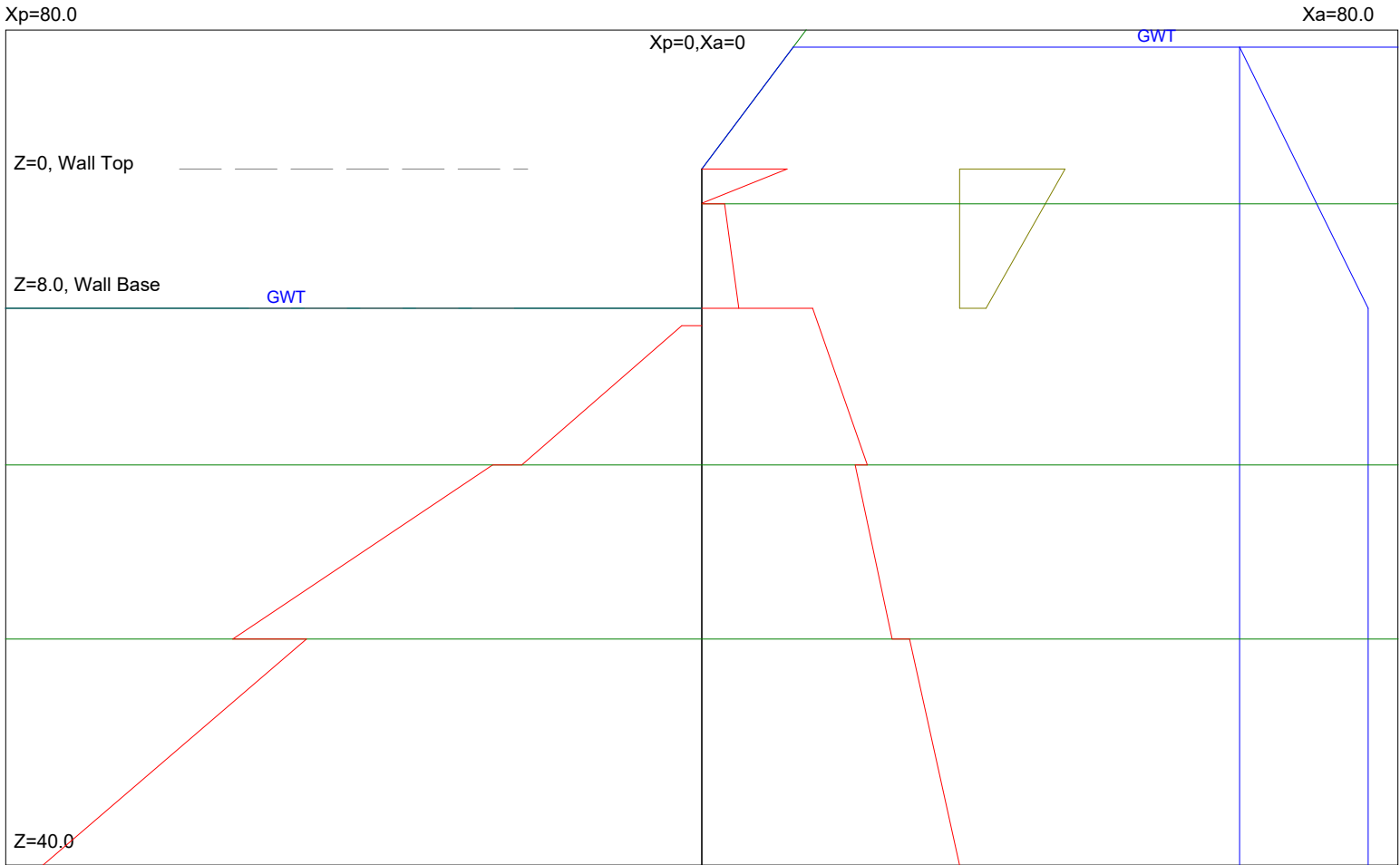
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X89: E (ksi)=29000.0, I (in⁴)/pile=904.0

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146th South 8' Seismic



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\8' Seismic.ep8

* INPUT DATA *

Wall Height=8.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-16.0	24.0	2	ML
2	-16.0	24.0	-16.0	800.0	2	ML
3	2.0	0.0	2.0	800.0	3	CL
4	17.0	0.0	17.0	800.0	2	ML
5	27.0	0.0	27.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	-7.0	10.5
2	-7.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	8.0	0.0	8.0	800.0	3	CL

2	17.0	0.0	17.0	800.0	2	ML
3	27.0	0.0	27.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	8.0	0.0
2	8.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 5.76 per one linear foot (or meter) width along wall height

Total Static Force above Base= 1.92

Total Earthquake Force above Base= 3.84. Distributed in trapezoid. Total earthquake force acting at 0.4H below wall top.

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.62	1.97	0.00	-0.3156	-5.4784
2.00	0.17	8.00	0.27	0.0174	0.3308

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
8.00	0.81	17.00	1.21	0.0442	0.8403
17.00	1.12	27.00	1.39	0.0269	0.4674
27.00	1.51	40.00	1.88	0.0281	0.5336

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
9.00	0.15	17.00	1.31	0.146	2.7698
17.00	1.52	27.00	3.42	0.189	3.2866
27.00	2.88	40.00	4.80	0.148	2.8102

Output Earthquake Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Total Earthq. Force, Ee = 3.84

No	Zq1	Pq1	Zq2	Pq2	Slope
0	0.00	0.767	8.00	0.192	-0.072

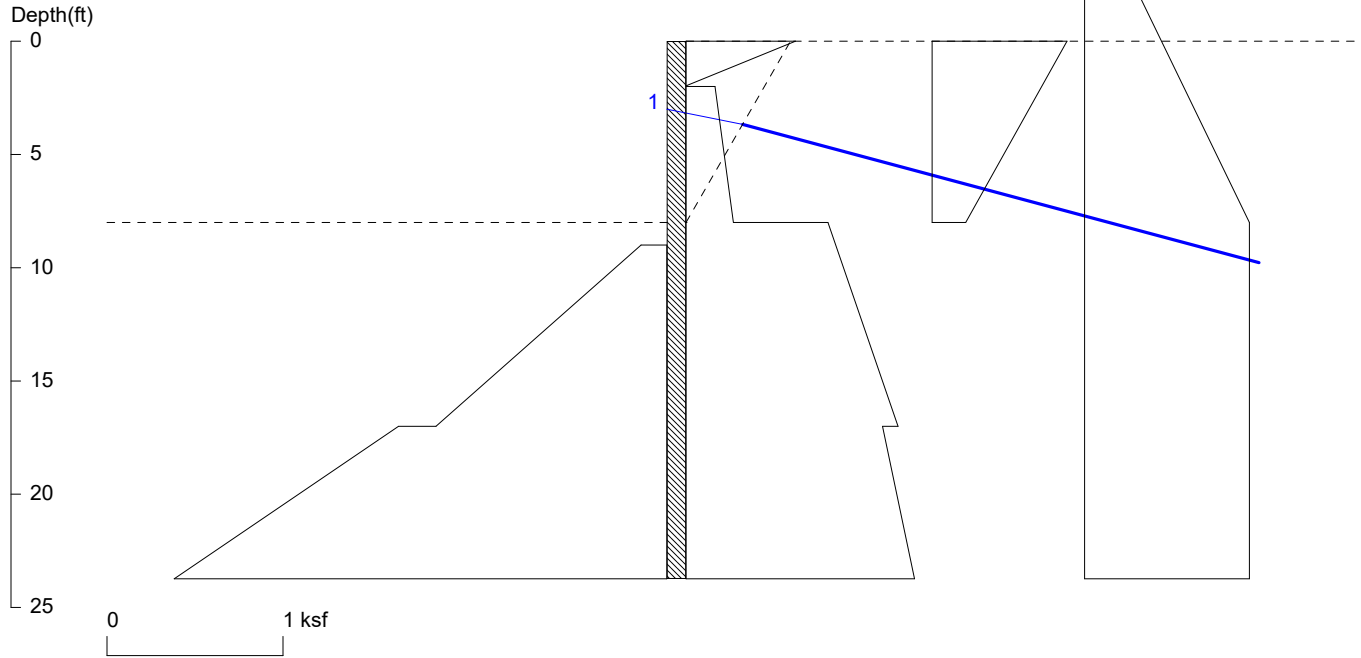
Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	-7.00	0.00	8.00	0.94	0.06
1	8.00	0.94	40.00	0.94	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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Wall Height=8.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=15.73 Min. Pile Length=23.73

MOMENT IN PILE: Max. Moment=74.84 per Pile Spacing=5.0 at Depth=3.01

PILE SELECTION:

Request Min. Section Modulus = 32.7 in³/pile=535.14 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has Section Modulus = 131.0 in³/pile=2146.70 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.02(in) based on E (ksi)=29000.00 and I (in⁴)/pile=904.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	3.0	15.0	5.0	72.0	69.5	18.6	2.6	47.5

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.622	1.970	0.000	-0.31555
2.000	0.165	8.000	0.270	0.017402
*	Below	Base		
8.000	0.807	17.00	1.205	0.044202
17.00	1.117	27.00	1.387	0.026920
*	Earth	Queck		
0.000	0.767	8.000	0.192	-0.07194
*	Water	Pres.		
-7.00	0.000	8.000	0.936	0.062400
8.000	0.936	72.00	0.936	0.000000

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		

9.000	0.146	17.00	1.311	0.145693
17.00	1.524	27.00	3.417	0.189309

ACTIVE SPACING:

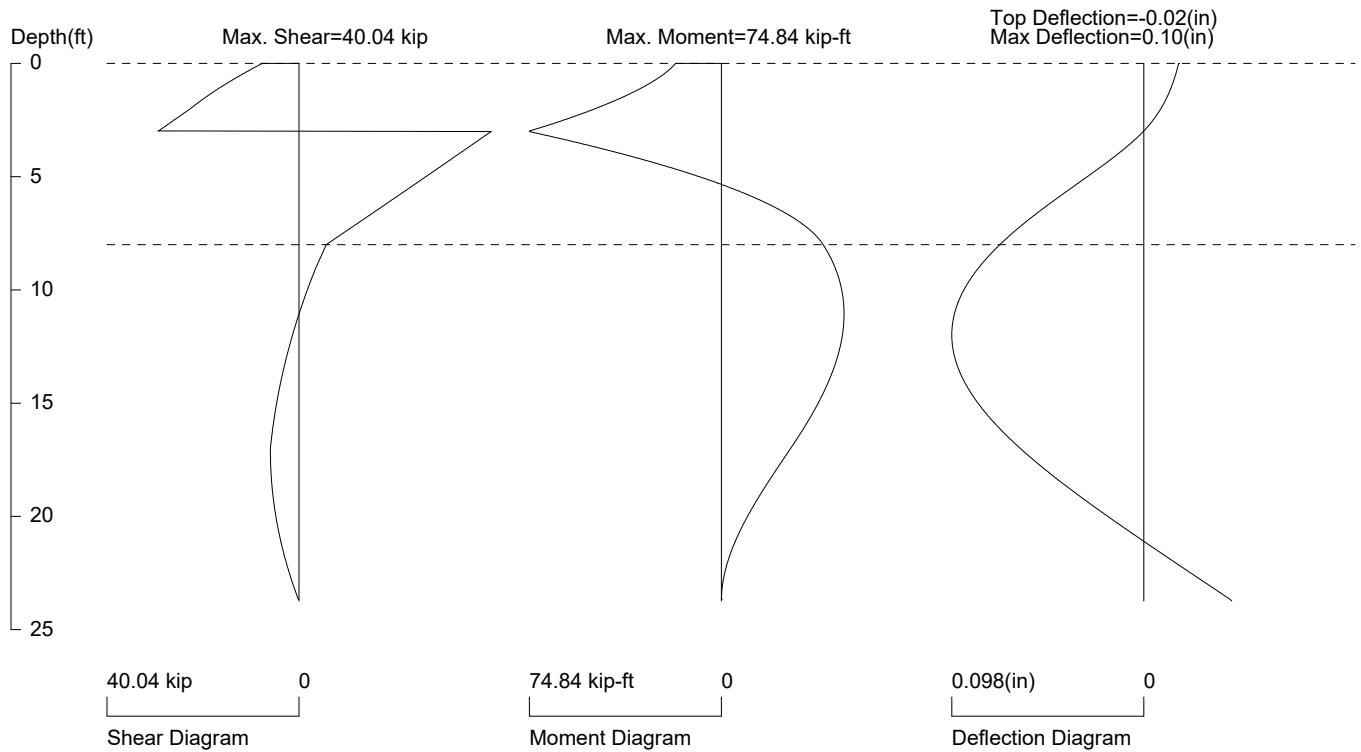
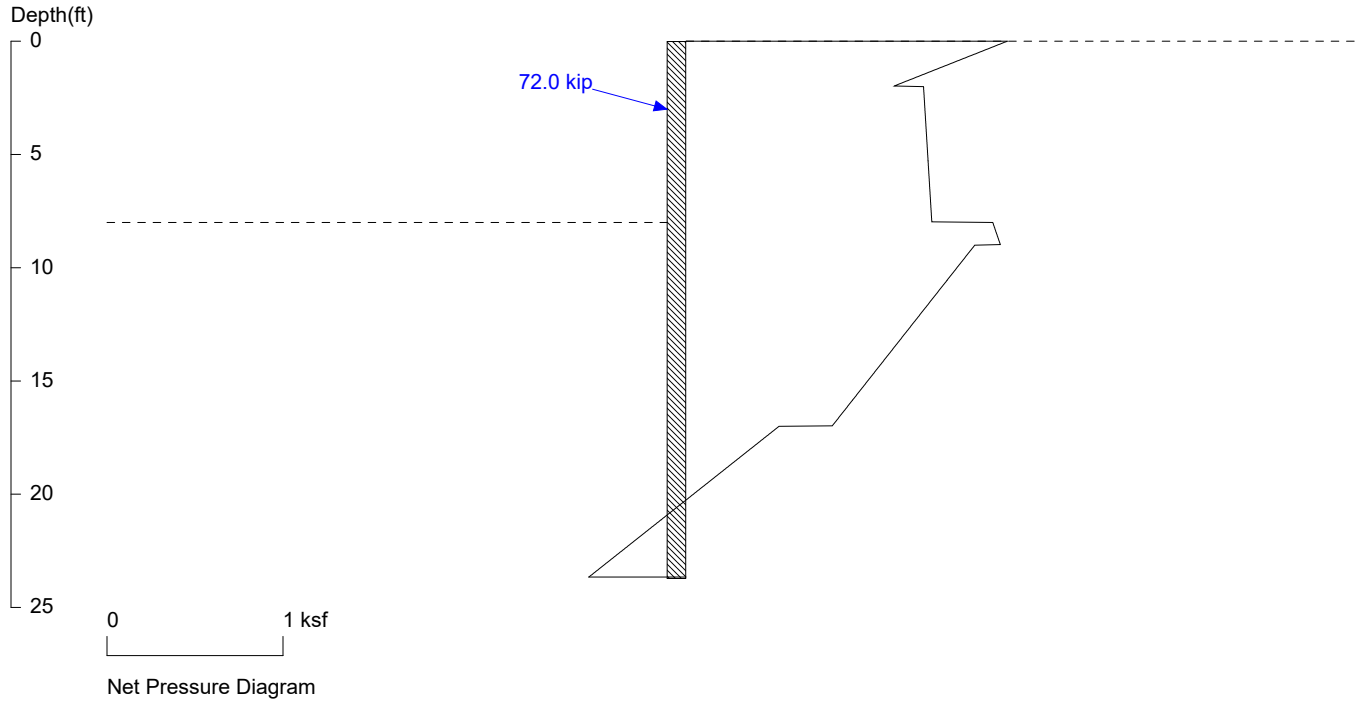
No.	Z depth	Spacing
1	-7.00	5.00
2	8.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	8.00	2.40

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 8' Seismic



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

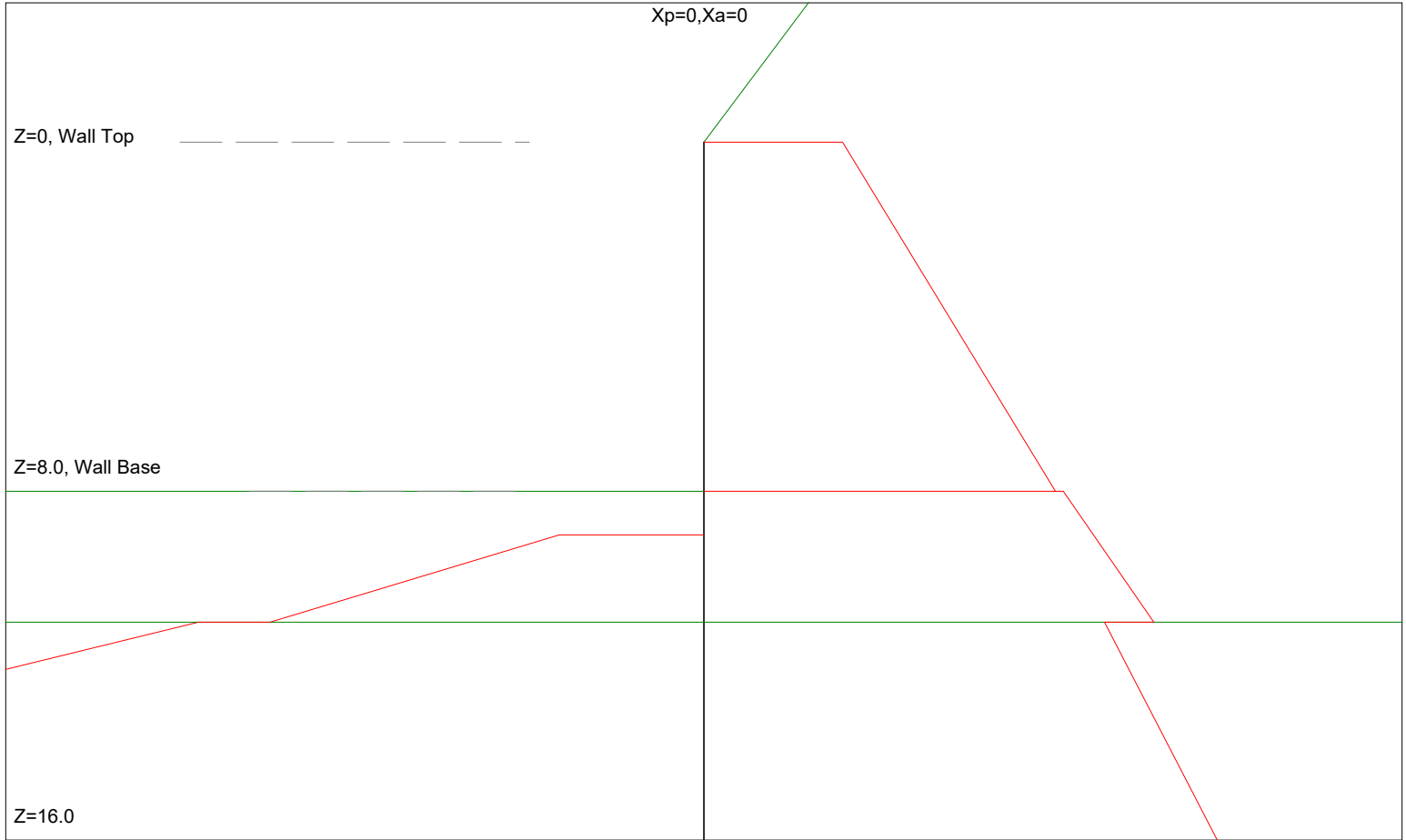
User Input Pile, HP14X89: E (ksi)=29000.0, I (in⁴)/pile=904.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 318' Seismic.sh8

146th South 8' Temporary

Xp=32.0

Xa=32.0



Xp=0, Xa=0

Z=0, Wall Top

Z=8.0, Wall Base

Z=16.0

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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/23/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\Cantilever Temporary.ep8

* INPUT DATA *

Wall Height=8.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	-22.0	33.0	3	CL
2	-22.0	33.0	-22.0	800.0	3	CL
3	11.0	0.0	11.0	800.0	2	ML
4	21.0	0.0	21.0	800.0	3	CL

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	8.0	0.0	8.0	800.0	3	CL
2	11.0	0.0	11.0	800.0	2	ML
3	21.0	0.0	21.0	800.0	3	CL

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 4.32 per one linear foot (or meter) width along wall height

Total Static Force above Base= 4.32

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.31	8.00	0.77	0.0586	0.5097

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
8.00	0.79	11.00	0.99	0.0664	0.5772
11.00	0.88	16.00	1.13	0.0497	0.4143

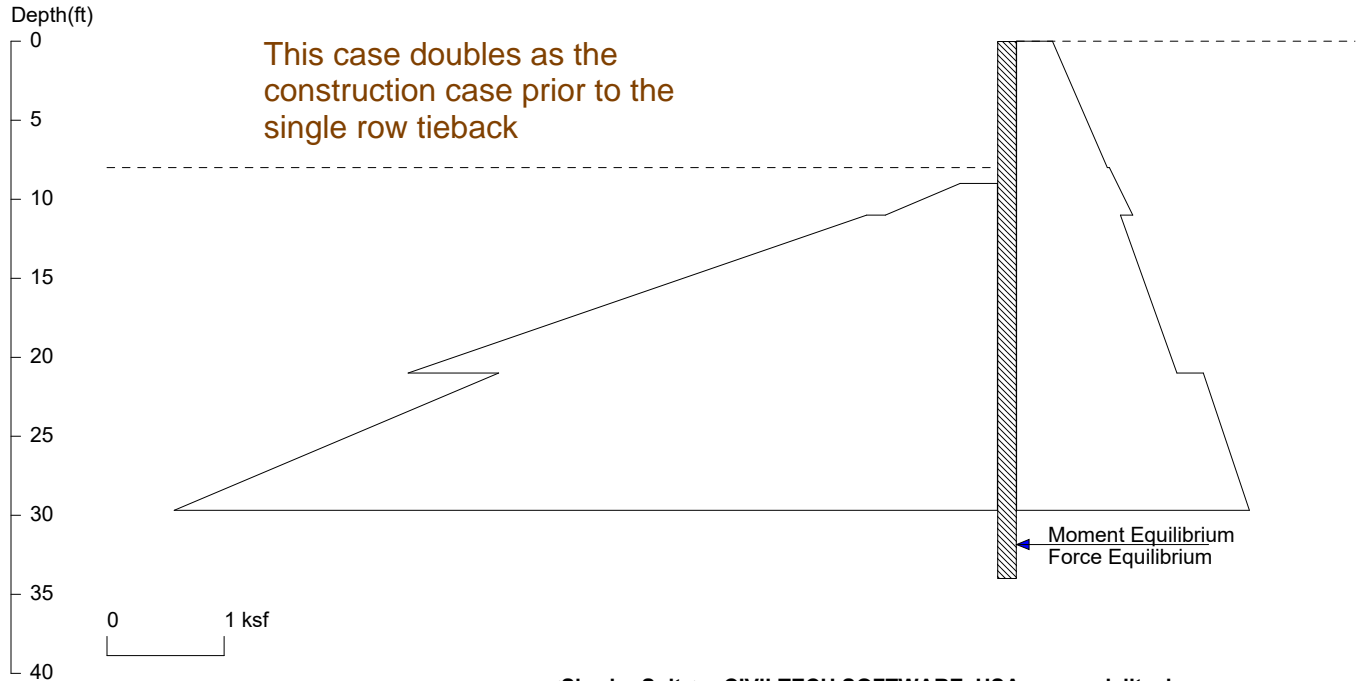
Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
9.00	0.32	11.00	0.96	0.319	2.7698
11.00	1.11	16.00	3.08	0.393	3.2724

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 8/23/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\Cantilever Temporary.ep8

146th South 8' Temporary



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Date: 8/23/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\Cantilever Temporary.sh8

Wall Height=8.0 Pile Diameter=1.2 Pile Spacing=6.0 Wall Type: 2. Soldier Pile, Drilled

PILE LENGTH: Min. Embedment=26.02 Min. Pile Length=34.02

MOMENT IN PILE: Max. Moment=314.91 per Pile Spacing=6.0 at Depth=19.58

PILE SELECTION:

Request Min. Section Modulus = 112.8 in³/pile=1848.53 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.67

HP14X89 has Section Modulus = 131.0 in³/pile=2146.70 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 1.17(in) based on E (ksi)=29000.00 and I (in⁴)/pile=904.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.305	8.000	0.774	0.058614
*	Below	Base		
8.000	0.792	11.000	0.991	0.066382
11.000	0.886	21.000	1.367	0.048111
21.000	1.593	72.000	3.905	0.045330

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
9.000	0.319	11.000	0.956	0.318530
11.000	1.117	21.000	5.030	0.391288
21.000	4.258	72.000	20.530	0.319048

ACTIVE SPACING:

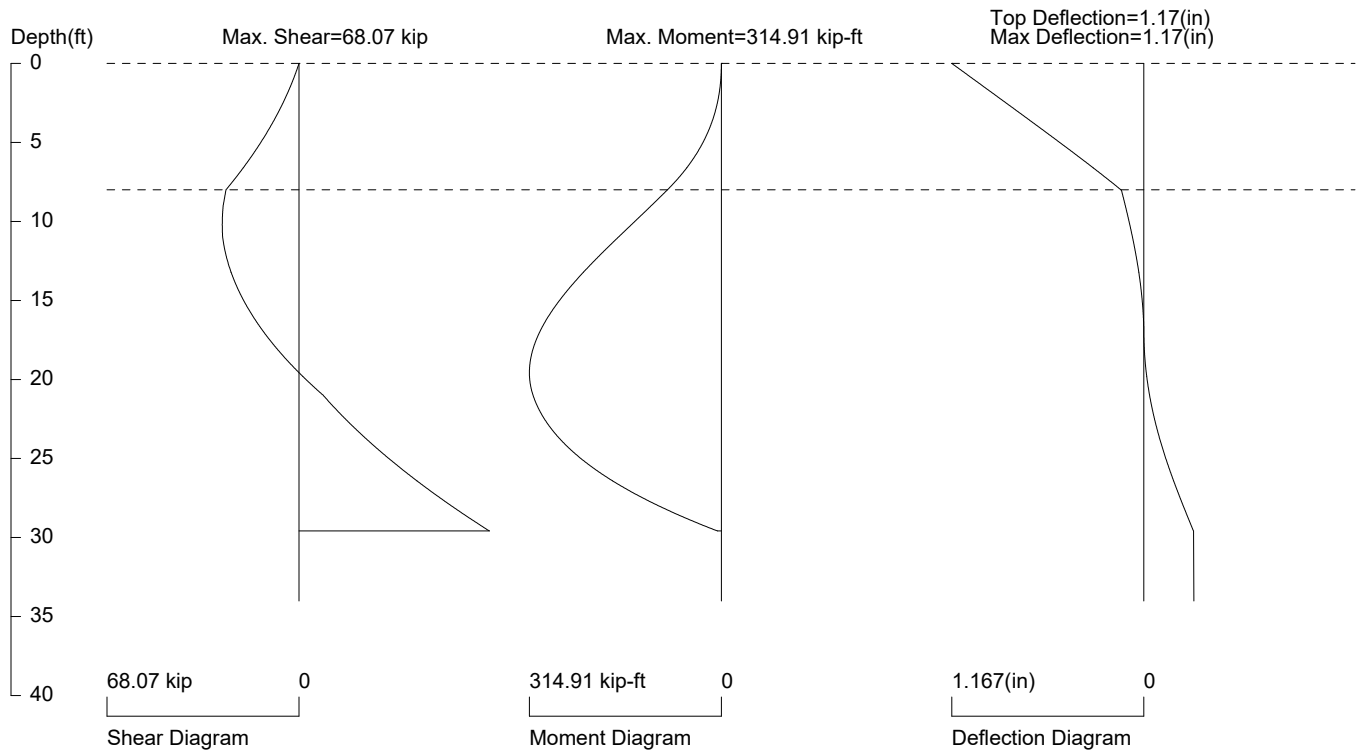
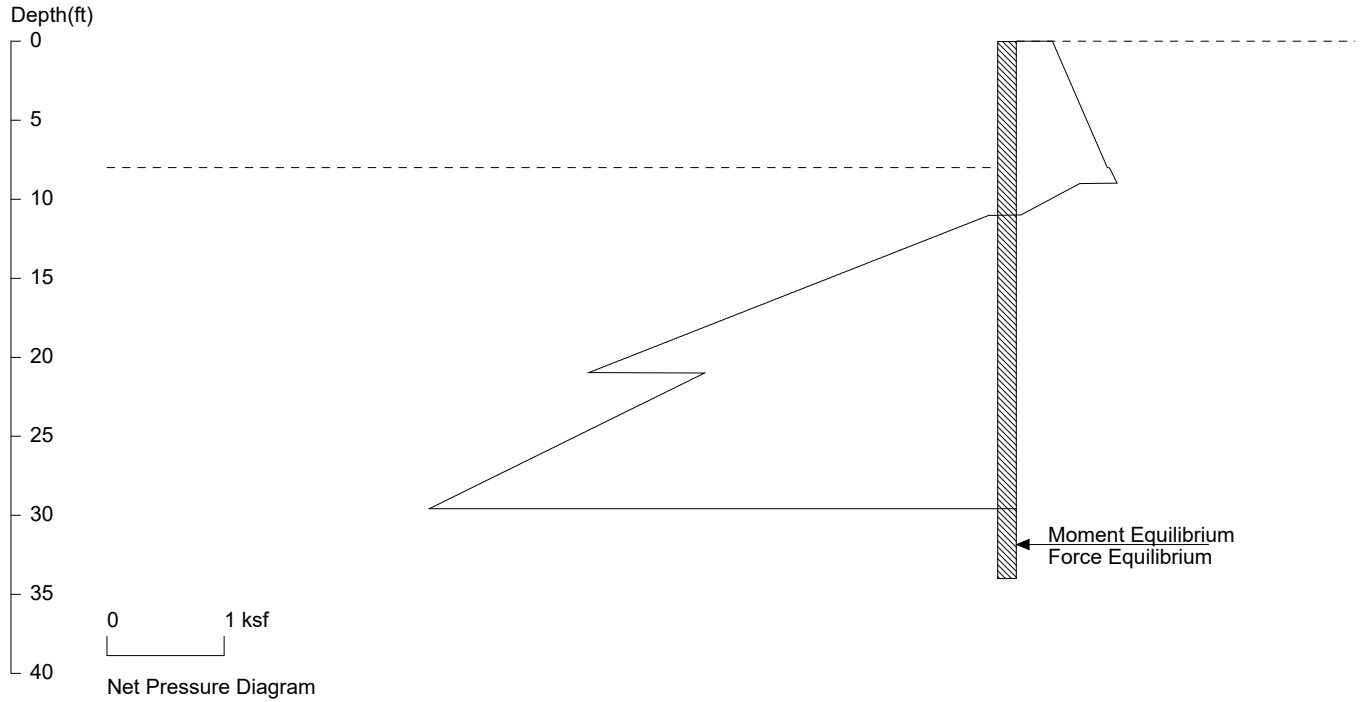
No.	Z depth	Spacing
1	0.00	6.00
2	8.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	8.00	2.40

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 8' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

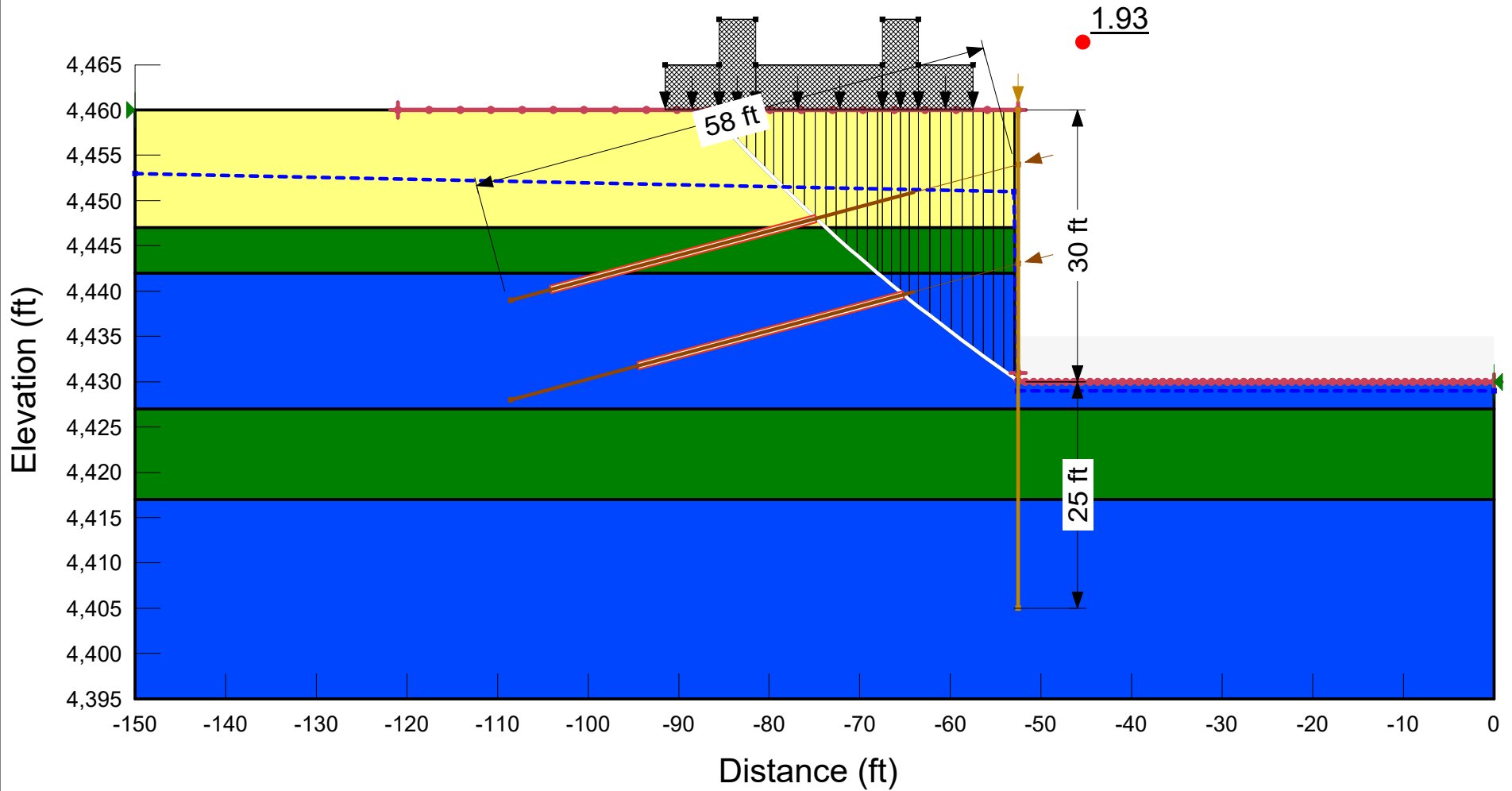
Based on pile spacing: 6.0 foot or meter

User Input Pile, HP14X89: E (ksi)=29000.0, I (in⁴)/pile=904.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuiteWall 318' Temporary.sh8

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Orange	Pile (Wall 3)	Pile			5
Brown	Tieback (Wall 3) (2)	Anchor	46	0.67	5

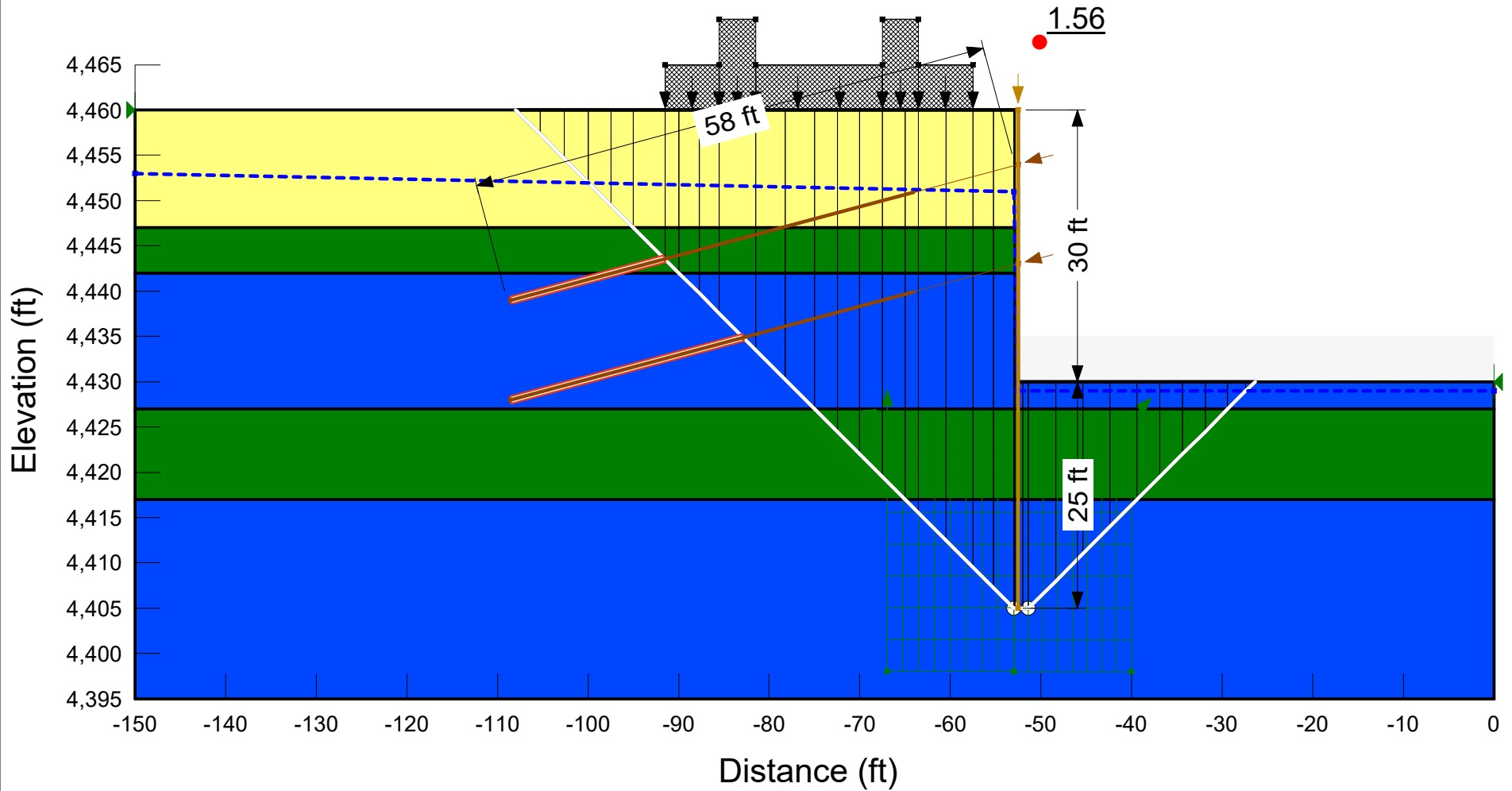


Wall 3 - Sta 1056+00 - Temporary Case

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Yellow	SM	125	0	33

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Orange	Pile (Wall 3)	Pile			5
Brown	Tieback (Wall 3) (2)	Anchor	46	0.67	5

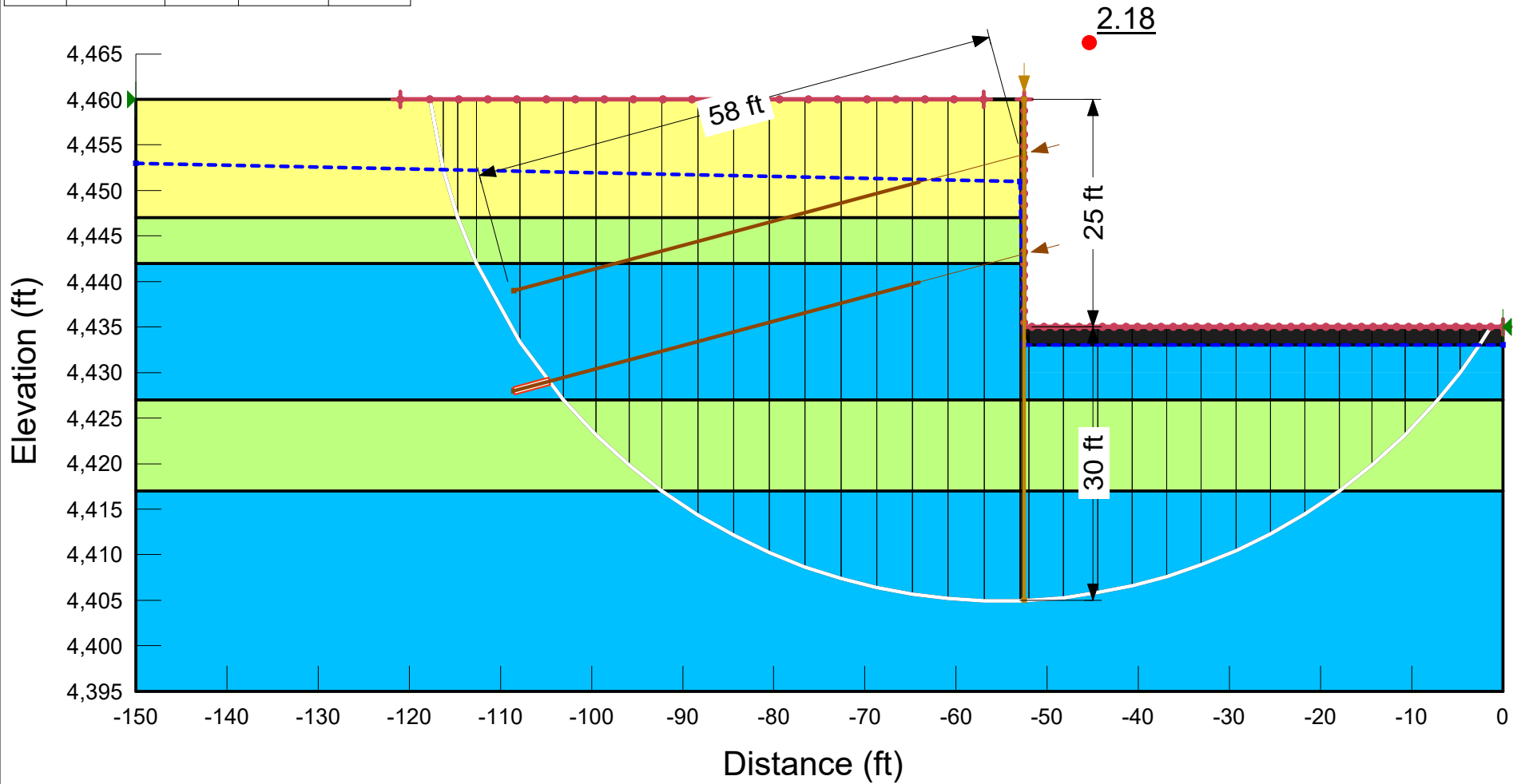


Wall 3 - Sta 1056+00 - Temporary Case - Non Circular

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Drained	115	150	28
Light Green	ML Drained	120	100	32
Black	Roadway Section	135	0	34
Yellow	SM	125	0	33

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Orange	Pile (Wall 3)	Pile			5
Brown	Tieback (Wall 3) (2)	Anchor	46	0.67	5

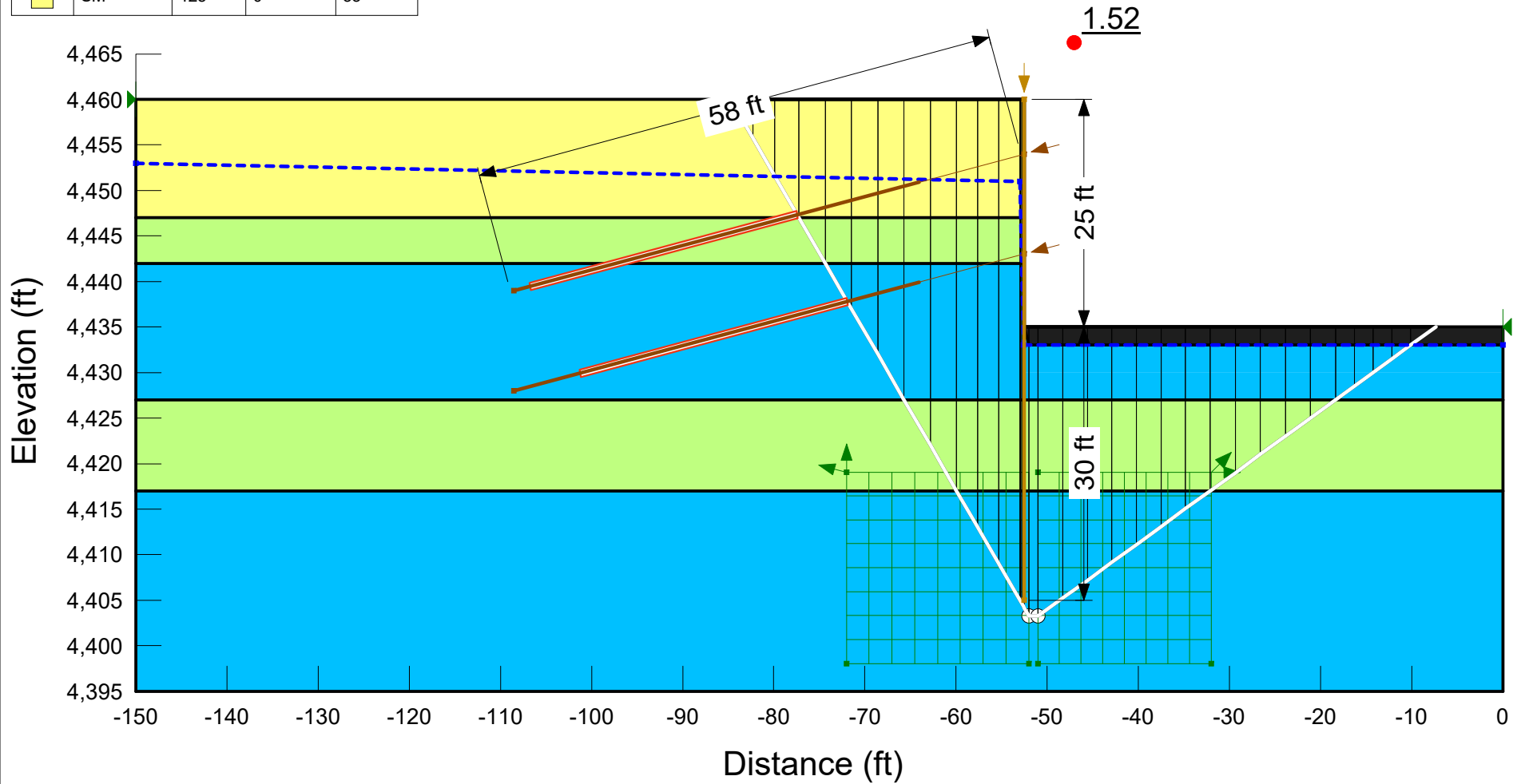


Wall 3 - Sta 1056+00 - Long Term Case

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Drained	115	150	28
Light Green	ML Drained	120	100	32
Black	Roadway Section	135	0	34
Yellow	SM	125	0	33

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Orange	Pile (Wall 3)	Pile			5
Brown	Tieback (Wall 3) (2)	Anchor	46	0.67	5

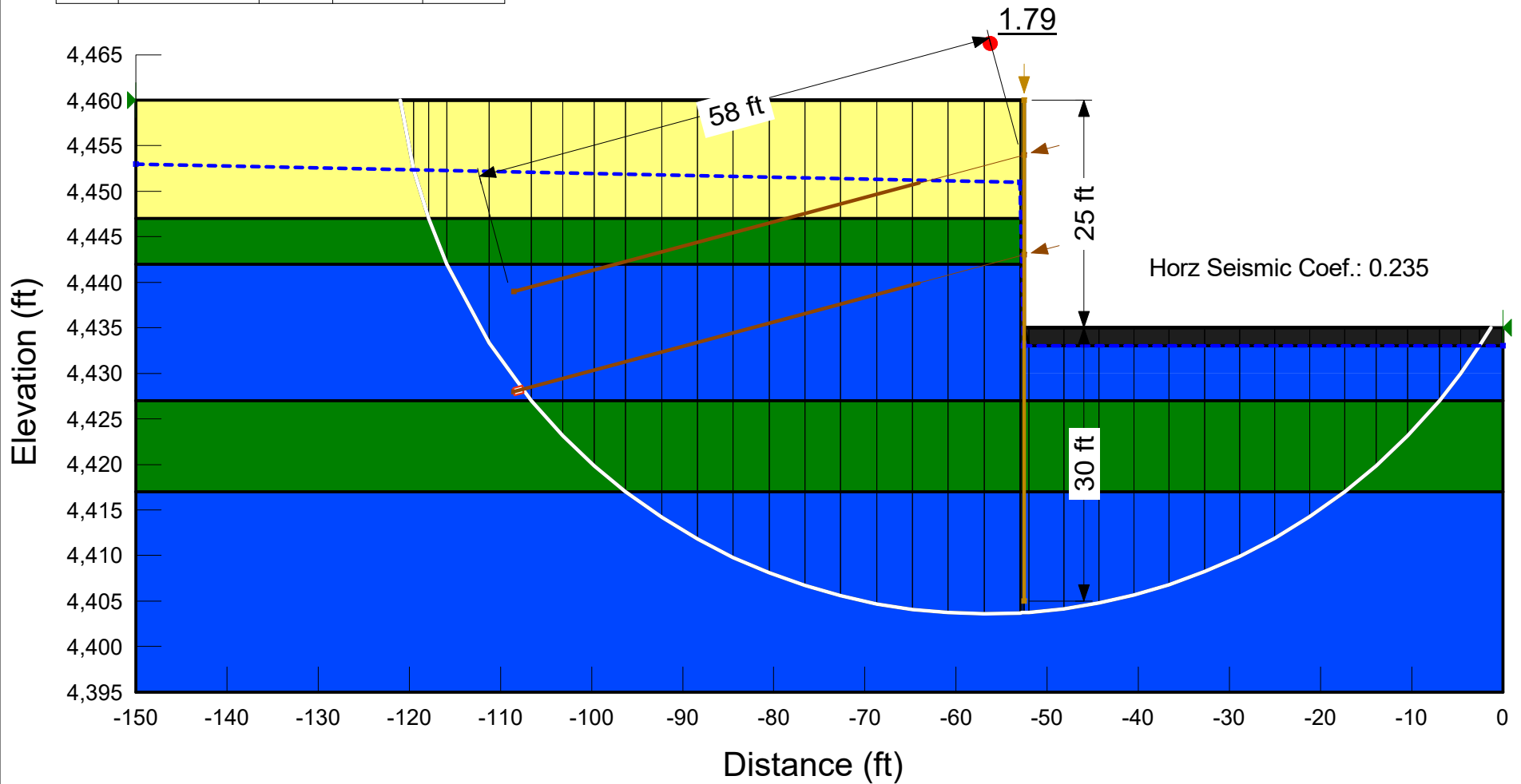


Wall 3 - Sta 1056+00 - Long Term Case - Non Circular

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Black	Roadway Section	135	0	34
Yellow	SM	125	0	33

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Orange	Pile (Wall 3)	Pile			5
Brown	Tieback (Wall 3) (2)	Anchor	46	0.67	5

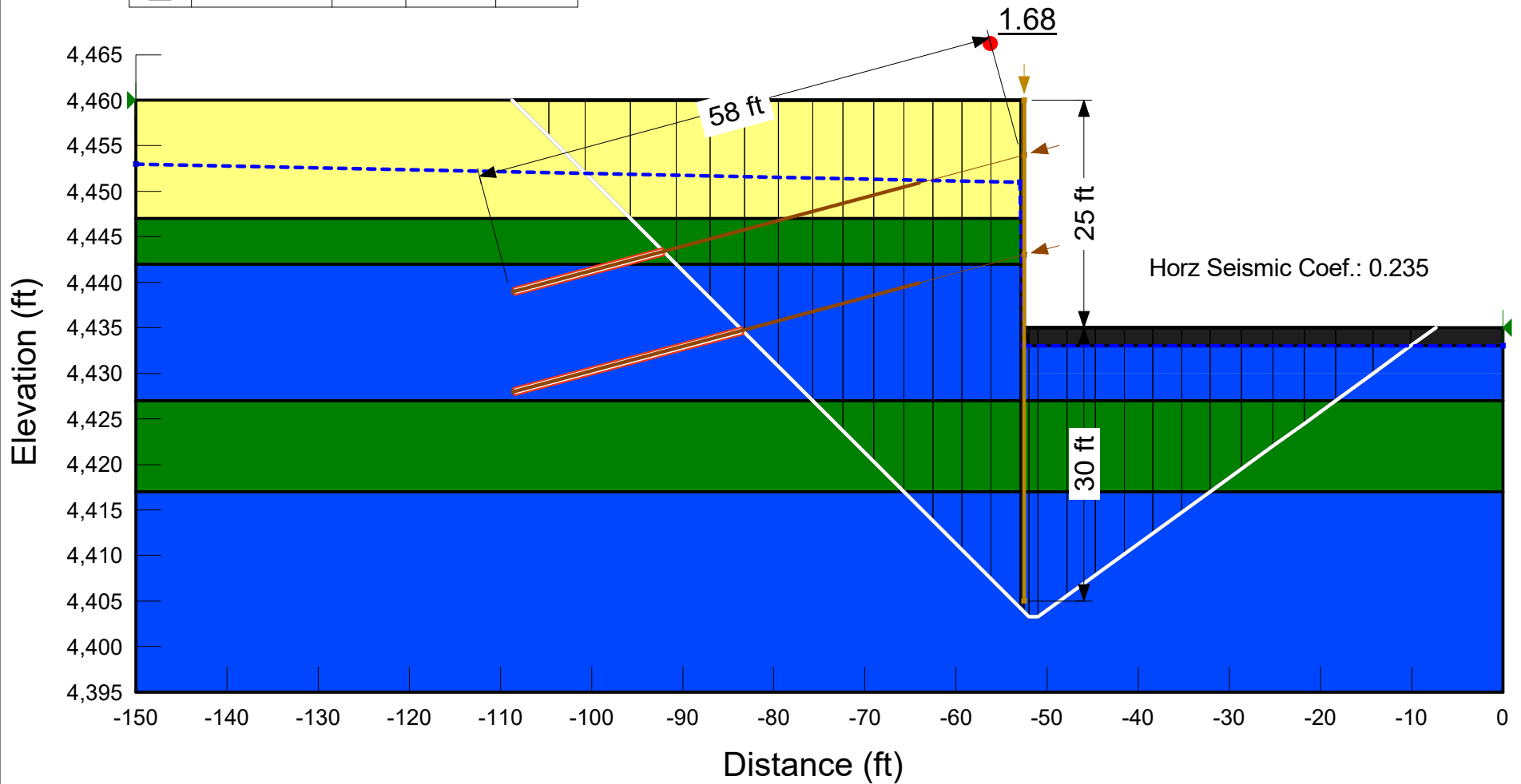


Wall 3 - Sta 1056+00 - Psuedo Static

14600 South Railroad Crossing

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Black	Roadway Section	135	0	34
Yellow	SM	125	0	33

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Orange	Pile (Wall 3)	Pile			5
Brown	Tieback (Wall 3) (2)	Anchor	46	0.67	5

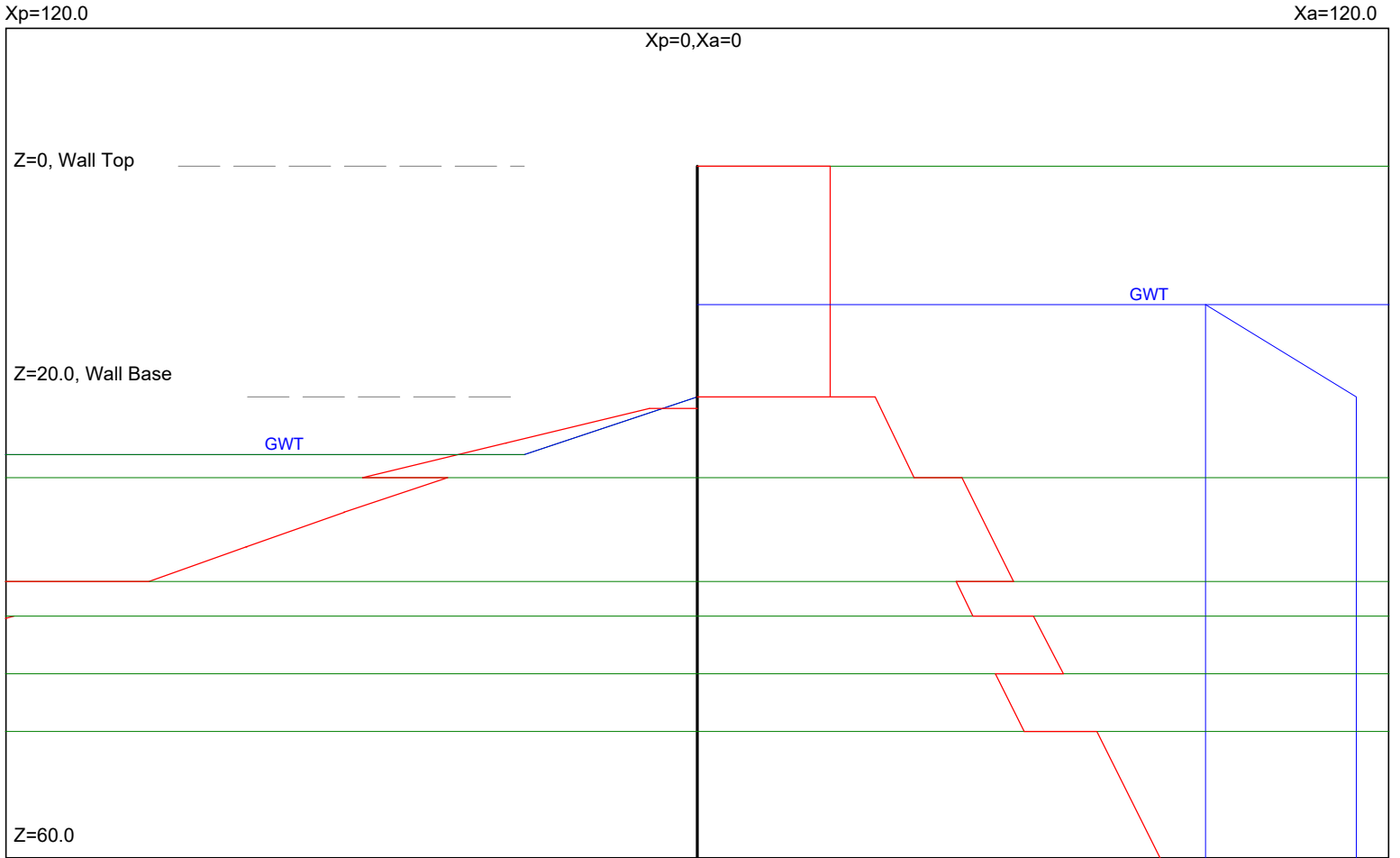


Wall 3 - Sta 1056+00 - Psuedo Static - Non Circular

14600 South Railroad Crossing

Wall 7 Calculations

146th South 20' Temporary



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 4/2/2025 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\20' Temporary-.ep8

* INPUT DATA *

Wall Height=20.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	27.0	0.0	27.0	800.0	3	CL
3	36.0	0.0	36.0	800.0	1	SM
4	39.0	0.0	39.0	800.0	3	CL
5	44.0	0.0	44.0	800.0	1	SM
6	49.0	0.0	49.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	12.0	0.0
2	12.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	20.0	0.0	25.0	30.0	1	SM

2	25.0	30.0	25.0	800.0	1	SM
3	27.0	0.0	27.0	800.0	3	CL
4	36.0	0.0	36.0	800.0	1	SM
5	39.0	0.0	39.0	800.0	3	CL
6	44.0	0.0	44.0	800.0	1	SM
7	49.0	0.0	49.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	20.0	0.0
2	25.0	30.0
3	25.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 6.78 per one linear foot (or meter) width along wall height

Total Static Force above Base= 6.78. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.44	20.00	0.44	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
20.00	0.59	27.00	0.72	0.0185	0.2947
27.00	0.88	36.00	1.05	0.0189	0.3600
36.00	0.86	39.00	0.91	0.0185	0.2947
39.00	1.11	44.00	1.21	0.0198	0.3769
44.00	0.99	49.00	1.08	0.0191	0.3050
49.00	1.33	60.00	1.54	0.0191	0.3634

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

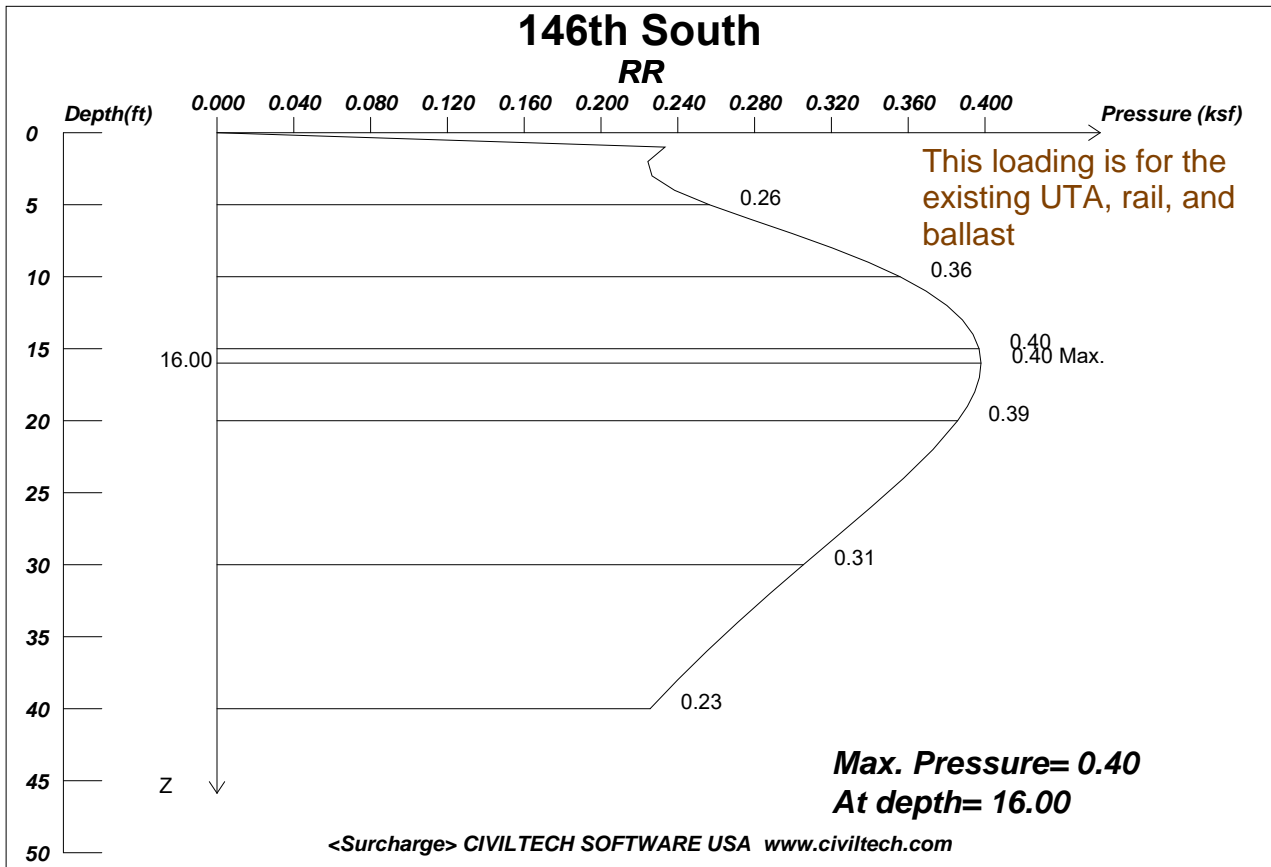
Z1	Pp1	Z2	Pp2	Slope	Kp
21.00	0.16	24.00	0.63	0.159	2.5338
24.00	0.63	27.00	1.11	0.159	2.5338
27.00	0.83	30.00	1.17	0.115	2.1800
30.00	1.17	33.00	1.50	0.109	2.0652
33.00	1.50	36.00	1.82	0.108	2.0465
36.00	2.33	39.00	2.89	0.188	3.0036
39.00	2.27	44.00	2.97	0.141	2.6847
44.00	3.74	45.00	3.92	0.179	2.8619
45.00	3.93	49.00	4.76	0.207	3.3128
49.00	3.74	51.00	4.03	0.140	2.6710
51.00	4.03	54.00	4.51	0.161	3.0633
54.00	4.49	57.00	4.95	0.152	2.8932
57.00	4.94	60.00	5.39	0.148	2.8079

Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	12.00	0.00	20.00	0.50	0.06
1	20.00	0.50	60.00	0.50	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 4/2/2025 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\20' Temporary-.ep8



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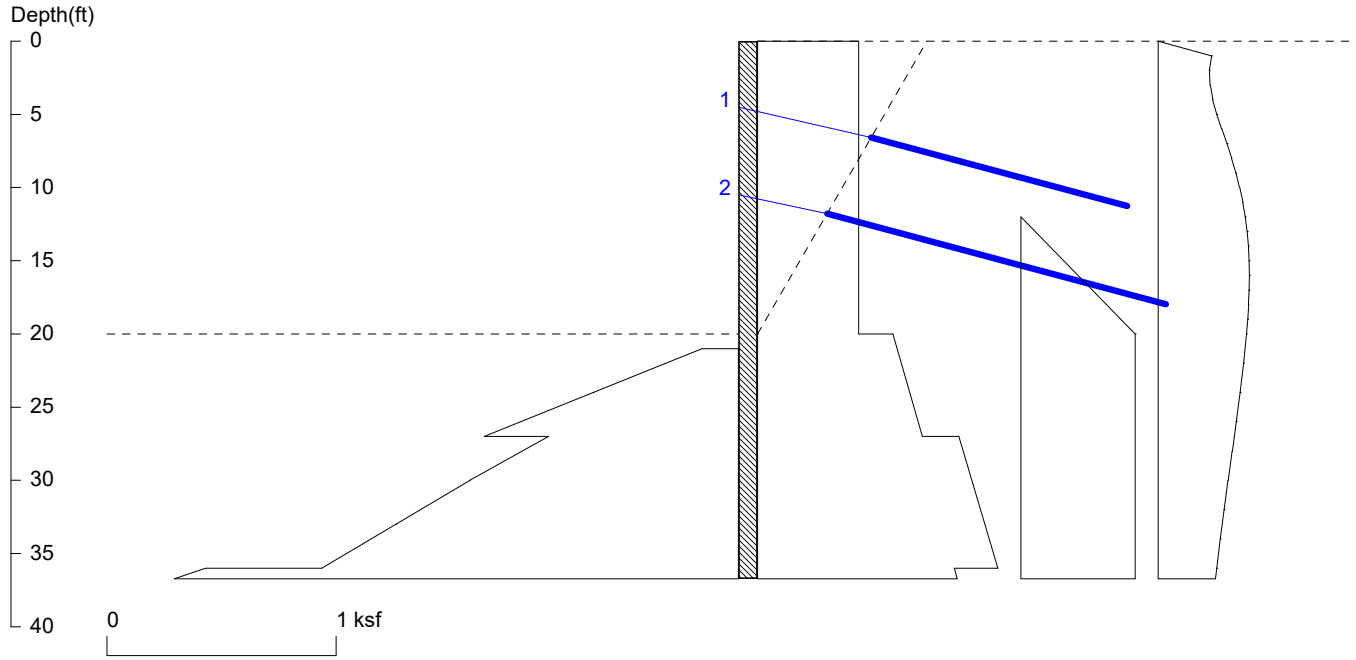
Wall Height, H= 20 Load Depth, D= 0
 Load Factor of Surcharge Loading = 1
 Rigid Wall Condition -- No movement or deflection of the wall are allowed.
 Max. Pressure = 0.398 at depth = 16.00

X		Line Load
27.5		.20
X	Width	Strip Load
.0	5.0	.25
15.0	70.0	.25

Cooper E80 Railroad Loading. From wall to railroad center, X=27.5

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 20' Temporary



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Wall Height=20.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=16.72 Min. Pile Length=36.72

MOMENT IN PILE: Max. Moment=142.33 per Pile Spacing=5.0 at Depth=18.92

PILE SELECTION:

Request Min. Section Modulus = 62.1 in³/pile=1017.79 cm³/pile, F_y= 50 ksi = 345 MPa, F_b/F_y=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.01(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L _{free}	Fixed Length
1. Tieback	4.5	15.0	5.0	36.6*	35.4	9.5	8.0	18.1
2. Tieback	10.5	15.0	5.0	48.4	46.8	12.5	4.9	24.0

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.441	20.000	0.441	0.000000
*	Below	Base		
20.000	0.590	27.000	0.719	0.018450
27.000	0.878	36.000	1.048	0.018935
36.000	0.858	39.000	0.914	0.018450
*	Water	Pres.		
12.000	0.000	20.000	0.499	0.062400
20.000	0.499	160.000	0.499	0.000000
*	Sur-	charge		
0.000	0.000	1.000	0.233	0.233331

1.000	0.233	2.000	0.224	-0.008899
2.000	0.224	3.000	0.227	0.002110
3.000	0.227	4.000	0.238	0.011777
4.000	0.238	5.000	0.256	0.018128
5.000	0.256	6.000	0.278	0.021226
6.000	0.278	7.000	0.300	0.021871
7.000	0.300	8.000	0.320	0.020885
8.000	0.320	9.000	0.339	0.018908
9.000	0.339	10.000	0.356	0.016385
10.000	0.356	11.000	0.369	0.013618
11.000	0.369	12.000	0.380	0.010806
12.000	0.380	13.000	0.388	0.008077
13.000	0.388	14.000	0.394	0.005512
14.000	0.394	15.000	0.397	0.003159
15.000	0.397	16.000	0.398	0.001042
16.000	0.398	17.000	0.397	-0.000829
17.000	0.397	18.000	0.395	-0.002458
18.000	0.395	19.000	0.391	-0.003855
19.000	0.391	20.000	0.386	-0.005034
20.000	0.386	22.000	0.373	-0.006412
22.000	0.373	24.000	0.358	-0.007695
24.000	0.358	26.000	0.341	-0.008442
26.000	0.341	28.000	0.323	-0.008786
28.000	0.323	30.000	0.305	-0.008839
30.000	0.305	32.000	0.288	-0.008690
32.000	0.288	34.000	0.271	-0.008405
34.000	0.271	36.000	0.255	-0.008036
36.000	0.255	38.000	0.240	-0.007619

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
21.000	0.159	24.000	0.634	0.158614
24.000	0.634	27.000	1.110	0.158614
27.000	0.828	30.000	1.172	0.114670
30.000	1.170	33.000	1.496	0.108628
33.000	1.496	36.000	1.819	0.107646
36.000	2.326	39.000	2.890	0.188025

ACTIVE SPACING:

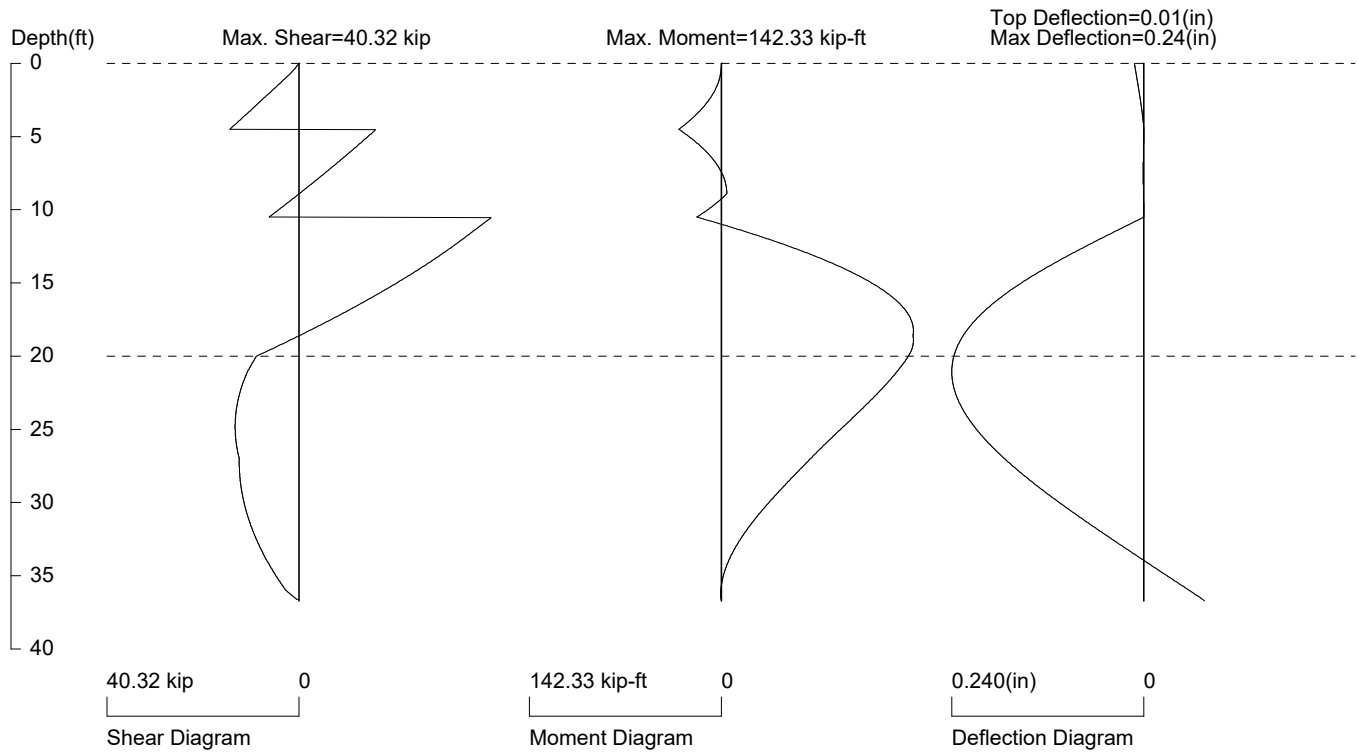
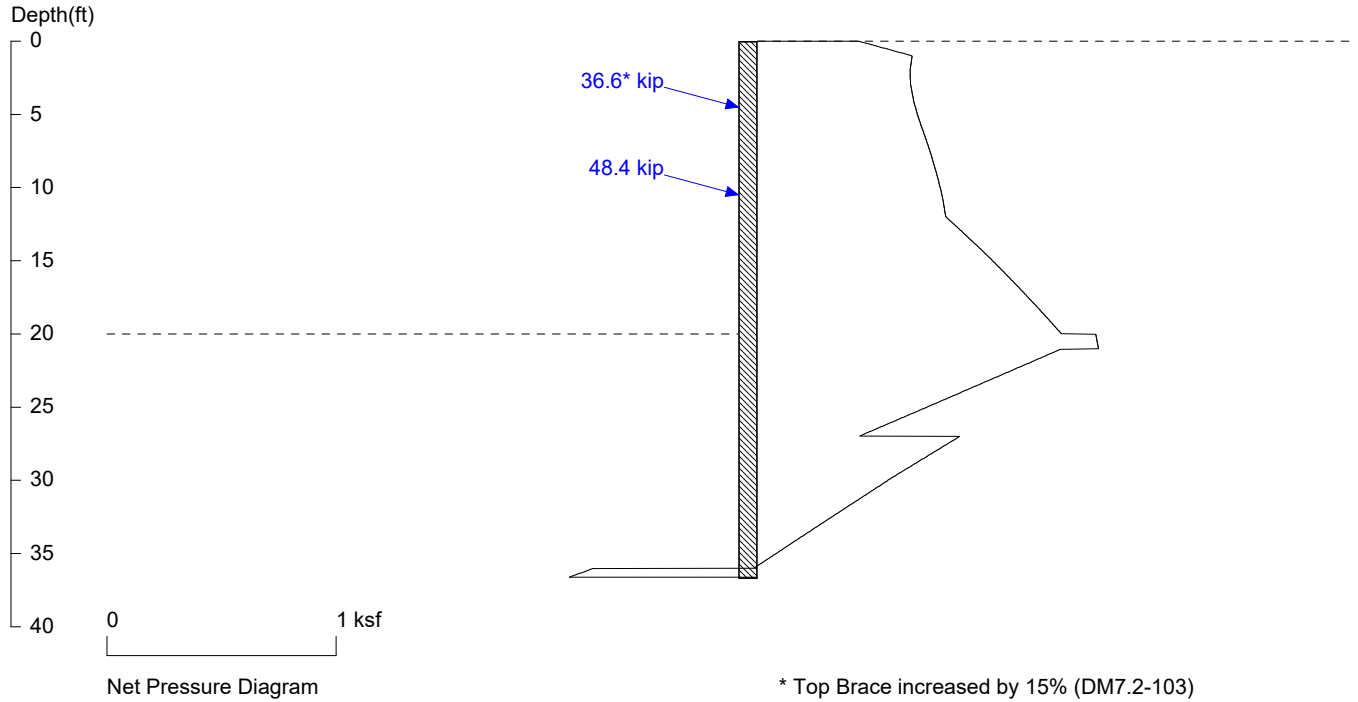
No.	Z depth	Spacing
1	0.00	5.00
2	20.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	20.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 20' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

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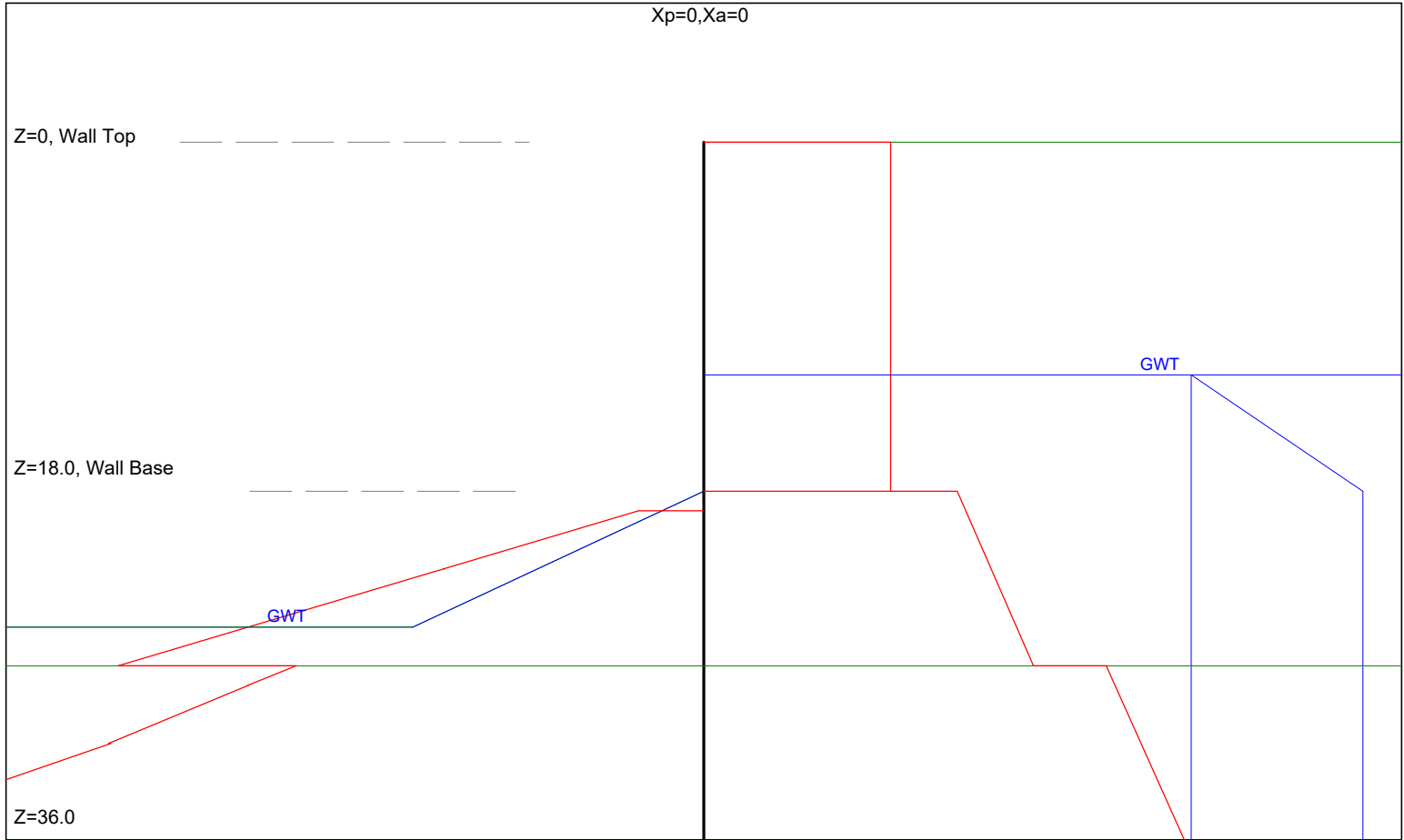
Calculation Sheet #106

146th South 18' Permanent

Xp=72.0

Xa=72.0

Xp=0,Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 4/2/2025

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\18' Permanent-.ep8

* INPUT DATA *

Wall Height=18.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	27.0	0.0	27.0	800.0	3	CL
3	36.0	0.0	36.0	800.0	1	SM
4	39.0	0.0	39.0	800.0	3	CL
5	44.0	0.0	44.0	800.0	1	SM
6	49.0	0.0	49.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	12.0	0.0
2	12.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	18.0	0.0	25.0	30.0	1	SM

2	25.0	30.0	25.0	800.0	1	SM
3	27.0	0.0	27.0	800.0	3	CL
4	36.0	0.0	36.0	800.0	1	SM
5	39.0	0.0	39.0	800.0	3	CL
6	44.0	0.0	44.0	800.0	1	SM
7	49.0	0.0	49.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	18.0	0.0
2	25.0	30.0
3	25.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 5.64 per one linear foot (or meter) width along wall height

Total Static Force above Base= 5.64. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.41	18.00	0.41	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
18.00	0.55	27.00	0.72	0.0185	0.2947
27.00	0.88	36.00	1.05	0.0189	0.3600

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

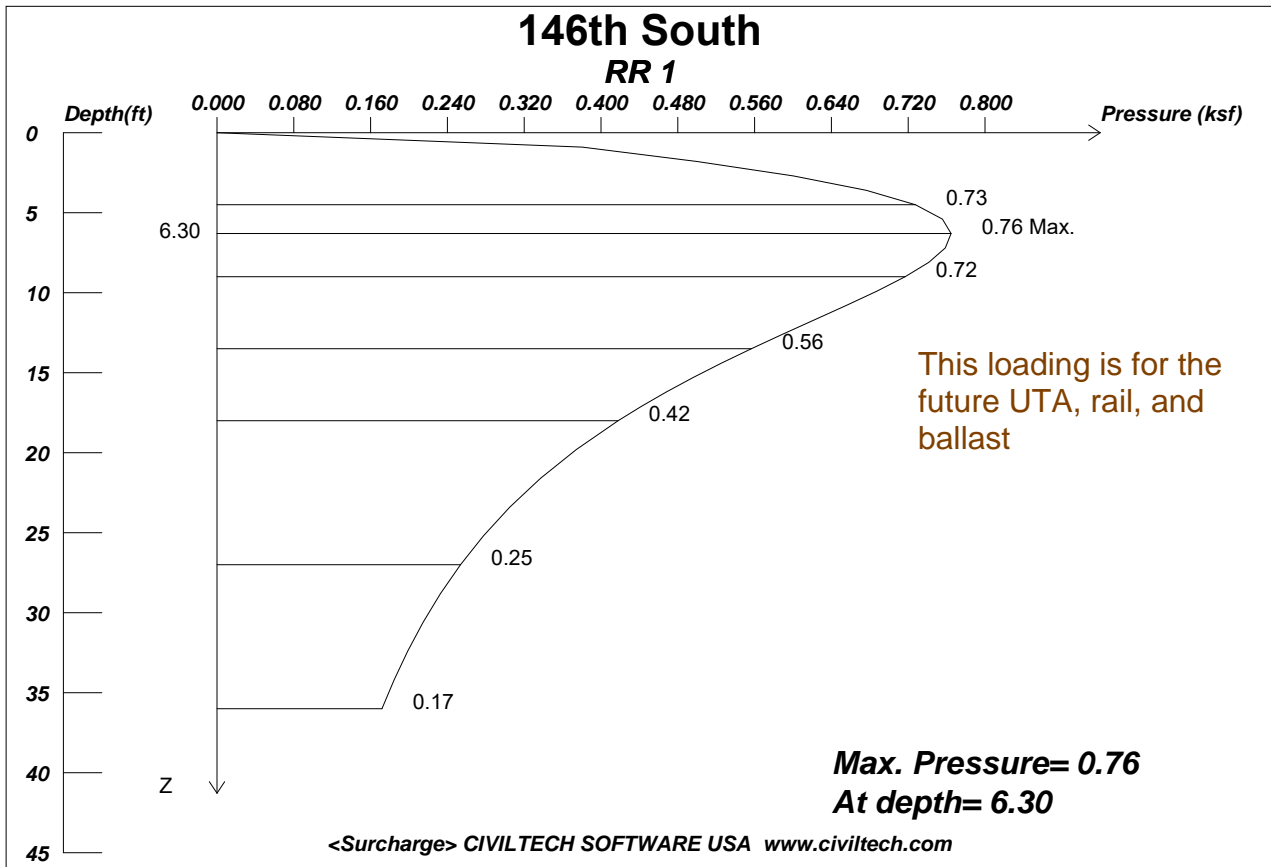
Z1	Pp1	Z2	Pp2	Slope	Kp
19.00	0.14	22.00	0.57	0.142	2.2677
22.00	0.57	27.00	1.28	0.142	2.2677
27.00	0.89	28.00	0.99	0.105	1.9984
28.00	0.99	31.00	1.30	0.102	1.9341
31.00	1.29	34.00	1.66	0.123	2.3343
34.00	1.66	36.00	1.92	0.130	2.4720

Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	12.00	0.00	18.00	0.37	0.06
1	18.00	0.37	36.00	0.37	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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Wall Height, H= 18

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

Rigid Wall Condition -- No movement or deflection of the wall are allowed.

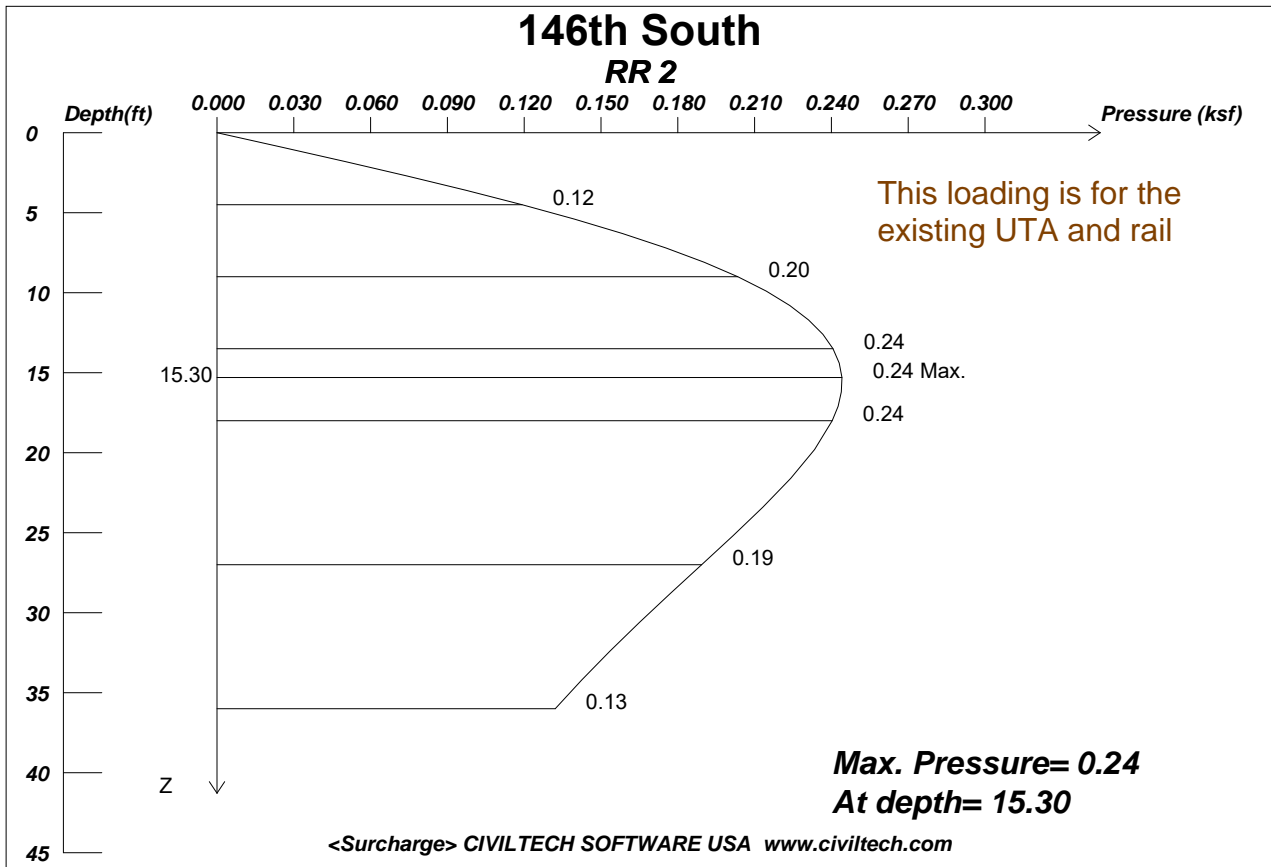
Max. Pressure = 0.765 at depth = 6.30

X	Line Load
12.5	.20

X	Width	Strip Load
.0	5.0	.25
5.0	70.0	.25

Cooper E80 Railroad Loading. From wall to railroad center, X=12.5

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf



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Wall Height, H= 18

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

Rigid Wall Condition -- No movement or deflection of the wall are allowed.

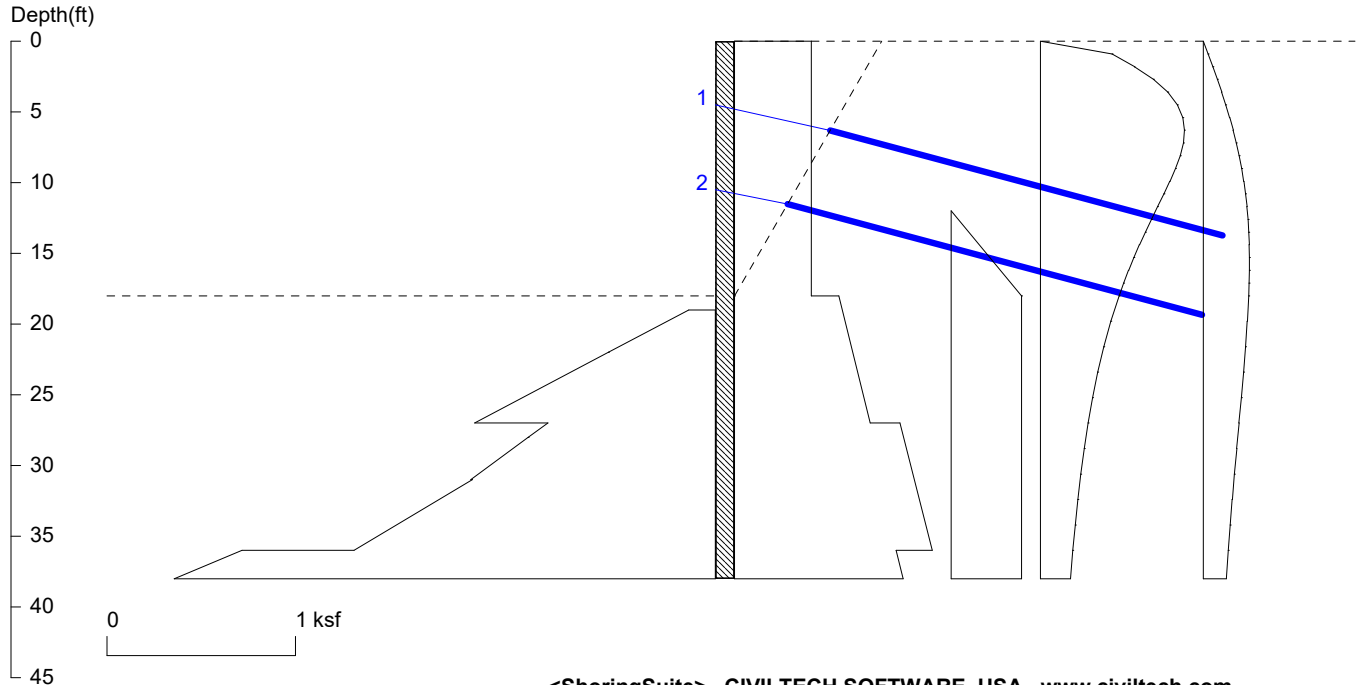
Max. Pressure = 0.244 at depth = 15.30

X	Line Load
27.5	.20

Cooper E80 Railroad Loading. From wall to railroad center, X=27.5

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 18' Permanent



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 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\18' Permanent-.sh8
 Wall Height=18.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=20.01 Min. Pile Length=38.01
 MOMENT IN PILE: Max. Moment=133.99 per Pile Spacing=5.0 at Depth=17.21

PILE SELECTION:
 Request Min. Section Modulus = 58.5 in³/pile=958.13 cm³/pile, F_y= 50 ksi = 345 MPa, F_b/F_y=0.55
 HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!
 Top Deflection = 0.01(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.5	15.0	5.0	58.0*	56.1	15.0	7.0	28.7
2. Tieback	10.5	15.0	5.0	61.3	59.2	15.9	3.9	30.3

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.407	18.000	0.407	0.000000
*	Below	Base		
18.000	0.553	27.000	0.719	0.018450
27.000	0.878	36.000	1.048	0.018935
36.000	0.858	39.000	0.914	0.018450
*	Water	Pres.		
12.000	0.000	18.000	0.374	0.062400
18.000	0.374	144.000	0.374	0.000000
*	Sur-	charge		
0.000	0.000	0.900	0.381	0.422848

0.900	0.381	1.800	0.500	0.132900
1.800	0.500	2.700	0.600	0.111278
2.700	0.600	3.600	0.676	0.084472
3.600	0.676	4.500	0.727	0.056761
4.500	0.727	5.400	0.756	0.031340
5.400	0.756	6.300	0.765	0.009992
6.300	0.765	7.200	0.759	-0.006703
7.200	0.759	8.100	0.742	-0.018957
8.100	0.742	9.000	0.717	-0.027379
9.000	0.717	9.900	0.687	-0.032712
9.900	0.687	10.800	0.655	-0.035674
10.800	0.655	11.700	0.622	-0.036888
11.700	0.622	12.600	0.589	-0.036862
12.600	0.589	13.500	0.557	-0.035989
13.500	0.557	14.400	0.525	-0.034570
14.400	0.525	15.300	0.496	-0.032822
15.300	0.496	16.200	0.468	-0.030902
16.200	0.468	17.100	0.442	-0.028921
17.100	0.442	18.000	0.418	-0.026953
18.000	0.418	19.800	0.374	-0.024140
19.800	0.374	21.600	0.337	-0.020735
21.600	0.337	23.400	0.305	-0.017800
23.400	0.305	25.200	0.277	-0.015320
25.200	0.277	27.000	0.254	-0.013247
27.000	0.254	28.800	0.233	-0.011522
28.800	0.233	30.600	0.215	-0.010085
30.600	0.215	32.400	0.199	-0.008885
32.400	0.199	34.200	0.185	-0.007879
34.200	0.185	36.000	0.172	-0.007031
36.000	0.172	39.600	0.150	-0.006005
*	Sur-	charge		
0.000	0.000	0.900	0.025	0.027956
0.900	0.025	1.800	0.050	0.027576
1.800	0.050	2.700	0.074	0.026829
2.700	0.074	3.600	0.097	0.025741
3.600	0.097	4.500	0.119	0.024349
4.500	0.119	5.400	0.140	0.022696
5.400	0.140	6.300	0.158	0.020835
6.300	0.158	7.200	0.175	0.018817
7.200	0.175	8.100	0.190	0.016698
8.100	0.190	9.000	0.203	0.014528
9.000	0.203	9.900	0.215	0.012355
9.900	0.215	10.800	0.224	0.010222
10.800	0.224	11.700	0.231	0.008164
11.700	0.231	12.600	0.237	0.006210
12.600	0.237	13.500	0.241	0.004382
13.500	0.241	14.400	0.243	0.002696
14.400	0.243	15.300	0.244	0.001161
15.300	0.244	16.200	0.244	-0.000219
16.200	0.244	17.100	0.243	-0.001443
17.100	0.243	18.000	0.240	-0.002515
18.000	0.240	19.800	0.233	-0.003835
19.800	0.233	21.600	0.224	-0.005160
21.600	0.224	23.400	0.213	-0.006036
23.400	0.213	25.200	0.201	-0.006550
25.200	0.201	27.000	0.189	-0.006780
27.000	0.189	28.800	0.177	-0.006798
28.800	0.177	30.600	0.165	-0.006663
30.600	0.165	32.400	0.153	-0.006423

32.400	0.153	34.200	0.142	-0.006114
34.200	0.142	36.000	0.132	-0.005764
36.000	0.132	39.600	0.113	-0.005209

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
19.000	0.142	22.000	0.568	0.141957
22.000	0.568	27.000	1.278	0.141957
27.000	0.889	28.000	0.994	0.105117
28.000	0.993	31.000	1.299	0.101735
31.000	1.290	36.000	1.918	0.125609
36.000	2.512	39.000	3.049	0.179152

ACTIVE SPACING:

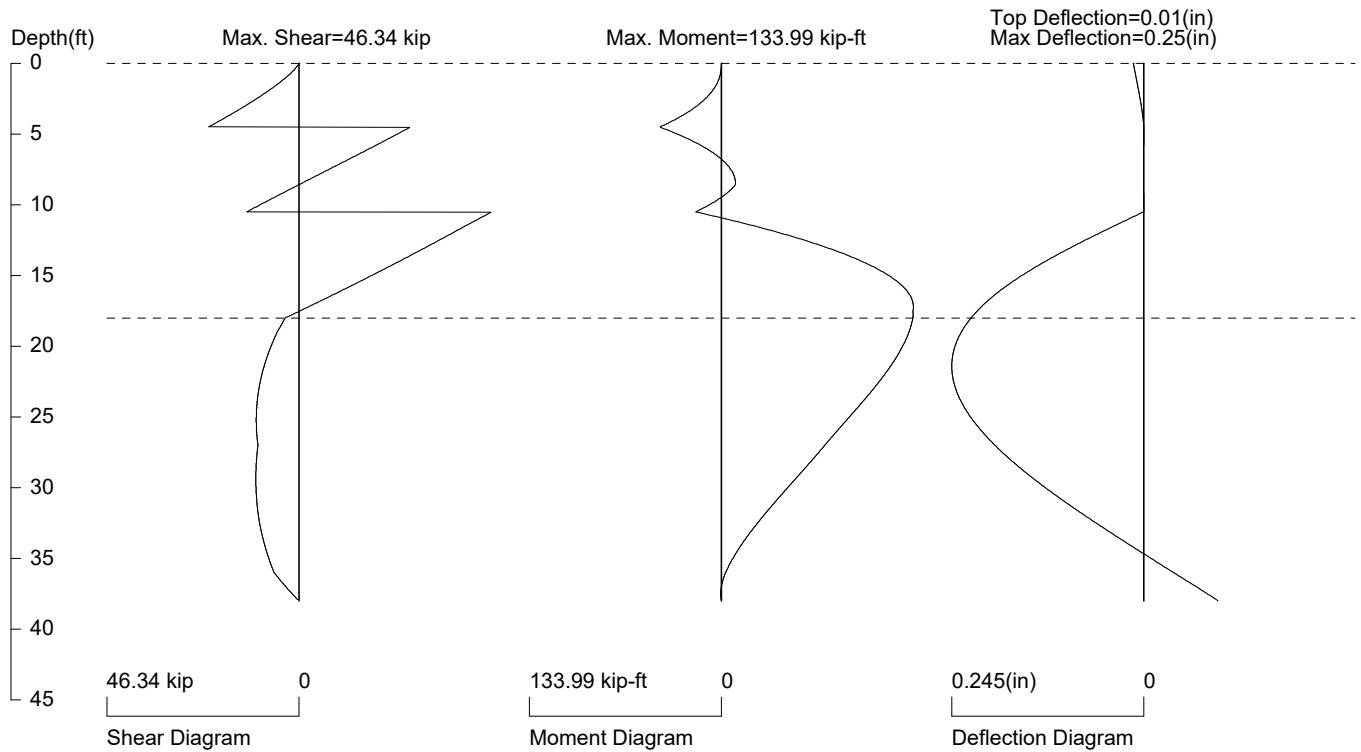
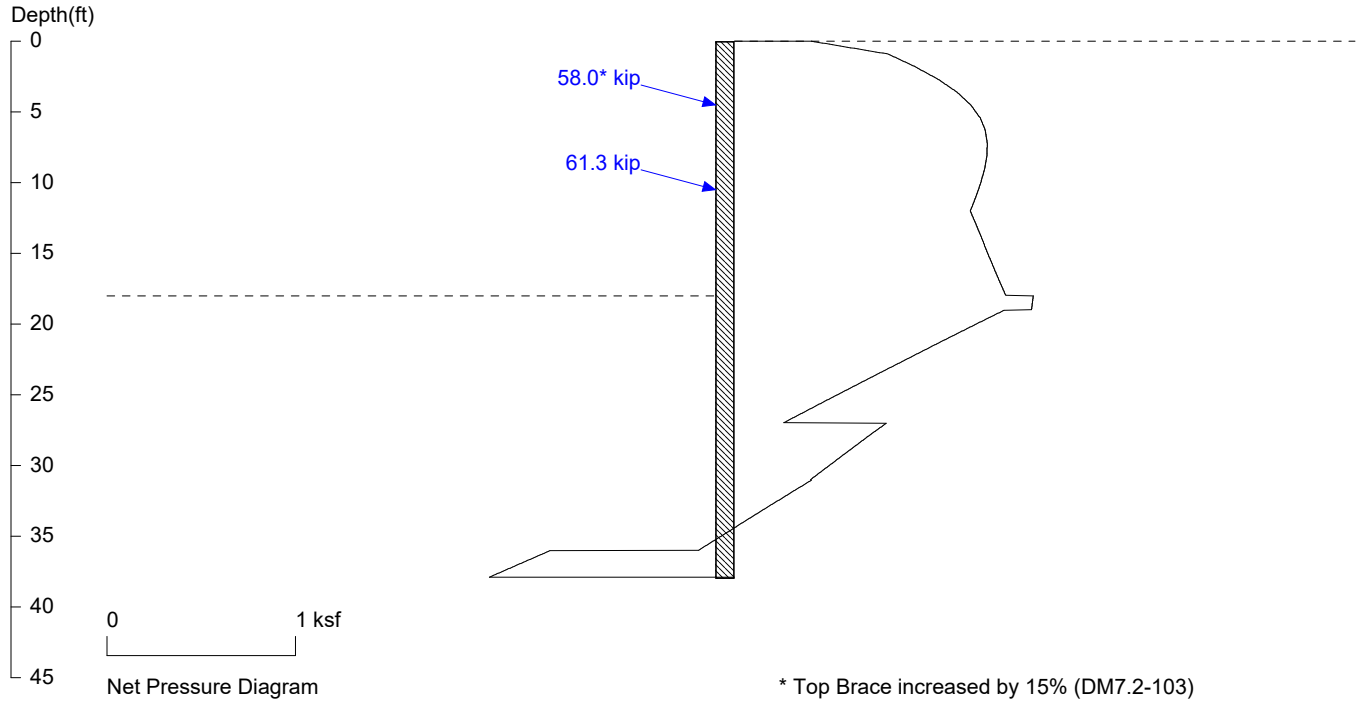
No.	Z depth	Spacing
1	0.00	5.00
2	18.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	18.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 18' Permanent



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

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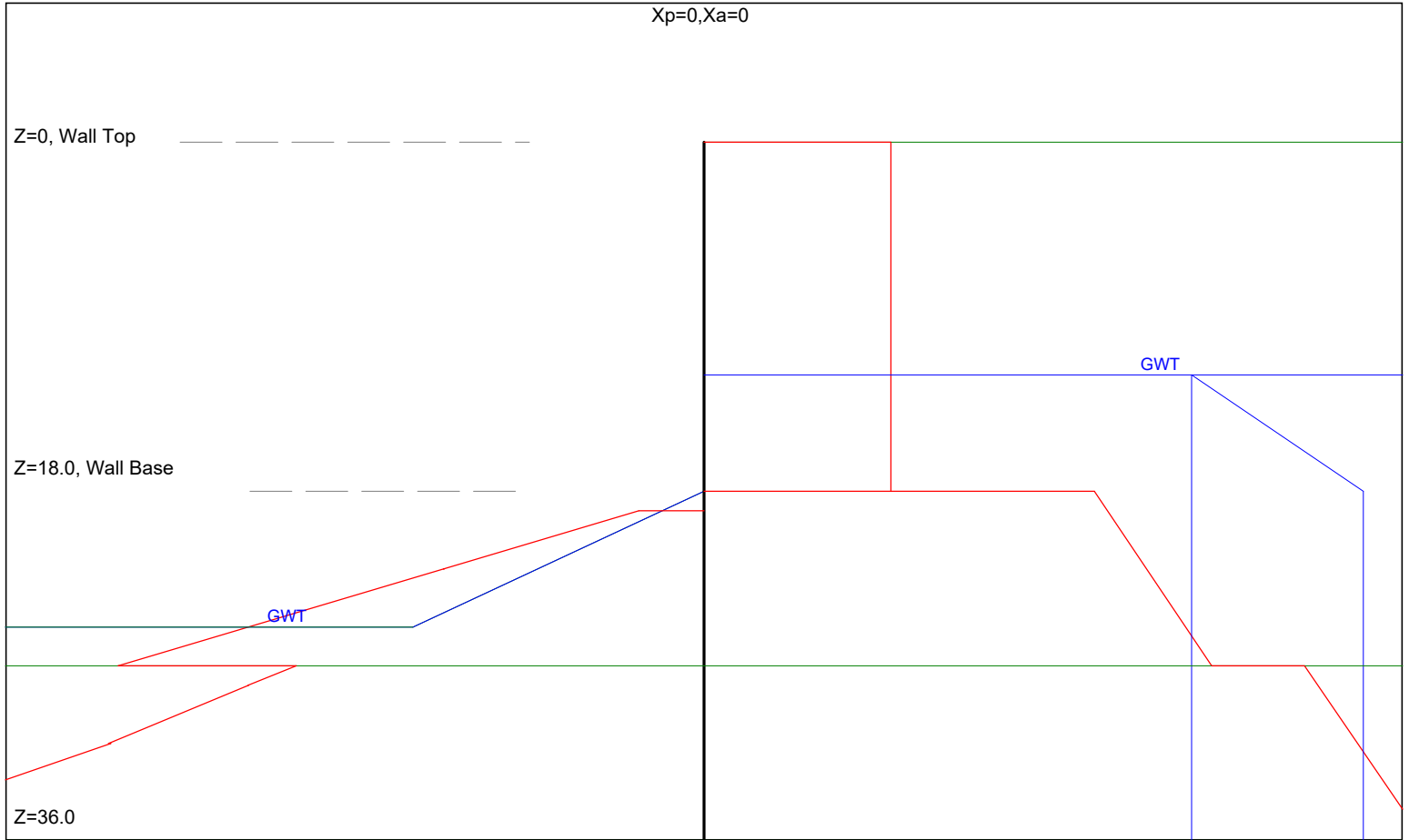
Calculation Sheet #114

146th South 18' Seismic

Xp=72.0

Xa=72.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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* INPUT DATA *

Wall Height=18.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	27.0	0.0	27.0	800.0	3	CL
3	36.0	0.0	36.0	800.0	1	SM
4	39.0	0.0	39.0	800.0	3	CL
5	44.0	0.0	44.0	800.0	1	SM
6	49.0	0.0	49.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	12.0	0.0
2	12.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	18.0	0.0	25.0	30.0	1	SM

2	25.0	30.0	25.0	800.0	1	SM
3	27.0	0.0	27.0	800.0	3	CL
4	36.0	0.0	36.0	800.0	1	SM
5	39.0	0.0	39.0	800.0	3	CL
6	44.0	0.0	44.0	800.0	1	SM
7	49.0	0.0	49.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	18.0	0.0
2	25.0	30.0
3	25.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 8.68 per one linear foot (or meter) width along wall height

Total Static Force above Base= 5.64. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Total Earthquake Force above Base= 3.04. Distributed in trapezoid. Total earthquake force acting at 0.4H below wall top.

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.41	18.00	0.41	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
18.00	0.85	27.00	1.11	0.0284	0.4537
27.00	1.31	36.00	1.57	0.0289	0.5500

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
19.00	0.14	22.00	0.57	0.142	2.2677
22.00	0.57	27.00	1.28	0.142	2.2677
27.00	0.89	28.00	0.99	0.105	1.9984
28.00	0.99	31.00	1.30	0.102	1.9341
31.00	1.29	34.00	1.66	0.123	2.3343
34.00	1.66	36.00	1.92	0.130	2.4720

Output Earthquake Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Total Earthq. Force, Ee = 3.04

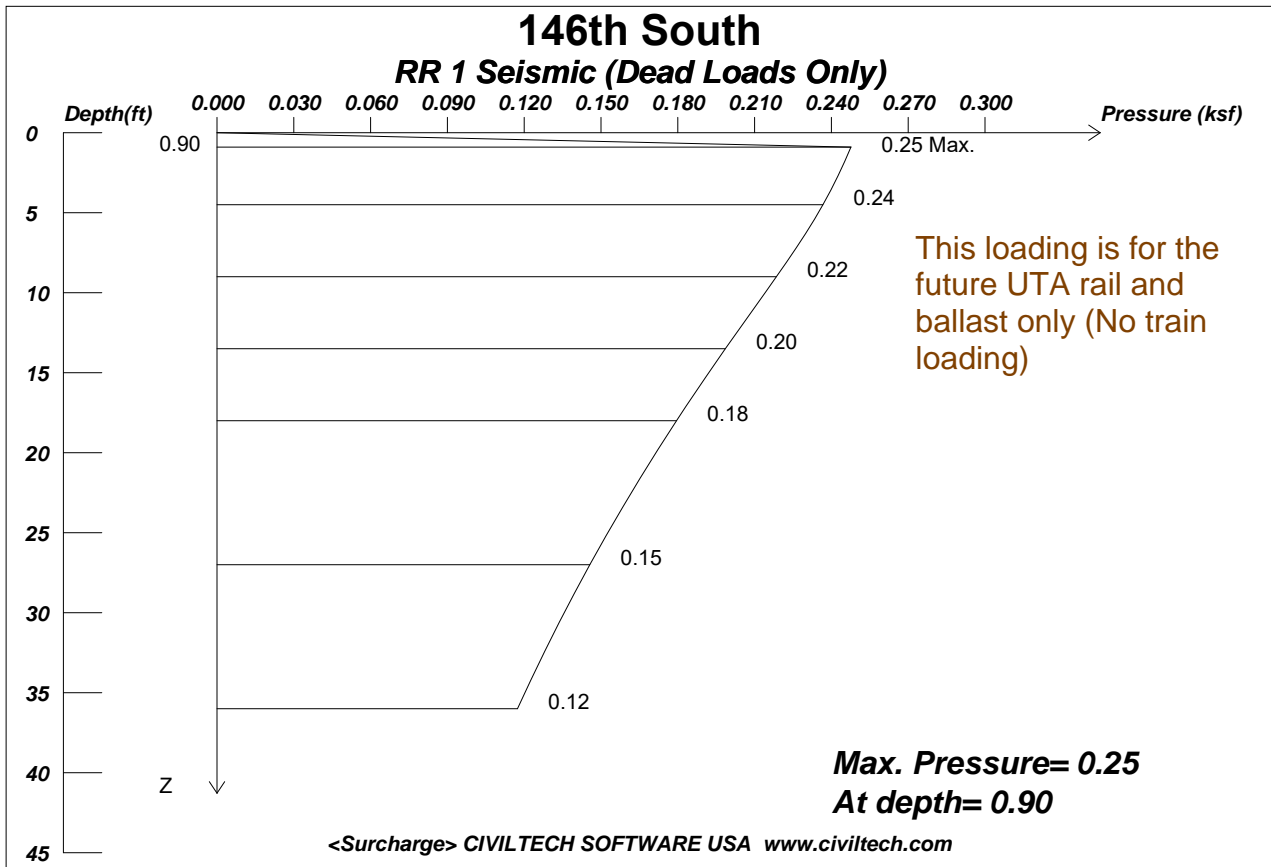
No	Zq1	Pq1	Zq2	Pq2	Slope
0	0.00	0.270	18.00	0.068	-0.011

Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	12.00	0.00	18.00	0.37	0.06
1	18.00	0.37	36.00	0.37	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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Wall Height, H= 18

Load Depth, D= 0

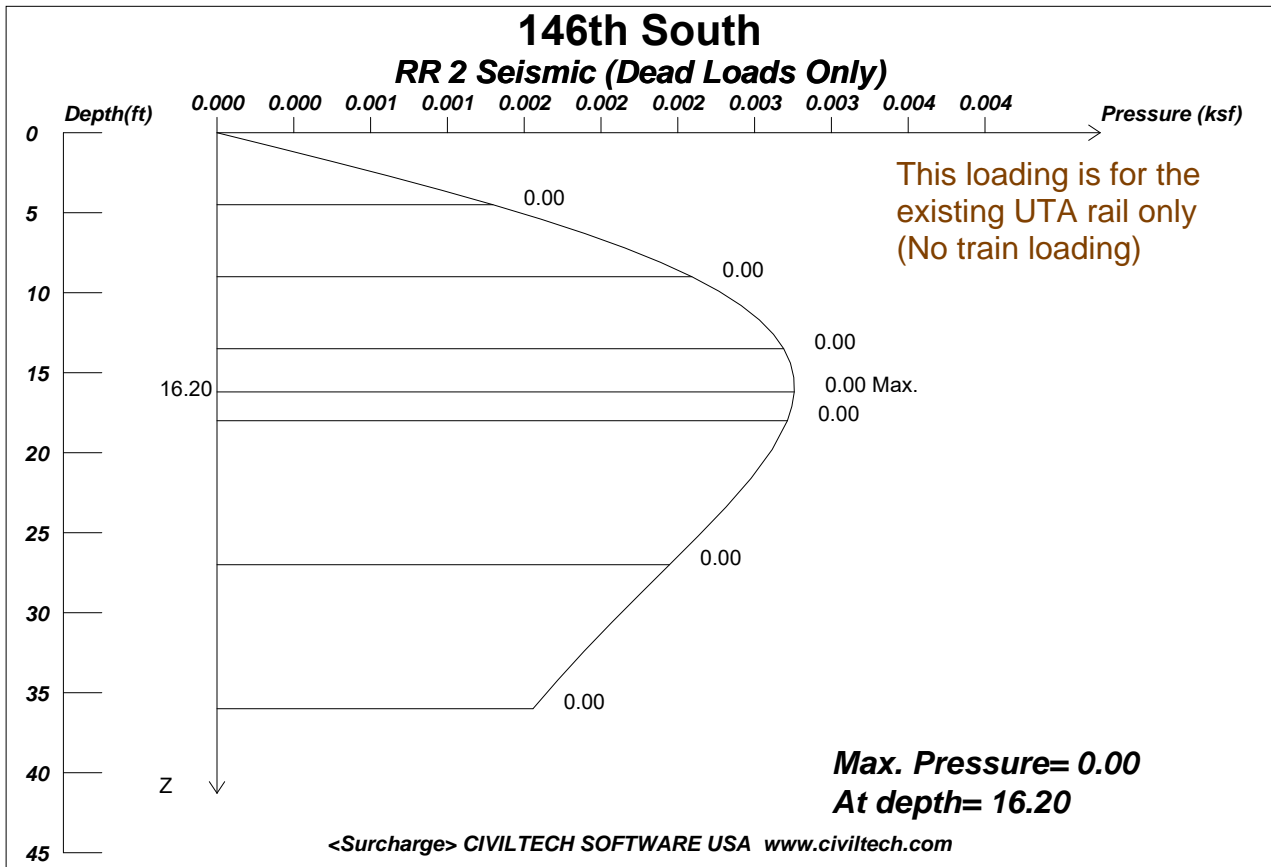
Load Factor of Surcharge Loading = 1

Rigid Wall Condition -- No movement or deflection of the wall are allowed.

Max. Pressure = 0.248 at depth = 0.90

X	Width	Strip Load
12.5		.20
.0	5.0	.25
5.0	70.0	.25

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf



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Wall Height, H= 18

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

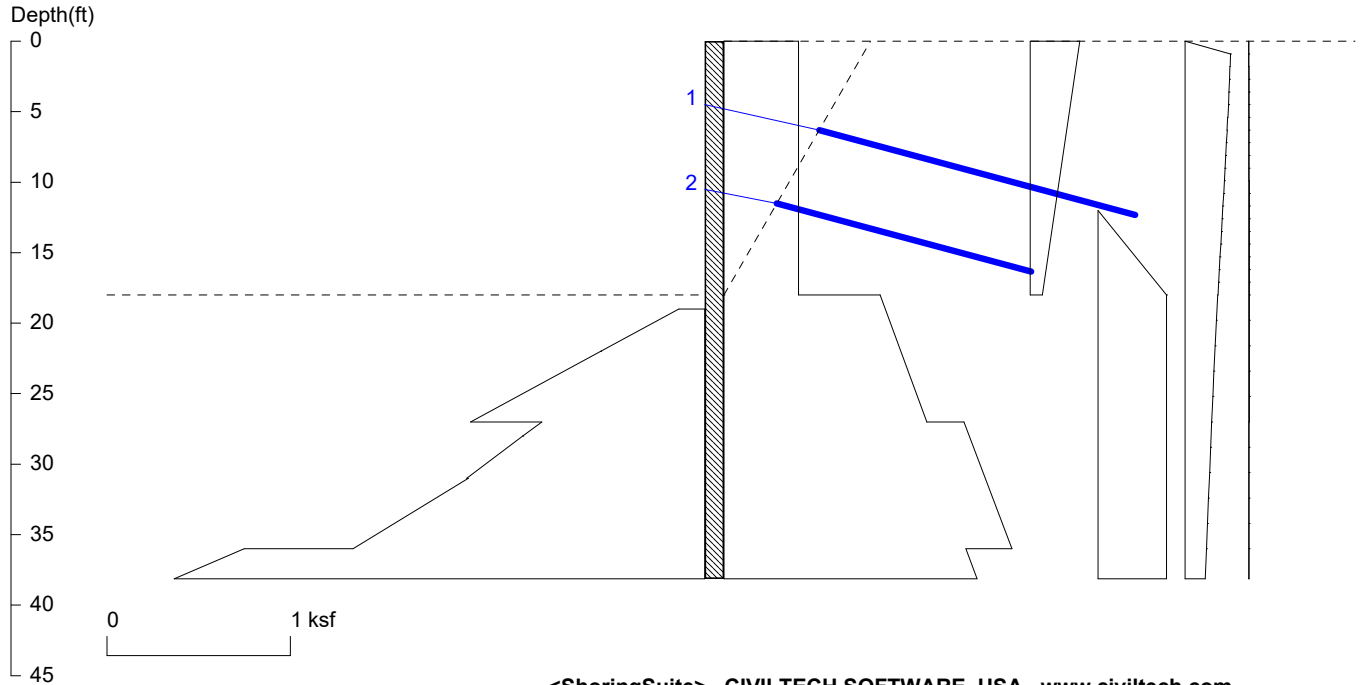
Rigid Wall Condition -- No movement or deflection of the wall are allowed.

Max. Pressure = 0.003 at depth = 16.20

X	Line Load
27.5	.20

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 18' Seismic



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Date: 4/2/2025

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Wall Height=18.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=20.13 Min. Pile Length=38.13

MOMENT IN PILE: Max. Moment=98.55 per Pile Spacing=5.0 at Depth=17.52

PILE SELECTION:

Request Min. Section Modulus = 43.0 in³/pile=704.71 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.02(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.5	15.0	5.0	46.9*	45.3	12.1	7.0	23.2
2. Tieback	10.5	15.0	5.0	37.7	36.5	9.8	3.9	18.7

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.407	18.000	0.407	0.000000
*	Below	Base		
18.000	0.851	27.000	1.107	0.028403
27.000	1.309	36.000	1.570	0.028929
36.000	1.319	39.000	1.404	0.028516
*	Earth	Queck		
0.000	0.270	18.000	0.068	-0.011263
*	Water	Pres.		
12.000	0.000	18.000	0.374	0.062400
18.000	0.374	144.000	0.374	0.000000

*	Sur-	charge		
0.000	0.000	0.900	0.248	0.275150
0.900	0.248	1.800	0.245	-0.002724
1.800	0.245	2.700	0.243	-0.002901
2.700	0.243	3.600	0.240	-0.003133
3.600	0.240	4.500	0.237	-0.003392
4.500	0.237	5.400	0.233	-0.003650
5.400	0.233	6.300	0.230	-0.003884
6.300	0.230	7.200	0.226	-0.004081
7.200	0.226	8.100	0.222	-0.004234
8.100	0.222	9.000	0.219	-0.004343
9.000	0.219	9.900	0.215	-0.004412
9.900	0.215	10.800	0.211	-0.004446
10.800	0.211	11.700	0.207	-0.004452
11.700	0.207	12.600	0.203	-0.004436
12.600	0.203	13.500	0.199	-0.004403
13.500	0.199	14.400	0.195	-0.004358
14.400	0.195	15.300	0.191	-0.004305
15.300	0.191	16.200	0.187	-0.004247
16.200	0.187	17.100	0.183	-0.004184
17.100	0.183	18.000	0.179	-0.004120
18.000	0.179	19.800	0.172	-0.004021
19.800	0.172	21.600	0.165	-0.003889
21.600	0.165	23.400	0.158	-0.003759
23.400	0.158	25.200	0.152	-0.003630
25.200	0.152	27.000	0.146	-0.003505
27.000	0.146	28.800	0.140	-0.003381
28.800	0.140	30.600	0.134	-0.003260
30.600	0.134	32.400	0.128	-0.003141
32.400	0.128	34.200	0.123	-0.003024
34.200	0.123	36.000	0.117	-0.002909
36.000	0.117	39.600	0.107	-0.002741
*	Sur-	charge		
0.000	0.000	0.900	0.000	0.000336
0.900	0.000	1.800	0.001	0.000332
1.800	0.001	2.700	0.001	0.000323
2.700	0.001	3.600	0.001	0.000311
3.600	0.001	4.500	0.001	0.000295
4.500	0.001	5.400	0.002	0.000276
5.400	0.002	6.300	0.002	0.000255
6.300	0.002	7.200	0.002	0.000231
7.200	0.002	8.100	0.002	0.000207
8.100	0.002	9.000	0.002	0.000181
9.000	0.002	9.900	0.003	0.000156
9.900	0.003	10.800	0.003	0.000130
10.800	0.003	11.700	0.003	0.000105
11.700	0.003	12.600	0.003	0.000082
12.600	0.003	13.500	0.003	0.000059
13.500	0.003	14.400	0.003	0.000039
14.400	0.003	15.300	0.003	0.000020
15.300	0.003	16.200	0.003	0.000002
16.200	0.003	17.100	0.003	-0.000013
17.100	0.003	18.000	0.003	-0.000027
18.000	0.003	19.800	0.003	-0.000044
19.800	0.003	21.600	0.003	-0.000061
21.600	0.003	23.400	0.003	-0.000073
23.400	0.003	25.200	0.003	-0.000080
25.200	0.003	27.000	0.002	-0.000083
27.000	0.002	28.800	0.002	-0.000084

28.800	0.002	30.600	0.002	-0.000083
30.600	0.002	32.400	0.002	-0.000080
32.400	0.002	34.200	0.002	-0.000076
34.200	0.002	36.000	0.002	-0.000072
36.000	0.002	39.600	0.001	-0.000065

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
19.000	0.142	22.000	0.568	0.141957
22.000	0.568	27.000	1.278	0.141957
27.000	0.889	28.000	0.994	0.105117
28.000	0.993	31.000	1.299	0.101735
31.000	1.290	36.000	1.918	0.125609
36.000	2.512	39.000	3.049	0.179152

ACTIVE SPACING:

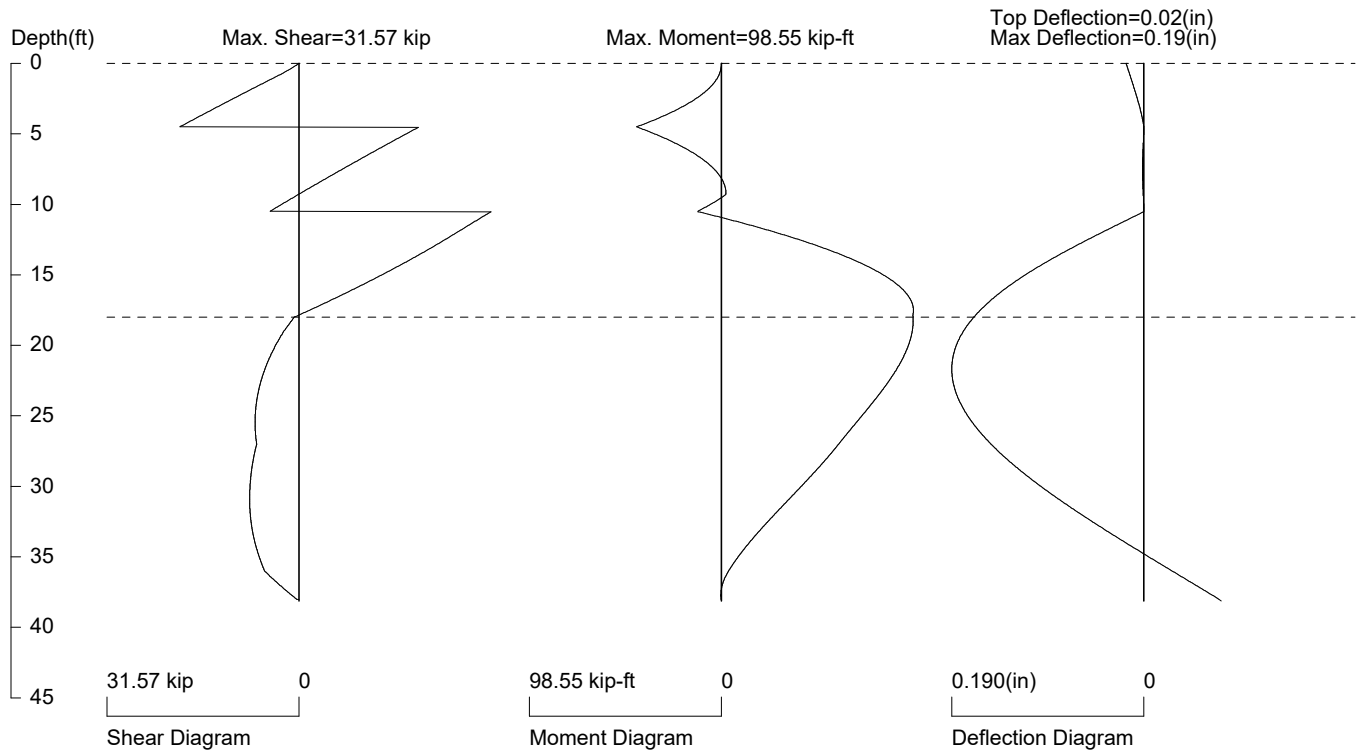
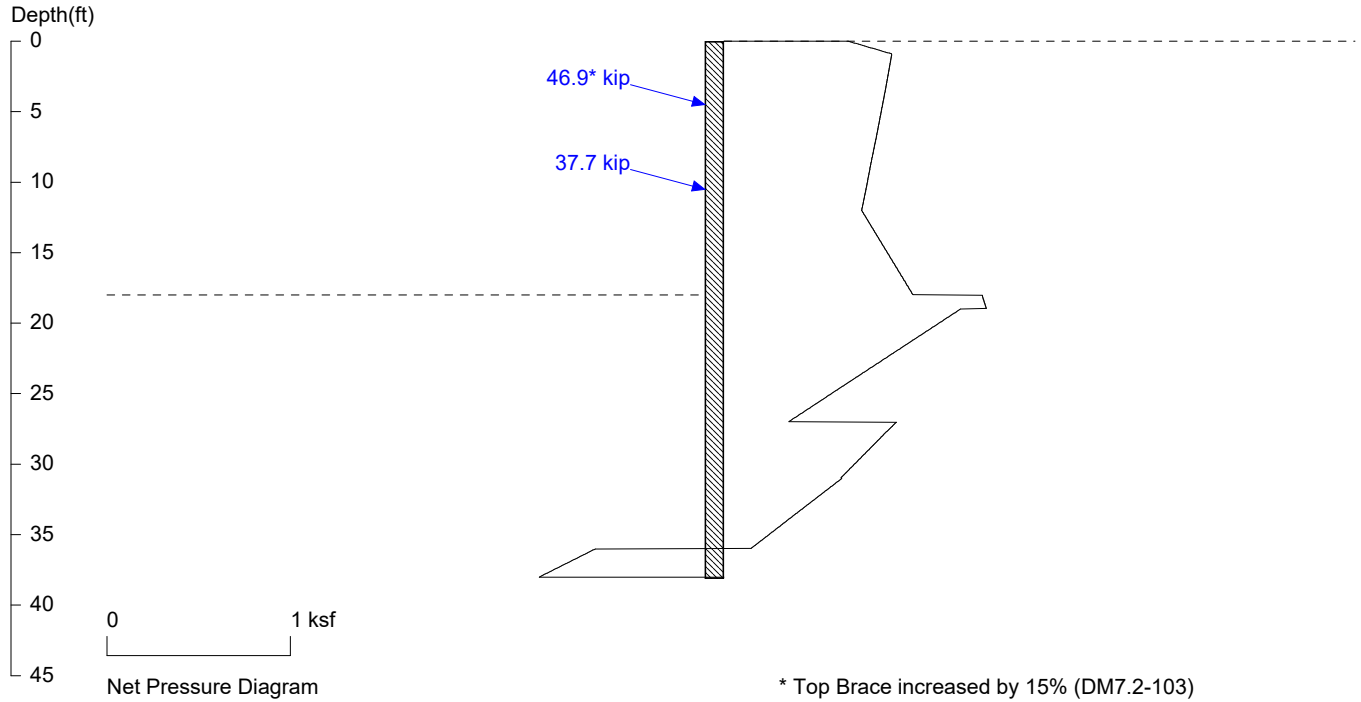
No.	Z depth	Spacing
1	0.00	5.00
2	18.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	18.00	3.60

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 18' Seismic



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\18' Seismic-sh8

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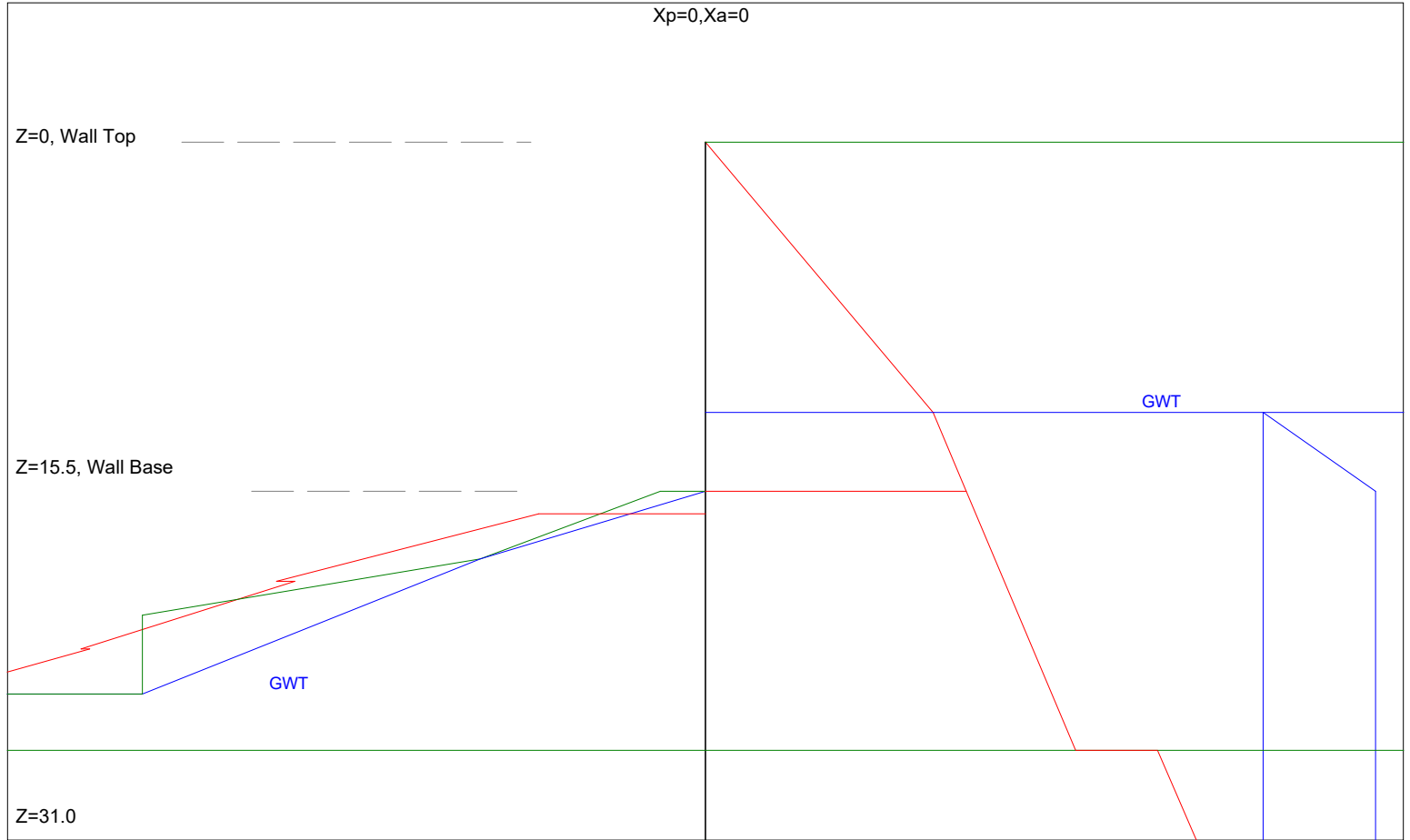
Calculation Sheet #122

146th South 15.5' Temporary

Xp=62.0

Xa=62.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\15.5' Temporary.ep8

* INPUT DATA *

Wall Height=15.5 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	27.0	0.0	27.0	800.0	3	CL
3	36.0	0.0	36.0	800.0	1	SM
4	39.0	0.0	39.0	800.0	3	CL
5	44.0	0.0	44.0	800.0	1	SM
6	49.0	0.0	49.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	12.0	0.0
2	12.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	15.5	0.0	15.5	4.0	1	SM

2	15.5	4.0	18.5	20.0	1	SM
3	18.5	20.0	21.0	50.0	1	SM
4	21.0	50.0	24.5	50.0	1	SM
5	24.5	50.0	24.5	800.0	1	SM
6	27.0	0.0	27.0	800.0	3	CL
7	36.0	0.0	36.0	800.0	1	SM
8	39.0	0.0	39.0	800.0	3	CL
9	44.0	0.0	44.0	800.0	1	SM
10	49.0	0.0	49.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	15.5	0.0
2	18.5	20.0
3	24.5	50.0
4	24.5	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 4.31 per one linear foot (or meter) width along wall height

Total Static Force above Base= 4.31

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	12.00	0.44	0.0368	0.2947
12.00	0.44	15.50	0.51	0.0185	0.2947

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
15.50	0.51	27.00	0.72	0.0185	0.2947
27.00	0.88	31.00	0.95	0.0189	0.3600

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
16.50	0.32	19.50	0.83	0.170	2.7117
19.50	0.80	22.50	1.21	0.138	2.2117
22.50	1.20	27.00	1.90	0.156	2.4946
27.00	1.47	28.50	1.66	0.126	2.3940
28.50	1.66	31.00	2.06	0.159	3.0196

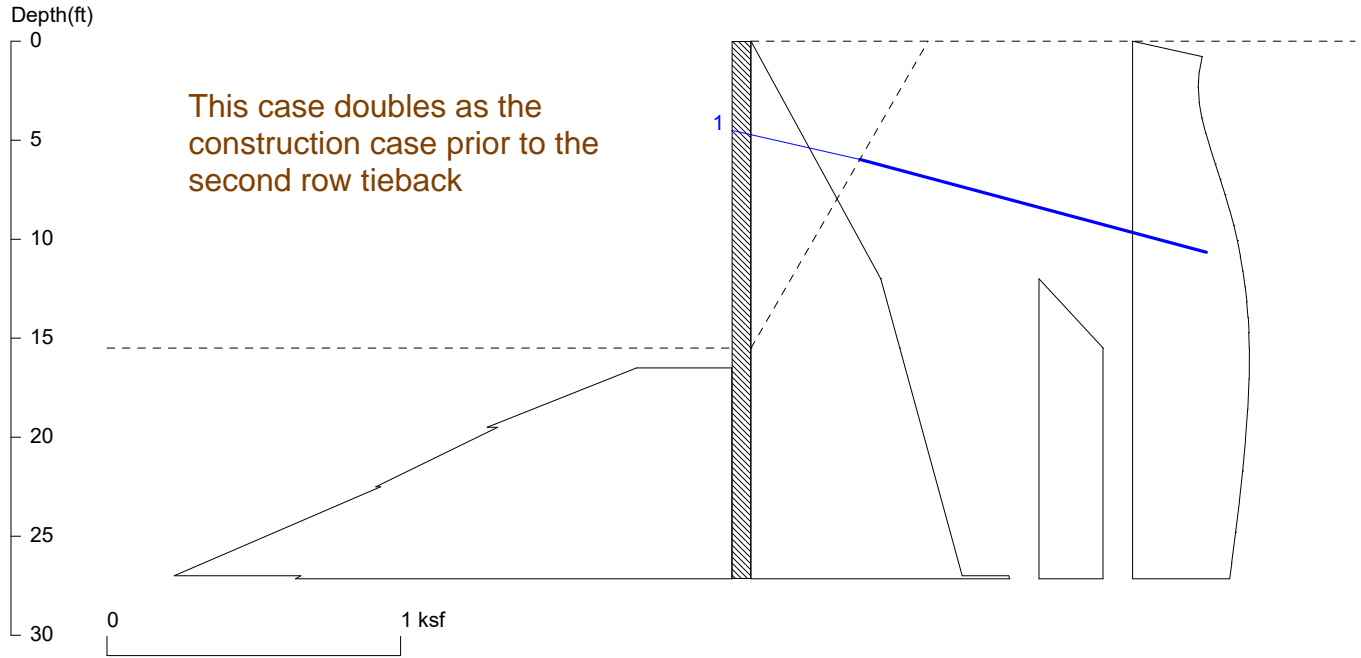
Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	12.00	0.00	15.50	0.22	0.06
1	15.50	0.22	31.00	0.22	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\15.5' Temporary.ep8

146th South 15.5' Temporary



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Date: 9/10/2024

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Wall Height=15.5 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=11.65 Min. Pile Length=27.15

MOMENT IN PILE: Max. Moment=128.02 per Pile Spacing=5.0 at Depth=13.20

PILE SELECTION:

Request Min. Section Modulus = 55.9 in³/pile=915.43 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.17(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.5	15.0	5.0	36.6	35.4	9.5	5.7	18.1

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	12.00	0.442	0.036841
12.00	0.442	15.50	0.507	0.018450
*	Below	Base		
15.50	0.507	27.00	0.719	0.018450
27.00	0.878	36.00	1.048	0.018935
*	Water	Pres.		
12.00	0.000	15.50	0.218	0.062400
15.50	0.218	139.5	0.218	0.000000
*	Sur-	charg		
0.000	0.000	0.775	0.237	0.305327
0.775	0.237	1.550	0.227	-0.01224
1.550	0.227	2.325	0.224	-0.00417

2.325	0.224	3.100	0.227	0.004424
3.100	0.227	3.875	0.236	0.011733
3.875	0.236	4.650	0.250	0.016995
4.650	0.250	5.425	0.265	0.020200
5.425	0.265	6.200	0.282	0.021686
6.200	0.282	6.975	0.299	0.021864
6.975	0.299	7.750	0.315	0.021109
7.750	0.315	8.525	0.331	0.019718
8.525	0.331	9.300	0.345	0.017920
9.300	0.345	10.07	0.357	0.015881
10.07	0.357	10.85	0.367	0.013725
10.85	0.367	11.62	0.376	0.011539
11.62	0.376	12.40	0.384	0.009389
12.40	0.384	13.17	0.389	0.007317
13.17	0.389	13.95	0.394	0.005355
13.95	0.394	14.72	0.396	0.003521
14.72	0.396	15.50	0.398	0.001830
15.50	0.398	17.05	0.397	-0.00041
17.05	0.397	18.60	0.392	-0.00292
18.60	0.392	20.15	0.385	-0.00488
20.15	0.385	21.70	0.375	-0.00636
21.70	0.375	23.25	0.364	-0.00742
23.25	0.364	24.80	0.351	-0.00814
24.80	0.351	26.35	0.338	-0.00858
26.35	0.338	27.90	0.324	-0.00880

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
16.50	0.324	19.50	0.833	0.169750
19.50	0.797	22.50	1.213	0.138453
22.50	1.196	27.00	1.899	0.156164
27.00	1.467	28.50	1.656	0.125926

ACTIVE SPACING:

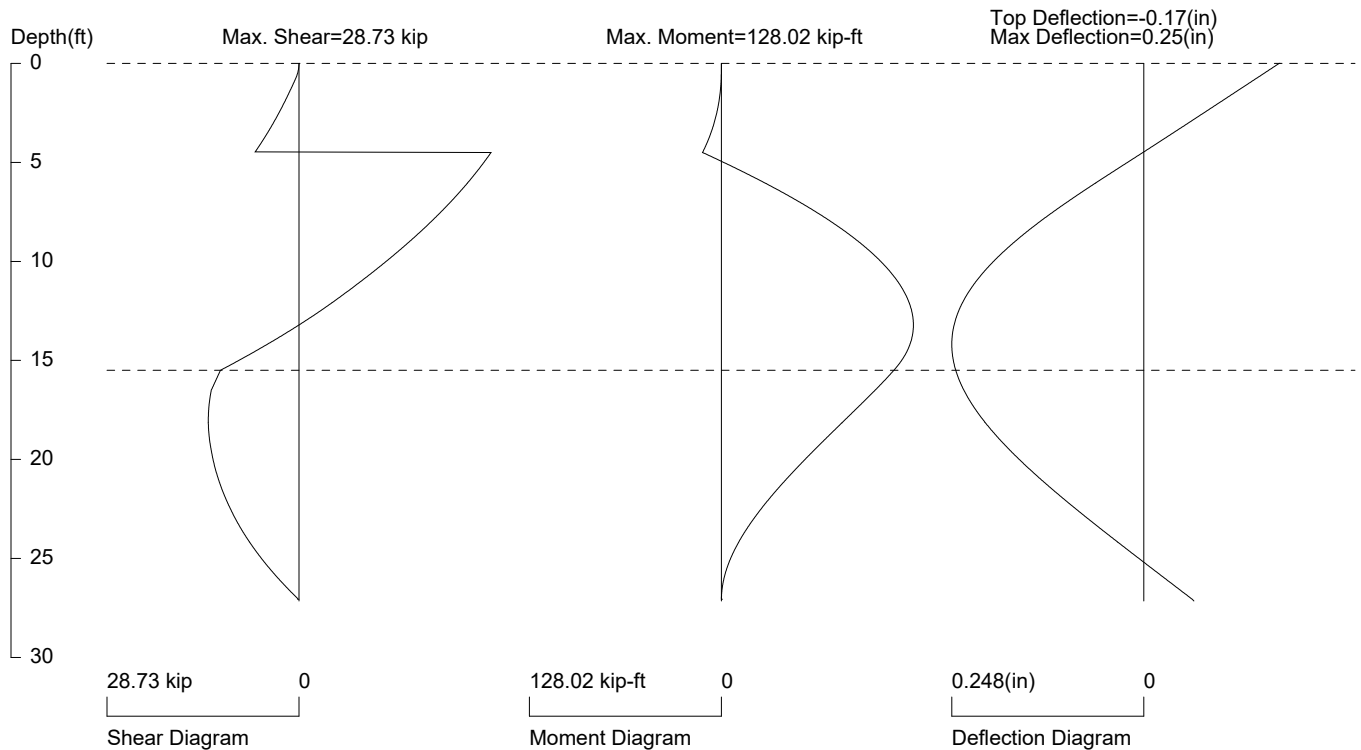
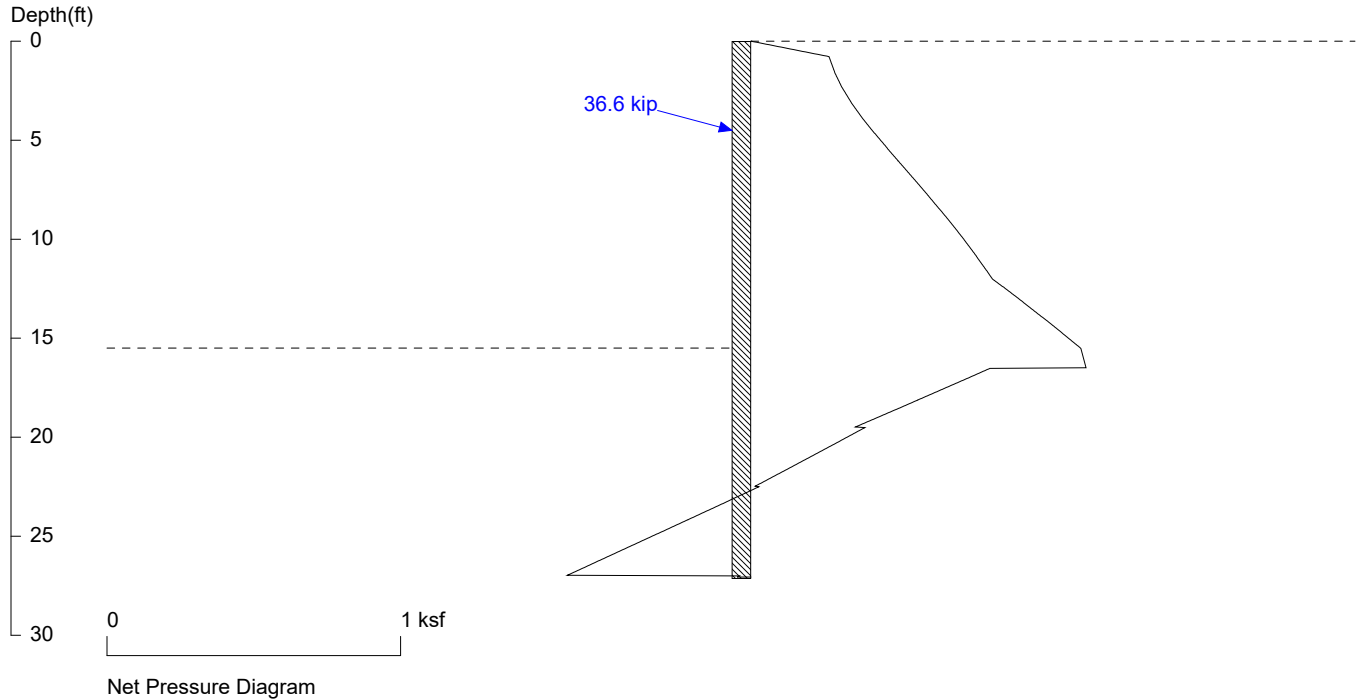
No.	Z depth	Spacing
1	0.00	5.00
2	15.50	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	15.50	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 15.5' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

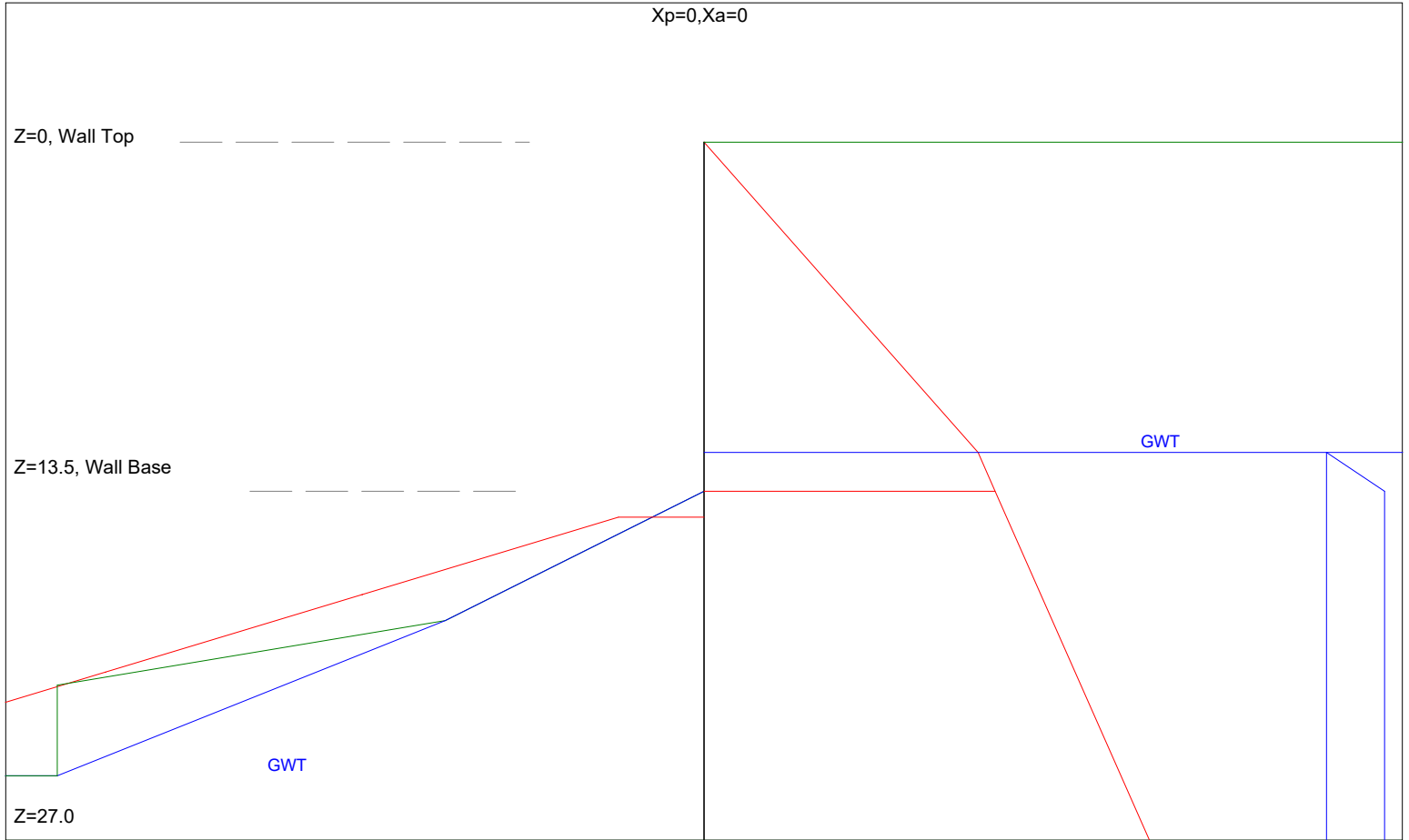
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146th South 13.5' Permanent

Xp=54.0

Xa=54.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/6/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\13.5' Permanent.ep8

* INPUT DATA *

Wall Height=13.5 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	27.0	0.0	27.0	800.0	3	CL
3	36.0	0.0	36.0	800.0	1	SM
4	39.0	0.0	39.0	800.0	3	CL
5	44.0	0.0	44.0	800.0	1	SM
6	49.0	0.0	49.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	12.0	0.0
2	12.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	13.5	0.0	18.5	20.0	1	SM

2	18.5	20.0	21.0	50.0	1	SM
3	21.0	50.0	24.5	50.0	1	SM
4	24.5	50.0	24.5	800.0	1	SM
5	27.0	0.0	27.0	800.0	3	CL
6	36.0	0.0	36.0	800.0	1	SM
7	39.0	0.0	39.0	800.0	3	CL
8	44.0	0.0	44.0	800.0	1	SM
9	49.0	0.0	49.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	13.5	0.0
2	18.5	20.0
3	24.5	50.0
4	24.5	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 3.34 per one linear foot (or meter) width along wall height

Total Static Force above Base= 3.34

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	12.00	0.44	0.0368	0.2947
12.00	0.44	13.50	0.47	0.0185	0.2947

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
13.50	0.47	27.00	0.72	0.0185	0.2947

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
14.50	0.14	17.50	0.55	0.138	2.2061
17.50	0.55	20.50	0.97	0.138	2.2061
20.50	0.97	23.50	1.38	0.138	2.2061
23.50	1.36	26.50	1.89	0.177	2.8276
26.50	1.92	27.00	1.97	0.104	1.6660

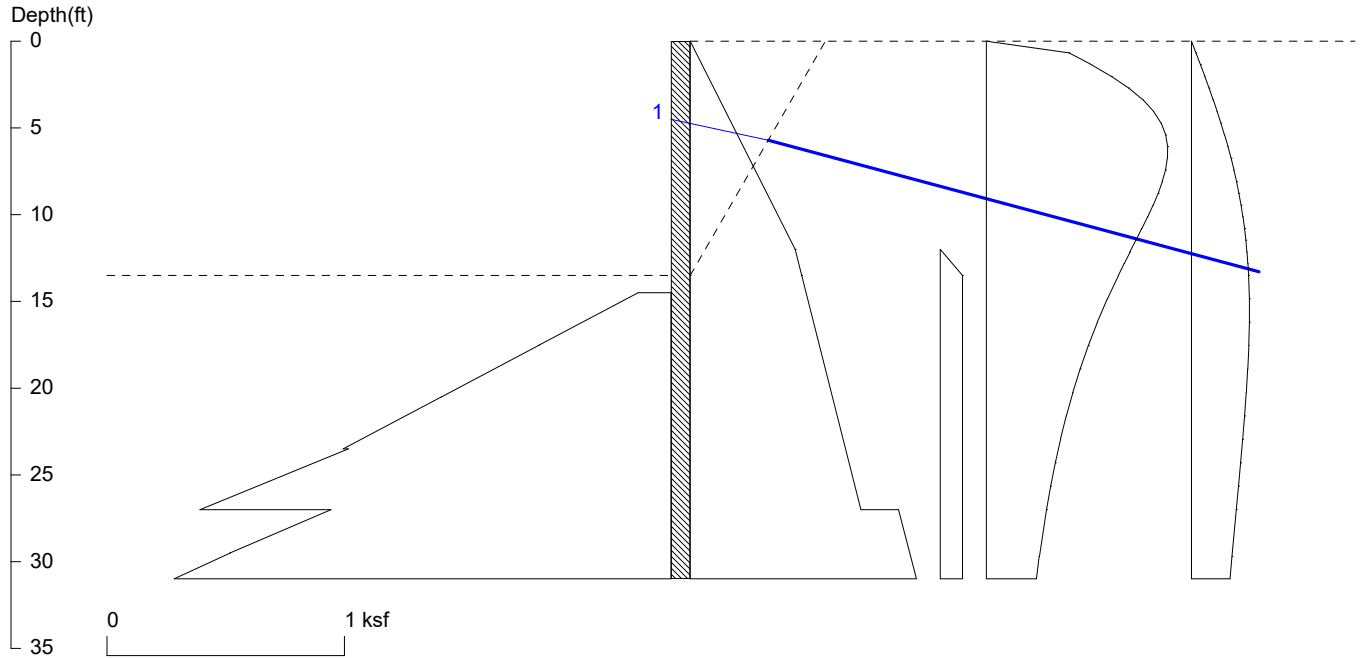
Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	12.00	0.00	13.50	0.09	0.06
1	13.50	0.09	27.00	0.09	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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146th South 13.5' Permanent



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Wall Height=13.5 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=17.49 Min. Pile Length=30.99

MOMENT IN PILE: Max. Moment=165.93 per Pile Spacing=5.0 at Depth=12.34

PILE SELECTION:

Request Min. Section Modulus = 72.4 in³/pile=1186.49 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.26(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.5	15.0	5.0	64.3	62.1	16.6	4.7	31.8

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	12.00	0.442	0.036841
12.00	0.442	13.50	0.470	0.018450
*	Below	Base		
13.50	0.470	27.00	0.719	0.018450
27.00	0.878	36.00	1.048	0.018935
*	Water	Pres.		
12.00	0.000	13.50	0.094	0.062400
13.50	0.094	121.5	0.094	0.000000
*	Sur-	charg		
0.000	0.000	0.675	0.349	0.516366
0.675	0.349	1.350	0.442	0.138968
1.350	0.442	2.025	0.527	0.125834

2.025	0.527	2.700	0.600	0.108201
2.700	0.600	3.375	0.660	0.087976
3.375	0.660	4.050	0.705	0.067000
4.050	0.705	4.725	0.737	0.046774
4.725	0.737	5.400	0.756	0.028348
5.400	0.756	6.075	0.764	0.012323
6.075	0.764	6.750	0.763	-0.00107
6.750	0.763	7.425	0.755	-0.01187
7.425	0.755	8.100	0.742	-0.02027
8.100	0.742	8.775	0.724	-0.02656
8.775	0.724	9.450	0.703	-0.03107
9.450	0.703	10.12	0.680	-0.03410
10.12	0.680	10.80	0.655	-0.03594
10.80	0.655	11.47	0.630	-0.03683
11.47	0.630	12.15	0.606	-0.03700
12.15	0.606	12.82	0.581	-0.03662
12.82	0.581	13.50	0.557	-0.03584
13.50	0.557	14.85	0.510	-0.03414
14.85	0.510	16.20	0.468	-0.03138
16.20	0.468	17.55	0.430	-0.02842
17.55	0.430	18.90	0.395	-0.02552
18.90	0.395	20.25	0.365	-0.02280
20.25	0.365	21.60	0.337	-0.02033
21.60	0.337	22.95	0.313	-0.01813
22.95	0.313	24.30	0.291	-0.01619
24.30	0.291	25.65	0.271	-0.01449
25.65	0.271	27.00	0.254	-0.01300
27.00	0.254	29.70	0.223	-0.01115
29.70	0.223	32.40	0.199	-0.00917
*	Sur-	charg		
0.000	0.000	0.675	0.019	0.027983
0.675	0.019	1.350	0.038	0.027769
1.350	0.038	2.025	0.056	0.027344
2.025	0.056	2.700	0.074	0.026717
2.700	0.074	3.375	0.092	0.025900
3.375	0.092	4.050	0.108	0.024909
4.050	0.108	4.725	0.124	0.023761
4.725	0.124	5.400	0.140	0.022478
5.400	0.140	6.075	0.154	0.021080
6.075	0.154	6.750	0.167	0.019591
6.750	0.167	7.425	0.179	0.018033
7.425	0.179	8.100	0.190	0.016429
8.100	0.190	8.775	0.200	0.014800
8.775	0.200	9.450	0.209	0.013167
9.450	0.209	10.12	0.217	0.011547
10.12	0.217	10.80	0.224	0.009959
10.80	0.224	11.47	0.229	0.008414
11.47	0.229	12.15	0.234	0.006927
12.15	0.234	12.82	0.238	0.005507
12.82	0.238	13.50	0.241	0.004161
13.50	0.241	14.85	0.244	0.002306
14.85	0.244	16.20	0.244	0.000120
16.20	0.244	17.55	0.242	-0.00171
17.55	0.242	18.90	0.237	-0.00321
18.90	0.237	20.25	0.231	-0.00439
20.25	0.231	21.60	0.224	-0.00530
21.60	0.224	22.95	0.216	-0.00595
22.95	0.216	24.30	0.207	-0.00640
24.30	0.207	25.65	0.198	-0.00667

25.65	0.198	27.00	0.189	-0.00679
27.00	0.189	29.70	0.171	-0.00676
29.70	0.171	32.40	0.153	-0.00648

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
14.50	0.138	17.50	0.552	0.138100
17.50	0.552	20.50	0.967	0.138100
20.50	0.967	23.50	1.381	0.138100
23.50	1.359	27.00	1.984	0.178584
27.00	1.432	29.50	1.859	0.170500
29.50	1.857	32.50	2.332	0.158485

ACTIVE SPACING:

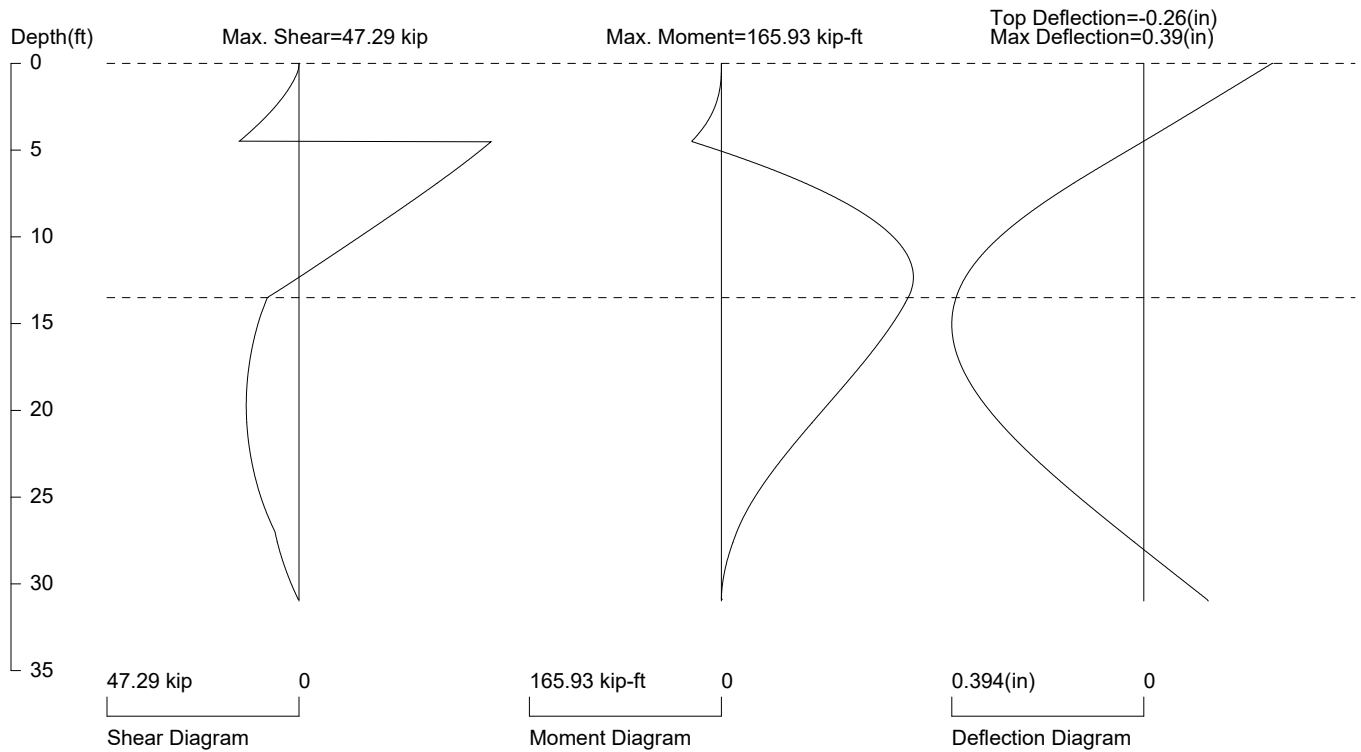
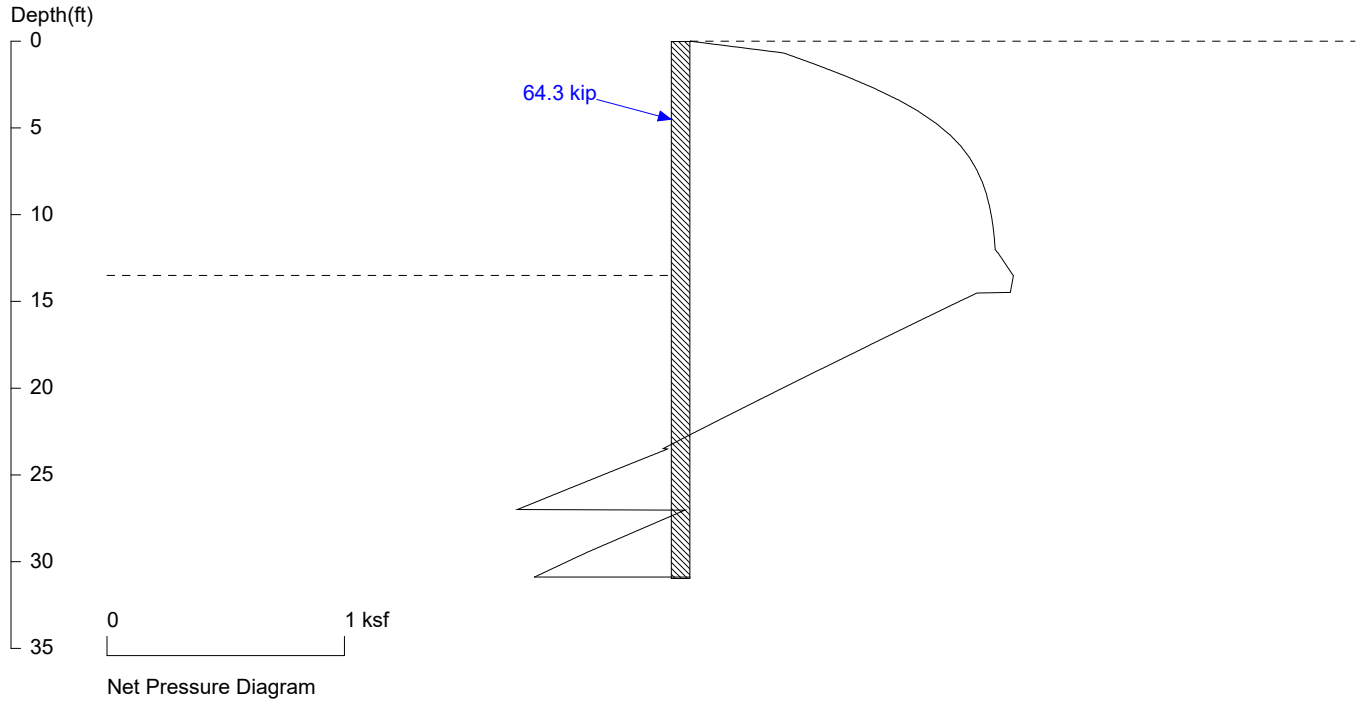
No.	Z depth	Spacing
1	0.00	5.00
2	13.50	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	13.50	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 13.5' Permanent



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

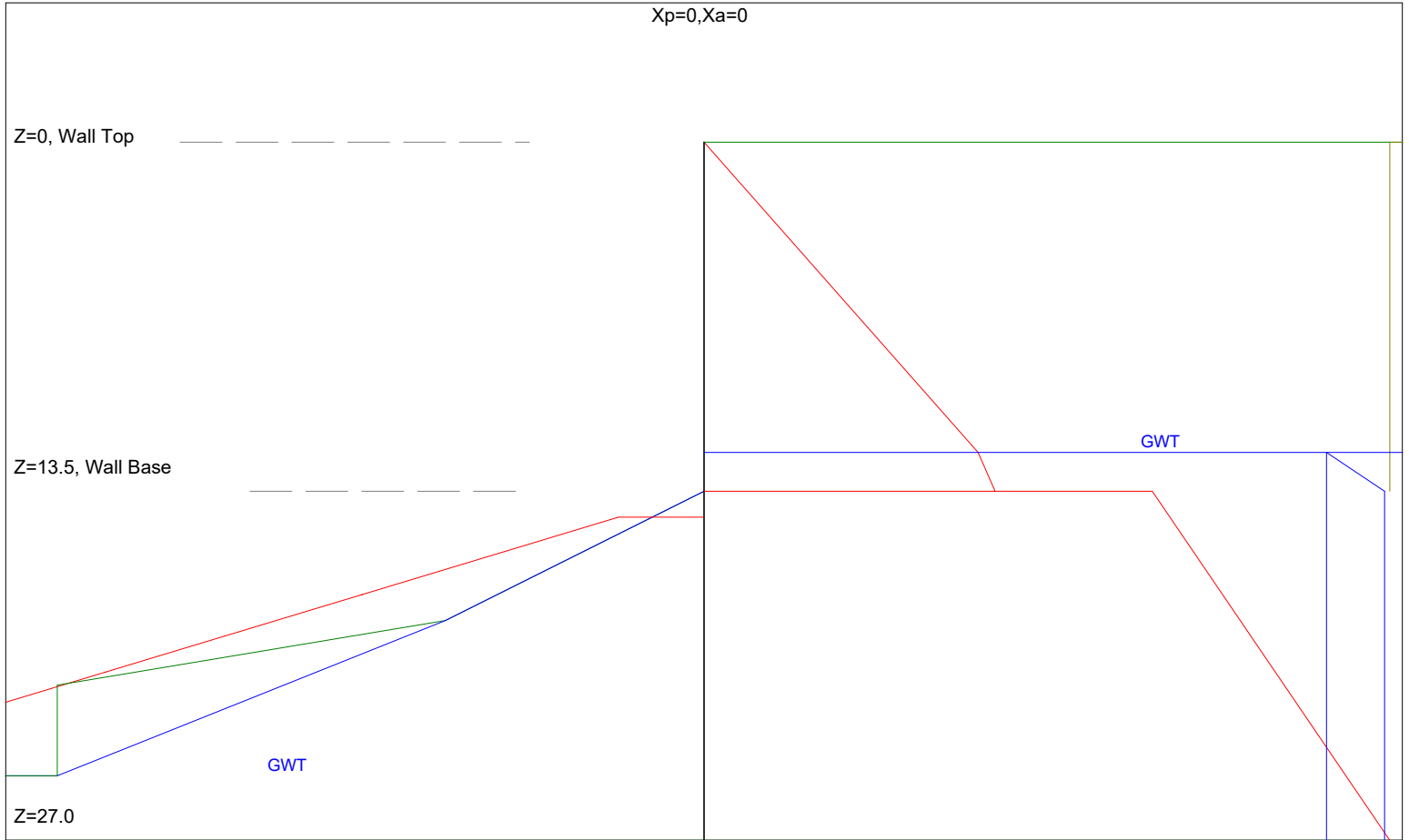
File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\13.5' Permanent.sh8

146th South 13.5' Seismic

Xp=54.0

Xa=54.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/6/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\13.5' Seismic.ep8

* INPUT DATA *

Wall Height=13.5 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	27.0	0.0	27.0	800.0	3	CL
3	36.0	0.0	36.0	800.0	1	SM
4	39.0	0.0	39.0	800.0	3	CL
5	44.0	0.0	44.0	800.0	1	SM
6	49.0	0.0	49.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	12.0	0.0
2	12.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	13.5	0.0	18.5	20.0	1	SM

2	18.5	20.0	21.0	50.0	1	SM
3	21.0	50.0	24.5	50.0	1	SM
4	24.5	50.0	24.5	800.0	1	SM
5	27.0	0.0	27.0	800.0	3	CL
6	36.0	0.0	36.0	800.0	1	SM
7	39.0	0.0	39.0	800.0	3	CL
8	44.0	0.0	44.0	800.0	1	SM
9	49.0	0.0	49.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	13.5	0.0
2	18.5	20.0
3	24.5	50.0
4	24.5	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 5.14 per one linear foot (or meter) width along wall height

Total Static Force above Base= 3.34

Total Earthquake Force above Base= 1.80. Distributed in trapezoid. Total earthquake force acting at 0.4H below wall top.

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	12.00	0.44	0.0368	0.2947
12.00	0.44	13.50	0.47	0.0185	0.2947

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
13.50	0.72	27.00	1.11	0.0284	0.4537

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
14.50	0.14	17.50	0.55	0.138	2.2061
17.50	0.55	20.50	0.97	0.138	2.2061
20.50	0.97	23.50	1.38	0.138	2.2061
23.50	1.36	26.50	1.89	0.177	2.8276
26.50	1.92	27.00	1.97	0.104	1.6660

Output Earthquake Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Total Earthq. Force, Ee = 1.80

No	Zq1	Pq1	Zq2	Pq2	Slope
0	0.00	0.213	13.50	0.053	-0.012

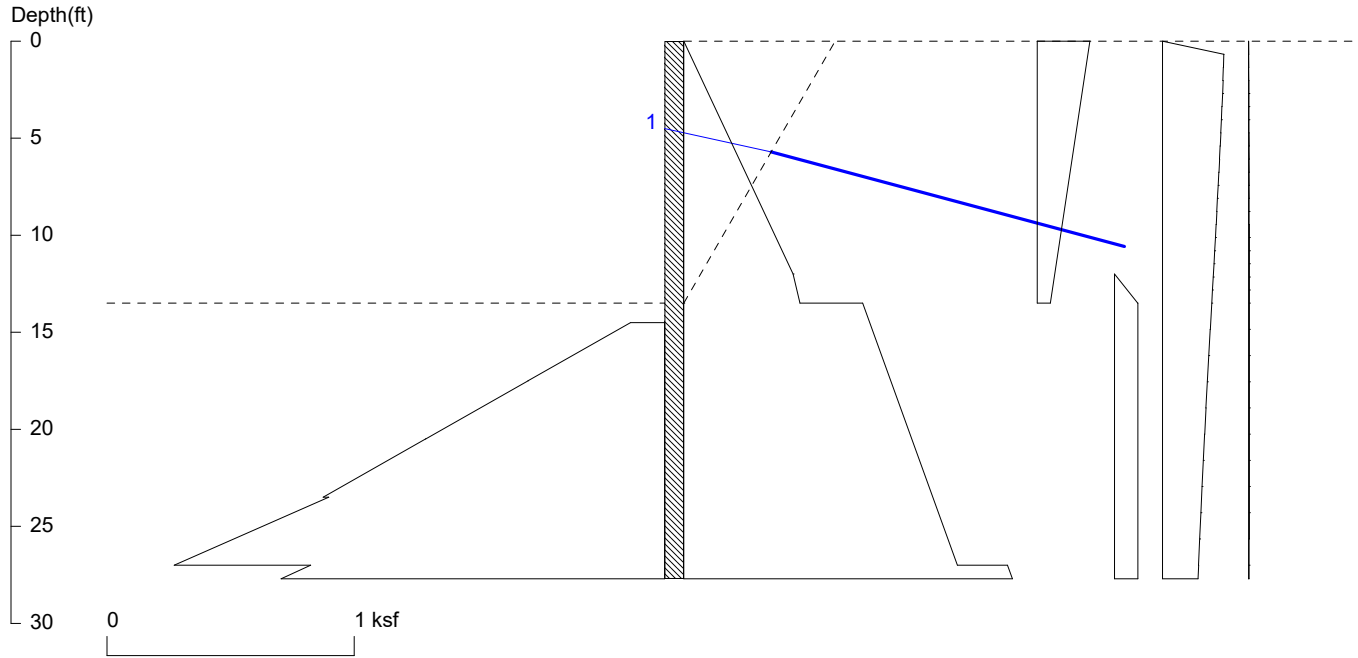
Water Pressure - Output to Shoring - Multiplier of Pressure = 1

No	Z1	Pw1	Z2	Pw2	kw1
0	12.00	0.00	13.50	0.09	0.06
1	13.50	0.09	27.00	0.09	0.00

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/6/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\13.5' Seismic.ep8

146th South 13.5' Seismic



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Date: 12/30/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\13.5' Seismic.sh8

Wall Height=13.5 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=14.20 Min. Pile Length=27.70

MOMENT IN PILE: Max. Moment=82.56 per Pile Spacing=5.0 at Depth=12.42

PILE SELECTION:

Request Min. Section Modulus = 36.0 in³/pile=590.33 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.11(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.5	15.0	5.0	38.1	36.8	9.9	4.7	18.8

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	12.00	0.442	0.036841
12.00	0.442	13.50	0.470	0.018450
*	Below	Base		
13.50	0.723	27.00	1.107	0.028403
27.00	1.309	36.00	1.570	0.028929
*	Earth	Queck		
0.000	0.213	13.50	0.053	-0.01185
*	Water	Pres.		
12.00	0.000	13.50	0.094	0.062400
13.50	0.094	121.5	0.094	0.000000
*	Sur-	charg		
0.000	0.000	0.675	0.248	0.367749

0.675	0.248	1.350	0.246	-0.00267
1.350	0.246	2.025	0.245	-0.00278
2.025	0.245	2.700	0.243	-0.00292
2.700	0.243	3.375	0.240	-0.00310
3.375	0.240	4.050	0.238	-0.00329
4.050	0.238	4.725	0.236	-0.00349
4.725	0.236	5.400	0.233	-0.00368
5.400	0.233	6.075	0.231	-0.00385
6.075	0.231	6.750	0.228	-0.00401
6.750	0.228	7.425	0.225	-0.00414
7.425	0.225	8.100	0.222	-0.00425
8.100	0.222	8.775	0.220	-0.00433
8.775	0.220	9.450	0.217	-0.00439
9.450	0.217	10.12	0.214	-0.00442
10.12	0.214	10.80	0.211	-0.00444
10.80	0.211	11.47	0.208	-0.00445
11.47	0.208	12.15	0.205	-0.00444
12.15	0.205	12.82	0.202	-0.00442
12.82	0.202	13.50	0.199	-0.00439
13.50	0.199	14.85	0.193	-0.00434
14.85	0.193	16.20	0.187	-0.00426
16.20	0.187	17.55	0.181	-0.00416
17.55	0.181	18.90	0.176	-0.00407
18.90	0.176	20.25	0.170	-0.00397
20.25	0.170	21.60	0.165	-0.00387
21.60	0.165	22.95	0.160	-0.00377
22.95	0.160	24.30	0.155	-0.00367
24.30	0.155	25.65	0.150	-0.00358
25.65	0.150	27.00	0.146	-0.00348
27.00	0.146	29.70	0.137	-0.00335
*	Sur-	charg		
0.000	0.000	0.675	0.000	0.000336
0.675	0.000	1.350	0.000	0.000334
1.350	0.000	2.025	0.001	0.000329
2.025	0.001	2.700	0.001	0.000322
2.700	0.001	3.375	0.001	0.000313
3.375	0.001	4.050	0.001	0.000302
4.050	0.001	4.725	0.002	0.000288
4.725	0.002	5.400	0.002	0.000274
5.400	0.002	6.075	0.002	0.000258
6.075	0.002	6.750	0.002	0.000240
6.750	0.002	7.425	0.002	0.000222
7.425	0.002	8.100	0.002	0.000204
8.100	0.002	8.775	0.002	0.000184
8.775	0.002	9.450	0.003	0.000165
9.450	0.003	10.12	0.003	0.000146
10.12	0.003	10.80	0.003	0.000127
10.80	0.003	11.47	0.003	0.000108
11.47	0.003	12.15	0.003	0.000090
12.15	0.003	12.82	0.003	0.000073
12.82	0.003	13.50	0.003	0.000057
13.50	0.003	14.85	0.003	0.000034
14.85	0.003	16.20	0.003	0.000007
16.20	0.003	17.55	0.003	-0.000001
17.55	0.003	18.90	0.003	-0.000003
18.90	0.003	20.25	0.003	-0.000005
20.25	0.003	21.60	0.003	-0.000006
21.60	0.003	22.95	0.003	-0.000007
22.95	0.003	24.30	0.003	-0.000007

24.30	0.003	25.65	0.002	-0.00008
25.65	0.002	27.00	0.002	-0.00008
27.00	0.002	29.70	0.002	-0.00008

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
14.50	0.138	17.50	0.552	0.138100
17.50	0.552	20.50	0.967	0.138100
20.50	0.967	23.50	1.381	0.138100
23.50	1.359	27.00	1.984	0.178584
27.00	1.432	29.50	1.859	0.170500

ACTIVE SPACING:

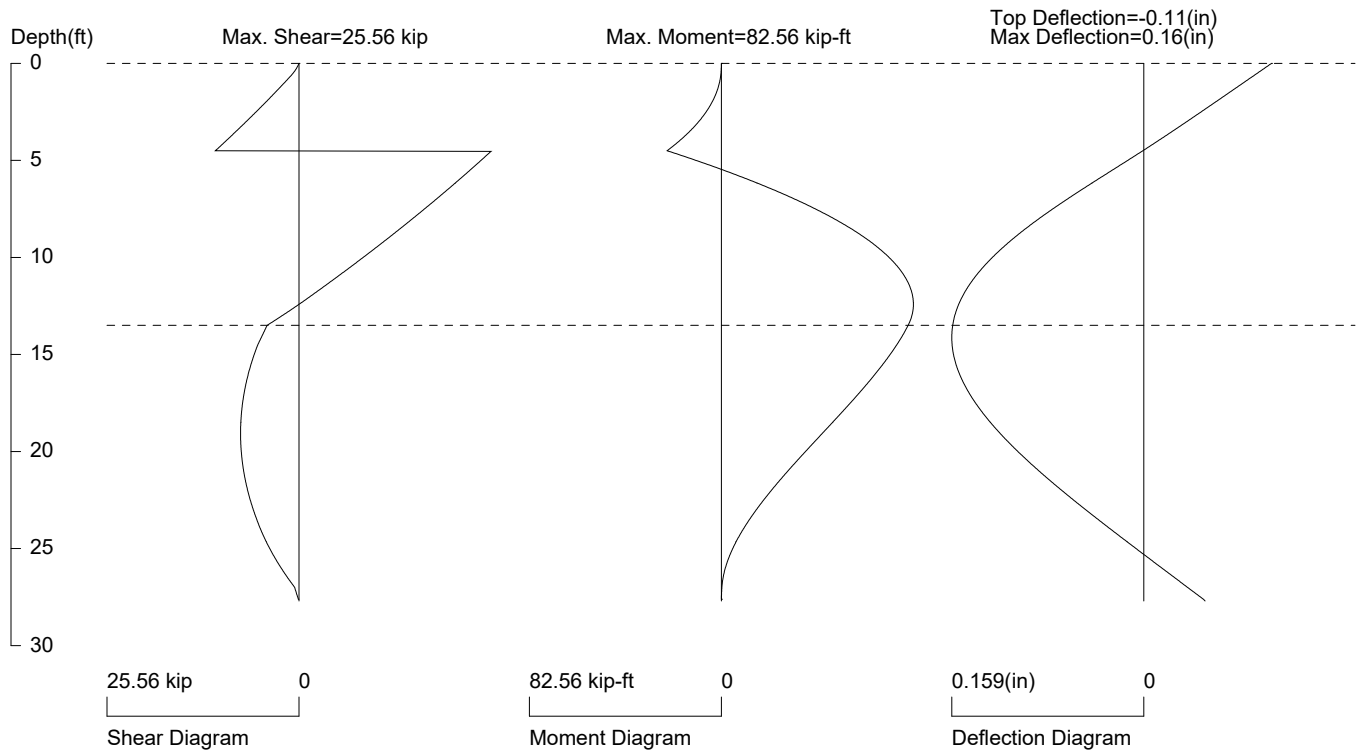
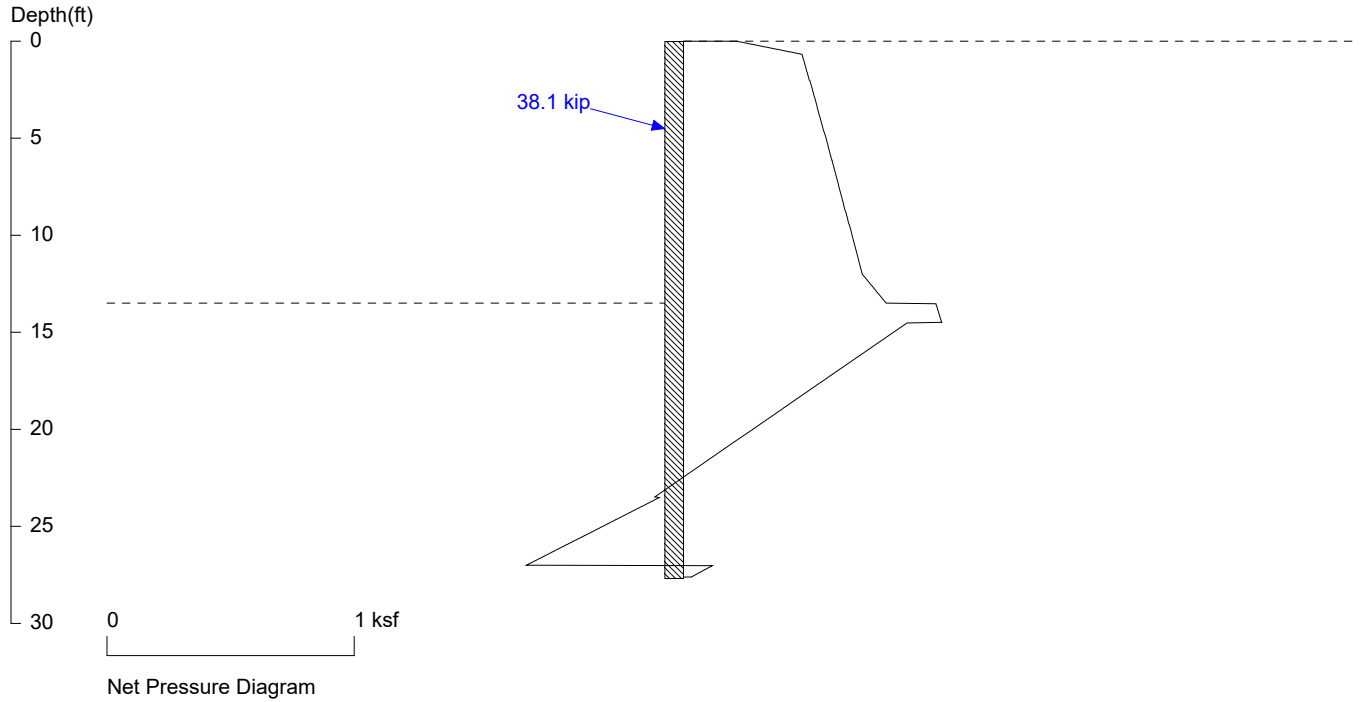
No.	Z depth	Spacing
1	0.00	5.00
2	13.50	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	13.50	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 13.5' Seismic



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

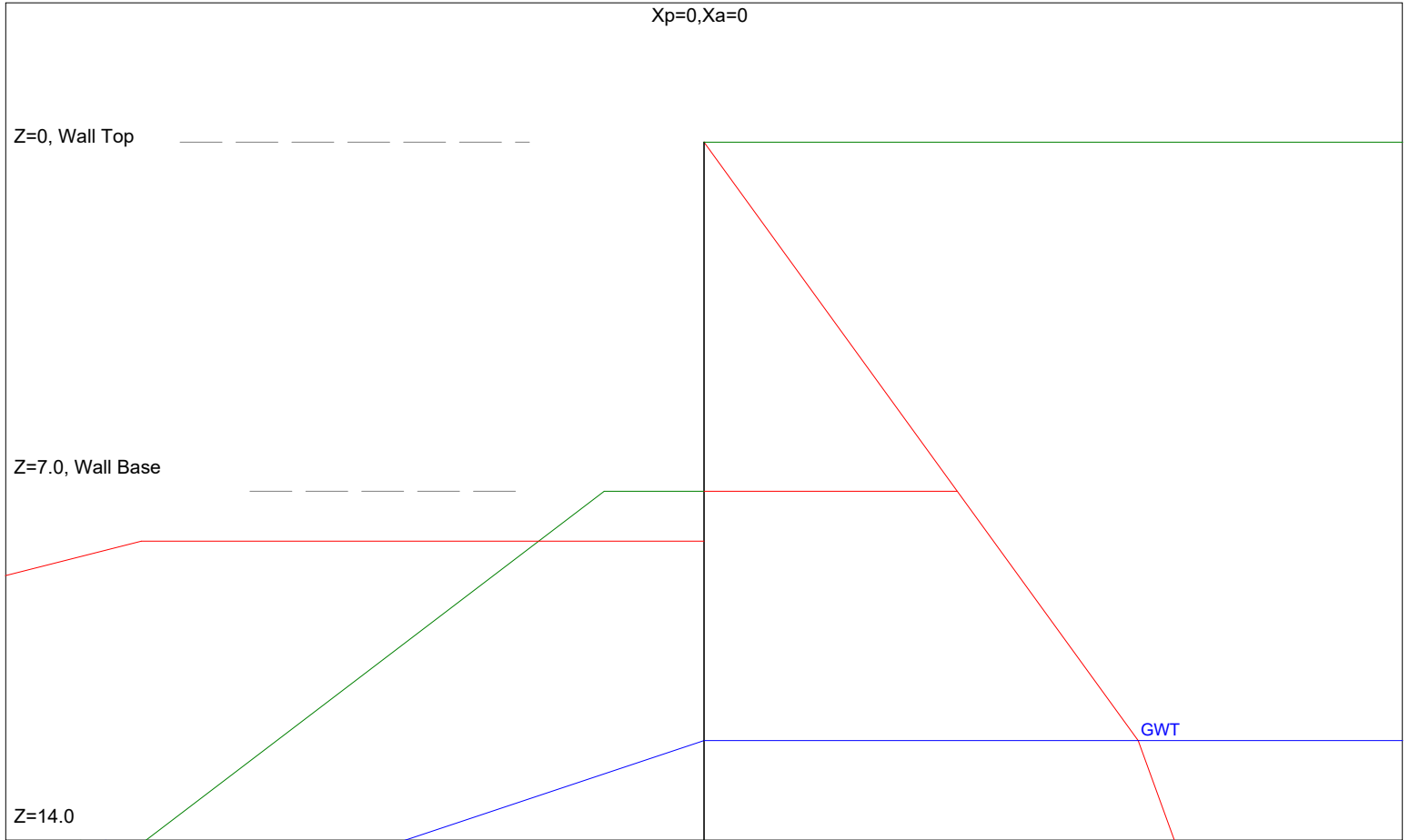
File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\13.5' Seismic.sh8

146th South 7' Temporary

Xp=28.0

Xa=28.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\7' Temporary.ep8

* INPUT DATA *

Wall Height=7.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	27.0	0.0	27.0	800.0	3	CL
3	36.0	0.0	36.0	800.0	1	SM
4	39.0	0.0	39.0	800.0	3	CL
5	44.0	0.0	44.0	800.0	1	SM
6	49.0	0.0	49.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	12.0	0.0
2	12.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	7.0	0.0	7.0	4.0	1	SM

2	7.0	4.0	15.0	25.0	1	SM
3	15.0	25.0	16.0	55.0	1	SM
4	16.0	55.0	30.0	90.0	1	SM
5	30.0	90.0	30.0	800.0	1	SM
6	27.0	0.0	27.0	800.0	3	CL
7	36.0	0.0	36.0	800.0	1	SM
8	39.0	0.0	39.0	800.0	3	CL
9	44.0	0.0	44.0	800.0	1	SM
10	49.0	0.0	49.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	12.0	0.0
2	16.0	24.0
3	17.0	54.0
4	31.0	89.0
5	31.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 0.90 per one linear foot (or meter) width along wall height

Total Static Force above Base= 0.90

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	7.00	0.26	0.0368	0.2947

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
7.00	0.26	12.00	0.44	0.0368	0.2947
12.00	0.44	14.00	0.48	0.0185	0.2947

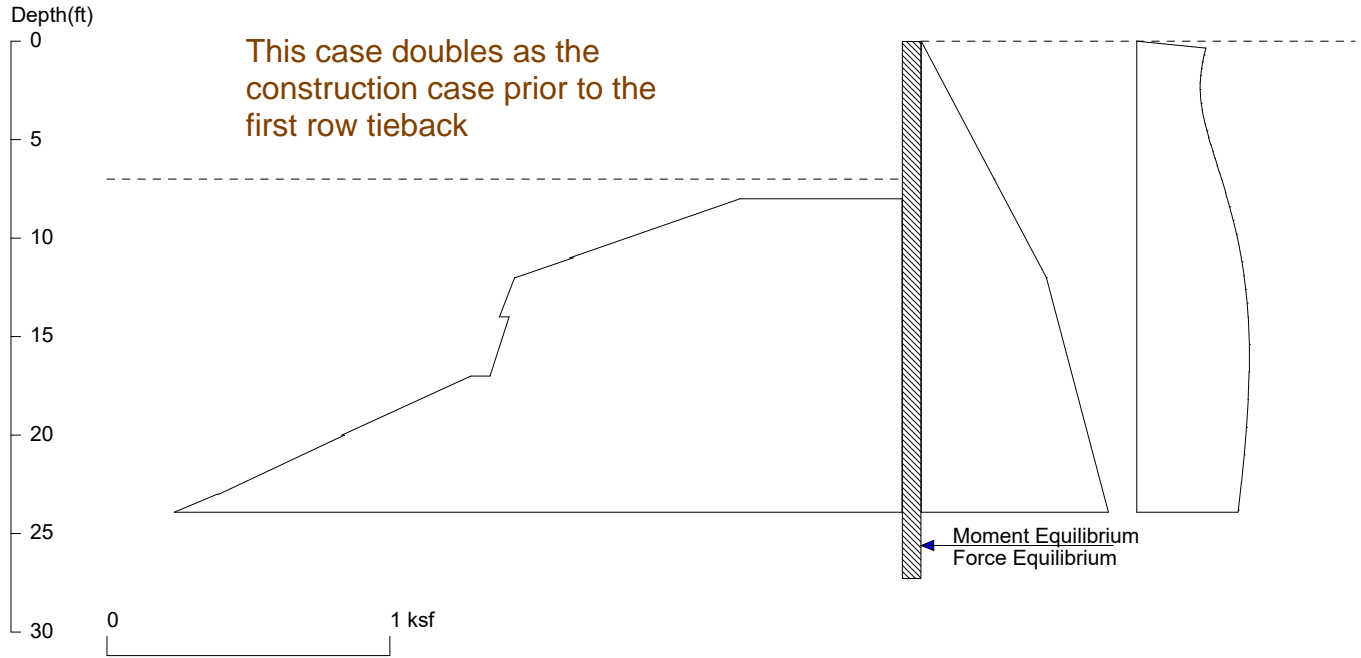
Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
8.00	0.57	11.00	1.17	0.200	1.6025
11.00	1.16	12.00	1.36	0.202	1.6170
12.00	1.37	14.00	1.42	0.027	0.4288

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\7' Temporary.ep8

146th South 7' Temporary



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Wall Height=7.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=20.30 Min. Pile Length=27.30

MOMENT IN PILE: Max. Moment=109.47 per Pile Spacing=5.0 at Depth=15.35

PILE SELECTION:

Request Min. Section Modulus = 47.8 in³/pile=782.78 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.24(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	7.000	0.258	0.036841
*	Below	Base		
7.000	0.258	12.000	0.442	0.036841
12.000	0.442	27.000	0.719	0.018450
27.000	0.878	36.000	1.048	0.018935
*	Sur-	charge		
0.000	0.000	0.350	0.244	0.696308
0.350	0.244	0.700	0.238	-0.016860
0.700	0.238	1.050	0.233	-0.014728
1.050	0.233	1.400	0.229	-0.011768
1.400	0.229	1.750	0.226	-0.008217
1.750	0.226	2.100	0.224	-0.004331
2.100	0.224	2.450	0.224	-0.000346
2.450	0.224	2.800	0.225	0.003536
2.800	0.225	3.150	0.228	0.007161
3.150	0.228	3.500	0.231	0.010428
3.500	0.231	3.850	0.236	0.013275

3.850	0.236	4.200	0.242	0.015682
4.200	0.242	4.550	0.248	0.017649
4.550	0.248	4.900	0.254	0.019200
4.900	0.254	5.250	0.262	0.020365
5.250	0.262	5.600	0.269	0.021182
5.600	0.269	5.950	0.277	0.021691
5.950	0.277	6.300	0.284	0.021930
6.300	0.284	6.650	0.292	0.021937
6.650	0.292	7.000	0.300	0.021744
7.000	0.300	7.700	0.314	0.021131
7.700	0.314	8.400	0.328	0.019903
8.400	0.328	9.100	0.341	0.018323
9.100	0.341	9.800	0.353	0.016524
9.800	0.353	10.500	0.363	0.014602
10.500	0.363	11.200	0.372	0.012631
11.200	0.372	11.900	0.379	0.010664
11.900	0.379	12.600	0.385	0.008743
12.600	0.385	13.300	0.390	0.006894
13.300	0.390	14.000	0.394	0.005140
14.000	0.394	15.400	0.398	0.002726
15.400	0.398	16.800	0.397	-0.000100
16.800	0.397	18.200	0.394	-0.002449
18.200	0.394	19.600	0.388	-0.004343
19.600	0.388	21.000	0.380	-0.005825
21.000	0.380	22.400	0.370	-0.006945
22.400	0.370	23.800	0.359	-0.007755
23.800	0.359	25.200	0.348	-0.008307
25.200	0.348	26.600	0.335	-0.008647
26.600	0.335	28.000	0.000	-0.239593

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
8.000	0.573	11.000	1.174	0.200310
11.000	1.163	12.000	1.365	0.202128
12.000	1.369	14.000	1.423	0.026843
14.000	1.389	17.000	1.457	0.022482
17.000	1.524	20.000	1.980	0.151999
20.000	1.971	23.000	2.415	0.147788
23.000	2.420	27.000	3.089	0.167217
27.000	2.008	29.000	2.317	0.154584

ACTIVE SPACING:

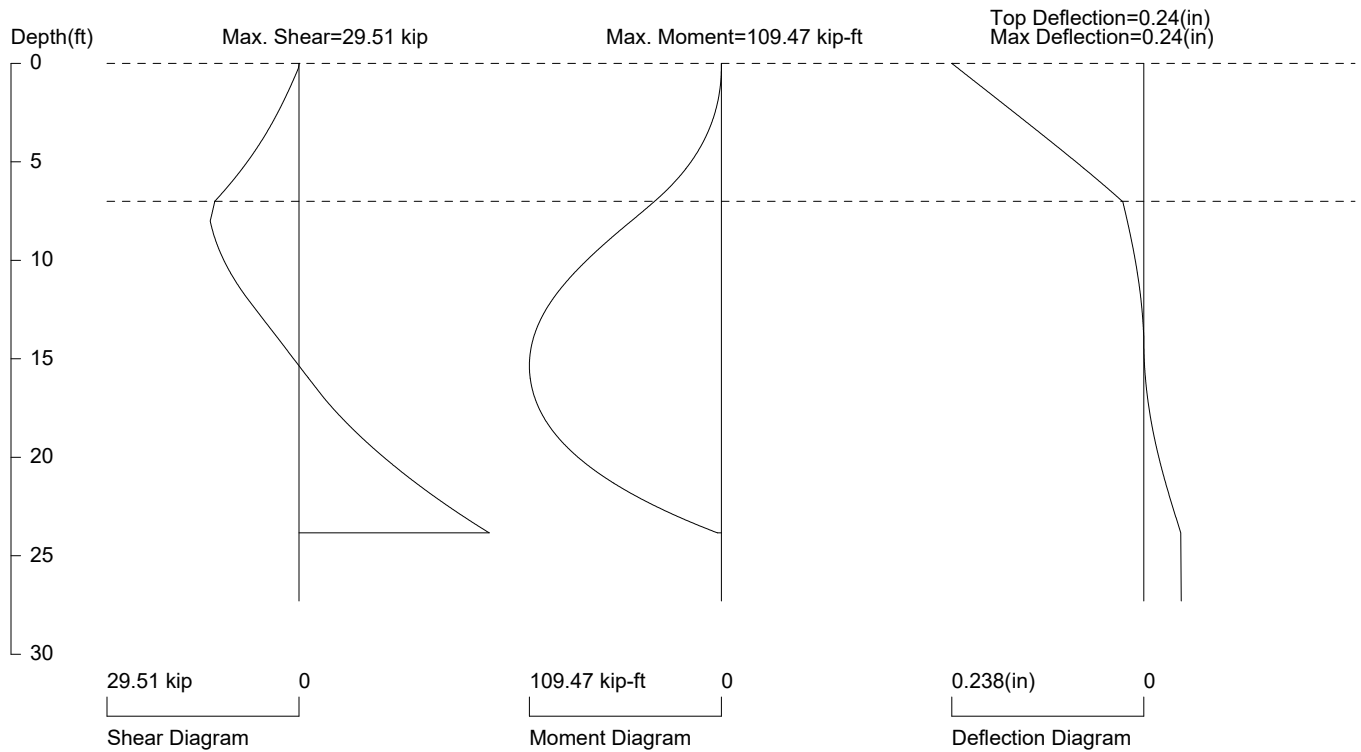
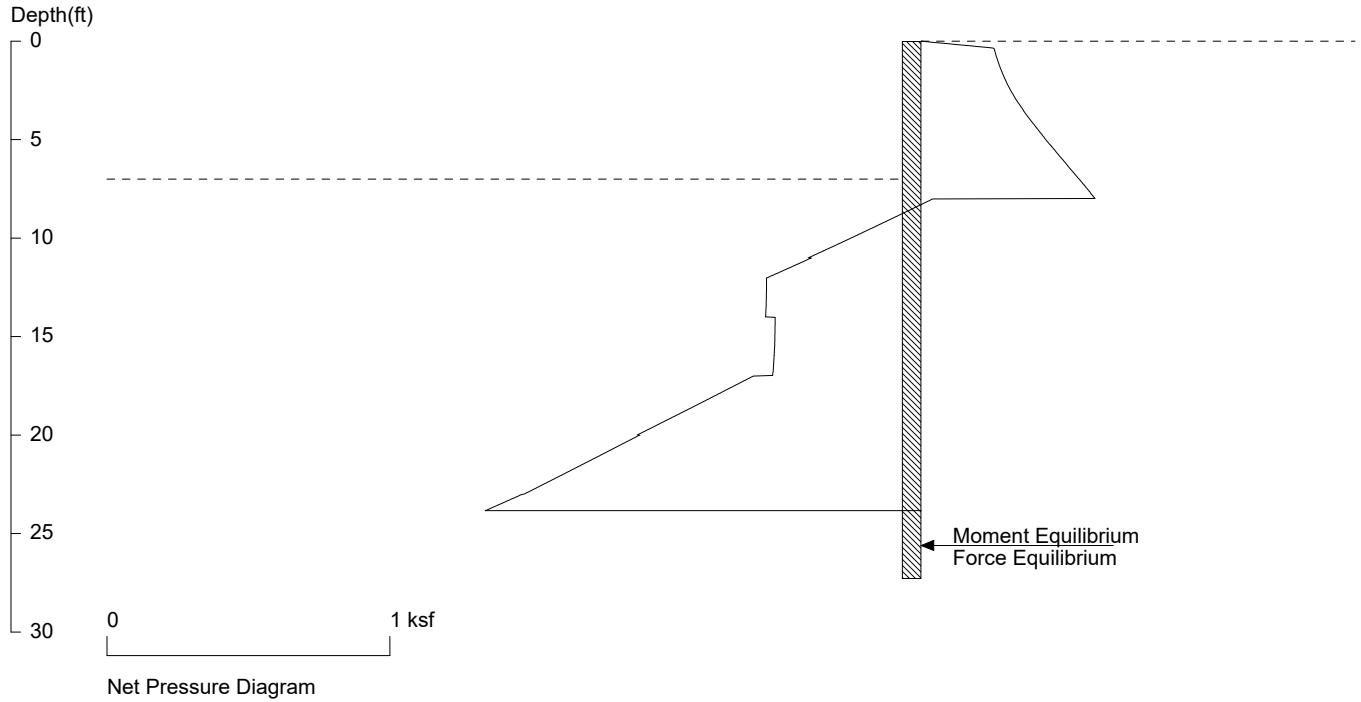
No.	Z depth	Spacing
1	0.00	5.00
2	7.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	7.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 7' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

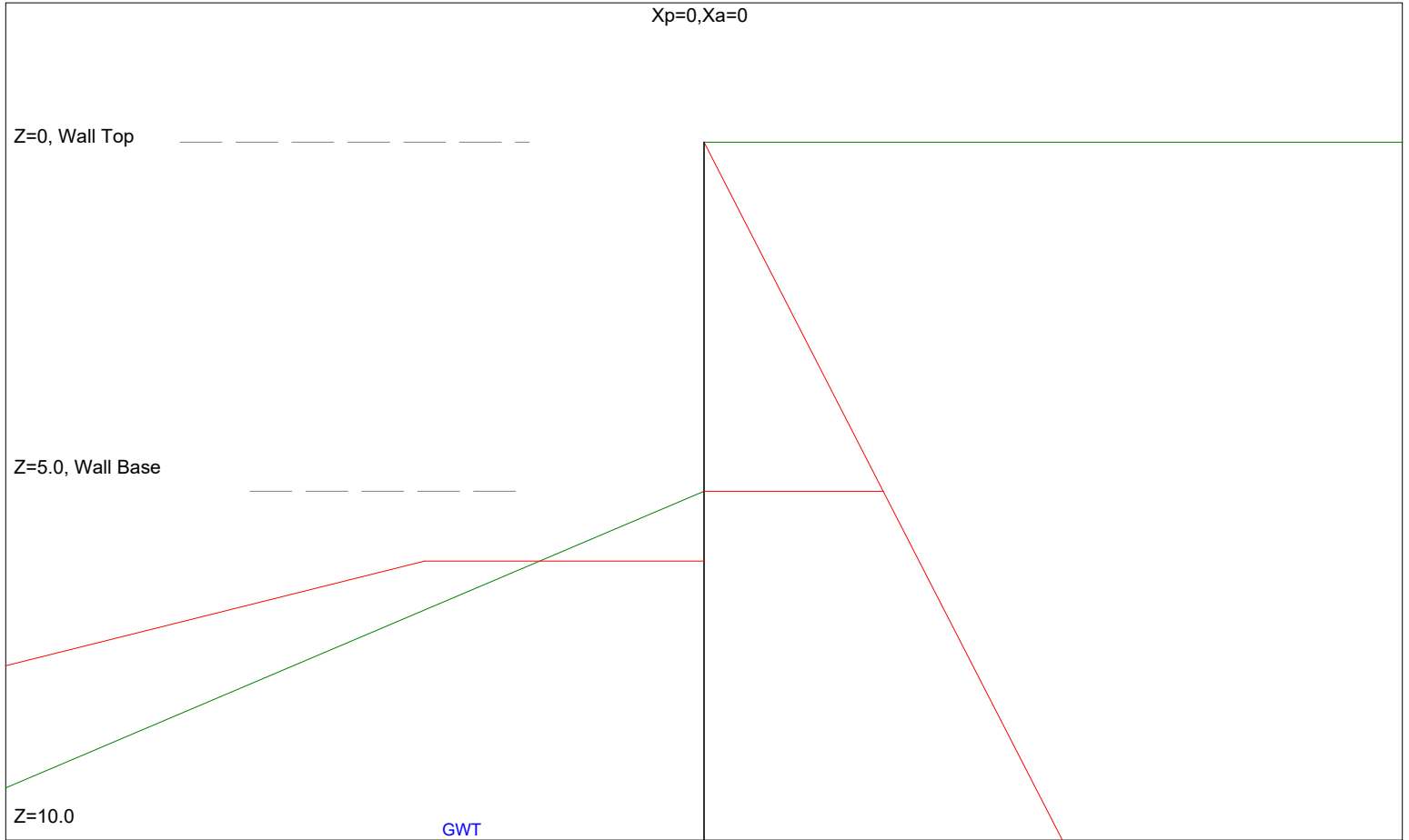
File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\7' Temporary.sh8

146th South 5' Permanent

Xp=20.0

Xa=20.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\5' Permanent.ep8

* INPUT DATA *

Wall Height=5.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	27.0	0.0	27.0	800.0	3	CL
3	36.0	0.0	36.0	800.0	1	SM
4	39.0	0.0	39.0	800.0	3	CL
5	44.0	0.0	44.0	800.0	1	SM
6	49.0	0.0	49.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	12.0	0.0
2	12.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	5.0	0.0	22.0	80.0	1	SM

2	22.0	80.0	22.0	800.0	1	SM
3	27.0	0.0	27.0	800.0	3	CL
4	36.0	0.0	36.0	800.0	1	SM
5	39.0	0.0	39.0	800.0	3	CL
6	44.0	0.0	44.0	800.0	1	SM
7	49.0	0.0	49.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	12.0	0.0
2	22.0	79.0
3	22.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 0.46 per one linear foot (or meter) width along wall height

Total Static Force above Base= 0.46

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	5.00	0.18	0.0368	0.2947

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
5.00	0.18	10.00	0.37	0.0368	0.2947

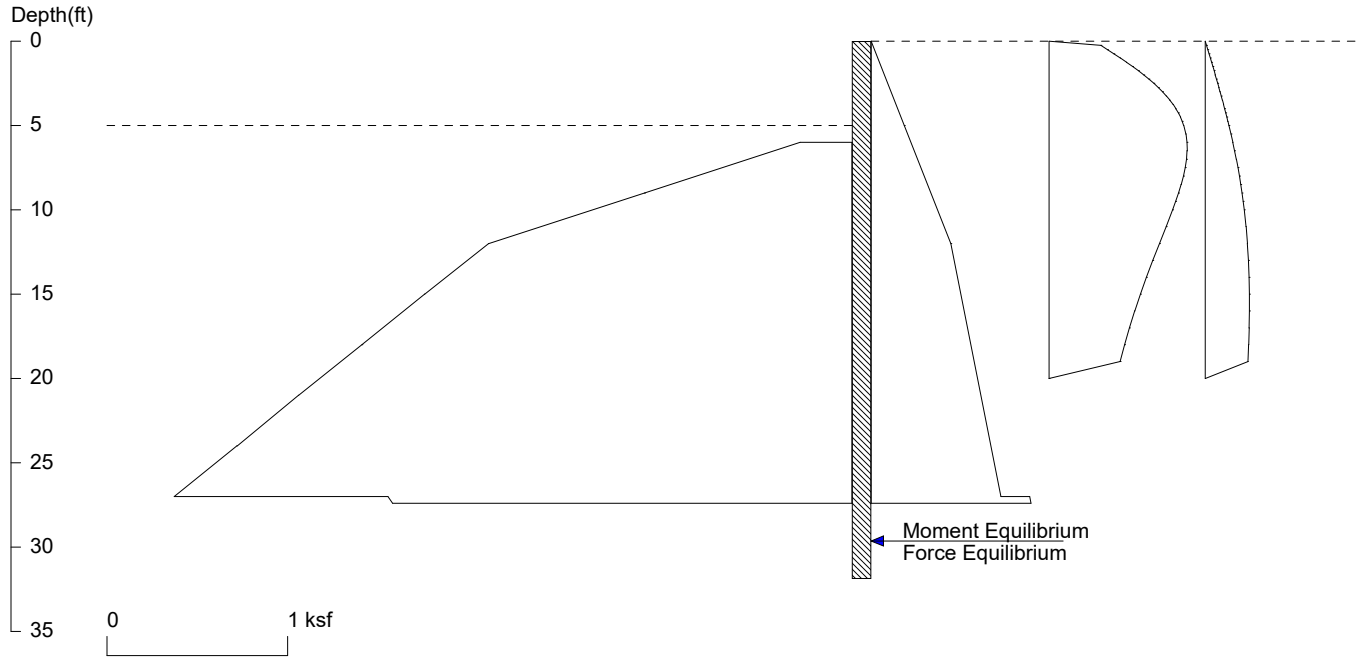
Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
6.00	0.29	9.00	1.15	0.287	2.2978
9.00	1.15	10.00	1.44	0.287	2.2978

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\5' Permanent.ep8

146th South 5' Permanent



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Date: 12/30/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\5' Permanent.sh8

Wall Height=5.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=26.88 Min. Pile Length=31.88

MOMENT IN PILE: Max. Moment=212.65 per Pile Spacing=5.0 at Depth=17.68

PILE SELECTION:

Request Min. Section Modulus = 92.8 in³/pile=1520.61 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.36(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	5.000	0.184	0.036841
*	Below	Base		
5.000	0.184	12.00	0.442	0.036841
12.00	0.442	27.00	0.719	0.018450
27.00	0.878	36.00	1.048	0.018935
*	Sur-	charg		
0.000	0.000	0.250	0.287	1.147034
0.250	0.287	0.500	0.323	0.146040
0.500	0.323	0.750	0.359	0.144073
0.750	0.359	1.000	0.395	0.141169
1.000	0.395	1.250	0.429	0.137379
1.250	0.429	1.500	0.462	0.132776
1.500	0.462	1.750	0.494	0.127437
1.750	0.494	2.000	0.524	0.121451
2.000	0.524	2.250	0.553	0.114919
2.250	0.553	2.500	0.580	0.107935
2.500	0.580	2.750	0.605	0.100603

2.750	0.605	3.000	0.628	0.093020
3.000	0.628	3.250	0.650	0.085281
3.250	0.650	3.500	0.669	0.077474
3.500	0.669	3.750	0.687	0.069681
3.750	0.687	4.000	0.702	0.061975
4.000	0.702	4.250	0.716	0.054419
4.250	0.716	4.500	0.727	0.047069
4.500	0.727	4.750	0.737	0.039970
4.750	0.737	5.000	0.746	0.033160
5.000	0.746	5.500	0.758	0.023592
5.500	0.758	6.000	0.764	0.012001
6.000	0.764	6.500	0.764	0.001861
6.500	0.764	7.000	0.761	-0.00683
7.000	0.761	7.500	0.754	-0.01414
7.500	0.754	8.000	0.744	-0.02017
8.000	0.744	8.500	0.731	-0.02504
8.500	0.731	9.000	0.717	-0.02888
9.000	0.717	9.500	0.701	-0.03182
9.500	0.701	10.00	0.684	-0.03399
10.00	0.684	11.00	0.648	-0.03596
11.00	0.648	12.00	0.611	-0.03697
12.00	0.611	13.00	0.574	-0.03659
13.00	0.574	14.00	0.539	-0.03532
14.00	0.539	15.00	0.506	-0.03352
15.00	0.506	16.00	0.474	-0.03144
16.00	0.474	17.00	0.445	-0.02925
17.00	0.445	18.00	0.418	-0.02706
18.00	0.418	19.00	0.393	-0.02494
19.00	0.393	20.00	0.000	-0.39288
*	Sur-	charg		
0.000	0.000	0.250	0.007	0.028014
0.250	0.007	0.500	0.014	0.027986
0.500	0.014	0.750	0.021	0.027926
0.750	0.021	1.000	0.028	0.027838
1.000	0.028	1.250	0.035	0.027720
1.250	0.035	1.500	0.042	0.027574
1.500	0.042	1.750	0.049	0.027400
1.750	0.049	2.000	0.055	0.027196
2.000	0.055	2.250	0.062	0.026967
2.250	0.062	2.500	0.069	0.026711
2.500	0.069	2.750	0.075	0.026428
2.750	0.075	3.000	0.082	0.026120
3.000	0.082	3.250	0.088	0.025788
3.250	0.088	3.500	0.095	0.025432
3.500	0.095	3.750	0.101	0.025053
3.750	0.101	4.000	0.107	0.024652
4.000	0.107	4.250	0.113	0.024230
4.250	0.113	4.500	0.119	0.023789
4.500	0.119	4.750	0.125	0.023329
4.750	0.125	5.000	0.131	0.022851
5.000	0.131	5.500	0.142	0.022102
5.500	0.142	6.000	0.152	0.021055
6.000	0.152	6.500	0.162	0.019958
6.500	0.162	7.000	0.172	0.018820
7.000	0.172	7.500	0.181	0.017651
7.500	0.181	8.000	0.189	0.016459
8.000	0.189	8.500	0.196	0.015254
8.500	0.196	9.000	0.203	0.014043
9.000	0.203	9.500	0.210	0.012835

9.500	0.210	10.00	0.216	0.011636
10.00	0.216	11.00	0.226	0.009874
11.00	0.226	12.00	0.233	0.007611
12.00	0.233	13.00	0.239	0.005485
13.00	0.239	14.00	0.242	0.003522
14.00	0.242	15.00	0.244	0.001741
15.00	0.244	16.00	0.244	0.000150
16.00	0.244	17.00	0.243	-0.00124
17.00	0.243	18.00	0.240	-0.00245
18.00	0.240	19.00	0.237	-0.00348
19.00	0.237	20.00	0.000	-0.23684

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
6.000	0.287	9.000	1.149	0.287228
9.000	1.149	12.00	2.011	0.287228
12.00	2.011	15.00	2.364	0.117905
15.00	2.366	18.00	2.713	0.115805
18.00	2.713	21.00	3.063	0.116796
21.00	3.064	24.00	3.403	0.112853
24.00	3.405	27.00	3.752	0.115725
27.00	2.569	30.00	2.374	-0.06513
30.00	2.125	33.00	2.898	0.257959

ACTIVE SPACING:

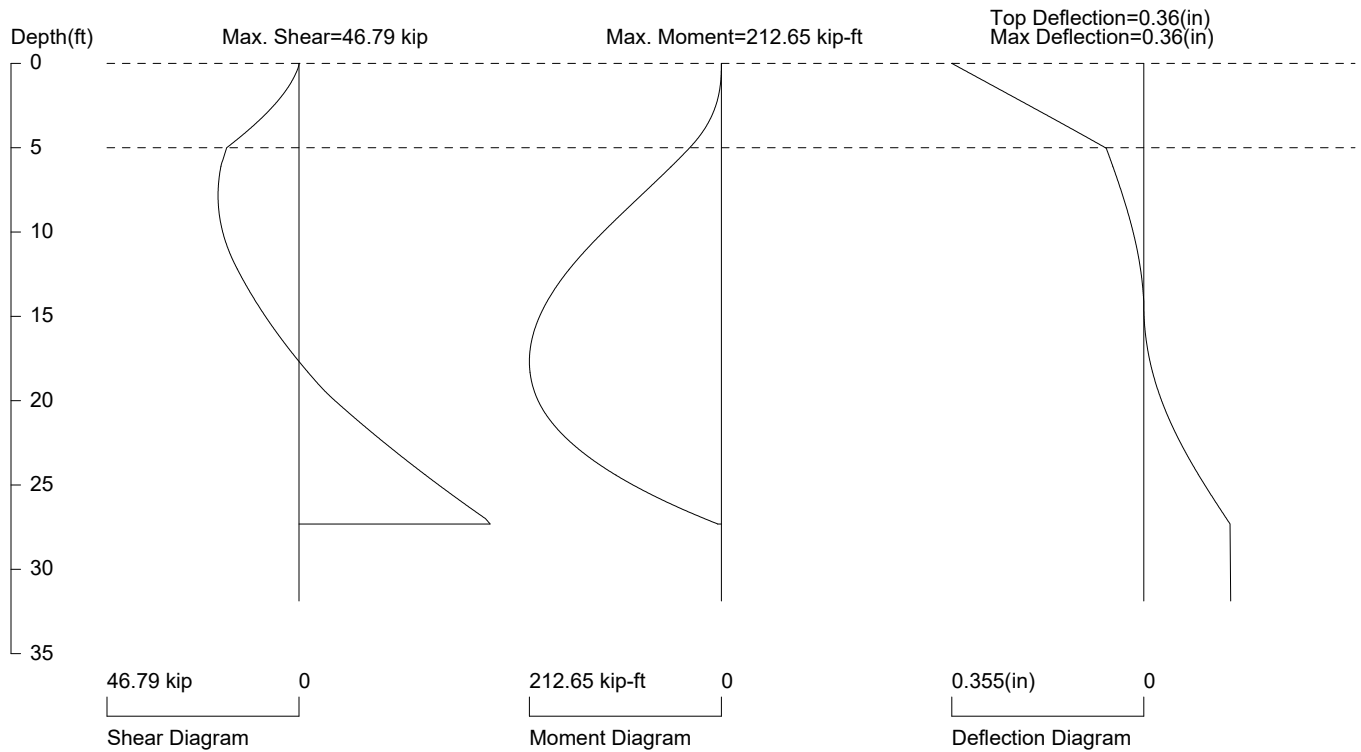
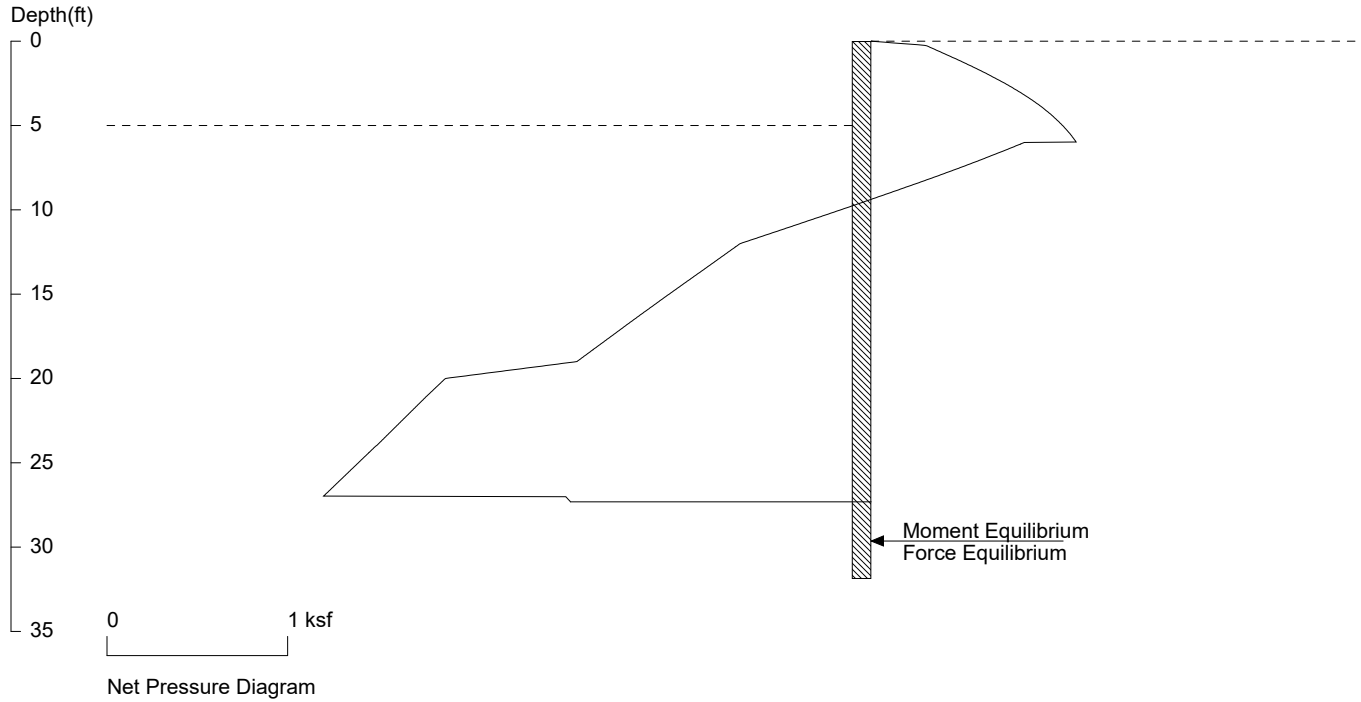
No.	Z depth	Spacing
1	0.00	5.00
2	5.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	5.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 5' Permanent



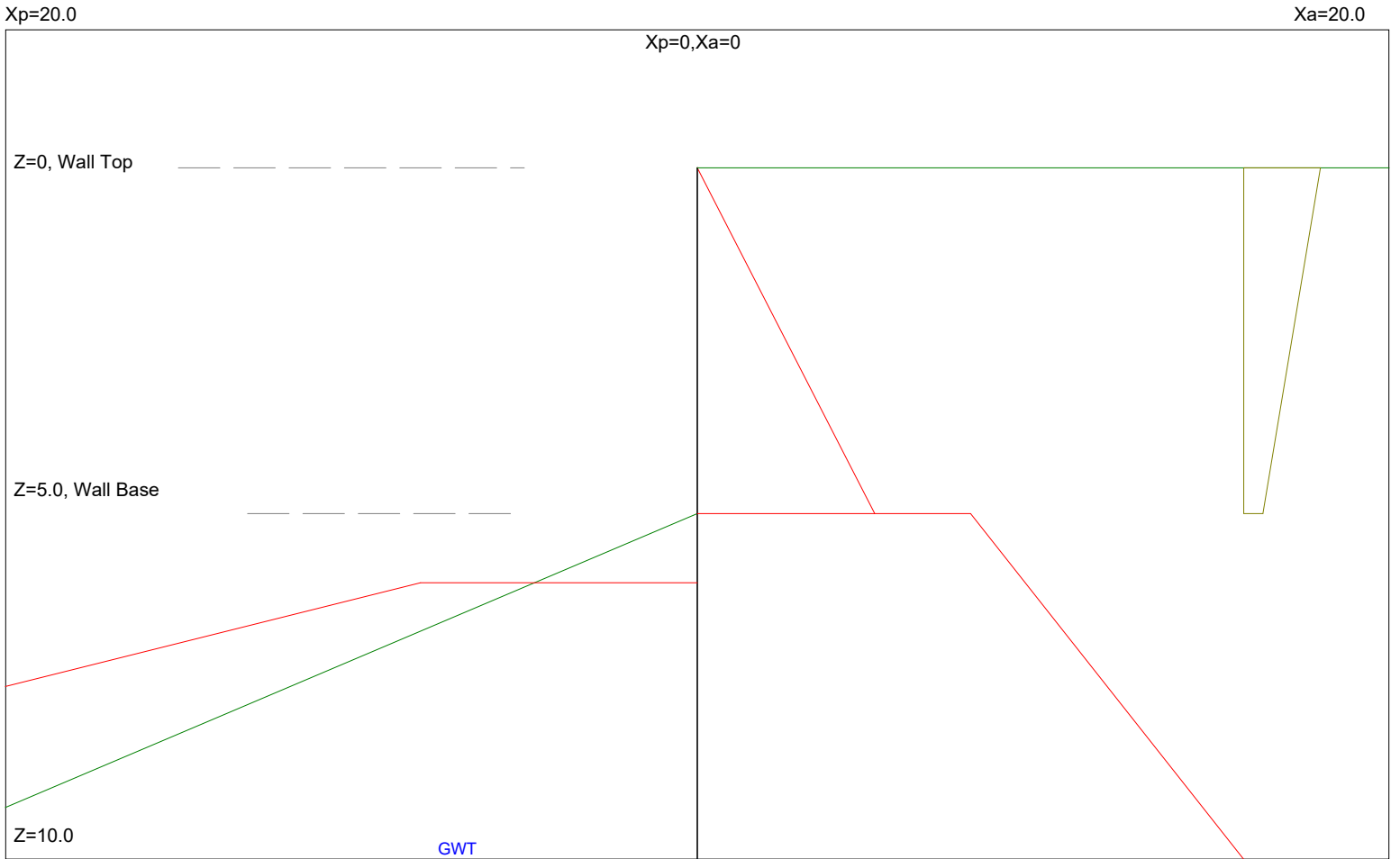
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

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146th South 5' Seismic



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\5' Seismic.ep8

* INPUT DATA *

Wall Height=5.0 Total Soil Types= 3

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	SM
2	27.0	0.0	27.0	800.0	3	CL
3	36.0	0.0	36.0	800.0	1	SM
4	39.0	0.0	39.0	800.0	3	CL
5	44.0	0.0	44.0	800.0	1	SM
6	49.0	0.0	49.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	12.0	0.0
2	12.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	5.0	0.0	22.0	80.0	1	SM

2	22.0	80.0	22.0	800.0	1	SM
3	27.0	0.0	27.0	800.0	3	CL
4	36.0	0.0	36.0	800.0	1	SM
5	39.0	0.0	39.0	800.0	3	CL
6	44.0	0.0	44.0	800.0	1	SM
7	49.0	0.0	49.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	12.0	0.0
2	22.0	79.0
3	22.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 0.71 per one linear foot (or meter) width along wall height

Total Static Force above Base= 0.46

Total Earthquake Force above Base= 0.25. Distributed in trapezoid. Total earthquake force acting at 0.4H below wall top.

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	5.00	0.18	0.0368	0.2947

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
5.00	0.28	10.00	0.57	0.0567	0.4537

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
6.00	0.29	9.00	1.15	0.287	2.2978
9.00	1.15	10.00	1.44	0.287	2.2978

Output Earthquake Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

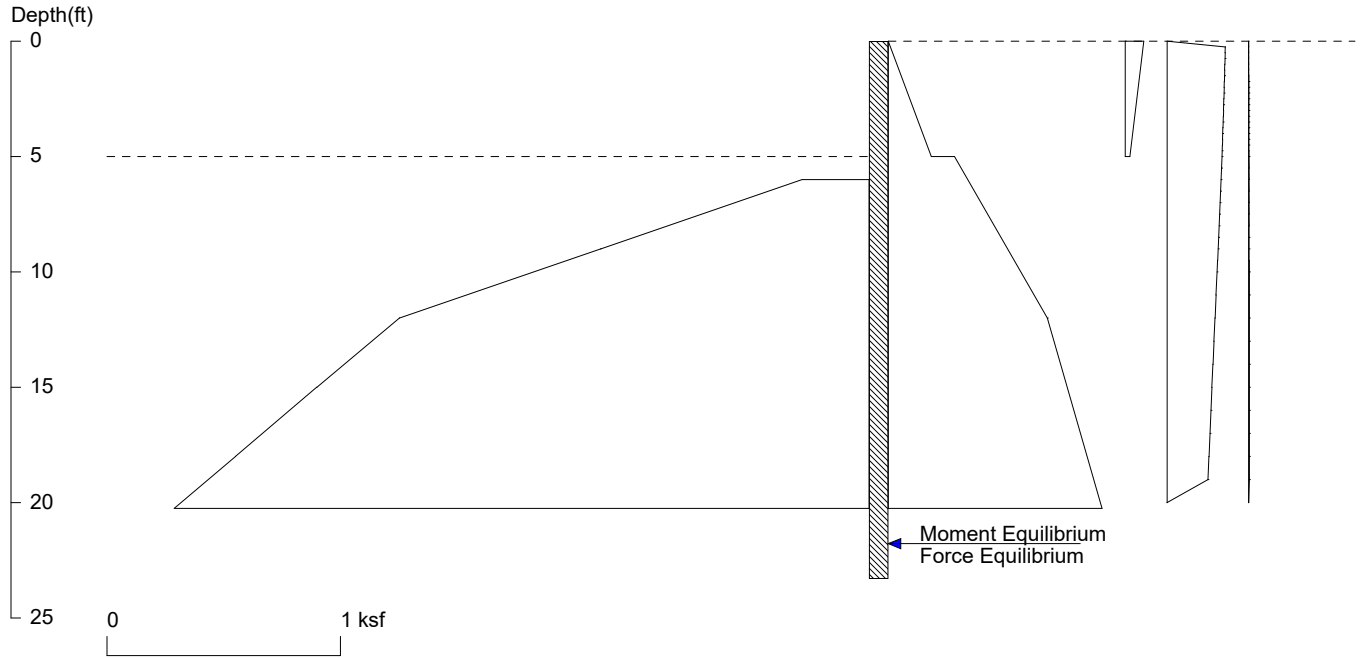
Total Earthq. Force, Ee = 0.25

No	Zq1	Pq1	Zq2	Pq2	Slope
0	0.00	0.079	5.00	0.020	-0.012

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 9/9/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\5' Seismic.ep8

146th South 5' Seismic



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Wall Height=5.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=18.30 Min. Pile Length=23.30

MOMENT IN PILE: Max. Moment=81.14 per Pile Spacing=5.0 at Depth=13.11

PILE SELECTION:

Request Min. Section Modulus = 35.4 in³/pile=580.22 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has Section Modulus = 172.0 in³/pile=2818.56 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.11(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1220.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	5.000	0.184	0.036841
*	Below	Base		
5.000	0.284	12.00	0.681	0.056716
12.00	0.681	27.00	1.107	0.028403
*	Earth	Queck		
0.000	0.079	5.000	0.020	-0.01192
*	Sur-	charg		
0.000	0.000	0.250	0.249	0.997387
0.250	0.249	0.500	0.249	-0.00262
0.500	0.249	0.750	0.248	-0.00263
0.750	0.248	1.000	0.247	-0.00265
1.000	0.247	1.250	0.247	-0.00268
1.250	0.247	1.500	0.246	-0.00272
1.500	0.246	1.750	0.245	-0.00276
1.750	0.245	2.000	0.245	-0.00281
2.000	0.245	2.250	0.244	-0.00287
2.250	0.244	2.500	0.243	-0.00292

2.500	0.243	2.750	0.242	-0.00299
2.750	0.242	3.000	0.242	-0.00305
3.000	0.242	3.250	0.241	-0.00312
3.250	0.241	3.500	0.240	-0.00319
3.500	0.240	3.750	0.239	-0.00326
3.750	0.239	4.000	0.238	-0.00334
4.000	0.238	4.250	0.238	-0.00341
4.250	0.238	4.500	0.237	-0.00348
4.500	0.237	4.750	0.236	-0.00355
4.750	0.236	5.000	0.235	-0.00363
5.000	0.235	5.500	0.233	-0.00373
5.500	0.233	6.000	0.231	-0.00386
6.000	0.231	6.500	0.229	-0.00397
6.500	0.229	7.000	0.227	-0.00408
7.000	0.227	7.500	0.225	-0.00417
7.500	0.225	8.000	0.223	-0.00425
8.000	0.223	8.500	0.221	-0.00431
8.500	0.221	9.000	0.219	-0.00436
9.000	0.219	9.500	0.216	-0.00440
9.500	0.216	10.00	0.214	-0.00442
10.00	0.214	11.00	0.210	-0.00444
11.00	0.210	12.00	0.205	-0.00444
12.00	0.205	13.00	0.201	-0.00442
13.00	0.201	14.00	0.196	-0.00438
14.00	0.196	15.00	0.192	-0.00432
15.00	0.192	16.00	0.188	-0.00426
16.00	0.188	17.00	0.184	-0.00419
17.00	0.184	18.00	0.179	-0.00412
18.00	0.179	19.00	0.175	-0.00405
19.00	0.175	20.00	0.000	-0.17544
*	Sur-	charg		
0.000	0.000	0.250	0.000	0.000337
0.250	0.000	0.500	0.000	0.000336
0.500	0.000	0.750	0.000	0.000336
0.750	0.000	1.000	0.000	0.000335
1.000	0.000	1.250	0.000	0.000333
1.250	0.000	1.500	0.001	0.000332
1.500	0.001	1.750	0.001	0.000330
1.750	0.001	2.000	0.001	0.000328
2.000	0.001	2.250	0.001	0.000325
2.250	0.001	2.500	0.001	0.000322
2.500	0.001	2.750	0.001	0.000319
2.750	0.001	3.000	0.001	0.000315
3.000	0.001	3.250	0.001	0.000312
3.250	0.001	3.500	0.001	0.000307
3.500	0.001	3.750	0.001	0.000303
3.750	0.001	4.000	0.001	0.000299
4.000	0.001	4.250	0.001	0.000294
4.250	0.001	4.500	0.001	0.000289
4.500	0.001	4.750	0.002	0.000283
4.750	0.002	5.000	0.002	0.000278
5.000	0.002	5.500	0.002	0.000269
5.500	0.002	6.000	0.002	0.000257
6.000	0.002	6.500	0.002	0.000245
6.500	0.002	7.000	0.002	0.000231
7.000	0.002	7.500	0.002	0.000218
7.500	0.002	8.000	0.002	0.000204
8.000	0.002	8.500	0.002	0.000190
8.500	0.002	9.000	0.002	0.000176

9.000	0.002	9.500	0.003	0.000161
9.500	0.003	10.00	0.003	0.000147
10.00	0.003	11.00	0.003	0.000126
11.00	0.003	12.00	0.003	0.000099
12.00	0.003	13.00	0.003	0.000073
13.00	0.003	14.00	0.003	0.000049
14.00	0.003	15.00	0.003	0.000027
15.00	0.003	16.00	0.003	0.000007
16.00	0.003	17.00	0.003	-0.00001
17.00	0.003	18.00	0.003	-0.00002
18.00	0.003	19.00	0.003	-0.00003
19.00	0.003	20.00	0.000	-0.00293

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
6.000	0.287	9.000	1.149	0.287228
9.000	1.149	12.00	2.011	0.287228
12.00	2.011	15.00	2.364	0.117905
15.00	2.366	18.00	2.713	0.115805
18.00	2.713	21.00	3.063	0.116796
21.00	3.064	24.00	3.403	0.112853

ACTIVE SPACING:

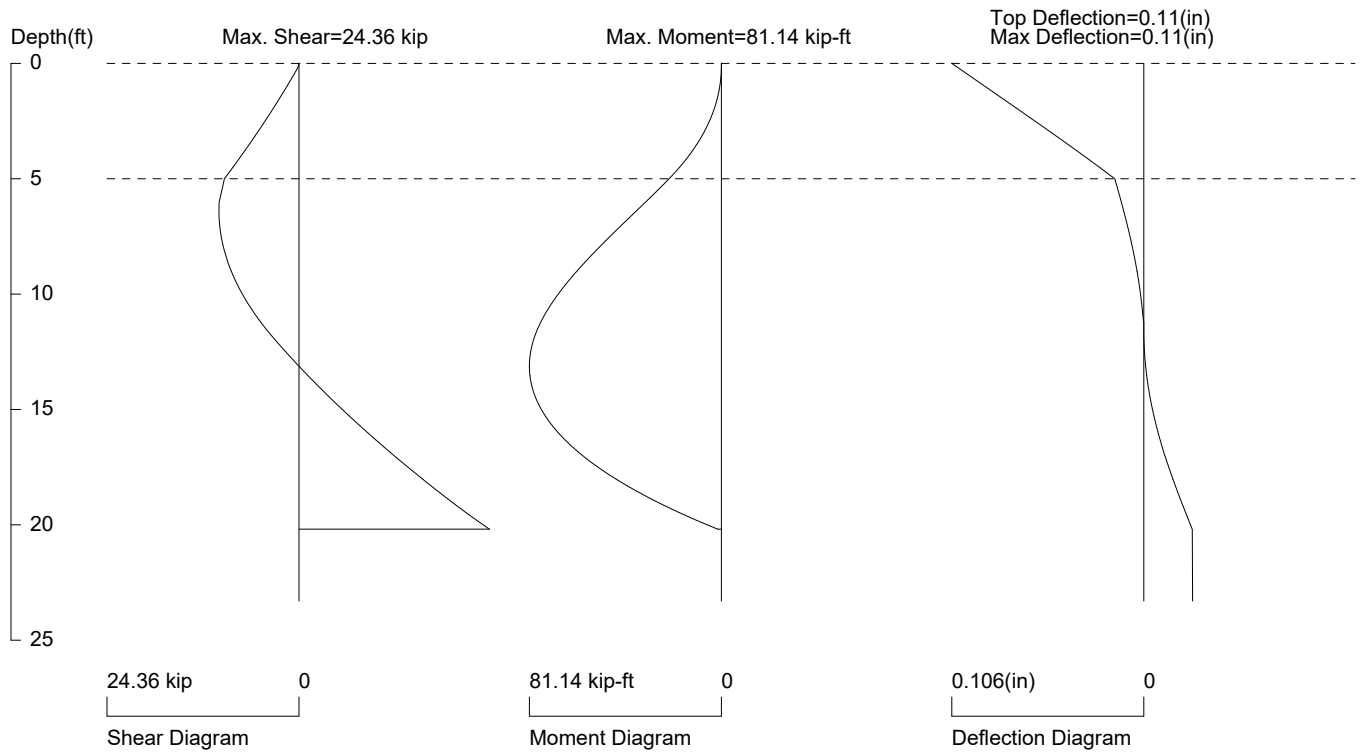
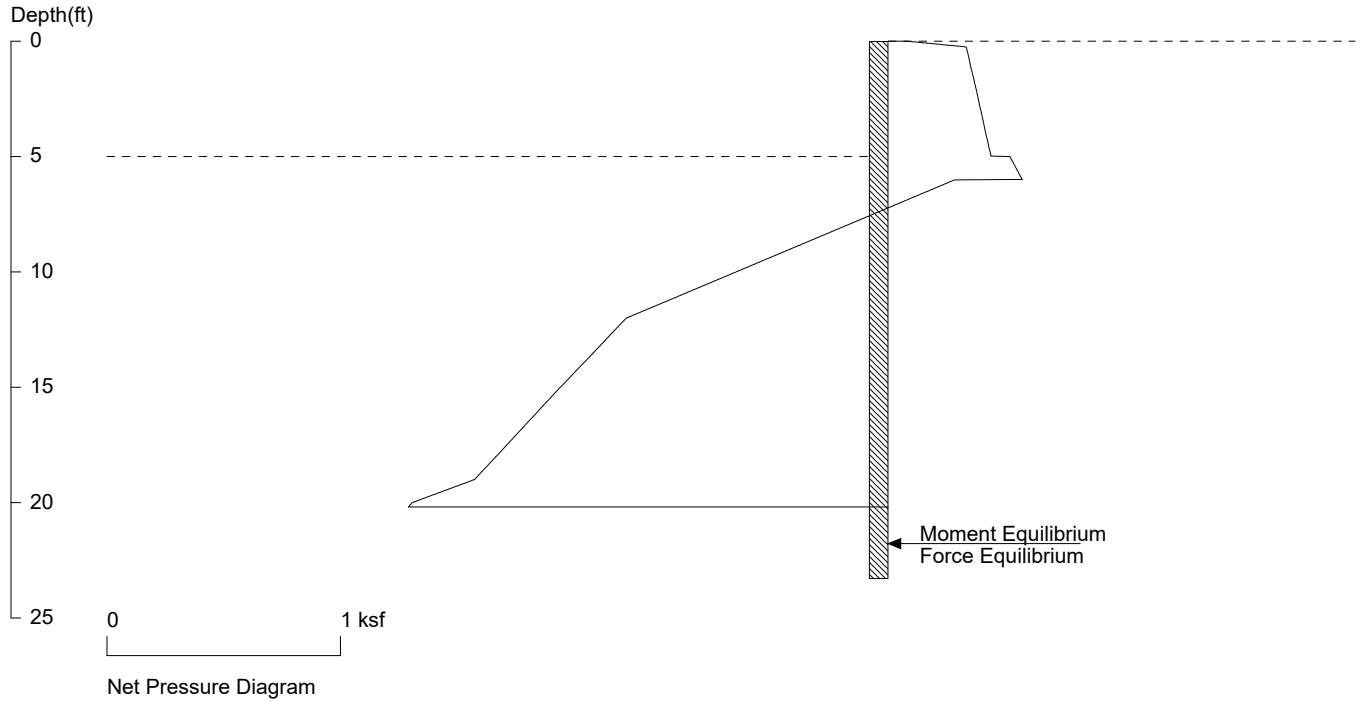
No.	Z depth	Spacing
1	0.00	5.00
2	5.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	5.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 5' Seismic



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

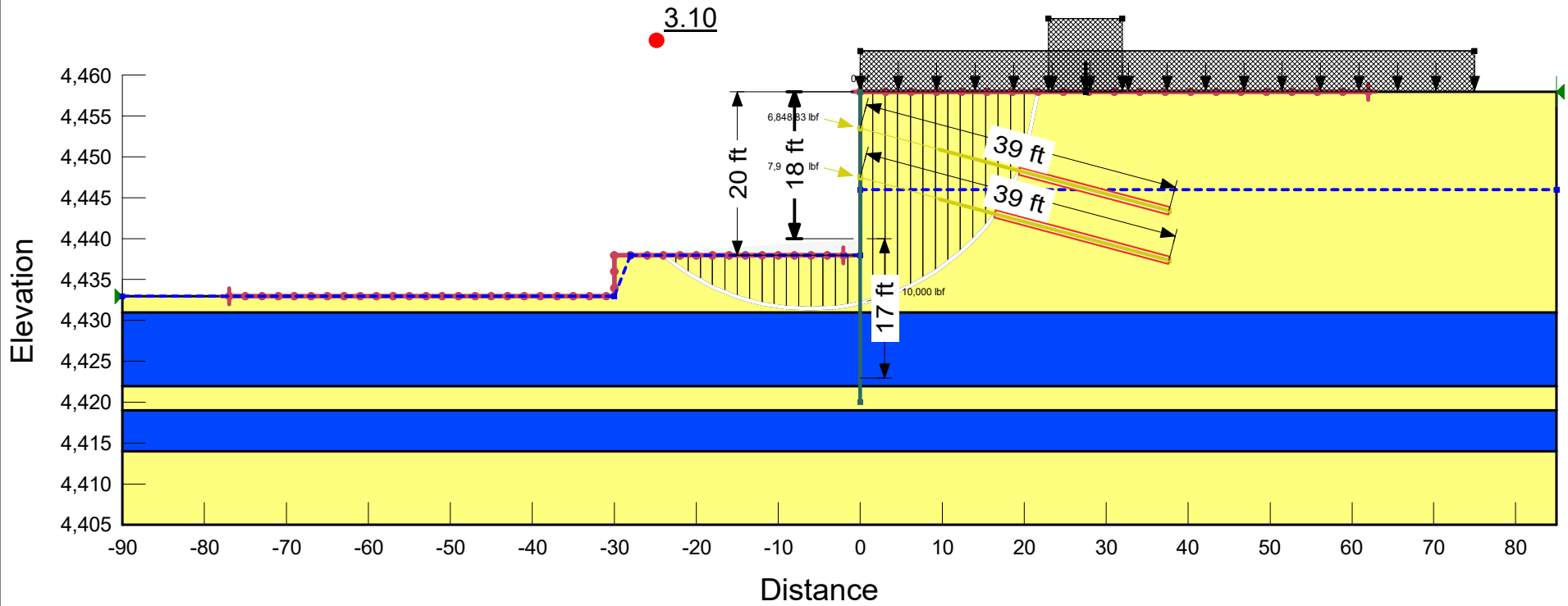
Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14X117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 715' Seismic.sh8

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
■	Pile (Wall 7)	Pile			5
■	Tieback (Wall 7)	Anchor	29	0.8	5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
■	CL Undrained	115	2,000	0
■	SM	125	0	33

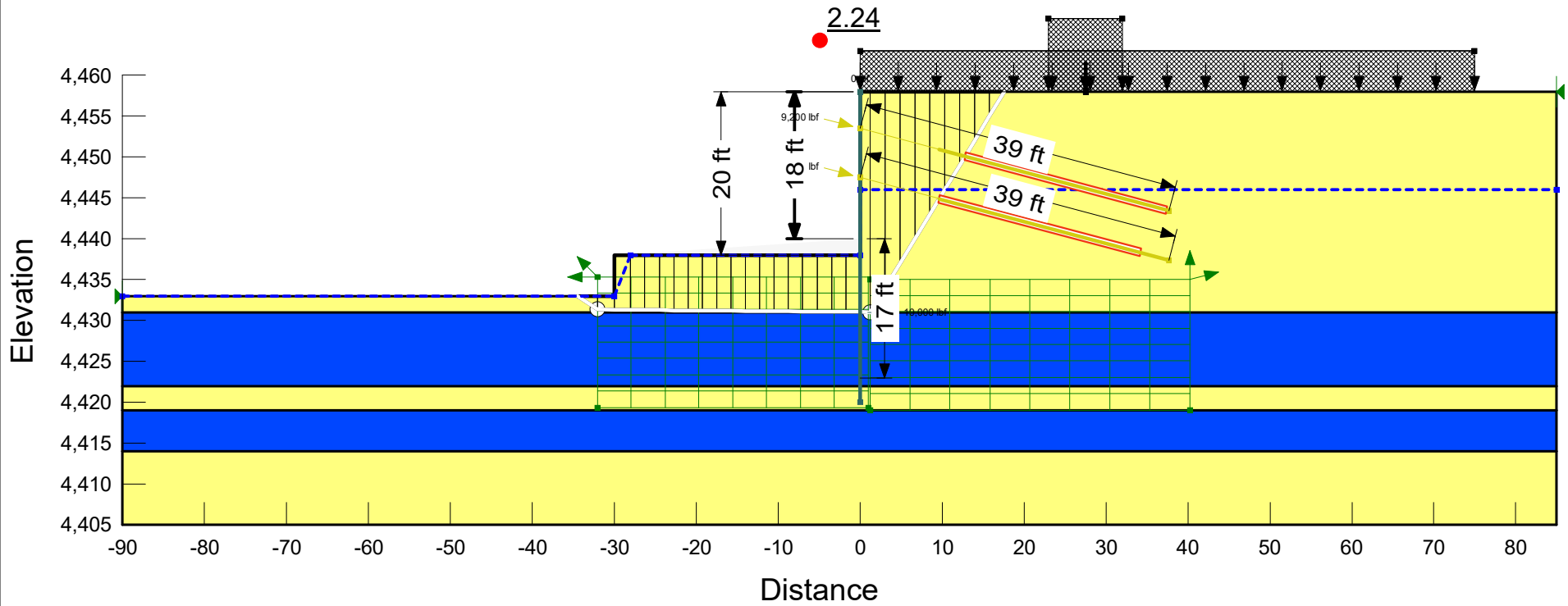


Wall 7 - 20 ft - Temporary Case

14600 South Railroad Crossing

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
■	Pile (Wall 7)	Pile			5
■	Tieback (Wall 7)	Anchor	29	0.8	5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
■	CL Undrained	115	2,000	0
■	SM	125	0	33

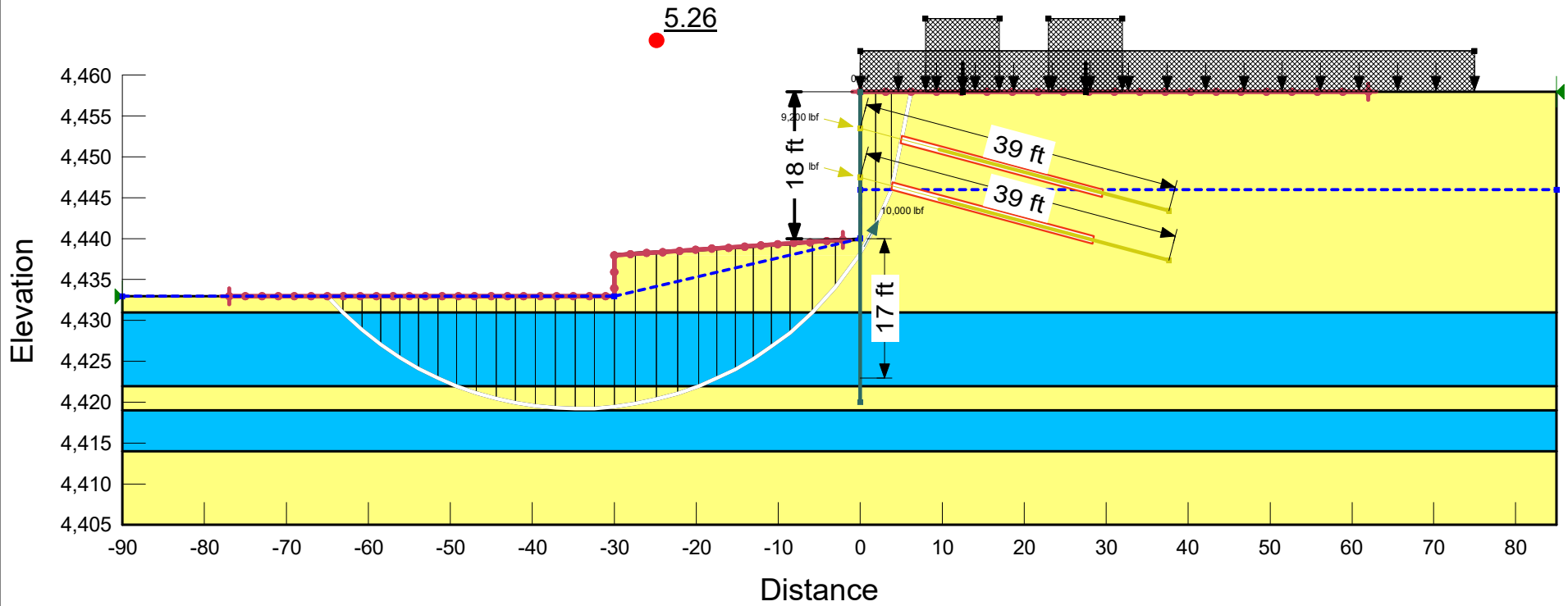


Wall 7 - 20 ft - Temporary Case - Non Circular

14600 South Railroad Crossing

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
■	Pile (Wall 7)	Pile			5
■	Tieback (Wall 7)	Anchor	29	0.8	5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
■	CL Drained	115	150	28
■	SM	125	0	33

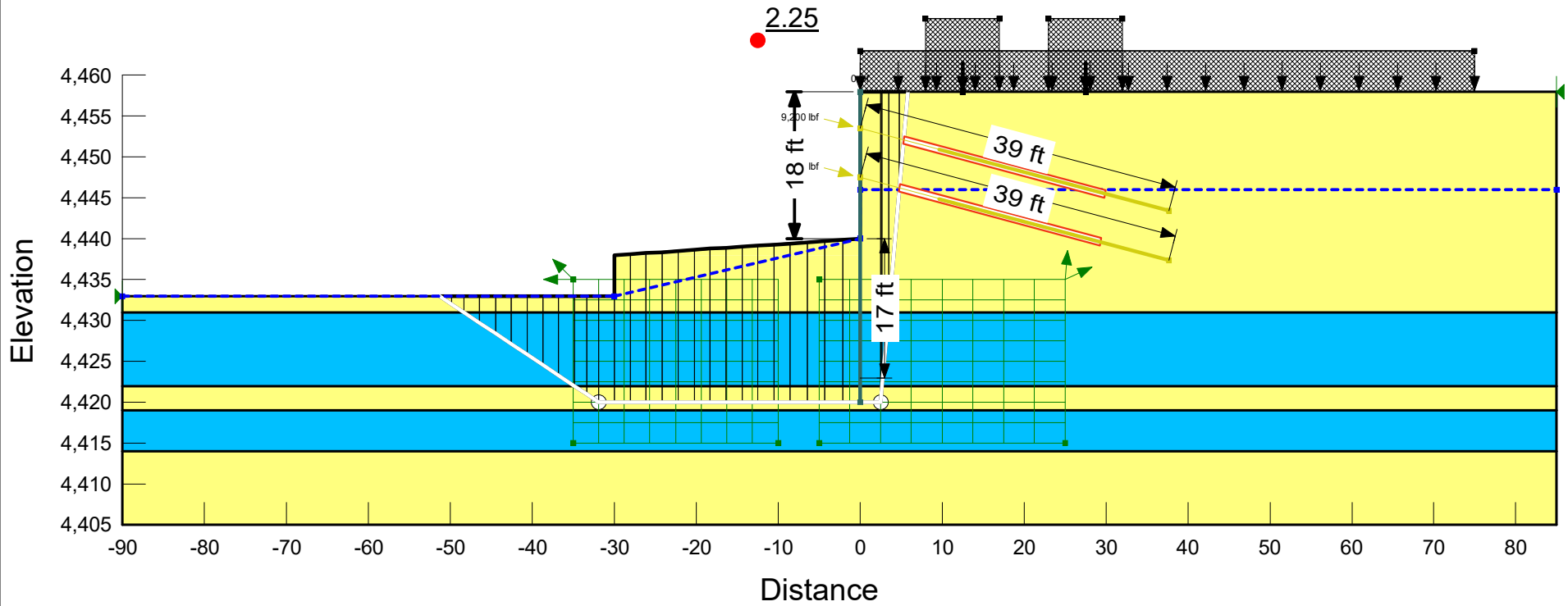


Wall 7 - 18 ft - Long Term

14600 South Railroad Crossing

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
■	Pile (Wall 7)	Pile			5
■	Tieback (Wall 7)	Anchor	29	0.8	5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
■	CL Drained	115	150	28
■	SM	125	0	33

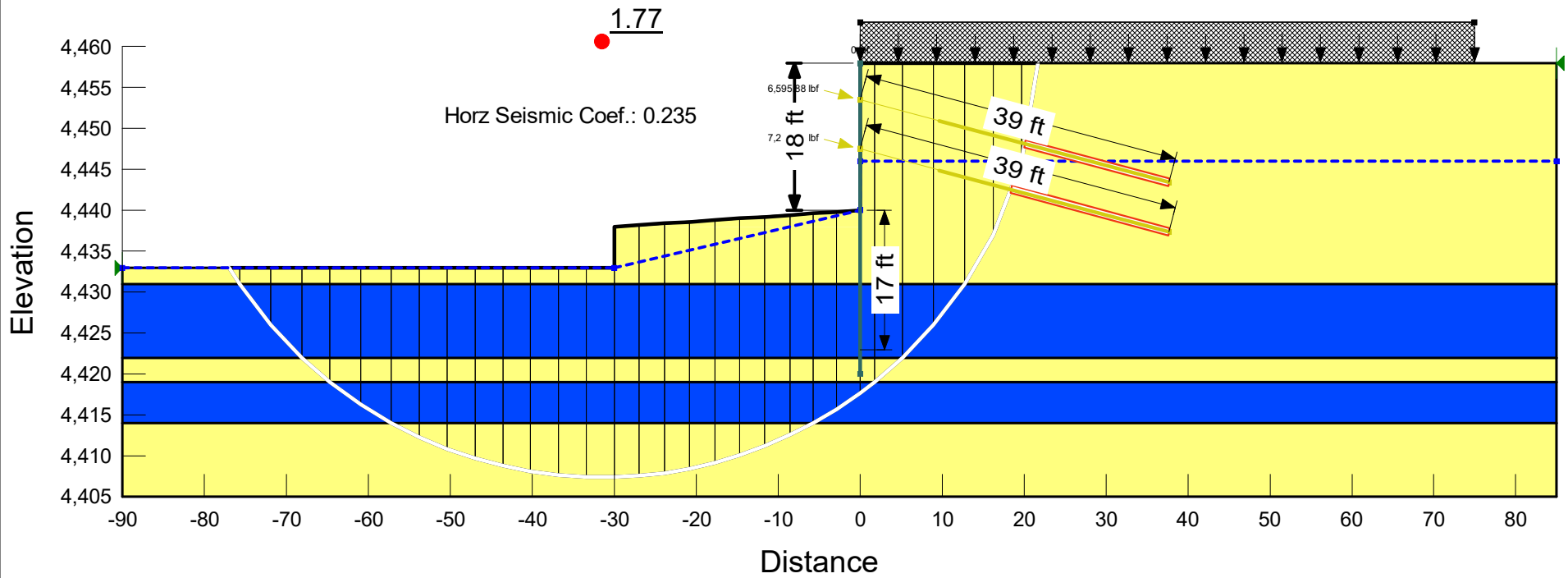


Wall 7 - 18 ft - Long Term - Non Circular

14600 South Railroad Crossing

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
■	Pile (Wall 7)	Pile			5
■	Tieback (Wall 7)	Anchor	29	0.8	5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
■	CL Undrained	115	2,000	0
■	SM	125	0	33

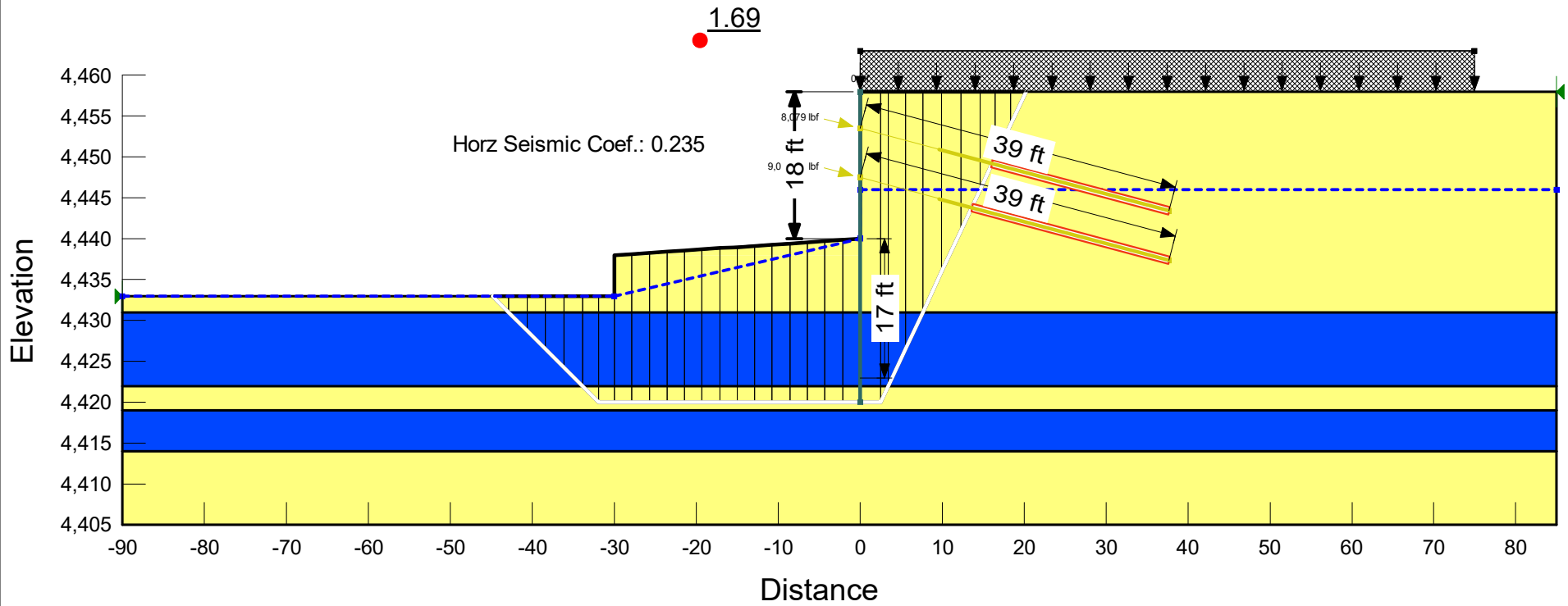


Wall 7 - 18 ft - Psuedo Static Case

14600 South Railroad Crossing

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
■	Pile (Wall 7)	Pile			5
■	Tieback (Wall 7)	Anchor	29	0.8	5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
■	CL Undrained	115	2,000	0
■	SM	125	0	33



Wall 7 - 18 ft - Psuedo Static Case - Non Circular

14600 South Railroad Crossing

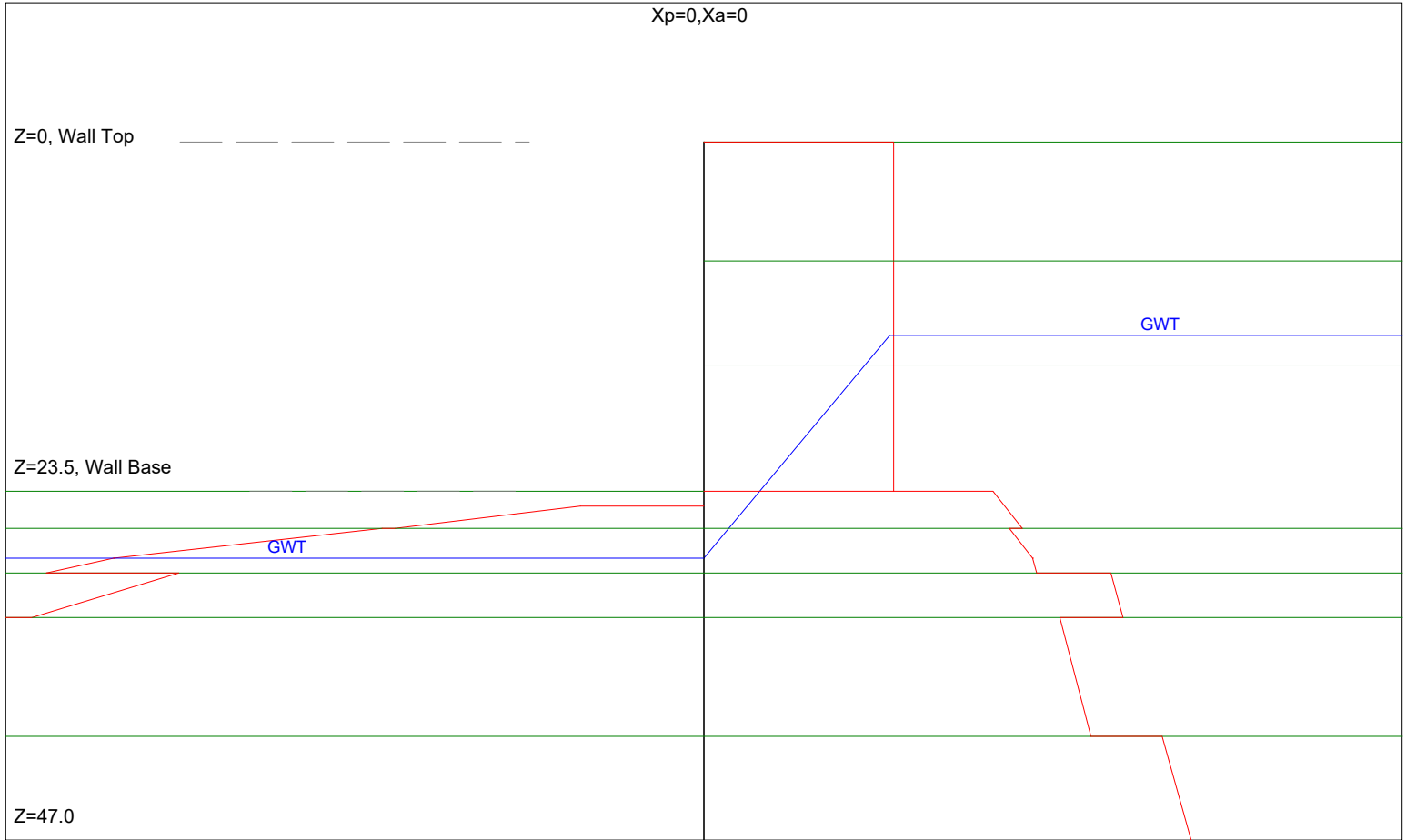
Wall 2 Calculations

146th South 23.5' Temporary

Xp=94.0

Xa=94.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/18/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\23.5' Temporary.ep8

* INPUT DATA *

Wall Height=23.5 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	23.5	0.0	23.5	800.0	2	ML
2	26.0	0.0	26.0	800.0	1	SM
3	29.0	0.0	29.0	800.0	3	CL
4	32.0	0.0	32.0	800.0	2	ML
5	40.0	0.0	40.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	28.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 10.84 per one linear foot (or meter) width along wall height

Total Static Force above Base= 10.84. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.60	23.50	0.60	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

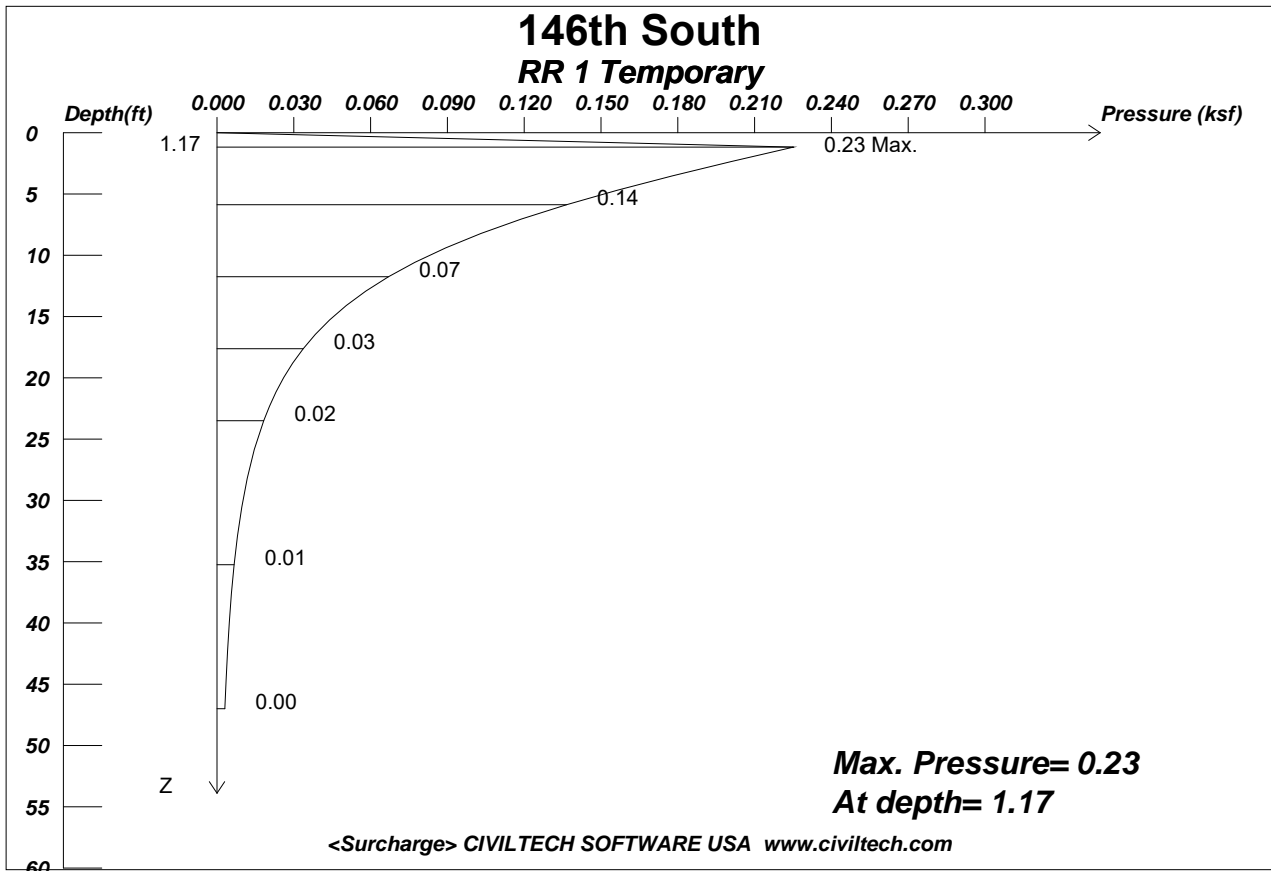
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
23.50	0.91	26.00	1.01	0.0369	0.3073
26.00	0.97	28.00	1.04	0.0368	0.2947
28.00	1.04	29.00	1.05	0.0129	0.2066
29.00	1.29	32.00	1.32	0.0128	0.2430
32.00	1.12	40.00	1.22	0.0123	0.2137
40.00	1.45	47.00	1.54	0.0131	0.2500

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
24.50	0.39	26.00	0.98	0.391	3.2546
26.00	1.02	28.00	1.87	0.425	3.3966
28.00	1.87	29.00	2.08	0.213	3.3946
29.00	1.66	32.00	2.12	0.155	2.9393
32.00	2.50	40.00	4.01	0.188	3.2592
40.00	3.37	47.00	4.42	0.150	2.8424

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/18/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\23.5' Temporary.ep8



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Date: 10/21/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\RR1 Temporary.

Wall Height, H= 23.5

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

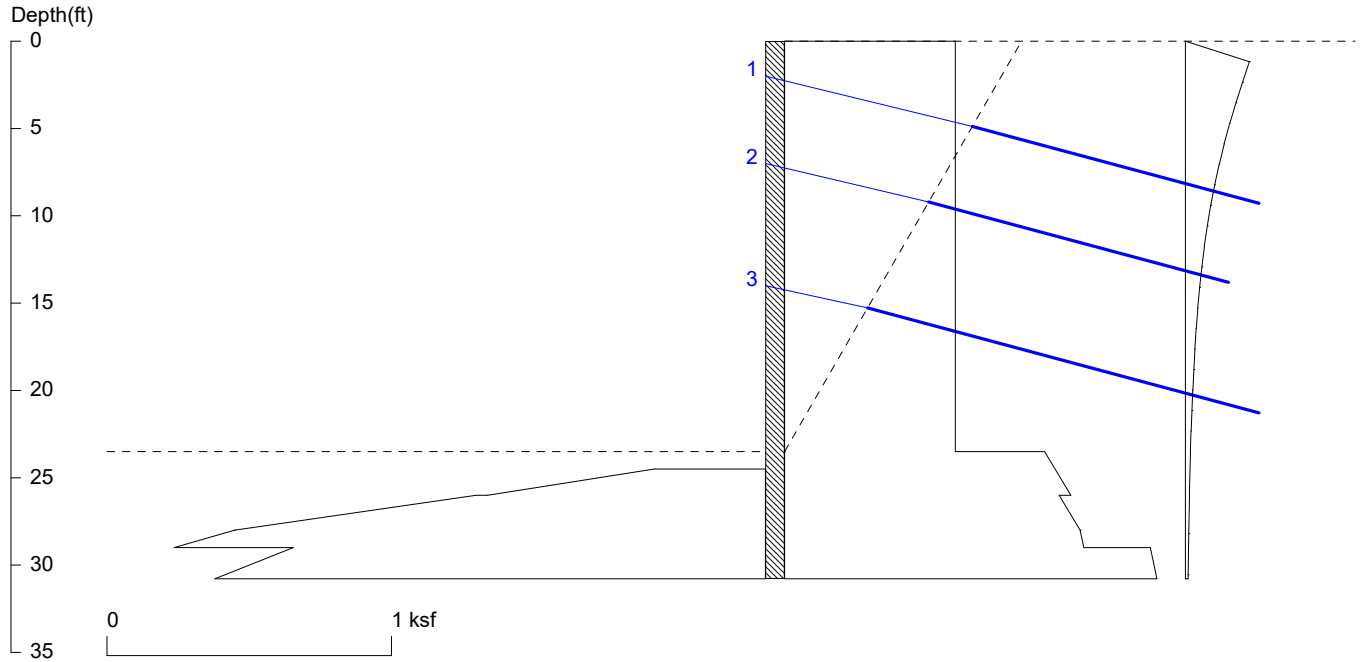
Rigid Wall Condition -- No movement or deflection of the wall are allowed.

Max. Pressure = 0.225 at depth = 1.17

X	Width	Strip Load
.0	5.0	.25
5.0	10.0	.25

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 23.5' Temporary



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Date: 10/21/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\23.5' Temporary.sh8

Wall Height=23.5 Pile Diameter=1.2 Pile Spacing=6.5 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=7.28 Min. Pile Length=30.78

MOMENT IN PILE: Max. Moment=68.34 per Pile Spacing=6.5 at Depth=20.86

PILE SELECTION:

Request Min. Section Modulus = 29.8 in³/pile=488.68 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	2.0	15.0	6.5	28.9*	27.9	7.5	11.1	19.1
2. Tieback	7.0	15.0	6.5	26.9	26.0	7.0	8.5	17.8
3. Tieback	14.0	15.0	6.5	43.3	41.8	11.2	4.9	28.6

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.600	23.50	0.600	0.000000
*	Below	Base		
23.50	0.914	26.00	1.006	0.036871
26.00	0.965	28.00	1.039	0.036841
28.00	1.039	29.00	1.052	0.012933
29.00	1.286	32.00	1.325	0.012781
*	Sur-	charge		
0.000	0.000	1.175	0.225	0.191632
1.175	0.225	2.350	0.201	-0.020628

2.350	0.201	3.525	0.178	-0.019667
3.525	0.178	4.700	0.156	-0.018347
4.700	0.156	5.875	0.137	-0.016784
5.875	0.137	7.050	0.119	-0.015095
7.050	0.119	8.225	0.103	-0.013385
8.225	0.103	9.400	0.089	-0.011733
9.400	0.089	10.575	0.077	-0.010193
10.575	0.077	11.750	0.067	-0.008796
11.750	0.067	12.925	0.058	-0.007557
12.925	0.058	14.100	0.050	-0.006473
14.100	0.050	15.275	0.044	-0.005536
15.275	0.044	16.450	0.038	-0.004734
16.450	0.038	17.625	0.034	-0.004050
17.625	0.034	18.800	0.030	-0.003470
18.800	0.030	19.975	0.026	-0.002979
19.975	0.026	21.150	0.023	-0.002563
21.150	0.023	22.325	0.020	-0.002210
22.325	0.020	23.500	0.018	-0.001912
23.500	0.018	25.850	0.015	-0.001551
25.850	0.015	28.200	0.012	-0.001181
28.200	0.012	30.550	0.010	-0.000911
30.550	0.010	32.900	0.008	-0.000710

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
24.50	0.391	26.00	0.976	0.390551
26.00	1.017	28.00	1.866	0.424574
28.00	1.866	29.00	2.078	0.212504
29.00	1.660	32.00	2.124	0.154609

ACTIVE SPACING:

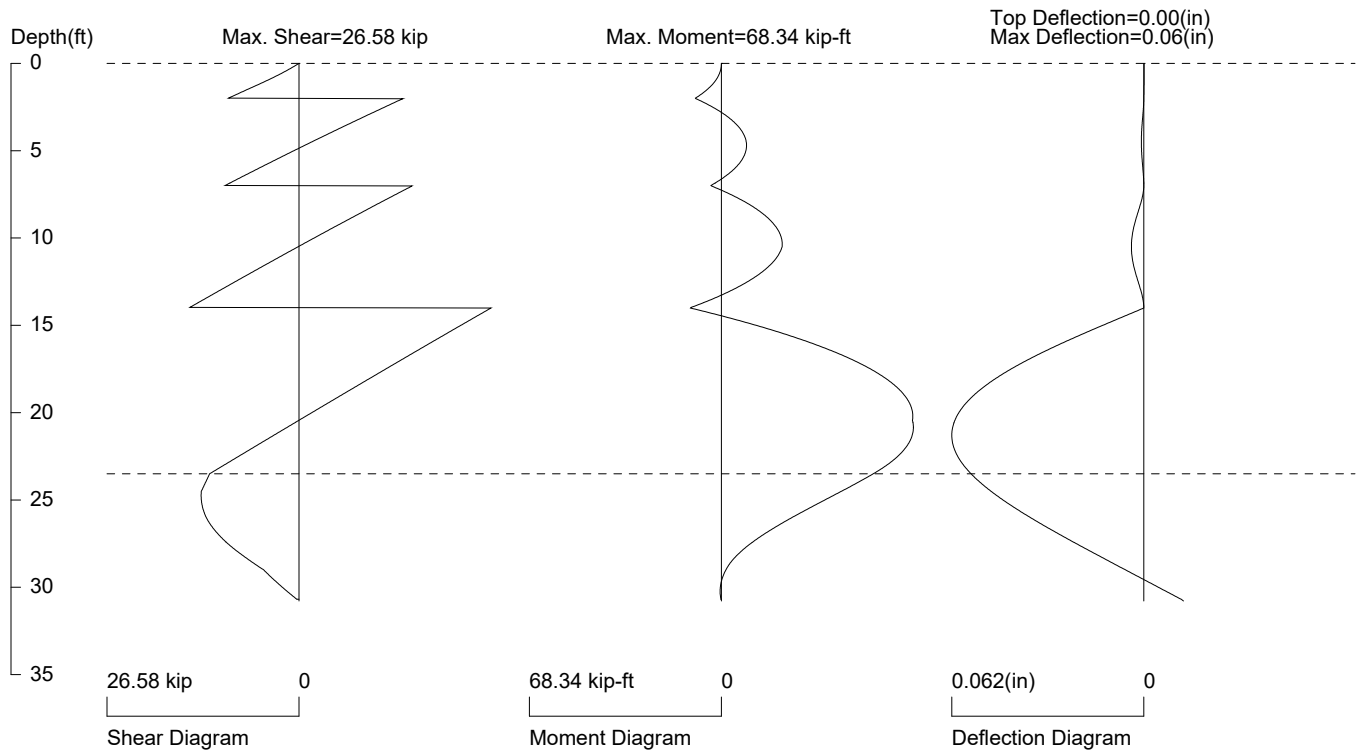
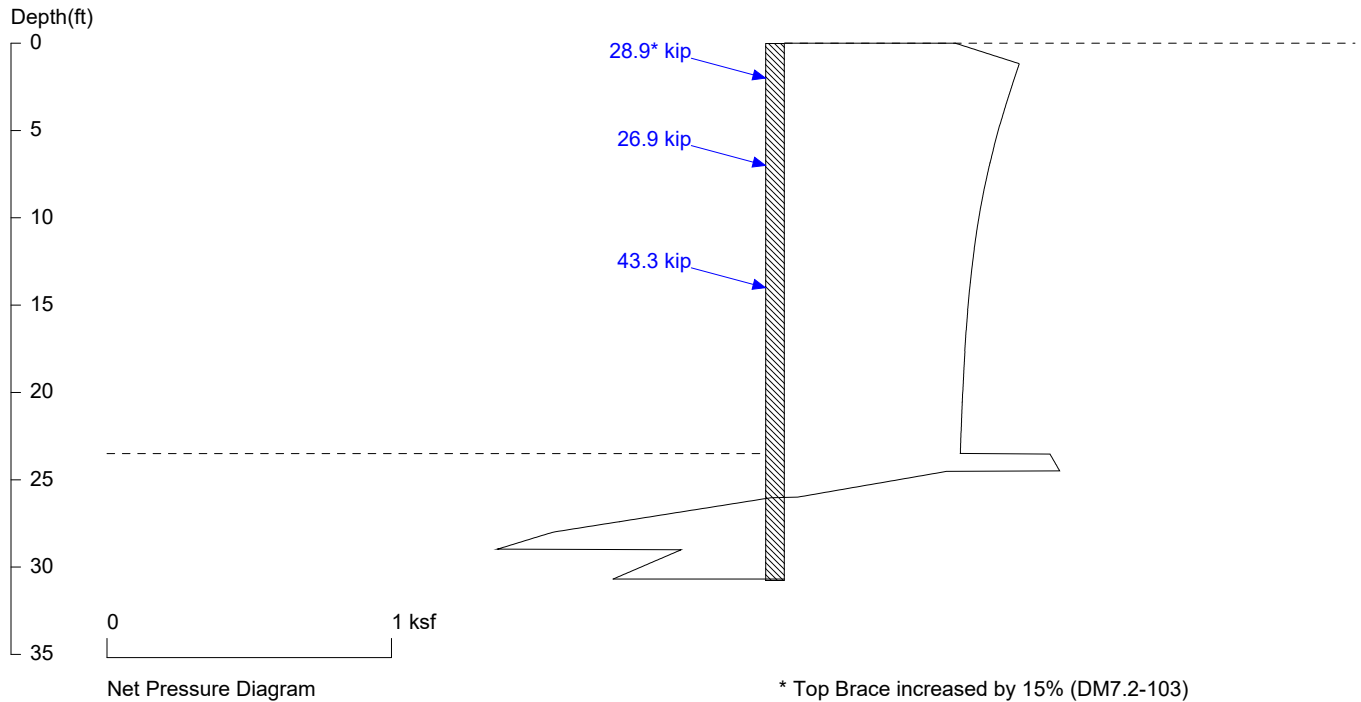
No.	Z depth	Spacing
1	0.00	6.50
2	23.50	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	23.50	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 23.5' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.5 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\23.5' Temporary.sh8

146th South 15' Temporary

Xp=60.0

Xa=60.0

Xp=0, Xa=0

Z=0, Wall Top

This case is for before the
box culvert is installed for the
23.5' temporary case

Z=15.0, Wall Base

GWT

GWT

Z=30.0

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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/21/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\15' Temporary.ep8

* INPUT DATA *

Wall Height=15.0 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	15.0	0.0	15.0	800.0	2	ML
2	26.0	0.0	26.0	800.0	1	SM
3	29.0	0.0	29.0	800.0	3	CL
4	32.0	0.0	32.0	800.0	2	ML
5	40.0	0.0	40.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	28.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 4.40 per one linear foot (or meter) width along wall height

Total Static Force above Base= 4.40. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.38	15.00	0.38	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

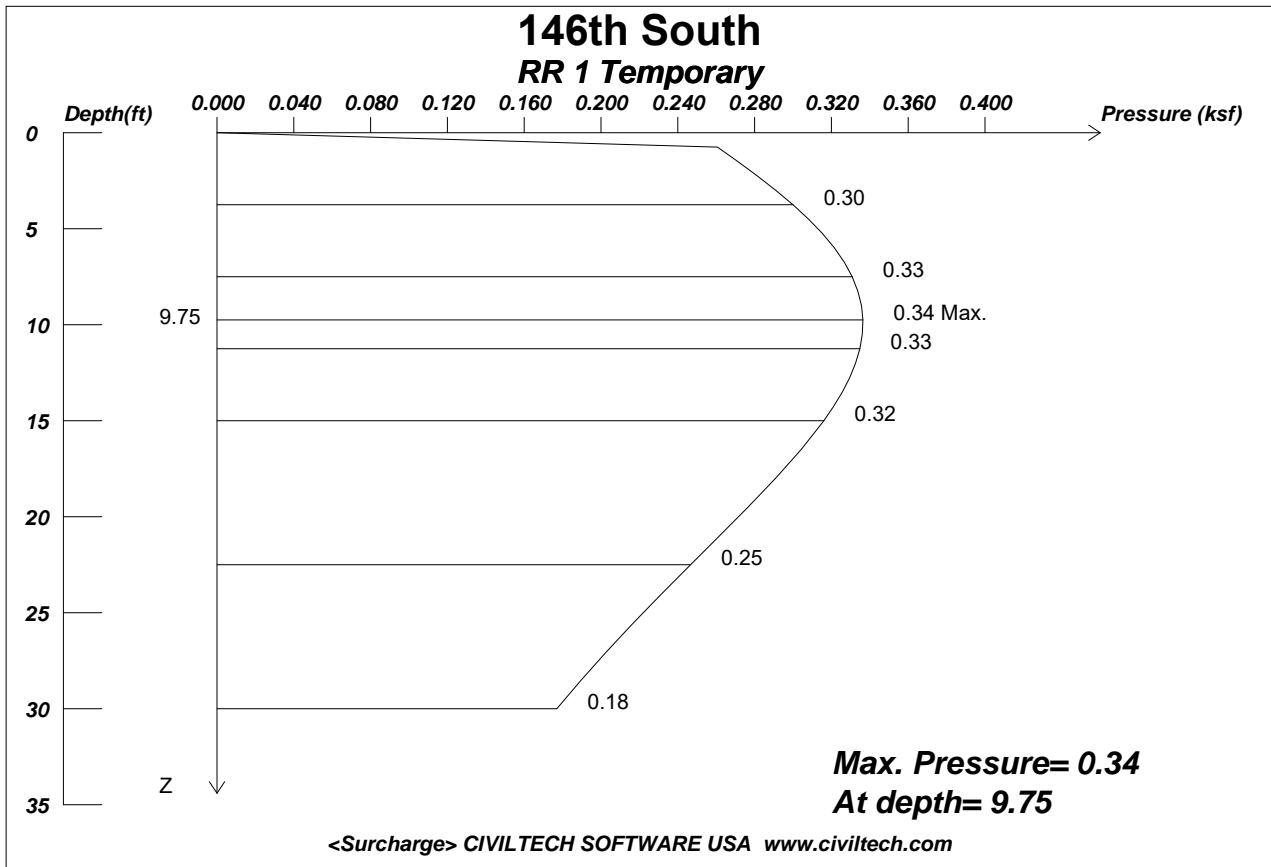
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
15.00	0.60	26.00	1.01	0.0369	0.3073
26.00	0.97	28.00	1.04	0.0368	0.2947
28.00	1.04	29.00	1.05	0.0129	0.2066
29.00	1.29	30.00	1.30	0.0128	0.2430

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
16.00	0.39	26.00	4.30	0.391	3.2546
26.00	4.47	28.00	5.32	0.425	3.4013
28.00	5.32	29.00	5.54	0.213	3.4050
29.00	4.42	30.00	4.59	0.173	3.2935

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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Date: 10/21/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\RR2 Temporary.

Wall Height, H= 15

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

Rigid Wall Condition -- No movement or deflection of the wall are allowed.

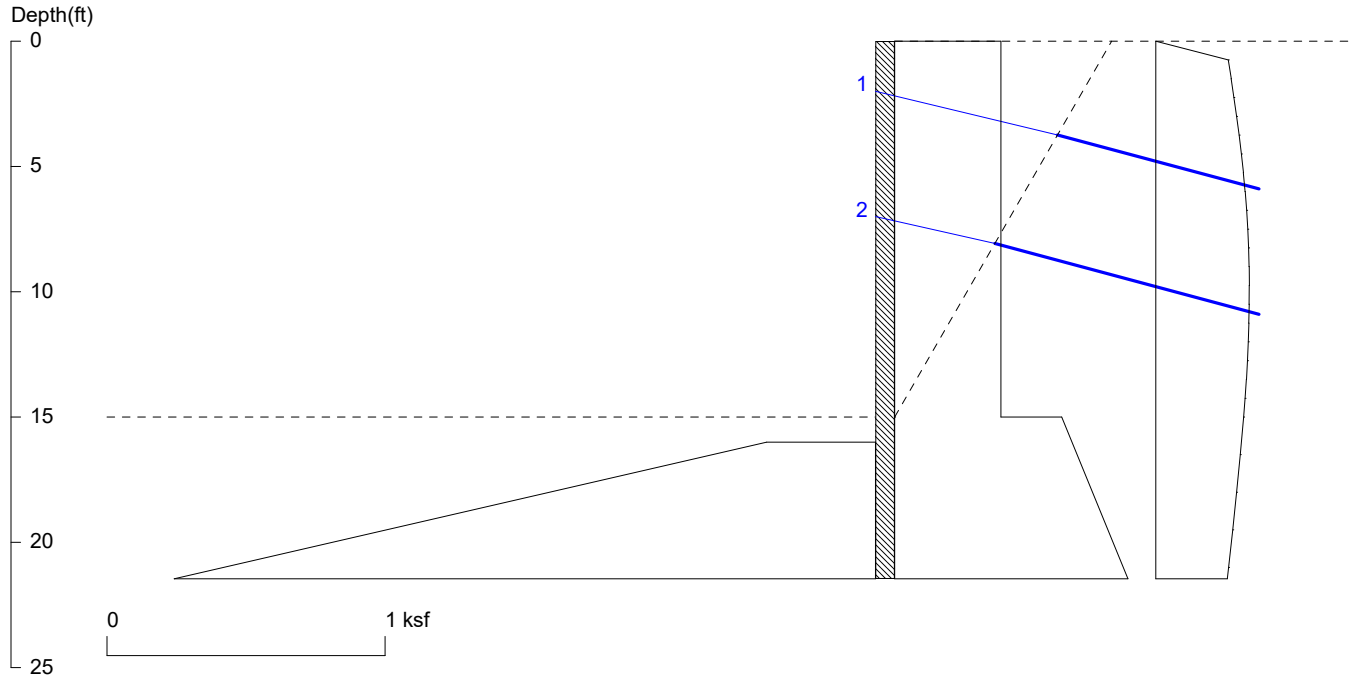
Max. Pressure = 0.336 at depth = 9.75

X	Line Load
25.5	.20

X	Width	Strip Load
.0	5.0	.25
5.0	30.0	.25
21.0	9.0	1.26

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 15' Temporary



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File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\15' Temporary.sh8

Wall Height=15.0 Pile Diameter=1.2 Pile Spacing=6.5 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=6.45 Min. Pile Length=21.45

MOMENT IN PILE: Max. Moment=57.58 per Pile Spacing=6.5 at Depth=12.89

PILE SELECTION:

Request Min. Section Modulus = 25.1 in³/pile=411.73 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	2.0	15.0	6.5	24.2*	23.3	6.3	6.7	15.9
2. Tieback	7.0	15.0	6.5	36.9	35.7	9.6	4.1	24.4

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.382	15.000	0.382	0.000000
*	Below	Base		
15.000	0.601	26.000	1.006	0.036871
*	Sur-	charge		
0.000	0.000	0.750	0.261	0.347599
0.750	0.261	1.500	0.271	0.014023
1.500	0.271	2.250	0.281	0.013545
2.250	0.281	3.000	0.291	0.012846
3.000	0.291	3.750	0.300	0.011947
3.750	0.300	4.500	0.308	0.010871

4.500	0.308	5.250	0.315	0.009649
5.250	0.315	6.000	0.322	0.008313
6.000	0.322	6.750	0.327	0.006894
6.750	0.327	7.500	0.331	0.005425
7.500	0.331	8.250	0.334	0.003936
8.250	0.334	9.000	0.336	0.002455
9.000	0.336	9.750	0.336	0.001008
9.750	0.336	10.500	0.336	-0.000384
10.500	0.336	11.250	0.335	-0.001704
11.250	0.335	12.000	0.333	-0.002938
12.000	0.333	12.750	0.330	-0.004075
12.750	0.330	13.500	0.326	-0.005109
13.500	0.326	14.250	0.321	-0.006036
14.250	0.321	15.000	0.316	-0.006855
15.000	0.316	16.500	0.304	-0.007873
16.500	0.304	18.000	0.291	-0.008897
18.000	0.291	19.500	0.277	-0.009561
19.500	0.277	21.000	0.262	-0.009920
21.000	0.262	22.500	0.247	-0.010029

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
16.000	0.391	26.000	4.296	0.390551

ACTIVE SPACING:

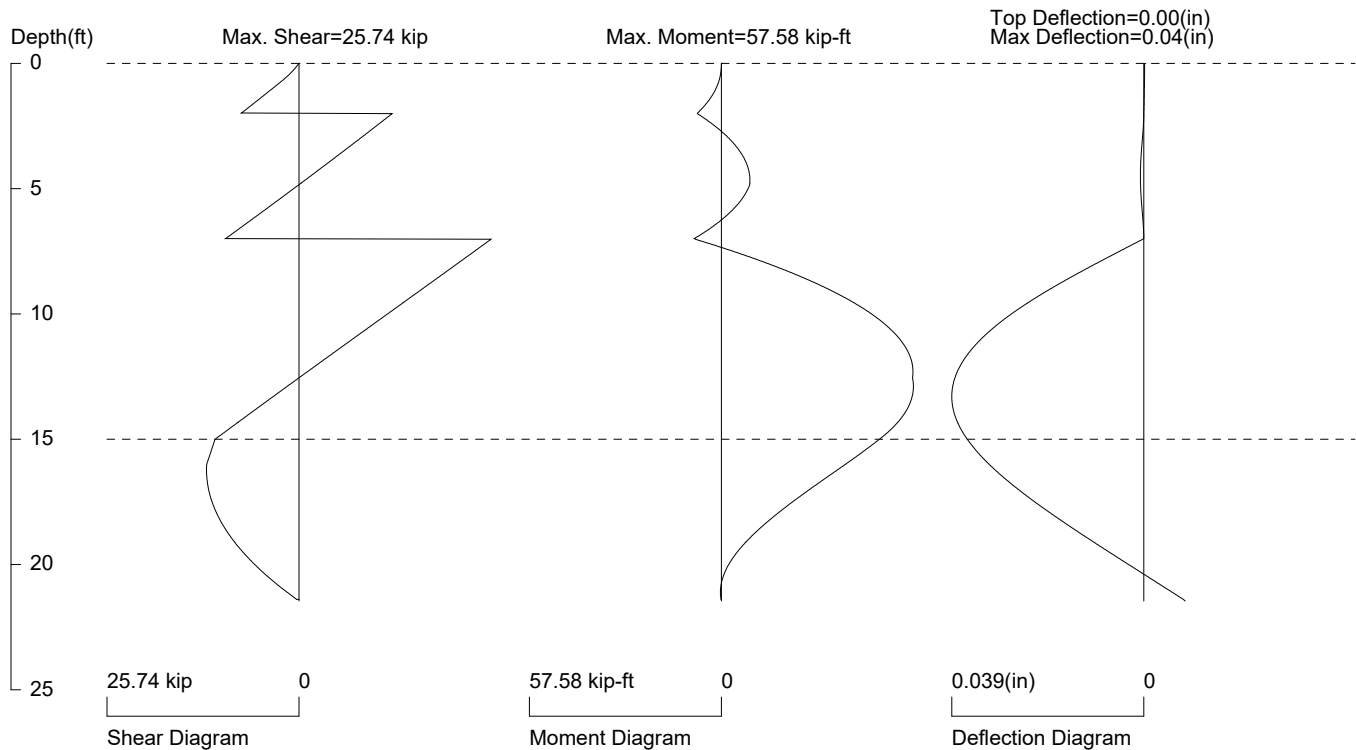
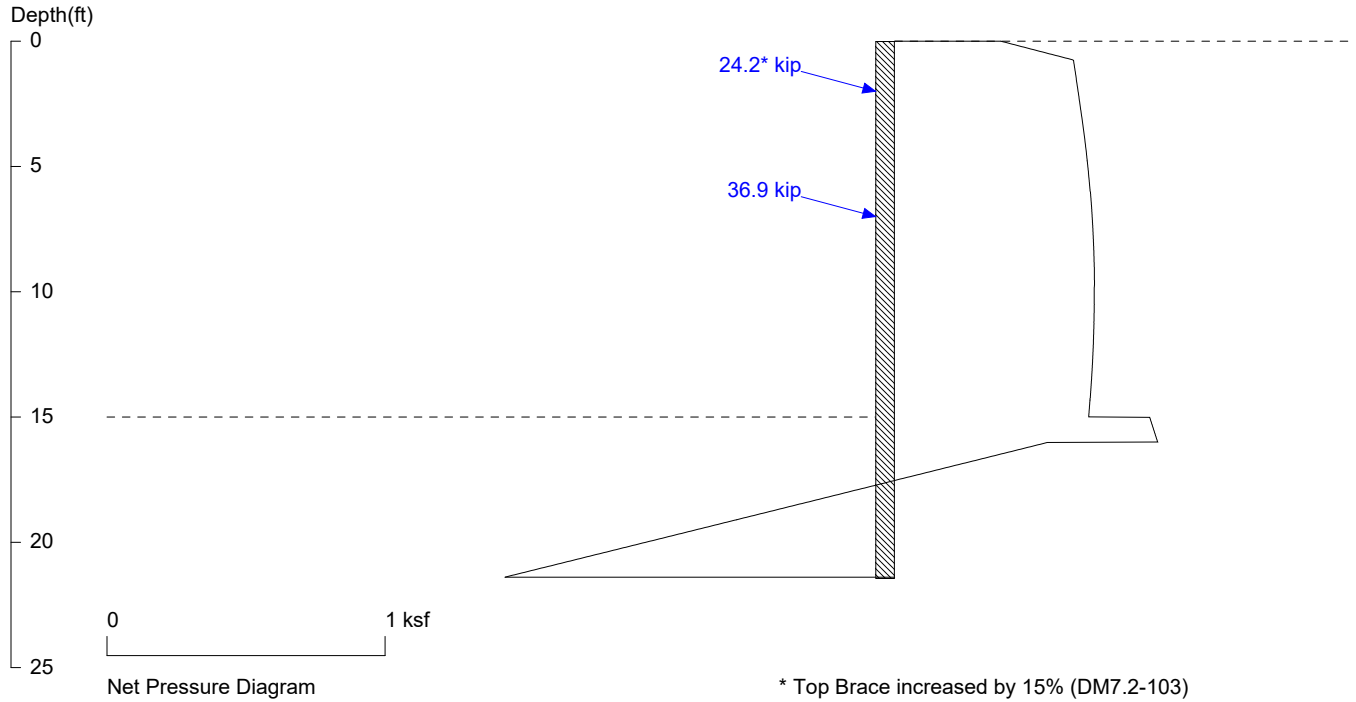
No.	Z depth	Spacing
1	0.00	6.50
2	15.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	15.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 15' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.5 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

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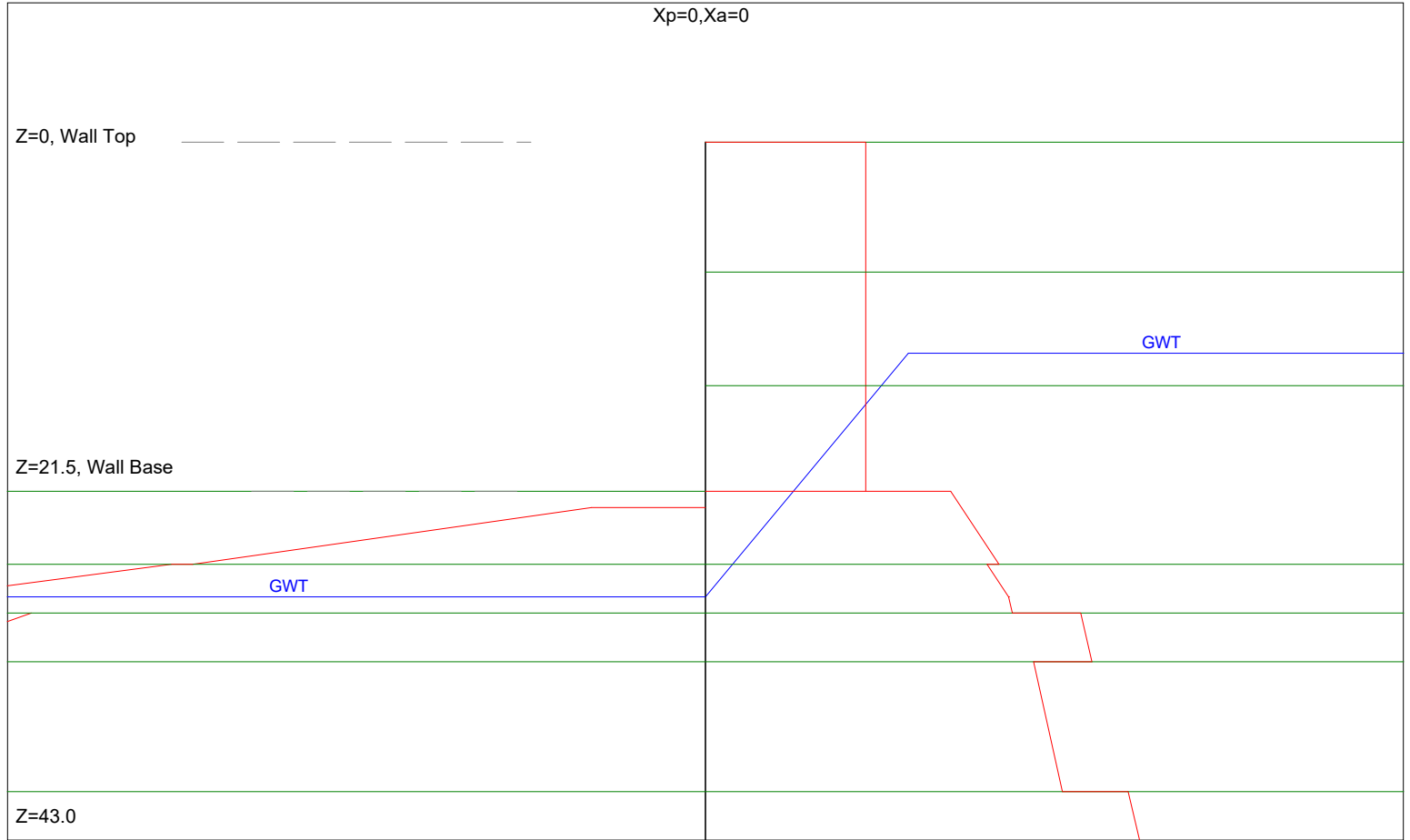
Calculation Sheet #175

146th South 21.5' Permanent

Xp=86.0

Xa=86.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/11/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\21.5' Permanent.ep8

* INPUT DATA *

Wall Height=21.5 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	21.5	0.0	21.5	800.0	2	ML
2	26.0	0.0	26.0	800.0	1	SM
3	29.0	0.0	29.0	800.0	3	CL
4	32.0	0.0	32.0	800.0	2	ML
5	40.0	0.0	40.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	28.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 9.09 per one linear foot (or meter) width along wall height

Total Static Force above Base= 9.09. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.55	21.50	0.55	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

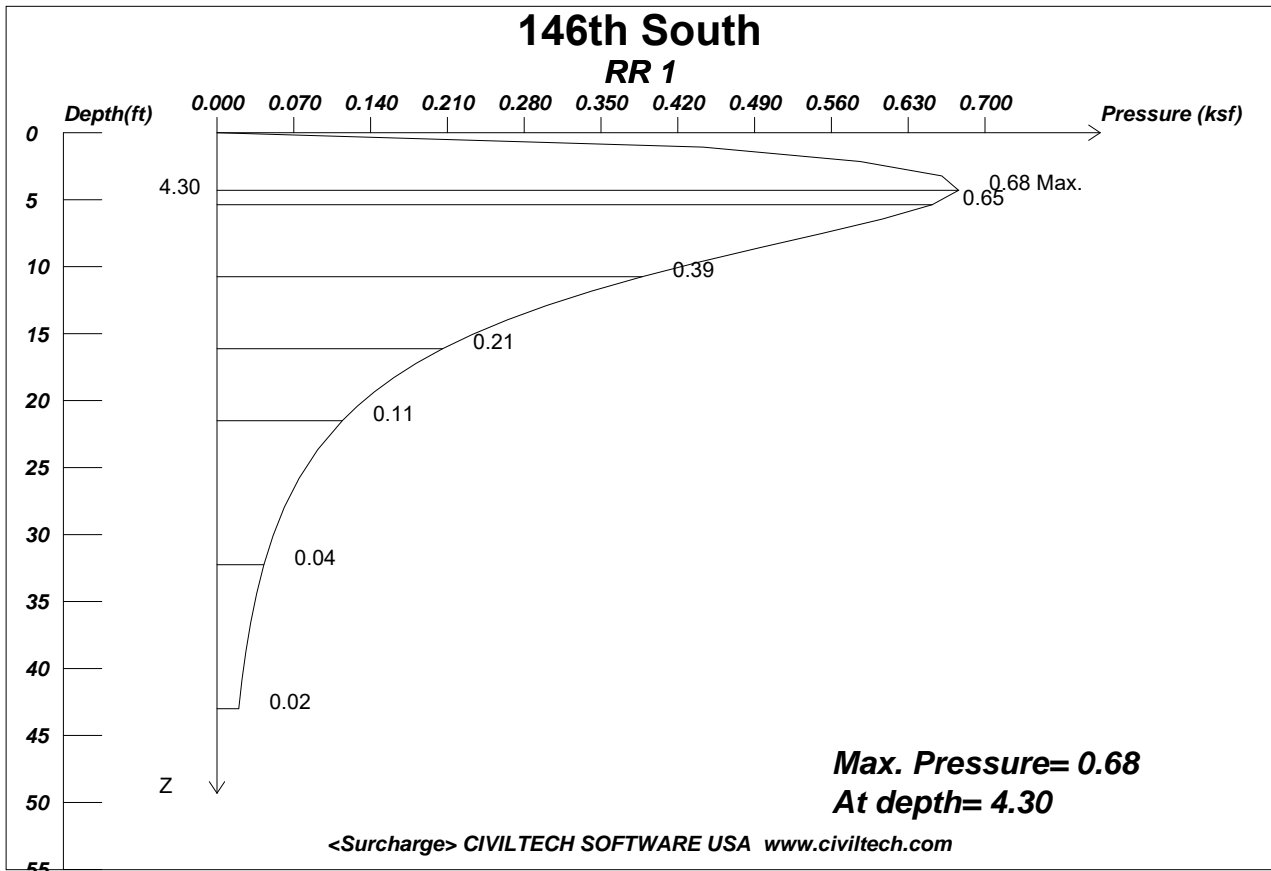
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
21.50	0.84	26.00	1.01	0.0369	0.3073
26.00	0.97	28.00	1.04	0.0368	0.2947
28.00	1.04	29.00	1.05	0.0129	0.2066
29.00	1.29	32.00	1.32	0.0128	0.2430
32.00	1.12	40.00	1.22	0.0123	0.2137
40.00	1.45	43.00	1.49	0.0131	0.2500

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
22.50	0.39	26.00	1.76	0.391	3.2546
26.00	1.83	28.00	2.68	0.425	3.3986
28.00	2.68	29.00	2.89	0.213	3.3976
29.00	2.31	32.00	2.78	0.157	2.9851
32.00	3.28	40.00	4.79	0.188	3.2574
40.00	4.03	43.00	4.47	0.146	2.7699

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/11/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\21.5' Permanent.ep8



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Date: 10/17/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\RR1.lp8

Wall Height, H= 21.5

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

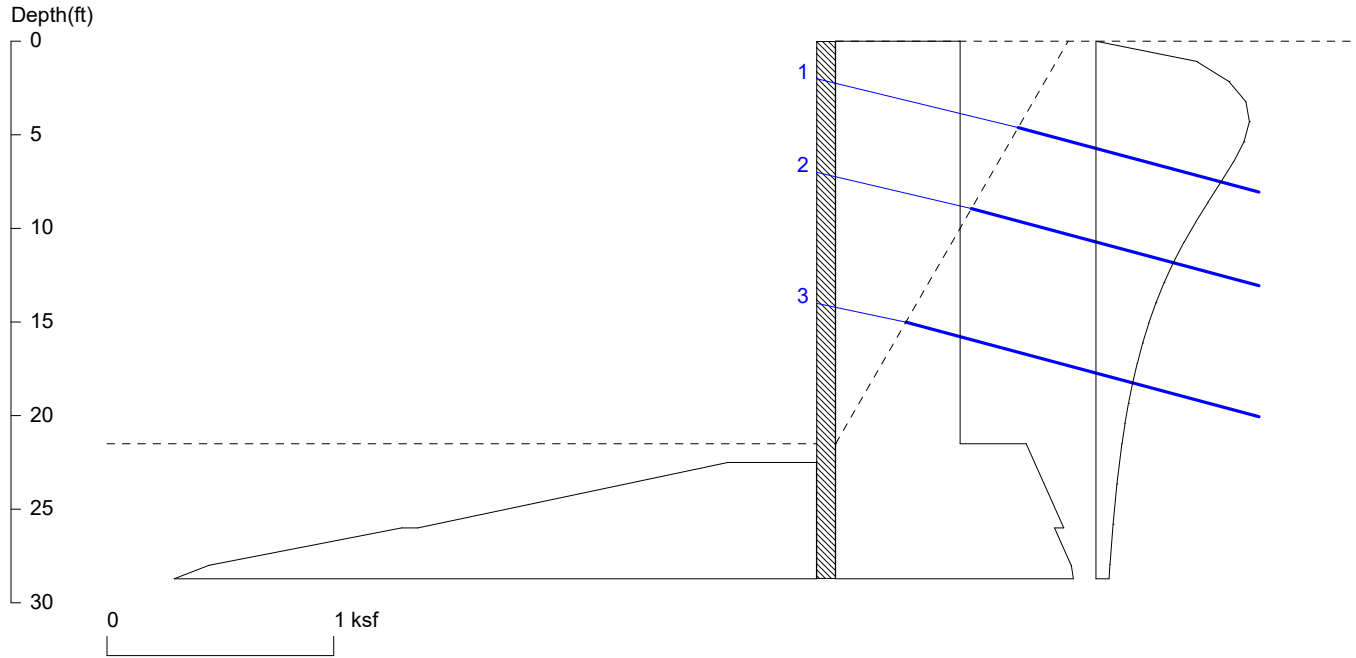
Rigid Wall Condition -- No movement or deflection of the wall are allowed.

Max. Pressure = 0.676 at depth = 4.30

X	Width	Strip Load
9.5		.20
.0	5.0	.25
5.0	10.0	.25
5.0	9.0	1.26

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 21.5' Permanent



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Date: 12/30/2024

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Wall Height=21.5 Pile Diameter=1.2 Pile Spacing=6.5 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=7.22 Min. Pile Length=28.72

MOMENT IN PILE: Max. Moment=54.33 per Pile Spacing=6.5 at Depth=19.68

PILE SELECTION:

Request Min. Section Modulus = 23.7 in³/pile=388.46 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	2.0	15.0	6.5	39.5*	38.1	10.2	10.1	26.0
2. Tieback	7.0	15.0	6.5	41.5	40.1	10.7	7.5	27.4
3. Tieback	14.0	15.0	6.5	48.1	46.5	12.5	3.9	31.8

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.549	21.50	0.549	0.000000
*	Below	Base		
21.50	0.840	26.00	1.006	0.036871
26.00	0.965	28.00	1.039	0.036841
28.00	1.039	29.00	1.052	0.012933
*	Sur-	charg		
0.000	0.000	1.075	0.443	0.412170
1.075	0.443	2.150	0.586	0.133172
2.150	0.586	3.225	0.661	0.069149

3.225	0.661	4.300	0.676	0.014239
4.300	0.676	5.375	0.652	-0.02228
5.375	0.652	6.450	0.606	-0.04245
6.450	0.606	7.525	0.551	-0.05132
7.525	0.551	8.600	0.494	-0.05328
8.600	0.494	9.675	0.439	-0.05138
9.675	0.439	10.75	0.387	-0.04753
10.75	0.387	11.82	0.341	-0.04288
11.82	0.341	12.90	0.300	-0.03807
12.90	0.300	13.97	0.264	-0.03347
13.97	0.264	15.05	0.233	-0.02924
15.05	0.233	16.12	0.206	-0.02545
16.12	0.206	17.20	0.182	-0.02211
17.20	0.182	18.27	0.161	-0.01920
18.27	0.161	19.35	0.143	-0.01668
19.35	0.143	20.42	0.128	-0.01451
20.42	0.128	21.50	0.114	-0.01264
21.50	0.114	23.65	0.092	-0.01035
23.65	0.092	25.80	0.075	-0.00796
25.80	0.075	27.95	0.061	-0.00618
27.95	0.061	30.10	0.051	-0.00485

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
22.50	0.391	26.00	1.757	0.390551
26.00	1.830	28.00	2.680	0.424828
28.00	2.680	29.00	2.892	0.212691

ACTIVE SPACING:

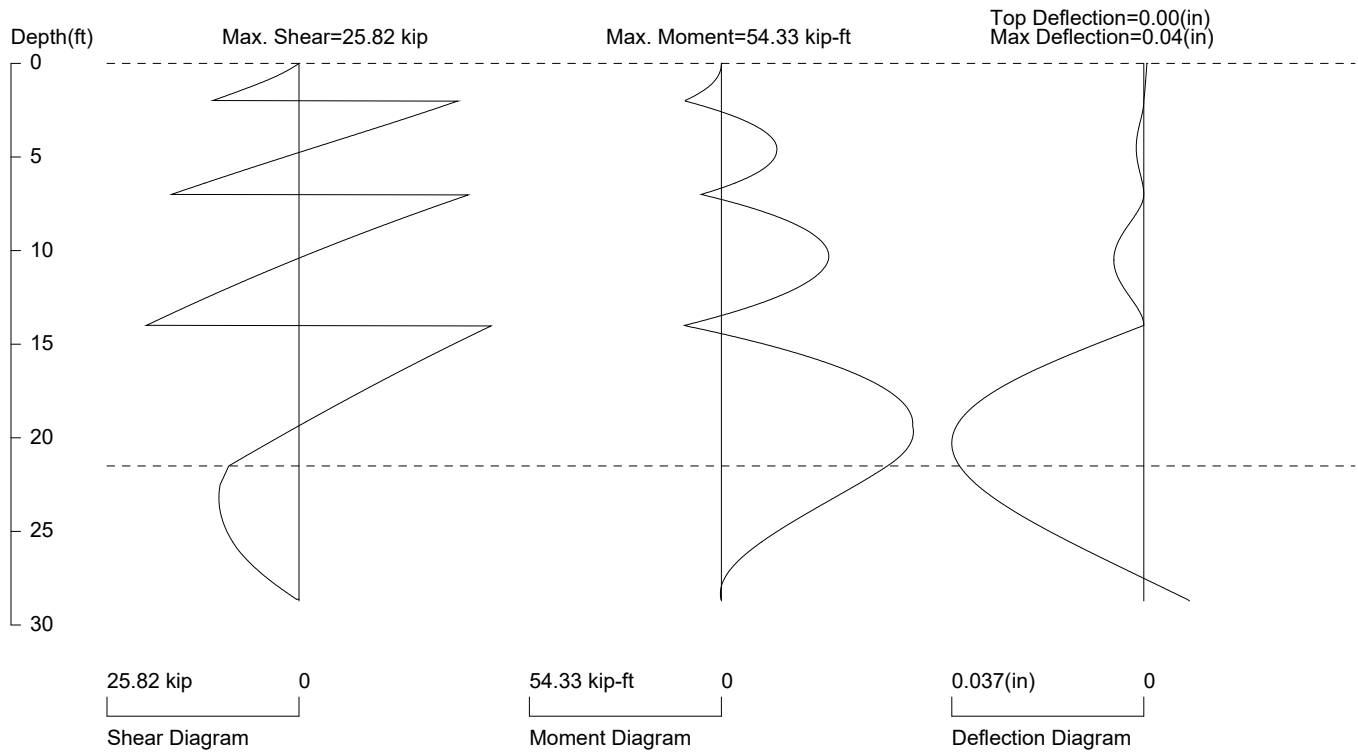
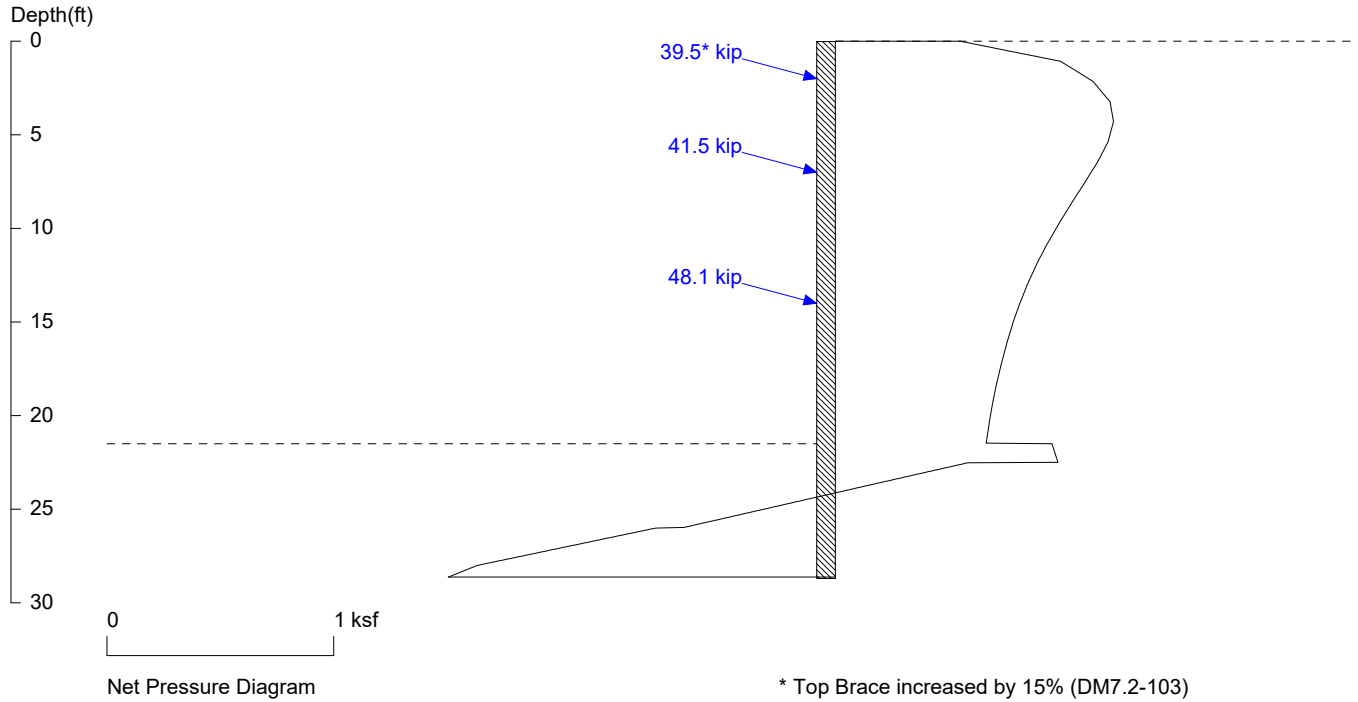
No.	Z depth	Spacing
1	0.00	6.50
2	21.50	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	21.50	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 21.5' Permanent



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.5 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

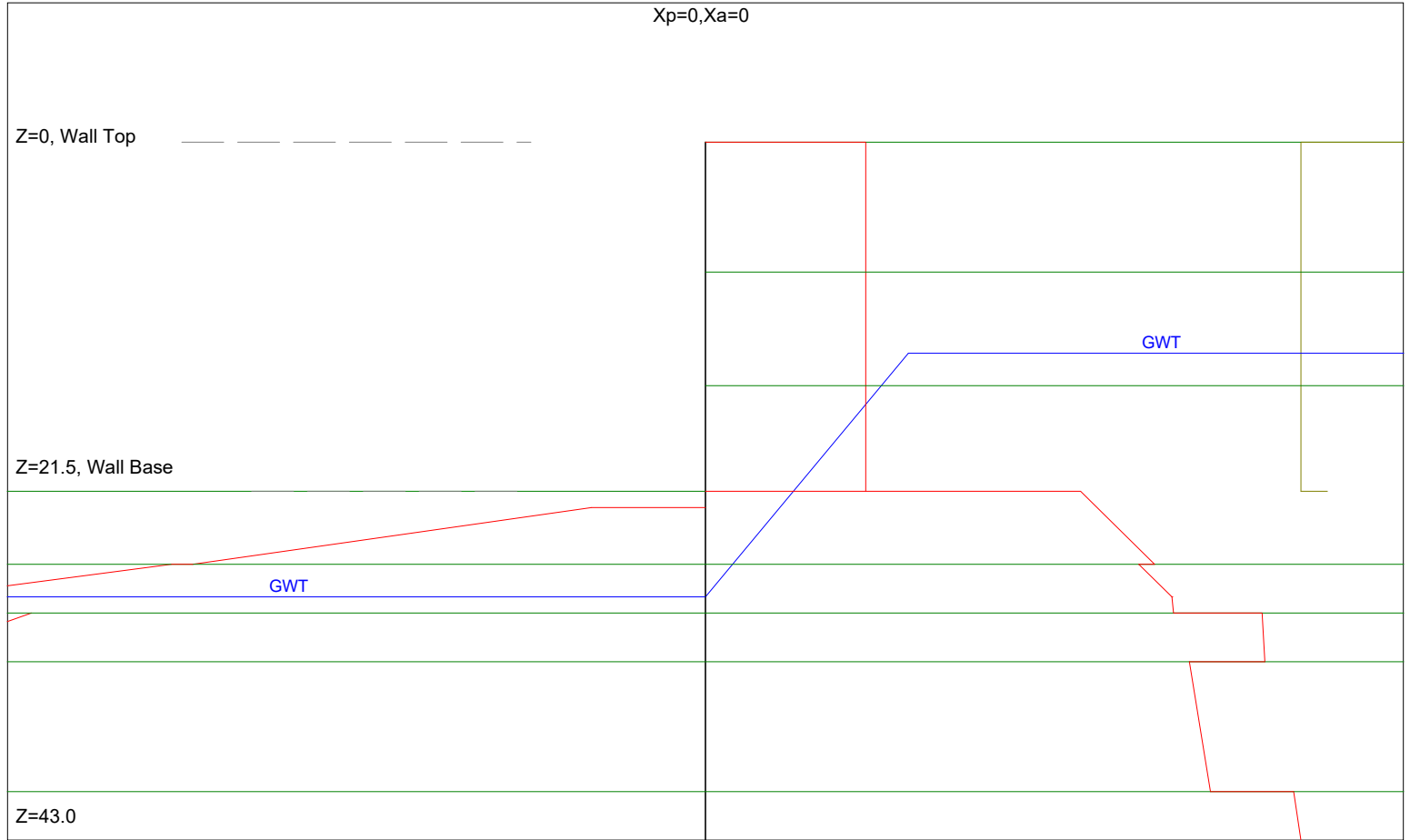
File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\21.5' Permanent.sh8

146th South 21.5' Seismic

Xp=86.0

Xa=86.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/11/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\21.5' Seismic.ep8

* INPUT DATA *

Wall Height=21.5 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	21.5	0.0	21.5	800.0	2	ML
2	26.0	0.0	26.0	800.0	1	SM
3	29.0	0.0	29.0	800.0	3	CL
4	32.0	0.0	32.0	800.0	2	ML
5	40.0	0.0	40.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	28.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 13.94 per one linear foot (or meter) width along wall height

Total Static Force above Base= 9.09. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Total Earthquake Force above Base= 4.85. Distributed in trapezoid. Total earthquake force acting at 0.4H below wall top.

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.55	21.50	0.55	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
21.50	1.29	26.00	1.54	0.0564	0.4701
26.00	1.49	28.00	1.60	0.0567	0.4535
28.00	1.60	29.00	1.60	0.0054	0.0857
29.00	1.91	32.00	1.92	0.0032	0.0600
32.00	1.66	40.00	1.73	0.0090	0.1571
40.00	2.02	43.00	2.04	0.0084	0.1593

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
22.50	0.39	26.00	1.76	0.391	3.2546
26.00	1.83	28.00	2.68	0.425	3.3986
28.00	2.68	29.00	2.89	0.213	3.3976
29.00	2.31	32.00	2.78	0.157	2.9851
32.00	3.28	40.00	4.79	0.188	3.2574
40.00	4.03	43.00	4.47	0.146	2.7699

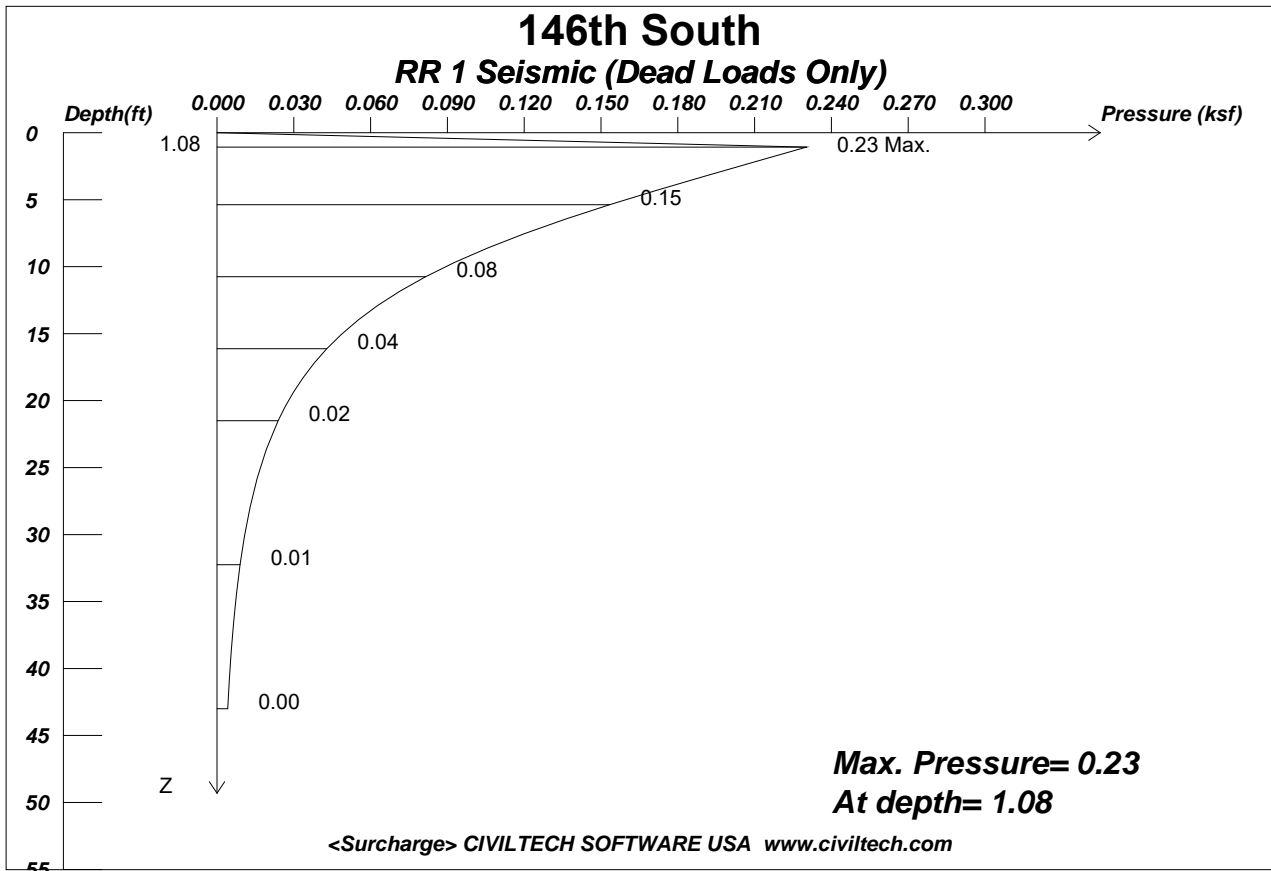
Output Earthquake Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Total Earthq. Force, Ee = 4.85

No	Zq1	Pq1	Zq2	Pq2	Slope
0	0.00	0.361	21.50	0.090	-0.013

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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Date: 10/17/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\RR1 Seismic.lp8

Wall Height, H= 21.5

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

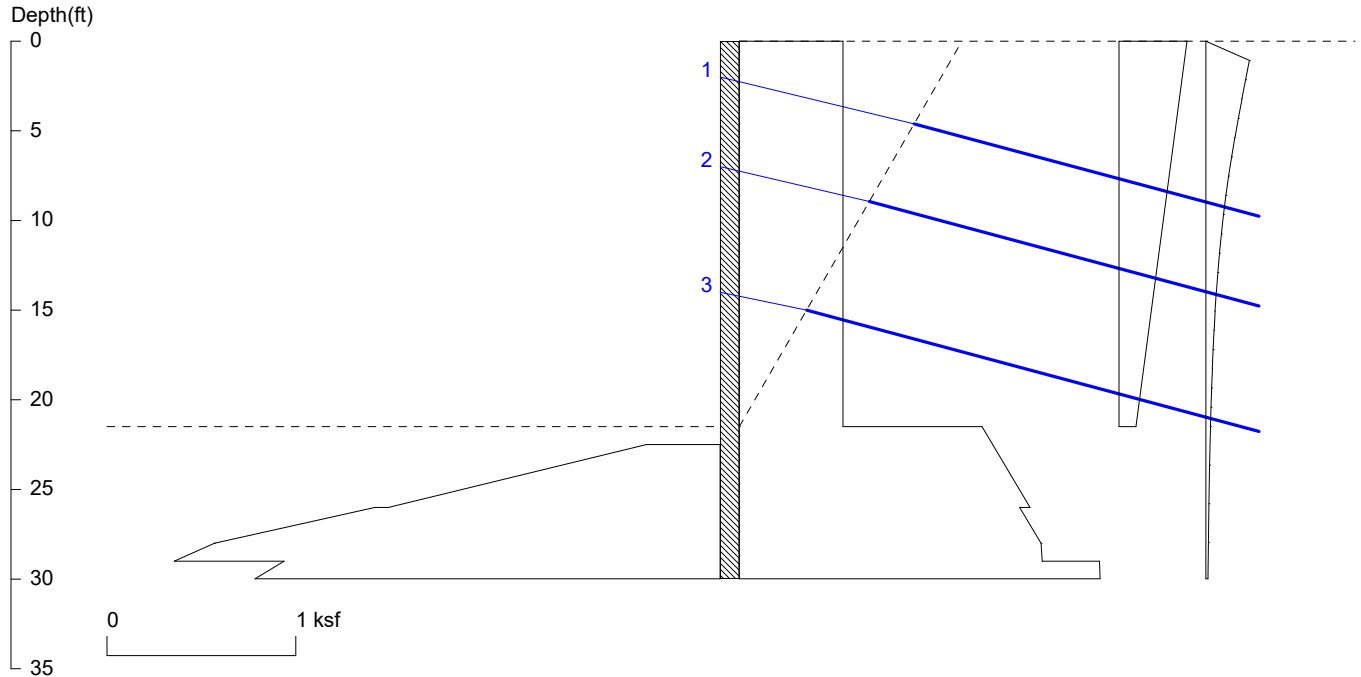
Rigid Wall Condition -- No movement or deflection of the wall are allowed.

Max. Pressure = 0.230 at depth = 1.08

X	Width	Line Load	Strip Load
9.5		.20	
.0	5.0		.25
5.0	10.0		.25

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 21.5' Seismic



Licensed to 4324324234 3424343 Date: 12/30/2024
 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\21.5' Seismic.sh8

Wall Height=21.5 Pile Diameter=1.2 Pile Spacing=6.5 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=8.48 Min. Pile Length=29.98
 MOMENT IN PILE: Max. Moment=58.79 per Pile Spacing=6.5 at Depth=19.88

PILE SELECTION:
 Request Min. Section Modulus = 25.7 in³/pile=420.41 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55
 HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!
 Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	2.0	15.0	6.5	39.9*	38.5	10.3	10.1	26.3
2. Tieback	7.0	15.0	6.5	35.0	33.8	9.1	7.5	23.1
3. Tieback	14.0	15.0	6.5	47.5	45.9	12.3	3.9	31.3

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.549	21.50	0.549	0.000000
*	Below	Base		
21.50	1.286	26.00	1.539	0.056406
26.00	1.485	28.00	1.599	0.056693
28.00	1.599	29.00	1.604	0.005368
29.00	1.908	32.00	1.917	0.003157
*	Earth	Queck		
0.000	0.361	21.50	0.090	-0.01260
*	Sur-	charg		

0.000	0.000	1.075	0.230	0.214168
1.075	0.230	2.150	0.210	-0.01836
2.150	0.210	3.225	0.191	-0.01820
3.225	0.191	4.300	0.172	-0.01780
4.300	0.172	5.375	0.153	-0.01708
5.375	0.153	6.450	0.136	-0.01606
6.450	0.136	7.525	0.120	-0.01480
7.525	0.120	8.600	0.106	-0.01341
8.600	0.106	9.675	0.093	-0.01199
9.675	0.093	10.75	0.082	-0.01060
10.75	0.082	11.82	0.072	-0.00930
11.82	0.072	12.90	0.063	-0.00811
12.90	0.063	13.97	0.055	-0.00705
13.97	0.055	15.05	0.049	-0.00612
15.05	0.049	16.12	0.043	-0.00530
16.12	0.043	17.20	0.038	-0.00459
17.20	0.038	18.27	0.034	-0.00398
18.27	0.034	19.35	0.030	-0.00346
19.35	0.030	20.42	0.027	-0.00301
20.42	0.027	21.50	0.024	-0.00262
21.50	0.024	23.65	0.019	-0.00215
23.65	0.019	25.80	0.016	-0.00165
25.80	0.016	27.95	0.013	-0.00129
27.95	0.013	30.10	0.011	-0.00101

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
22.50	0.391	26.00	1.757	0.390551
26.00	1.830	28.00	2.680	0.424828
28.00	2.680	29.00	2.892	0.212691
29.00	2.310	32.00	2.781	0.157019

ACTIVE SPACING:

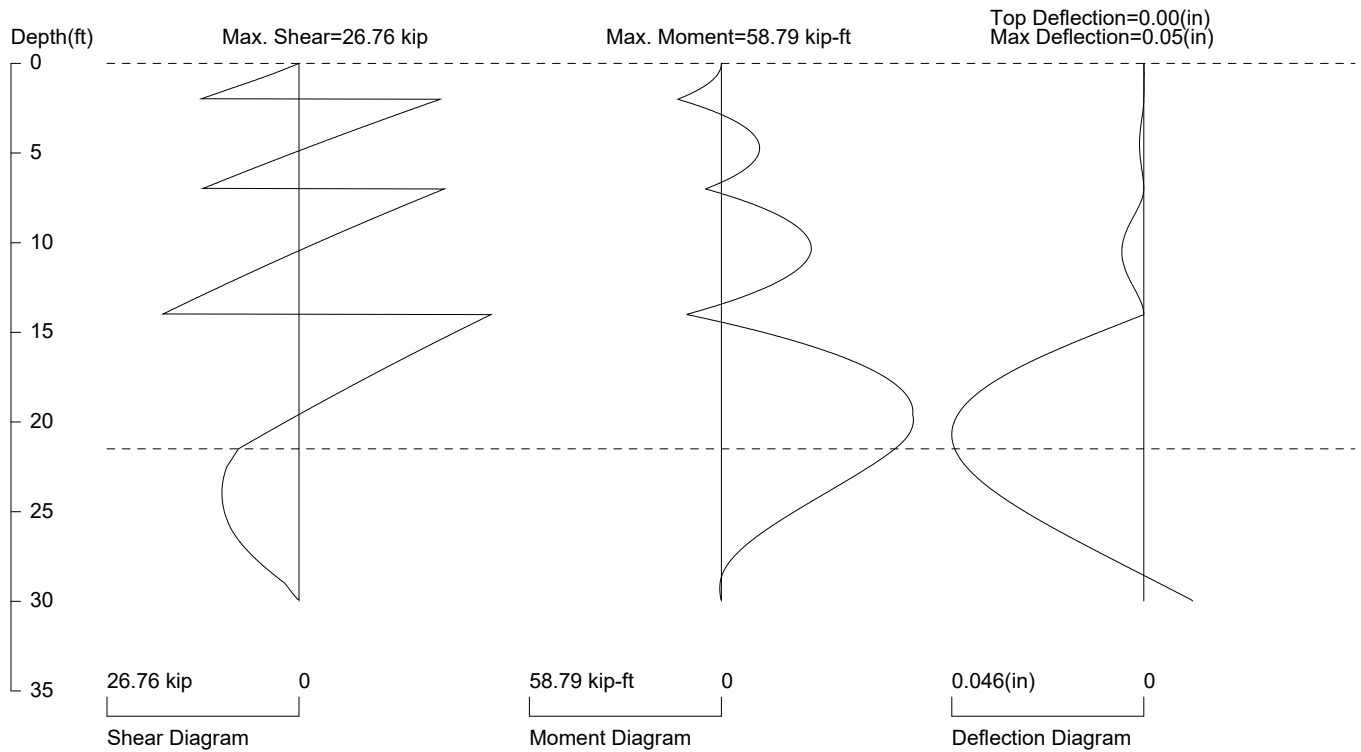
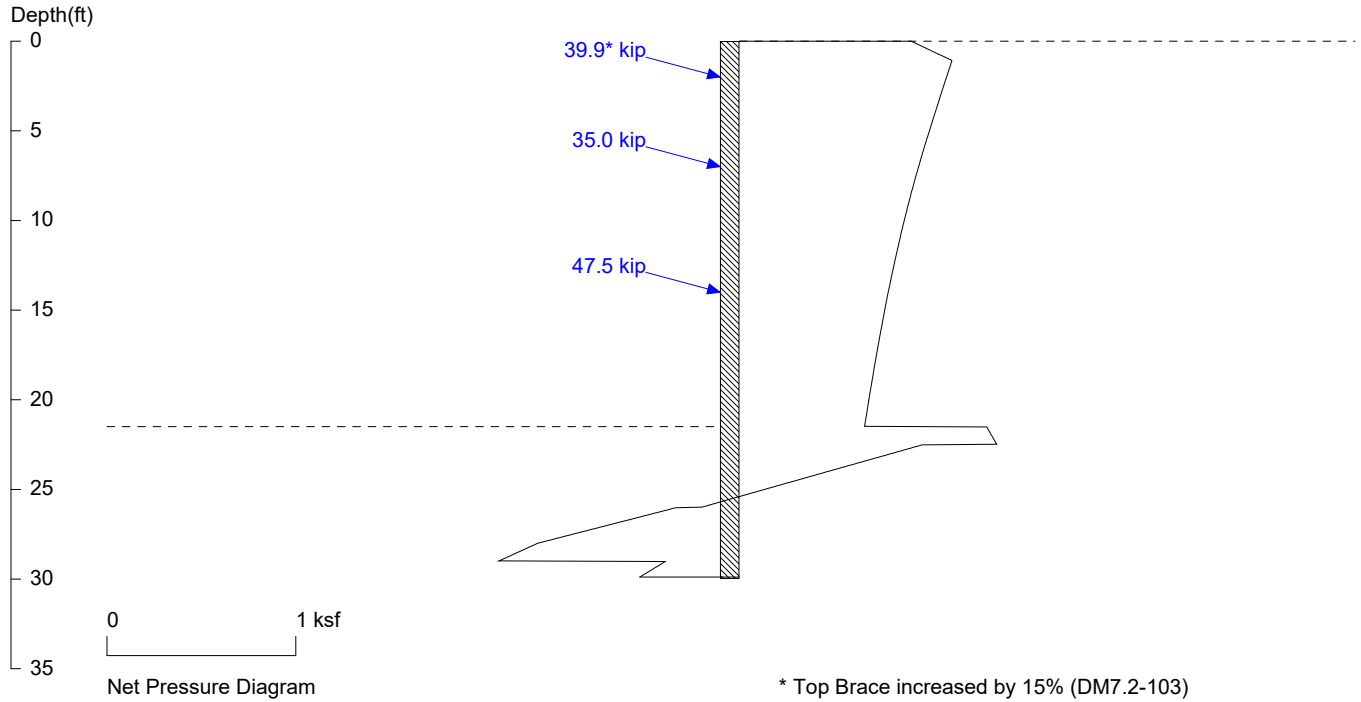
No.	Z depth	Spacing
1	0.00	6.50
2	21.50	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	21.50	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 21.5' Seismic



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 6.5 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

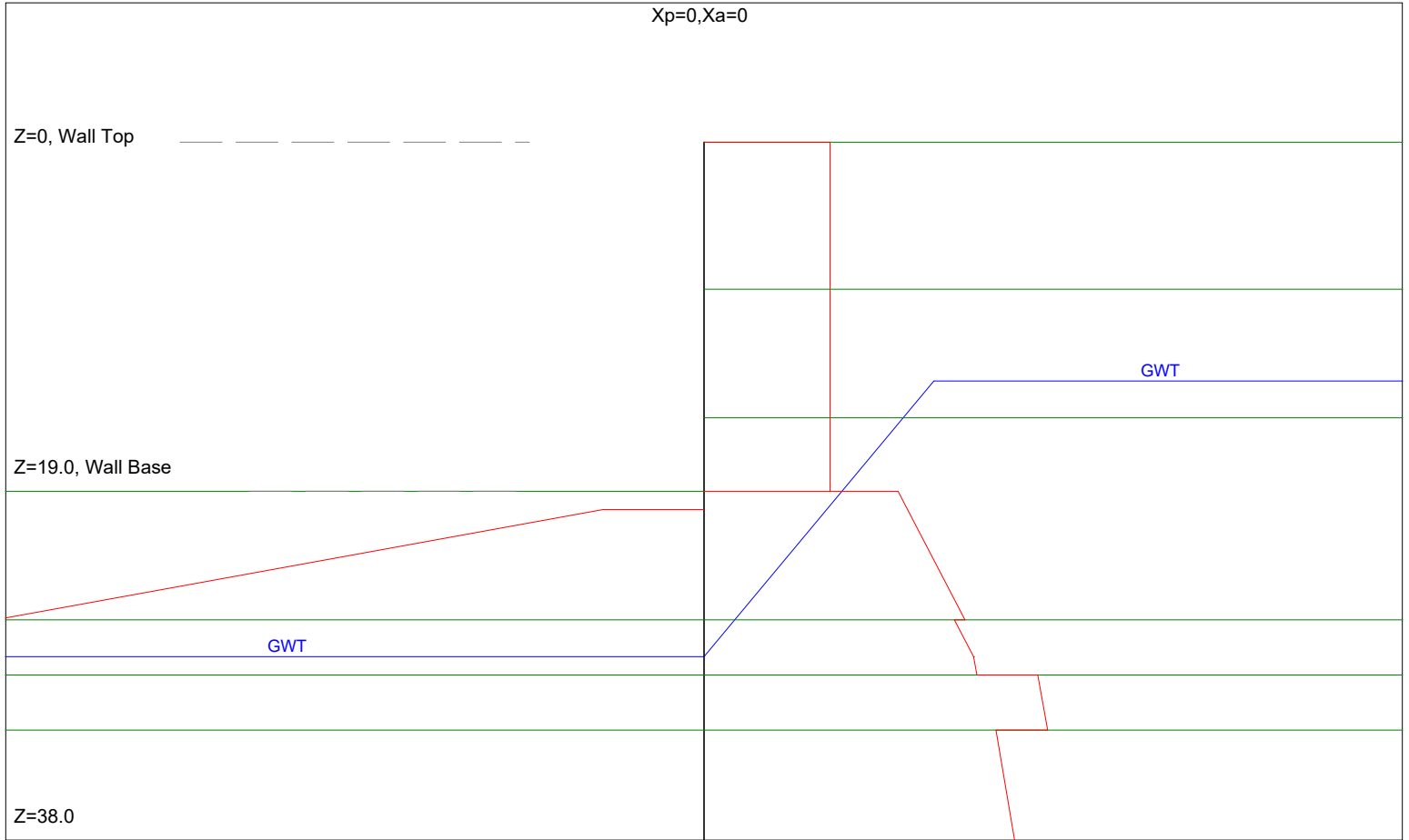
File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\21.5' Seismic.sh8

146th South 19' Temporary

Xp=76.0

Xa=76.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/14/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\19' Temporary.ep8

* INPUT DATA *

Wall Height=19.0 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	19.0	0.0	19.0	800.0	2	ML
2	26.0	0.0	26.0	800.0	1	SM
3	29.0	0.0	29.0	800.0	3	CL
4	32.0	0.0	32.0	800.0	2	ML
5	40.0	0.0	40.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	28.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 7.10 per one linear foot (or meter) width along wall height

Total Static Force above Base= 7.10. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.49	19.00	0.49	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

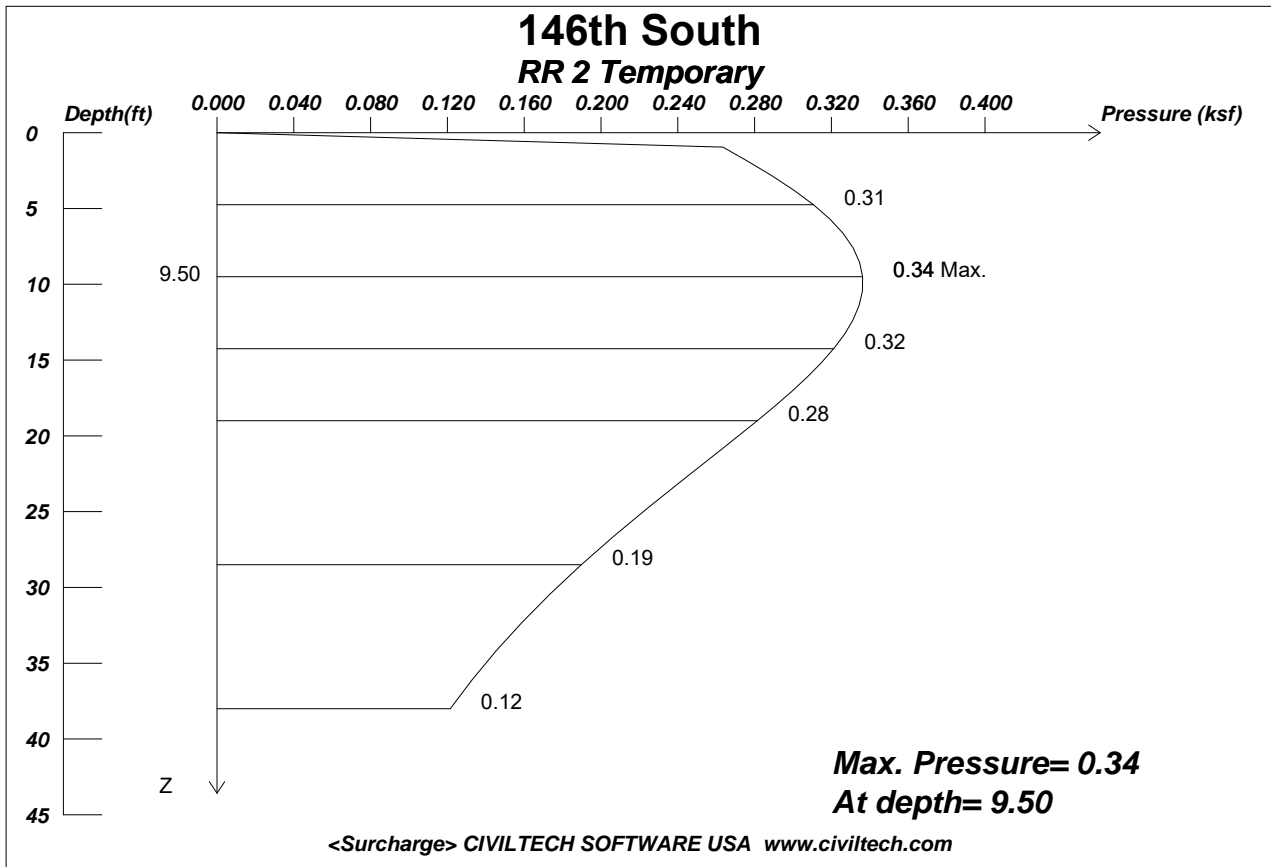
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
19.00	0.75	26.00	1.01	0.0369	0.3073
26.00	0.97	28.00	1.04	0.0368	0.2947
28.00	1.04	29.00	1.05	0.0129	0.2066
29.00	1.29	32.00	1.32	0.0128	0.2430
32.00	1.13	38.00	1.20	0.0119	0.2074

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
20.00	0.39	26.00	2.73	0.391	3.2546
26.00	2.85	28.00	3.70	0.425	3.4001
28.00	3.70	29.00	3.91	0.213	3.4010
29.00	3.12	32.00	3.60	0.160	3.0393
32.00	4.26	38.00	5.39	0.187	3.2536

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/14/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\19' Temporary.ep8



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Date: 10/17/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\RR2 Temporary.

Wall Height, H= 19

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

Rigid Wall Condition -- No movement or deflection of the wall are allowed.

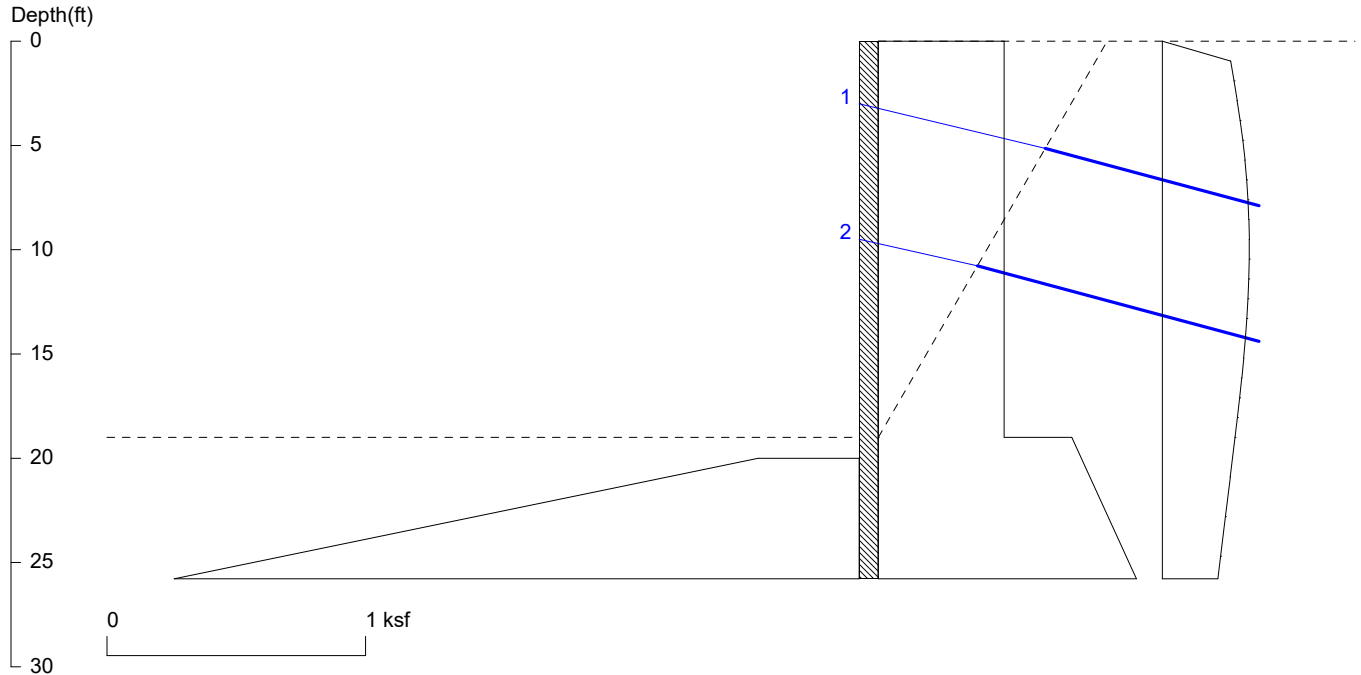
Max. Pressure = 0.336 at depth = 9.50

X	Line Load
25.5	.20

X	Width	Strip Load
.0	5.0	.25
5.0	30.0	.25
21.0	9.0	1.26

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 19' Temporary



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File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\19' Temporary.sh8

Wall Height=19.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=6.78 Min. Pile Length=25.78

MOMENT IN PILE: Max. Moment=67.36 per Pile Spacing=5.0 at Depth=16.38

PILE SELECTION:

Request Min. Section Modulus = 29.4 in³/pile=481.70 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	3.0	15.0	5.0	31.1*	30.0	8.0	8.3	20.5
2. Tieback	9.5	15.0	5.0	38.3	37.0	9.9	4.9	25.3

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.486	19.00	0.486	0.000000
*	Below	Base		
19.00	0.748	26.00	1.006	0.036871
*	Sur-	charge		
0.000	0.000	0.950	0.264	0.277399
0.950	0.264	1.900	0.277	0.013854
1.900	0.277	2.850	0.289	0.013097
2.850	0.289	3.800	0.301	0.012008
3.800	0.301	4.750	0.311	0.010634
4.750	0.311	5.700	0.319	0.009036

5.700	0.319	6.650	0.326	0.007277
6.650	0.326	7.600	0.331	0.005424
7.600	0.331	8.550	0.335	0.003540
8.550	0.335	9.500	0.336	0.001679
9.500	0.336	10.450	0.336	-0.000109
10.450	0.336	11.400	0.334	-0.001787
11.400	0.334	12.350	0.331	-0.003325
12.350	0.331	13.300	0.327	-0.004705
13.300	0.327	14.250	0.321	-0.005916
14.250	0.321	15.200	0.315	-0.006954
15.200	0.315	16.150	0.307	-0.007821
16.150	0.307	17.100	0.299	-0.008526
17.100	0.299	18.050	0.290	-0.009078
18.050	0.290	19.000	0.281	-0.009490
19.000	0.281	20.900	0.263	-0.009863
20.900	0.263	22.800	0.244	-0.010023
22.800	0.244	24.700	0.225	-0.009873
24.700	0.225	26.600	0.207	-0.009507

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
20.00	0.391	26.00	2.734	0.390551

ACTIVE SPACING:

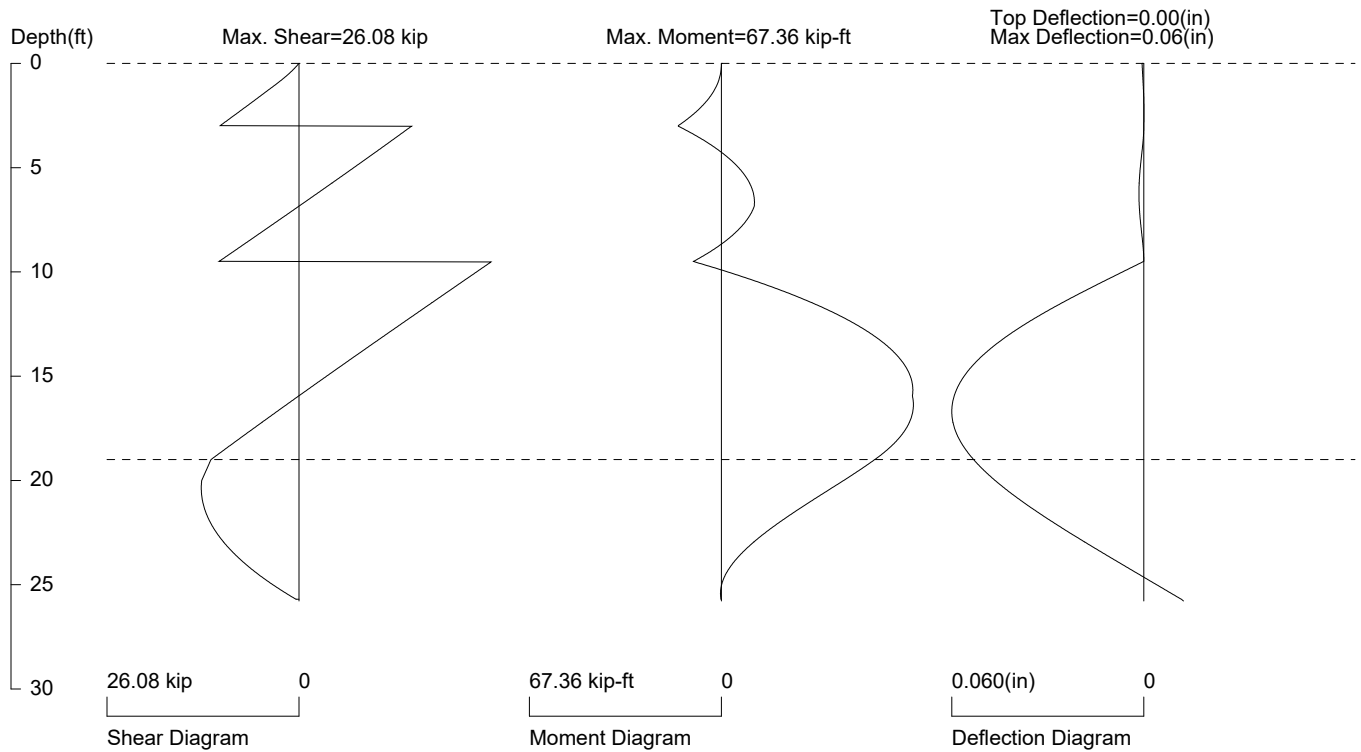
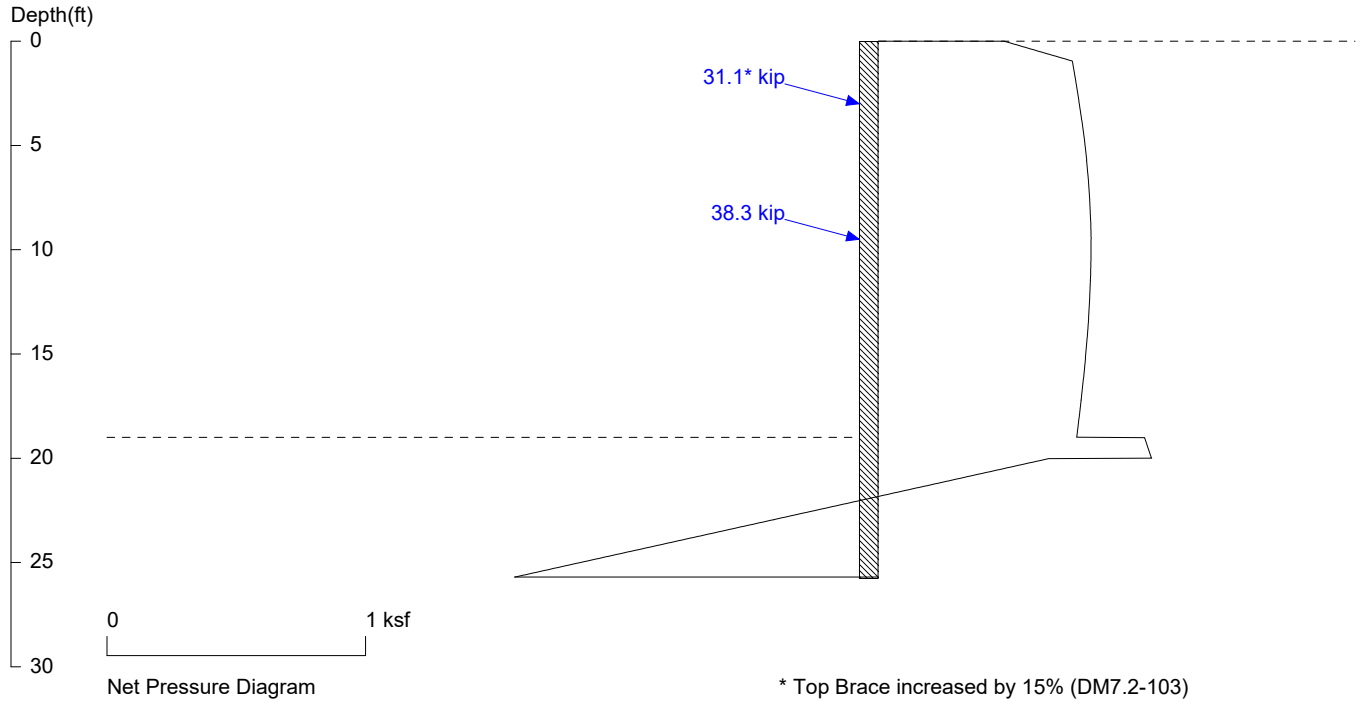
No.	Z depth	Spacing
1	0.00	5.00
2	19.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	19.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 19' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

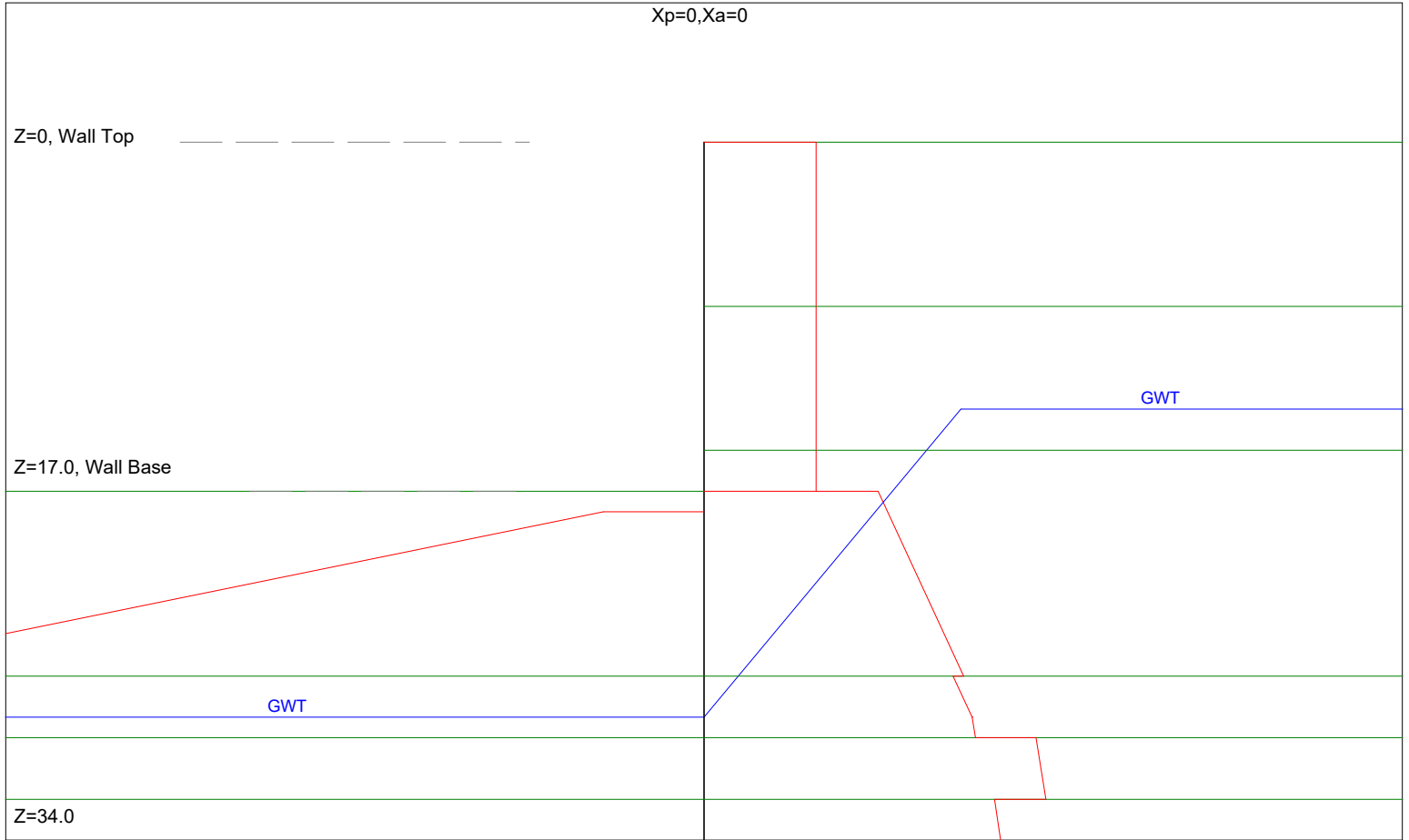
File: J:\PROJECTS\HDMI22-1474 14600 South SES\Analyses\ShoringSuite\Wall 219' Temporary.sh8

146th South 17' Permanent

Xp=68.0

Xa=68.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/11/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\17' Permanent.ep8

* INPUT DATA *

Wall Height=17.0 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	17.0	0.0	17.0	800.0	2	ML
2	26.0	0.0	26.0	800.0	1	SM
3	29.0	0.0	29.0	800.0	3	CL
4	32.0	0.0	32.0	800.0	2	ML
5	40.0	0.0	40.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	28.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 5.68 per one linear foot (or meter) width along wall height

Total Static Force above Base= 5.68. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.43	17.00	0.43	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

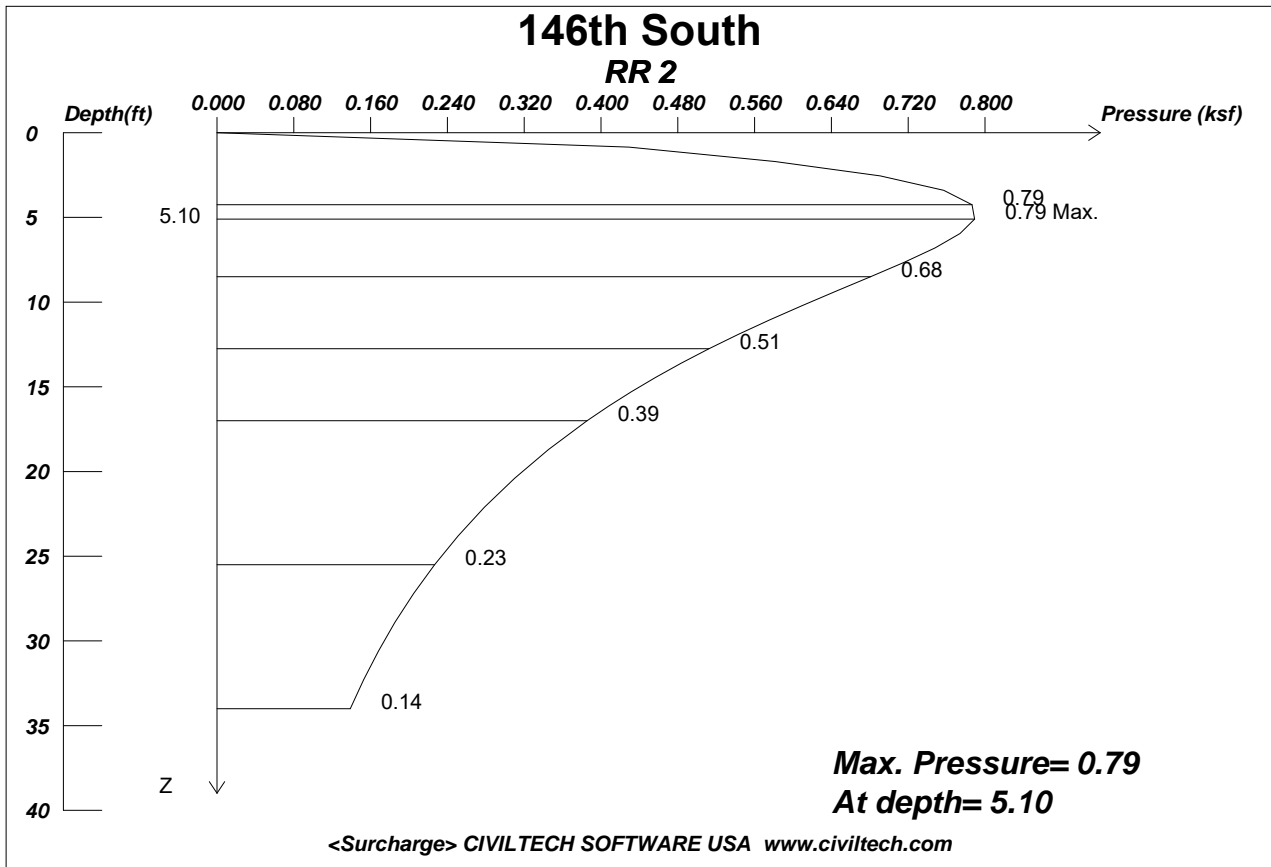
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
17.00	0.67	26.00	1.01	0.0369	0.3073
26.00	0.97	28.00	1.04	0.0368	0.2947
28.00	1.04	29.00	1.05	0.0129	0.2066
29.00	1.29	32.00	1.32	0.0128	0.2430
32.00	1.13	34.00	1.15	0.0119	0.2074

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
18.00	0.39	26.00	3.51	0.391	3.2546
26.00	3.66	28.00	4.51	0.425	3.4008
28.00	4.51	29.00	4.72	0.213	3.4032
29.00	3.77	32.00	4.26	0.162	3.0865
32.00	5.05	34.00	5.41	0.185	3.2062

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/11/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\17' Permanent.ep8



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Date: 10/17/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\RR2.lp8

Wall Height, H= 17

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

Rigid Wall Condition -- No movement or deflection of the wall are allowed.

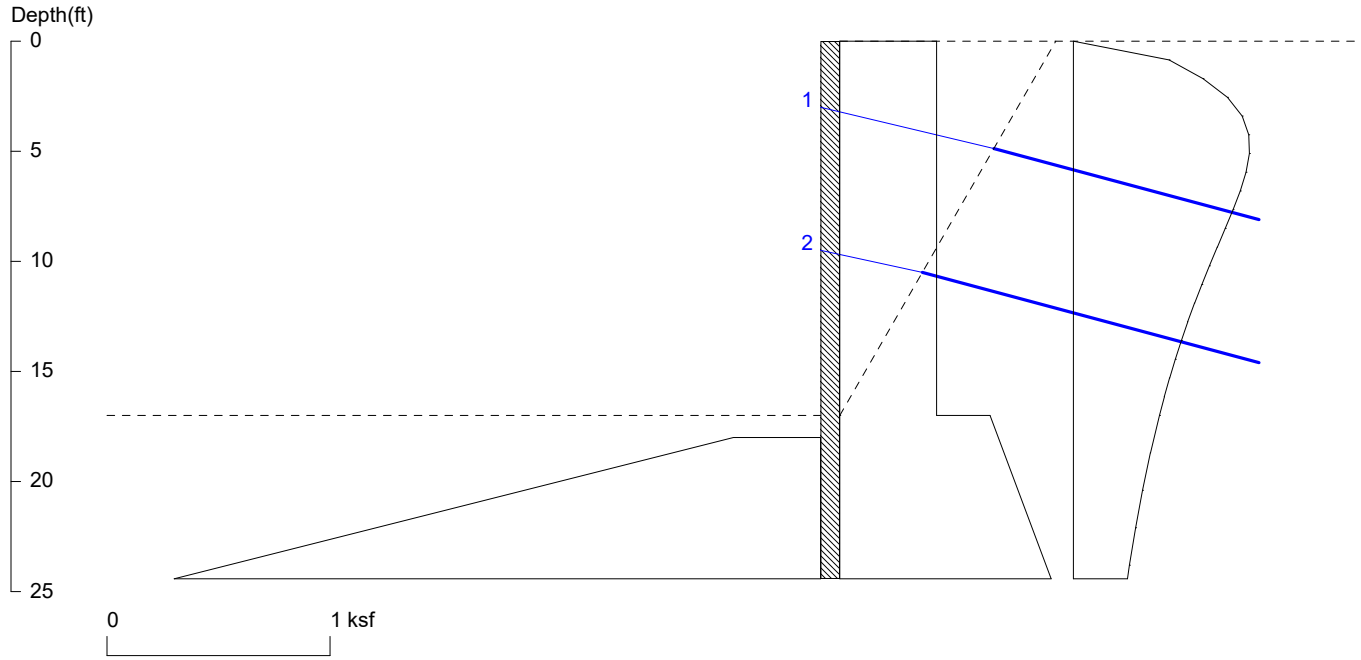
Max. Pressure = 0.789 at depth = 5.10

X	Line Load
9.5	.20
25.5	.20

X	Width	Strip Load
.0	5.0	.25
5.0	25.0	.25
5.0	9.0	1.26
21.0	9.0	.93

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 17' Permanent



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Date: 12/30/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\17' Permanent.sh8

Wall Height=17.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=7.42 Min. Pile Length=24.42

MOMENT IN PILE: Max. Moment=54.27 per Pile Spacing=5.0 at Depth=15.19

PILE SELECTION:

Request Min. Section Modulus = 23.7 in³/pile=388.10 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	3.0	15.0	5.0	43.0*	41.5	11.1	7.2	28.4
2. Tieback	9.5	15.0	5.0	43.4	41.9	11.2	3.9	28.7

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.434	17.00	0.434	0.000000
*	Below	Base		
17.00	0.674	26.00	1.006	0.036871
*	Sur-	charg		
0.000	0.000	0.850	0.429	0.504807
0.850	0.429	1.700	0.581	0.178992
1.700	0.581	2.550	0.691	0.129190
2.550	0.691	3.400	0.757	0.077649
3.400	0.757	4.250	0.786	0.034601
4.250	0.786	5.100	0.789	0.003138

5.100	0.789	5.950	0.774	-0.01780
5.950	0.774	6.800	0.748	-0.03064
6.800	0.748	7.650	0.716	-0.03780
7.650	0.716	8.500	0.681	-0.04115
8.500	0.681	9.350	0.645	-0.04208
9.350	0.645	10.20	0.610	-0.04152
10.20	0.610	11.05	0.576	-0.04009
11.05	0.576	11.90	0.543	-0.03819
11.90	0.543	12.75	0.513	-0.03608
12.75	0.513	13.60	0.484	-0.03392
13.60	0.484	14.45	0.457	-0.03179
14.45	0.457	15.30	0.431	-0.02976
15.30	0.431	16.15	0.408	-0.02785
16.15	0.408	17.00	0.386	-0.02607
17.00	0.386	18.70	0.345	-0.02365
18.70	0.345	20.40	0.310	-0.02080
20.40	0.310	22.10	0.279	-0.01836
22.10	0.279	23.80	0.251	-0.01625
23.80	0.251	25.50	0.227	-0.01442

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
18.00	0.391	26.00	3.515	0.390551

ACTIVE SPACING:

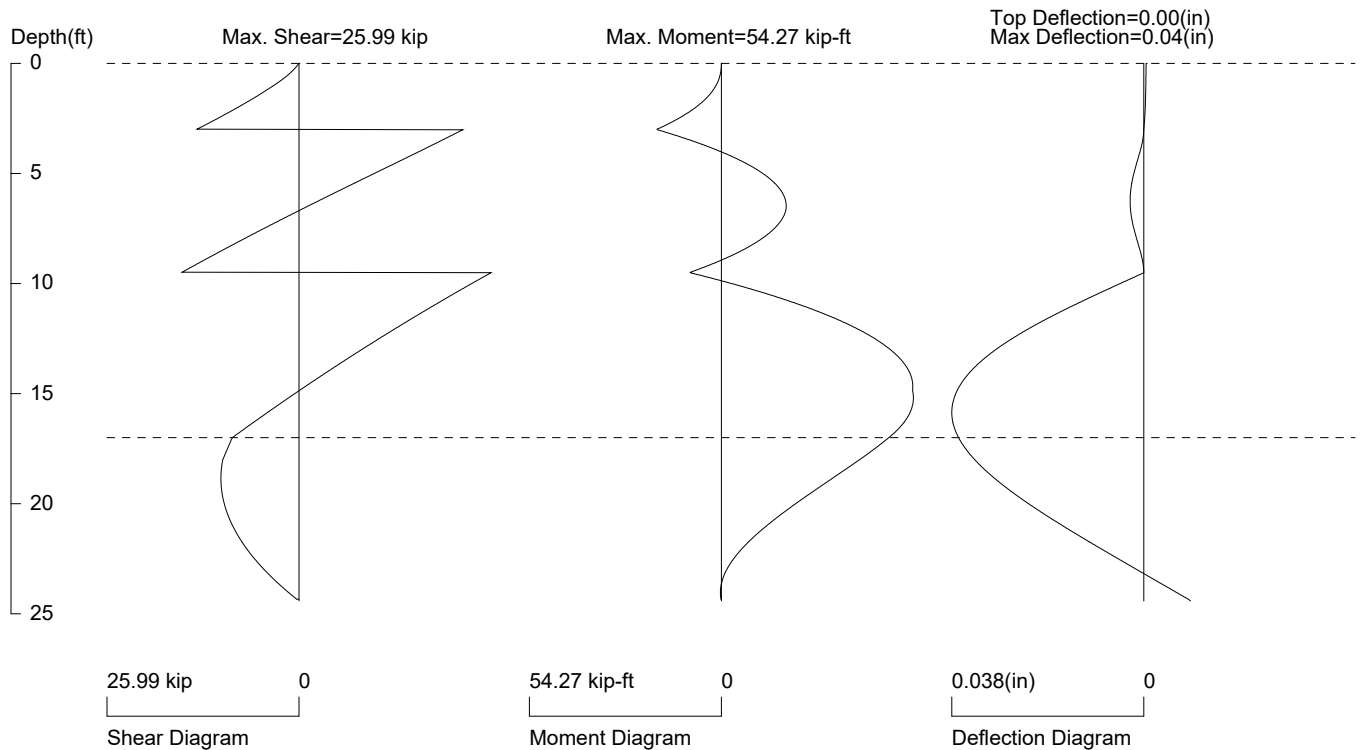
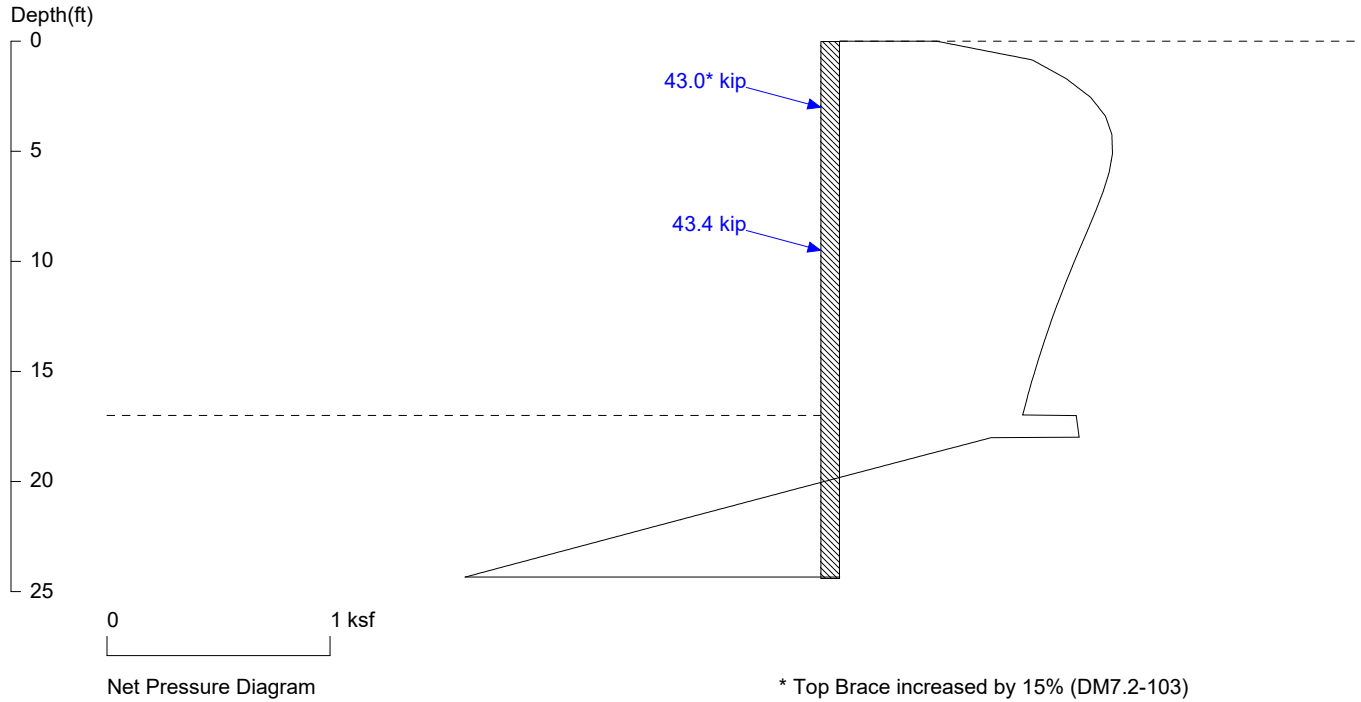
No.	Z depth	Spacing
1	0.00	5.00
2	17.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	17.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 17' Permanent



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

File: J:\PROJECTS\HDMI\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\17' Permanent.sh8

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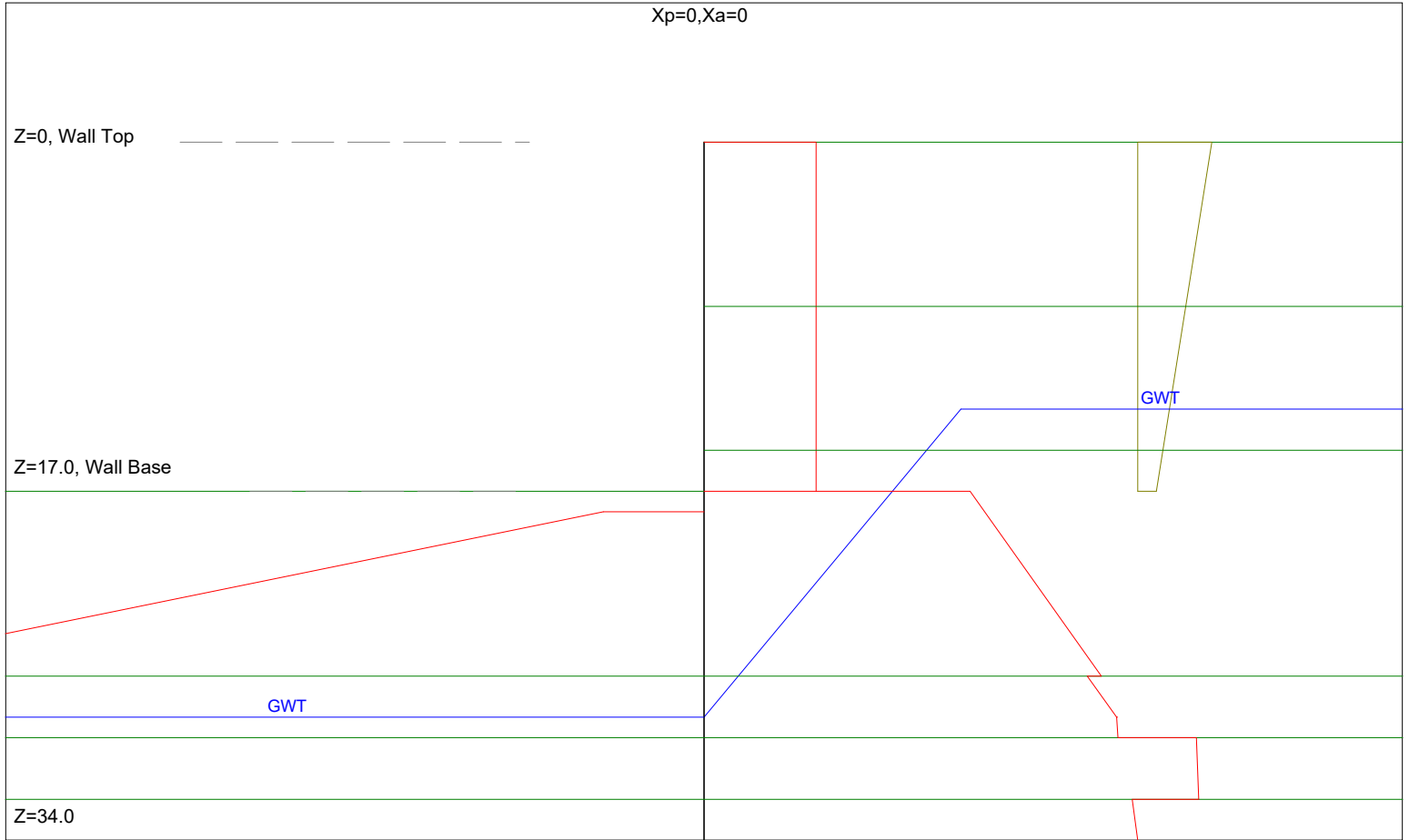
Calculation Sheet #199

146th South 17' Seismic

Xp=68.0

Xa=68.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/11/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\17' Seismic.ep8

* INPUT DATA *

Wall Height=17.0 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	17.0	0.0	17.0	800.0	2	ML
2	26.0	0.0	26.0	800.0	1	SM
3	29.0	0.0	29.0	800.0	3	CL
4	32.0	0.0	32.0	800.0	2	ML
5	40.0	0.0	40.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	28.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

*** OUTPUT RESULTS ***

Total Force above Base= 8.73 per one linear foot (or meter) width along wall height

Total Static Force above Base= 5.68. Distributed in Apparent Envelope along wall height. Ignore soil layers and water line

Total Earthquake Force above Base= 3.05. Distributed in trapezoid. Total earthquake force acting at 0.4H below wall top.

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.43	17.00	0.43	0.0000	0.0000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
17.00	1.03	26.00	1.54	0.0565	0.4708
26.00	1.49	28.00	1.60	0.0567	0.4535
28.00	1.60	29.00	1.60	0.0054	0.0857
29.00	1.91	32.00	1.92	0.0032	0.0600
32.00	1.66	34.00	1.68	0.0107	0.1854

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
18.00	0.39	26.00	3.51	0.391	3.2546
26.00	3.66	28.00	4.51	0.425	3.4008
28.00	4.51	29.00	4.72	0.213	3.4032
29.00	3.77	32.00	4.26	0.162	3.0865
32.00	5.05	34.00	5.41	0.185	3.2062

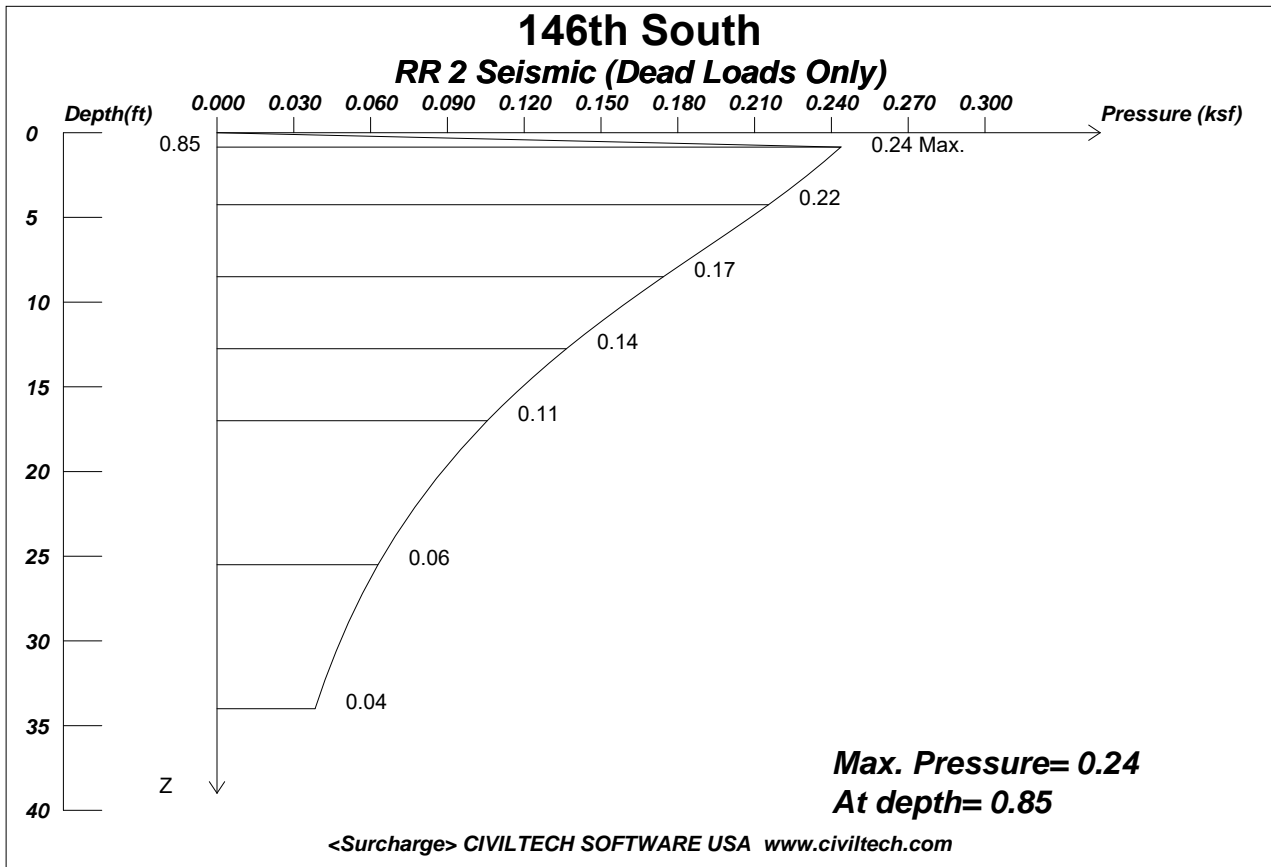
Output Earthquake Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Total Earthq. Force, Ee = 3.05

No	Zq1	Pq1	Zq2	Pq2	Slope
0	0.00	0.287	17.00	0.072	-0.013

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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Date: 10/17/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\RR2 Seismic.lp8

Wall Height, H= 17

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

Rigid Wall Condition -- No movement or deflection of the wall are allowed.

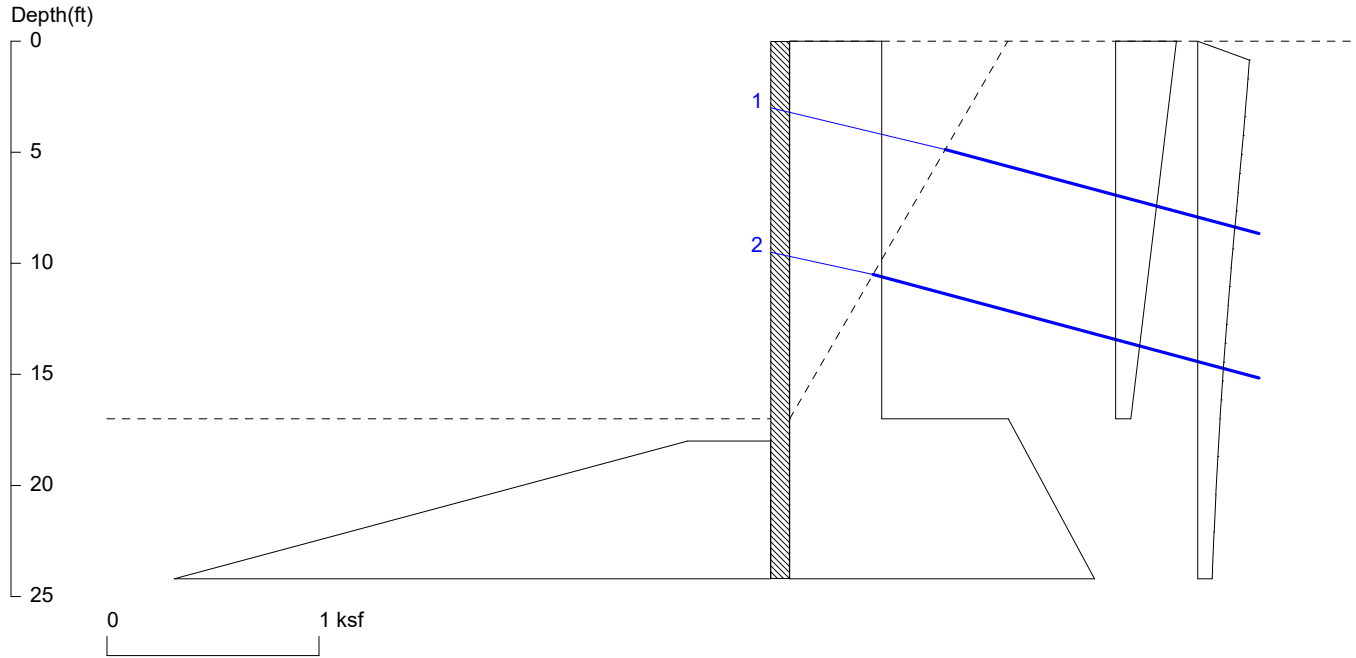
Max. Pressure = 0.244 at depth = 0.85

X	Line Load
9.5	.20
25.5	.20

X	Width	Strip Load
.0	5.0	.25
5.0	25.0	.25

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 17' Seismic



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Date: 12/30/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\17' Seismic.sh8

Wall Height=17.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=7.20 Min. Pile Length=24.20

MOMENT IN PILE: Max. Moment=41.05 per Pile Spacing=5.0 at Depth=15.29

PILE SELECTION:

Request Min. Section Modulus = 17.9 in³/pile=293.54 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!

Top Deflection = 0.00(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	3.0	15.0	5.0	36.5*	35.2	9.4	7.2	24.1
2. Tieback	9.5	15.0	5.0	30.5	29.4	7.9	3.9	20.1

* Top Brace increased by 15% (DM7.2-103)

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.434	17.00	0.434	0.000000
*	Below	Base		
17.00	1.031	26.00	1.540	0.056494
*	Earth	Queck		
0.000	0.287	17.00	0.072	-0.01266
*	Sur-	charg		
0.000	0.000	0.850	0.244	0.286688
0.850	0.244	1.700	0.237	-0.00765
1.700	0.237	2.550	0.230	-0.00805
2.550	0.230	3.400	0.223	-0.00854

3.400	0.223	4.250	0.215	-0.00900
4.250	0.215	5.100	0.207	-0.00939
5.100	0.207	5.950	0.199	-0.00964
5.950	0.199	6.800	0.191	-0.00977
6.800	0.191	7.650	0.183	-0.00976
7.650	0.183	8.500	0.174	-0.00966
8.500	0.174	9.350	0.166	-0.00947
9.350	0.166	10.20	0.159	-0.00922
10.20	0.159	11.05	0.151	-0.00894
11.05	0.151	11.90	0.144	-0.00862
11.90	0.144	12.75	0.137	-0.00829
12.75	0.137	13.60	0.130	-0.00795
13.60	0.130	14.45	0.123	-0.00761
14.45	0.123	15.30	0.117	-0.00727
15.30	0.117	16.15	0.111	-0.00694
16.15	0.111	17.00	0.106	-0.00661
17.00	0.106	18.70	0.095	-0.00613
18.70	0.095	20.40	0.086	-0.00553
20.40	0.086	22.10	0.077	-0.00497
22.10	0.077	23.80	0.070	-0.00446
23.80	0.070	25.50	0.063	-0.00399

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
18.00	0.391	26.00	3.515	0.390551

ACTIVE SPACING:

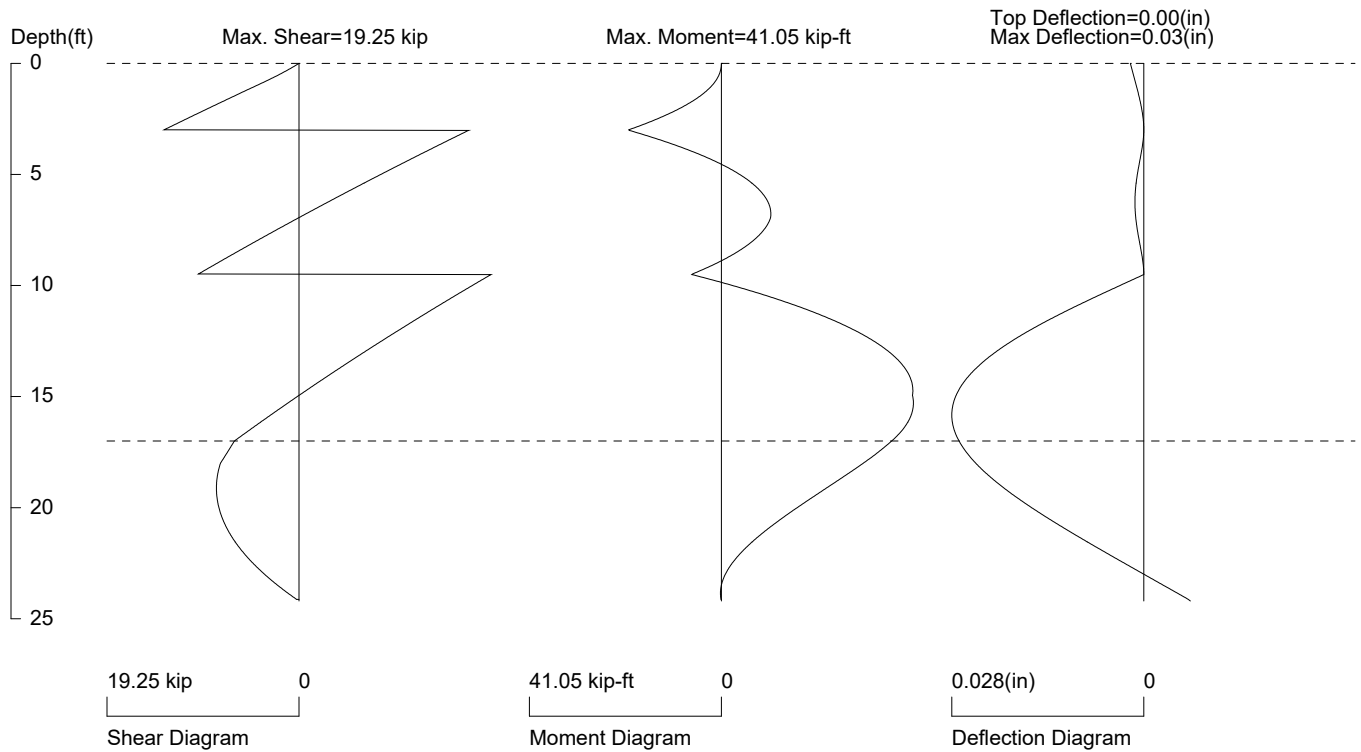
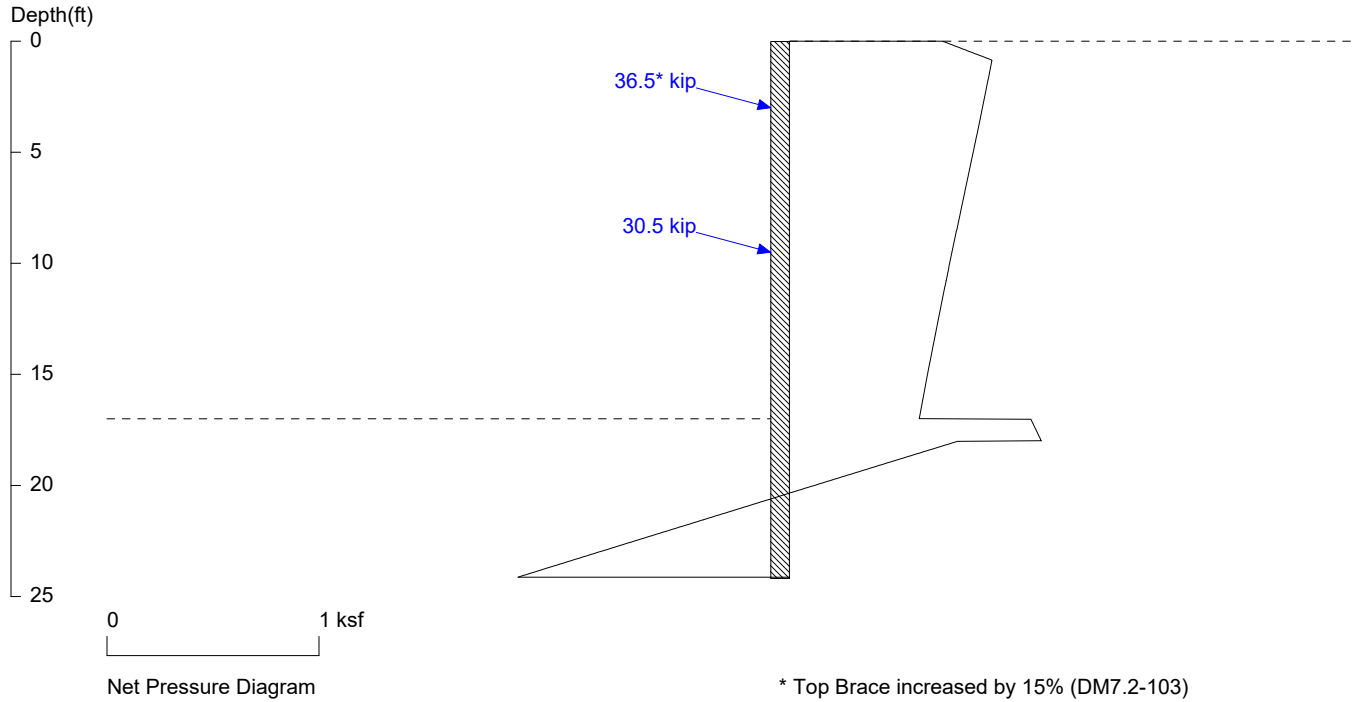
No.	Z depth	Spacing
1	0.00	5.00
2	17.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	17.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 17' Seismic



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

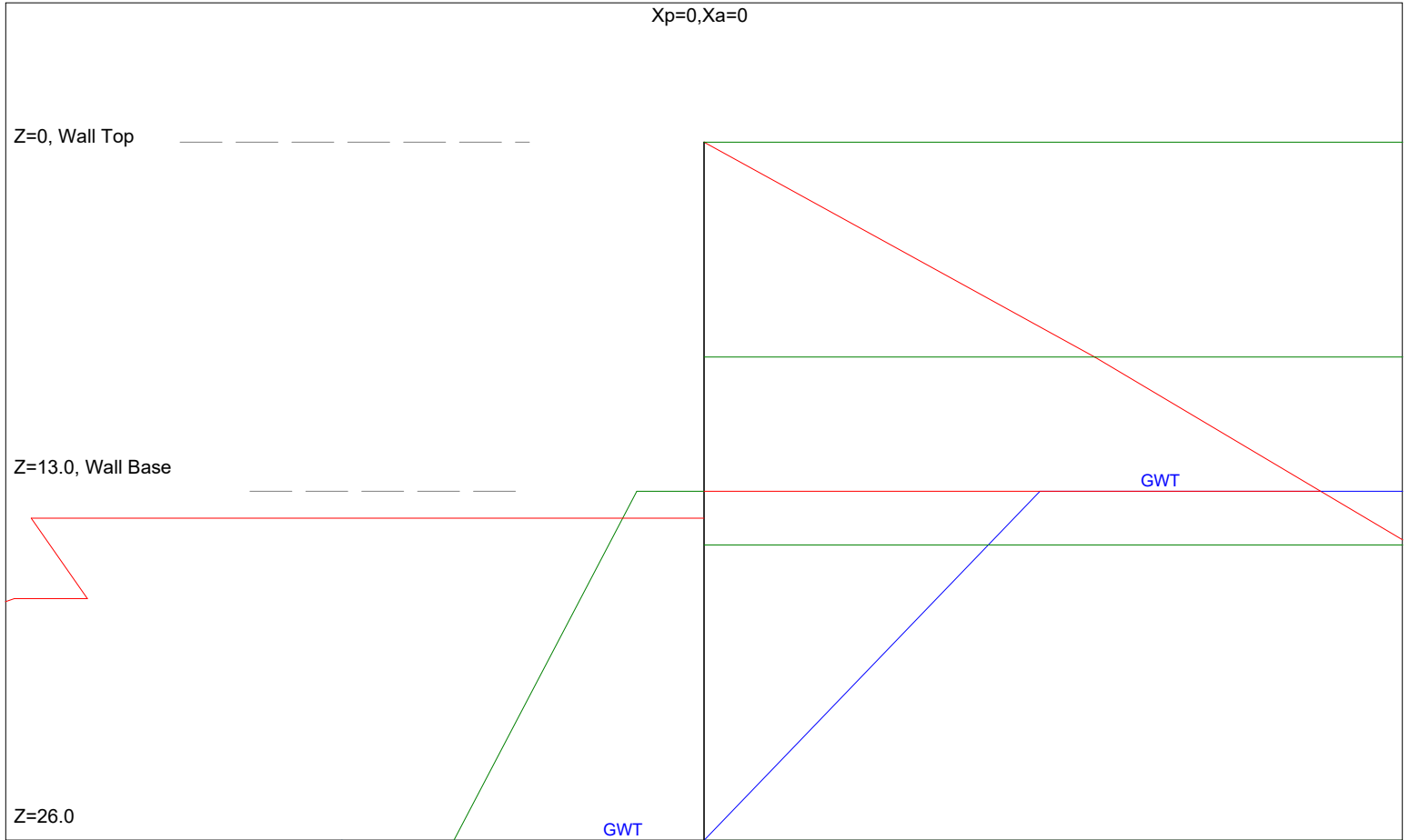
File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 217' Seismic.sh8

146th South 13' Temporary

Xp=52.0

Xa=52.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/17/2024

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\13' Temporary.ep8

* INPUT DATA *

Wall Height=13.0 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	13.0	0.0	13.0	5.0	3	CL
2	13.0	5.0	34.0	27.0	3	CL
3	34.0	27.0	34.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	34.0	27.0
3	34.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 3.33 per one linear foot (or meter) width along wall height

Total Static Force above Base= 3.33

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	8.00	0.32	0.0398	0.2947
8.00	0.32	13.00	0.50	0.0368	0.2947

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

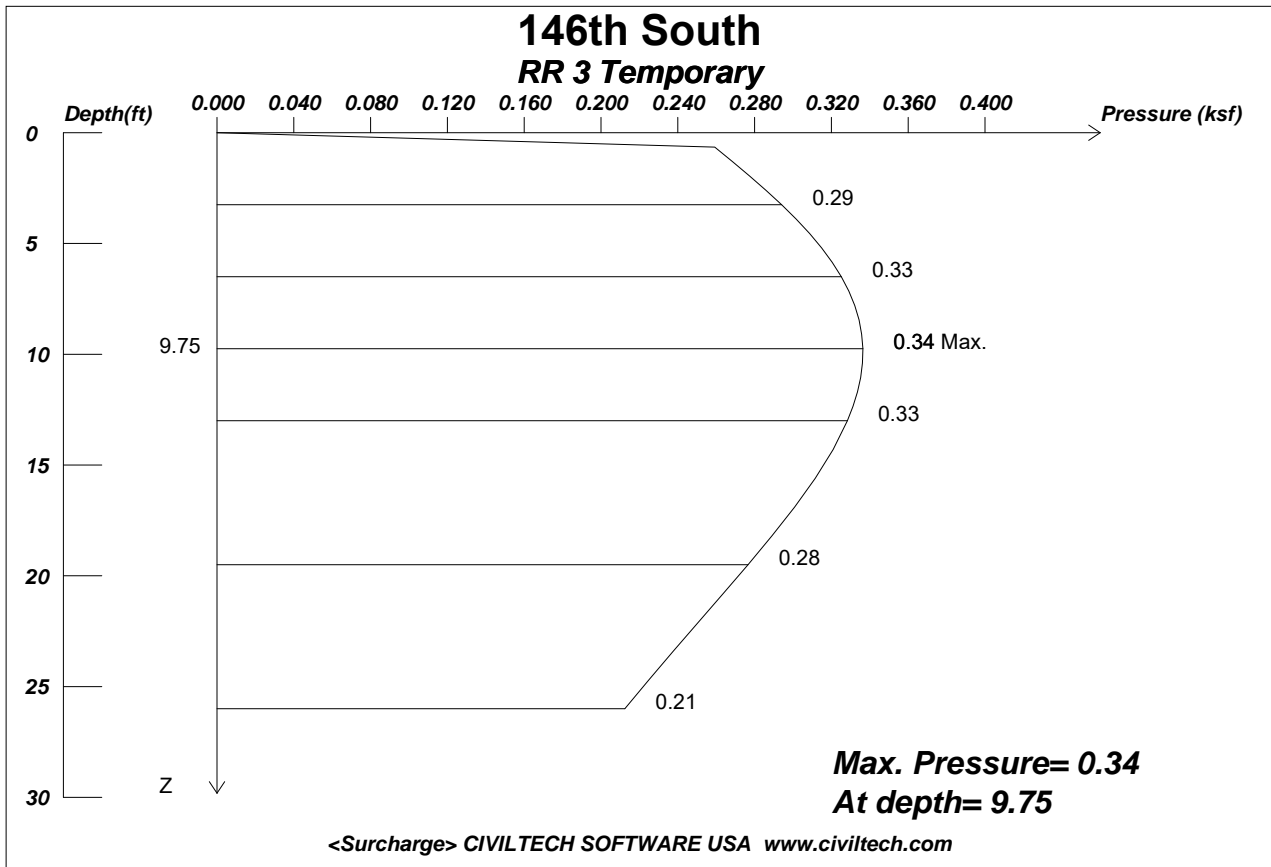
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
13.00	0.50	15.00	0.58	0.0368	0.2947
15.00	0.60	26.00	1.01	0.0369	0.3073

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
14.00	0.55	17.00	0.50	-0.015	-0.1328
17.00	0.56	20.00	0.75	0.064	0.5570
20.00	0.75	23.00	0.95	0.064	0.5570
23.00	0.95	26.00	1.14	0.064	0.5570

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/17/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\13' Temporary.ep8



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Wall Height, H= 13

Load Depth, D= 0

Load Factor of Surcharge Loading = 1

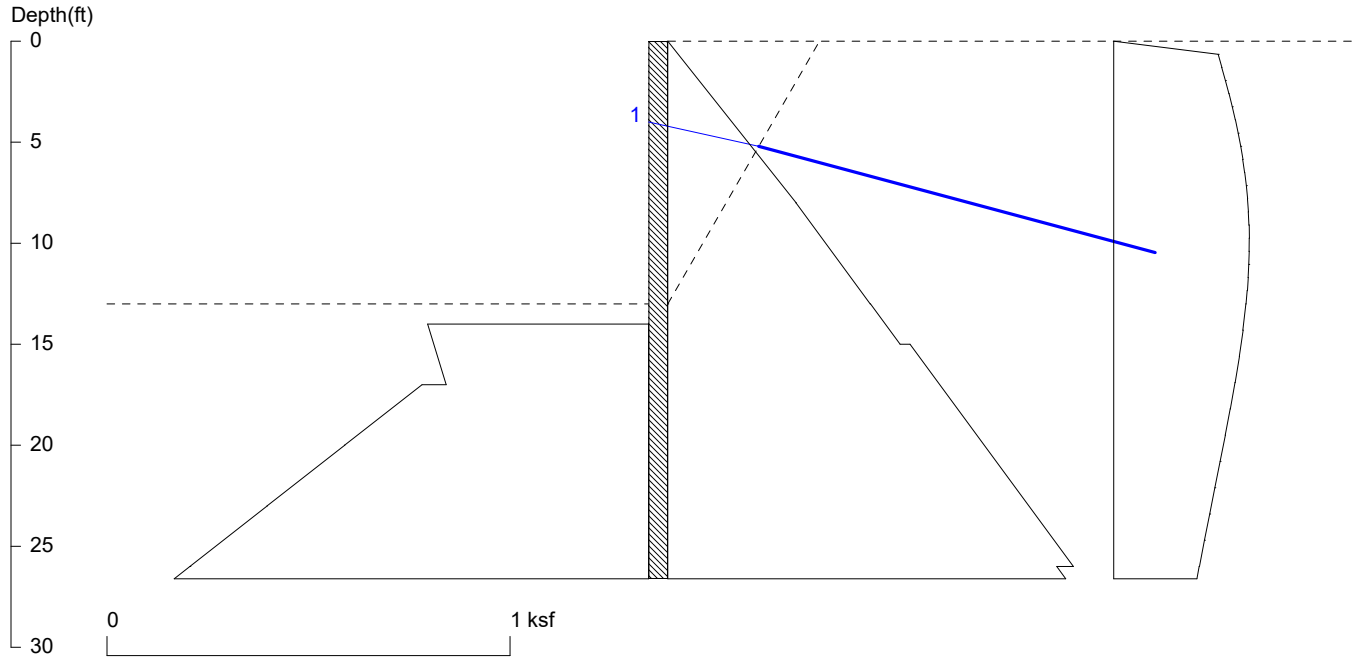
Rigid Wall Condition -- No movement or deflection of the wall are allowed.

Max. Pressure = 0.336 at depth = 9.75

X		Line Load
25.5		.20
X	Width	Strip Load
.0	5.0	.25
5.0	30.0	.25
21.0	9.0	1.26

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 13' Temporary



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File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\13' Temporary.sh8

Wall Height=13.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=13.61 Min. Pile Length=26.61

MOMENT IN PILE: Max. Moment=79.77 per Pile Spacing=5.0 at Depth=11.31

PILE SELECTION:

Request Min. Section Modulus = 34.8 in³/pile=570.41 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.11(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.0	15.0	5.0	30.8	29.7	8.0	4.7	20.3

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	8.000	0.318	0.039789
8.000	0.318	13.000	0.503	0.036841
*	Below	Base		
13.000	0.503	15.000	0.576	0.036841
15.000	0.601	26.000	1.006	0.036871
26.000	0.965	28.000	1.039	0.036841
*	Sur-	charge		
0.000	0.000	0.650	0.259	0.398891
0.650	0.259	1.300	0.268	0.014093
1.300	0.268	1.950	0.277	0.013732
1.950	0.277	2.600	0.286	0.013201
2.600	0.286	3.250	0.294	0.012511

3.250	0.294	3.900	0.302	0.011677
3.900	0.302	4.550	0.309	0.010718
4.550	0.309	5.200	0.315	0.009651
5.200	0.315	5.850	0.320	0.008498
5.850	0.320	6.500	0.325	0.007280
6.500	0.325	7.150	0.329	0.006017
7.150	0.329	7.800	0.332	0.004731
7.800	0.332	8.450	0.334	0.003440
8.450	0.334	9.100	0.336	0.002162
9.100	0.336	9.750	0.336	0.000913
9.750	0.336	10.400	0.336	-0.000294
10.400	0.336	11.050	0.335	-0.001448
11.050	0.335	11.700	0.334	-0.002538
11.700	0.334	12.350	0.331	-0.003558
12.350	0.331	13.000	0.328	-0.004502
13.000	0.328	14.300	0.321	-0.005760
14.300	0.321	15.600	0.312	-0.007168
15.600	0.312	16.900	0.301	-0.008261
16.900	0.301	18.200	0.289	-0.009060
18.200	0.289	19.500	0.277	-0.009597
19.500	0.277	20.800	0.264	-0.009907
20.800	0.264	22.100	0.251	-0.010026
22.100	0.251	23.400	0.238	-0.009991
23.400	0.238	24.700	0.225	-0.009832
24.700	0.225	26.000	0.212	-0.009579
26.000	0.212	28.600	0.189	-0.009071

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.5

Z1	P1	Z2	P2	Slope
*	Below	Base		
14.000	0.548	17.000	0.502	-0.015274
17.000	0.562	20.000	0.754	0.064058
20.000	0.754	23.000	0.946	0.064058
23.000	0.946	26.000	1.138	0.064058
26.000	1.138	28.000	1.267	0.064058

ACTIVE SPACING:

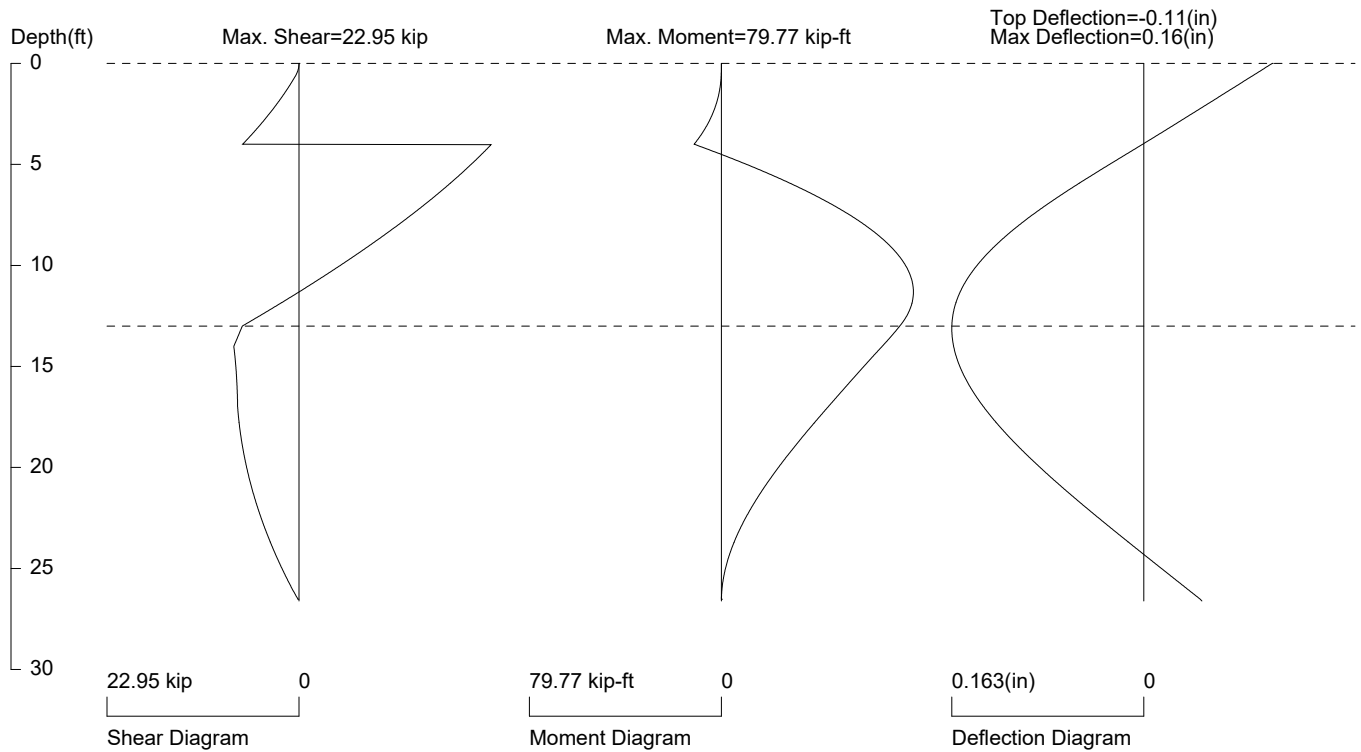
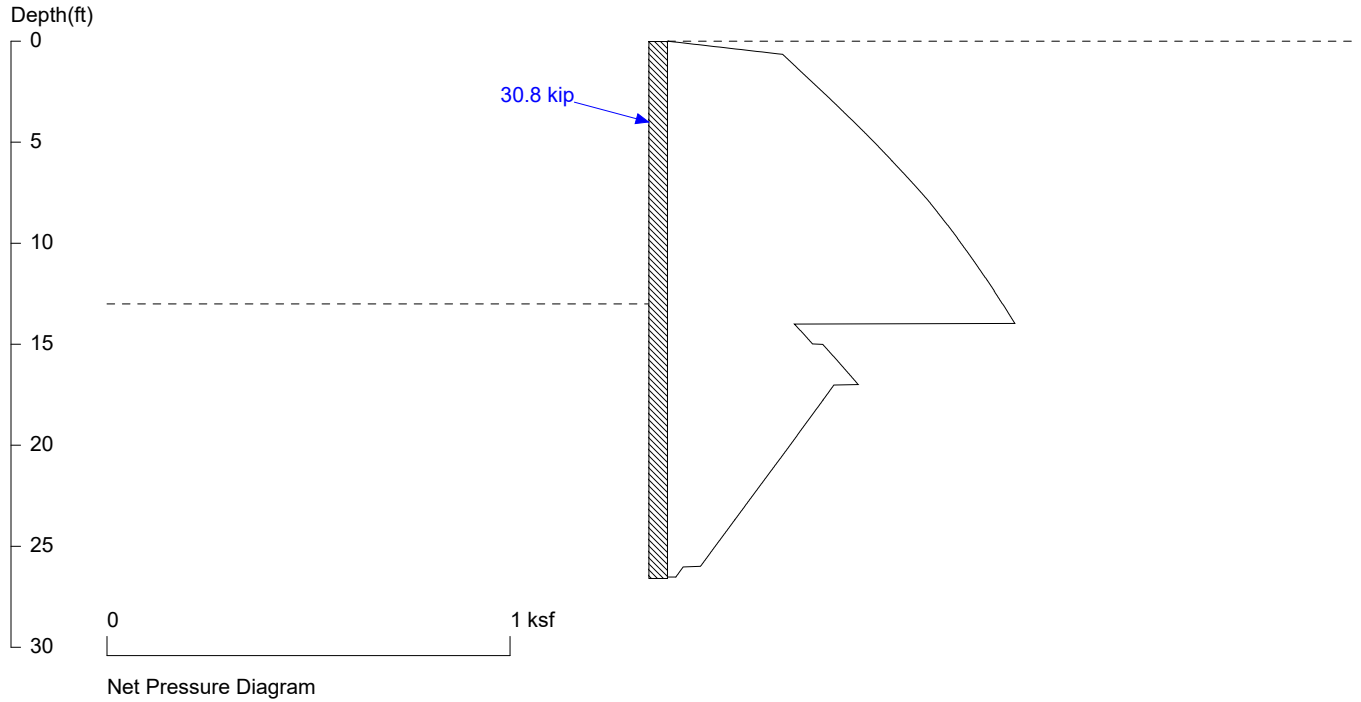
No.	Z depth	Spacing
1	0.00	5.00
2	13.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	13.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 13' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

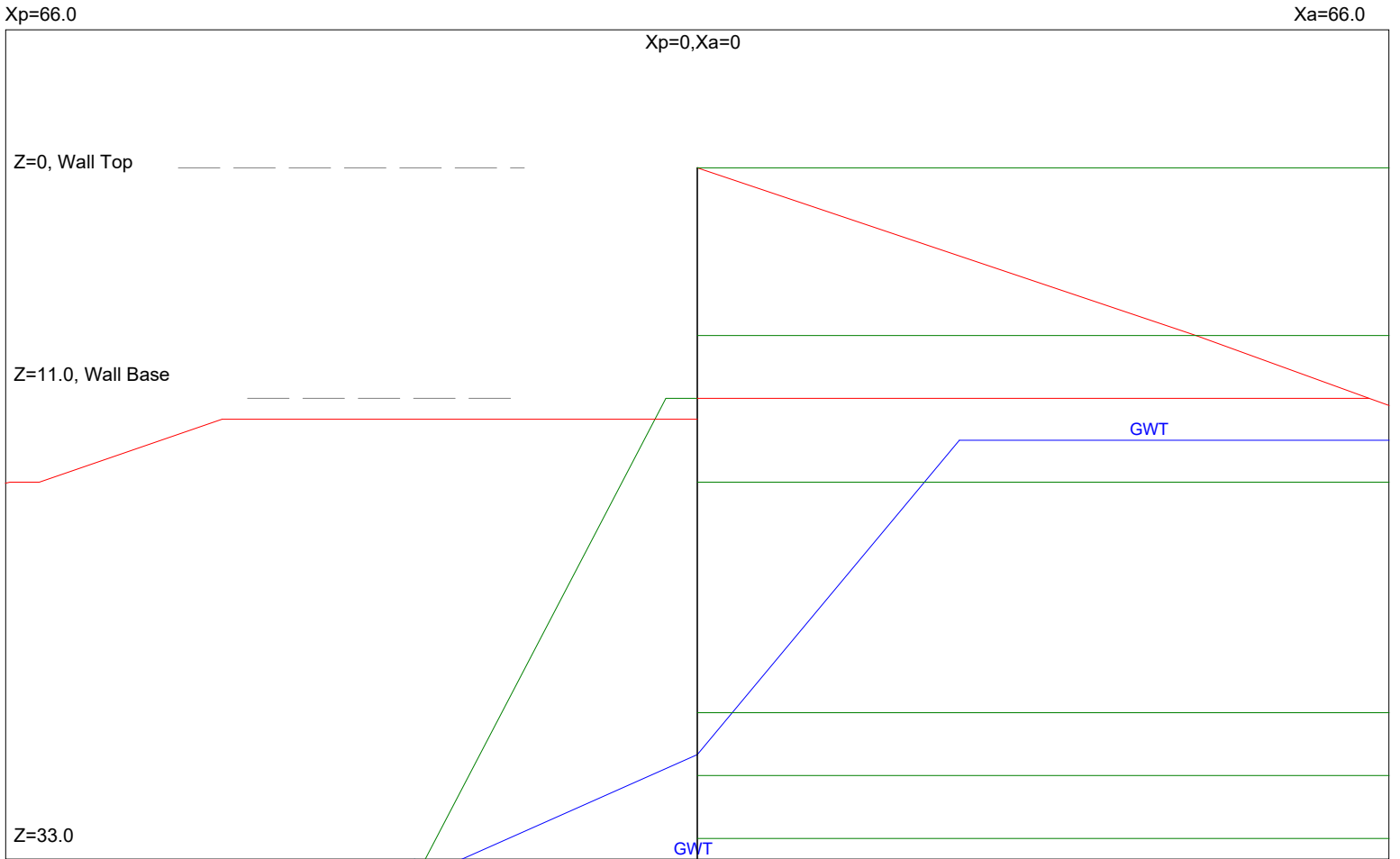
File: J:\PROJECTS\HDMI\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 213' Temporary.sh8

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Calculation Sheet #211

146th South 11' Permanent



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/17/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\11' Permanent.ep8

* INPUT DATA *

Wall Height=11.0 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	11.0	0.0	11.0	3.0	3	CL
2	11.0	3.0	34.0	27.0	3	CL
3	34.0	27.0	34.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	34.0	27.0
3	34.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 2.39 per one linear foot (or meter) width along wall height

Total Static Force above Base= 2.39

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	8.00	0.32	0.0398	0.2947
8.00	0.32	11.00	0.43	0.0368	0.2947

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

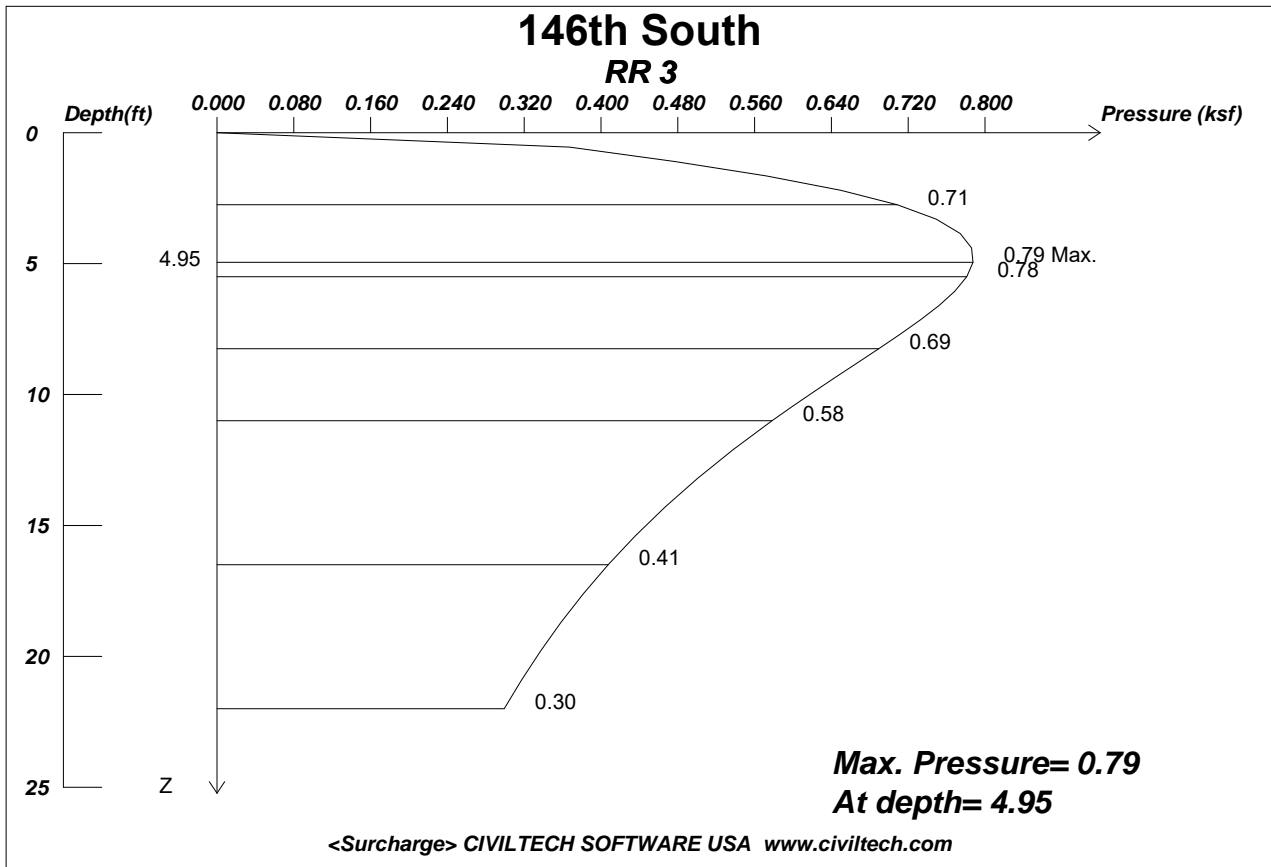
Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
11.00	0.43	15.00	0.58	0.0368	0.2947
15.00	0.60	26.00	1.01	0.0369	0.3073
26.00	0.97	28.00	1.04	0.0368	0.2947
28.00	1.04	29.00	1.05	0.0129	0.2066
29.00	1.29	32.00	1.32	0.0128	0.2430
32.00	1.13	33.00	1.14	0.0119	0.2074

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
12.00	0.30	15.00	0.42	0.039	0.3381
15.00	0.44	18.00	0.63	0.064	0.5548
18.00	0.63	21.00	0.82	0.064	0.5548
21.00	0.82	24.00	1.01	0.064	0.5548
24.00	1.01	27.00	1.20	0.064	0.5548
27.00	1.20	28.00	1.27	0.064	0.5548
28.00	1.27	30.00	1.10	-0.082	-1.5587
30.00	1.10	33.00	0.86	-0.082	-1.5587

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/17/2024 File Name: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\111' Permanent.ep8



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Wall Height, H = 11

Load Depth, D = 0

Load Factor of Surcharge Loading = 1

Rigid Wall Condition -- No movement or deflection of the wall are allowed.

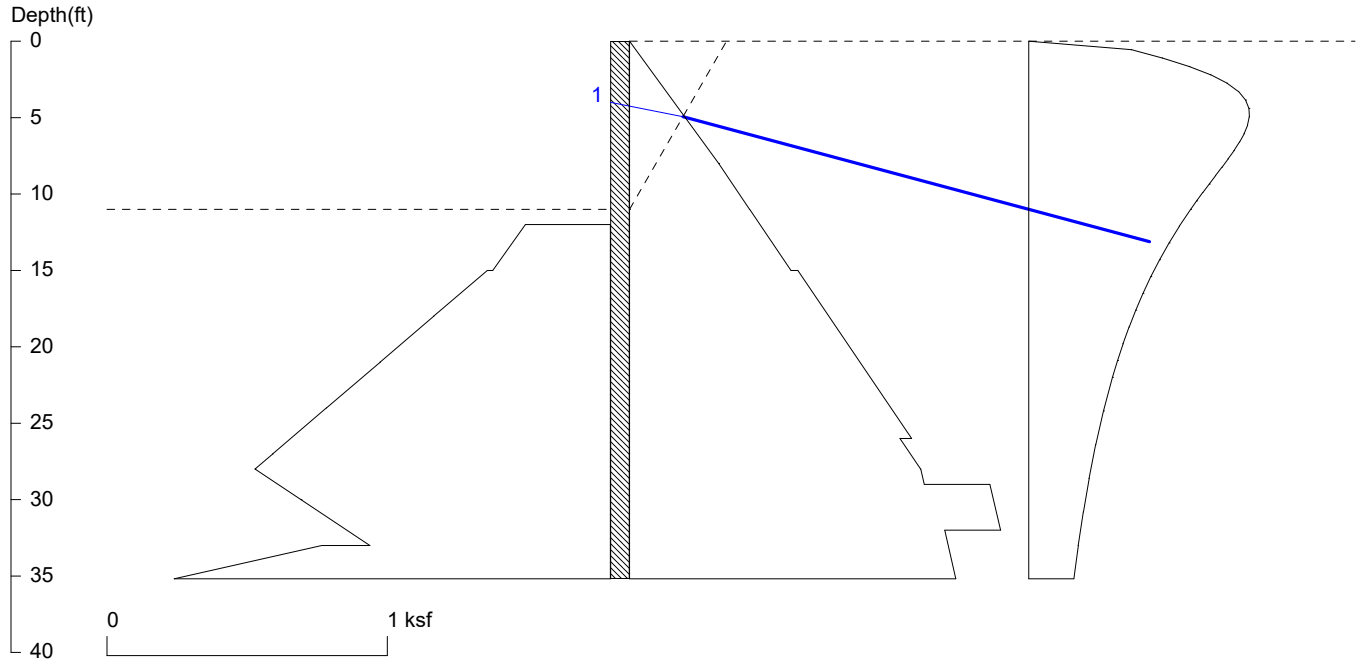
Max. Pressure = 0.787 at depth = 4.95

X	Line Load
9.5	.20
25.5	.20

X	Width	Strip Load
.0	5.0	.25
5.0	55.0	.25
5.0	9.0	1.26
21.0	5.0	.93

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 11' Permanent



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Wall Height=11.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=24.18 Min. Pile Length=35.18

MOMENT IN PILE: Max. Moment=90.92 per Pile Spacing=5.0 at Depth=10.65

PILE SELECTION:

Request Min. Section Modulus = 39.7 in³/pile=650.17 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.17(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.0	15.0	5.0	47.9	46.3	12.4	3.6	31.6

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	8.000	0.318	0.039789
8.000	0.318	11.00	0.429	0.036841
*	Below	Base		
11.00	0.429	15.00	0.576	0.036841
15.00	0.601	26.00	1.006	0.036871
26.00	0.965	28.00	1.039	0.036841
28.00	1.039	29.00	1.052	0.012933
29.00	1.286	32.00	1.325	0.012781
32.00	1.125	40.00	1.223	0.012308
*	Sur-	charg		
0.000	0.000	0.550	0.367	0.667858
0.550	0.367	1.100	0.477	0.199052

1.100	0.477	1.650	0.572	0.173432
1.650	0.572	2.200	0.650	0.141073
2.200	0.650	2.750	0.708	0.106722
2.750	0.708	3.300	0.749	0.074077
3.300	0.749	3.850	0.774	0.045379
3.850	0.774	4.400	0.786	0.021561
4.400	0.786	4.950	0.787	0.002660
4.950	0.787	5.500	0.781	-0.01179
5.500	0.781	6.050	0.769	-0.02246
6.050	0.769	6.600	0.752	-0.03006
6.600	0.752	7.150	0.733	-0.03524
7.150	0.733	7.700	0.712	-0.03855
7.700	0.712	8.250	0.689	-0.04043
8.250	0.689	8.800	0.667	-0.04126
8.800	0.667	9.350	0.644	-0.04131
9.350	0.644	9.900	0.621	-0.04081
9.900	0.621	10.45	0.599	-0.03991
10.45	0.599	11.00	0.578	-0.03875
11.00	0.578	12.10	0.538	-0.03671
12.10	0.538	13.20	0.501	-0.03379
13.20	0.501	14.30	0.467	-0.03087
14.30	0.467	15.40	0.436	-0.02812
15.40	0.436	16.50	0.408	-0.02560
16.50	0.408	17.60	0.382	-0.02333
17.60	0.382	18.70	0.358	-0.02131
18.70	0.358	19.80	0.337	-0.01950
19.80	0.337	20.90	0.317	-0.01789
20.90	0.317	22.00	0.299	-0.01646
22.00	0.299	24.20	0.267	-0.01460
24.20	0.267	26.40	0.239	-0.01253
26.40	0.239	28.60	0.216	-0.01084
28.60	0.216	30.80	0.195	-0.00944
30.80	0.195	33.00	0.177	-0.00827
33.00	0.177	35.20	0.161	-0.00729

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
12.00	0.303	15.00	0.420	0.038882
15.00	0.439	18.00	0.630	0.063805
18.00	0.630	21.00	0.821	0.063805
21.00	0.821	24.00	1.013	0.063805
24.00	1.013	27.00	1.204	0.063805
27.00	1.204	28.00	1.268	0.063805
28.00	1.268	30.00	1.104	-0.08198
30.00	1.104	33.00	0.858	-0.08198
33.00	1.030	36.00	1.754	0.241420

ACTIVE SPACING:

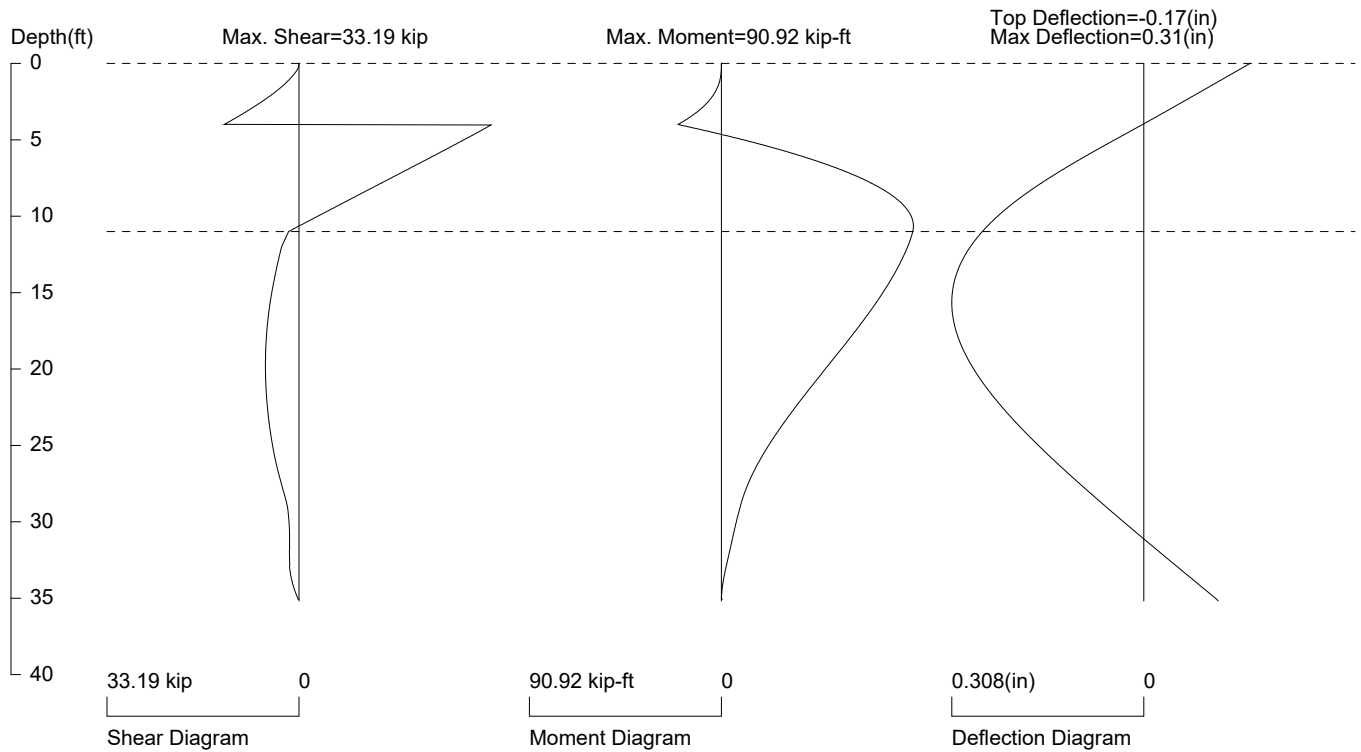
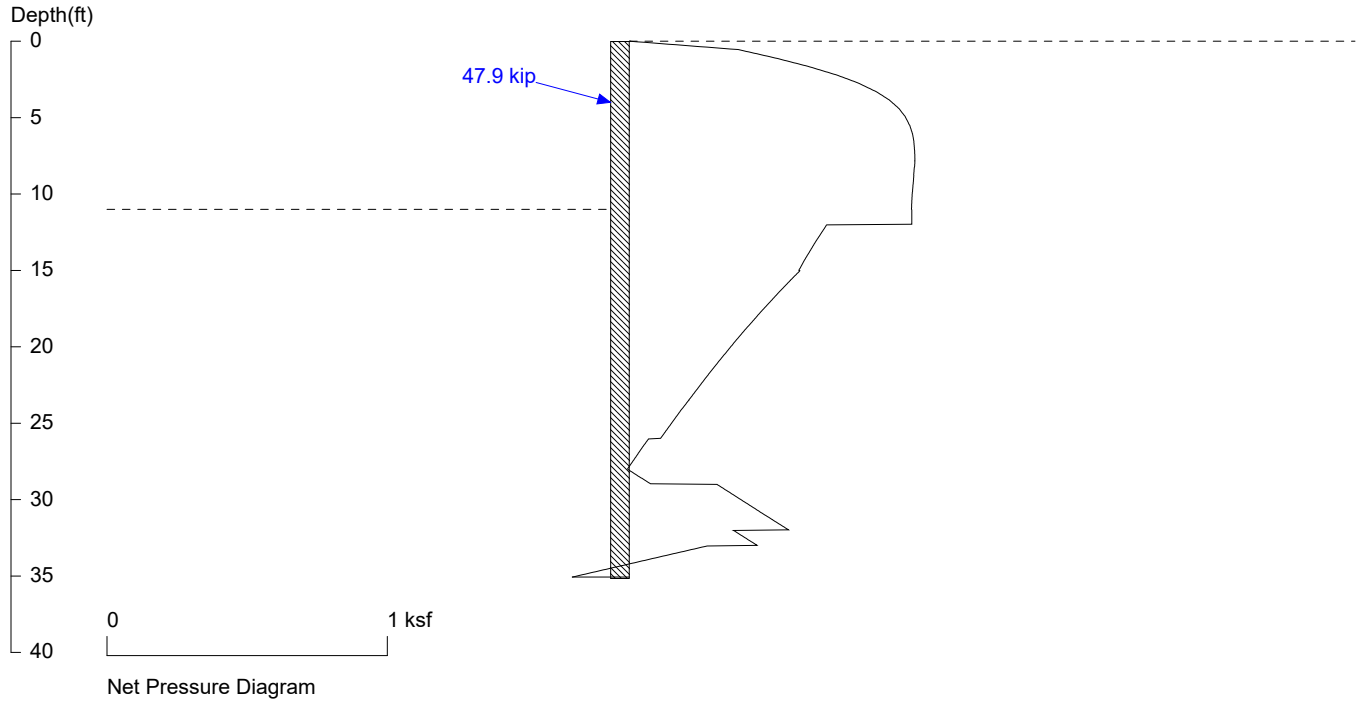
No.	Z depth	Spacing
1	0.00	5.00
2	11.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	11.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 11' Permanent



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

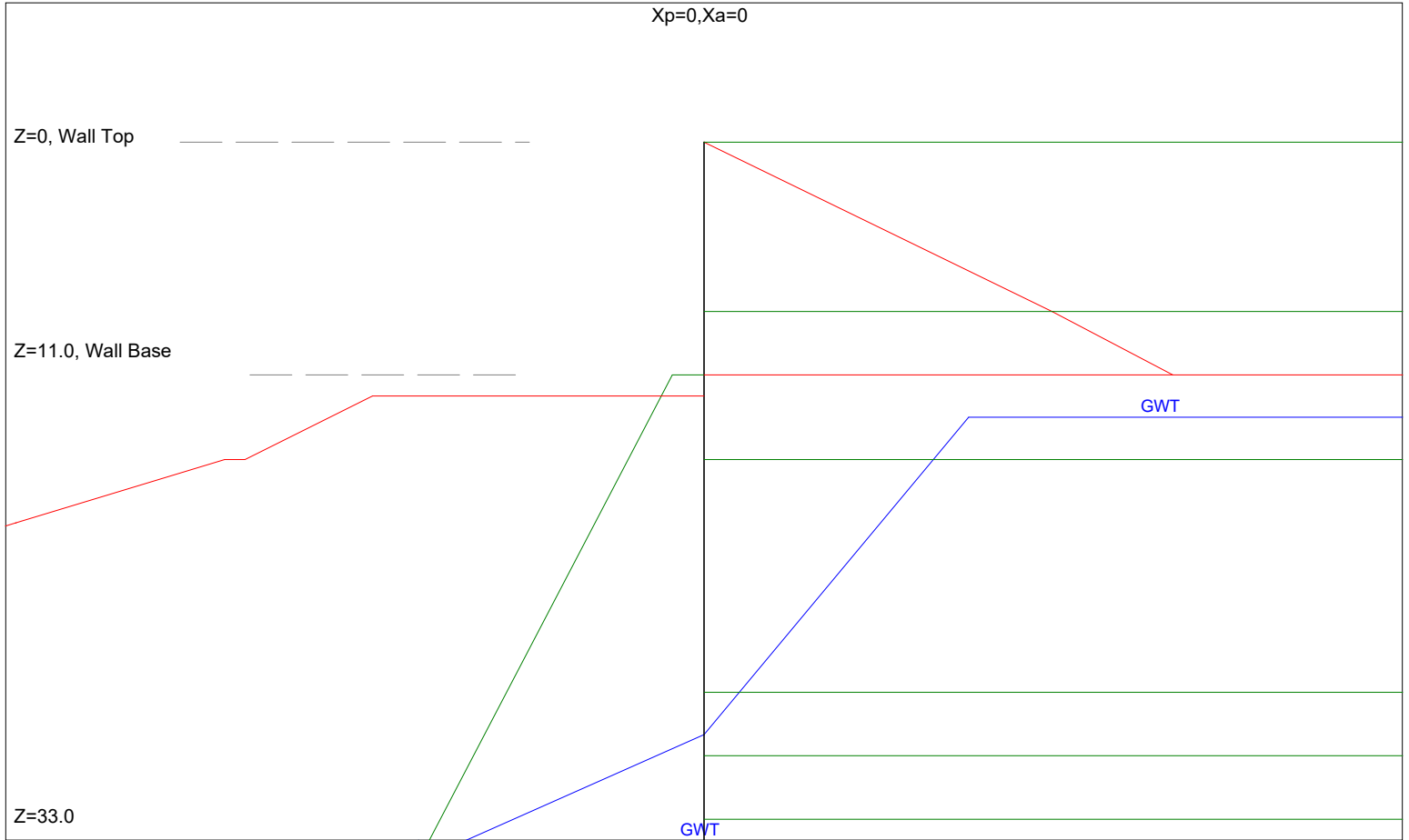
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Xp=66.0

Xa=66.0

Xp=0, Xa=0



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/17/2024

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* INPUT DATA *

Wall Height=11.0 Total Soil Types= 4

Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	125.0	125.0	33	0.0	0	4	SM
2	120.0	120.0	32	0.0	0	4	ML
3	115.0	115.0	28	0.0	0	4	CL
4	135.0	135.0	33	0.0	0	4	FILL

Ground Surface at Active Side:

Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	4	FILL
2	8.0	0.0	8.0	800.0	1	SM
3	15.0	0.0	15.0	800.0	2	ML
4	26.0	0.0	26.0	800.0	1	SM
5	29.0	0.0	29.0	800.0	3	CL
6	32.0	0.0	32.0	800.0	2	ML
7	40.0	0.0	40.0	800.0	3	CL

Water Table at Active Side:

Point	Z-water	X-water
1	28.0	0.0
2	13.0	25.0
3	13.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	11.0	0.0	11.0	3.0	3	CL
2	11.0	3.0	34.0	27.0	3	CL
3	34.0	27.0	34.0	800.0	3	CL

Water Table at Passive Side:

Point	Z-water	X-water
1	28.0	0.0
2	34.0	27.0
3	34.0	800.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 3.69 per one linear foot (or meter) width along wall height

Total Static Force above Base= 2.39

Total Earthquake Force above Base= 1.29. Distributed in trapezoid. Total earthquake force acting at 0.4H below wall top.

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	8.00	0.32	0.0398	0.2947
8.00	0.32	11.00	0.43	0.0368	0.2947

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
11.00	0.66	15.00	0.89	0.0567	0.4537
15.00	0.92	26.00	1.54	0.0565	0.4708
26.00	1.49	28.00	1.60	0.0567	0.4535
28.00	1.60	29.00	1.60	0.0054	0.0857
29.00	1.91	32.00	1.92	0.0032	0.0600
32.00	1.66	33.00	1.67	0.0138	0.2404

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 1

Z1	Pp1	Z2	Pp2	Slope	Kp
12.00	0.30	15.00	0.42	0.039	0.3381
15.00	0.44	18.00	0.63	0.064	0.5548
18.00	0.63	21.00	0.82	0.064	0.5548
21.00	0.82	24.00	1.01	0.064	0.5548
24.00	1.01	27.00	1.20	0.064	0.5548
27.00	1.20	28.00	1.27	0.064	0.5548
28.00	1.27	30.00	1.10	-0.082	-1.5587
30.00	1.10	33.00	0.86	-0.082	-1.5587

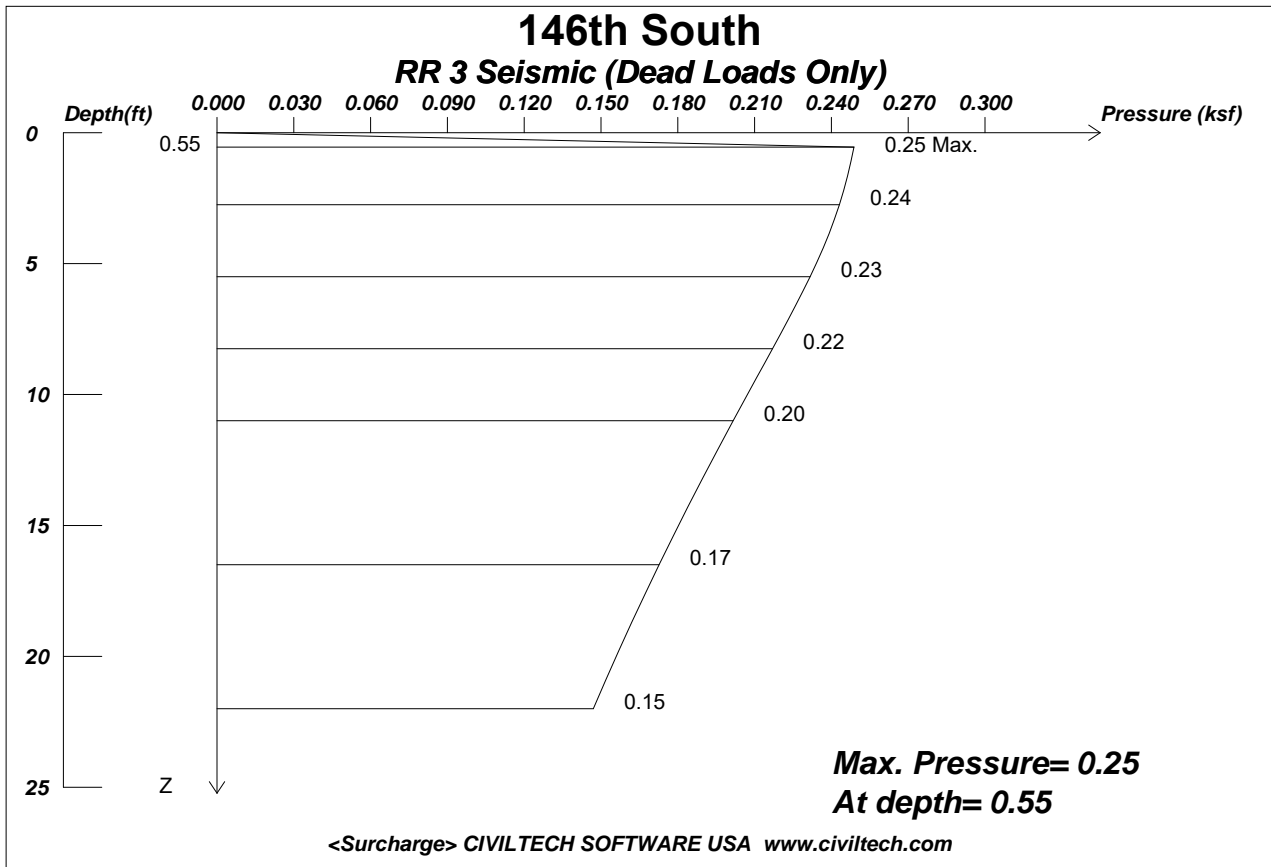
Output Earthquake Pressure above Base - Output to Shoring - Multiplier of Pressure = 1

Total Earthq. Force, Ee = 1.29

No	Zq1	Pq1	Zq2	Pq2	Slope
0	0.00	0.188	11.00	0.047	-0.013

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

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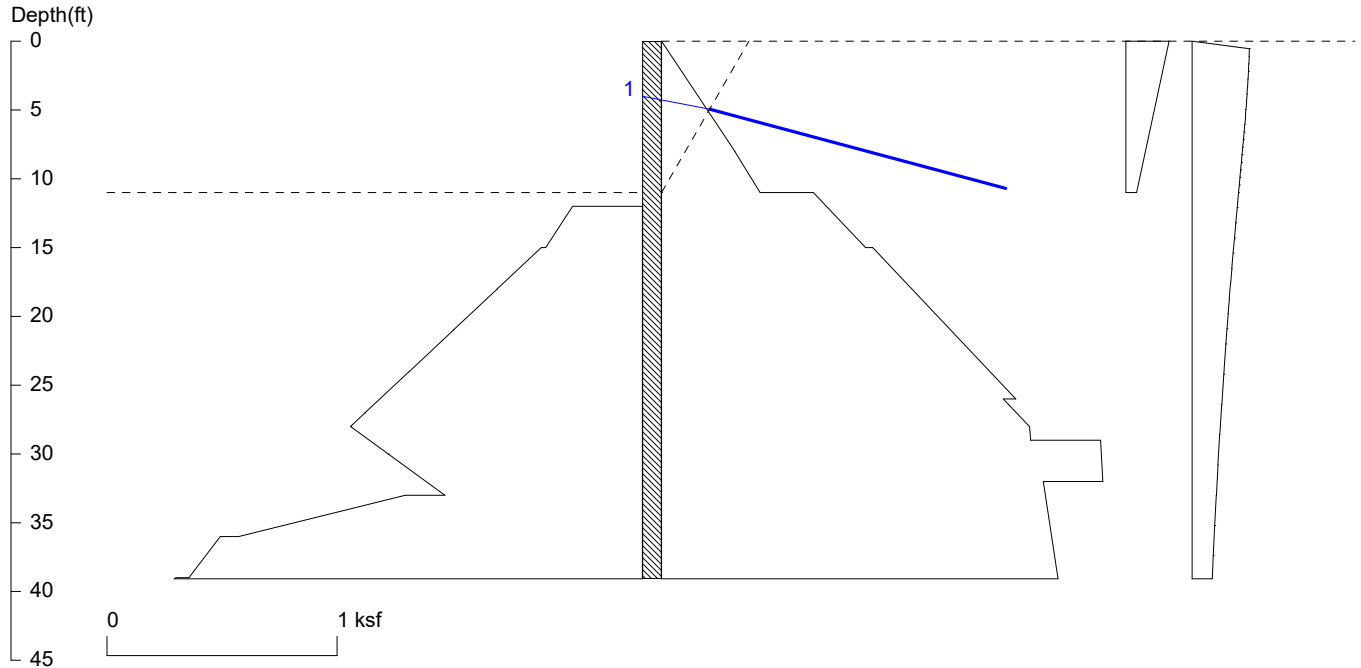
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Wall Height, H= 11 Load Depth, D= 0
 Load Factor of Surcharge Loading = 1
 Rigid Wall Condition -- No movement or deflection of the wall are allowed.
 Max. Pressure = 0.249 at depth = 0.55

X		Line Load
9.5		.20
25.5		.20
X	Width	Strip Load
.0	5.0	.25
5.0	55.0	.25

UNITS: LENGTH/DEPTH: ft, Qpoint: kip, Qline: kip/ft, Qstrip/Qarea/PRESSURE: ksf

146th South 11' Seismic



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Wall Height=11.0 Pile Diameter=1.2 Pile Spacing=5.0 Wall Type: 3. Soldier Pile, Driving

PILE LENGTH: Min. Embedment=28.08 Min. Pile Length=39.08

MOMENT IN PILE: Max. Moment=75.20 per Pile Spacing=5.0 at Depth=13.52

PILE SELECTION:

Request Min. Section Modulus = 32.8 in³/pile=537.72 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has Section Modulus = 150.0 in³/pile=2458.05 cm³/pile. It is greater than Min. Requirements!

Top Deflection = -0.18(in) based on E (ksi)=29000.00 and I (in⁴)/pile=1050.0

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Fixed Length
1. Tieback	4.0	15.0	5.0	33.8	32.6	8.7	3.6	22.3

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	8.000	0.318	0.039789
8.000	0.318	11.00	0.429	0.036841
*	Below	Base		
11.00	0.660	15.00	0.887	0.056716
15.00	0.918	26.00	1.540	0.056495
26.00	1.485	28.00	1.599	0.056693
28.00	1.599	29.00	1.604	0.005368
29.00	1.908	32.00	1.917	0.003157
32.00	1.659	40.00	1.731	0.009046
*	Earth	Queck		
0.000	0.188	11.00	0.047	-0.01280
*	Sur-	charg		

0.000	0.000	0.550	0.249	0.452442
0.550	0.249	1.100	0.248	-0.00221
1.100	0.248	1.650	0.246	-0.00242
1.650	0.246	2.200	0.245	-0.00272
2.200	0.245	2.750	0.243	-0.00307
2.750	0.243	3.300	0.241	-0.00345
3.300	0.241	3.850	0.239	-0.00383
3.850	0.239	4.400	0.237	-0.00419
4.400	0.237	4.950	0.234	-0.00452
4.950	0.234	5.500	0.232	-0.00480
5.500	0.232	6.050	0.229	-0.00504
6.050	0.229	6.600	0.226	-0.00523
6.600	0.226	7.150	0.223	-0.00537
7.150	0.223	7.700	0.220	-0.00548
7.700	0.220	8.250	0.217	-0.00554
8.250	0.217	8.800	0.214	-0.00558
8.800	0.214	9.350	0.211	-0.00560
9.350	0.211	9.900	0.208	-0.00559
9.900	0.208	10.45	0.205	-0.00557
10.45	0.205	11.00	0.202	-0.00554
11.00	0.202	12.10	0.196	-0.00548
12.10	0.196	13.20	0.190	-0.00538
13.20	0.190	14.30	0.184	-0.00526
14.30	0.184	15.40	0.178	-0.00515
15.40	0.178	16.50	0.173	-0.00503
16.50	0.173	17.60	0.167	-0.00491
17.60	0.167	18.70	0.162	-0.00479
18.70	0.162	19.80	0.157	-0.00467
19.80	0.157	20.90	0.152	-0.00455
20.90	0.152	22.00	0.147	-0.00443
22.00	0.147	24.20	0.138	-0.00426
24.20	0.138	26.40	0.129	-0.00403
26.40	0.129	28.60	0.120	-0.00380
28.60	0.120	30.80	0.113	-0.00357
30.80	0.113	33.00	0.105	-0.00336
33.00	0.105	35.20	0.098	-0.00315
35.20	0.098	37.40	0.092	-0.00294
37.40	0.092	39.60	0.086	-0.00275

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =2

Z1	P1	Z2	P2	Slope
*	Below	Base		
12.00	0.303	15.00	0.420	0.038882
15.00	0.439	18.00	0.630	0.063805
18.00	0.630	21.00	0.821	0.063805
21.00	0.821	24.00	1.013	0.063805
24.00	1.013	27.00	1.204	0.063805
27.00	1.204	28.00	1.268	0.063805
28.00	1.268	30.00	1.104	-0.08198
30.00	1.104	33.00	0.858	-0.08198
33.00	1.030	36.00	1.754	0.241420
36.00	1.834	39.00	1.971	0.045441
39.00	2.026	42.00	2.347	0.106999

ACTIVE SPACING:

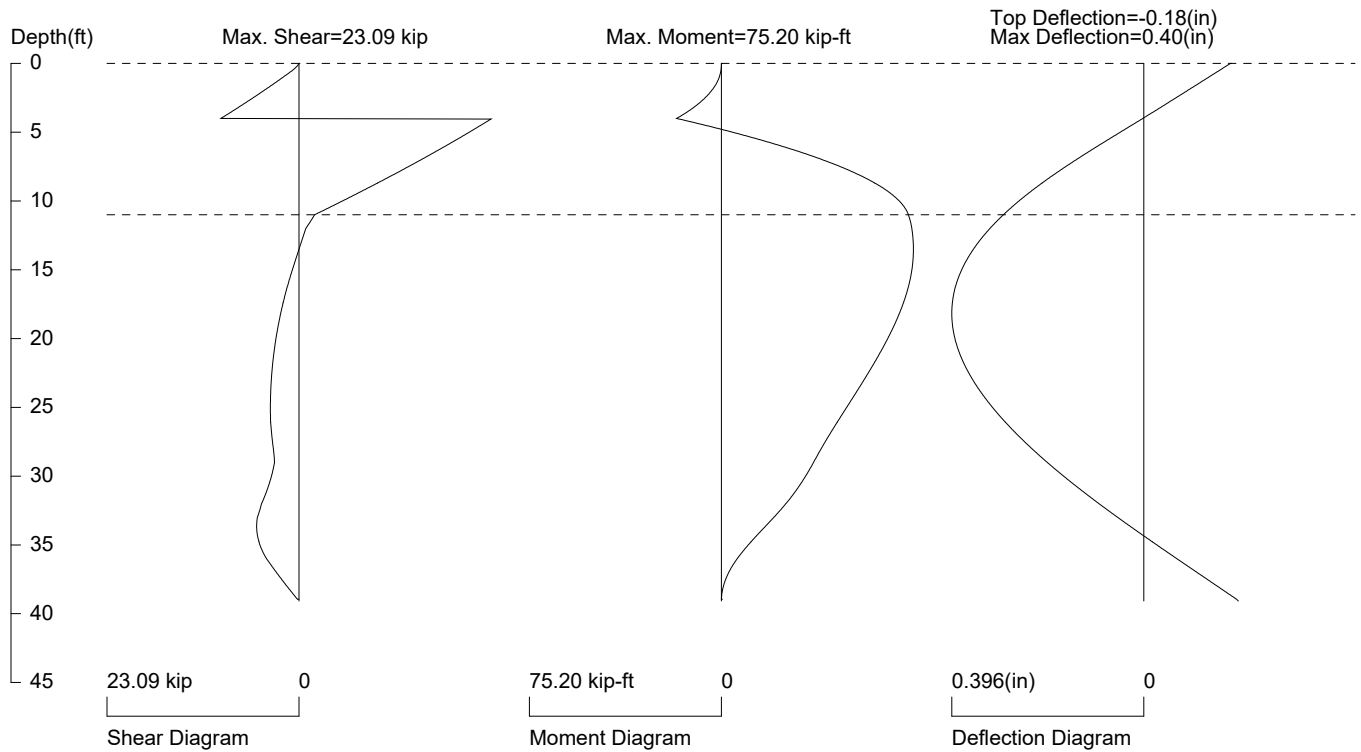
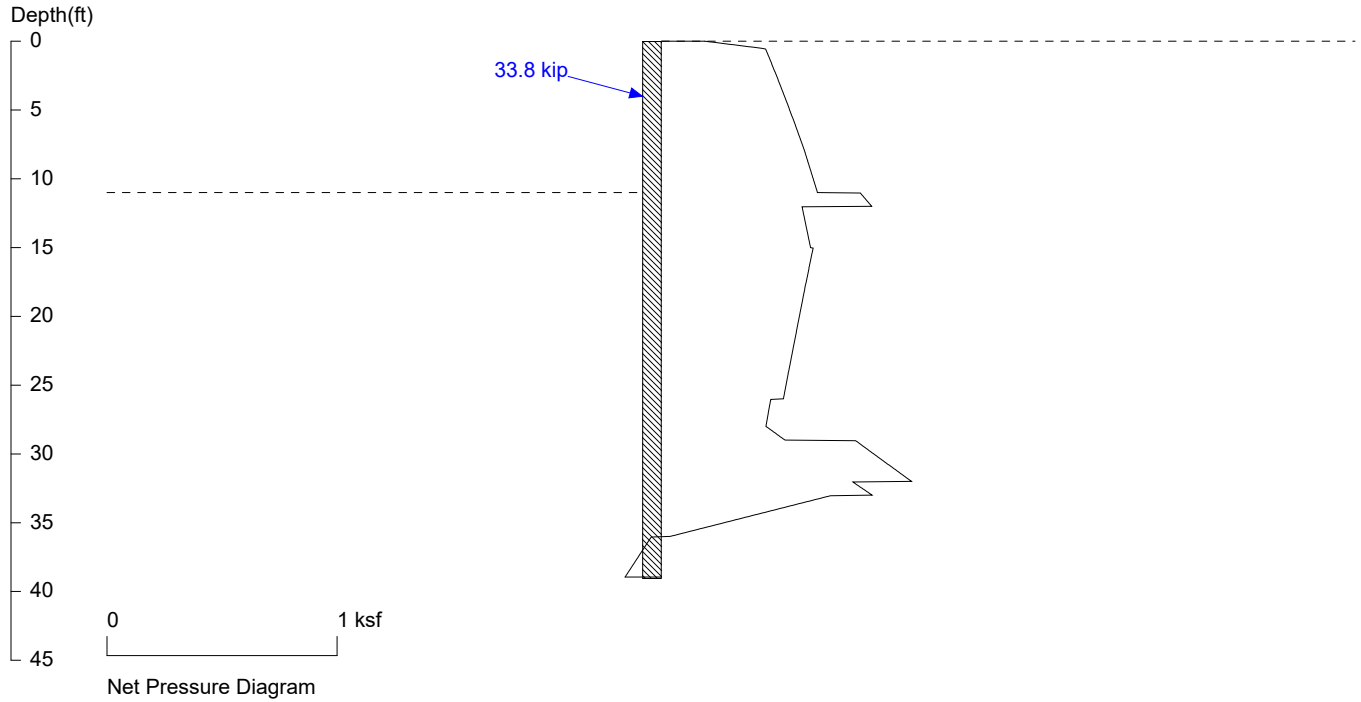
No.	Z depth	Spacing
1	0.00	5.00
2	11.00	1.20

PASSIVE SPACING:

No.	Z depth	Spacing
1	11.00	3.60

UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

146th South 11' Seismic



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

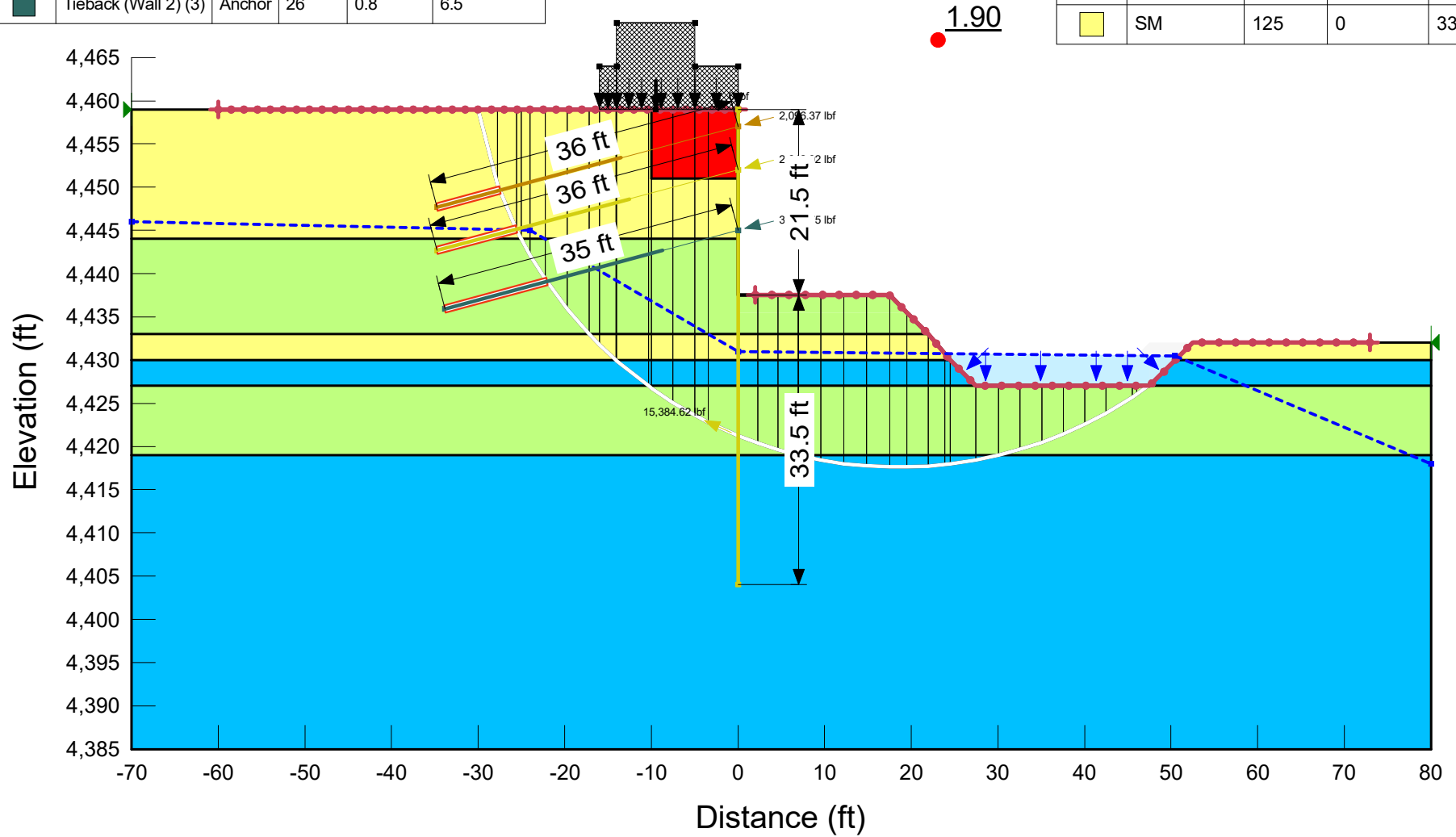
Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x102: E (ksi)=29000.0, I (in⁴)/pile=1050.0

File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\11' Seismic.sh8

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Yellow	Pile (Wall 2)	Pile			6.5
Brown	Tieback (Wall 2)	Anchor	22	0.8	6.5
Light Green	Tieback (Wall 2) (2)	Anchor	23	0.8	6.5
Dark Green	Tieback (Wall 2) (3)	Anchor	26	0.8	6.5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Drained	115	150	30
Light Green	ML Drained	120	100	32
Red	MSE Backfill	135	0	33
Yellow	SM	125	0	33

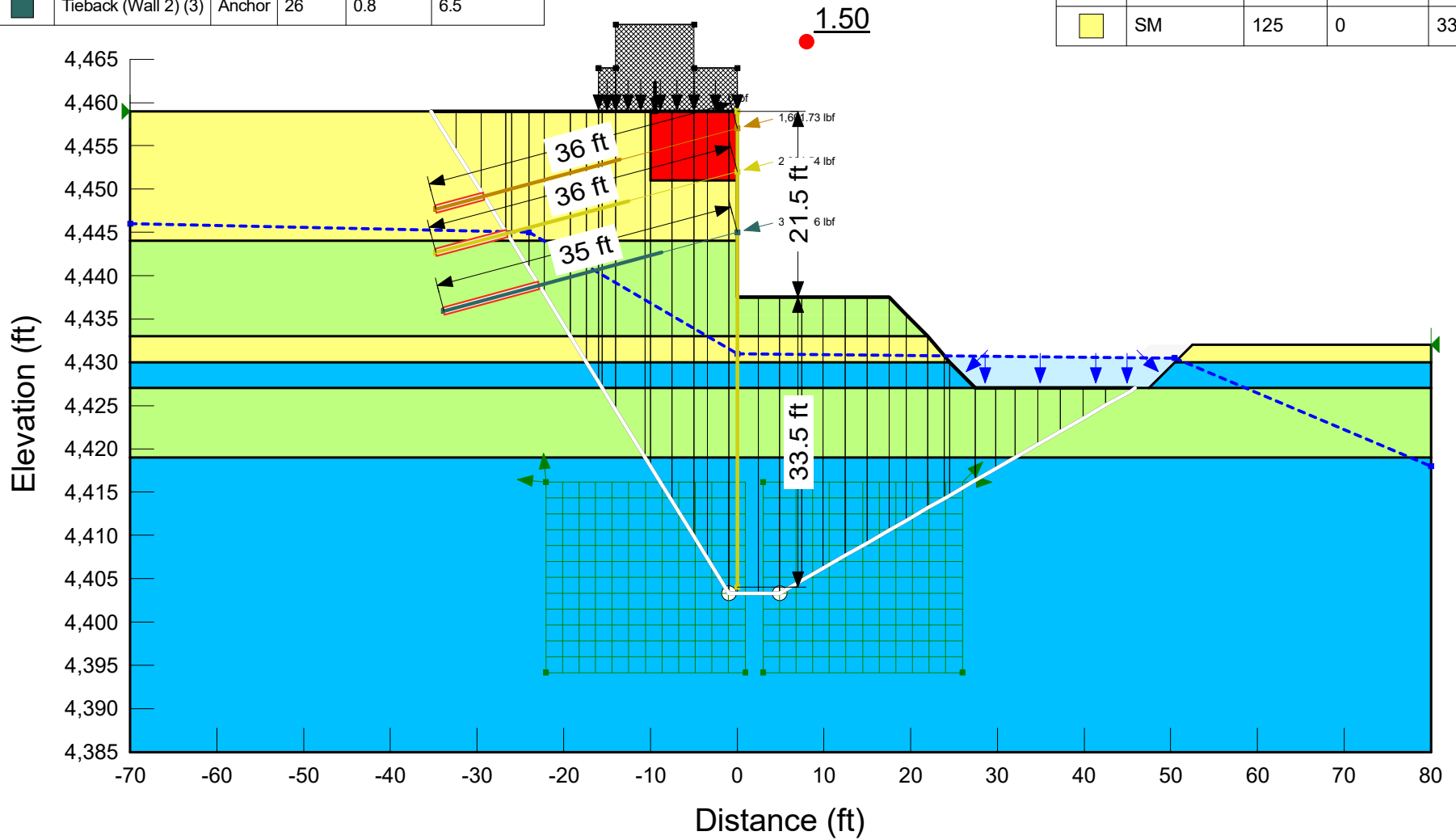


Wall 2 - 21.5' Long Term Case

14600 South Railroad Crossing

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Yellow	Pile (Wall 2)	Pile			6.5
Brown	Tieback (Wall 2)	Anchor	22	0.8	6.5
Light Green	Tieback (Wall 2) (2)	Anchor	23	0.8	6.5
Dark Green	Tieback (Wall 2) (3)	Anchor	26	0.8	6.5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Drained	115	150	30
Light Green	ML Drained	120	100	32
Red	MSE Backfill	135	0	33
Yellow	SM	125	0	33

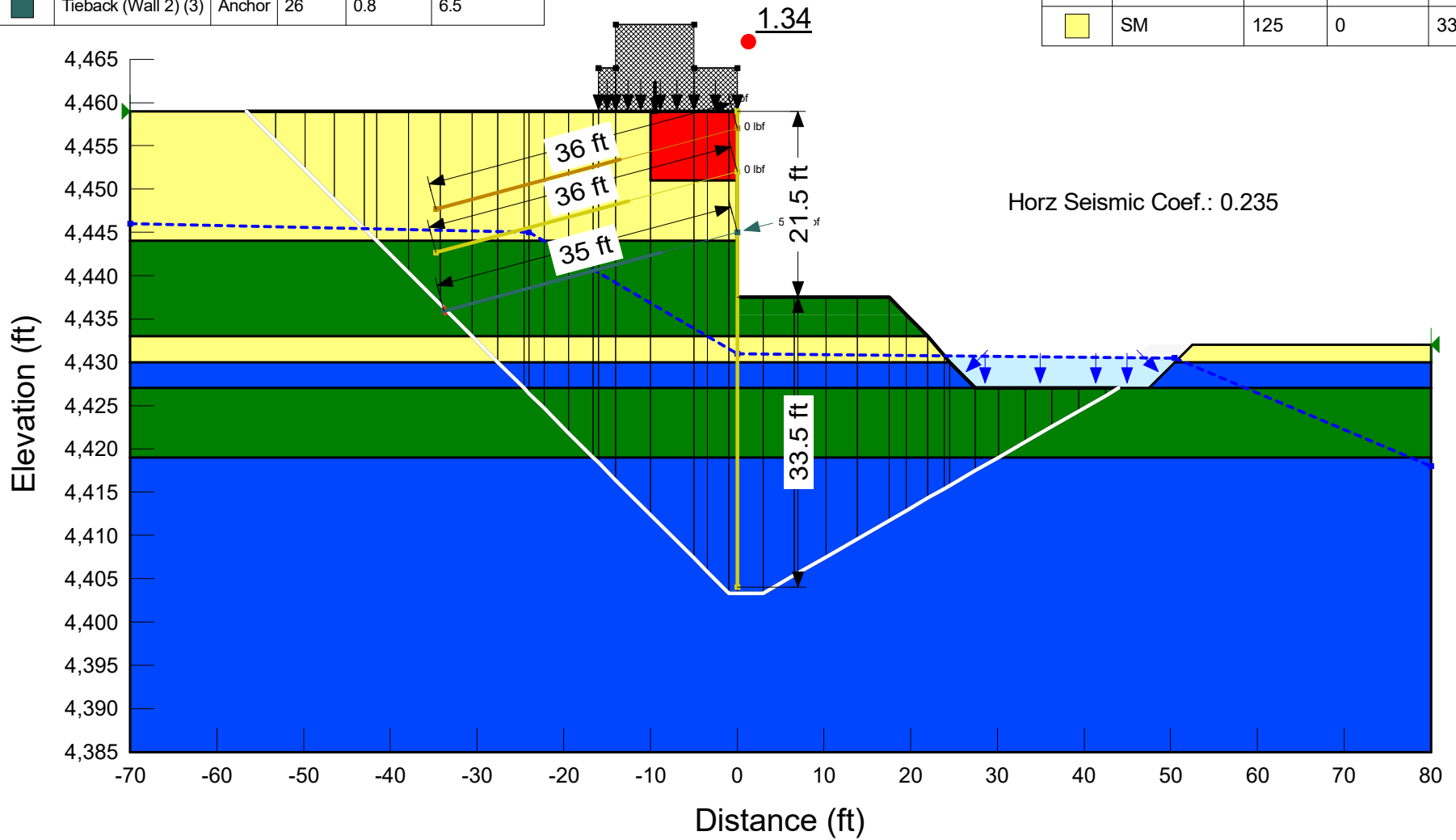


Wall 2 - 21.5' Long Term Case - Non Circular

14600 South Railroad Crossing

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Yellow	Pile (Wall 2)	Pile			6.5
Brown	Tieback (Wall 2)	Anchor	22	0.8	6.5
Light Green	Tieback (Wall 2) (2)	Anchor	23	0.8	6.5
Dark Green	Tieback (Wall 2) (3)	Anchor	26	0.8	6.5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Red	MSE Backfill	135	0	33
Light Yellow	SM	125	0	33



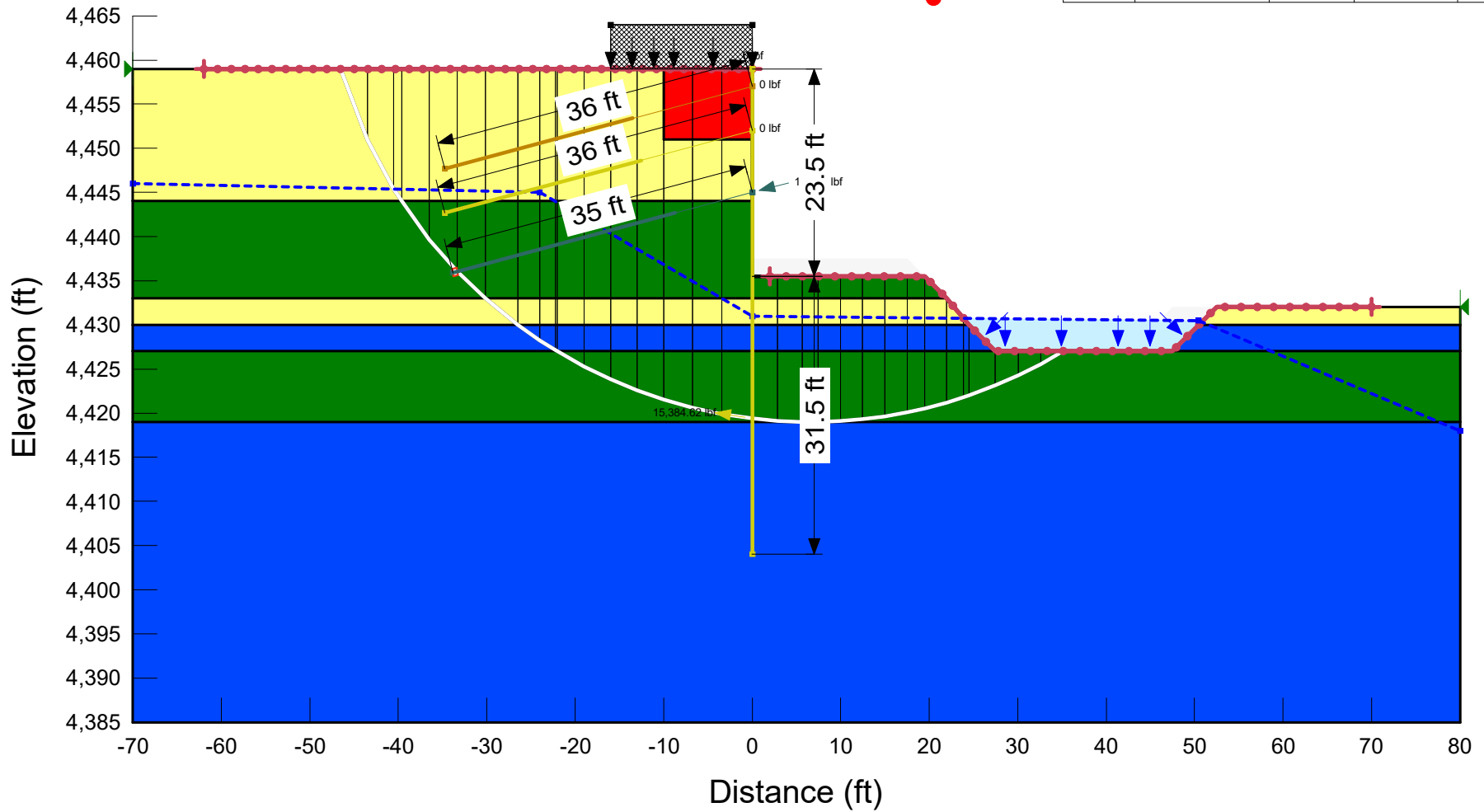
Wall 2 - 21.5' Pseudo Static Case - Non Circular

14600 South Railroad Crossing

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Yellow	Pile (Wall 2)	Pile			6.5
Brown	Tieback (Wall 2)	Anchor	22	0.8	6.5
Light Green	Tieback (Wall 2) (2)	Anchor	23	0.8	6.5
Dark Green	Tieback (Wall 2) (3)	Anchor	26	0.8	6.5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Red	MSE Backfill	135	0	33
Light Yellow	SM	125	0	33

2.23

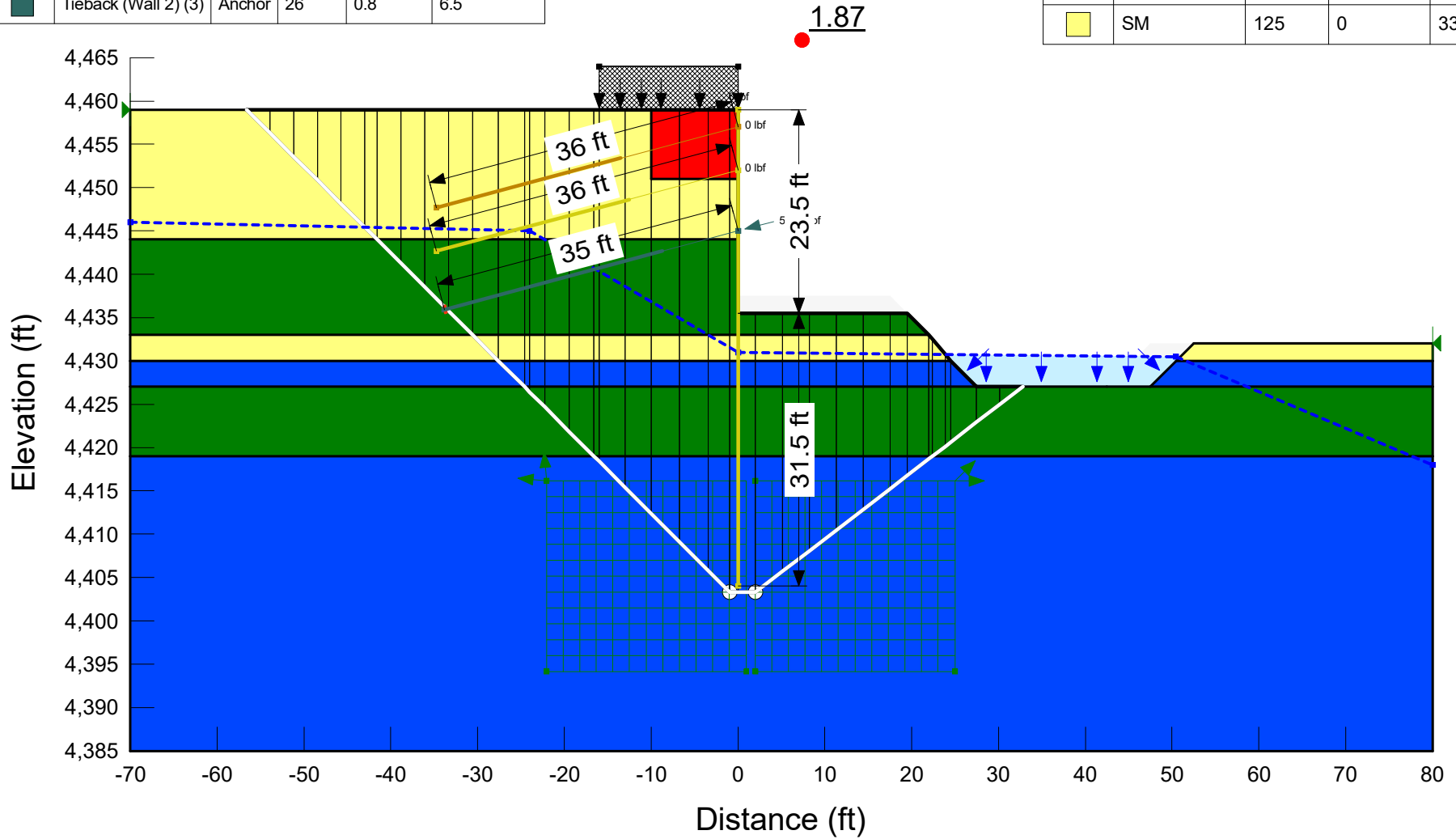


Wall 2 - 23.5' Temporary Case

14600 South Railroad Crossing

Color	Name	Type	Bond Length (ft)	Bond Diameter (ft)	Out-of-Plane Spacing (ft)
Yellow	Pile (Wall 2)	Pile			6.5
Brown	Tieback (Wall 2)	Anchor	22	0.8	6.5
Light Yellow	Tieback (Wall 2) (2)	Anchor	23	0.8	6.5
Dark Green	Tieback (Wall 2) (3)	Anchor	26	0.8	6.5

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
Blue	CL Undrained	115	2,000	0
Green	ML Undrained	120	1,250	0
Red	MSE Backfill	135	0	33
Light Yellow	SM	125	0	33




Wall 2 - 23.5' Temporary Case - Non Circular

14600 South Railroad Crossing

Tieback Anchor Calculations

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8 Project: 146th South Design: Tieback Anchor Design Type A (Wall 3) Date: 7/9/2025 Designed By: AWL	Reviewed By: BHG
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Midvale, UT

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	69	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	69	Anchor Load for Temporary Case Controlled by Upper Row.
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	77	
Lock-Off Load (kips) =	69	Anchor Load for Permanent/Seismic Cases Controlled by Lower Row.
Max. Test Load (kips) = $1.33 * DL_{Max}$ (kips) =	92	

Design Parameters

Assumed Grout Body Diameter, D (in) =	8	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	46	$BL = (DL * FS) / (\tau * \pi * D)$
Static Required Bonded Length, BL_{Static} (ft) =	46	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	51	
Unbonded Length $_{Temp}$ (ft) =	12	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	4	
Required Total Length $_{Temp}$ (ft) =	58	

2. Required Anchor Tendon Size

Allowable Anchor Loads


Allowable Working Load = $0.6 * F_u * A_s$

Allowable Lock-off Load = $0.7 * F_u * A_s$

Allowable Test Load = $0.8 * F_u * A_s$

Proposed Tendon Type	#14	
Cross-Section Area of Steel, A_s (in ²)	2.25	
Ultimate Stress, F_u (ksi)	100.0	
Allowable Working Load (kips)	135.0	Design Check OK
Allowable Lock-Off Load (kips)	157.5	OK
Allowable Test Load (kips)	180.0	OK
AREMA Check - 1/2 Yield Strength of Steel (kips)	84.4	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8 Project: 146th South Design: Tieback Anchor Design Type B (Wall 3) Date: 7/9/2025 Designed By: AWL	Reviewed By: BHG
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Midvale, UT

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	30	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	49	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	72	
Lock-Off Load (kips) =	49	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	72	

Design Parameters

Assumed Grout Body Diameter, D (in) =	8	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	20	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	32	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	48	
Unbonded Length $_{Temp}$ (ft) =	6	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	3	
Required Total Length $_{Temp}$ (ft) =	53	

2. Required Anchor Tendon Size

Allowable Anchor Loads


Allowable Working Load = $0.6 \cdot F_u \cdot A_s$

Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$

Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	#11	
Cross-Section Area of Steel, A_s (in ²)	1.56	
Ultimate Stress, F_u (ksi)	100.0	
Allowable Working Load (kips)	93.6	Design Check OK
Allowable Lock-Off Load (kips)	109.2	OK
Allowable Test Load (kips)	124.8	OK
AREMA Check - 1/2 Yield Strength of Steel (kips)	58.5	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8 Project: 146th South Design: Tieback Anchor Design Type C (Wall 7) Date: 7/9/2025 Designed By: AWL	Reviewed By: BHG
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Midvale, UT

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	37	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	64	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	38	
Lock-Off Load (kips) =	64	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	85	

Design Parameters

Assumed Grout Body Diameter, D (in) =	9.625	
Ultimate Soil/Grout Bond Strength, τ (psi) =	12	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	17	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	29	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	18	
Unbonded Length $_{Temp}$ (ft) =	11	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	10	
Required Total Length $_{Temp}$ (ft) =	40	


2. Required Anchor Tendon Size

Allowable Anchor Loads

Allowable Working Load = $0.6 \cdot F_u \cdot A_s$
 Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$
 Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	2 Strand	
Cross-Section Area of Steel, A_s (in ²)	0.434	
Ultimate Stress, F_u (ksi)	270.0	
Allowable Working Load (kips)	70.3	Design Check OK
Allowable Lock-Off Load (kips)	82.0	OK
Allowable Test Load (kips)	93.7	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8
	Project: 146th South Design: Tieback Anchor Design Type D (Wall 7) Date: 7/9/2025 Designed By: AWL
Midvale, UT	Reviewed By: BHG

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	37	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	58	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	47	
Lock-Off Load (kips) =	58	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	77	

Design Parameters

Assumed Grout Body Diameter, D (in) =	9.625	
Ultimate Soil/Grout Bond Strength, τ (psi) =	12	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	17	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	27	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	22	
Unbonded Length $_{Temp}$ (ft) =	13	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	12	
Required Total Length $_{Temp}$ (ft) =	40	

2. Required Anchor Tendon Size

Allowable Anchor Loads


Allowable Working Load = $0.6 \cdot F_u \cdot A_s$

Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$

Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	2 Strand	
Cross-Section Area of Steel, A_s (in ²)	0.434	
Ultimate Stress, F_u (ksi)	270.0	
Allowable Working Load (kips)	70.3	Design Check OK
Allowable Lock-Off Load (kips)	82.0	OK
Allowable Test Load (kips)	93.7	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8 Project: 146th South Design: Tieback Anchor Design Type E (Temporary Walls) Date: 7/9/2025 Designed By: AWL	Reviewed By: BHG
Midvale, UT		

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	68	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	0	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	0	
Lock-Off Load (kips) =	68	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	91	

Design Parameters

Assumed Grout Body Diameter, D (in) =	8	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	45	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	0	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	0	
Unbonded Length $_{Temp}$ (ft) =	11	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	0	
Required Total Length $_{Temp}$ (ft) =	56	


2. Required Anchor Tendon Size

Allowable Anchor Loads

Allowable Working Load = $0.6 \cdot F_u \cdot A_s$
 Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$
 Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	#14	
Cross-Section Area of Steel, A_s (in ²)	2.25	
Ultimate Stress, F_u (ksi)	100.0	
		Design Check
Allowable Working Load (kips)	135.0	OK
Allowable Lock-Off Load (kips)	157.5	OK
Allowable Test Load (kips)	180.0	OK
AREMA Check - 1/2 Yield Strength of Steel (kips)	84.4	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8 Project: 146th South Design: Tieback Anchor Design Type F (Temporary Walls) Date: 7/9/2025 Designed By: AWL
Midvale, UT	Reviewed By: BHG

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	47	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	0	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	0	
Lock-Off Load (kips) =	47	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	63	

Design Parameters

Assumed Grout Body Diameter, D (in) =	8	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	31	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	0	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	0	
Unbonded Length $_{Temp}$ (ft) =	7	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	0	
Required Total Length $_{Temp}$ (ft) =	38	

2. Required Anchor Tendon Size

Allowable Anchor Loads

Allowable Working Load = $0.6 \cdot F_u \cdot A_s$
 Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$
 Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	#10	
Cross-Section Area of Steel, A_s (in ²)	1.27	
Ultimate Stress, F_u (ksi)	100.0	
Allowable Working Load (kips)	76.2	Design Check
Allowable Lock-Off Load (kips)	88.9	OK
Allowable Test Load (kips)	101.6	OK
AREMA Check - 1/2 Yield Strength of Steel (kips)	47.6	OK

Tieback Anchor Calculations



Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6
and AREMA Chapter 8

Project: 146th South
Design: Tieback Anchor Design Type G (Wall 4)
Date: 5/15/2025

Midvale, UT

Designed By: AWL

Reviewed By: BHG

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	68	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	44	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	83	
Lock-Off Load (kips) =	68	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	83	

Design Parameters

Assumed Grout Body Diameter, D (in) =	8	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	45	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	29	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	55	
Unbonded Length $_{Temp}$ (ft) =	0	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	5	
Required Total Length $_{Temp}$ (ft) =	60	

2. Required Anchor Tendon Size

Allowable Anchor Loads


Allowable Working Load = $0.6 \cdot F_u \cdot A_s$

Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$

Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	#14	
Cross-Section Area of Steel, A_s (in ²)	2.25	
Ultimate Stress, F_u (ksi)	100.0	
		Design Check
Allowable Working Load (kips)	135.0	OK
Allowable Lock-Off Load (kips)	157.5	OK
Allowable Test Load (kips)	180.0	OK
AREMA Check - 1/2 Yield Strength of Steel (kips)	84.4	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8
	Project: 146th South Design: Tieback Anchor Design Type H (Wall 2) Date: 7/9/2025 Designed By: AWL
Midvale, UT	Reviewed By: BHG

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	43	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	48	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	48	
Lock-Off Load (kips) =	48	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	64	

Design Parameters

Assumed Grout Body Diameter, D (in) =	9.625	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	24	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	26	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	26	
Unbonded Length $_{Temp}$ (ft) =	10	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	9	
Required Total Length $_{Temp}$ (ft) =	36	

2. Required Anchor Tendon Size

Allowable Anchor Loads


Allowable Working Load = $0.6 \cdot F_u \cdot A_s$

Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$

Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	2 Strand	
Cross-Section Area of Steel, A_s (in ²)	0.434	
Ultimate Stress, F_u (ksi)	270.0	
Allowable Working Load (kips)	70.3	Design Check OK
Allowable Lock-Off Load (kips)	82.0	OK
Allowable Test Load (kips)	93.7	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8 Project: 146th South Design: Tieback Anchor Design Type I (Wall 2) Date: 7/9/2025 Designed By: AWL	Reviewed By: BHG
	Midvale, UT	

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	31	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	43	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	37	
Lock-Off Load (kips) =	43	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	57	

Design Parameters

Assumed Grout Body Diameter, D (in) =	9.625	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	17	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	24	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	20	
Unbonded Length $_{Temp}$ (ft) =	13	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	12	
Required Total Length $_{Temp}$ (ft) =	37	

2. Required Anchor Tendon Size

Allowable Anchor Loads


Allowable Working Load = $0.6 \cdot F_u \cdot A_s$

Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$

Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	2 Strand	
Cross-Section Area of Steel, A_s (in ²)	0.434	
Ultimate Stress, F_u (ksi)	270.0	
Allowable Working Load (kips)	70.3	Design Check OK
Allowable Lock-Off Load (kips)	82.0	OK
Allowable Test Load (kips)	93.7	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8 Project: 146th South Design: Tieback Anchor Design Type J (Wall 2) Date: 7/9/2025 Designed By: AWL	Reviewed By: BHG
Midvale, UT		

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	27	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	42	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	35	
Lock-Off Load (kips) =	42	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	55	

Design Parameters

Assumed Grout Body Diameter, D (in) =	9.625	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	15	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	23	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	19	
Unbonded Length $_{Temp}$ (ft) =	14	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	13	
Required Total Length $_{Temp}$ (ft) =	37	

2. Required Anchor Tendon Size

Allowable Anchor Loads


Allowable Working Load = $0.6 \cdot F_u \cdot A_s$

Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$

Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	2 Strand	
Cross-Section Area of Steel, A_s (in ²)	0.434	
Ultimate Stress, F_u (ksi)	270.0	
Allowable Working Load (kips)	70.3	Design Check OK
Allowable Lock-Off Load (kips)	82.0	OK
Allowable Test Load (kips)	93.7	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8 Project: 146th South Design: Tieback Anchor Design Type K (Wall 2) Date: 7/9/2025 Designed By: AWL	Reviewed By: BHG
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Midvale, UT

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	29	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	40	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	40	
Lock-Off Load (kips) =	40	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	53	

Design Parameters

Assumed Grout Body Diameter, D (in) =	9.625	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	16	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	22	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	22	
Unbonded Length $_{Temp}$ (ft) =	16	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	15	
Required Total Length $_{Temp}$ (ft) =	38	


2. Required Anchor Tendon Size

Allowable Anchor Loads

Allowable Working Load = $0.6 \cdot F_u \cdot A_s$
 Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$
 Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	2 Strand	
Cross-Section Area of Steel, A_s (in ²)	0.434	
Ultimate Stress, F_u (ksi)	270.0	
Allowable Working Load (kips)	70.3	Design Check OK
Allowable Lock-Off Load (kips)	82.0	OK
Allowable Test Load (kips)	93.7	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8
	Project: 146th South Design: Tieback Anchor Design Type L (Wall 2) Date: 7/9/2025 Designed By: AWL
Midvale, UT	Reviewed By: BHG

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	38	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	43	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	31	
Lock-Off Load (kips) =	43	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	58	

Design Parameters

Assumed Grout Body Diameter, D (in) =	9.625	
Ultimate Soil/Grout Bond Strength, τ (psi) =	10	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	21	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	24	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	17	
Unbonded Length $_{Temp}$ (ft) =	10	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	9	
Required Total Length $_{Temp}$ (ft) =	34	


2. Required Anchor Tendon Size

Allowable Anchor Loads

Allowable Working Load = $0.6 \cdot F_u \cdot A_s$
 Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$
 Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	2 Strand	
Cross-Section Area of Steel, A_s (in ²)	0.434	
Ultimate Stress, F_u (ksi)	270.0	
Allowable Working Load (kips)	70.3	Design Check OK
Allowable Lock-Off Load (kips)	82.0	OK
Allowable Test Load (kips)	93.7	OK

Tieback Anchor Calculations

	Design Reference: Recommendations for Prestressed Rock and Soil Anchors, PTI Section 6.6 and AREMA Chapter 8
	Project: 146th South Design: Tieback Anchor Design Type M (Wall 7) Date: 7/9/2025 Designed By: AWL
Midvale, UT	Reviewed By: BHG

Loads

Location:

Max. Design Load (Temporary), DL_{Temp} (kips) =	48	(See ShoringSuite Calculations)
Max. Design Load (Permanent), DL_{Perm} (kips) =	61	
Max. Design Load (Seismic), $DL_{Seismic}$ (kips) =	38	
Lock-Off Load (kips) =	61	
Max. Test Load (kips) = $1.33 \cdot DL_{Max}$ (kips) =	81	

Design Parameters

Assumed Grout Body Diameter, D (in) =	9.625	
Ultimate Soil/Grout Bond Strength, τ (psi) =	12	(Estimated, to be verified by testing)
Factor of Safety for Pullout, FS_{Temp} =	2.0	
Factor of Safety for Pullout, FS_{Perm} =	2.0	
Factor of Safety for Pullout, $FS_{Seismic}$ =	2.0	

1. Required Minimum Lengths

Required Bonded Length, BL_{Temp} (ft) =	22	$BL = (DL \cdot FS) / (\tau \cdot \pi \cdot D)$
Static Required Bonded Length, BL_{Static} (ft) =	28	
Seismic Required Bonded Length, $BL_{Seismic}$ (ft) =	17	
Unbonded Length $_{Temp}$ (ft) =	10	
Unbonded Length $_{Perm \text{ and } Seismic}$ (ft) =	9	
Required Total Length $_{Temp}$ (ft) =	38	

2. Required Anchor Tendon Size

Allowable Anchor Loads

Allowable Working Load = $0.6 \cdot F_u \cdot A_s$

Allowable Lock-off Load = $0.7 \cdot F_u \cdot A_s$

Allowable Test Load = $0.8 \cdot F_u \cdot A_s$

Proposed Tendon Type	2 Strand	
Cross-Section Area of Steel, A_s (in ²)	0.434	
Ultimate Stress, F_u (ksi)	270.0	
Allowable Working Load (kips)	70.3	Design Check OK
Allowable Lock-Off Load (kips)	82.0	OK
Allowable Test Load (kips)	93.7	OK

Critical Failure Plane / Unbonded Length Calculations

Critical Failure Plane



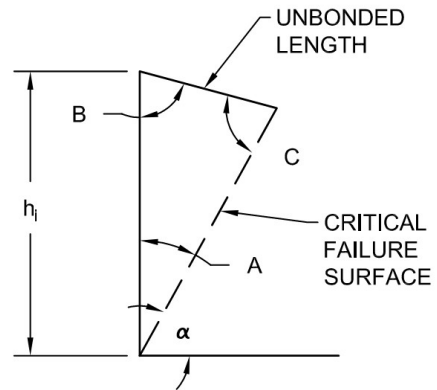
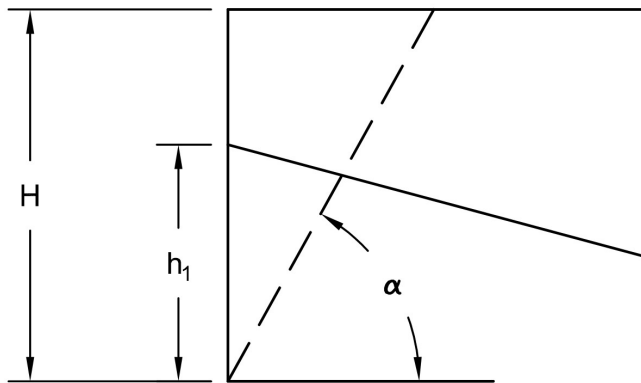
References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 2
 Design Section H=11 ft

Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback} := 4.0 \text{ ft}$ $H := 11 \text{ ft}$

$\phi := 32$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61$ Critical Failure Plane



Unbonded Length Calculation Tieback "H":

$$h_1 := H - depth_{tieback} = 7 \text{ ft}$$

$$A := 90 - \alpha = 29 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 3.5 \text{ ft}$$

$$Tieback_{unbonded} := a = 3.5 \text{ ft} \quad \text{Length to Critical Failure Plane}$$

$$Tieback_{unbonded} := a + 5 \text{ ft} = 8.5 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



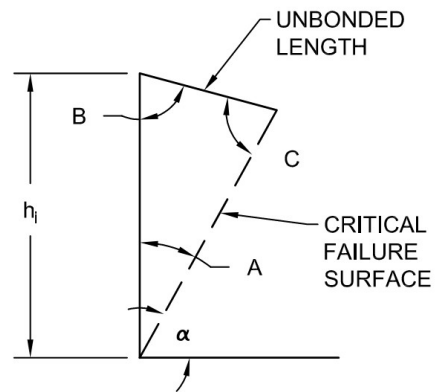
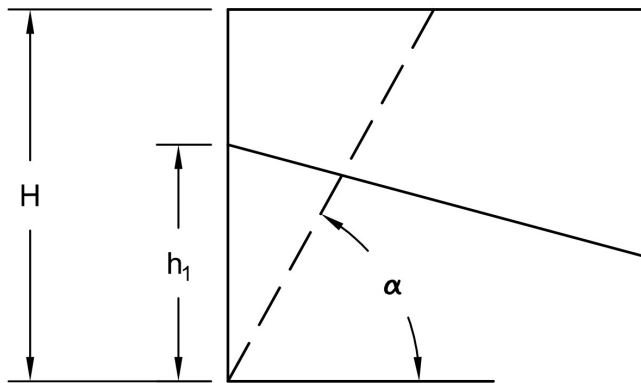
References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 2
 Design Section H=13 ft

Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback} := 4.0 \text{ ft}$ $H := 13 \text{ ft}$

$\phi := 32$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61$ Critical Failure Plane



Unbonded Length Calculation Tieback "H":

$$h_1 := H - depth_{tieback} = 9 \text{ ft}$$

$$A := 90 - \alpha = 29 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 4.5 \text{ ft}$$

$$Tieback_{unbonded} := a = 4.5 \text{ ft} \quad \text{Length to Critical Failure Plane}$$

$$Tieback_{unbonded} := a + 5 \text{ ft} = 9.5 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



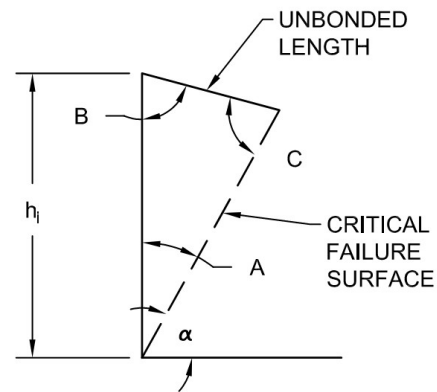
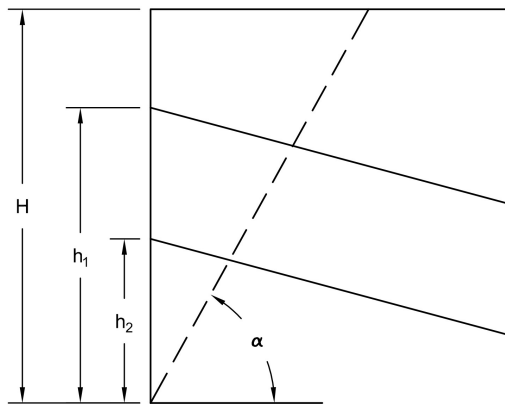
References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 2
 Design Section H=15 ft

Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback1} := 2.0 \text{ ft}$ $depth_{tieback2} := 7.0 \text{ ft}$ $H := 15 \text{ ft}$

$\phi := 32$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61$ Critical Failure Plane



Unbonded Length Calculation Tieback "I":

$$h_1 := H - depth_{tieback1} = 13 \text{ ft}$$

$$A := 90 - \alpha = 29 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 6.5 \text{ ft}$$

$$Tieback_{unbonded1} := a = 6.5 \text{ ft} \quad \text{Length to Critical Failure Plane}$$

$$Tieback_{unbonded1} := a + 5 \text{ ft} = 11.5 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Unbonded Length Calculation Tieback "L":

$$h_2 := H - \text{depth}_{\text{tieback2}} = 8 \text{ ft}$$

$$\alpha := 45 + \frac{\phi}{2} = 61$$

$$A := 90 - \alpha = 29 \quad B := 90 - \text{Angle}_{\text{Tieback}} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_2}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 4 \text{ ft}$$

$$\text{Tieback}_{\text{unbonded2}} := a = 4 \text{ ft} \quad \text{Critical Failure Plane}$$

$$\text{Tieback}_{\text{unbonded2}} := a + 5 \text{ ft} = 9 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



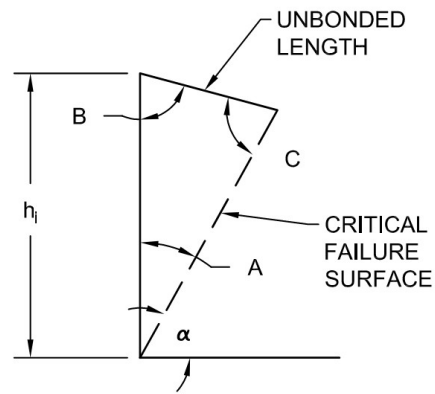
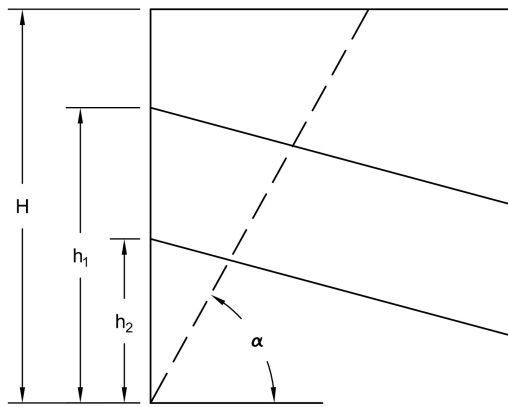
References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 2
 Design Section H=17 ft

Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback1} := 3 \text{ ft}$ $depth_{tieback2} := 9.5 \text{ ft}$ $H := 17 \text{ ft}$

$\phi := 32$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61$ Critical Failure Plane



Unbonded Length Calculation Tieback "I":

$$h_1 := H - depth_{tieback1} = 14 \text{ ft}$$

$$A := 90 - \alpha = 29 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 7 \text{ ft}$$

$$Tieback_{unbonded1} := a = 7 \text{ ft} \quad \text{Length to Critical Failure Plane}$$

$$Tieback_{unbonded1} := a + 5 \text{ ft} = 12 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Unbonded Length Calculation Tieback "L":

$$h_2 := H - \text{depth}_{\text{tieback2}} = 7.5 \text{ ft}$$

$$\alpha := 45 + \frac{\phi}{2} = 61$$

$$A := 90 - \alpha = 29 \quad B := 90 - \text{Angle}_{\text{Tieback}} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_2}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 3.7 \text{ ft}$$

$$\text{Tieback}_{\text{unbonded2}} := a = 3.7 \text{ ft} \quad \text{Critical Failure Plane}$$

$$\text{Tieback}_{\text{unbonded2}} := a + 5 \text{ ft} = 8.7 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



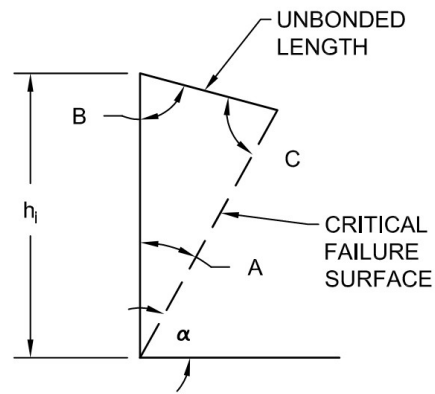
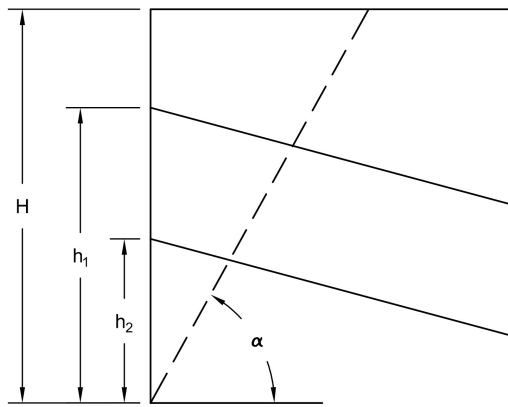
References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 2
 Design Section H=19 ft

Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback1} := 3 \text{ ft}$ $depth_{tieback2} := 9.5 \text{ ft}$ $H := 19 \text{ ft}$

$\phi := 32$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61$ Critical Failure Plane



Unbonded Length Calculation Tieback "I":

$$h_1 := H - depth_{tieback1} = 16 \text{ ft}$$

$$A := 90 - \alpha = 29 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 8 \text{ ft}$$

$$Tieback_{unbonded1} := a = 8 \text{ ft} \quad \text{Length to Critical Failure Plane}$$

$$Tieback_{unbonded1} := a + 5 \text{ ft} = 13 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Unbonded Length Calculation Tieback "L":

$$h_2 := H - \text{depth}_{\text{tieback2}} = 9.5 \text{ ft}$$

$$\alpha := 45 + \frac{\phi}{2} = 61$$

$$A := 90 - \alpha = 29 \quad B := 90 - \text{Angle}_{\text{Tieback}} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_2}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 4.7 \text{ ft}$$

$$\text{Tieback}_{\text{unbonded2}} := a = 4.7 \text{ ft} \quad \text{Critical Failure Plane}$$

$$\text{Tieback}_{\text{unbonded2}} := a + 5 \text{ ft} = 9.7 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 2
 Design Section H=21.5 ft

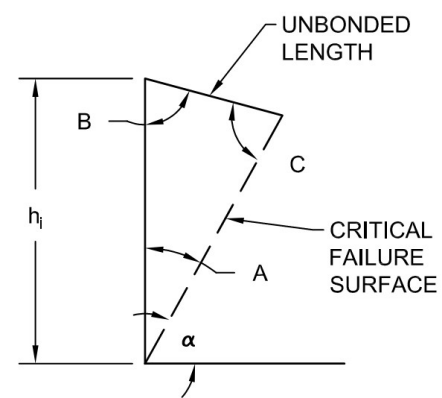
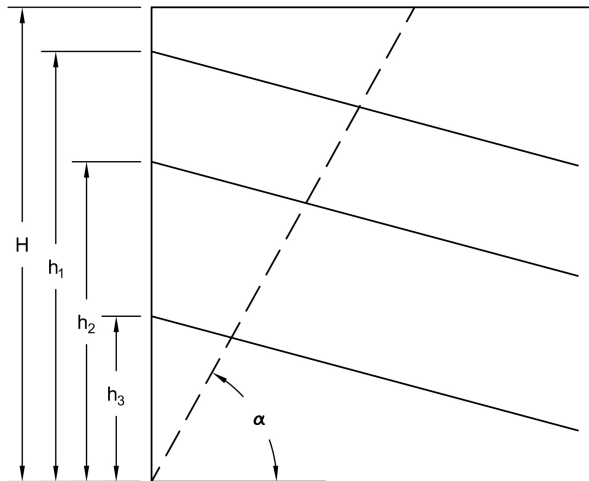
Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback1} := 2.0 \text{ ft}$ $depth_{tieback2} := 7.0 \text{ ft}$ $depth_{tieback3} := 14.0 \text{ ft}$

$H := 21.5 \text{ ft}$

$\phi := 32$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61$ Critical Failure Plane



Unbonded Length Calculation Tieback "K":

$$h_1 := H - depth_{tieback1} = 19.5 \text{ ft}$$

$$A := 90 - \alpha = 29 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 9.7 \text{ ft}$$

$Tieback_{unbonded1} := a = 9.7 \text{ ft}$ Length to Critical Failure Plane

$Tieback_{unbonded1} := a + 5 \text{ ft} = 14.7 \text{ ft}$ Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)

Unbonded Length Calculation Tieback "J":

$$h_2 := H - \text{depth}_{\text{tieback2}} = 14.5 \text{ ft}$$

$$\alpha := 45 + \frac{\phi}{2} = 61$$

$$A := 90 - \alpha = 29 \quad B := 90 - \text{Angle}_{\text{Tieback}} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_2}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 7.2 \text{ ft}$$

$$\text{Tieback}_{\text{unbonded2}} := a = 7.2 \text{ ft} \quad \text{Critical Failure Plane}$$

$$\text{Tieback}_{\text{unbonded2}} := a + 5 \text{ ft} = 12.2 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Unbonded Length Calculation Tieback "H":

$$h_3 := H - \text{depth}_{\text{tieback3}} = 7.5 \text{ ft}$$

$$\alpha := 45 + \frac{\phi}{2} = 61$$

$$A := 90 - \alpha = 29 \quad B := 90 - \text{Angle}_{\text{Tieback}} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_3}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 3.7 \text{ ft}$$

$$\text{Tieback}_{\text{unbonded3}} := a = 3.7 \text{ ft} \quad \text{Critical Failure Plane}$$

$$\text{Tieback}_{\text{unbonded3}} := a + 5 \text{ ft} = 8.7 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 2
 Design Section H=23.5 ft

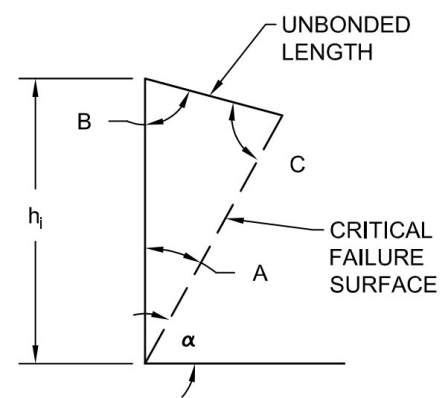
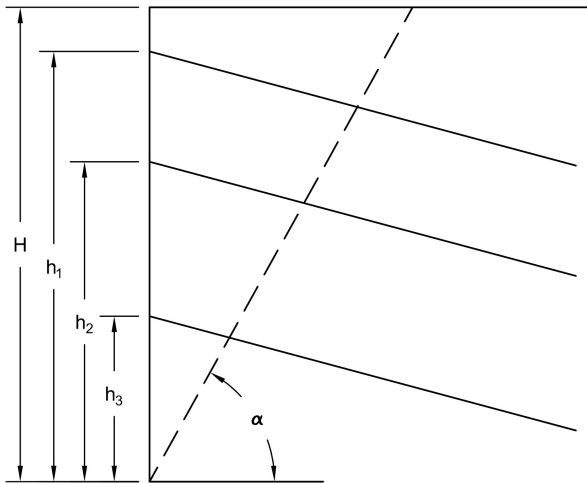
Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback1} := 2.0 \text{ ft}$ $depth_{tieback2} := 7.0 \text{ ft}$ $depth_{tieback3} := 14.0 \text{ ft}$

$H := 23.5 \text{ ft}$

$\phi := 32$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61$ Critical Failure Plane



Unbonded Length Calculation Tieback "K":

$$h_1 := H - depth_{tieback1} = 21.5 \text{ ft}$$

$$A := 90 - \alpha = 29 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 10.7 \text{ ft}$$

$Tieback_{unbonded1} := a = 10.7 \text{ ft}$ Length to Critical Failure Plane

$Tieback_{unbonded1} := a + 5 \text{ ft} = 15.7 \text{ ft}$ Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)

Unbonded Length Calculation Tieback "J":

$$h_2 := H - \text{depth}_{\text{tieback2}} = 16.5 \text{ ft}$$

$$\alpha := 45 + \frac{\phi}{2} = 61$$

$$A := 90 - \alpha = 29 \quad B := 90 - \text{Angle}_{\text{Tieback}} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_2}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 8.2 \text{ ft}$$

$$\text{Tieback}_{\text{unbonded2}} := a = 8.2 \text{ ft} \quad \text{Critical Failure Plane}$$

$$\text{Tieback}_{\text{unbonded2}} := a + 5 \text{ ft} = 13.2 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Unbonded Length Calculation Tieback "H":

$$h_3 := H - \text{depth}_{\text{tieback3}} = 9.5 \text{ ft}$$

$$\alpha := 45 + \frac{\phi}{2} = 61$$

$$A := 90 - \alpha = 29 \quad B := 90 - \text{Angle}_{\text{Tieback}} = 75 \quad C := 180 - A - B = 76$$

$$a := \frac{h_3}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 4.7 \text{ ft}$$

$$\text{Tieback}_{\text{unbonded3}} := a = 4.7 \text{ ft} \quad \text{Critical Failure Plane}$$

$$\text{Tieback}_{\text{unbonded3}} := a + 5 \text{ ft} = 9.7 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



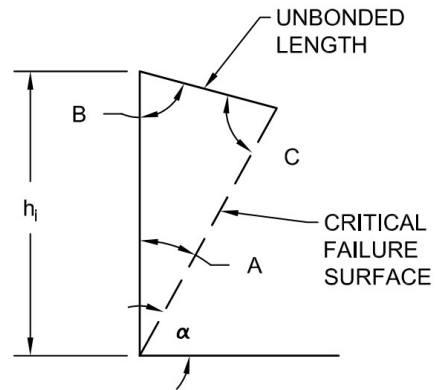
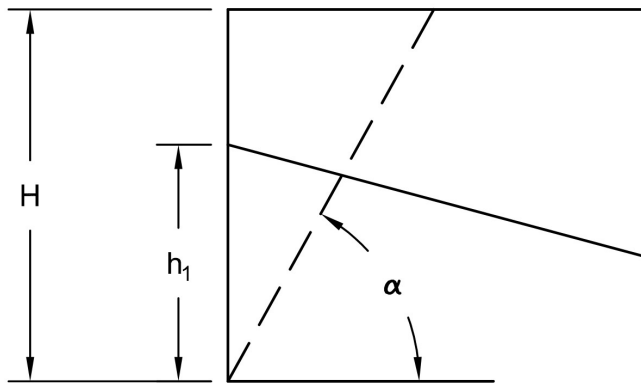
References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 7
 Design Section H=13.5 ft

Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback1} := 4.5 \text{ ft}$ $H := 13.5 \text{ ft}$

$\phi := 33$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61.5$ Critical Failure Plane



Unbonded Length Calculation Tieback "C":

$$h_1 := H - depth_{tieback1} = 9 \text{ ft}$$

$$A := 90 - \alpha = 28.5 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76.5$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 4.4 \text{ ft}$$

$$Tieback_{unbonded1} := a = 4.4 \text{ ft} \quad \text{Length to Critical Failure Plane}$$

$$Tieback_{unbonded1} := a + 5 \text{ ft} = 9.4 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



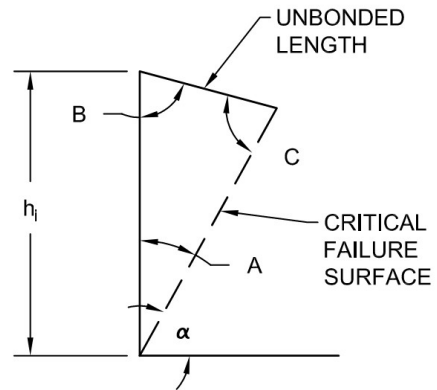
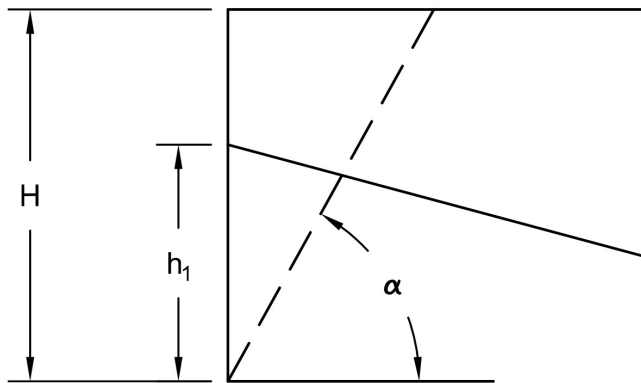
References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 7
 Design Section H=15.5 ft

Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback1} := 4.5 \text{ ft}$ $H := 15.5 \text{ ft}$

$\phi := 33$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61.5$ Critical Failure Plane



Unbonded Length Calculation Tieback "C":

$$h_1 := H - depth_{tieback1} = 11 \text{ ft}$$

$$A := 90 - \alpha = 28.5 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76.5$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 5.4 \text{ ft}$$

$$Tieback_{unbonded1} := a = 5.4 \text{ ft} \quad \text{Length to Critical Failure Plane}$$

$$Tieback_{unbonded1} := a + 5 \text{ ft} = 10.4 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



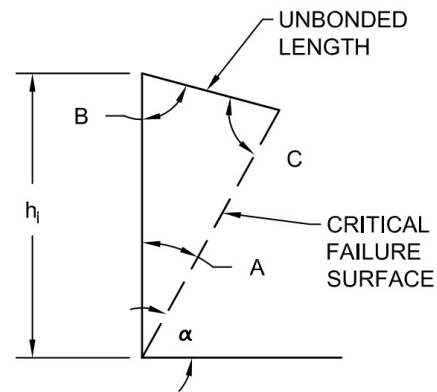
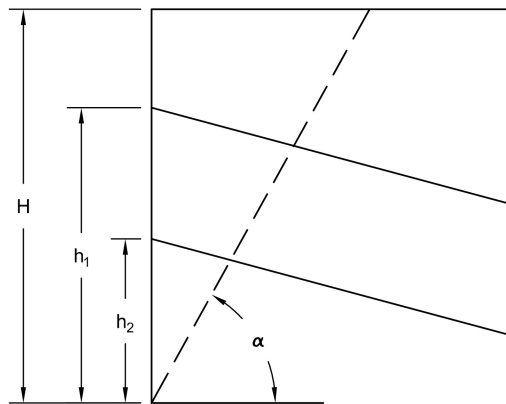
References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 7
 Design Section H=18 ft

Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback1} := 4.5 \text{ ft}$ $depth_{tieback2} := 10.5 \text{ ft}$ $H := 18 \text{ ft}$

$\phi := 33$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61.5$ Critical Failure Plane



Unbonded Length Calculation Tieback "D":

$$h_1 := H - depth_{tieback1} = 13.5 \text{ ft}$$

$$A := 90 - \alpha = 28.5 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76.5$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 6.6 \text{ ft}$$

$$Tieback_{unbonded1} := a = 6.6 \text{ ft} \quad \text{Length to Critical Failure Plane}$$

$$Tieback_{unbonded1} := a + 5 \text{ ft} = 11.6 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Unbonded Length Calculation Tieback "M":

$$h_2 := H - \text{depth}_{\text{tieback2}} = 7.5 \text{ ft}$$

$$\alpha := 45 + \frac{\phi}{2} = 61.5$$

$$A := 90 - \alpha = 28.5 \quad B := 90 - \text{Angle}_{\text{Tieback}} = 75 \quad C := 180 - A - B = 76.5$$

$$a := \frac{h_2}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 3.7 \text{ ft}$$

$$\text{Tieback}_{\text{unbonded2}} := a = 3.7 \text{ ft} \quad \text{Critical Failure Plane}$$

$$\text{Tieback}_{\text{unbonded2}} := a + 5 \text{ ft} = 8.7 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Critical Failure Plane



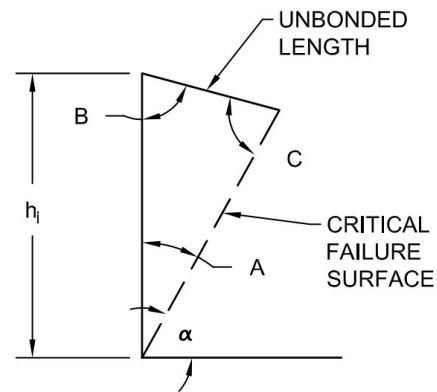
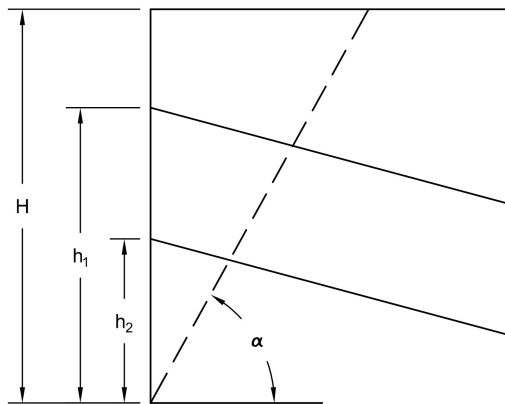
References: FHWA GEC 4 (1999)
 Date: 7/3/2025
 Project: 14600 South Realignment
 Client: HDR
 Description: Critical Failure Plane Wall 7
 Design Section H=20 ft

Designed by: RRB
 Checked by: AWL

Wall Information: $depth_{tieback1} := 4.5 \text{ ft}$ $depth_{tieback2} := 10.5 \text{ ft}$ $H := 20 \text{ ft}$

$\phi := 33$ Soil Friction Angle

$Angle_{Tieback} := 15$ $\alpha := 45 + \frac{\phi}{2} = 61.5$ Critical Failure Plane



Unbonded Length Calculation Tieback "D":

$$h_1 := H - depth_{tieback1} = 15.5 \text{ ft}$$

$$A := 90 - \alpha = 28.5 \quad B := 90 - Angle_{Tieback} = 75 \quad C := 180 - A - B = 76.5$$

$$a := \frac{h_1}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 7.6 \text{ ft}$$

$$Tieback_{unbonded1} := a = 7.6 \text{ ft} \quad \text{Length to Critical Failure Plane}$$

$$Tieback_{unbonded1} := a + 5 \text{ ft} = 12.6 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Unbonded Length Calculation Tieback "M":

$$h_2 := H - \text{depth}_{\text{tieback2}} = 9.5 \text{ ft}$$

$$\alpha := 45 + \frac{\phi}{2} = 61.5$$

$$A := 90 - \alpha = 28.5 \quad B := 90 - \text{Angle}_{\text{Tieback}} = 75 \quad C := 180 - A - B = 76.5$$

$$a := \frac{h_2}{\sin\left(C \cdot \frac{\pi}{180}\right)} \cdot \sin\left(A \cdot \frac{\pi}{180}\right) = 4.7 \text{ ft}$$

$$\text{Tieback}_{\text{unbonded2}} := a = 4.7 \text{ ft} \quad \text{Critical Failure Plane}$$

$$\text{Tieback}_{\text{unbonded2}} := a + 5 \text{ ft} = 9.7 \text{ ft} \quad \text{Critical Failure Plane plus 5 feet (FHWA GEC 4; 5.3.4)}$$

Lagging Calculations

Timber Lagging Design



Reference: 2024 AREMA MRE Chapter 7
 Project: 146th South
 Design: Timber Lagging - 5' c-c pile spacing & 21' depth
 Date: 5/15/2025
 Designed By: AWL

BHG

Geometry & Loads

Load Type: ASD

H =	21	ft	
w =	1.07	ksf	(Max. Pressure On Wall - See Subsequent Shoring Suite Report for 21' Temp Wall Case)
Arching =	0.67		(Reduction Factor) May be reduced by 1/3 per AREMA Ch 8 - 28.5.3.5
w _{lag} =	0.71	ksf	(Reduced Pressure Due to Arching)
Pile Spacing =	5.0	ft	
Pile Flange Width =	14.0	in	
L =	3.83	ft	(Lagging Span)
M _{max} =	1.31	k-ft/ft	M _{max} = w _{lag} L ² /8

Lagging design for temporary walls (Temporary Wall North & Temporary Wall South)

Timber Properties

Species:	Douglas Fir	Treatment:	None
Grade:	No. 2	Design Duration:	1 Year
Cut:	Full Sawn		

Values below referenced from AREMA Table 7-2-9

F _b =	690	psi	(Reference Design Bending Stress)
F _{pp} =	380	psi	(Reference Design Compressive Stress(Perpendicular to Grain))
F _v =	155	psi	(Reference Design Shear Stress)
C _M =	1.00		(Dry Use Factor, bending)
C _M =	1.00		(Dry Use Factor, shear)
C _{fu} =	1.0		(Flat Use Factor)
C _L =	1.1		(No RR Loading)
F _b ' =	759	psi	F _b ' = F _b * C _M * C _{FU} * C _L
F _v ' =	171	psi	F _v ' = F _v * C _L * C _M

Check Minimum Thickness (Based on Maximum Moment)

S _{req'd} =	20.7	in ³ /ft	S _{req'd} = M _{max} *b/12/F _b '
S _{lag} =	bt ² /6		
	S _{lag} > S _{req'd}		
b =	12	in	Width of lagging = 1ft for M _{lag} computed per unit width of lagging
t _{min} =	3.22	in	t _{min} = (6S _{req'd} /b) ^{0.5}

Check for Shear

b =	12	in	
t =	4	in	(Actual Thickness)
V =	2050.8	lbs	V = wL/2
S =	64.09	psi	S = 3V/2bt = Unit Shear Stress
	S < F _v		OK

Check for Compression

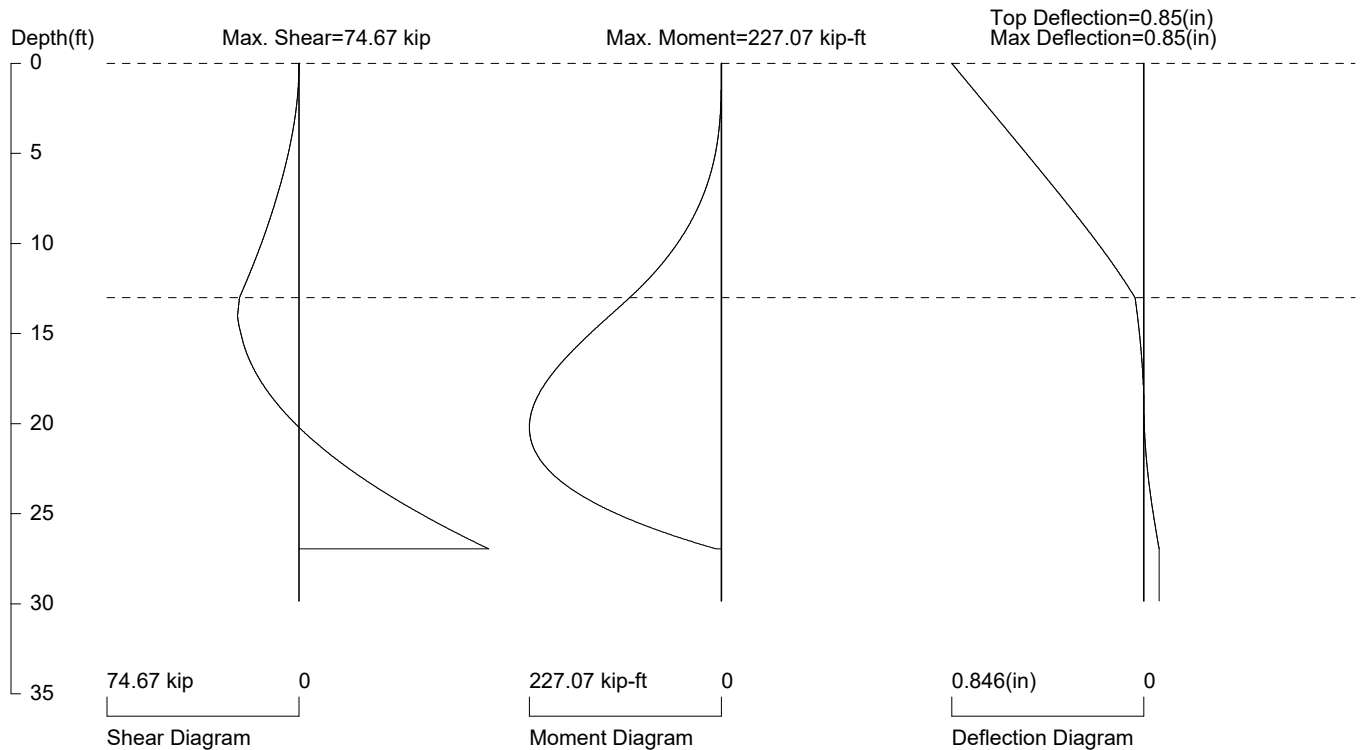
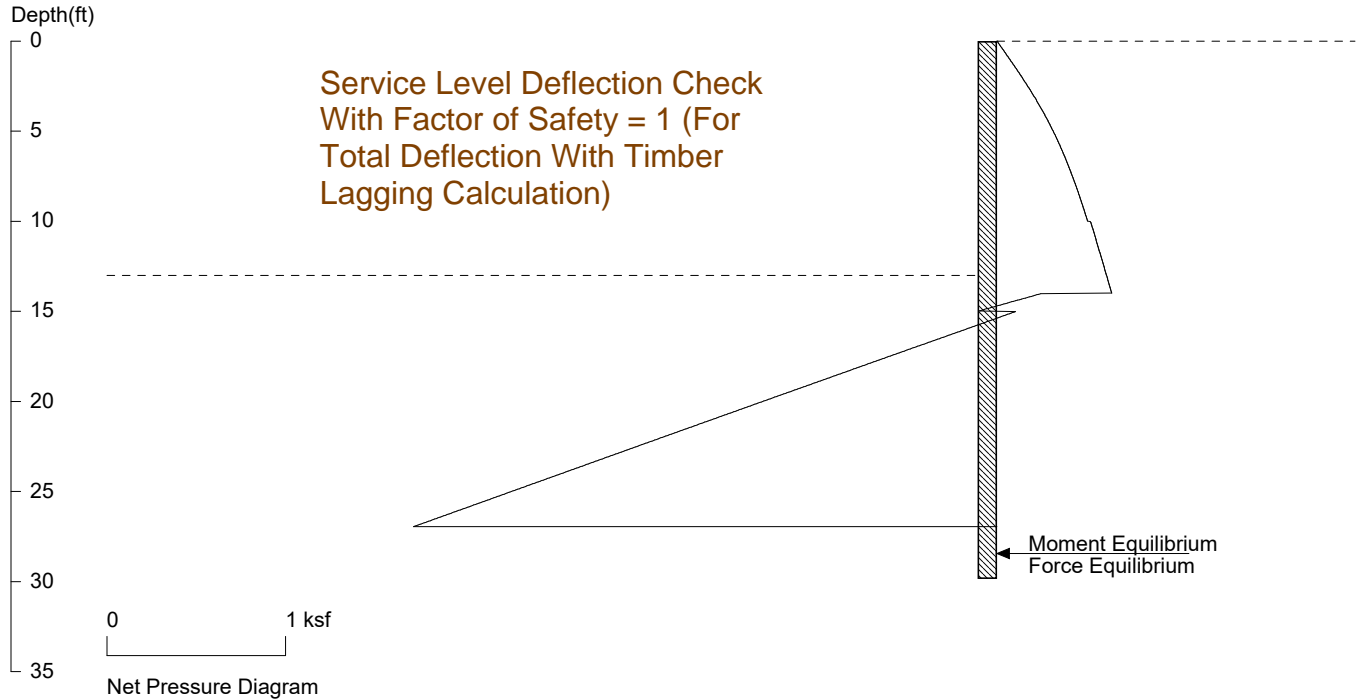
B =	3.0	in	Min Bearing Length
b =	12.0	in	Board Width
t =	4.0	in	
C =	57.0	psi	C = V/Bb
	C < F _{pp}		OK

USE: 4"X12" Full Sawn No. 2 Douglas Fir Lagging or Better

Deflection

b=	12 in	Width of lagging board
h=	4 in	Thickness of lagging board
E=	1440 ksi	Table 7-2-9
I=	64 in ⁴	$I = b \cdot h^3 / 12$
L=	46 in	Length of board between flanges
w _{lag} =	0.059 k/in/ft	
D _{lag} =	0.038 in	$D_{lag} = 5w_{lag}L^4 / 384EI$
D _{pile} =	0.85 in	(See Shoring Suite Calculation, 13' Temporary Case - Temporary Wall Calculations)
D _{total} =	0.888 in	

146th South 13' Temporary



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 5.0 foot or meter

User Input Pile, HP14x117: E (ksi)=29000.0, I (in⁴)/pile=1220.0

File: J:\PROJECTS\HDMI22-1474 14600 South SES\Analyses\ShoringSuite\Temp Walls\13' Temporary.sh8

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
www.civiltech.com

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft³, Deflection - in

Licensed to 4324324234 3424343
Date: 5/13/2025 File: J:\PROJECTS\HDR\22-1474 14600 South
SES\Analyses\ShoringSuite\Temp Walls\21' Temporary.sh8

Title: 146th South
Subtitle: 21' Temporary

*****INPUT DATA*****

Wall Type: 3. Soldier Pile, Driving
 Wall Height: 21.00
 Pile Diameter: 1.20
 Pile Spacing: 5.00
 Factor of Safety (F.S.): 1.50
 Lateral Support Type (Braces): 3. Tieback
 Top Brace Increase (Multi-Bracing): Add 15%*
 Brace Position (One Brace Case): Normal Brace*
 No-Load Zone:
 Vertical Depth for No-Load Zone: 21.00
 H-Distance (Input H/V ratio) for No-Load Zone: 0.00
 Angle from H. Line for No-Load Zone: 60.00
 Embedment Option: 1. Yes
 Friction at Pile Tip: No
 Pile Properties:

Steel Strength, Fy: 50 ksi = 345 MPa
 Allowable Fb/Fy: 0.55
 Elastic Module, E: 29000.00
 Moment of Inertia, I: 1220.0
 User Input Pile: HP14x117

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		
2	0.000	0.000	10.00	0.368	0.036841
3	10.00	0.384	15.00	0.568	0.036871
4	15.00	0.665	21.00	0.917	0.041937
5	*	Below	Base		
6	21.00	0.916	30.00	1.290	0.041488
7	30.00	1.097	40.00	1.466	0.036838
8	40.00	1.835	168.0	7.624	0.045226
9	*	Sur-	charge		
10	0.000	0.000	1.050	0.055	0.052360
11	1.050	0.055	2.100	0.106	0.048960
12	2.100	0.106	3.150	0.151	0.042808
13	3.150	0.151	4.200	0.188	0.034952
14	4.200	0.188	5.250	0.216	0.026505
15	5.250	0.216	6.300	0.235	0.018371
16	6.300	0.235	7.350	0.247	0.011132
17	7.350	0.247	8.400	0.252	0.005066
18	8.400	0.252	9.450	0.252	0.000222
19	9.450	0.252	10.500	0.249	-0.003487
20	10.500	0.249	11.550	0.242	-0.006212
21	11.550	0.242	12.600	0.234	-0.008125
22	12.600	0.234	13.650	0.224	-0.009389
23	13.650	0.224	14.700	0.213	-0.010148
24	14.700	0.213	15.750	0.202	-0.010524
25	15.750	0.202	16.800	0.191	-0.010612
26	16.800	0.191	17.850	0.180	-0.010491
27	17.850	0.180	18.900	0.169	-0.010222
28	18.900	0.169	19.950	0.159	-0.009851
29	19.950	0.159	21.000	0.149	-0.009414
30	21.000	0.149	23.100	0.131	-0.008691
31	23.100	0.131	25.200	0.115	-0.007696
32	25.200	0.115	27.300	0.100	-0.006737
33	27.300	0.100	29.400	0.088	-0.005857
34	29.400	0.088	31.500	0.077	-0.005073
35	31.500	0.077	33.600	0.068	-0.004385
36	33.600	0.068	35.700	0.060	-0.003789
37	35.700	0.060	37.800	0.053	-0.003276
38	37.800	0.053	39.900	0.047	-0.002837
39	39.900	0.047	42.000	0.042	-0.002461
40	42.000	0.042	46.200	0.034	-0.002003
41	46.200	0.034	50.400	0.027	-0.001530

42	50.400	0.027	54.600	0.023	-0.001182
43	54.600	0.023	58.800	0.019	-0.000923
44	58.800	0.019	63.000	0.016	-0.000729
45	63.000	0.016	67.200	0.013	-0.000582
46	67.200	0.013	71.400	0.011	-0.000469
47	71.400	0.011	75.600	0.010	-0.000382
48	75.600	0.010	79.800	0.008	-0.000313
49	79.800	0.008	84.000	0.000	-0.001960

* PASSIVE PRESSURE *

The pressures below will be divided by a Factor of Safety =1.5

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	22.00	0.319	30.00	2.867	0.318530
3	30.00	3.332	40.00	7.277	0.394574
4	40.00	6.177	168.0	46.96	0.318665

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	5.00
2	21.00	1.20

* PASSIVE SPACE *

No.	Z depth	Spacing
1	21.00	3.60

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

No.	Z brace	Angle	Spacing	Input1*	Input2*
1	7.00	15.0	5.00	0.67	0.72

Tieback

*For Tieback: Input1 = Diameter; Input2 = Bond Strength

*For Plate: Input1 = Diameter; Input2 = Allowable Pressure

*For Deadman: Input1 = Horz. Width; Input2 = Passive Pressure;

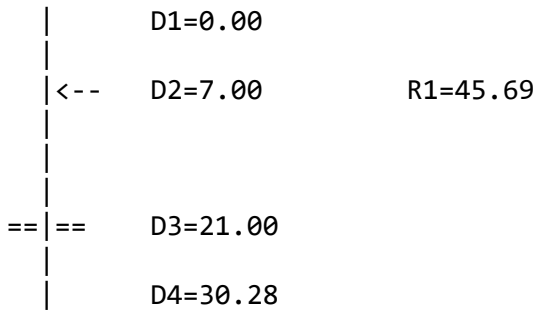
*For Sheet Pile Anchor: Input1 = Horz. Width; Input2 = Passive Slope;

*****CALCULATION*****

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

NUMBER OF BRACE LEVEL = 1



- D1 - TOP DEPTH
- D2 - BRACE DEPTH R1 - REACTION
- D3 - EXCAVATION BASE
- D4 - PILE TIP

TOTAL REACTION: R1 = 45.69
 TOTAL PRESSURES ACTING ON WALL = 45.69
 Total Reactions = Total Pressures, OK!

BRACE NO.1 AT DEPTH = 7.00
 R1 = Brace Load = 45.69

*****RESULTS*****

* EMBEDMENT *

MINIMUM EMBEDMENT = 9.28, TOTAL MINIMUM PILE LENGTH = 30.28

* MOMENT IN PILE (per pile spacing)*

Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.

No.	Depth	M @ Brace	Mmax in Span	Depth of Mmax
1	7.00	23.45	177.32	17.15

Overall Maximum Moment = 177.32 at 17.15

Maximum Shear = 35.95

Moment and Shear are per pile spacing: 5.0 foot or meter

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

The calculated brace force are per brace spacing.

No.	DEPTH	Tangle	SPACING	HORIZONTAL	VERTICAL
1	7.00	15.0	5.00	45.69	12.24

No.	DEPTH	Free length	Brace Type
1	7.00	7.25	Tieback, Bond length = 31.21

* VERTICAL LOADING *
 Vertical Loading from Braces = 12.24
 Vertical Loading from External Load = 0.00
 Total Vertical Loading = 12.24

*****SPECIFIED PILE *****

Overall Maximum Moment = 177.32 at 17.15
 The pile selection is based on the magnitude of the moment only. Axial force is neglected.

Request Min. Section Modulus = 77.37 in³/pile = 1267.93 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has been found in Soldier Pile list!
 (English Units):
 Area= 34.4 in. Depth= 14.2 in. Width= 14.9 in. Height= 14 in.
 Flange thickness= 0.805 in. Web thickness= 0.805 in.
 Ix= 1220 in⁴/pile Sx= 172 in³/pile Iy= 443 in⁴/pile Sy= 59.5 in³/pile
 (Metric Units):
 Ix= 507.76 x100cm⁴/pile Sx=2818.56 cm³/pile Iy= 184.38 x100cm⁴/pile Sy= 975.03 cm³/pile

The pile selection is based on the magnitude of the moment only. Axial force is neglected.

HP14X117 is capable to support the shoring!
 Top deflection = -0.384(in)
 Max. deflection = 0.392(in)

***** LAGGING SIZE ESTIMATION *****

Max. Pressure above base = 1.07

Piles are more rigid than timber lagging, due to arching, only portion of pressures are acting to lagging, 30-50% loading is suggested.

If 50% loading is used for lagging design, Design Pressure = 0.53

Pile Spacing =5.0, Max. Moment in lagging = 1.66

For 4"x12" Timber, Section Modules $S=23.47 \text{ in}^3$. The request allowable bending strength, $fb=M/S=0.85$

For 6"x12" Timber, Section Modules $S=57.98 \text{ in}^3$. The request allowable bending strength, $fb=M/S=0.34$

If 30% loading is used for lagging design, Design Pressure = 0.32

Pile Spacing =5.0, Max. Moment in lagging = 1.00

For 4"x12" Timber, Section Modules $S=23.47 \text{ in}^3$. The request allowable bending strength, $fb=M/S=0.51$

For 6"x12" Timber, Section Modules $S=57.98 \text{ in}^3$. The request allowable bending strength, $fb=M/S=0.21$

Unit: Pressure: ksf, Spacing: ft, Moment: kip-ft, Bending Strength, fb: ksi

Timber Lagging Design



Reference: NDS for Wood Construction - 2018 and AREMA Chapter 8

Project: 146th South

Design: Timber Lagging - 5' c-c pile spacing & 20' depth

Date: 9/25/2024

Designed By: AWL

Reviewed By: MPH

Geometry & Loads

Load Type: ASD

H =	20	ft	
w =	1.33	ksf	(Max. Pressure On Wall - See Subsequent Shoring Suite Report for 20' Temp Wall Case)
Arching =	0.67		(Reduction Factor) May be reduced by 1/3 per AREMA Ch 8 - 28.5.3.5
w _{lag} =	0.89	ksf	(Reduced Pressure Due to Arching)
Pile Spacing =	5.0	ft	Lagging design for temporary condition of permanent walls (Walls 2, 3, & 7), lagging to be left in place Controlled by 20' Temporary Case from Wall 7
Pile Flange Width =	14.0	in	
L =	3.83	ft	
M _{max} =	1.63	k-ft/ft	M _{max} = w _{lag} L ² /8

Timber Properties

Species:	Douglas Fir-Larch	Treatment:	Pressure Treated
Grade:	No. 1 & Btr	Design Duration:	1 Year
Cut:	Full Sawn		
F _b =	1200	psi	(Reference Design Bending Stress - NDS Supplement Table 4A)
F _v =	180	psi	(Reference Design Shear Stress - NDS Supplement Table 4A)
C _D =	1.1		(Load Duration Factor - ASD Only)
C _M =	0.85		(Wet Service Factor)
C _F =	1		(Size Factor)
C _{fu} =	1.2		(Flat Use Factor)
C _i =	0.8		(Incising Factor)
C _r =	1.15		(Repetitive Use Factor)
K _F =	NA		(Format Conversion Factor - LRFD Only)
φ _b =	NA		(Resistance Factor - LRFD Only)
λ =	NA		(Time Effect Factor - LRFD Only)
F _b ' =	1239	psi	

Check Minimum Thickness (Based on Maximum Moment)

S _{req'd} =	15.8	in ³ /ft	S _{req'd} = M _{max} ·b/12/F _b '
S _{lag} =	bt ² /6		
	S _{lag} > S _{req'd}		
b =	12	in	Width of lagging = 1ft for M _{lag} computed per unit width of lagging
t _{min} =	2.81	in	t _{min} = (6S _{req'd} /b) ^{0.5}

Check for Shear

b =	12	in	
t =	3	in	(Actual Thickness)
V =	1700.3	lbs	V = w _{lag} L/2
S =	70.85	psi	S = 3V/2bt = Unit Shear Stress
	S < F _v	OK	

USE: 3"X12" Full Sawn No. 1 & Btr Pressure Treated Douglas Fir-Larch Lagging or better

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
www.civiltech.com

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

- 1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
5. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
6. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Date: 9/9/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 7\20' Temporary.sh8

Title: 146th South
Subtitle: 20' Temporary

*****INPUT DATA*****

Wall Type: 3. Soldier Pile, Driving
Wall Height: 20.00
Pile Diameter: 1.20
Pile Spacing: 5.00
Factor of Safety (F.S.): 1.50
As Continuous Span Beam
Lateral Support Type (Braces): 3. Tieback
Top Brace Increase (Multi-Bracing): Add 15%*
No-Load Zone:
Vertical Depth for No-Load Zone: 20.00
H-Distance (Input H/V ratio) for No-Load Zone: 0.00
Angle from H. Line for No-Load Zone: 60.00
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.55
Elastic Module, E: 29000.00
Moment of Inertia, I: 1220.0
User Input Pile: HP14X117

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *
Table with 6 columns: No., Z1 top, Top Pres., Z2 bottom, Bottom Pres., Slope. Rows 1-25 showing pressure and slope data at various depths.

26	12.00	0.380	13.00	0.388	0.008077
27	13.00	0.388	14.00	0.394	0.005512
28	14.00	0.394	15.00	0.397	0.003159
29	15.00	0.397	16.00	0.398	0.001042
30	16.00	0.398	17.00	0.397	-0.00082
31	17.00	0.397	18.00	0.395	-0.00245
32	18.00	0.395	19.00	0.391	-0.00385
33	19.00	0.391	20.00	0.386	-0.00503
34	20.00	0.386	22.00	0.373	-0.00641
35	22.00	0.373	24.00	0.358	-0.00769
36	24.00	0.358	26.00	0.341	-0.00844
37	26.00	0.341	28.00	0.323	-0.00878
38	28.00	0.323	30.00	0.305	-0.00883
39	30.00	0.305	32.00	0.288	-0.00869
40	32.00	0.288	34.00	0.271	-0.00840
41	34.00	0.271	36.00	0.255	-0.00803
42	36.00	0.255	38.00	0.240	-0.00761
43	38.00	0.240	40.00	0.226	-0.00718
44	40.00	0.226	44.00	0.199	-0.00652
45	44.00	0.199	48.00	0.177	-0.00568
46	48.00	0.177	52.00	0.157	-0.00494
47	52.00	0.157	56.00	0.140	-0.00428
48	56.00	0.140	60.00	0.125	-0.00372
49	60.00	0.125	64.00	0.112	-0.00324
50	64.00	0.112	68.00	0.101	-0.00283
51	68.00	0.101	72.00	0.091	-0.00248
52	72.00	0.091	76.00	0.082	-0.00218
53	76.00	0.082	80.00	0.000	-0.02046

* PASSIVE PRESSURE *

The pressures below will be divided by a Factor of Safety =1.5

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	21.00	0.262	24.00	1.048	0.262098
3	24.00	1.048	27.00	1.835	0.262098
4	27.00	1.498	30.00	2.059	0.186866
5	30.00	2.057	33.00	2.610	0.184198
6	33.00	2.289	36.00	1.998	-0.09711
7	36.00	2.729	39.00	3.286	0.185926
8	39.00	2.606	44.00	3.226	0.124025
9	44.00	3.989	45.00	4.236	0.247614
10	45.00	4.271	49.00	4.892	0.155445
11	49.00	3.761	51.00	4.053	0.145927
12	51.00	4.031	54.00	4.825	0.264606
13	54.00	4.708	57.00	5.159	0.150163
14	57.00	5.160	60.00	5.117	-0.01436
15	60.00	5.235	63.00	5.646	0.137057
16	63.00	5.706	66.00	6.427	0.240560
17	66.00	6.358	69.00	6.801	0.147624
18	69.00	6.818	72.00	7.190	0.124029
19	72.00	7.207	75.00	7.647	0.146792
20	75.00	7.647	78.00	8.088	0.146768
21	78.00	8.088	81.00	8.528	0.146749
22	81.00	8.517	84.00	8.930	0.137930
23	84.00	8.936	87.00	9.375	0.146184
24	87.00	9.375	90.00	9.814	0.146174
25	90.00	9.814	93.00	10.25	0.146166
26	93.00	10.25	96.00	10.69	0.146160
27	96.00	10.69	99.00	11.12	0.146154
28	99.00	11.12	102.0	11.56	0.146150
29	102.0	11.55	105.0	11.97	0.141951
30	105.0	11.98	108.0	12.41	0.145822
31	108.0	12.41	111.0	12.85	0.145819
32	111.0	12.85	114.0	13.29	0.145817
33	114.0	13.29	117.0	13.73	0.145815
34	117.0	13.73	120.0	14.16	0.145813
35	120.0	14.16	123.0	14.60	0.145812
36	123.0	14.60	126.0	15.04	0.145810
37	126.0	15.04	129.0	15.48	0.145809
38	129.0	15.48	132.0	15.91	0.145808
39	132.0	15.91	135.0	16.35	0.145807
40	135.0	16.35	138.0	16.79	0.145807
41	138.0	16.79	141.0	17.23	0.145806
42	141.0	17.23	144.0	17.66	0.145805
43	144.0	17.66	147.0	18.10	0.145805
44	147.0	18.10	150.0	18.54	0.145804
45	150.0	18.54	153.0	18.98	0.145804
46	153.0	18.98	156.0	19.41	0.145804
47	156.0	19.41	159.0	19.85	0.145803

48 159.0 19.85 160.0 20.00 0.145803

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	5.00
2	20.00	1.20

* PASSIVE SPACE *

No.	Z depth	Spacing
1	20.00	3.60

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

No.	Z brace	Angle	Spacing	Input1*	Input2*	Type
1	4.50	15.0	5.00	0.67	0.96	Tieback
2	10.50	15.0	5.00	0.67	0.96	Tieback

*For Tieback: Input1 = Diameter; Input2 = Bond Strength
 *For Plate: Input1 = Diameter; Input2 = Allowable Pressure
 *For Deadman: Input1 = Horz. Width; Input2 = Passive Pressure;
 *For Sheet Pile Anchor: Input1 = Horz. Width; Input2 = Passive Slope;

*****CALCULATION*****

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

* CALCULATE REQUEST EMBEDMENT *

```

| <-- D1=10.50
== == D2=20.00
| D3=31.37

```

D1 - TOP DEPTH R1 - TOP REACTION
 D2 - EXCAVATION BASE
 D3 - PILE TIP

TOTAL REACTION: R1 = 36.14
 TOTAL PRESSURES ACTING ON WALL = 36.14
 Total Reactions = Total Pressures, OK!
 The Calculated Embedment, Yend = 11.37

-----MULTIPLE BRACE / TIEBACK CASE-----

** Use the calculated embedment, Yend = 11.37 for graphics and analysis.

NUMBER OF BRACE LEVEL= 2

* CANTILEVER SPAN, NO.0 *

```

| D1=0.00
| <-- D2=4.50                    R2=14.54, with Cantilever Moment=31.55

```

D1 - TOP DEPTH
 D2 - BOTTOM DEPTH R2 - BOTTOM REACTION

TOTAL REACTION: R2 = 14.54
 TOTAL PRESSURES ACTING ON WALL = 14.54
 Total Reactions = Total Pressures, OK!

BRACE NO.1 AT DEPTH = 4.50
 R2 of Span No.0 } Sum of Reaction = Brace Load = 30.74
 R1 of Last Span

* LAST SPAN *

```

| <-- D1=4.50          R1=16.19
|
| <-- D2=10.50       R2=42.42
|
|      D3=31.37

```

```

D1 - TOP DEPTH          R1 - TOP REACTION
D2 - LAST BRACE DEPTH  R2 - LAST BRACE REACTION
D3 - BOTTOM DEPTH

```

```

TOTAL REACTION: R1+R2 = 58.61
TOTAL PRESSURES ACTING ON WALL = 58.61
Total Reactions >= Total Pressures,    OK!

```

```

-----
BRACE NO.2 AT DEPTH = 10.50
R2 of Last Span = Brace Load = 42.42
-----

```

*****RESULTS*****

```

* EMBEDMENT *
MINIMUM EMBEDMENT = 11.37,  TOTAL MINIMUM PILE LENGTH = 31.37

```

```

* MOMENT IN PILE (per pile spacing)*
Pile Spacing:  sheet piles are one foot or one meter; soldier piles are one pile.
No.      Depth      M @ Brace      Mmax in Span      Depth of Mmax
-----
1         4.50         31.51          3.96              8.87
2         10.50        14.67         115.44            18.25
-----

```

```

Overall Maximum Moment = 115.44 at 18.25
Maximum Shear = 36.12
Moment and Shear are per pile spacing: 5.0 foot or meter

```

-> Top Brace Increase 15%. (Horizontal) From 30.74 to 35.35

```

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*
The calculated brace force are per brace spacing.

```

No.	DEPTH	Tangle	SPACING	HORIZONTAL	VERTICAL	TOTAL LOAD
1	4.50	15.0	5.00	35.35	9.47	36.60
2	10.50	15.0	5.00	42.42	11.37	43.92

No.	DEPTH	Free length	Brace Type
1	4.50	8.02	Tieback, Bond length = 18.11
2	10.50	4.92	Tieback, Bond length = 21.73

```

* VERTICAL LOADING *
Vertical Loading from Braces = 20.84
Vertical Loading from External Load = 0.00
Total Vertical Loading = 20.84

```

*****SPECIFIED PILE *****

```

Overall Maximum Moment = 115.44 at 18.25
The pile selection is based on the magnitude of the moment only. Axial force is neglected.

Request Min. Section Modulus = 50.37 in3/pile = 825.48 cm3/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X117 has been found in Soldier Pile list!
(English Units):
Area= 34.4 in.  Depth= 14.2 in.  Width= 14.9 in.  Height= 14 in.
Flange thickness= 0.805 in.  Web thickness= 0.805 in.
Ix= 1220 in4/pile  Sx= 172 in3/pile  Iy= 443 in4/pile  Sy= 59.5 in3/pile
(Metric Units):
Ix= 507.76 x100cm4/pile  Sx= 2818.56 cm3/pile  Iy= 184.38 x100cm4/pile  Sy= 975.03 cm3/pile

```

```

The pile selection is based on the magnitude of the moment only. Axial force is neglected.
HP14X117 is capable to support the shoring!

```

Top deflection = 0.012(in)
Max. deflection = 0.129(in)

***** LAGGING SIZE ESTIMATION *****

Max. Pressure above base = 1.33

Piles are more rigid than timber lagging, due to arching, only portion of pressures are acting to lagging, 30-50% loading is suggested.

If 50% loading is used for lagging design, Design Pressure = 0.66

File Spacing =5.0, Max. Moment in lagging = 2.07

For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=1.06

For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.43

If 30% loading is used for lagging design, Design Pressure = 0.40

File Spacing =5.0, Max. Moment in lagging = 1.24

For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=0.64

For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.26

Unit: Pressure: ksf, Spacing: ft, Moment: kip-ft, Bending Strength, fb: ksi

Reinforced Shotcrete Lagging Design



Design Reference: ACI 318 and AREMA Chapter 8

Project: 146th South

Design: Shotcrete Lagging - Continuous - 5' C-C Spacing Static

Date: 9/25/2024

Midvale, UT 84047

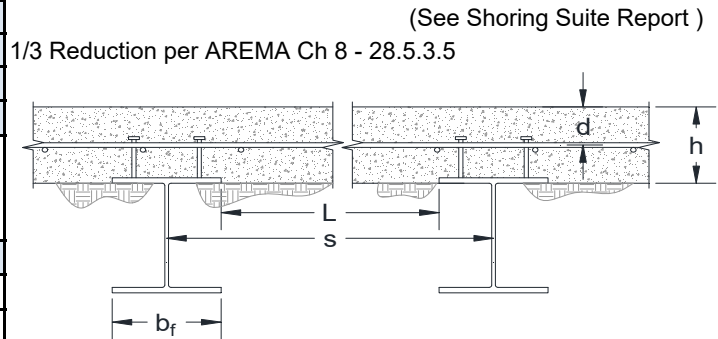
Designed By: AWL

Reviewed By: BHG

Reinforced Beam

Loads

Max Pressure, w (psf)	1550
Arching Reduction	0.33
Pile Spacing, s (ft)	5.00
Flange Width, b_f (in)	14.0
Facing Span, L (ft)	4.4
Moment, $M_{MAX} = wL^2/10$ (k-ft/ft)	2.03
Shear, $V_{MAX} = wL/2$ (kips/ft)	2.3
Load Factor, LF	1.6
$M_u = (LF)M_{MAX}$ (k-ft)	3.24
$V_u = (LF)V_{MAX}$ (k/ft)	3.7



*LF = 1.6 and 1.0 applied to static and seismic soil pressures

Geometry

b_w (in)	12
h (in)	8
d (in)	4.00
c_c (in)	3.25
f_c (psi)	4000
f_y (psi)	60000
β_1	0.85

Reinforcement: Rebar

Horizontal Bar Size:	#4	
@	12	inches o.c.
(Tension Reinforcement) A_s (in ² /ft)	0.20	
Bar diameter d_b (in)	0.5	
$A_{s, MIN} = 3(f_c^{1/2})/f_y(b_w d)$ (in ²)	0.15	
or $200b_w d/f_y$ (in ²)	0.16	
$s_{MAX} = 15(40000/f_s) - 2.5c_c$ (in)	6.88	

Requirements Summary

8" thick shotcrete with #4 bar @ 12" o.c. centered in the shotcrete. Anchor to soldier piles using 1 row(s) of 1/2" x 5-5/16" headed studs spaced 18" o.c. vertically

Controlled by 25' Permanent Case from Wall 3

Flexure

a (in)	0.29
c (in)	0.34
ϵ_t	0.0323
ϕ^*	0.90
$\phi M_n = \phi A_s f_y (d - a/2)$ (k-ft)	3.41
Check that $\phi M_n > M_u$	Passes

Shear

ϕV_n (kips)	4.6	$((0.75)2\lambda(f_c^{1/2})b_w d)$ (11-3)
Check that $\phi V_n > V_u$	Passes	

Reinforced Shotcrete Lagging Design



Design Reference: ACI 318 and AREMA Chapter 8

Project: 146th South

Design: Shotcrete Lagging - Continuous - 5' C-C Spacing Static

Date: 9/25/2024

Midvale, UT 84047

Designed By: AWL

Reviewed By: BHG

Headed Studs

Loads & Geometry

Factored Tension Load = $2V_{MAX}$ (kips/ft)	7.34	
Factored Shear Load (kips/ft)	0.50	(weight of facing)
Horizontal Stud Spacing, s_1 (in)	NA	
Vertical Stud Spacing, s_2 (in)	18	
# of Vertical Rows	1	
Factored Tension Load, N_{ua} (kips/Stud)	11.0	
Factored Shear Load, V_{ua} (kips/Stud)	0.75	
Headed Stud Size	1/2" x 5-5/16"	
Headed-stud shaft diameter, D_s (in)	0.5	
Head diameter, D_H (in)	1	
Head thickness, t_H (in)	0.31	
Length of shaft, $L_s = h_{ef}$ (in)	4.94	
Yield strength of studs, $f_{y, studs}$ (ksi)	51	

Punching Shear (Breakout)

Concrete Breakout Strength, ϕN_{cb} (kips)	12.5	OK	$\psi_{ec} =$	1
$\phi N_{cb} = A_{Nc} / A_{Nco} * \psi_{ec} N_{ed} N_{\psi_c} N_{\psi_{cp}} N_b$ (Eq. D-5)			$\psi_{ed} =$	1
A_{Nc} (in ²)	220	(Fig. RD.5.2.1.b)	$\psi_c =$	1
$A_{Nco} = 9 * h_{ef}^2$ (in ²)	220	(Eq. D-6)	$\psi_{cp} =$	1
$N_b = k_c (f_c^{1/2}) h_{ef}^{1.5}$ (kips)	16.7	(Eq. D-7)		

Pullout Strength

$\phi N_{pn} = \phi \psi_{c,P} 8 A_{brg} f_c$ (kips)	14.1	OK	(Eq. D-15)
$\phi =$	0.75		
A_{brg} (in ²)	0.59		
$\psi_{c,P} =$	1.00		

Shear Strength

$\phi V_{sa} = 0.7 n A_{se,N} f_{uta}$ (kips)	7.0	OK	(Eq. D-19 for $n = 1$)
$0.2 \phi V_{sa} > V_{ua}$ - No Reduction to Tensile Strength is Necessary (D.7.1)			

Tensile Strength

$\phi N_{sa} = \phi n A_{se,N} f_{uta}$ (kips)	14.3	OK	(Eq. D-3)
$\phi =$	0.75		
$n =$ number of anchors =	1		
$A_{se,N}$ (in ²) =	0.20		(effective cross-sectional area of single anchor)
f_{uta} (ksi) = $1.9 f_y =$	96.9		(f_{uta} cannot exceed 125 ksi)

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
www.civiltech.com

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.

The calculation method is based on the following references:

- 1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
5. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
6. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Date: 9/14/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\25' Permanent.sh8

Title: 146th South
Subtitle: 25' Permanent

*****INPUT DATA*****

Wall Type: 2. Soldier Pile, Drilled
Wall Height: 25.00
Pile Diameter: 1.20
Pile Spacing: 5.00
Factor of Safety (F.S.): 1.50
As Continuous Span Beam
Lateral Support Type (Braces): 3. Tieback
Top Brace Increase (Multi-Bracing): Add 15%*
No-Load Zone:
Vertical Depth for No-Load Zone: 25.00
H-Distance (Input H/V ratio) for No-Load Zone: 0.00
Angle from H. Line for No-Load Zone: 60.00
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.55
Elastic Module, E: 29000.00
Moment of Inertia, I: 904.00
User Input Pile: HP14X89

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *
Table with 6 columns: No., Z1 top, Top Pres., Z2 bottom, Bottom Pres., Slope. Rows 1-25 showing pressure and slope data at various depths.

26	18.75	0.049	20.00	0.046	-0.00263
27	20.00	0.046	21.25	0.043	-0.00247
28	21.25	0.043	22.50	0.040	-0.00231
29	22.50	0.040	23.75	0.038	-0.00215
30	23.75	0.038	25.00	0.035	-0.00200
31	25.00	0.035	27.50	0.031	-0.00180
32	27.50	0.031	30.00	0.027	-0.00155
33	30.00	0.027	32.50	0.023	-0.00133
34	32.50	0.023	35.00	0.020	-0.00115
35	35.00	0.020	37.50	0.018	-0.00098
36	37.50	0.018	40.00	0.016	-0.00085
37	40.00	0.016	42.50	0.014	-0.00073
38	42.50	0.014	45.00	0.012	-0.00063
39	45.00	0.012	47.50	0.011	-0.00054
40	47.50	0.011	50.00	0.010	-0.00047
41	50.00	0.010	55.00	0.008	-0.00038
42	55.00	0.008	60.00	0.006	-0.00029
43	60.00	0.006	65.00	0.005	-0.00023
44	65.00	0.005	70.00	0.004	-0.00018
45	70.00	0.004	75.00	0.004	-0.00014
46	75.00	0.004	80.00	0.003	-0.00011
47	80.00	0.003	85.00	0.003	-0.00009
48	85.00	0.003	90.00	0.002	-0.00007
49	90.00	0.002	95.00	0.002	-0.00006
50	95.00	0.002	100.0	0.000	-0.00038

* PASSIVE PRESSURE *

The pressures below will be divided by a Factor of Safety =1.5

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	26.00	0.146	33.00	1.166	0.145693
3	33.00	1.355	43.00	3.246	0.189021
4	43.00	2.756	200.0	25.63	0.145734

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	5.00
2	25.00	1.20

* PASSIVE SPACE *

No.	Z depth	Spacing
1	25.00	2.40

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

No.	Z brace	Angle	Spacing	Input1*	Input2*	Type
1	6.00	15.0	5.00	0.67	0.72	Tieback
2	17.00	15.0	5.00	0.67	0.72	Tieback

*For Tieback: Input1 = Diameter; Input2 = Bond Strength

*For Plate: Input1 = Diameter; Input2 = Allowable Pressure

*For Deadman: Input1 = Horz. Width; Input2 = Passive Pressure;

*For Sheet Pile Anchor: Input1 = Horz. Width; Input2 = Passive Slope;

*****CALCULATION*****

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

* CALCULATE REQUEST EMBEDMENT *

```

|-- D1=17.00
==
|-- D2=25.00
|-- D3=43.16

```

D1 - TOP DEPTH R1 - TOP REACTION
D2 - EXCAVATION BASE
D3 - PILE TIP

TOTAL REACTION: R1 = 47.88
 TOTAL PRESSURES ACTING ON WALL = 47.88
 Total Reactions = Total Pressures, OK!
 The Calculated Embedment, Yend = 18.16

-----MULTIPLE BRACE / TIEBACK CASE-----
 ** Use the calculated embedment, Yend = 18.16 for graphics and analysis.

NUMBER OF BRACE LEVEL= 2

* CANTILEVER SPAN, NO.0 *

```

  |      D1=0.00
  |
  |<--  D2=6.00      R2=17.72, with Cantilever Moment=51.96
  |
  D1 - TOP DEPTH
  D2 - BOTTOM DEPTH      R2 - BOTTOM REACTION
  
```

TOTAL REACTION: R2 = 17.72
 TOTAL PRESSURES ACTING ON WALL = 17.72
 Total Reactions = Total Pressures, OK!

BRACE NO.1 AT DEPTH = 6.00
 R2 of Span No.0
 R1 of Last Span } Sum of Reaction = Brace Load = 41.29

* LAST SPAN *

```

  |<--  D1=6.00      R1=23.57
  |
  |<--  D2=17.00     R2=66.80
  |
  |      D3=43.16
  |
  D1 - TOP DEPTH      R1 - TOP REACTION
  D2 - LAST BRACE DEPTH R2 - LAST BRACE REACTION
  D3 - BOTTOM DEPTH
  
```

TOTAL REACTION: R1+R2 = 90.37
 TOTAL PRESSURES ACTING ON WALL = 90.37
 Total Reactions >= Total Pressures, OK!

BRACE NO.2 AT DEPTH = 17.00
 R2 of Last Span = Brace Load = 66.80

*****RESULTS*****

* EMBEDMENT *
 MINIMUM EMBEDMENT = 18.16, TOTAL MINIMUM PILE LENGTH = 43.16

* MOMENT IN PILE (per pile spacing)*
 Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.

No.	Depth	M @ Brace	Mmax in Span	Depth of Mmax
1	6.00	51.91	28.88	12.77
2	17.00	22.30	150.28	24.68

Overall Maximum Moment = 150.28 at 24.68
 Maximum Shear = 47.64
 Moment and Shear are per pile spacing: 5.0 foot or meter

-> Top Brace Increase 15%. (Horizontal) From 41.29 to 47.48

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*
 The calculated brace force are per brace spacing.

No.	DEPTH	Tangle	SPACING	HORIZONTAL	VERTICAL	TOTAL LOAD
1	6.00	15.0	5.00	47.48	12.72	49.16

No.	DEPTH	Free length	Brace Type
2	17.00	15.0	5.00
			66.80
			17.90
			69.16
1	6.00	9.84	Tieback, Bond length = 32.43
2	17.00	4.14	Tieback, Bond length = 45.63

* VERTICAL LOADING *

Vertical Loading from Braces = 30.62

Vertical Loading from External Load = 0.00

Total Vertical Loading = 30.62

*****SPECIFIED PILE *****

Overall Maximum Moment = 150.28 at 24.68

The pile selection is based on the magnitude of the moment only. Axial force is neglected.

Request Min. Section Modulus = 65.57 in³/pile = 1074.57 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has been found in Soldier Pile list!

(English Units):

Area= 26.1 in. Depth= 13.8 in. Width= 14.7 in. Height= 14 in.

Flange thickness= 0.615 in. Web thickness= 0.615 in.

Ix= 904 in⁴/pile Sx= 131 in³/pile Iy= 326 in⁴/pile Sy= 44.3 in³/pile

(Metric Units):

Ix= 376.24 x100cm⁴/pile Sx= 2146.70 cm³/pile Iy= 135.68 x100cm⁴/pile Sy= 725.94 cm³/pile

The pile selection is based on the magnitude of the moment only. Axial force is neglected.

HP14X89 is capable to support the shoring!

Top deflection = 0.027(in)

Max. deflection = 0.341(in)

***** LAGGING SIZE ESTIMATION *****

Max. Pressure above base = 1.55

Piles are more rigid than timber lagging, due to arching, only portion of pressures are acting to lagging, 30-50% loading is suggested.

If 50% loading is used for lagging design, Design Pressure = 0.77

Pile Spacing =5.0, Max. Moment in lagging = 2.42

For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=1.24

For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.50

If 30% loading is used for lagging design, Design Pressure = 0.46

Pile Spacing =5.0, Max. Moment in lagging = 1.45

For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=0.74

For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.30

Unit: Pressure: ksf, Spacing: ft, Moment: kip-ft, Bending Strength, fb: ksi

Reinforced Shotcrete Lagging Design



Design Reference: ACI 318 and AREMA Chapter 8

Project: 146th South

Design: Shotcrete Lagging - Continuous - 5' C-C Spacing Seismic

Date: 9/25/2024

Midvale, UT 84047

Designed By: AWL

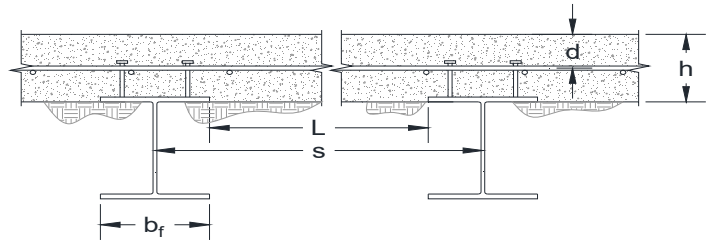
Reviewed By: BHG

Reinforced Beam

Loads

Max Pressure, w (psf)	1830
Arching Reduction	0.33
Pile Spacing, s (ft)	5.00
Flange Width, b_f (in)	14.0
Facing Span, L (ft)	4.4
Moment, $M_{MAX} = wL^2/10$ (k-ft/ft)	2.39
Shear, $V_{MAX} = wL/2$ (kips/ft)	2.7
Load Factor, LF	1
$M_u = (LF)M_{MAX}$ (k-ft)	2.39
$V_u = (LF)V_{MAX}$ (k/ft)	2.7

(See Shoring Suite Report)
1/3 Reduction per AREMA Ch 8 - 28.5.3.5



*LF = 1.6 and 1.0 applied to static and seismic soil pressures

Geometry

b_w (in)	12
h (in)	8
d (in)	4.00
c_c (in)	3.25
f_c (psi)	4000
f_y (psi)	60000
β_1	0.85

Reinforcement: Rebar

Horizontal Bar Size:	#4	
@	12	inches o.c.
(Tension Reinforcement) A_S (in ² /ft)	0.20	
Bar diameter d_b (in)	0.5	
$A_{S, MIN} = 3(f_c^{1/2})/f_y(b_w d)$ (in ²)	0.15	
or $200b_w d/f_y$ (in ²)	0.16	
$s_{MAX} = 15(40000/f_s) - 2.5c_c$ (in)	6.88	

Requirements Summary

8" thick shotcrete with #4 bar @ 12" o.c. centered in the shotcrete. Anchor to soldier piles using 1 row(s) of 1/2" x 5-5/16" headed studs spaced 18" o.c. vertically

Controlled by 8' Seismic Case from Wall 3

Flexure

a (in)	0.29
c (in)	0.34
ϵ_t	0.0323
ϕ^*	0.90
$\phi M_n = \phi A_S f_y (d - a/2)$ (k-ft)	3.41
Check that $\phi M_n > M_u$	Passes

Shear

ϕV_n (kips)	4.6	$((0.75)2\lambda(f_c^{1/2})b_w d)$ (11-3)
Check that $\phi V_n > V_u$	Passes	

Reinforced Shotcrete Lagging Design



Design Reference: ACI 318 and AREMA Chapter 8

Project: 146th South

Design: Shotcrete Lagging - Continuous - 5' C-C Spacing Seismic

Date: 9/25/2024

Midvale, UT 84047

Designed By: AWL

Reviewed By: BHG

Headed Studs

Loads & Geometry

Factored Tension Load = $2V_{MAX}$ (kips/ft)	5.42	
Factored Shear Load (kips/ft)	0.50	(weight of facing)
Horizontal Stud Spacing, s_1 (in)	NA	
Vertical Stud Spacing, s_2 (in)	18	
# of Vertical Rows	1	
Factored Tension Load, N_{ua} (kips/Stud)	8.1	
Factored Shear Load, V_{ua} (kips/Stud)	0.75	
Headed Stud Size	1/2" x 5-5/16"	
Headed-stud shaft diameter, D_s (in)	0.5	
Head diameter, D_H (in)	1	
Head thickness, t_H (in)	0.31	
Length of shaft, $L_s = h_{ef}$ (in)	4.94	
Yield strength of studs, $f_{y, studs}$ (ksi)	51	

Punching Shear (Breakout)

Concrete Breakout Strength, ϕN_{cb} (kips)	12.5	OK	$\psi_{ec} =$	1
$\phi N_{cb} = A_{Nc} / A_{Nco} * \psi_{ec} N_{ed} N_{\psi_c} N_{\psi_{cp}} N_b$ (Eq. D-5)			$\psi_{ed} =$	1
A_{Nc} (in ²)	220	(Fig. RD.5.2.1.b)	$\psi_c =$	1
$A_{Nco} = 9 * h_{ef}^2$ (in ²)	220	(Eq. D-6)	$\psi_{cp} =$	1
$N_b = k_c (f_c^{1/2}) h_{ef}^{1.5}$ (kips)	16.7	(Eq. D-7)		

Pullout Strength

$\phi N_{pn} = \phi \psi_{c,P} 8 A_{brg} f_c$ (kips)	14.1	OK	(Eq. D-15)
$\phi =$	0.75		
A_{brg} (in ²)	0.59		
$\psi_{c,P} =$	1.00		

Shear Strength

$\phi V_{sa} = 0.7 n A_{se,N} f_{uta}$ (kips)	7.0	OK	(Eq. D-19 for $n = 1$)
$0.2 \phi V_{sa} > V_{ua}$ - No Reduction to Tensile Strength is Necessary (D.7.1)			

Tensile Strength

$\phi N_{sa} = \phi n A_{se,N} f_{uta}$ (kips)	9.6	OK	(Eq. D-3)
$\phi =$	0.75		
$n =$ number of anchors =	1		
$A_{se,N}$ (in ²) =	0.20		(effective cross-sectional area of single anchor)
f_{uta} (ksi) = min 1.9fy or 65 ksi =	65		(f_{uta} cannot exceed 125 ksi)

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
www.civiltech.com

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

- 1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
5. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
6. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Date: 9/16/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 3\8' Seismic.sh8

Title: 146th South
Subtitle: 8' Seismic

*****INPUT DATA*****

Wall Type: 2. Soldier Pile, Drilled
Wall Height: 8.00
Pile Diameter: 1.20
Pile Spacing: 5.00
Factor of Safety (F.S.): 1.50
Lateral Support Type (Braces): 3. Tieback
Top Brace Increase (Multi-Bracing): Add 15%*
Brace Position (One Brace Case): Normal Brace*
No-Load Zone:
Vertical Depth for No-Load Zone: 8.00
H-Distance (Input H/V ratio) for No-Load Zone: 0.00
Angle from H. Line for No-Load Zone: 60.00
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.55
Elastic Module, E: 29000.00
Moment of Inertia, I: 904.00
User Input Pile: HP14X89

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *
Table with 6 columns: No., Z1 top, Top Pres., Z2 bottom, Bottom Pres., Slope. Rows 1-12 showing pressure data at various depths.

* PASSIVE PRESSURE *
The pressures below will be divided by a Factor of Safety =1.5
Table with 6 columns: No., Z1 top, Top Pres., Z2 bottom, Bottom Pres., Slope. Rows 1-4 showing passive pressure data.

* ACTIVE SPACE *

No.	Z depth	Spacing
1	-7.00	5.00
2	8.00	1.20

* PASSIVE SPACE *

No.	Z depth	Spacing
1	8.00	2.40

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

No.	Z brace	Angle	Spacing	Input1*	Input2*	Type
1	3.00	15.0	5.00	0.67	0.72	Tieback

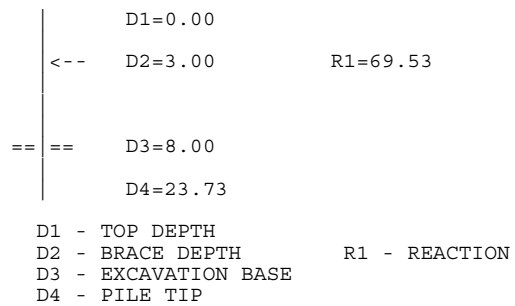
*For Tieback: Input1 = Diameter; Input2 = Bond Strength
 *For Plate: Input1 = Diameter; Input2 = Allowable Pressure
 *For Deadman: Input1 = Horz. Width; Input2 = Passive Pressure;
 *For Sheet Pile Anchor: Input1 = Horz. Width; Input2 = Passive Slope;

*****CALCULATION*****

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = -7.00

NUMBER OF BRACE LEVEL = 1



TOTAL REACTION: R1 = 69.53
 TOTAL PRESSURES ACTING ON WALL = 69.53
 Total Reactions = Total Pressures, OK!

BRACE NO.1 AT DEPTH = 3.00
 R1 = Brace Load = 69.53

*****RESULTS*****

* EMBEDMENT *
 MINIMUM EMBEDMENT = 15.73, TOTAL MINIMUM PILE LENGTH = 23.73

* MOMENT IN PILE (per pile spacing)*
 Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.

No.	Depth	M @ Brace	Mmax in Span	Depth of Mmax
1	3.00	74.77	47.81	11.06

Overall Maximum Moment = 74.84 at 3.01
 Maximum Shear = 40.04
 Moment and Shear are per pile spacing: 5.0 foot or meter

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*
 The calculated brace force are per brace spacing.

No.	DEPTH	Tangle	SPACING	HORIZONTAL	VERTICAL	TOTAL LOAD
1	3.00	15.0	5.00	69.53	18.63	71.98
No.	DEPTH	Free length	Brace Type			

1 3.00 2.59 Tieback, Bond length = 47.50

* VERTICAL LOADING *
Vertical Loading from Braces = 18.63
Vertical Loading from External Load = 0.00
Total Vertical Loading = 18.63

*****SPECIFIED PILE *****

Overall Maximum Moment = 74.84 at 3.01
The pile selection is based on the magnitude of the moment only. Axial force is neglected.
Request Min. Section Modulus = 32.66 in³/pile = 535.14 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X89 has been found in Soldier Pile list!
(English Units):
Area= 26.1 in. Depth= 13.8 in. Width= 14.7 in. Height= 14 in.
Flange thickness= 0.615 in. Web thickness= 0.615 in.
Ix= 904 in⁴/pile Sx= 131 in³/pile Iy= 326 in⁴/pile Sy= 44.3 in³/pile
(Metric Units):
Ix= 376.24 x100cm⁴/pile Sx= 2146.70 cm³/pile Iy= 135.68 x100cm⁴/pile Sy= 725.94 cm³/pile

The pile selection is based on the magnitude of the moment only. Axial force is neglected.
HP14X89 is capable to support the shoring!
Top deflection = -0.018(in)
Max. deflection = 0.098(in)

***** LAGGING SIZE ESTIMATION *****

Max. Pressure above base = 1.83
Piles are more rigid than timber lagging, due to arching, only portion of pressures are acting to lagging, 30-50% loading is suggested.
If 50% loading is used for lagging design, Design Pressure = 0.91
Pile Spacing =5.0, Max. Moment in lagging = 2.85
For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=1.46
For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.59

If 30% loading is used for lagging design, Design Pressure = 0.55
Pile Spacing =5.0, Max. Moment in lagging = 1.71
For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=0.88
For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.35

Unit: Pressure: ksf, Spacing: ft, Moment: kip-ft, Bending Strength, fb: ksi

Reinforced Shotcrete Lagging Design



Design Reference: ACI 318 and AREMA Chapter 8

Project: 146th South

Design: Shotcrete Lagging - Continuous - 6.5' C-C Spacing Static

Date: 10/18/2024

Midvale, UT 84047

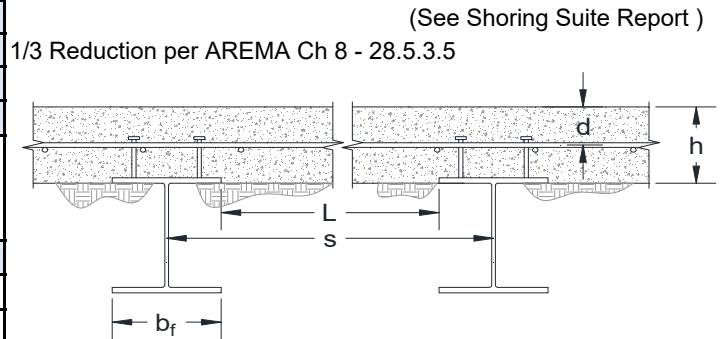
Designed By: AWL

Reviewed By: BHG

Reinforced Beam

Loads

Max Pressure, w (psf)	1230
Arching Reduction	0.33
Pile Spacing, s (ft)	6.50
Flange Width, b_f (in)	14.0
Facing Span, L (ft)	5.9
Moment, $M_{MAX} = wL^2/10$ (k-ft/ft)	2.88
Shear, $V_{MAX} = wL/2$ (kips/ft)	2.4
Load Factor, LF	1.6
$M_u = (LF)M_{MAX}$ (k-ft)	4.62
$V_u = (LF)V_{MAX}$ (k/ft)	3.9



*LF = 1.6 and 1.0 applied to static and seismic soil pressures

Geometry

b_w (in)	12
h (in)	8
d (in)	4.00
c_c (in)	3.06
f_c (psi)	4000
f_y (psi)	60000
β_1	0.85

Reinforcement: Rebar

Horizontal Bar Size:	#5	
@	12	inches o.c.
(Tension Reinforcement) A_s (in ² /ft)	0.31	
Bar diameter d_b (in)	0.625	
$A_{s, MIN} = 3(f_c^{1/2})/f_y(b_w d)$ (in ²)	0.15	
or $200b_w d/f_y$ (in ²)	0.16	
$s_{MAX} = 15(40000/f_s) - 2.5c_c$ (in)	7.34	

Requirements Summary

8" thick shotcrete with #5 bar @ 12" o.c. centered in the shotcrete. Anchor to soldier piles using 1 row(s) of 1/2" x 5-5/16" headed studs spaced 18" o.c. vertically

Controlled by 21.5' Permanent Case from Wall 2

Flexure

a (in)	0.45
c (in)	0.53
ϵ_t	0.0196
ϕ^*	0.90
$\phi M_n = \phi A_s f_y (d - a/2)$ (k-ft)	5.21
Check that $\phi M_n > M_u$	Passes

Shear

ϕV_n (kips)	4.6	$((0.75)2\lambda(f_c^{1/2})b_w d)$ (11-3)
Check that $\phi V_n > V_u$	Passes	

Reinforced Shotcrete Lagging Design



Design Reference: ACI 318 and AREMA Chapter 8

Project: 146th South

Design: Shotcrete Lagging - Continuous - 6.5' C-C Spacing Static

Date: 10/18/2024

Midvale, UT 84047

Designed By: AWL

Reviewed By: BHG

Headed Studs

Loads & Geometry

Factored Tension Load = $2V_{MAX}$ (kips/ft)	7.80	
Factored Shear Load (kips/ft)	0.65	(weight of facing)
Horizontal Stud Spacing, s_1 (in)	NA	
Vertical Stud Spacing, s_2 (in)	18	
# of Vertical Rows	1	
Factored Tension Load, N_{ua} (kips/Stud)	11.7	
Factored Shear Load, V_{ua} (kips/Stud)	0.98	
Headed Stud Size	1/2" x 5-5/16"	
Headed-stud shaft diameter, D_s (in)	0.5	
Head diameter, D_H (in)	1	
Head thickness, t_H (in)	0.31	
Length of shaft, $L_s = h_{ef}$ (in)	4.94	
Yield strength of studs, $f_{y, studs}$ (ksi)	51	

Punching Shear (Breakout)

Concrete Breakout Strength, ϕN_{cb} (kips)	12.5	OK	$\psi_{ec} =$	1
$\phi N_{cb} = A_{Nc}/A_{Nco} * \psi_{ec, N} \psi_{ed, N} \psi_{c, N} \psi_{cp, N} N_b$ (Eq. D-5)			$\psi_{ed} =$	1
A_{Nc} (in ²)	220	(Fig. RD.5.2.1.b)	$\psi_c =$	1
$A_{Nco} = 9 * h_{ef}^2$ (in ²)	220	(Eq. D-6)	$\psi_{cp} =$	1
$N_b = k_c (f_c^{1/2}) h_{ef}^{1.5}$ (kips)	16.7	(Eq. D-7)		

Pullout Strength

$\phi N_{pn} = \phi \psi_{c,P} 8 A_{brg} f_c$ (kips)	14.1	OK	(Eq. D-15)
$\phi =$	0.75		
A_{brg} (in ²)	0.59		
$\psi_{c,P} =$	1.00		

Shear Strength

$\phi V_{sa} = 0.7 n A_{se,N} f_{uta}$ (kips)	7.0	OK	(Eq. D-19 for n = 1)
$0.2 \phi V_{sa} > V_{ua}$ - No Reduction to Tensile Strength is Necessary (D.7.1)			

Tensile Strength

$\phi N_{sa} = \phi n A_{se,N} f_{uta}$ (kips)	14.3	OK	(Eq. D-3)
$\phi =$	0.75		
n = number of anchors =	1		
$A_{se,N}$ (in ²) =	0.20	(effective cross-sectional area of single anchor)	
f_{uta} (ksi) = $1.9 f_y =$	96.9	(f _{uta} cannot exceed 125 ksi)	

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
www.civiltech.com

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.

The calculation method is based on the following references:

- 1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
5. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
6. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

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Date: 10/17/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\21.5' Permanent.sh8

Title: 146th South
Subtitle: 21.5' Permanent

*****INPUT DATA*****

Wall Type: 3. Soldier Pile, Driving
Wall Height: 21.50
Pile Diameter: 1.20
Pile Spacing: 6.50
Factor of Safety (F.S.): 1.50
As Continuous Span Beam
Lateral Support Type (Braces): 3. Tieback
Top Brace Increase (Multi-Bracing): Add 15%*
No-Load Zone:
Vertical Depth for No-Load Zone: 21.50
H-Distance (Input H/V ratio) for No-Load Zone: 0.00
Angle from H. Line for No-Load Zone: 60.00
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.55
Elastic Module, E: 29000.00
Moment of Inertia, I: 1050.0
User Input Pile: HP14x102

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *
Table with 6 columns: No., Z1 top, Top Pres., Z2 bottom, Bottom Pres., Slope. Rows 1-25 showing pressure and slope data at various depths.

26	16.125	0.206	17.200	0.182	-0.022115
27	17.200	0.182	18.275	0.161	-0.019206
28	18.275	0.161	19.350	0.143	-0.016687
29	19.350	0.143	20.425	0.128	-0.014515
30	20.425	0.128	21.500	0.114	-0.012647
31	21.500	0.114	23.650	0.092	-0.010350
32	23.650	0.092	25.800	0.075	-0.007961
33	25.800	0.075	27.950	0.061	-0.006185
34	27.950	0.061	30.100	0.051	-0.004856
35	30.100	0.051	32.250	0.043	-0.003852
36	32.250	0.043	34.400	0.036	-0.003085
37	34.400	0.036	36.550	0.031	-0.002495
38	36.550	0.031	38.700	0.026	-0.002036
39	38.700	0.026	40.850	0.023	-0.001675
40	40.850	0.023	43.000	0.020	-0.001389
41	43.000	0.020	47.300	0.015	-0.001068
42	47.300	0.015	51.600	0.012	-0.000765
43	51.600	0.012	55.900	0.009	-0.000561
44	55.900	0.009	60.200	0.008	-0.000420
45	60.200	0.008	64.500	0.006	-0.000321
46	64.500	0.006	68.800	0.005	-0.000249
47	68.800	0.005	73.100	0.004	-0.000196
48	73.100	0.004	77.400	0.004	-0.000156
49	77.400	0.004	81.700	0.003	-0.000126
50	81.700	0.003	86.000	0.000	-0.000735

* PASSIVE PRESSURE *

The pressures below will be divided by a Factor of Safety =1.5

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	22.50	0.391	26.00	1.757	0.390551
3	26.00	1.830	28.00	2.680	0.424828
4	28.00	2.680	29.00	2.892	0.212691
5	29.00	2.310	32.00	2.781	0.157019
6	32.00	3.285	40.00	4.786	0.187626
7	40.00	4.063	172.0	23.31	0.145806

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	6.50
2	21.50	1.20

* PASSIVE SPACE *

No.	Z depth	Spacing
1	21.50	3.60

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

No.	Z brace	Angle	Spacing	Input1*	Input2*	Type
1	2.00	15.0	6.50	0.67	0.72	Tieback
2	7.00	15.0	6.50	0.67	0.72	Tieback
3	14.00	15.0	6.50	0.67	0.72	Tieback

*For Tieback: Input1 = Diameter; Input2 = Bond Strength

*For Plate: Input1 = Diameter; Input2 = Allowable Pressure

*For Deadman: Input1 = Horz. Width; Input2 = Passive Pressure;

*For Sheet Pile Anchor: Input1 = Horz. Width; Input2 = Passive Slope;

*****CALCULATION*****

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

* CALCULATE REQUEST EMBEDMENT *

<--	D1=14.00
==	D2=21.50
	D3=27.68

D1 - TOP DEPTH R1 - TOP REACTION
D2 - EXCAVATION BASE
D3 - PILE TIP

TOTAL REACTION: R1 = 25.18
TOTAL PRESSURES ACTING ON WALL = 25.18
Total Reactions = Total Pressures, OK!
The Calculated Embedment, Yend = 6.18

-----MULTIPLE BRACE / TIEBACK CASE-----
** Use the calculated embedment, Yend = 6.18 for graphics and analysis.

NUMBER OF BRACE LEVEL= 3

* CANTILEVER SPAN, NO.0 *

 | D1=0.00
 |
 |<-- D2=2.00 R2=11.72, with Cantilever Moment=10.47

D1 - TOP DEPTH
D2 - BOTTOM DEPTH R2 - BOTTOM REACTION

TOTAL REACTION: R2 = 11.72
TOTAL PRESSURES ACTING ON WALL = 11.72
Total Reactions = Total Pressures, OK!

BRACE NO.1 AT DEPTH = 2.00
R2 of Cantilever Span } Sum of Reaction = Brace Load = 33.15
R1 of Span No.1

* MIDDLE SPAN NO.1 *

 |<-- D1=2.00 R1=21.43, with Cantilever Moment=10.47
 |
 |<-- D2=7.00 R2=17.16

D1 - TOP DEPTH R1 - TOP REACTION
D2 - BOTTOM DEPTH R2 - BOTTOM REACTION

TOTAL REACTION: R1+R2 = 38.58
TOTAL PRESSURES ACTING ON WALL = 38.58
Total Reactions = Total Pressures, OK!

BRACE NO.2 AT DEPTH = 7.00
R2 of Span No.1 } Sum of Reaction = Brace Load = 40.11
R1 of Last Span

* LAST SPAN *

 |<-- D1=7.00 R1=22.96
 |
 |<-- D2=14.00 R2=45.72
 |
 | D3=27.68

D1 - TOP DEPTH R1 - TOP REACTION
D2 - LAST BRACE DEPTH R2 - LAST BRACE REACTION
D3 - BOTTOM DEPTH

TOTAL REACTION: R1+R2 = 68.68
TOTAL PRESSURES ACTING ON WALL = 68.68
Total Reactions >= Total Pressures, OK!

BRACE NO.3 AT DEPTH = 14.00
R2 of Last Span = Brace Load = 45.72

*****RESULTS*****

* EMBEDMENT *

MINIMUM EMBEDMENT = 6.18, TOTAL MINIMUM PILE LENGTH = 27.68

* MOMENT IN PILE (per pile spacing)*

Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.

No.	Depth	M @ Brace	Mmax in Span	Depth of Mmax
1	2.00	10.43	15.69	4.59
2	7.00	5.58	30.38	10.32
3	14.00	9.85	51.08	19.52

Overall Maximum Moment = 51.08 at 19.52

Maximum Shear = 25.12

Moment and Shear are per pile spacing: 6.5 foot or meter

-> Top Brace Increase 15%. (Horizontal) From 33.15 to 38.12

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

The calculated brace force are per brace spacing.

No.	DEPTH	Tangle	SPACING	HORIZONTAL	VERTICAL	TOTAL LOAD
1	2.00	15.0	6.50	38.12	10.21	39.46
2	7.00	15.0	6.50	40.11	10.75	41.53
3	14.00	15.0	6.50	45.72	12.25	47.33

No.	DEPTH	Free length	Brace Type
1	2.00	10.09	Tieback, Bond length = 26.04
2	7.00	7.51	Tieback, Bond length = 27.40
3	14.00	3.88	Tieback, Bond length = 31.23

* VERTICAL LOADING *

Vertical Loading from Braces = 33.21

Vertical Loading from External Load = 0.00

Total Vertical Loading = 33.21

*****SPECIFIED PILE *****

Overall Maximum Moment = 51.08 at 19.52

The pile selection is based on the magnitude of the moment only. Axial force is neglected.

Request Min. Section Modulus = 22.29 in³/pile = 365.24 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has been found in Soldier Pile list!

(English Units):

Area= 30 in. Depth= 14 in. Width= 14.8 in. Height= 14 in.

Flange thickness= 0.705 in. Web thickness= 0.705 in.

Ix= 1050 in⁴/pile Sx= 150 in³/pile Iy= 380 in⁴/pile Sy= 51.4 in³/pile

(Metric Units):

Ix= 437.01 x100cm⁴/pile Sx= 2458.05 cm³/pile Iy= 158.16 x100cm⁴/pile Sy= 842.29 cm³/pile

The pile selection is based on the magnitude of the moment only. Axial force is neglected.

HP14X102 is capable to support the shoring!

Top deflection = -0.001(in)

Max. deflection = 0.031(in)

***** LAGGING SIZE ESTIMATION *****

Max. Pressure above base = 1.23

Piles are more rigid than timber lagging, due to arching, only portion of pressures are acting to lagging, 30-50% loading is suggested.

If 50% loading is used for lagging design, Design Pressure = 0.61

Pile Spacing =6.5, Max. Moment in lagging = 3.23

For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=1.65

For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.67

If 30% loading is used for lagging design, Design Pressure = 0.37

Pile Spacing =6.5, Max. Moment in lagging = 1.94

For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=0.99

For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.40

Unit: Pressure: ksf, Spacing: ft, Moment: kip-ft, Bending Strength, fb: ksi

Reinforced Shotcrete Lagging Design



Design Reference: ACI 318 and AREMA Chapter 8

Project: 146th South

Design: Shotcrete Lagging - Continuous - 6.5' C-C Spacing Seismic

Date: 10/18/2024

Midvale, UT 84047

Designed By: AWL

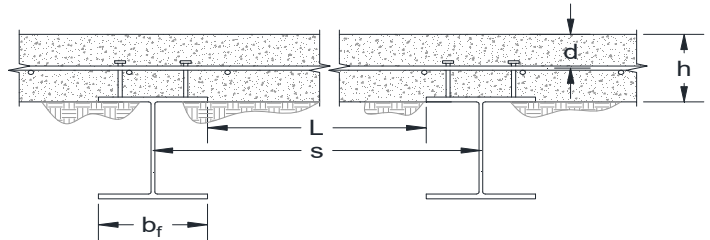
Reviewed By: BHG

Reinforced Beam

Loads

Max Pressure, w (psf)	1130
Arching Reduction	0.33
Pile Spacing, s (ft)	6.50
Flange Width, b_f (in)	14.0
Facing Span, L (ft)	5.9
Moment, $M_{MAX} = wL^2/10$ (k-ft/ft)	2.65
Shear, $V_{MAX} = wL/2$ (kips/ft)	2.2
Load Factor, LF	1
$M_u = (LF)M_{MAX}$ (k-ft)	2.65
$V_u = (LF)V_{MAX}$ (k/ft)	2.2

(See Shoring Suite Report)
1/3 Reduction per AREMA Ch 8 - 28.5.3.5



*LF = 1.6 and 1.0 applied to static and seismic soil pressures

Geometry

b_w (in)	12
h (in)	8
d (in)	4.00
c_c (in)	3.06
f_c (psi)	4000
f_y (psi)	60000
β_1	0.85

Reinforcement: Rebar

Horizontal Bar Size:	#5	
@	12	inches o.c.
(Tension Reinforcement) A_s (in ² /ft)	0.31	
Bar diameter d_b (in)	0.625	
$A_{s, MIN} = 3(f_c^{1/2})/f_y(b_w d)$ (in ²)	0.15	
or $200b_w d/f_y$ (in ²)	0.16	
$s_{MAX} = 15(40000/f_s) - 2.5c_c$ (in)	7.34	

Requirements Summary

8" thick shotcrete with #5 bar @ 12" o.c. centered in the shotcrete. Anchor to soldier piles using 1 row(s) of 1/2" x 5-5/16" headed studs spaced 18" o.c. vertically

Controlled by 21.5' Seismic Case from Wall 2

Flexure

a (in)	0.45
c (in)	0.53
ϵ_t	0.0196
ϕ^*	0.90
$\phi M_n = \phi A_s f_y (d - a/2)$ (k-ft)	5.21
Check that $\phi M_n > M_u$	Passes

Shear

ϕV_n (kips)	4.6	$((0.75)2\lambda(f_c^{1/2})b_w d)$ (11-3)
Check that $\phi V_n > V_u$	Passes	

Reinforced Shotcrete Lagging Design



Design Reference: ACI 318 and AREMA Chapter 8

Project: 146th South

Design: Shotcrete Lagging - Continuous - 6.5' C-C Spacing Seismic

Date: 10/18/2024

Midvale, UT 84047

Designed By: AWL

Reviewed By: BHG

Headed Studs

Loads & Geometry

Factored Tension Load = $2V_{MAX}$ (kips/ft)	4.48	
Factored Shear Load (kips/ft)	0.65	(weight of facing)
Horizontal Stud Spacing, s_1 (in)	NA	
Vertical Stud Spacing, s_2 (in)	18	
# of Vertical Rows	1	
Factored Tension Load, N_{ua} (kips/Stud)	6.7	
Factored Shear Load, V_{ua} (kips/Stud)	0.98	
Headed Stud Size	1/2" x 5-5/16"	
Headed-stud shaft diameter, D_s (in)	0.5	
Head diameter, D_H (in)	1	
Head thickness, t_H (in)	0.31	
Length of shaft, $L_s = h_{ef}$ (in)	4.94	
Yield strength of studs, $f_{y, studs}$ (ksi)	51	

Punching Shear (Breakout)

Concrete Breakout Strength, ϕN_{cb} (kips)	12.5	OK	$\psi_{ec} =$	1
$\phi N_{cb} = A_{Nc} / A_{Nco} * \psi_{ec, N} \psi_{ed, N} \psi_{c, N} \psi_{cp, N} N_b$ (Eq. D-5)			$\psi_{ed} =$	1
A_{Nc} (in ²)	220	(Fig. RD.5.2.1.b)	$\psi_c =$	1
$A_{Nco} = 9 * h_{ef}^2$ (in ²)	220	(Eq. D-6)	$\psi_{cp} =$	1
$N_b = k_c (f_c^{1/2}) h_{ef}^{1.5}$ (kips)	16.7	(Eq. D-7)		

Pullout Strength

$\phi N_{pn} = \phi \psi_{c,P} 8 A_{brg} f_c$ (kips)	14.1	OK	(Eq. D-15)
$\phi =$	0.75		
A_{brg} (in ²)	0.59		
$\psi_{c,P} =$	1.00		

Shear Strength

$\phi V_{sa} = 0.7 n A_{se,N} f_{uta}$ (kips)	7.0	OK	(Eq. D-19 for n = 1)
$0.2 \phi V_{sa} > V_{ua}$ - No Reduction to Tensile Strength is Necessary (D.7.1)			

Tensile Strength

$\phi N_{sa} = \phi n A_{se,N} f_{uta}$ (kips)	9.6	OK	(Eq. D-3)
$\phi =$	0.75		
n = number of anchors =	1		
$A_{se,N}$ (in ²) =	0.20		(effective cross-sectional area of single anchor)
f_{uta} (ksi) = min 1.9fy or 65 ksi =	65		(f_{uta} cannot exceed 125 ksi)

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
www.civiltech.com

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.

The calculation method is based on the following references:

- 1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
5. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
6. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

UNITS: Width/Spacing/Diameter/Length/Depth - ft, Force - kip, Moment - kip-ft, Friction/Bearing/Pressure - ksf, Pres. Slope - kip/ft3, Deflection - in

Licensed to 4324324234 3424343
Date: 10/17/2024 File: J:\PROJECTS\HDR\22-1474 14600 South SES\Analyses\ShoringSuite\Wall 2\21.5' Seismic.sh8

Title: 146th South
Subtitle: 21.5' Seismic

*****INPUT DATA*****

Wall Type: 3. Soldier Pile, Driving
Wall Height: 21.50
Pile Diameter: 1.20
Pile Spacing: 6.50
Factor of Safety (F.S.): 1.50
As Continuous Span Beam
Lateral Support Type (Braces): 3. Tieback
Top Brace Increase (Multi-Bracing): Add 15%*
No-Load Zone:
Vertical Depth for No-Load Zone: 21.50
H-Distance (Input H/V ratio) for No-Load Zone: 0.00
Angle from H. Line for No-Load Zone: 60.00
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.55
Elastic Module, E: 29000.00
Moment of Inertia, I: 1050.0
User Input Pile: HP14x102

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *
Table with 6 columns: No., Z1 top, Top Pres., Z2 bottom, Bottom Pres., Slope. Rows 1-25 showing pressure and slope data at various depths.

26	13.975	0.055	15.050	0.049	-0.006123
27	15.050	0.049	16.125	0.043	-0.005306
28	16.125	0.043	17.200	0.038	-0.004599
29	17.200	0.038	18.275	0.034	-0.003988
30	18.275	0.034	19.350	0.030	-0.003463
31	19.350	0.030	20.425	0.027	-0.003012
32	20.425	0.027	21.500	0.024	-0.002625
33	21.500	0.024	23.650	0.019	-0.002151
34	23.650	0.019	25.800	0.016	-0.001657
35	25.800	0.016	27.950	0.013	-0.001290
36	27.950	0.013	30.100	0.011	-0.001015
37	30.100	0.011	32.250	0.009	-0.000806
38	32.250	0.009	34.400	0.008	-0.000647
39	34.400	0.008	36.550	0.006	-0.000524
40	36.550	0.006	38.700	0.006	-0.000428
41	38.700	0.006	40.850	0.005	-0.000353
42	40.850	0.005	43.000	0.004	-0.000293
43	43.000	0.004	47.300	0.003	-0.000225
44	47.300	0.003	51.600	0.003	-0.000162
45	51.600	0.003	55.900	0.002	-0.000119
46	55.900	0.002	60.200	0.002	-0.000089
47	60.200	0.002	64.500	0.001	-0.000068
48	64.500	0.001	68.800	0.001	-0.000053
49	68.800	0.001	73.100	0.001	-0.000042
50	73.100	0.001	77.400	0.001	-0.000033
51	77.400	0.001	81.700	0.001	-0.000027
52	81.700	0.001	86.000	0.000	-0.000156

* PASSIVE PRESSURE *

The pressures below will be divided by a Factor of Safety =1.5

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	22.50	0.391	26.00	1.757	0.390551
3	26.00	1.830	28.00	2.680	0.424828
4	28.00	2.680	29.00	2.892	0.212691
5	29.00	2.310	32.00	2.781	0.157019
6	32.00	3.285	40.00	4.786	0.187626
7	40.00	4.063	172.0	23.31	0.145806

* ACTIVE SPACE *

No. Z depth Spacing

1	0.00	6.50
2	21.50	1.20

* PASSIVE SPACE *

No. Z depth Spacing

1	21.50	3.60
---	-------	------

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

No.	Z brace	Angle	Spacing	Input1*	Input2*	Type
1	2.00	15.0	6.50	0.67	0.72	Tieback
2	7.00	15.0	6.50	0.67	0.72	Tieback
3	14.00	15.0	6.50	0.67	0.72	Tieback

*For Tieback: Input1 = Diameter; Input2 = Bond Strength

*For Plate: Input1 = Diameter; Input2 = Allowable Pressure

*For Deadman: Input1 = Horz. Width; Input2 = Passive Pressure;

*For Sheet Pile Anchor: Input1 = Horz. Width; Input2 = Passive Slope;

*****CALCULATION*****

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

* CALCULATE REQUEST EMBEDMENT *

$$\left| \begin{array}{l} \leftarrow D1=14.00 \\ == D2=21.50 \end{array} \right.$$

| D3=28.24
 D1 - TOP DEPTH R1 - TOP REACTION
 D2 - EXCAVATION BASE
 D3 - FILE TIP

TOTAL REACTION: R1 = 25.78
 TOTAL PRESSURES ACTING ON WALL = 25.78
 Total Reactions = Total Pressures, OK!
 The Calculated Embedment, Yend = 6.74

-----MULTIPLE BRACE / TIEBACK CASE-----
 ** Use the calculated embedment, Yend = 6.74 for graphics and analysis.

NUMBER OF BRACE LEVEL= 3

* CANTILEVER SPAN, NO.0 *

| D1=0.00
 |<-- D2=2.00 R2=13.80, with Cantilever Moment=13.38
 D1 - TOP DEPTH
 D2 - BOTTOM DEPTH R2 - BOTTOM REACTION

TOTAL REACTION: R2 = 13.80
 TOTAL PRESSURES ACTING ON WALL = 13.80
 Total Reactions = Total Pressures, OK!

BRACE NO.1 AT DEPTH = 2.00
 R2 of Cantilever Span } Sum of Reaction = Brace Load = 33.49
 R1 of Span No.1

* MIDDLE SPAN NO.1 *

|<-- D1=2.00 R1=19.69, with Cantilever Moment=13.38
 |<-- D2=7.00 R2=13.53
 D1 - TOP DEPTH R1 - TOP REACTION
 D2 - BOTTOM DEPTH R2 - BOTTOM REACTION

TOTAL REACTION: R1+R2 = 33.22
 TOTAL PRESSURES ACTING ON WALL = 33.22
 Total Reactions = Total Pressures, OK!

BRACE NO.2 AT DEPTH = 7.00
 R2 of Span No.1 } Sum of Reaction = Brace Load = 33.81
 R1 of Last Span

* LAST SPAN *

|<-- D1=7.00 R1=20.27
 |<-- D2=14.00 R2=44.84
 | D3=28.24
 D1 - TOP DEPTH R1 - TOP REACTION
 D2 - LAST BRACE DEPTH R2 - LAST BRACE REACTION
 D3 - BOTTOM DEPTH

TOTAL REACTION: R1+R2 = 65.11
 TOTAL PRESSURES ACTING ON WALL = 65.11
 Total Reactions >= Total Pressures, OK!

BRACE NO.3 AT DEPTH = 14.00
 R2 of Last Span = Brace Load = 44.84

*****RESULTS*****

* EMBEDMENT *

MINIMUM EMBEDMENT = 6.74, TOTAL MINIMUM PILE LENGTH = 28.24

* MOMENT IN PILE (per pile spacing)*

Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.

No.	Depth	M @ Brace	Mmax in Span	Depth of Mmax
1	2.00	13.16	11.70	4.71
2	7.00	4.74	27.52	10.34
3	14.00	9.82	54.28	19.70

Overall Maximum Moment = 54.28 at 19.70

Maximum Shear = 25.70

Moment and Shear are per pile spacing: 6.5 foot or meter

-> Top Brace Increase 15%. (Horizontal) From 33.49 to 38.52

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

The calculated brace force are per brace spacing.

No.	DEPTH	Tangle	SPACING	HORIZONTAL	VERTICAL	TOTAL LOAD
1	2.00	15.0	6.50	38.52	10.32	39.87
2	7.00	15.0	6.50	33.81	9.06	35.00
3	14.00	15.0	6.50	44.84	12.01	46.42

No.	DEPTH	Free length	Brace Type
1	2.00	10.09	Tieback, Bond length = 26.31
2	7.00	7.51	Tieback, Bond length = 23.09
3	14.00	3.88	Tieback, Bond length = 30.63

* VERTICAL LOADING *

Vertical Loading from Braces = 31.39

Vertical Loading from External Load = 0.00

Total Vertical Loading = 31.39

*****SPECIFIED PILE *****

Overall Maximum Moment = 54.28 at 19.70

The pile selection is based on the magnitude of the moment only. Axial force is neglected.

Request Min. Section Modulus = 23.69 in³/pile = 388.14 cm³/pile, Fy= 50 ksi = 345 MPa, Fb/Fy=0.55

HP14X102 has been found in Soldier Pile list!

(English Units):

Area= 30 in. Depth= 14 in. Width= 14.8 in. Height= 14 in.

Flange thickness= 0.705 in. Web thickness= 0.705 in.

Ix= 1050 in⁴/pile Sx= 150 in³/pile Iy= 380 in⁴/pile Sy= 51.4 in³/pile

(Metric Units):

Ix= 437.01 x100cm⁴/pile Sx= 2458.05 cm³/pile Iy= 158.16 x100cm⁴/pile Sy= 842.29 cm³/pile

The pile selection is based on the magnitude of the moment only. Axial force is neglected.

HP14X102 is capable to support the shoring!

Top deflection = 0.000(in)

Max. deflection = 0.035(in)

***** LAGGING SIZE ESTIMATION *****

Max. Pressure above base = 1.13

Piles are more rigid than timber lagging, due to arching, only portion of pressures are acting to lagging, 30-50% loading is suggested.

If 50% loading is used for lagging design, Design Pressure = 0.56

Pile Spacing =6.5, Max. Moment in lagging = 2.97

For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=1.52

For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.62

If 30% loading is used for lagging design, Design Pressure = 0.34

Pile Spacing =6.5, Max. Moment in lagging = 1.78


For 4"x12" Timber, Section Modules S=23.47 in³. The request allowable bending strength, fb=M/S=0.91

For 6"x12" Timber, Section Modules S=57.98 in³. The request allowable bending strength, fb=M/S=0.37

Unit: Pressure: ksf, Spacing: ft, Moment: kip-ft, Bending Strength, fb: ksi

Corroded Pile Properties

SOLDIER PILE CORROSION LOSS CALCULATION

	Project: 14600 South	
	Date: 9/19/2024	
	Designed By: AWL	Reviewed By: BHG

*Decker Equation for Corrosion

Corrosion Loss

Service Life, t_f = 75 years

$$X = 83 \times t_f^{0.81} \text{ Eq. 4 (Decker 2008)}$$

Loss of steel, X = 2741 μm (Decker)

Loss of steel, X = 0.108 in (Decker)

Pile Size =

HP14x89	HP14x117
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Original Dimensions

Flange Width, b_f (in) =	14.7	14.9
Flange Thickness, t_f (in) =	0.615	0.805
Web Thickness, t_w (in) =	0.615	0.805
Beam Depth, d (in) =	13.8	14.2
I_x (in ⁴) =	888.2	1211.2
S_x (in ³) =	128.72	170.60

Dimensions after Corrosion

Flange Width, b_f (in) =	14.48	14.68
Flange Thickness, t_f (in) =	0.40	0.59
Web Thickness, t_w (in) =	0.40	0.59
Beam Depth, d (in) =	13.58	13.98

Est. Pile Properties

$I_{x\text{mod}}$ (in ⁴) =	572.3	879.8
$S_{x\text{mod}}$ (in ³) =	84.3	125.8
Max S_x Required (in ³) =	77.1	75.9
(See Shoring Suite Calcs)	OK	OK

References:

Decker, J.B., Rollins, K.M. and Ellsworth, J.C., 2008, *Corrosion Rate Evaluation and Prediction for Piles Based on Long-Term Field Performance*, Journal of Geotechnical and Geoenvironmental Engineering. Volume 134, Issue 3. ASCE.