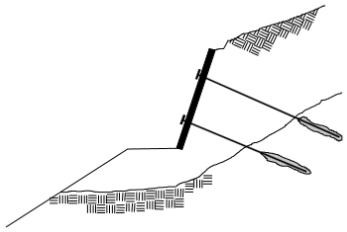
# Managing Risk In Ground Construction: Differing Site Conditions, Implied Warranties & Lessons Learned The Hardway

## Ground Construction Course @ UC Berkeley
## Professor Dimitrios Zekkos


## by Andre Hawks, PhD, PE, A/C57/HAZ
### MS GeoEngineering 2009 – Jane Lewis Fellowship



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**CA DBE Certification #46897**
**CA SBE & SBE Public Works Certification #2016781**
**CA General Engineering Contractor, HAZ, C57 Licenses CSLB #1062689**

# Agenda

1. My Background and Design Experience
2. 07-327604 Azusa Project Background & Our Scope
3. Understanding & Putting A Price To The Geologic Risk Of The Project
4. Actual Ground Conditions Encountered & The Contractual Issues @ Hand
5. Implied Warranty Issues Encountered
6. Personal Advice & Conclusions

# Andre Hawks Background

**Wine Cave In Napa Valley 2000**

***Learned how to read ground behavior early on like Gen-Hua Shi Professor Goodman's PhD Student and Terzaghi by being underground***

**Work History ( 25 years in June 2025 )**

1. Started as a laborer building wine caves
2. Project Engineer intern for Kiewit Pacific & Pankow Builders while at Cal Poly
3. Staff Engineer @ Jacobs Associates in San Francisco and Brierley Associates in Denver
4. Project Manager, Estimator, & Engineer for Drill Tech Drilling & Shoring Inc
5. Geotechnical/Structural Specialist at Christensen Associates for Dam projects
6. Principal & Founder of my own firm since 2015
7. Want to emulate Professor Gerwick/Brekke

**Professional Registrations**

1. CA PE in CA 14+ Yrs + TX PE/NCEES Record
2. Cal OSHA certified Gas Tester & Safety Rep
3. Future CA GE & CA SE Stamp

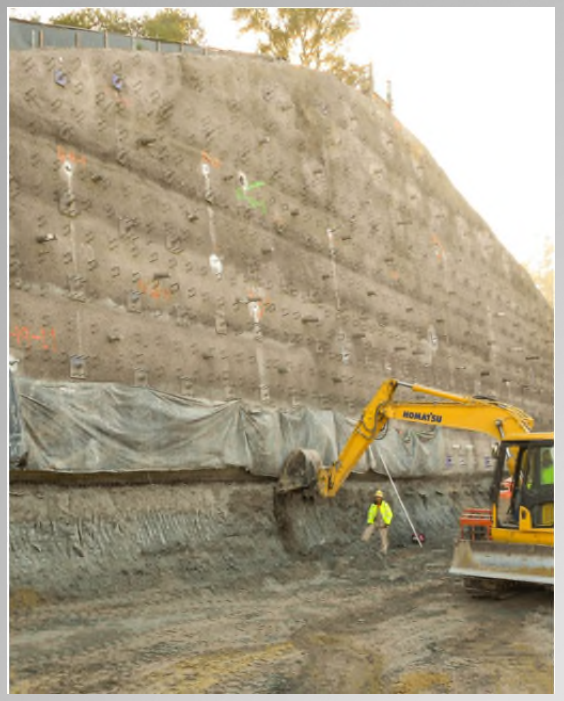
**Educational Background**

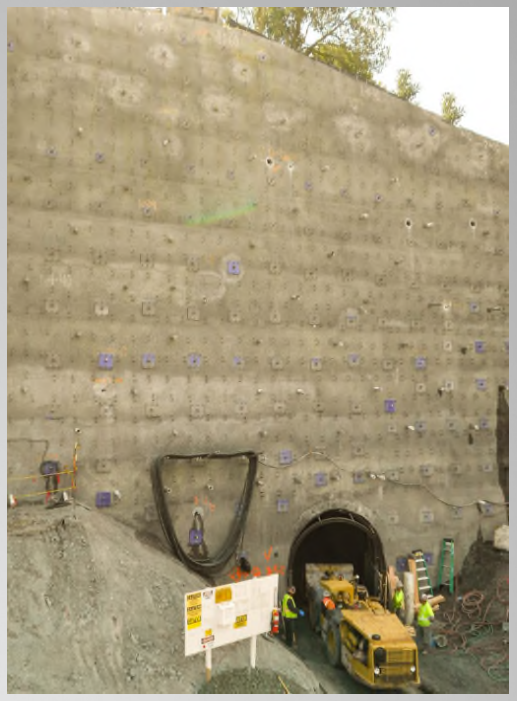
1. BS Civil Engineering Cal Poly San Luis Obispo 2007
2. MS GeoEngineering UC Berkeley 2009 + Accepted to the SEMM MS Program as well
3. Geological Engineering PhD Missouri S&T 2021

# My Design Experience

1. Structural Engineering (Masonry, Wood, Concrete, & Steel design)
2. Tunnel & Shaft Engineering (Wine Caves, Underground Parking structures, Access Shafts)
3. Geotechnical Engineering (Soils Reports, Grading Inspections, Geotechnical Characterization)
4. Special Inspections (Sheer Walls, Tie-downs, Drilled Piers, Shotcrete Placement, etc)
5. Shoring & Retaining Walls (Soldier Pile & Wood Lagging, Tiebacks, Soil Nail Walls, Cantilevered Cast-in-Place Walls)
6. Foundation Systems (Micropiles, Drilled Piers, Push Piers, Helical Anchors, Underpinning, etc)

# SFPUC Harry Tracy Water Treatment Plant



<u>Scope of Work</u>

1. Grouted Bars & Shotcrete
2. Micropiles
3. Tunnels
4. Shoring Pit

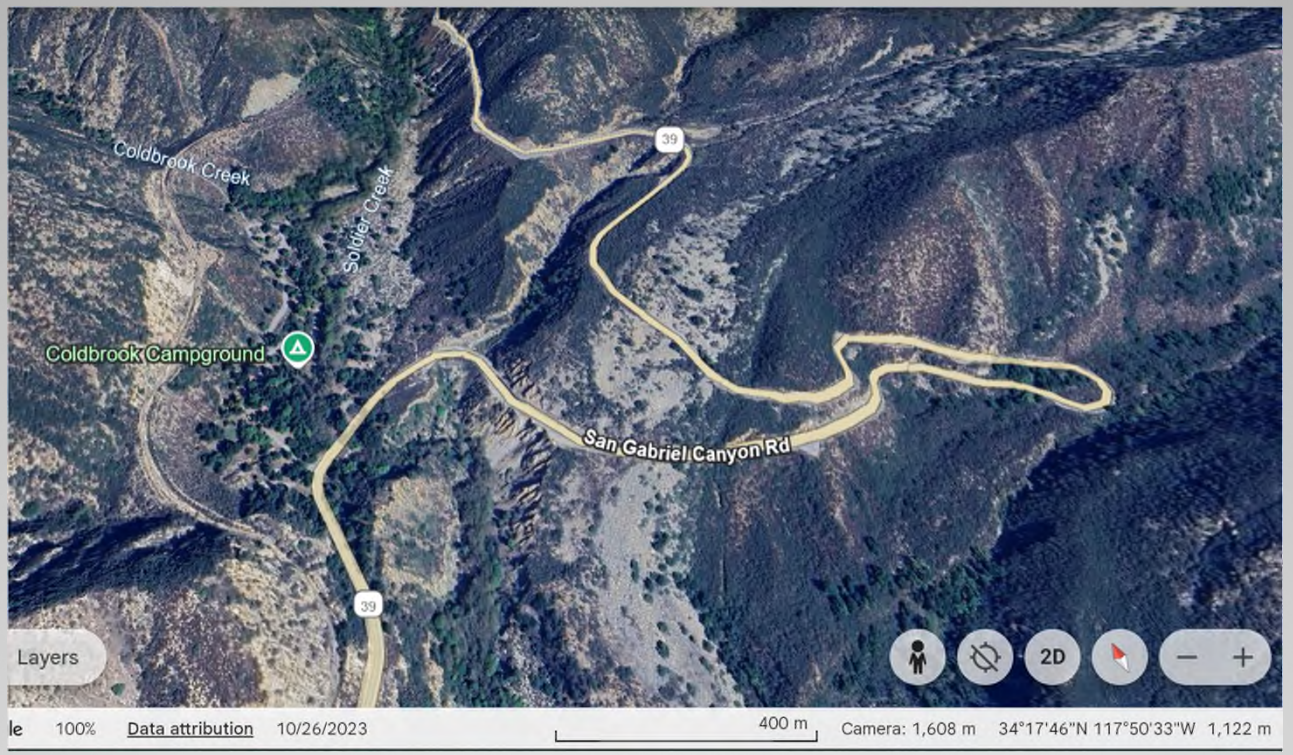
# SFPUC Bay Division Pipelines 3 & 4

**Scope of Work**

1. **Secant Piles**

Project Video: https://www.youtube.com/watch?v=s3m-2kUkD9U

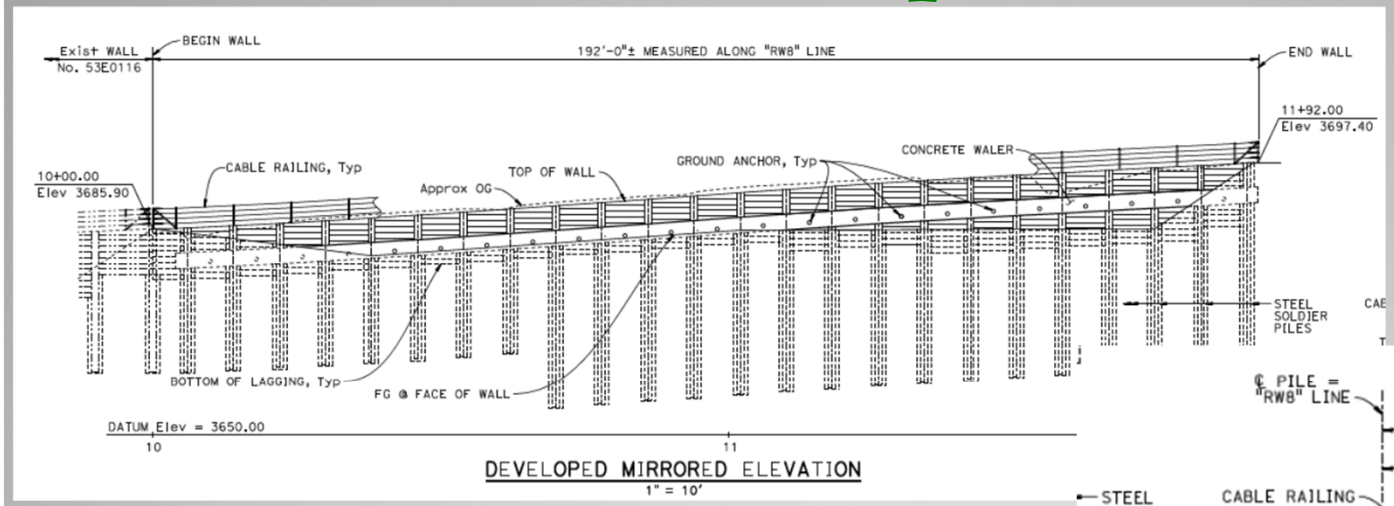
# 07-327604 Caltrans Project Azusa, CA




**Scope of Work**

1. 3 Soldier Pile Walls with Timber Lagging w/Ground Anchors
2. Guardrail replacement to increase vehicular safety
3. $5,981,239 Project won by Bosco Constructors, Inc of Chadsworth, CA
4. Single Dispute Resolution Advisor project due to contract size vs three members of a Dispute Resolution Board => Risk

# Our Scope of Work




DEVELOPED MIRRORED ELEVATION
1" = 10'

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

**DBE CONFIRMATION**

OBEO-0007 (REV 09/2017)

CONTRACT NO.
07-327604

NAME OF DBE BUSINESS
Geostructural Engineering Inc

NAME OF DBE REPRESENTATIVE

DBE CERTIFICATION NUMBER
46897

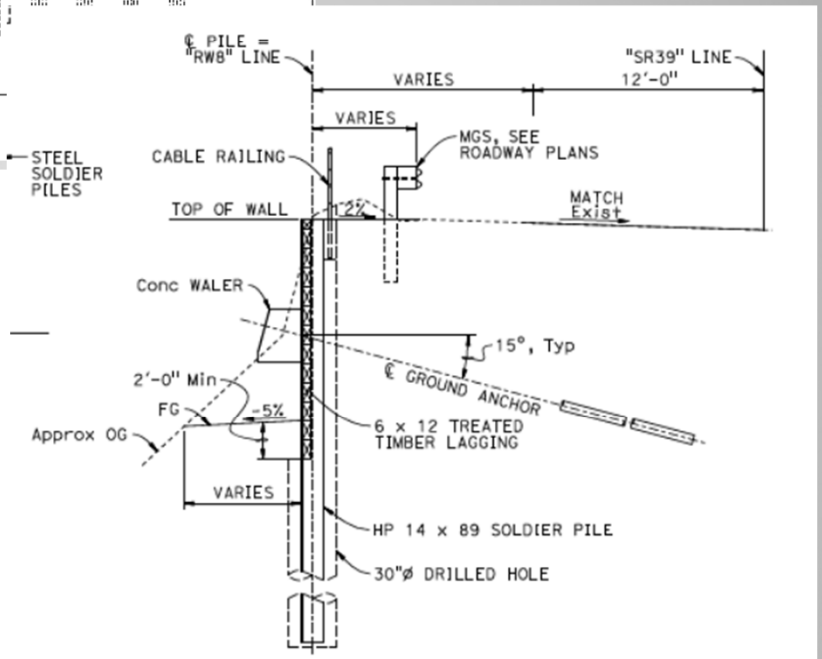
NAME OF BIDDER
Bosco Constructors, Inc.

NAME OF PRIME CONTRACTOR IF DIFFERENT FROM THE BIDDER
Same

NAME OF REPRESENTATIVE OF BIDDER OR CONTRACTOR
Patrick Robinson

DATE
1/12/2022

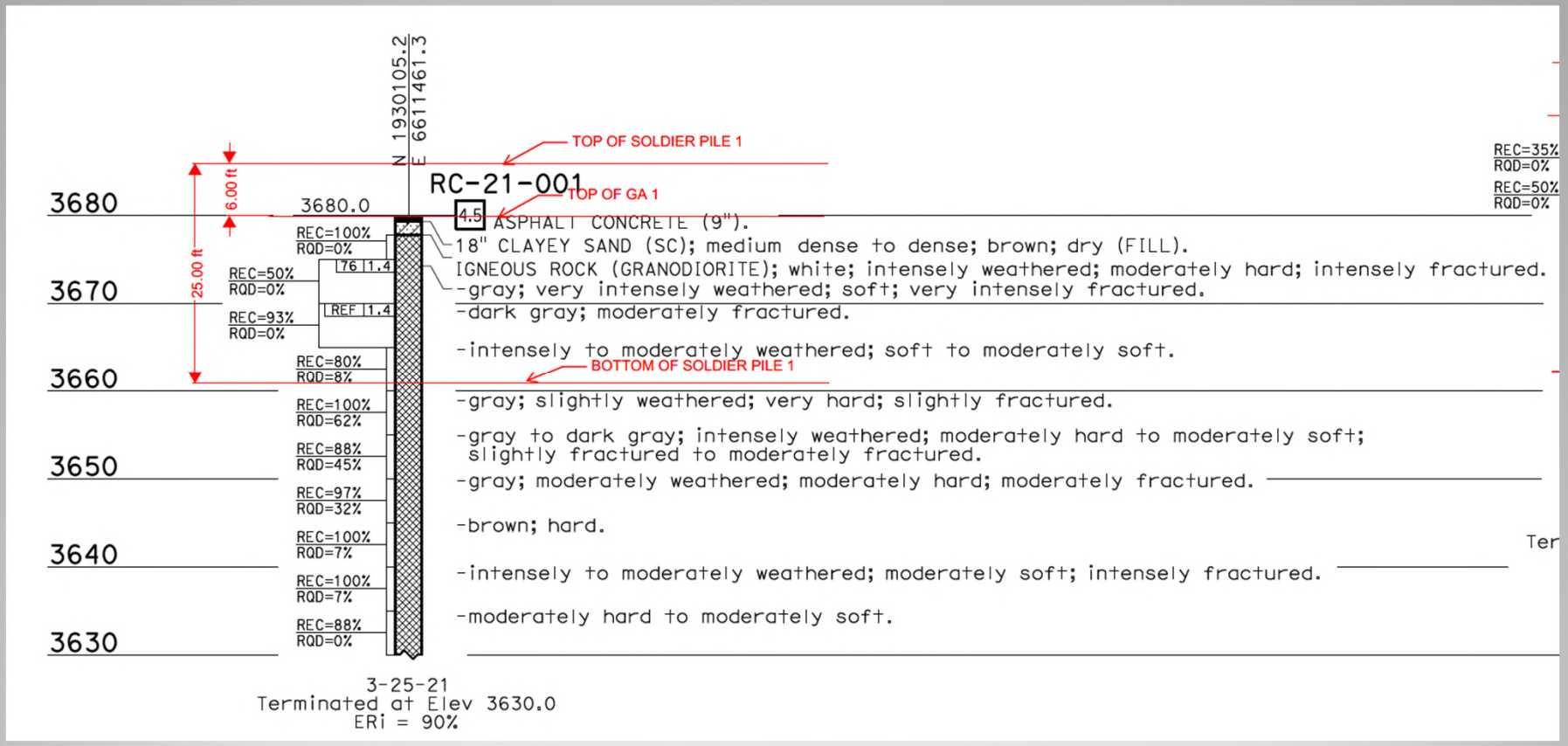
| Bid item number | Item of work and description of services to be subcontracted or materials to be provided[1] | Amount ($) |
|---|---|---|
| 43 | GROUND ANCHOR (SUBHORIZONTAL) | 504,774.0 |
| 45 | 30" DRILLED HOLE | 425,232.0 |
| 72 - 1 | MOBILIZATION - Soldier piles | 57,000.0 |
| 72 - 2 | MOBILIZATION - Ground Anchors | 62,000.0 |




TYPICAL SECTION
¼" = 1'-0"

QUANTITIES

# Geologic Interpretation aka "Risk"




**Always evaluate the factual data then look at the interpretative data Geotechnical Data Report before the Geotechnical Baseline Report**

# Geologic Interpretation aka "Risk"


**Always go look at the soil/rock core boxes + Walk The Site**

# Managing The "Risk" With Interpretation/Characterization

PROJECT SOLDIER PILE WALLS 8,9,20 NEAR AZUZA, CA
CONTRACT NO. 07-327604

| BORING ID | RC-21-001 | | RC-21-002 | | RC-21-003 | | RC-21-004 | | RC-20-001 | | RC-20-002 | | RC-20-003 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOP OF BORING ELEV | 3680.0 | | 3699.8 | | 3750.4 | | 3758.0 | | 4479.2 | | 4495.1 | | 4490.0 | |
| DEPTH TO ROCK | 2.0 | | 11.5 | | 2.2 | | 2.1 | | 10.1 | | 5.0 | | 11.9 | |
| | RQD | REC | RQD | REC | RQD | REC | RQD | REC | RQD | REC | RQD | REC | RQD | REC |
| SAMPLE 1 | 0% | 100% | 0% | 35% | 0% | 78% | 0% | 45% | 7% | 48% | 53% | 85% | 18% | 53% |
| SAMPLE 2 | 0% | 50% | 0% | 50% | 0% | 94% | 0% | 82% | 0% | 18% | 90% | 100% | 0% | 40% |
| SAMPLE 3 | 0% | 93% | 0% | 88% | 62% | 92% | 0% | 75% | 0% | 32% | 0% | 50% | 0% | 48% |
| SAMPLE 4 | 8% | 80% | 0% | 80% | 0% | 53% | 0% | 100% | 7% | 25% | 7% | 25% | 0% | 3% |
| SAMPLE 5 | 62% | 100% | 8% | 77% | 0% | 90% | 0% | 93% | 0% | 45% | 25% | 96% | 0% | 100% |
| SAMPLE 6 | 45% | 88% | 33% | 65% | 0% | 67% | 0% | 50% | 0% | 22% | 0% | 75% | 25% | 69% |
| SAMPLE 7 | 32% | 97% | 13% | 93% | 0% | 72% | 0% | 97% | | | 0% | 30% | 8% | 50% |
| SAMPLE 8 | 7% | 100% | 0% | 87% | 0% | 27% | 0% | 87% | | | 13% | 68% | 0% | 65% |
| SAMPLE 9 | 7% | 100% | | | 0% | 120% | 0% | 50% | | | | | 14% | 70% |
| SAMPLE 10 | 0% | 88% | | | 0% | 80% | 0% | 87% | | | | | 0% | 48% |
| SAMPLE 11 | | | | | 0% | 93% | 0% | 40% | | | | | 0% | 30% |
| SAMPLE 12 | | | | | 0% | 93% | 0% | 87% | | | | | 0% | 20% |
| SAMPLE 13 | | | | | 0% | 85% | 0% | 40% | | | | | 13% | 60% |
| SAMPLE 14 | | | | | | | 0% | 70% | | | | | 20% | 83% |
| SAMPLE 15 | | | | | | | 0% | 50% | | | | | 11% | 33% |
| SAMPLE 16 | | | | | | | 0% | 100% | | | | | | |
| SAMPLE 17 | | | | | | | 0% | 100% | | | | | | |
| TERMINATION ELEVATION | 3630.0 | | 3649.8 | | 3700.4 | | 3708.0 | | 4439.2 | | 4455.1 | | 4412.0 | |

## RQD/UCS vs Drilling Rate

# Putting A Cost To The "Risk"

07-327604
07-LA-39-32
01/12/22

CONTRACT PROPOSAL OF LOW BIDDER

BID211
PAGE 19
01/13/22

| ITEM NO. | ITEM CODE | ITEM DESCRIPTION | UNIT OF MEASURE | ESTIMATED QUANTITY | BID | AMOUNT |
|---|---|---|---|---|---|---|
| 34 | 205035 | WOOD MULCH | CY | 9 | 150.00 | 1,350.00 |
| 35 | 210350 | FIBER ROLLS | LF | 35 | 30.00 | 1,050.00 |
| 36 | 280015 | LEAN CONCRETE BASE RAPID SETTING | CY | 41 | 600.00 | 24,600.00 |
| 37 | 390132 | HOT MIX ASPHALT (TYPE A) | TON | 230 | 200.00 | 46,000.00 |
| 38 | 394073 | PLACE HOT MIX ASPHALT DIKE (TYPE A) | LF | 6,000 | 15.00 | 90,000.00 |
| 39 | 394074 | PLACE HOT MIX ASPHALT DIKE (TYPE C) | LF | 1,230 | 15.00 | 18,450.00 |
| 40 | 397005 | TACK COAT | TON | 0.1 | 1,500.00 | 150.00 |
| 41 | 398000 | REMOVE ASPHALT CONCRETE PAVEMENT (CY) | CY | 27 | 200.00 | 5,400.00 |
| 42 | 398100 | REMOVE ASPHALT CONCRETE DIKE | LF | 7,170 | 12.00 | 86,040.00 |
| 43 | 460210 | GROUND ANCHOR (SUBHORIZONTAL) | EA | 87 | 6,021.00 | 523,827.00 |
| 44 | 047975 | STEEL SOLDIER PILE (HP 14 X 89) | LF | 3,019 | 120.00 | 362,280.00 |
| 45 | 490403 | 30" DRILLED HOLE | LF | 2,953 | 155.00 | 457,715.00 |
| 46 (F) | 047976 | STRUCTURAL CONCRETE, WALER | CY | 150 | 1,000.00 | 150,000.00 |
| 47 (F) | 047977 | BAR REINFORCING STEEL (WALER) | LB | 39,069 | 3.00 | 117,207.00 |
| 48 (F) | 575004 | TIMBER LAGGING | MFBM | 43 | 3,500.00 | 150,500.00 |

07-327604
07-LA-39-32
01/12/22

SUMMARY OF REMAINING BIDDERS

| ITEM | SECOND BID | SECOND AMOUNT | THIRD BID | THIRD AMOUNT | FOURTH BID | FOURTH AMOUNT |
|---|---|---|---|---|---|---|
| 40 | 30,000.00 | 3000.00 | 10,500.00 | 1050.00 | 2,000.00 | 200.00 |
| 41 | 1,700.00 | 45900.00 | 210.00 | 5670.00 | 288.00 | 7776.00 |
| 42 | 6.40 | 45888.00 | 15.75 | 112927.50 | 11.50 | 82455.00 |
| 43 | 5,100.00 | 443700.00 | 6,300.00 | 548100.00 | 5,835.00 | 507645.00 |
| 44 | 95.00 | 286805.00 | 173.25 | 523041.75 | 154.00 | 464926.00 |
| 45 | 165.00 | 487245.00 | 172.00 | 507916.00 | 169.00 | 499057.00 |
| 46 | 1,800.00 | 270000.00 | 2,100.00 | 315000.00 | 3,079.00 | 461850.00 |
| 47 | 2.30 | 89858.70 | 2.63 | 102751.47 | 2.25 | 87905.25 |

**2 Piles Per Shift via a Lodrill – Long Reach Lower Torque**

**Rock Auger and Core Barrell As Needed For Tooling no Cluster Hammer needed**

# Cluster Hammer vs Rock Augers

https://www.youtube.com
/watch?v=BPJO2vg-o2Y

https://www.youtube.co
m/shorts/tfGu2TwqhSM

# The Issue We Encountered

**Gun Barrel Encountered**

1. Solid Rock not Weathered Fractured Rock as per LOTBs
2. Bid the job for 2 piles per day and was getting 1-2 piles per week
3. In Ground Construction costs are huge ranging in $16,000++ per day
4. Mark Ups in the 20 to 35 percent rage
5. Takes very little extra days to eat up your profit

# Contractual Issues At Hand

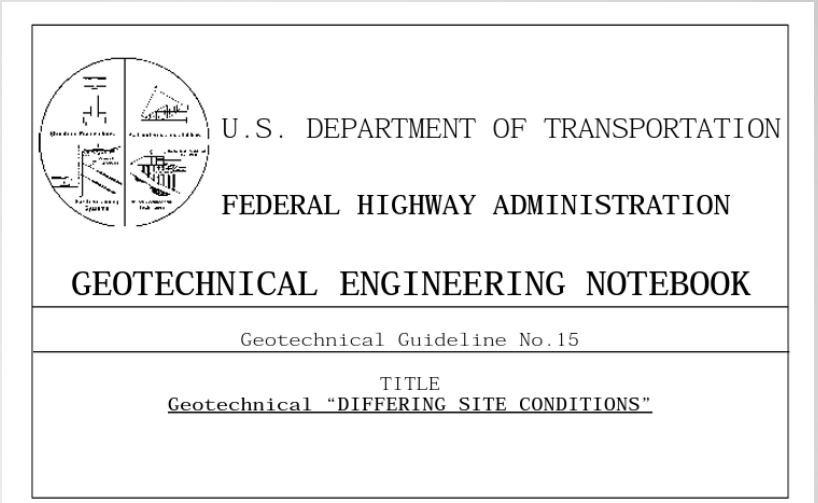
**Geotechnical Information Presented/Site Conditions Encountered**

1. Interpretive VS Factual Information Presented
2. Materially Different Material Encountered

**Implied Warranty**

1. Caltrans is responsible for workable specifications and drawings

**Federal-Aid Project**
**ACSTG-S039(015)E**


U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

GEOTECHNICAL ENGINEERING NOTEBOOK

Geotechnical Guideline No.15

TITLE
Geotechnical "DIFFERING SITE CONDITIONS"

# FHWA Geotechnical Guideline 15: Interpretive vs Factual

**Notes for Specifications**

1. The contractor should be made aware that construction of the soldier pile walls will encounter bedrock. Excavation and coring of the hard to very hard granitic bedrock is expected to be difficult.

**VS**

**Table 5. Design Soil Parameters for Location 20 at Route 39, PM R36.6**

| Boring ID | Approx. Elevation (ft) | Soil Profile | Approximate Engineering Properties |
|---|---|---|---|
| RC-20-001 | 4478.40 – 4469.15 | Well-graded Gravel with Sand (GW) | ϕ =32°, c=0 psf |
| | 4469.15 – 4449.15 | IGNEOUS ROCK (intensely weathered Granite); well-graded Gravel with Sand (GW) | ϕ =34°, c=0 psf |
| | 4449.15 – 4439.15 | IGNEOUS ROCK (intensely weathered Granite); well-graded SAND with Gravel (SW) | |
| RC-20-002 | 4494.38 – 4490.05 | Well-graded SAND (SW) | ϕ =32°, c=0 psf |
| | 4490.05 – 4475.05 | IGNEOUS ROCK (Moderately weathered Granite | ϕ =34°, c=0 psf |

**Notes for Constructions**

1. The boring data indicates the rock behind the construction area will be generally difficult to excavate due to hardness and/or degree of fracturing. There are some relatively soft zones where drilling might be easier. For estimating excavation conditions, refer to the LOTBs. Also, it would be advisable to make an appointment to view the rock core boxes that are located at the California Transportation District 7 Office, located at 100 S Main St, Los Angeles, CA 90012.

**Laboratory Testing Program**

During the March 2020 and December 2020 field investigations, soil samples were collected from borings RC-20-001, RC-20-002, and RC-20-003 for soil classification. No laboratory test was performed for this project.

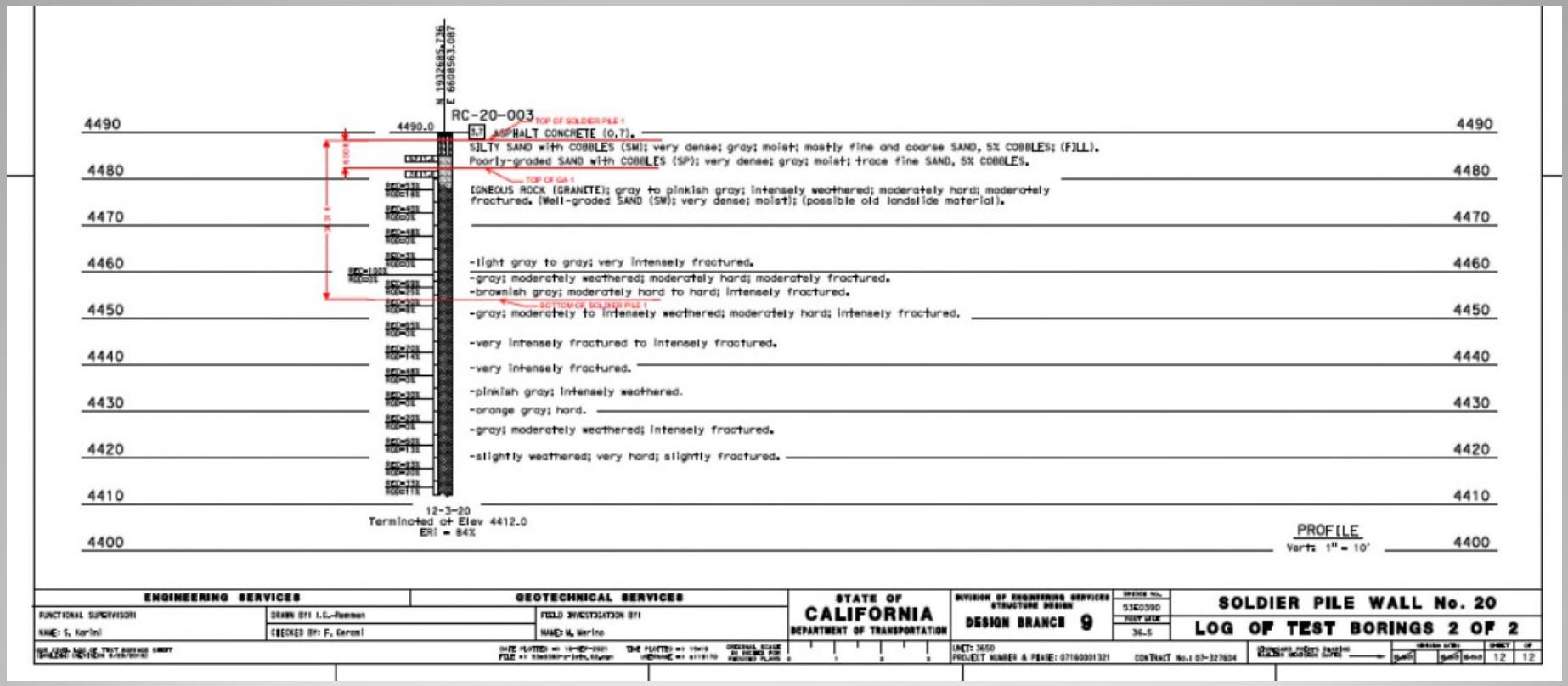
**Table 5. Design Soil Parameters for Location 8 at Route 39, PM R34.13**

| Layer No. | Approx. Layer Boundaries (ft) | Group Name | Friction Angle (degree) | Unit Weight (pcf) |
|---|---|---|---|---|
| 1 | Elev. 3679 to 3630 | Igneous Rock | 40 | 130 |

**Table 6. Design Soil Parameters for Location 8 at Route 39, PM R34.20**

| Layer No. | Approx. Layer Boundaries (ft) | Group Name | Friction Angle (degree) | Unit Weight (pcf) |
|---|---|---|---|---|
| 1 | Elev. 3699 to 3688 | Silty Sand (SM) | 30 | 120 |
| 2 | Elev. 3688 to 3650 | Igneous Rock Weathered and FR-fractured | 40 | 130 |

# Sample LOTB – RC-20-003




**LOTBs are in the drawing package with higher contractual precedence vs the Foundation Report.**

**LOTBs show *fractured and weathered rock and low RQD Values* consistent with the Engineer's use of "Soil Properties" in the Foundation Report for design**

# Rock Hardness Descriptors in LOTBs – Tooling Selection

| Wall | Pile Depth | LOTB | Hardness Descriptors (feet per Rotary Core) s | ms | mh | h | vh | |
|---|---|---|---|---|---|---|---|---|
| 8 | | RC21-1 | 15 | 5 | | | 5 | |
| | 25 ft | | 15 | 5 | 0 | 0 | 5 | ft |
| | | RC21-2 | 10 | 5 | | 5 | 5 | |
| | | | | 5 | | 5 | | |
| | 35 ft | | 10 | 10 | 0 | 10 | 5 | ft |
| Wall | | | s | ms | mh | h | vh | |
| 9 | | RC21-3 | 2 | | 5 | 3 | | |
| | | | | | | 17 | | |
| | 27 ft | | 2 | 0 | 5 | 20 | 0 | ft |
| | | RC21-4 | | | 15 | 22 | | |
| | 37 ft | | 0 | 0 | 15 | 22 | 0 | ft |
| Wall | | | s | ms | mh | h | vh | |
| 20 | | RC20-1 | 10 | | 5 | | | |
| | | | | | | 19 | | |
| | 34 ft | | 10 | 0 | 5 | 19 | 0 | ft |
| | | RC20-3 | 10 | | 21 | | | |
| | | | | | | 3 | | |
| | 34 ft | | 10 | 0 | 21 | 3 | 0 | ft |
| Subtotals | 192 ft | | 47 | 15 | 46 | 74 | 10 | ft per ea |
| Percentages | 100% | | 24% | 8% | 24% | 39% | 5% | per ea |

**This says: Very Hard rock is encountered in 5% within the depth of the Soldier Piles.**
**Four of six borings did NOT have Very Hard descriptors at all**

# Rock Hardness Descriptors in LOTBs – Tooling Selection

### 2.6.8 Rock Hardness

Describe the hardness of intact rock core (Figure 2-32).

**Figure 2-32 (after USBR 2001)**
**Rock Hardness**

| Description | Criteria |
|---|---|
| Extremely Hard | Cannot be scratched with a pocketknife or sharp pick. Can only be chipped with repeated heavy hammer blows. |
| Very Hard | Cannot be scratched with a pocketknife or sharp pick. Breaks with repeated heavy hammer blows. |
| Hard | Can be scratched with a pocketknife or sharp pick with difficulty (heavy pressure). Breaks with heavy hammer blows. |
| Moderately Hard | Can be scratched with a pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows. |
| Moderately Soft | Can be grooved 1/16 in. deep with a pocketknife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure. |
| Soft | Can be grooved or gouged easily with a pocketknife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure. |
| Very Soft | Can be readily indented, grooved or gouged with fingernail, or carved with a pocketknife. Breaks with light manual pressure. |

*Figure 1: D*

ROCK HARDNESS DESCRIPTORS VS. UC [PSI]

| Hardness Description | Hardness Abvr. Lvl. | UC psi | UC MPa | |
|---|---|---|---|---|
| Extremely Hard | eh | **29,000** | 200 | |
| | vh-eh | 19,577 | 135 | |
| **Very Hard** | vh | **10,153** | **70** | Range Described in Borings |
| | h-vh | 6,890 | **48** | " " |
| **Hard** | h | **3,626** | **25** | " " |
| | mh-h | 2,538 | **17** | " " |
| **Moderately Hard** | mh | **1,450** | **10** | " " |
| | ms-mh | 1,196 | **8** | " " |
| **Moderately Soft** | ms | **943** | **6** | " " |
| | s-ms | 689 | 5 | |
| Soft | s | **435** | 3 | |
| | vs-s | 290 | 2 | |
| Very Soft | vs | **145** | 1 | |

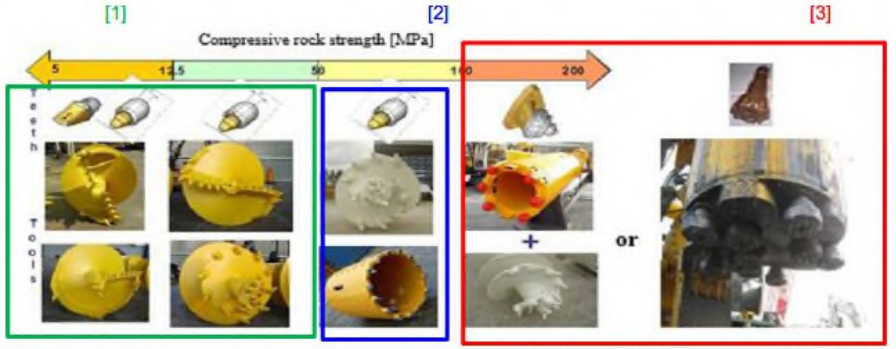



*Figure 1: Different drill teeth and tools correlated to compressive rock strength (UCS) for bored piles (left section of the figure from Bauer Maschinen GmbH, Germany)*

Notes on Drilling Types

**[1]**
**Tools Indicated by Contract Documents**
**[2]**
**Tools for a Low Amount of Very Hard Rock if Needed**
**[3]**
**Tools for Large Amounts of Very Hard Rock and Harder**

**This says: GSE's tool selection was correct**

# FHWA Geotechnical Guideline 15: Interpretive vs Factual

**Notes for Specifications**

1. The contractor should be made aware that construction of the soldier pile walls will encounter bedrock. Excavation and coring of the hard to very hard granitic bedrock is expected to be difficult.

**VS**

**Table 5. Design Soil Parameters for Location 20 at Route 39, PM R36.6**

| Boring ID | Approx. Elevation (ft) | Soil Profile | Approximate Engineering Properties |
|---|---|---|---|
| RC-20-001 | 4478.40 – 4469.15 | Well-graded Gravel with Sand (GW) | ϕ =32°, c=0 psf |
| | 4469.15 – 4449.15 | IGNEOUS ROCK (intensely weathered Granite); well-graded Gravel with Sand (GW) | ϕ =34°, c=0 psf |
| | 4449.15 – 4439.15 | IGNEOUS ROCK (intensely weathered Granite); well-graded SAND with Gravel (SW) | |
| RC-20-002 | 4494.38 – 4490.05 | Well-graded SAND (SW) | ϕ =32°, c=0 psf |
| | 4490.05 – 4475.05 | IGNEOUS ROCK (Moderately weathered Granite | ϕ =34°, c=0 psf |

**Notes for Constructions**

1. The boring data indicates the rock behind the construction area will be generally difficult to excavate due to hardness and/or degree of fracturing. There are some relatively soft zones where drilling might be easier. For estimating excavation conditions, refer to the LOTBs. Also, it would be advisable to make an appointment to view the rock core boxes that are located at the California Transportation District 7 Office, located at 100 S Main St, Los Angeles, CA 90012.

**Table 5. Design Soil Parameters for Location 8 at Route 39, PM R34.13**

| Layer No. | Approx. Layer Boundaries (ft) | Group Name | Friction Angle (degree) | Unit Weight (pcf) |
|---|---|---|---|---|
| 1 | Elev. 3679 to 3630 | Igneous Rock | 40 | 130 |

**Table 6. Design Soil Parameters for Location 8 at Route 39, PM R34.20**

| Layer No. | Approx. Layer Boundaries (ft) | Group Name | Friction Angle (degree) | Unit Weight (pcf) |
|---|---|---|---|---|
| 1 | Elev. 3699 to 3688 | Silty Sand (SM) | 30 | 120 |
| 2 | Elev. 3688 to 3650 | Igneous Rock Weathered and FR-fractured | 40 | 130 |

**This says: Documents say rock encountered to be hard to very hard rock will be difficult, the LOTBs show its only about 5% of the total drilling depth**

**Instead, GSE encountered approximately 85-95% of Very Hard Rock**

# LOTBs in Center of the Road
# More Weathering @ Exposed Slope

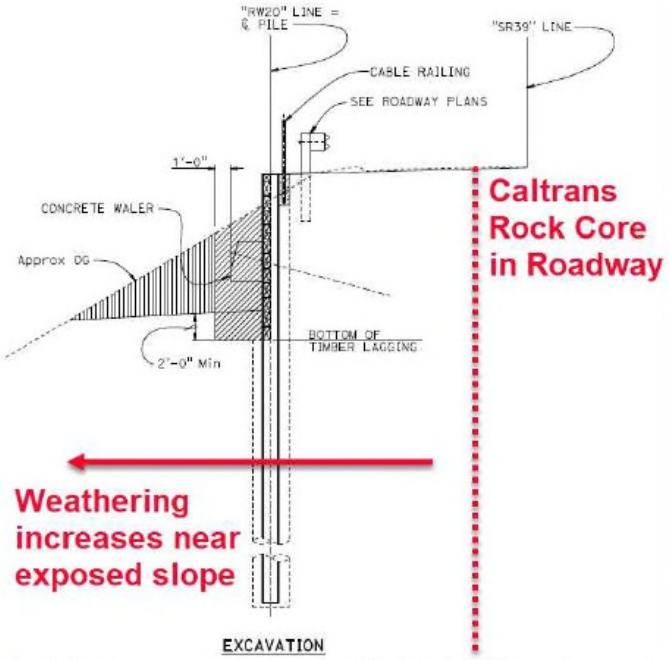
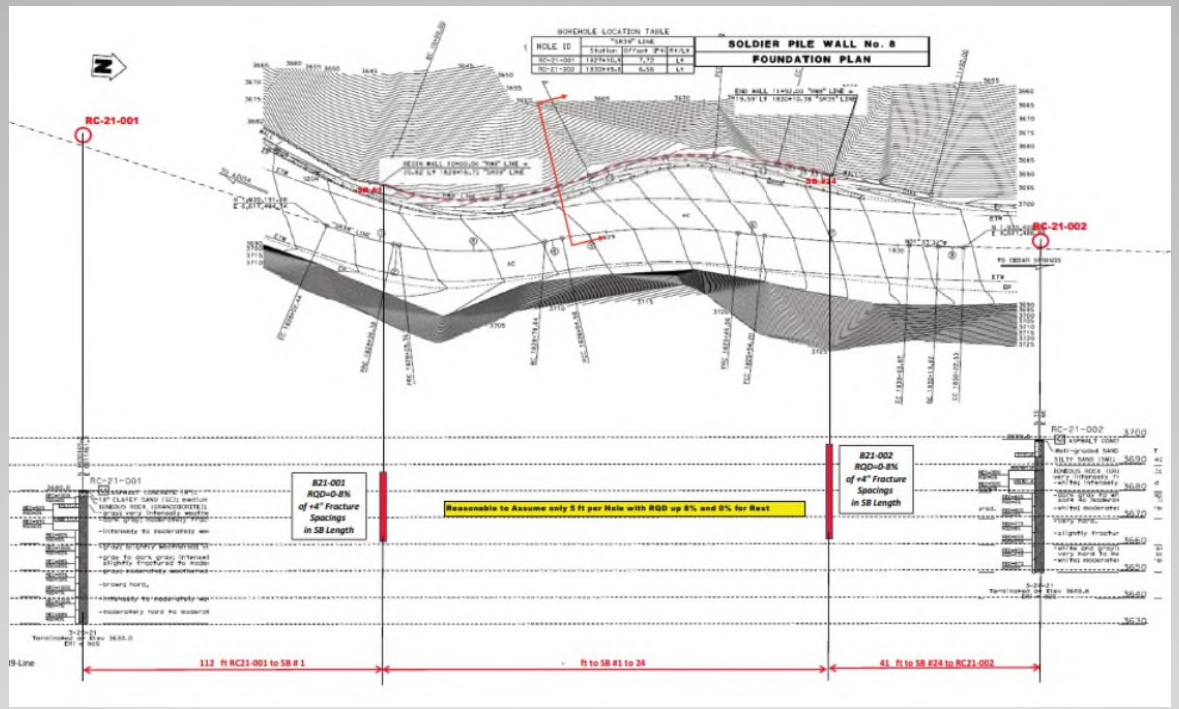


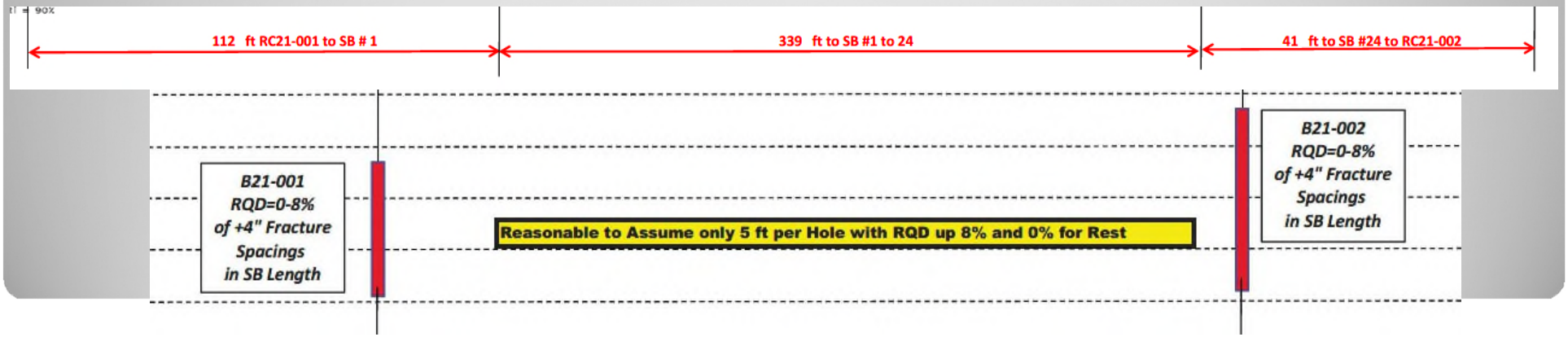

*Figure 4: Weathering of rock increases as one moves from the interior of the rock mass to the exposed slope.*

**LOTBs show weathered and fractured rock in the <u>center</u> of the road. Therefore where GSE drilled should have been *more weathered***

**The designers use of "Soils Properties" table for design is consistent with GSE's view of LOTBs and all other bidders**

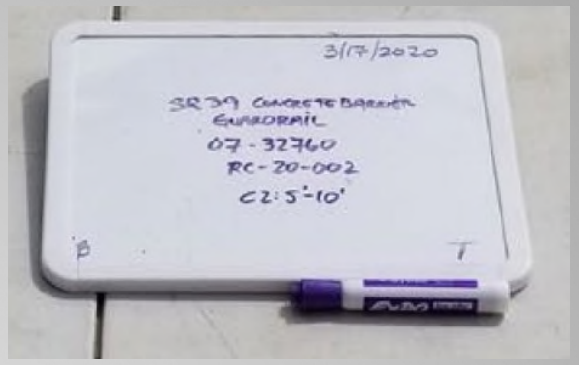
# LOTBs – 41 to 112 ft Distance To Work Area

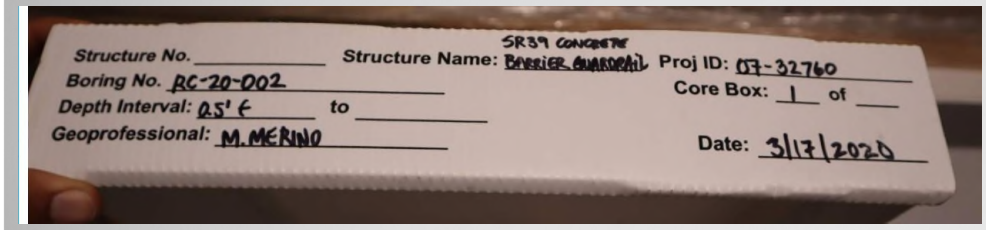


# Core Samples Degraded In Transport

It appears that the LOTBs described in the contract documents do not match Caltrans field core photographs presented




# Materially Different Material *Encountered* – RW 8 Pile 2

## Document/Ask For Observation by Owner

# Materially Different Material *Encountered* – RW 8 Pile 3

## Document/Ask For Observation by Owner

# Materially Different Material *Encountered* – RW 8 Pile 5

## Document/Ask For Observation by Owner

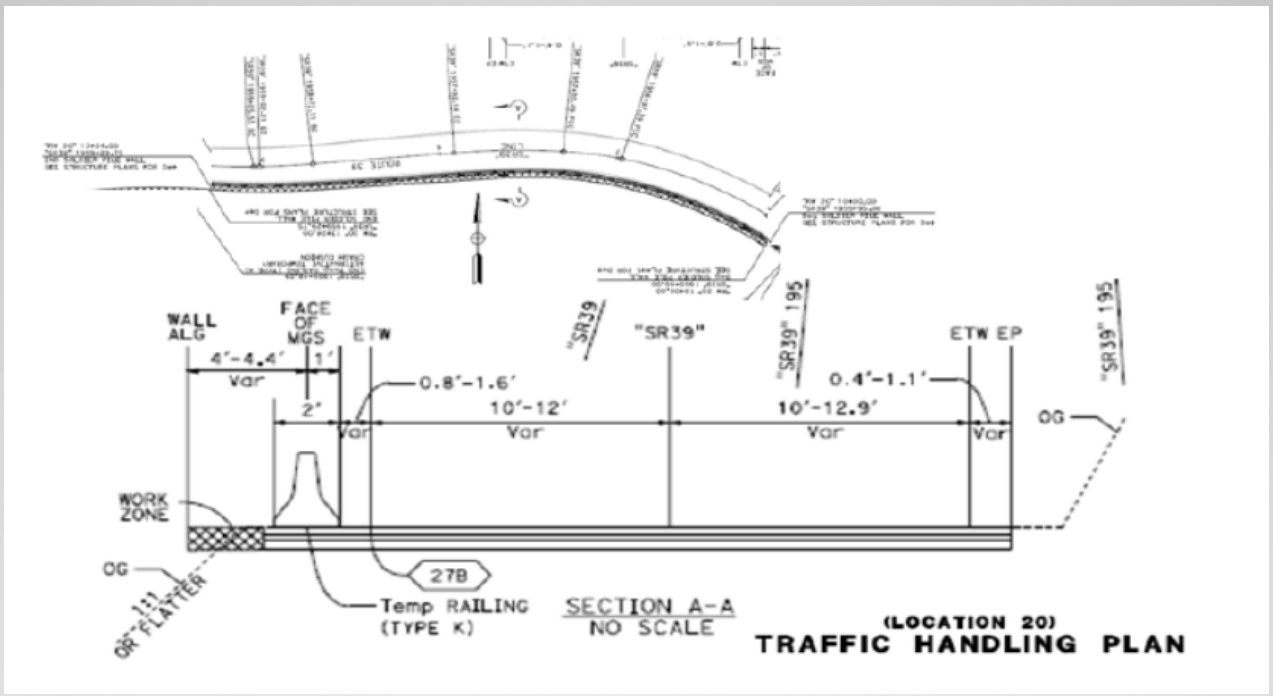
# Materially Different Material *Encountered* – RW 8 Pile 7

## Document/Ask For Observation by Owner

# Caltrans Implied Warranty

Caltrans is responsible to provide workable specifications and drawings for bidders. Caltrans presented a limited work zone requiring traffic control and only one lane of working area.

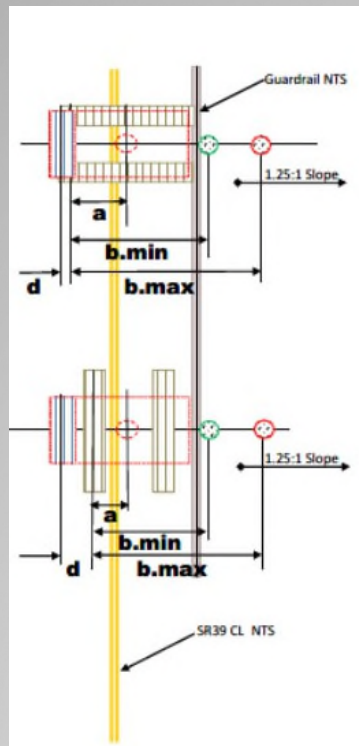
Public Contract code section 10120 states "The department shall provide full, complete, and accurate plans and specifications" aka Spearin Doctrine



# Caltrans Implied Warranty
# LoDrill Style Rig Is The Only Type Of Rig That Fits

Limited work area limited torque and crowd available to be provided by the Drill Rig. Reaching over the guardrail also limits the torque and crowd. Specs only allowed one lane closure

# Caltrans Implied Warranty
# LoDrill Style Rig Is The Only Type Of Rig That Fits




**Over the Front**

| Excavator Drill Type | Rig Wt W lb | Back Wheel BW a ft | Counter CW lb | CW Dist d ft | Rig +CW W+CW lb | BW to Reach b.i ft | | Available Down Crowd V lbs | |
|---|---|---|---|---|---|---|---|---|---|
| LR125 on CAT336 | 115,000 | 8.00 | - | 0.00 | 115,000 | 29.00 | V1= | 31,724 | at **b.max** |
| LR125 on CAT336 | 115,000 | 8.00 | - | 0.00 | 115,000 | 17.00 | V2= | 54,118 | at **b.min** |
| | | | | | | | V.cyl.lim= | 44,500 | cylinder force |
| TR50-63 on PC170LC-11 | 61,000 | 5.16 | 7,900 | 2.81 | 68,900 | 21.03 | V1= | 15,850 | at **b.max** |
| TR50-63 on PC170LC-11 | 61,000 | 5.16 | 7,900 | 2.81 | 68,900 | 14.50 | V2= | 22,988 | at **b.min** |
| | | | | | | | V.cyl.lim= | 24,000 | cylinder force |

**Over the Side**

| Excavator Drill Type | Rig Wt W lb | BT a ft | Counter CW lb | CW Dist d ft | Rig +CW W+CW | BW to Reach b.1 | | Available Down Crowd V lbs | |
|---|---|---|---|---|---|---|---|---|---|
| LR125 on CAT336 | 115,000 | 6.07 | - | 0.00 | 115,000 | 24.14 | V1= | 28,919 | at **b.max** |
| LR125 on CAT336 | 115,000 | 6.07 | - | 0.00 | 115,000 | 17.14 | V2= | 40,728 | at **b.min** |
| | | | | | | | V.cyl.lim= | 44,500 | cylinder force |
| TR50-63 on PC170LC-11 | 61,000 | 3.3 | 7,900 | 10.8 | 68,900 | 19.55 | V1= | 7,266 | at **b.max** |
| TR50-63 on PC170LC-11 | 61,000 | 3.3 | 7,900 | 10.8 | 68,900 | 12.30 | V2= | 11,549 | at **b.min** |
| | | | | | | | V.cyl.lim= | 24,000 | cylinder force |

| | | | |
|---|---|---|---|
| Required Crowd Force per Bullet Tooth | 2,000 lbs | per Champion Equipment "Vince Jew"" | 14,413 diagonally TR50 |
| No. Bullet Teeth per 30" Hole | 20 | | 36,468 Diagonally LR125 |
| No. Bullet Teeth per 18 " Hole | 12 | | |
| Crowd fac for Uneven Teeth/Surface | 1.25 | | |
| **Min 30" Hole Crowd** | **50,000 lbs** | The Kelly Bars May Need to Be Pinned if Torque Resistance is to Low to Lock the Bars | |
| **Min 18" Hole Crowd** | **30,000 lbs** | Possiblely Requiring a Man Lift | |

**This says: TR50 has 14,413 lbs of Crowd vs 50,000 lbs required**

**Caltrans used a CS2000 drill rig which required both lanes**

# Caltrans Implied Warranty - CS200 Drill Rig


The CS2000 drill rig required both lanes

# Summary of Issues On The Job

1. LOTBs were the most specific factual contract documents and showed approximately 5% of very hard rock with no very hard rock in 4 of 6 borings
2. Caltrans designer used "Soil Properties" to design the Soldier Piles confirming what was to be encountered was soil/fractured and weathered rock: plus limited one lane access
3. LOTBs description and field core photos for boring RC-20-002 seem to not match
4. By the contract indications and limitation of one lane for drilling use the specifications provide an implied warranty that GSE's equipment would have sufficient torque and crowd to achieve efficient drilling
5. General remarks that drilling in very hard rock would be difficult did not quantify how much very hard rock would be encountered: the LOTBs did with only 5% being very hard rock
7. Court cases and applicable FHWA Guideline 15 requires a DSC analysis to focus on factual LOTB information rather than general statements in the Foundation Report or contract documents
8. **Specs tell bidders to "refer to LOTBs" for bidding purposes *consistent with the above rules***

# Managing Risk - California Public Contract Code 7104

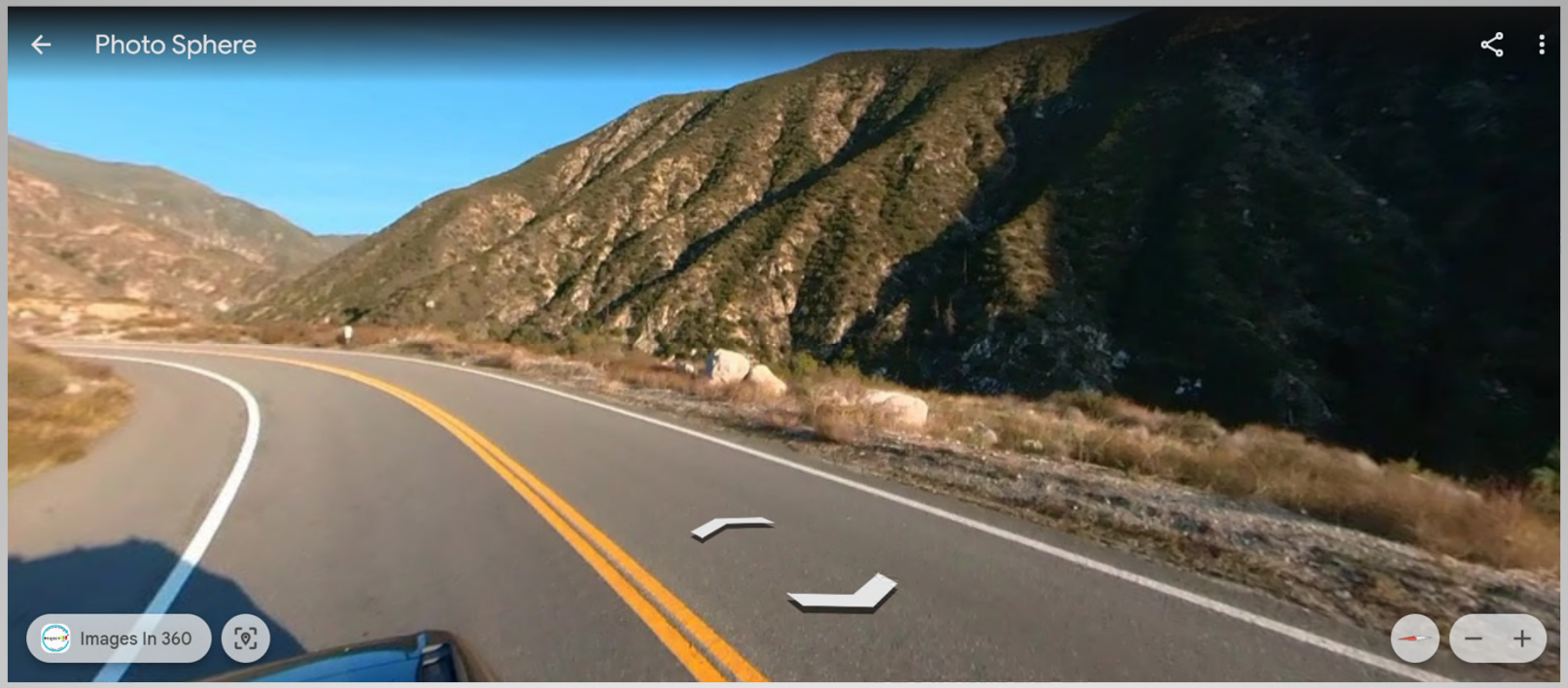
1. Know the contract and the different site conditions law
2. Law to be well aware of:

Any public works contract of a local public entity which involves digging trenches or other excavations that extend deeper than four feet below the surface shall contain a clause which provides the following:

**That, in the event that a dispute arises between the local public entity and the contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the contractor's cost of, or time required for, performance of any part of the work, the contractor shall not be excused from any scheduled completion date provided for by the contract, but shall proceed with all work to be performed under the contract. The contractor shall retain any and all rights provided either by contract or by law which pertain to the resolution of disputes and protests between the contracting parties.**

**You have to have the money to complete the job then wait YEARS to recover your money**

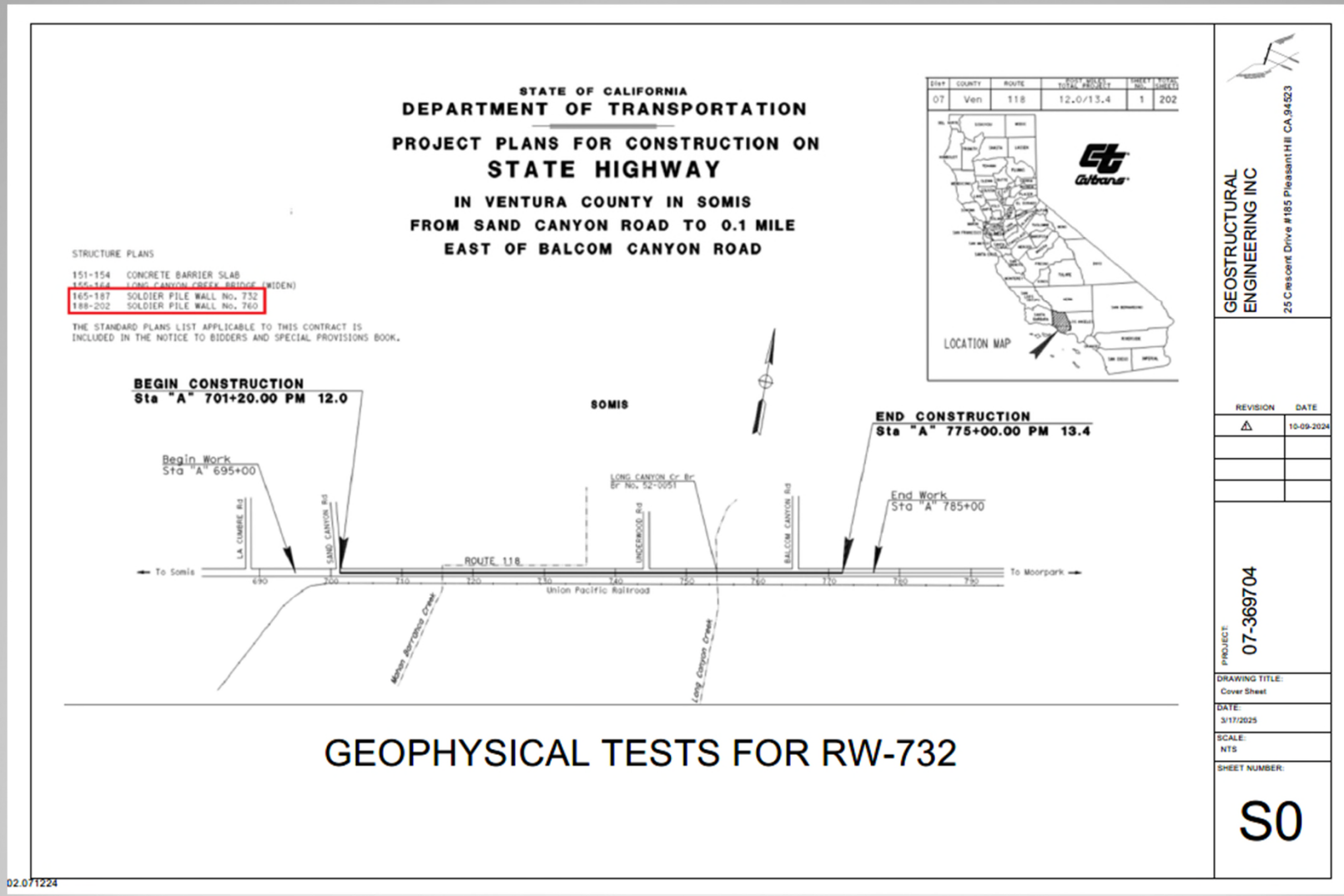
# Exposed Geology – Lesson Learned The Hard Way



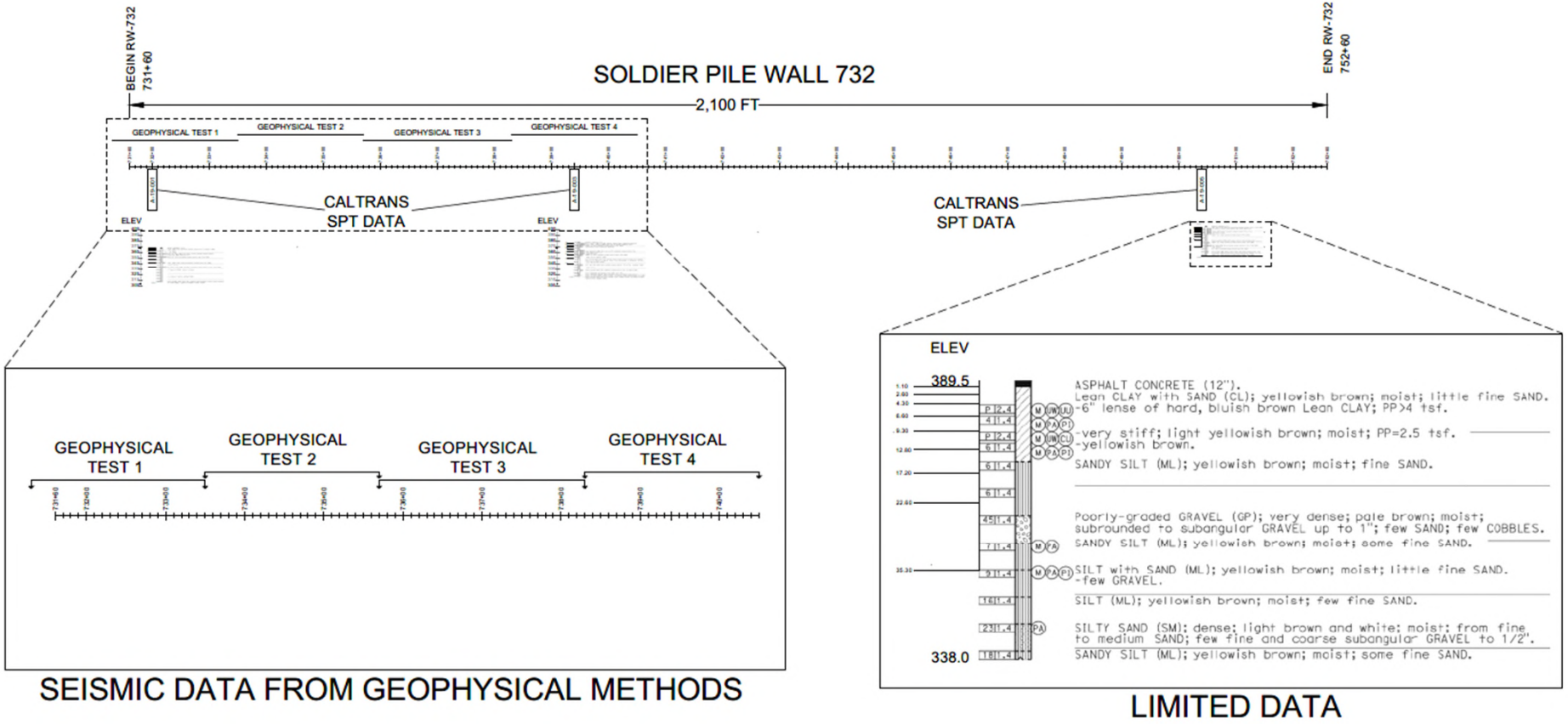

**Understanding The Geologic Risk**

1. For each project **ALWAYS ALWAYS** walk the jobsite to observe the road cuts. What the LOTBs describe is not always accurate
2. The more data you have on ground conditions the better you can quantify the risk akin to sample size in statistics
3. Obtain water well logs for the area if possible
4. Use Geophysics to interpret between the boring logs – Future Research @ UCB

# Future Geophysics Research



# Future Geophysics Research

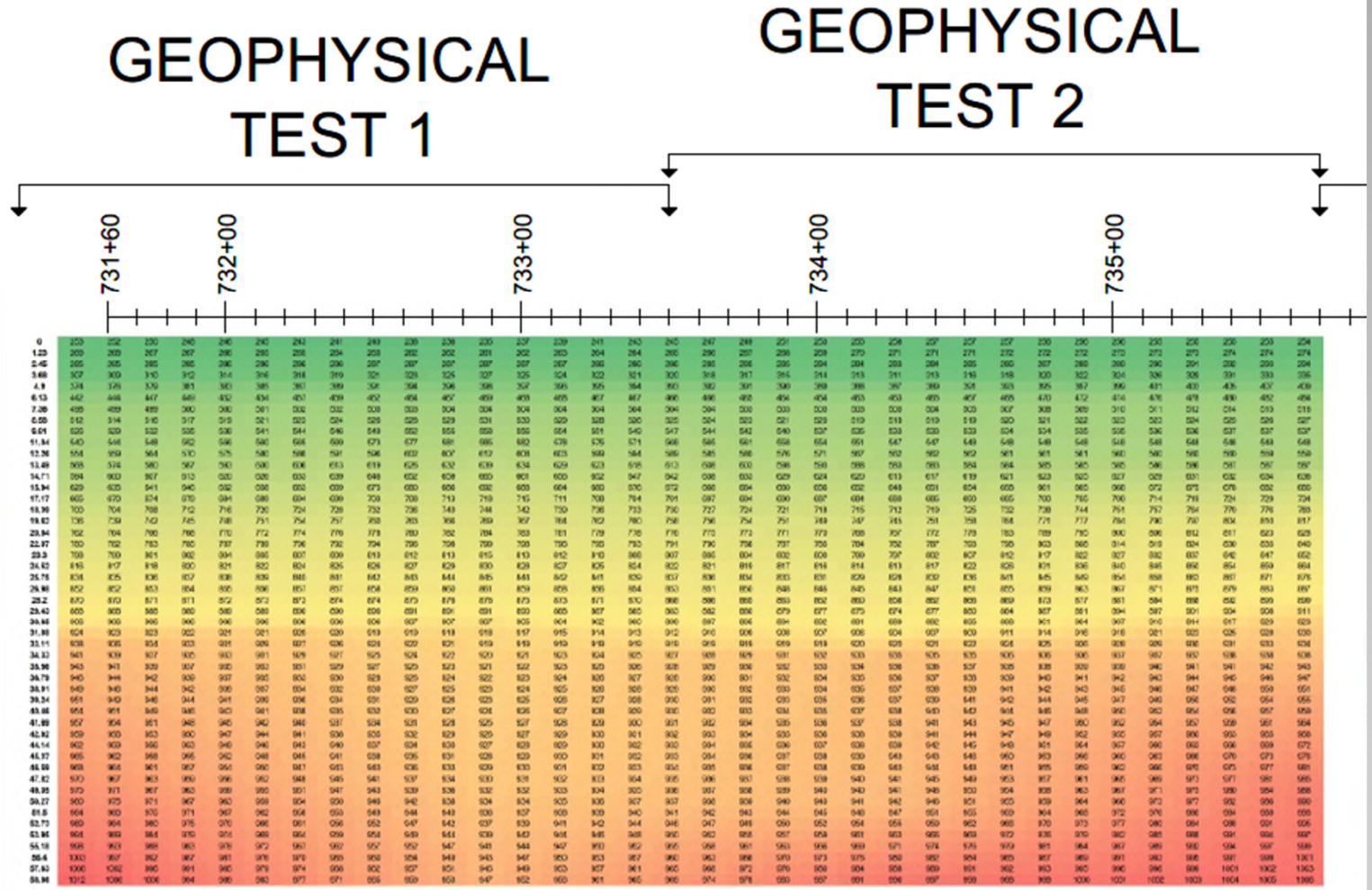



SEISMIC DATA FROM GEOPHYSICAL METHODS

LIMITED DATA

Vp and Vs waves to correlate with data from nearby borings and characterize the subsoil and estimate the SPT blow counts

# Future Geophysics Research




Vs (m/s) wave velocities approximately every 15 feet at a depth of 60 ft.

By having the velocities and calibrating the correlation formula with nearby soundings, the blow counts along the wall can be estimated.

# My Personal Advice For Starting A Ground Construction Company

1. Work for one of the larger Ground Construction Companies like Drill Tech, Malcolm, Condon Johnson, Keller, etc to cut your teeth
2. Make a business plan and review it with other Ground Construction professionals and business advisors
3. Grow slowly and organically because Ground Construction is High Risk High Reward or Painful Failures
4. Minimum two partners one an Engineer with Business Acumen and one in Operations/Equipment Design aka how Drill Tech Drilling & Shoring Got Started
5. If married your significant other should have a stable job to counter the highs and lows of owning your own company. My wife has always been the rock and me the entrepreneur
6. Have a Board of Directors/Advisors because multiple heads are always better than one