



Thinking Outside the Box

Leveraging New Technology in
Excavation Shoring Systems

Bruce Magee

Region Product Development Manager

United Rentals Trench Safety

The Job

Project Description

North Outfall Sewer Rehab Unit 13 Sanitary Sewer Upgrade

- City of Los Angeles, CA
- Clean and clear 5,127 LF of 48" clay tile-lined sewer
- Prepare for slip lining of 48", rehab/replacement of manholes
- Sewer lies in public right-of-way under center of Blake Ave



Bid Results

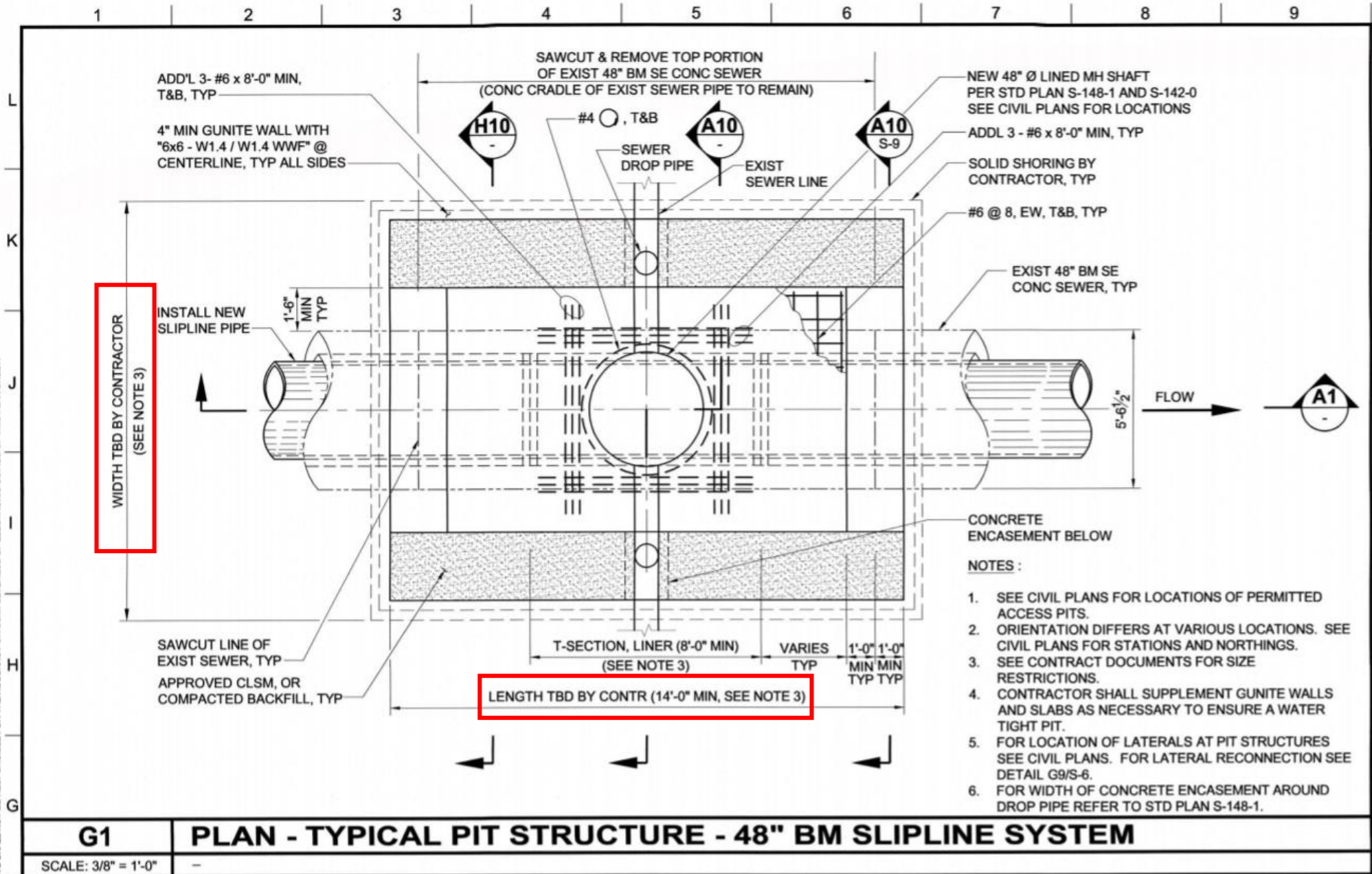
- Low Bid - \$10,306,679 – 12.4% under 2nd
- 2nd Lowest - \$11,761,855
- City Engineer's Estimate - \$13,630,465
- Winning bid 75.6% of City Engineer's Estimate
- Winning bid = 3 planned access pits at \$250,000 total
- Avg bid of the next 5, for all three pits - \$700k +

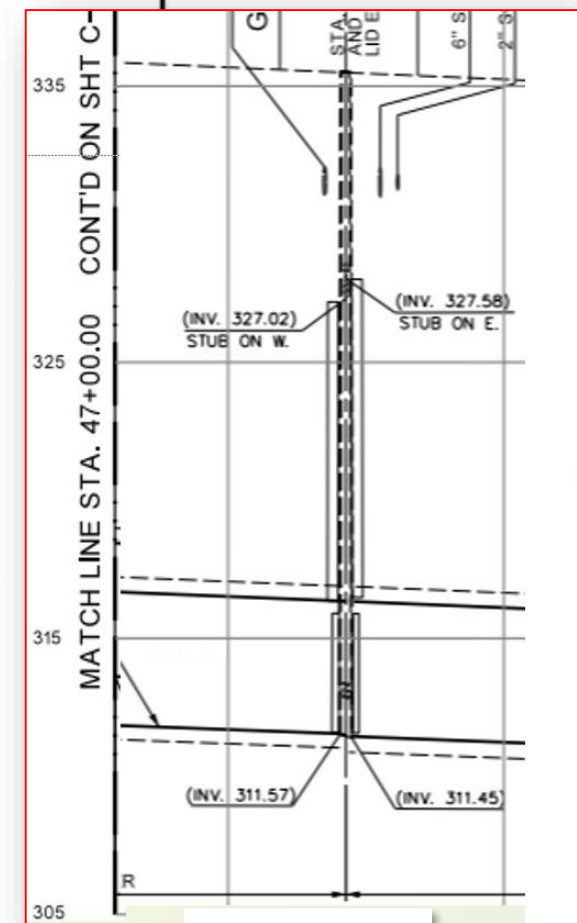
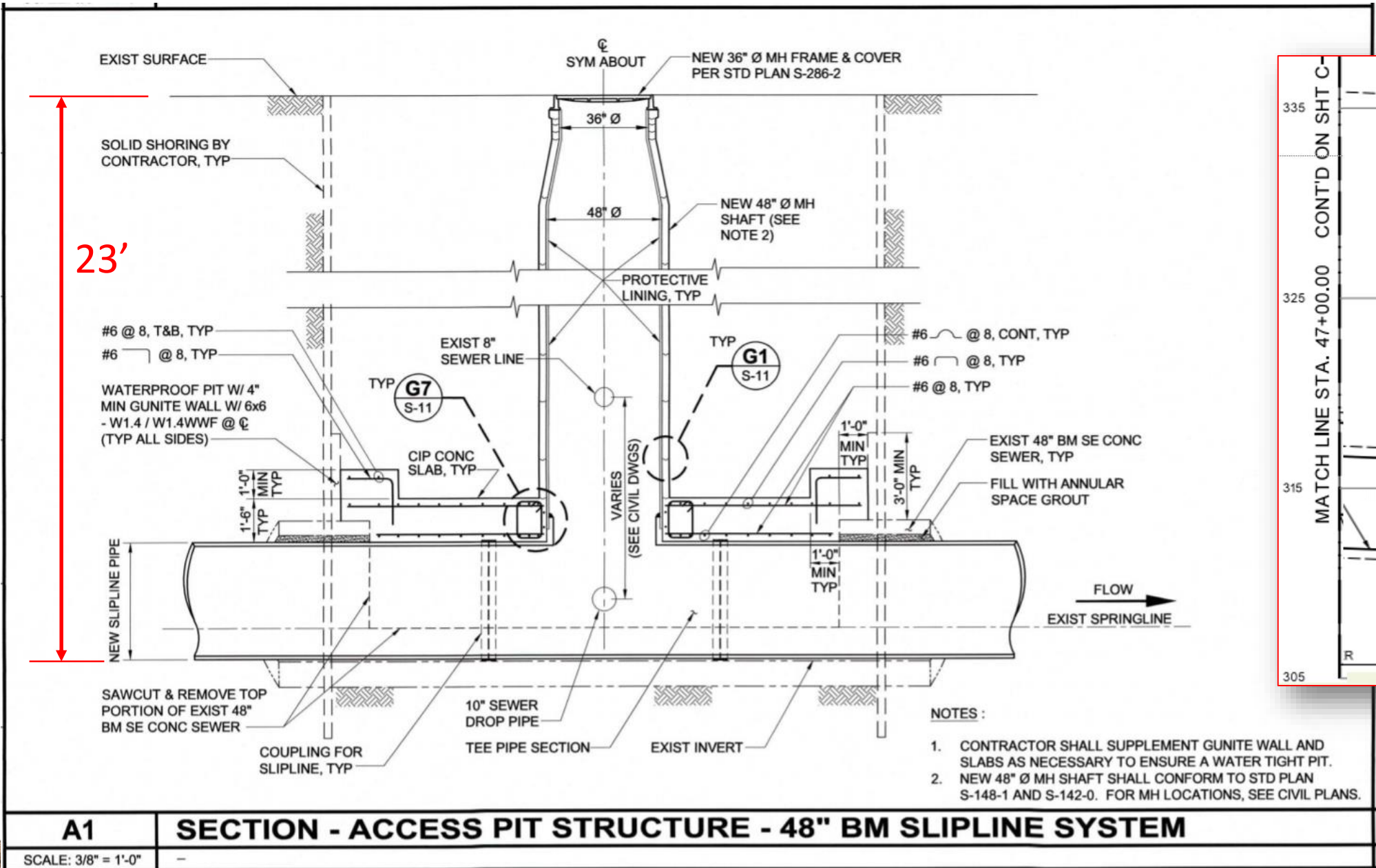


The Location

The Drawings

ITS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.



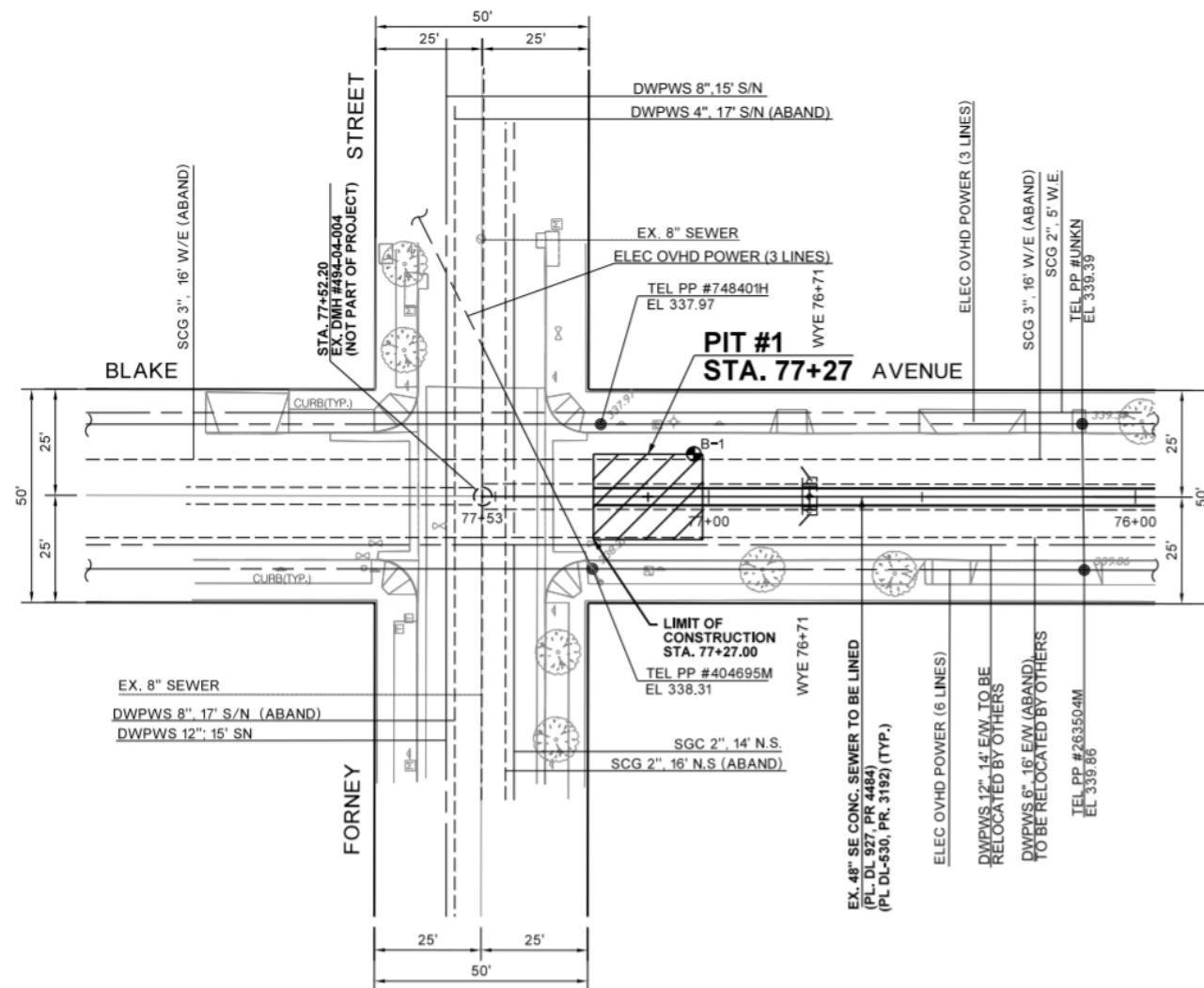


PROFILE

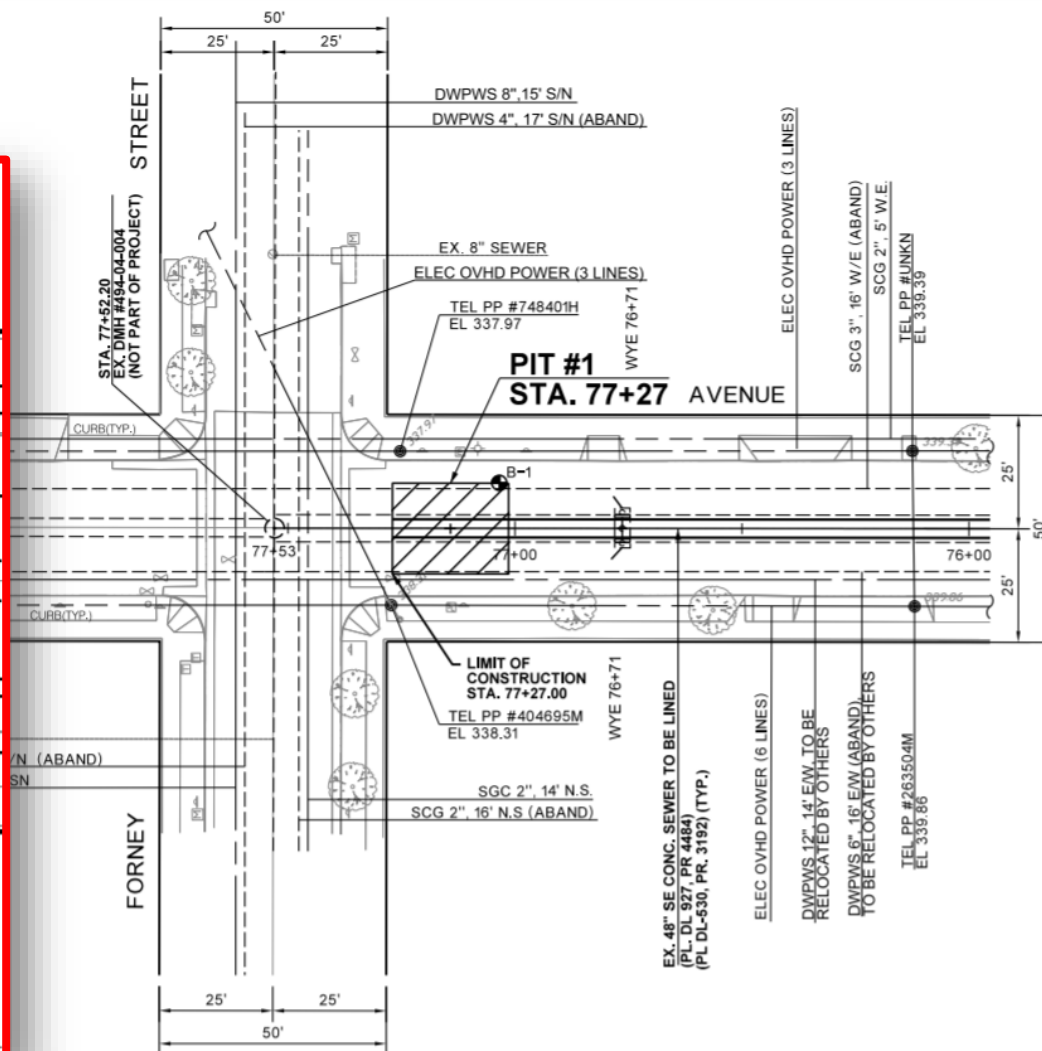
A1	SECTION - ACCESS PIT STRUCTURE - 48" BM SLIPLINE SYSTEM
SCALE: 3/8" = 1'-0"	

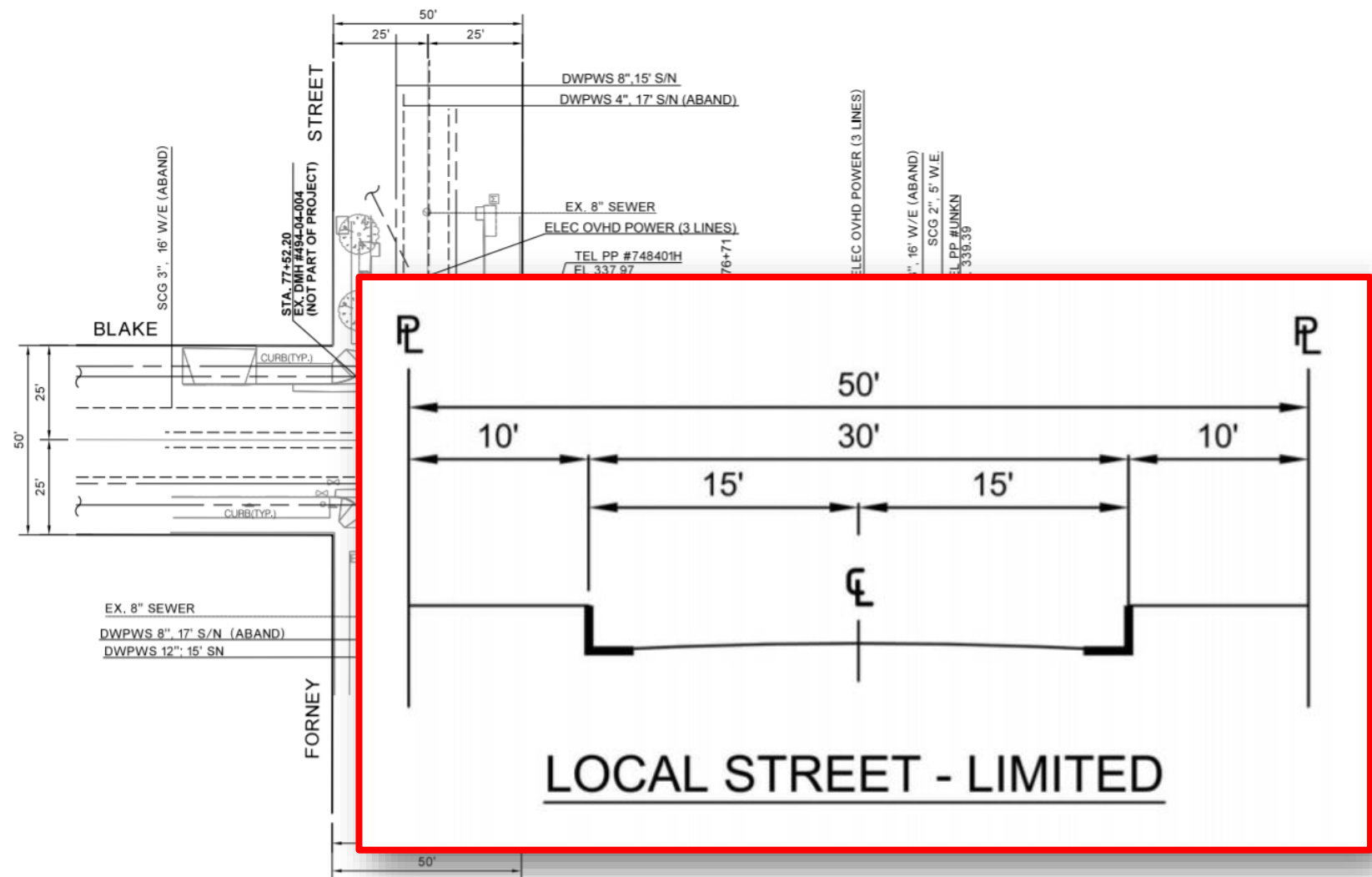


The Working Room



PIT #1 DETAIL
SCALE: 1" = 20'





PIT #1 DETAIL
SCALE: 1" = 20'



Available Space



The Soil

LOG OF TEST BORING

LAB. NO.: 140- NOS - PROJECT: NOS Rehabilitation - Unit 13 - Forney to Duvall
 BORING NO.: B-1 ELEVATION: 339 DRILLING DATE: 2/1/17
 LOCATION: 5' W/o ECF Blake Av. & 35' S/o SCF Forney St.
 DRILL RIG TYPE: CME-75HT using 8" diameter hollow stem augers
 DEPTH TO STANDING WATER: 24' DEPTH TO WATER SEEPAGE: 24'
 DRILLER: Ramirez LOGGER: Roth ENGINEER: None Present

ELEVATION / DEPTH (ft)	SOIL SYMBOLS, SAMPLER SYMBOLS AND BLOWS/INCHES	LEL (%)	OVA (PPM)	USCS	Field Description	Moist. %	Dry Dens. Pcf
0				SM	4" AC Pavement in good condition.		
335				SP	Brown silty fine-medium sand with a trace of gravel; moist. Bulk soil sample was taken from 4"-2½' depth.		
5	4/6 3/6	0	0		Gray poorly-graded fine-medium sand with a trace of gravel; moist and loose.	4.4	106
330				SM	Gray silty sand with gravel, moist and medium dense. Encountered a 6" silt lens @ 10' Gravel content increased @ 10½' with a trace of cobbles.	9.9	101
10	3/6 4/6	0	0				
325					Dense below 15'.	5.0	126
15	8/6 9/6	0	0				
320							
20	9/6 9/6	0	25			5.7	132
315					Encountered groundwater @ 24'.	9.4	132
25	10/6 12/6	0	25				
310					Test Boring Location Coordinates 34° 05' 41.62" North 118° 14' 27.72" West		

Soil Analysis

- Gray, Silty Sand with Gravel, Moist, Medium Dense
- Type C-60
- Water @ 24'

The Protective System Options

Protective System Options

- OSHA-Provided Options
 - Sloping/Benching, Timber, Aluminum Hydraulic
- Manufactured Systems
 - Trench Shields, Conventional Slide Rail
- Site Specific Designs
 - Driven Sheet piling, Secant Pile
 - Beam/Lagging, Beam/Plate



The Limiters

Plans and Specifications

- Contractor's Actions May Be Limited By The Plans And Specification
- Restrictions Placed To Protect Public
- Intent
 - to have bidders compete on a level field
 - to ensure taxpayers get value
- Specifications Often Get Into Contractor's Means and Methods
 - may limit how a contractor does something



Temporary Excavation Requirements

[illegible]

Temporary Excavation Requirements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16														
L K J I H G F E D C B A	PIPES 1. THE REQUIRED PIPES UNDER THIS CONTRACT HAVE BEEN DESIGNED BASED ON FINAL IN-PLACE CONDITIONS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THE REQUIRED PIPES CAN ACCOMMODATE TEMPORARY HANDLING, TRANSPORTATION AND CONSTRUCTION LOADS. 2. INCREASE PIPE STRENGTH AS NECESSARY FOR STRESSES INDUCED BY LOADS FROM HANDLING, TRANSPORTATION, ETC. 3. ALL PIPE JOINT SYSTEMS SHALL BE CAPABLE OF WITHSTANDING EXTERNAL WATER PRESSURES AS REQUIRED BY THE "DESIGN HYDROSTATIC HEAD" WHEN NO HEIGHT IS LISTED, REFER TO THE CONTRACT DOCUMENTS FOR INFORMATION. THE GREATER HEIGHT LISTED SHALL GOVERN. FIELD TEST ALL JOINTS OCCURRING BELOW GROUNDWATER TABLE IN ACCORDANCE WITH ASTM C1103 (PRECAST CONCRETE PIPE), OR APPROVED EQUAL. 4. JOINTS: a. TYPE FOR RCP: "STEEL RING TONGUE & GROOVE" OR "FLUSH STEEL COUPLER" GASKETED WITH O-RING.															TEMPORARY EXCAVATION SHORING 1. ALL SHORING SHALL BE IN ACCORDANCE WITH SECTION 306-1.1.6 OF THE STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION (SSPWC), LATEST EDITION AS MODIFIED BY THE CITY OF LOS ANGELES BROWN BOOK, TITLE 8, DIVISION 1, CHAPTER 4, SUBCHAPTER 4 OF THE CALIFORNIA CODE OF REGULATIONS, CALIFORNIA CONSTRUCTION SAFETY ORDERS, THE PROJECT GEOTECHNICAL REPORT, SPECIFICATION 0224L AND THE NOTES HEREIN, WHERE A CONFLICT OCCURS, THE MOST STRINGENT REQUIREMENTS SHALL APPLY. 2. SHORING PLANS AND CALCULATIONS SHALL BE PREPARED, SEALED AND SIGNED BY A CALIFORNIA REGISTERED CIVIL OR STRUCTURAL ENGINEER FOR REVIEW BY THE ENGINEER AND THE GEOTECHNICAL ENGINEERING GROUP FOR ACCEPTANCE. 3. CONFIGURATION AND/OR TYPE OF SHORING SHALL MITIGATE CONDITIONS WHERE THE STABILITY OF THE ADJACENT CITY RIGHT-OF-WAY AND/OR UTILITIES MAY BE COMPROMISED, DISTURBED OR UNDERMINED. 4. LOADING USED FOR SHORING DESIGN SHALL CONFORM WITH RELATED REQUIREMENTS OF THE CONTRACT DOCUMENTS.														
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	b. TEST JOINTS PER ASTM C-443 FOR RCP. 6. PIPE CONNECTION AT STRUCTURES: a. PROVIDE CONNECTOR PIPE WITH FLEXIBLE JOINT AT ALL STRUCTURES. LENGTH SHALL BE NO LESS THAN 18 INCHES NOR GREATER THAN 30 INCHES, UNO. SEE REQUIREMENTS ABOVE FOR JOINTS REQUIRED TO SUSTAIN A DESIGN HYDROSTATIC HEIGHT. c. RCP: USE INTEGRALLY CAST BELL-END OR SPOT-END COUPLINGS WITH FLEXIBLE JOINTS APPROVED BY THE ENGINEER. APPROVED FORMED VERSIONS MAY ALSO BE CONSIDERED. VCP: SEE STANDARD PLANS FOR TYPICAL CONDITIONS, UNO. 7. VCP PIPE PER SSPWC 207-8, EXTRA STRENGTH CLASS PIPE, UNO. 8. THE CONTRACTOR SHALL IMPLEMENT ACTIVE CONTINUOUS CONTROLS TO MITIGATE ANY IMPACT DUE TO THE HEAT OF HYDRATION CAUSED BY CEMENTITIOUS BACKFILL/GROUT, SUCH AS THE USE OF MULTIPLE LIFTS, TEMPERATURE CONTROL OF THE GROUT COMPONENTS PRIOR TO MIXING, MAINTAINING THE UPPER BOUND OF THE GROUT COMPRESSIVE STRENGTH WITHIN THE SPECIFIED VALUE, ETC. 9. THE CONTRACTOR SHALL INSTALL CASE 5 BEDDING IN LIEU OF THE BEDDING DESIGNATED ON THE PLANS WHEN ANY PORTION OF THE PROPOSED SEWER FALLS WITHIN A TUNNEL/MICROTUNNEL/JACKING SHAFT AREA, FOR WIDE PORTIONS OF A TRENCH EXCAVATION WHICH EXCEED THE STANDARD MAXIMUM TRENCH WIDTH, PERMITTED BY "TABLE A" OF STANDARD PLAN S-291, THE CASE BEDDING SHALL BE INCREASED PER "TABLE B" OF STANDARD PLAN S-291. PROVIDE 1 INCH THICK PREFORMED BITUMINOUS EXPANSION JOINT FILLER EXTENDING THE ENTIRE WIDTH AND HEIGHT OF ENCASEMENT PER STANDARD PLAN S-140. 11. PROVIDE THE REQUIRED TESTING DATA AS STIPULATED UNDER SSPWC 207-17 THROUGH 207-22 AND SECTION 500 FOR PIPE ACCEPTANCE EXCEPT AS MODIFIED BY THE BROWN BOOK, LATEST EDITION AND THE FOLLOWING: a. DELIVERY OF PIPE SHALL NOT COMMENCE UNTIL ALL THE REQUIRED VERIFICATION DATA HAS BEEN SUBMITTED AND APPROVED. b. TESTING DATA SHALL BE FOR THE PARTICULAR PIPE BEING PROVIDED AND NOT ARCHIVED DATA UP TO 24 MONTHS OLD. IT SHALL BE SUBMITTED AS A FORMAL DOCUMENT WITH RESULTS FROM EACH TEST ON A SEPARATE SHEET(S). INCLUDE LABORATORY INFORMATION ALONG WITH SIGNED STATEMENT OF CERTIFICATION FROM AUTHORIZED INSPECTOR THAT WITNESSED THE TESTS. PROVIDE CONTACT INFORMATION OF THIRD PARTY INSPECTOR WHEN ONE IS USED. c. RESULTS FROM PARALLEL PLATE TEST PER 02412 MAY BE USED TO FULFILL ITEM (2), INITIAL FLEXURAL MODULUS (7700'), OF THE TESTING DATA REQUIREMENTS OF 207-20, 207-22 PER THE BROWN BOOK. REPORT AT 5% DEFLECTION. d. RESULTS FROM BARCOL IMPRESSION (D2583) MAY BE USED TO FULFILL ITEM (4), "IMPACT STRENGTH (ASTM D256) OR SHORE D HARDNESS (ASTM D2240)", OF THE TESTING DATA REQUIREMENTS OF 207-20, 207-22 PER THE BROWN BOOK. e. RESULTS FROM HOOP & AXIAL COMPRESSION TESTING IN ACCORDANCE WITH D695.															AVOID DAMAGE, DISRUPTION OR IMPOSE ADDITIONAL LOAD. AS A MINIMUM, MAINTAIN A CLEAR DISTANCE OF 3 X DRILLED HOLE DIAMETER, BUT NOT LESS THAN 3 FEET. A GREATER DISTANCE MAY BE REQUIRED ADJACENT TO DEEPLY EMBEDDED UTILITIES OR WHERE UTILITIES/STRUCTURE LOCATION IS NOT ACCURATELY KNOWN. 11. SHORING SUBMITTAL SHALL INCLUDE CONSTRUCTION PROCEDURES FOR SHORING INSTALLATION AND REMOVAL UNLESS SPECIFICALLY PERMITTED TO REMAIN IN A PLACE AT A PARTICULAR LOCATION PER THE CONTRACT DOCUMENTS. CONTRACTOR SHALL ADHERE TO REQUIREMENTS PER BUREAU OF ENGINEERING SPECIAL ORDER 03-0201, DATED FEBRUARY 16, 2000, WHERE SPECIAL ORDER REQUIREMENTS CONFLICT WITH THE CONTRACT DOCUMENTS, THE MORE STRINGENT SHALL APPLY. 12. SHORING DESIGN ASSUMPTIONS SHALL BE CLEARLY INDICATED AND REFERENCED ON THE SUBMITTAL. 13. FOR STEEL CONNECTIONS OF SHORING SYSTEM, THE SHORING ENGINEER OF RECORD SHALL PROVIDE DETAILS SHOWING EXACT LOCATION OF WELD PLACEMENT, INCLUDING APPROPRIATE WELD SYMBOLS PER AWS. CALLOUTS SHALL INDICATE TOTAL LENGTH OF WELD AT A CONNECTION IS NOT ACCEPTABLE. 14. UNLESS A MORE STRINGENT LIMIT IS REQUIRED BY THE PROJECT GEOTECHNICAL ENGINEER OF RECORD, THE MAXIMUM ALLOWABLE HORIZONTAL DEFLECTION FOR CANTILEVERED SHORING SYSTEMS, LAGGING PANELS SPANNING MORE THAN 9.5 FEET, OR CANTILEVERED PORTIONS OF ALL SHORING SYSTEMS SHALL BE 1/2 INCH. 15. SHORING DESIGNS USING 1/3 ALLOWABLE STRESS INCREASES SHALL ONLY BE APPLIED FOR SHORING SYSTEMS EXPECTED TO BE IN-PLACE FOR A MAXIMUM OF 90 DAYS. 16. LAGGING DESIGN SHALL CONFORM TO THE PROJECT GEOTECHNICAL REPORT AND CALTRANS "TRENCH & SHORING MANUAL". UNLESS SPECIFICALLY ALLOWED BY THE PROJECT GEOTECHNICAL REPORT, THE SOIL ARCHING REDUCTION FACTOR SHALL NOT BE APPLIED TO THE SURCHARGED LOAD. 17. THE USE OF SHEETING PER CALIFORNIA CONSTRUCTION SAFETY ORDERS - ARTICLE 6: EXCAVATION, SECTION 1441.1, APPENDIX D, NOTE (G) USED WITH ALUMINUM HYDRAULIC SHORES IN TYPE C OR UNSTABLE TYPE B SOILS IS NOT PERMITTED UNLESS THE FOLLOWING CONDITIONS ARE MET: A. THE GEOTECHNICAL ENGINEER OF RECORD HAS PROVIDED SITE SPECIFIC RECOMMENDATIONS FOR DESIGN OF THIS SHORING SYSTEM AND PERMIT THE USE OF THIS SHEETING. B. CALCULATIONS ARE PROVIDED SHOWING ITS INTEGRITY. 18. THE USE OF TRENCH SHIELDS AS THE BASIS FOR SUPPORTING SOIL AND ACT AS THE SHORING SYSTEM IS NOT PERMITTED. 19. UNLESS APPROVED BY THE GEOTECHNICAL ENGINEER OF RECORD, IF 2-SACK PORTLAND CEMENT SLURRY IS USED AS BACKFILL BELOW THE PROPOSED DEPTH OF EXCAVATION, THEN THE EFFECTIVE WIDTH OF THE PILE FOR THE PURPOSE OF CALCULATING PASSIVE RESISTANCE SHALL BE TAKEN AS THE WIDTH OF THE STEEL BEAM. IF STRUCTURAL CONCRETE IS USED THEN THE EFFECTIVE WIDTH OF THE BEAM FOR THE PURPOSE OF CALCULATING THE PASSIVE RESISTANCE SHALL BE TAKEN AS THE WIDTH OF THE DRILLED HOLE. TO ACCOUNT FOR THE EFFECT OF "PASSIVE ARCHING" THE EFFECTIVE WIDTH IS PERMITTED TO BE DOUBLED WHERE THE BEAMS ARE SPACED A MINIMUM OF 3.5 TIMES THE DRILLED DIAMETER. 20. A POSITIVE CONNECTION SHALL BE PROVIDED AT BOTH ENDS OF STRUTS TO ENSURE THAT A MINIMUM OF 400 LBS LOAD APPLIED AT MID-SPAN, IN ADDITION TO ANY ASSOCIATED DEAD AND LIVE LOAD CAN BE SUSTAINED. 21. SHORING SHALL BE SELF-SUPPORTING. IT SHALL NOT RELY ON EXISTING IMPROVEMENTS SUCH AS MAINTENANCE HOLES, BRIDGE ABUTMENTS, OR UNDERGROUND STRUCTURES FOR SUPPORT OR STABILITY, UNLESS OTHERWISE APPROVED BY THE ENGINEER. 22. SHORING SYSTEM SHALL COMPLY WITH THE CONTRACT DOCUMENTS AND ALL APPLICABLE LOCAL, STATE, AND FEDERAL REGULATIONS.														
Sheet Number 5.07																														

ENGINEERING
CITY OF LOS ANGELES

DATE: 01/11/23
BY: [Signature]
CHECKED BY: [Signature]
APPROVED BY: [Signature]

SSW005

DEPARTMENT OF PUBLIC WORKS
CITY OF LOS ANGELES

GARY LEE MOORE, PE, ENV SP
DESIGN GROUP
ENGINEER: AMELIO MORALES, PE
CHECKED BY: AMELIO MORALES, PE
APPROVED BY: A. SCHWAB, PE
PROJECT: NGS REHABILITATION UNIT 13
FURNACE TO RANGLAY
ACROSS: LOS ANGELES CH

STRUCTURAL NOTES (3)
NGS REHABILITATION UNIT 13
FURNACE TO RANGLAY
ACROSS: LOS ANGELES CH

NEW DESIGN NO.: SZC13158
DRAWING NO.: S-4
SHEET 01



Temporary Excavation Requirements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16																
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	8. JOINTING OF PIPES DISSIMILAR IN SIZE OR MATERIAL SHALL BE ACCOMPLISHED EITHER BY USE OF A JUNCTION STRUCTURE OR BY THE USE OF SPECIAL ADAPTERS OR COUPLINGS AS INDICATED BY THE ENGINEER FOR SUCH USE. ALL FIELD CUT PIPE SHALL BE ACCOMPLISHED BY METHODS AND EQUIPMENT RECOMMENDED BY THE PIPE MANUFACTURER. NO HAMMER AND CHISEL CUTS WILL BE PERMITTED. 9. THE CONTRACTOR SHALL IMPLEMENT ACTIVE CONTINUOUS CONTROLS TO MITIGATE ANY IMPACT DUE TO THE HEAT OF HYDRATION CAUSED BY CEMENTITIOUS BACKFILL/GROUTING, SUCH AS THE USE OF MULTIPLE LIFTS, TEMPERATURE CONTROL OF THE GROUT COMPONENTS PRIOR TO MIXING, MAINTAINING THE UPPER BOUND OF THE GROUT COMpressive STRENGTH WITHIN THE SPECIFIED VALUE, ETC. 10. THE CONTRACTOR SHALL INSTALL CASE 5 BEDDING IN LIEU OF THE BEDDING DESIGNATED ON THE PLANS WHEN ANY PORTION OF THE PROPOSED SEWER FALLS WITHIN A TUNNEL/MICROTUNNEL/JACKING SHAFT AREA. 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ENGINEERING	
DATE: 01/11/2023	PROJECT: S-4
CITY OF LOS ANGELES	INDEX NO. D-35034
SWW005	

GARY LEE MOORE, PE, ENV SP	
DESIGNER: GARY LEE MOORE, PE, ENV SP	DATE: 01/11/2023
APPROVED BY: GARY LEE MOORE, PE, ENV SP	PROJECT: S-4
CITY OF LOS ANGELES	INDEX NO. D-35034
SWW005	



Temporary Excavation Requirements

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L	PIPES															
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D	<p>18. RESULTS FROM HOOP & AXIAL COMPRESSION TESTING IN ACCORDANCE WITH D695.</p>															
C	<p>17. REQUIREMENTS OF 207-20, 207-22 PER THE BROWN BOOK.</p>															
B	<p>16. RESULTS FROM HOOP & AXIAL COMPRESSION TESTING IN ACCORDANCE WITH D695.</p>															
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ENGINEERING
CITY OF LOS ANGELES
SHEET NO. D-35034
INDEX NO. SW01055

DATE: 10/18/2023
BY: [Signature]
CHECKED: [Signature]
CITY OF LOS ANGELES
BUREAU OF ENGINEERING
SHEET NO. S-4



Temporary Excavation Requirements

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L	PIPES																
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H	<p>12. LAGGING DESIGN SHALL CONFORM TO THE PROJECT GEOTECHNICAL REPORT AND CALTRANS "TRENCH & SHORING MANUAL". UNLESS SPECIFICALLY ALLOWED BY THE PROJECT GEOTECHNICAL REPORT, THE SOIL ARCHING REDUCTION FACTOR SHALL NOT BE APPLIED TO THE SURCHARGED LOAD.</p> <p>13. THE USE OF SHEETING PER CALIFORNIA CONSTRUCTION SAFETY ORDERS - ARTICLE 6, EXCAVATION, SECTION 1441.1, APPENDIX D, NOTE (G) USED WITH ALUMINUM HYDRAULIC SHORES IN TYPE C OR UNSTABLE TYPE B SOILS IS NOT PERMITTED UNLESS THE FOLLOWING CONDITIONS ARE MET:</p> <ul style="list-style-type: none">A. THE GEOTECHNICAL ENGINEER OF RECORD HAS PROVIDED SITE SPECIFIC RECOMMENDATIONS FOR DESIGN OF THIS SHORING SYSTEM AND PERMIT THE USE OF THIS SHEETING.B. CALCULATIONS ARE PROVIDED SHOWING ITS INTEGRITY. <p>14. THE USE OF TRENCH SHIELDS AS THE BASIS FOR SUPPORTING SOIL AND ACT AS THE SHORING SYSTEM IS NOT PERMITTED.</p> <p>15. UNLESS APPROVED BY THE GEOTECHNICAL ENGINEER OF RECORD, IF 2-SACK PORTLAND CEMENT SLURRY IS USED AS BACKFILL BELOW THE PROPOSED DEPTH OF EXCAVATION, THEN THE EFFECTIVE WIDTH OF THE FILL FOR THE PURPOSE OF CALCULATING PASSIVE RESISTANCE SHALL BE TAKEN AS THE WIDTH OF THE STEEL BEAM. IF STRUCTURAL CONCRETE IS USED THEN THE EFFECTIVE WIDTH OF THE BEAM FOR THE PURPOSE OF CALCULATING THE PASSIVE RESISTANCE SHALL BE TAKEN AS THE WIDTH OF THE DRILLED HOLE. TO ACCOUNT FOR THE EFFECT OF "PASSIVE ARCHING" THE EFFECTIVE WIDTH IS PERMITTED TO BE DOUBLED WHERE THE BEAMS ARE SPACED A MINIMUM OF 3.5 TIMES THE LAG DIAMETER.</p> <p>16. A POSITIVE CONNECTION SHALL BE PROVIDED AT BOTH ENDS OF STRUTS TO ENSURE THAT A MINIMUM OF 400 LBS LOAD APPLIED AT MID-SPAN, IN ADDITION TO ANY ASSOCIATED DEAD AND LIVE LOAD CAN BE SUSTAINED.</p> <p>17. SHORING SHALL BE SELF-SUPPORTING. IT SHALL NOT RELY ON EXISTING IMPROVEMENTS SUCH AS MAINTENANCE HOLES, BRIDGE ABUTMENTS, OR UNDERGROUND STRUCTURES FOR SUPPORT OR STABILITY, UNLESS OTHERWISE APPROVED BY THE ENGINEER.</p> <p>18. SHORING SYSTEM SHALL COMPLY WITH THE CONTRACT DOCUMENTS AND ALL APPLICABLE LOCAL, STATE, AND FEDERAL REGULATIONS.</p>																
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14. UNLESS A MORE STRINGENT LIMIT IS REQUIRED BY THE PROJECT GEOTECHNICAL ENGINEER OF RECORD, THE **MAXIMUM ALLOWABLE HORIZONTAL DEFLECTION** FOR CANTEVERED SHORING SYSTEMS. LAGGING PANELS SPANNING **MORE THAN 9.5 FEET**, OR **CANTEVERED PORTIONS OF ALL SHORING SYSTEMS SHALL BE 1/2 INCH.**



Temporary Excavation Requirements

PIPES		TEMPORARY EXCAVATION SHORING	
1.	THE REQUIRED PIPES UNDER THIS CONTRACT HAVE BEEN DESIGNED BASED ON FINAL IN-PLACE CONDITIONS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THE REQUIRED PIPES CAN ACCOMMODATE TEMPORARY HANDLING, TRANSPORTATION AND CONSTRUCTION LOADS.	1.	ALL SHORING SHALL BE IN ACCORDANCE WITH SECTION 306-1.1.6 OF THE STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION (SPSPWC), LATEST EDITION AS MODIFIED BY THE CITY OF LOS ANGELES BROWN BOOK, TITLE 8, DIVISION 1, CHAPTER 4, SUBCHAPTER 4 OF THE CALIFORNIA CODE OF REGULATIONS, CALIFORNIA CONSTRUCTION SAFETY ORDERS, THE PROJECT GEOTECHNICAL REPORT, SPECIFICATION 02240, AND THE NOTES HEREIN, WHERE A CONFLICT OCCURS, THE MOST STRINGENT REQUIREMENTS SHALL APPLY.
2.	INCREASE PIPE STRENGTH AS NECESSARY FOR STRESSES INDUCED BY LOADS FROM CONSTRUCTION ACTIVITIES SUCH AS INSTALLATION, BEDDING, GROUTING, JACKING, HANDLING, TRANSPORTATION, ETC.	2.	SHORING PLANS AND CALCULATIONS SHALL BE PREPARED, SEALED AND SIGNED BY A CALIFORNIA REGISTERED CIVIL OR STRUCTURAL ENGINEER FOR REVIEW BY THE ENGINEER AND THE GEOTECHNICAL ENGINEERING GROUP FOR ACCEPTANCE.
3.	ALL PIPE JOINT SYSTEMS SHALL BE CAPABLE OF WITHSTANDING EXTERNAL WATER PRESSURES AS REQUIRED BY THE DESIGN HYDROSTATIC HEAD. WHEN NO HEIGHT IS LISTED, REFER TO THE CONTRACT DOCUMENTS FOR INFORMATION. THE GREATER HEIGHT LISTED SHALL GOVERN. FIELD TEST ALL JOINTS OCCURRING BELOW GROUNDWATER TABLE IN ACCORDANCE WITH ASTM C1103 (PRECAST CONCRETE PIPE), OR APPROVED EQUAL.	3.	CONFIGURATION AND/OR TYPE OF SHORING SHALL MITIGATE CONDITIONS WHERE THE STABILITY OF THE ADJACENT CITY RIGHT-OF-WAY AND OR UTILITIES MAY BE COMPROMISED, DISTURBED OR UNDERMINED.
4.	JOINTS:	4.	LOADING USED FOR SHORING DESIGN SHALL CONFORM WITH RELATED REQUIREMENTS OF THE CONTRACT DOCUMENTS.
a.	TYPE FOR RCP: "STEEL RING TONGUE & GROOVE" OR "FLUSH STEEL COUPLER" GASKETED WITH O-RING.	5.	SHORING SHALL CONFORM TO THE LATEST REFERENCE STANDARDS TO THE MATERIAL BEING CONSIDERED AS LISTED IN THE LATEST LOS ANGELES BUILDING CODE, INCLUDING REFERENCED DOCUMENTS FOR THE DESIGN OF STEEL (AISC) AND TIMBER (NDS).
b.	TYPE FOR OTHERS: AS SHOWN ON CONTRACT DOCUMENTS OR AS APPROVED BY THE ENGINEER.	6.	SHORING SUBMITTAL SHALL INCLUDE PLAN VIEWS, TRANSVERSE AND LONGITUDINAL SECTION VIEWS, THE EXISTING AND PROPOSED GRIDES, AND ANY OTHER DETAILS NEEDED FOR CLARIFICATION.
c.	PRIOR TO PIPE FABRICATION, SUBMIT JOINT DETAILS, LISTING NORMAL, CLOSURE GAP WIDTH, INCLUDING MAXIMUM WIDTH FOR PULLED JOINT. MAXIMUM GAP WIDTH SHALL CONFORM TO THE LIMITS OF THE DEPARTMENT OF PUBLIC WORKS "BROWN BOOK", LATEST EDITION.	7.	SYSTEMS OF EXCAVATION NECESSARY TO ERECT SHORING, INCLUDING ANCHOR RODS OR A TIEBACK LIMITS, SHALL NOT ENCRUSCH ONTO PRIVATE PROPERTY FOR WHICH NO EASEMENT IS AVAILABLE.
d.	CONDUCT FIELD TESTING OF PIPELINE IN ACCORDANCE WITH SSPWC SECTION 306-1.4 (NOT APPLICABLE TO SPLINE PIPES).	8.	WIDTH OF TRENCH SHALL NOT EXCEED THE DESIGN LIMITS FOR THE PIPE, IF ANY, BEING INSTALLED, NOR THE LIMITS SET PER CITY OF LOS ANGELES STD PLAN S-251.
e.	SEE CIVIL DRAWINGS FOR ADDITIONAL REQUIREMENTS.	9.	PROPOSED SIZE OF SHORED AREA SHALL BE OF SUFFICIENT SIZE TO CONSTRUCT AND/OR ERECT STRUCTURE, ALLOW FOR FORM PLACEMENT, ETC.
f.	ALL PIPE JOINT SYSTEMS AND JOINT QUALIFICATION TEST REQUIREMENTS SHALL BE IN CONFORMANCE WITH THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS (SSPWC) AND MANUFACTURER'S RECOMMENDATION.	10.	DISTANCE OF SHORING FROM EXISTING UTILITIES OR IMPROVEMENTS SHALL BE SUFFICIENT TO AVOID DAMAGE, DISRUPTION OR IMPOSE ADDITIONAL LOAD. AS A MINIMUM, MAINTAIN A CLEAR DISTANCE OF 3 X DRILLED HOLE DIAMETER, BUT NOT LESS THAN 3 FEET. A GREATER DISTANCE MAY BE REQUIRED ADJACENT TO DEEPLY EMBEDDED UTILITIES OR WHERE UTILITY/SUBSTRUCTURE LOCATION IS NOT ACCURATELY KNOWN.
g.	APPLY APPROVED CORROSION INHIBITOR TO EXPOSED SURFACE OF STEEL RINGS WHEN USED.	11.	SHORING SUBMITTAL SHALL INCLUDE CONSTRUCTION PROCEDURES FOR SHORING INSTALLATION AND REMOVAL, UNLESS SPECIFICALLY PERMITTED TO REMAIN IN A PLACE AT A PARTICULAR LOCATION PER THE CONTRACT DOCUMENTS. CONTRACTOR SHALL ADHERE TO REQUIREMENTS PER BUREAU OF ENGINEERING SPECIAL ORDER 03-0201, DATED FEBRUARY 16, 2000, WHERE SPECIAL ORDER REQUIREMENTS CONFLICT WITH THE CONTRACT DOCUMENTS, THE MORE STRINGENT SHALL APPLY.
5.	RCP JOINT QUALIFICATION TEST:		
a.	PRIOR TO PIPE FABRICATION, SUBMIT TEST REPORTS THAT DEMONSTRATE JOINT INTEGRITY FROM APPROVED TEST LABORATORY USING FULLY ASSEMBLED JOINTS.		
b.	TEST JOINTS PER ASTM C-443 FOR RCP.		
6.	PIPE CONNECTION AT STRUCTURES:		
a.	PROVIDE CONNECTOR PIPE WITH FLEXIBLE JOINT AT ALL STRUCTURES. LENGTH SHALL BE NO LESS THAN 18 INCHES NOR GREATER THAN 30 INCHES, UNLESS OTHERWISE SPECIFIED ABOVE FOR JOINTS REQUIRED TO SUSTAIN A DESIGN HYDROSTATIC HEIGHT.		
b.	RCP: USE INTEGRALLY CAST BELL-END OR SPOOT-END COUPLINGS WITH FLEXIBLE JOINTS APPROVED BY THE ENGINEER. APPROVED FORMER VERSIONS MAY ALSO BE CONSIDERED.		
c.	VCP: SEE STANDARD PLANS FOR TYPICAL CONDITIONS, UNLESS OTHERWISE SPECIFIED.		
7.	USE OF TRENCH SHIELDS AS THE BASIS FOR SUPPORTING SOIL AND ACT AS THE SHORING SYSTEM IS NOT PERMITTED.		
8.	UNLESS APPROVED BY THE GEOTECHNICAL ENGINEER OF RECORD, IF 2-SACK PORTLAND CEMENT SLURRY IS USED AS BACKFILL BELOW THE PROPOSED DEPTH OF EXCAVATION, THEN THE EFFECTIVE WIDTH OF THE PILE FOR THE PURPOSE OF CALCULATING PASSIVE RESISTANCE SHALL BE TAKEN AS THE WIDTH OF THE STEEL BEAM. IF STRUCTURAL CONCRETE IS USED THEN THE EFFECTIVE WIDTH OF THE BEAM FOR THE PURPOSE OF CALCULATING THE PASSIVE RESISTANCE SHALL BE TAKEN AS THE WIDTH OF THE DRILLED HOLE. TO ACCOUNT FOR THE EFFECT OF "PASSIVE ANCHORING" THE EFFECTIVE WIDTH IS PERMITTED TO BE DOUBLED WHERE THE BEAMS ARE SPACED A MINIMUM OF 2.5 TIMES THE DRILLED DIAMETER.		
9.	A POSITIVE CONNECTION SHALL BE PROVIDED AT BOTH ENDS OF STRUTS TO ENSURE THAT A MINIMUM OF 400 LBS LOAD APPLIED AT MID-SPAN, IN ADDITION TO ANY ASSOCIATED DEAD AND LIVE LOAD CAN BE SUSTAINED.		
10.	SHORING SHALL BE SELF-SUPPORTING. IT SHALL NOT RELY ON EXISTING IMPROVEMENTS SUCH AS MAINTENANCE HOLES, BRIDGE ABUTMENTS, OR UNDERGROUND STRUCTURES FOR SUPPORT OR STABILITY, UNLESS OTHERWISE APPROVED BY THE ENGINEER.		
11.	SHORING SYSTEM SHALL COMPLY WITH THE CONTRACT DOCUMENTS AND ALL APPLICABLE LOCAL, STATE, AND FEDERAL REGULATIONS.		
12.	TESTING DATA SHALL BE FOR THE PARTICULAR PIPE BEING PROVIDED AND NOT ARCHIVED DATA UP TO 24 MONTHS OLD. IT SHALL BE SUBMITTED AS A FORMAL DOCUMENT WITH RESULTS FROM EACH TEST ON A SEPARATE SHEET(S), INCLUDE LABORATORY INFORMATION ALONG WITH THE SIGNED STATEMENT OF CERTIFICATION FROM AUTHORIZED INSPECTOR THAT WITNESSED THE TESTS. PROVIDE CONTACT INFORMATION OF THIRD PARTY INSPECTOR WHEN ONE IS USED.		
13.	RESULTS FROM PARALLEL PLATE TEST PER D2412 MAY BE USED TO FULFILL ITEM 02, "INITIAL FLEXURAL MODULUS (E700)", OF THE TESTING DATA REQUIREMENTS OF 207-20, 207-22 PER THE BROWN BOOK. REPORT AT 5% DEFLECTION.		
14.	RESULTS FROM BARCOL IMPRESSOR PER D2583 MAY BE USED TO FULFILL ITEM (4), "IMPACT STRENGTH (ASTM D258) OR SHORE D HARDNESS (ASTM D2240)", OF THE TESTING DATA REQUIREMENTS OF 207-20, 207-22 PER THE BROWN BOOK.		
15.	RESULTS FROM HOOP & AXIAL COMPRESSION TESTING IN ACCORDANCE WITH D069.		



Bureau of Engineering

2. Loading: Design and construct shoring to withstand all soil and hydrostatic loading that might occur during the various stages of construction and for any surcharging loading caused by equipment loads, loads from material or soil stockpiles and earthquake-induced loads.
 - a. Determine the soil, surcharge, and hydrostatic loading, but in no case shall the loading be less than the earth and minimum equipment surcharge pressures.
 - b. Determine the proper load distributions caused by such activities and assure that those conditions are not exceeded in the field during construction.
 - c. Design the shoring for lateral earth and water pressures and surcharge loads that could result from construction methods and dewatering activities.
 - d. Consider sequence of excavation and placement as well as their removal of the lateral support elements in design of shoring.
3. Allowable deflection: Maximum deflection of any portion of the shoring system is 0.5 inch. The maximum allowable deflection, where there are no structures, utilities, or other improvements that may be impacted by

2. Loading: Design and construct shoring to withstand all soil and hydrostatic loading that might occur during the various stages of construction and for any surcharging loading caused by equipment loads, loads from material or soil stockpiles and earthquake-induced loads.

1.6 DE

A. Shop Drawings with supporting calculations for the various excavation support systems shall be prepared in accordance with the following criteria:

1. Design the excavation support systems in "dry" or "wet" conditions and other requirements as described in Section 01573.
2. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads, as well as jacking and pushing loads, in such manner as will allow the safe and expeditious construction of the permanent structures, to minimize ground movement or settlement, and to prevent damage to or movement of adjacent buildings, structures, roadways and utilities. Use the recommended design parameters in the Geotechnical Design Memorandum attached to the Reference Document.
3. Design support members to resist the maximum loads expected to occur during the excavation, use, and support removal stages.

Job Specifications

City of Los Angeles

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2. Loading: Design and construct shoring to withstand all soil and hydrostatic loading that might occur during the various stages of construction and for any surcharging loading caused by equipment loads, loads from material or soil stockpiles and earthquake-induced loads.
 - a. Determine the soil, surcharge, and hydrostatic loading, but in no case shall the loading be less than the earth and minimum equipment surcharge pressures.
 - b. Determine the proper load distributions caused by such activities and assure that those conditions are not exceeded in the field during construction.
 - c. Design the shoring for lateral earth and water pressures and surcharge loads that could result from construction methods and dewatering activities.
 - d. Consider sequence of excavation and placement as well as their removal of the lateral support elements in design of shoring.
3. Allowable deflection: Maximum deflection of any portion of the shoring system is 0.5 inch. The maximum allowable deflection, where there are no structures, utilities, or other improvements that may be impacted by the movement of shoring elements, may be increased up to one inch with

3. The design, planning, installation, and removal of all shoring shall be accomplished in such a manner as to maintain stability of the required excavation or trench section and to prevent any movement of soil that may cause damage to adjacent structures and utilities, damage or delay the work, or endanger life and health.

and utilities, and the installation of adequate supports for all excavations shall be the sole responsibility of the Contractor.

3. The design, planning, installation, and removal of all shoring shall be accomplished in such a manner as to maintain stability of the required excavation or trench section and to prevent any movement of soil that may cause damage to adjacent structures and utilities, damage or delay the work, or endanger life and health.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02310 Earthwork.
- B. Section 03300 Cast-in-Place Concrete

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[08/21/2015]

SHEETING, SHORING AND BRACING SYSTEMS
DIVISION 2
02240-2

UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



- A. Shop Drawings with supporting calculations for the various excavation support systems shall be prepared in accordance with the following criteria:
1. Design the excavation support systems in "dry" or "wet" conditions and other requirements as described in Section 01573.
 2. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads, as well as jacking and pushing loads, in such manner as will allow the safe and expeditious construction of the permanent structures, to minimize ground movement or settlement, and to prevent damage to or movement of adjacent buildings, structures, roadways and utilities. Use the recommended design parameters in the Geotechnical Design Memorandum attached to the Reference Document.
 3. Design support members to resist the maximum loads expected to occur during the excavation, use, and support removal stages.

4. Contractor's Engineer prepared computations of load demands used in conjunction with engineered stamped Tabulated Data sheets shall be site specific – sole submission of Tabulated Data is insufficient. Supporting calculations of Tabulated Data sheets shall be made available upon request by the ENGINEER.

8. No portion of the excavation shall be unsupported in Type C soils or in Type B soils having the characteristics of Type C.
9. Utilize a minimum factor of safety of 1.3 against bottom instability or heave, 1.5 against buckling for invert plugs, and 1.5 against piping.
10. Review of the CONTRACTOR's Shop Drawings and methods of construction by the ENGINEER does not relieve the CONTRACTOR of responsibility for the adequacy of the excavation support systems.
11. Use of sheet piling may not be acceptable in the vicinity of existing sewer or other fragile utilities and is subject to review and approval by the Engineer. Use vibration free installation technologies only.
12. No portion of the excavation support system's vertical face will be permitted to penetrate the design lines as indicated on the Drawings for the permanent concrete structure to be constructed within the excavation.

Bureau of Engineering



1.6 DESIGN CRITERIA

A. Shop Drawings with supporting calculations for the various excavation support systems shall be prepared in accordance with the following criteria:

1. Design the excavation support systems in "dry" or "wet" conditions and other requirements as described in Section 01573.
2. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads, as well as jacking and pushing loads, in such manner as will allow the safe and expeditious construction of the permanent structures, to minimize ground movement or settlement, and to prevent damage to or movement of adjacent buildings, structures, roadways and utilities. Use the recommended design parameters in the Geotechnical Design Memorandum attached to the Reference Document.
3. Design support members to resist the maximum loads expected to occur during the excavation, use, and support removal stages.
4. Contractor's Engineer prepared computations of load demands used in conjunction with engineered stamped Tabulated Data sheets shall be site specific – sole submission of Tabulated Data is insufficient. Supporting calculations of Tabulated Data sheets shall be made available upon request.

8. No portion of the excavation shall be unsupported in Type C soils or in Type B soils having the characteristics of Type C.

6. Pothole all affected utilities per Sections 01711 and 01732 in near vicinity of the proposed excavation prior to submitting the shoring layout and design.
7. Maximum vertical center-to-center spacing of supports shall be 8 feet.
8. No portion of the excavation shall be unsupported in Type C soils or in Type B soils having the characteristics of Type C.
9. Utilize a minimum factor of safety of 1.3 against bottom instability or heave, 1.5 against buckling for invert plugs, and 1.5 against piping.
10. Review of the CONTRACTOR's Shop Drawings and methods of construction by the ENGINEER does not relieve the CONTRACTOR of responsibility for the adequacy of the excavation support systems.
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3. Design support members to resist the maximum loads expected to occur during the excavation, use, and support removal stages.
4. Contractor's Engineer prepared computations of load demands used in conjunction with engineered stamped Tabulated Data sheets shall be site

11. Use of sheet piling may not be acceptable in the vicinity of existing sewer or other fragile utilities and is subject to review and approval by the Engineer. Use vibration free installation technologies only.

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9. Utilize a minimum factor of safety of 1.3 against bottom instability or heave, 1.5 against buckling for invert plugs, and 1.5 against piping.
10. Review of the CONTRACTOR's Shop Drawings and methods of construction by the ENGINEER does not relieve the CONTRACTOR of responsibility for the adequacy of the excavation support systems.
11. Use of sheet piling may not be acceptable in the vicinity of existing sewer or other fragile utilities and is subject to review and approval by the Engineer. Use vibration free installation technologies only.
12. No portion of the excavation support system's vertical face will be permitted to penetrate the design lines as indicated on the Drawings for the permanent concrete structure to be constructed within the excavation.

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PART 2 — EXECUTION

2.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until detrimental conditions are corrected.
- B. Existing Utilities: Contract Drawings show major utilities, but all utilities may not be shown. The Contractor will obtain all as-built records of existing utilities from local government authorities or Utility Companies and field check locations of utilities with representatives of the Utility Company. Protect and provide utility trench support to any sewer, water, gas, electric or other pipelines or conduits uncovered during work from damage.
 - 1. Excavate by hand or other excavation methods acceptable to the utility owner.
 - 2. If existing utilities interfere with Contractor's proposed method of support

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A. Shop Drawings with supporting calculations for the various excavation support systems shall be prepared in accordance with the following criteria:

1. Design the excavation support systems in "dry" or "wet" conditions and other requirements as described in Section 01573.
2. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads, as well as jacking and pushing loads, in such manner as will allow the safe and expeditious construction of the permanent structures, to minimize ground movement or settlement, and to prevent damage to or movement of adjacent buildings, structures, roadways and utilities. Use the recommended design parameters in the Geotechnical Design Memorandum attached to the Reference Document.
3. Design support members to resist the maximum loads expected to occur during the excavation, use, and support removal stages.
4. Contractor's Engineer prepared computations of load demands used in conjunction with engineered stamped Tabulated Data sheets shall be site specific – sole submission of Tabulated Data is insufficient. Supporting calculations of Tabulated Data sheets shall be made available upon request by the ENGINEER.

15. No trench box or shield systems will be permitted.

6. Pothole all affected utilities per Sections 01711 and 01732 in near vicinity of the proposed excavation prior to submitting the shoring layout and design.
7. Maximum vertical center-to-center spacing of supports shall be 8 feet.
8. No portion of the excavation shall be unsupported in Type C soils or in Type B soils having the characteristics of Type C.
9. Utilize a minimum factor of safety of 1.3 against bottom instability or heave, 1.5 against buckling for invert plugs, and 1.5 against piping.
10. Review of the CONTRACTOR's Shop Drawings and methods of construction by the ENGINEER does not relieve the CONTRACTOR of responsibility for the adequacy of the excavation support systems.
11. Use of sheet piling may not be acceptable in the vicinity of existing sewer or other fragile utilities and is subject to review and approval by the Engineer. Use vibration free installation technologies only.
12. No portion of the excavation support system's vertical face will be permitted to penetrate the design lines as indicated on the Drawings for the permanent concrete structure to be constructed within the excavation.

Bureau of Engineering



- A. Shoring shall be designed to be gradually removed as necessary to allow backfill to be placed and compacted. All voids existing behind the shoring which remains in place shall be backfilled with structural concrete as specified in Section 02310 - EARTHWORK.
- B. Shoring shall be removed as backfilling progresses. Removal shall be conducted in such a manner to avoid any damage to, **adjacent facilities**, or to other members of the shoring system. Impact loading **in members of the shoring system** will not be allowed. All wood forms, loose or casual wood and debris shall be removed. Areas that cannot be accessed or achieve adequate compaction shall be backfilled with structural backfill without additional cost to the City.

- C. During backfilling, temporary support elements shall not be removed until

- A. Shoring shall be designed to be gradually removed as necessary to allow backfill to be placed and compacted. All voids existing behind the shoring which remains in place shall be backfilled with structural concrete as specified in Section 02310 - EARTHWORK.

- C. During backfilling, temporary support elements shall not be removed until alternative support is available, such as substituted struts, backfill, or ability of the support system to act as a cantilever without detrimental deflection.

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PART 2 — EXECUTION

2.1 Preparation

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

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- 1. **Do not close or obstruct streets,** walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

DESIGN DATA

DESIGN CODES:

ACI 318-14, ACI 350-06 (MODIFIED)
ANSI / AISC 14TH EDITION
AASHTO LRFD WITH CALTRANS AMENDMENTS (LOADS ONLY)
WITH REVISIONS & MODIFICATIONS PER STRUCTURAL ENGINEERING

SOILS DESIGN PARAMETERS:

1. ALLOW VERTICAL BEARING PRESSURE 2,500 PSF
2. ALLOW LATERAL PASSIVE PRESSURE 250 PSF
3. ANGLE OF INTERNAL FRICTION 33 DEG
4. COEFFICIENT OF FRICTION 0.4
5. SOIL MODULUS 2,500 PSF
6. POISSON'S RATIO 0.35
7. RADIAL AND TANGENTIAL SPRING STIFFNESS FOR USE IN FEM MODELING SHALL BE PER THE ENGINEERING MANUAL, "TUNNELS AND SHAFTS IN ROCK" BY THE U.S. ARMY CORPS OF ENGINEERS, DATED MAY 30, 1997 OR APPROVED ALTERNATE

REINFORCED CONCRETE DESIGN:

ULTIMATE STRENGTH DESIGN
CONCRETE $f_c = 4,000$ PSI
STEEL REINFORCEMENT $f_y = 60,000$ PSI

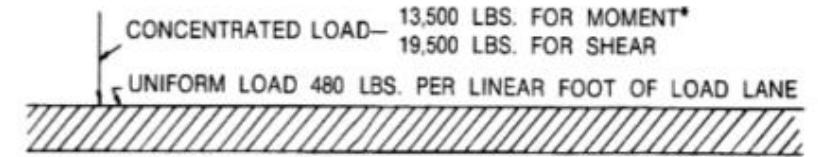
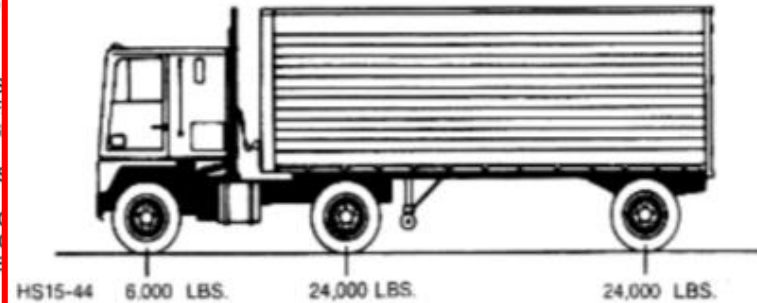
DESIGN LOADS:

1. STRUCTURE LOADS - VERTICAL:
 - a. DEAD LOADS CALCULATED
 - b. LIVE LOADS W/ VEHICULAR TRAFFIC HL-93

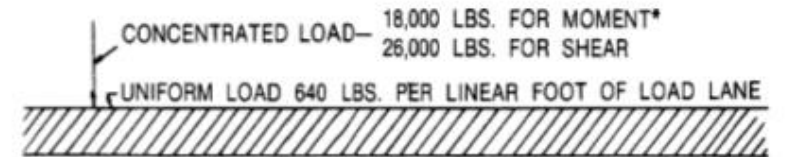
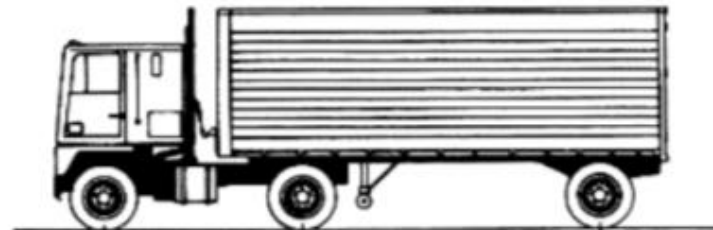
b. LIVE LOADS W/ VEHICULAR TRAFFIC

- c. INTERNAL HYDROSTATIC PRESSURE 62.4 PSF
3. 48" SEMI-ELLIPTICAL (BURNS MCDONNELL) CONCRETE PIPE REHABILITATION (REHAB SYSTEM DESIGNED FOR LOAD SHARING APPROACH)
 - a. DEPTH OF EARTH COVER (FT), H VARIES
 - b. VERTICAL LOAD
 - i. DEAD LOAD, D CALCULATED
 - ii. SOIL LOAD, V $1.3H \times (F_1 + F_2)$
 - iii. VERTICAL SCALE FACTOR, FV 1.32
 - c. LATERAL LOAD
 - i. SOIL LOAD (UNIFORM), L1 $0.35V$ (PSF)
 - ii. SOIL LOAD (UNIFORM), L2 $0.44V$ (PSF)
 - iii. HORIZONTAL SCALE FACTOR, FH 1.42
 - d. LOAD COMBINATIONS
 - i. $[D + (V + L1)] \times RF$
 - ii. $[D + (V + L2)] \times RF$
 - e. REDUCTION FACTOR (RF)
 - i. SLIPLINE RMPM LINER 0.38
 - ii. OTHERS CALCULATED

HS TRUCK AND LANE LOADING

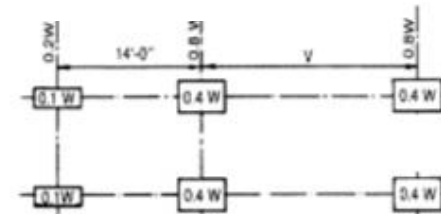


HS15-44 LOADING



HS20-44 LOADING

HS20-44



W = COMBINED WEIGHT ON THE FIRST TWO AXLES WHICH IS THE SAME AS FOR THE CORRESPONDING H TRUCK.
V = VARIABLE SPACING — 14 FEET TO 30 FEET INCLUSIVE. SPACING TO BE USED IS THAT WHICH PRODUCES MAXIMUM STRESSES.

The Limiters: Job Specifications

- Support All Adjacent Areas At All Times
- Do Not Encroach Onto Private Property
- Stay At Least 3' From Existing Utilities With Augered Holes
- No Interlocking Sheeting Vibrated Into Place
- No Other Vibration Producing-Installation/Removal Systems
- Withstand All Earthen and Hydrostatic Loads
- Withstand Load Imposed by Spoil, Equipment, and Earthquake
- Withstand All Potential Construction Loads
- No Movement Of Soil At Any Time During Installation/Removal

- Tabulated Data Alone Are Not Sufficient
- Staged Shoring Removal for Incremental Backfill
- Allow for Future Construction - No Permanent TRS
- Allow for Crossing Utilities
- Support Crossing Or Exposed Utilities
- Excavate By Hand/Soft Excavation Near Utilities
- No Shielding Permitted
- Street Closure Not Permitted
- Allow for Vehicular Traffic Loads
- No Unsupported Type C Soil

**Contractor is free to select means and methods,
as long as they conform to plans / specifications**

Protective System Options

- ~~OSHA-Provided Options~~
 - ~~Sloping/Benching, Timber, Aluminum Hydraulic~~
- ~~Manufactured Systems~~
 - ~~Trench Shields, Conventional Slide Rail~~
- Site Specific Designs
 - ~~Driven Sheet piling, Secant Pile~~
 - ~~Beam/Lagging, Beam/Plate~~



The Solution



SHEETING GUIDE MANUFACTURER'S TABULATED DATA

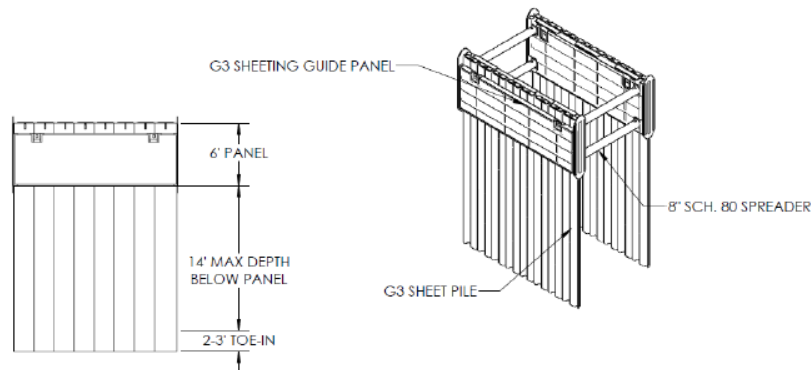


SOIL TYPE	EFP	MAXIMUM DEPTH (FT)	IDEAL SHEET TOE-IN (FT)	MIN. SHEET TOE-IN (FT)	MAX. DEPTH BELOW PANEL (FT)
A	25	20	3	2	14
B	45	20	3	2	14
C	60	20	3	2	14
C	80	20	3	2	14

****Note:** Toe-In is the distance the sheet pile is driven into the soil at the bottom of the excavation.
Reference Figure 1.0 for terminology and parameters.

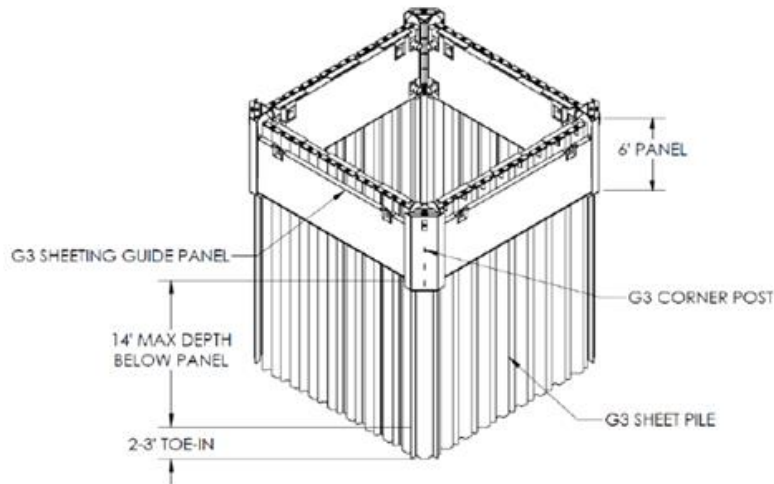
MODEL	SPREADER SIZE	SPREADER PIN DIAM. (IN.)	SPREADER PIN STRENGTH (KSI)	MAX SPREADER LENGTH (FT)
CSR-SG3-0612	8" SCH. 80	2	90	20
CSR-SG3-0616	8" SCH. 80	2	90	20
CSR-SG3-0620	8" SCH. 80	2	90	20
CSR-SG3-0624	8" SCH. 80	2	90	20

FIG. 1.0 (Linear Application)



- Manufactured System
- Tabulated Data
- Dig and Push System
- Uses Non-Interlocking Sheeting
- Work Around Utilities

FIG. 1.1 (4-Sided Pit Application)

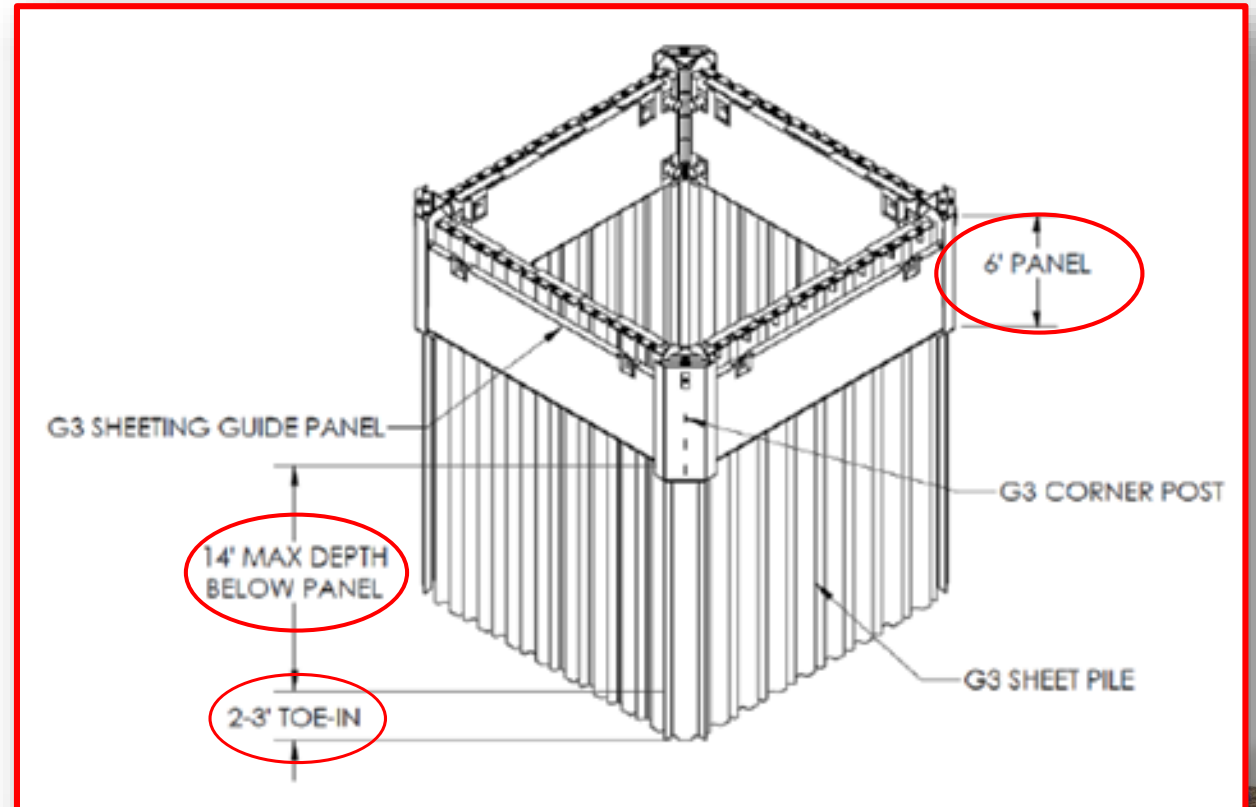
**GENERAL NOTES:**

1. Excavation depths shall be a maximum of 20 feet deep
2. The bottom of the excavation shall be no greater than 14 feet below the bottom of the sheeting guide panels.
3. Use only G3 sheet piling furnished by Vestek Manufacturing
4. This tabulated data sheet is valid for models CSR-0SG3-0612, CSR-SG3-0616, CSR-SG3-0620, and CSR-SG3-0624

CONDITIONS FOR USE OF SHEETING GUIDE

5. Excavate the trench 4 feet deep before placing the Sheeting Guide. Excavate under the Sheeting Guide and push (DO NOT POUND) the bottom of the Sheeting Guide down to a maximum of 6 feet
6. Panels longer than 24' require a tie-back system furnished by Vestek Manufacturing.
7. Place the Sheet Piling into the Sheeting Guide and drive the bottom of the Sheet Piling a minimum of 2-3 feet into the bottom of the excavation.
8. The bottom of the Sheet Piling shall always be a minimum of 2 feet into the bottom of the excavation.
9. When the Sheet Piling is placed directly above a crossing utility, sheet piling must be secured over crossing utility.
10. The Vestek Sheeting Guide System is not intended to provide stability to adjacent buildings or other structures.
11. Sheeting Guide models CSR-SG3-0612, CSR-SG3-0616, CSR-SG3-0620, and CSR-SG3-0624 can be used in a linear application using 8" sch. 80 spreader pipe. 2 inch diameter pins with strength of 90 ksi shall be placed in all spreader to collar connections. Any spreader pins used on this shielding system that do not meet the required diameter specified above will invalidate and void this data
12. The spreader is a compression member and plays the most critical role for the integrity of the shield system. To prevent member buckling failure, any type of lateral load should not be applied to the spreaders
13. All sheeting guide panels can be used in a pit application by connecting each end to a corner post furnished by Vestek Manufacturing.
14. Any applications that exceed the allowed parameters will void this tabulated data.
15. Modifications of any kind to this Sheeting Guide not specifically allowed by Vestek Manufacturing, LLC. in writing will void this data.

Sheeting Guide





SHEETING GUIDE MANUFACTURER'S TABULATED DATA

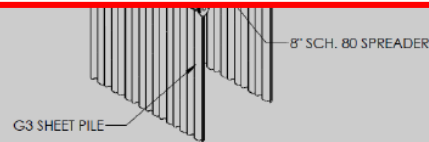
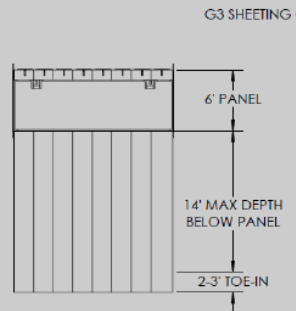


SOIL TYPE	EFP	MAXIMUM DEPTH (FT)	IDEAL SHEET TOE-IN (FT)	MIN. SHEET TOE-IN (FT)	MAX. DEPTH BELOW PANEL (FT)
A	25	20	3	2	14
B	45	20	3	2	14
C	60	20	3	2	14
C	80	20	3	2	14

****Note:** Toe-In is the distance the sheet pile is driven into the soil.
Reference Figure 1.0 for terminology and panel dimensions.

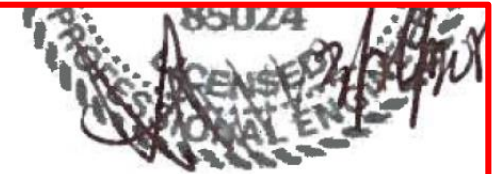
MODEL	SPREADER SIZE	SPI
CSR-SG3-0612	8" SCH. 80	D
CSR-SG3-0616	8" SCH. 80	D
CSR-SG3-0620	8" SCH. 80	D
CSR-SG3-0624	8" SCH. 80	D

FIG. 1.0 (Linear Application)



SHEETING GUIDE MANUFACTURER'S TABULATED DATA

SOIL TYPE	EFP	MAXIMUM DEPTH (FT)	IDEAL SHEET TOE-IN (FT)	MIN. SHEET TOE-IN (FT)	MAX. DEPTH BELOW PANEL (FT)
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C	60	20	3	2	14
C	80	20	3	2	14



Sheeting Guide



16. This Tabulated Data has been prepared by a Registered Professional Engineer as required to comply with the OSHA standard 29 CFR Part 1926, Subpart P.
 17. Sheeting Guide Systems must be used in a manner consistent with safe working procedures, Federal, State, and Local regulations.
 18. A "competent person", who has been trained in the proper use of Sheeting Guide Systems, safe excavation practices, and soil classification methods, must direct and control the use of this sheeting guide system.
 19. The "competent person" must be knowledgeable and capable of complying with all Federal, State, and Local laws and ordinances.
 20. No surcharge load is considered in the tabulated maximum panel capacity and depth rating. Surcharge loads occur due to heavy equipment, vibrations, or soil piles adjacent to the trench where adjacent is defined as within a distance equal to the depth of the trench. State and Local Regulations and Previsions shall be followed for surcharge loading application.
 21. Maximum depths are based on Sheeting Guide being in structurally sound condition. This Sheeting Guide should be inspected prior to each use for damage or deterioration. If a sheeting guide has sustained major structural damage or permanent deformation of a structural member or connection, the Tabulated Data is void until repairs are made as specified by a Registered Professional Engineer.
 22. The use of Vestek Manufacturing, LLC Sheeting Guide shall be in accordance with this tabulated data and all requirements of the OSHA standard. Sheeting Guide usage other than specified or required may create unsafe conditions that could cause a cave – in, structural failure, or collapse resulting in a disabling injury or even death. Vestek Manufacturing, LLC shall not be liable for shield usage other than specified. Use of this Sheeting Guide not in accordance with Manufacturer's Tabulation Data could cause injury or death.
- 03.07.01R – Page 1 of 1

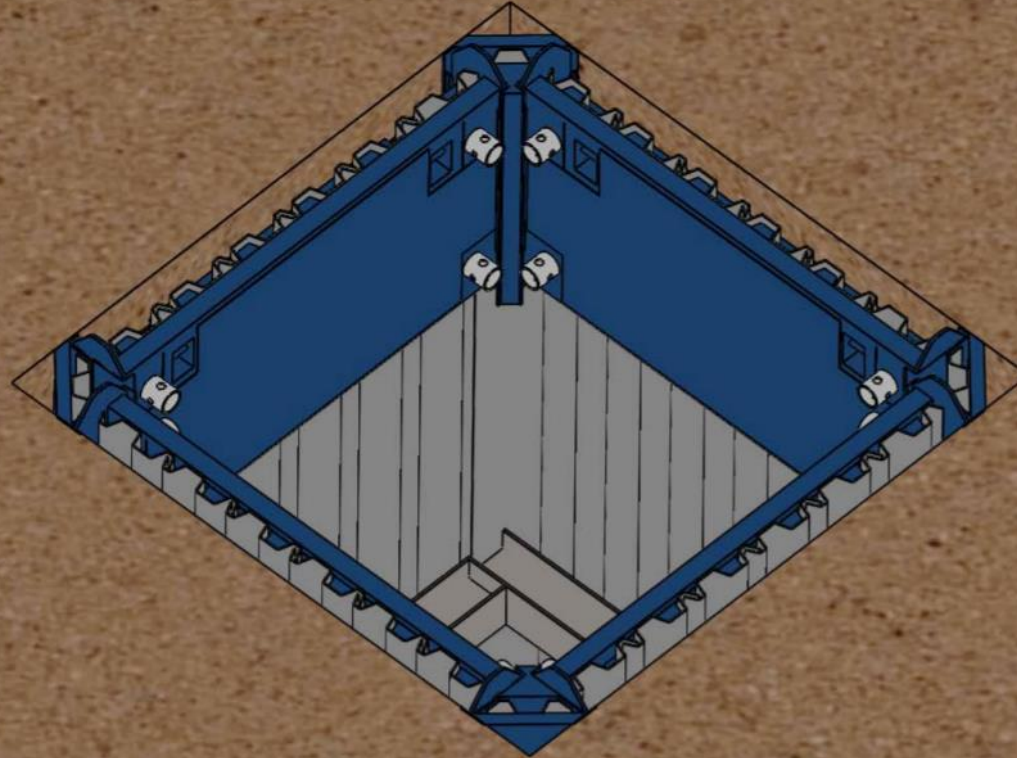
Vestek Manufacturing, LLC
 7600 S. Santa Fe Dr. Bldg. B-West
 Houston, TX 77061
 Phone: 713-242-7700



Sheeting Guide

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6. ALL STEEL (INCLUDING MANUFACTURER ASSEMBLIES) SHALL BE IN GOOD CONDITION AND FREE OF ANY DAMAGE, HOLES OR VISUAL DEFECTS. STRUCTURAL STEEL SHAPES TO BE ASTM A992 OR A572 GR. 50, MIN Fy = 50 KSI. STEEL PIPE TO BE ASTM A53 GR. B, MIN Fy = 35 KSI. UNLESS OTHERWISE NOTED, ALL TIMBER LAGGING SHALL BE ROUGH-CUT WITH MIN Fd = 850 PSI. FOR ALL OTHER MODULAR COMPONENTS, REFER TO MANUFACTURER'S TABULATED DATA OR PRODUCT TECHNICAL INFORMATION.
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16. ALL WELDING SHALL BE DONE BY A CERTIFIED WELDER IN ACCORDANCE WITH THE LATEST EDITION OF AWS D1.1. ALL WELD ELECTRODES TO BE E70XX LOW HYDROGEN.
17. EDGE OF EXCAVATION IS TO ADJ. EXISTING ASPHALT ROAD. CONTRACTOR IS TO PROVIDE SUITABLE TRAFFIC BARRIERS IN ORDER TO KEEP LIVE HS20-44 VEHICULAR TRAFFIC A MINIMUM OF 5' AWAY FROM EDGE OF EXCAVATION.

ISOMETRIC PLAN VIEW

SCALE: 3/8" = 1'-0" (1:32)



DRAWING NUMBER		REVISION
EGR191406A		9/16/2019
DRAWN	CHECKED	
WAT	JIG	
SHEET	DATE	
1 of 8	9/12/2019	

TITLE:
SHORING DESIGN PLAN

PROJECT:
**NORTH OUTFALL SEWER NOS
REHABILITATION UNIT 13 - SEWER
LINE REHABILITATION**
PROJECT LOCATION:
LOS ANGELES, CA

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SETBACK TABLE

CRANE TO 30 TON MAX	X= 7'
CAT 325 EXCAVATOR	X= 6'
CAT 345 EXCAVATOR	X= 10'
CAT 375 EXCAVATOR	X= 12'
3 CY LOADER	X= 4'
5 CY LOADER	X= 6'
DUMP TRUCK	X= 5'
SPOIL PILE (6' TALL)	X= 4'
CONCRETE TRUCK	X= 10'
RAILROAD TRACK	X= 100'
EXISTING STRUCTURES	X= 25'
HS20-44 VEHICULAR TRAFFIC	X= SEE NOTE #17

SEAL:

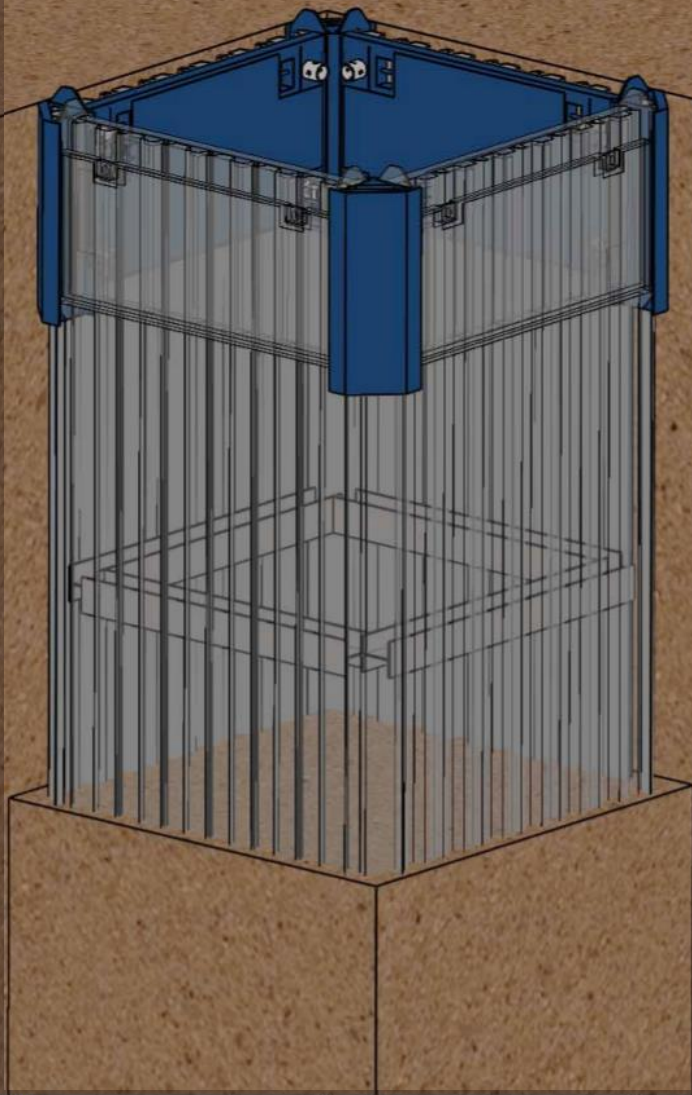


NOTE: AT NO TIME SHALL THE SHORING SYSTEM BE CONNECTED TO OR RELY ON ANY EXISTING UTILITIES/ STRUCTURES FOR SUPPORT.

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SETBACK TABLE	
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SEAL:



ISOMETRIC SECTION VIEW-PHASE I
SCALE: 1/4" = 1'-0" (1:48)



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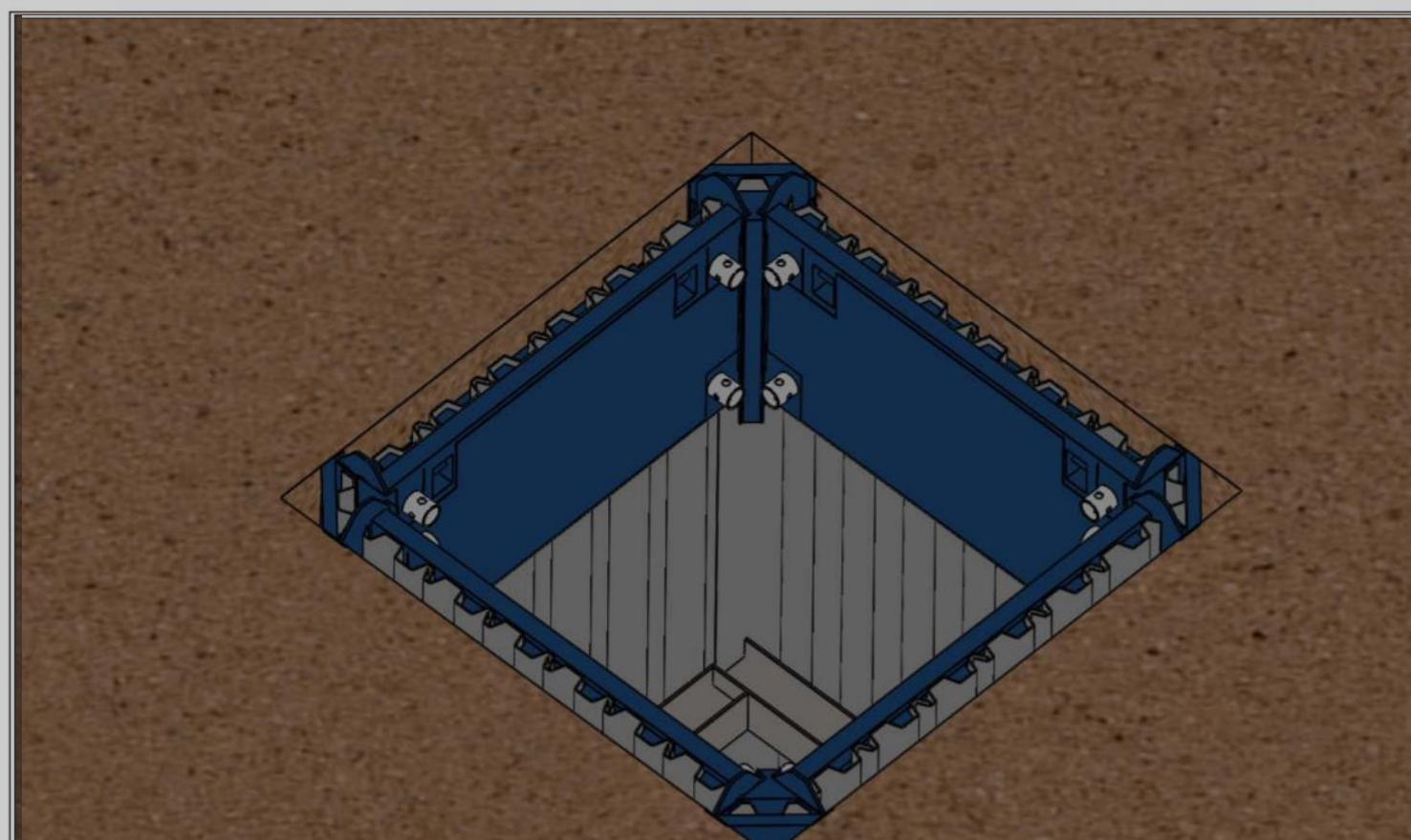
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ISOMETRIC PLAN VIEW
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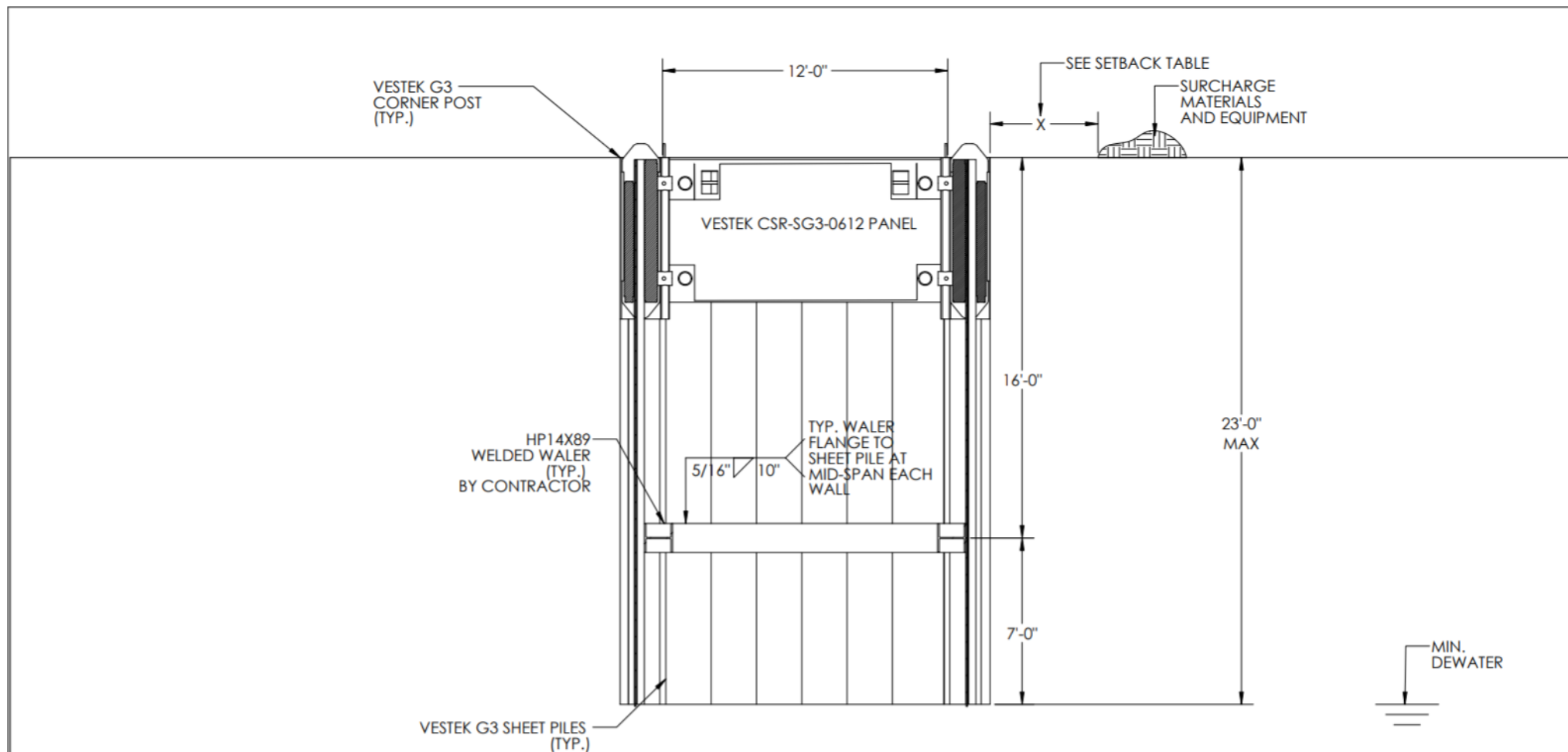
TITLE:
SHORING DESIGN PLAN

PROJECT:
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REHABILITATION UNIT 13 - SEWER
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PROJECT LOCATION:
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SHORING DESCRIPTION	X=
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RAILROAD TRACK	X= 100'
EXISTING STRUCTURES	X= 25'
HS20-44 VEHICULAR TRAFFIC	X= SEE NOTE #17





SECTION-A-A-VIEW-PHASE I

SCALE: 1/4" = 1'-0" (1:48)



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Los Angeles, California

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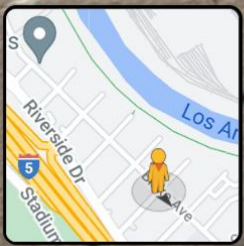


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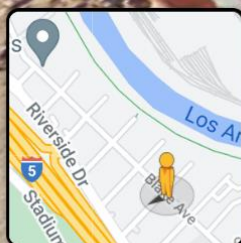




1529 Blake Ave
Los Angeles, California



Street View

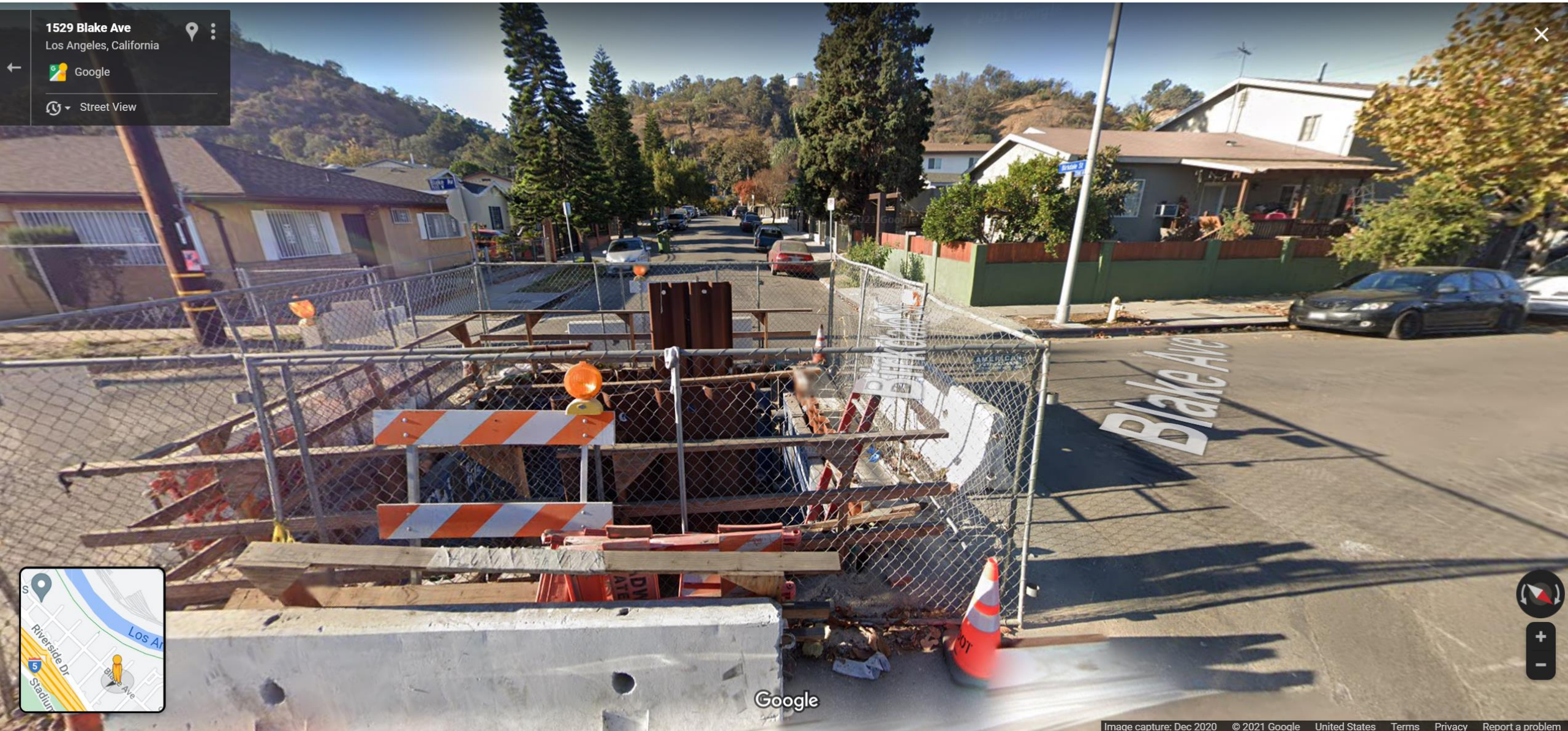


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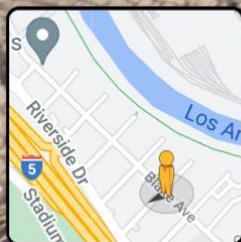




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Questions?