

INFORMATION HANDOUT

**For Contract No. 10-1C4214
At 10-SJ-99-14.3/14.9, 18.4/23.0**

**Identified by
Project ID 1015000131**

MATERIALS INFORMATION

Geotechnical Design Report
Alternative In-Line Terminal System
Alternative Flared Terminal System
Existing TMS List

**FINAL GEOTECHNICAL DESIGN REPORT
FOR RETAINING WALLS AT
ROUTE 99/ARCH ROAD INTERCHANGE FOR
SAN JOAQUIN COUNCIL OF GOVERNMENTS**
Arch Road/State Route 99 Ramp Improvements
San Joaquin County, California
EA 10-1C4214; 10-SJ-99; PM 14.3/14.9

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March 2016

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Geotechnical ▪ Geo-Environmental ▪ Construction Services ▪ Forensics

File No. 1201.X
March 28, 2016

Martha M. Dadala, P.E.
HDR, Inc.
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Sacramento, California 95833

Subject: **FINAL GEOTECHNICAL DESIGN REPORT FOR
RETAINING WALLS AT ROUTE 99/ARCH ROAD
INTERCHANGE FOR SAN JOAQUIN COUNCIL
OF GOVERNMENTS (SJCOG)**
Arch Road/State Route 99 Ramp Improvements
San Joaquin County, California
EA 10-1C4214; 10-SJ-99; PM 14.3/14.9

Dear Ms. Dadala,

Blackburn Consulting (BCI) prepared this Geotechnical Design Report for the proposed Retaining Walls RW1-RW4 associated with the Arch Road/State Route 99 Ramp Improvements in San Joaquin County, California. BCI prepared this report in accordance with Amendment 1 to our June 4, 2013 Subconsultant Agreement between BCI and HDR, Inc. Thank you for the opportunity to be part of your design team. Please call us if you have questions or require additional information.

Sincerely;

BLACKBURN CONSULTING



David J. Morrell, P.E., G.E.
Senior Project Manager

Reviewed by:



Patrick Fischer, P.E., C.E.G.
Principal

Copies: 2 to Addressee (Hard Copies and PDF)

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RETAINING WALLS AT ROUTE 99/ARCH ROAD INTERCHANGE
FOR SAN JOAQUIN COUNCIL OF GOVERNMENTS (SJCOG)**

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1. INTRODUCTION

1.1 Purpose

HDR, Inc. (HDR) retained Blackburn Consulting (BCI) to prepare this Final Geotechnical Design Report (SPGR) for design and construction of Retaining Walls RW1-RW4 associated with the overall Arch Road/State Route 99 (SR 99) Ramp Improvements Project in San Joaquin County, California.

This report documents subsurface geotechnical conditions, provides analyses of the anticipated site conditions as they pertain to the retaining walls described herein, and recommends geotechnical design and construction criteria for Retaining Walls RW1-RW4. This report also establishes a geotechnical “baseline” to assess the existence and scope of possible changed site conditions with respect to construction of the retaining walls. BCI’s scope of services did not include preparation of a Geotechnical Design Report or Materials Report for other aspects of the overall ramp improvement project.

1.2 Scope of Services

To prepare this report, BCI:

- Discussed the project with HDR.
- Reviewed preliminary layout and typical cross section plans for the walls prepared by HDR.
- Reviewed published maps and literature related to site soil and geologic conditions.
- Drilled, logged and sampled a total of 5 borings adjacent to the proposed retaining wall locations.
- Performed laboratory tests on soil samples retrieved from the borings.
- Performed engineering analysis and calculations to develop our conclusions and recommendations.

1.3 Project Location and Description

The project is located at Arch Road/SR 99 about 2 miles south of the E. Mariposa Road Overcrossing and about 3 miles north of the French Camp Road Undercrossing in San Joaquin County, California. Figure 1 presents a site Vicinity Map.

The project will widen the existing SR 99 southbound on-ramp (“AL1” Line) and northbound on-ramp (“AR3” Line) to provide maintenance vehicle pullouts and California Highway Patrol (CHP) enforcement area pullouts along the outside shoulder of the ramps. Retaining Walls RW1 to RW3 will be constructed on the southbound on-ramp and Retaining Wall RW4 will be constructed on the northbound on-ramp. The walls will be Type 1 Retaining Walls (Case 1)

designed in accordance with Caltrans Standard Plan B3-1A (2015). Refer to the Log of Test Borings in Appendix A for the proposed wall layouts.

We describe the proposed walls in Table 1 based on information provided by HDR:

Table 1: Type 1 Retaining Wall Descriptions			
Retaining Wall No.	Approximate Limits	Wall Height (ft.)	Notes
RW1	“AL1” Line Sta. 756+26 to 756+91	6	Spread footing will be founded entirely within the existing 2:1 (horizontal to vertical) embankment fill slope without a level bench in front of the wall. Although wall will be designed for a 6-foot height, the actual height of new approach fill retained will be about 2 feet. The closest top edge of the footing will be at least 4 feet (horizontally) away from the finish slope face
RW2	“AL1” Line Sta. 759+06 to 760+38	10-12	Spread footing will be founded within the planned 2:1 embankment fill slope, partially on existing and new embankment fill. A level bench (2½ to 4 feet wide) will be constructed in front of the wall.
RW3	“AL1” Line Sta. 762+49 to 763+26	12-14	Spread footing will be founded within the planned 2:1 embankment fill slope, partially on existing and new embankment fill. A level bench (2½ to 4 feet wide) will be constructed in front of the wall.
RW4	“AR3” Line Sta. 778+60 to 779+50	6-8	Spread footing will be founded near the toe of the new 2:1 embankment fill slope, partially on existing and on new embankment fill. A level bench (2½ to 4 feet wide) will be constructed in front of the wall.

2. SUBSURFACE EXPLORATION PROGRAM

To characterize the site subsurface conditions, BCI retained Taber Drilling to drill and sample 5 borings (A-15-001 through A-15-005) to depths ranging from 21.5 to 26.5 feet within the existing paved shoulder areas near the proposed retaining walls. The Log of Test Borings in Appendix A show the approximate boring locations with respect to the proposed retaining wall layouts.

Taber Drilling used a CME 55 track rig to drill Borings A-15-001 through A-15-002, and a CME 75 truck rig to drill Borings A-15-003 through A-15-005. Taber Drilling used 4-inch solid stem augers to advance the borings. BCI obtained soil samples at various intervals using both a 3.0-inch O.D. Modified California (MC) sampler (equipped with 2.4-inch diameter brass liners) and a 2-inch O.D. Standard Penetration (SPT) sampler. Samples were driven with an automatic hammer, weighing 140-pounds and falling approximately 30-inches per blow. We also collected bulk composite samples from the upper 1.5 to 5 feet of the borings. Upon completion of drilling, Taber Drilling backfilled the borings with neat cement grout and patched the surface with concrete.

Kristy Chapman, our project engineer, logged the borings generally consistent with the Caltrans “Soil and Rock Logging, Classification and Presentation Manual” (2010 edition) and retained the samples for laboratory testing.

3. SITE GEOLOGY AND SUBSURFACE CONDITIONS

3.1 General Project Area Geology

Literature published by the California Geological Survey (CGS) indicates that the site is located in the San Joaquin Valley within the central portion of the Great Valley Geomorphic Province. This province encompasses the San Joaquin Valley in the south and the Sacramento Valley in the north. The province is bound by the Sierra Nevada to the east, the Coast Ranges to the west, the Klamath Mountains and Cascade Range to the north.

The Great Valley is a broad, elongated, northwest trending, structural trough that has been filled with a thick sequence of sediments. The eastern margin of the valley is formed by the west sloping Sierran bedrock surface that extends westward beneath the alluvium and older sedimentary bedrock within the valley. The western border is underlain by east dipping rock of the Coast Ranges that form a deeply buried trough.

During the late Mesozoic and through most of Tertiary time (approximately 100 million to 20 million years ago), deposition of thousands of feet of marine sediments occurred within the Great Valley. Continental deposits (generally alluvium) of late Tertiary and Quaternary age (approximately 20 million years ago to the present) overlie these marine deposits. Both the continental deposits and the underlying marine sediments form a wedge of sediments that generally thickens from east to west. The accumulated thickness of the marine and continental sediments is at least several thousand feet at the site.

Mapping by the California Geologic Survey¹ shows the site is underlain by sediments of the Pleistocene-age Modesto Formation. These sediments are alluvium comprised mostly of sand, silt and clay.

¹ Geologic Map of the San Francisco-San Jose Quadrangle, 1:250,000, California Division of Mines and Geology, 1990.

3.2 Subsurface Soil Conditions

Within the southbound on-ramp borings, the existing pavement section consists of 6.5 to 7 inches of hot mix asphalt concrete, over 5 to 6 inches of aggregate base, over a layer of clayey to silty sand with gravel (possible subbase material) that extends to depths of 2 to 2.5 feet below existing grade. Beneath the pavement sections, we generally observed fill that consists of very stiff to hard, lean to fat clay to depths of 15 to 19 feet below existing grade (Elevations 29.0 to 30.0 ft., NAVD 83). Beneath the fill, we observed very stiff to hard, lean to fat clay to the maximum depths explored in these borings.

Within the northbound on-ramp borings, the existing pavement section consisted of 8 to 8.5 inches of hot mix asphalt concrete, over 6 to 7.5 inches of aggregate base, over clayey sand with gravel (possible subbase material) that extends to a depth of about 2 feet below existing grade. Beneath the pavement sections, we generally observed fill that consists of hard, lean to fat clay and dense silty sand to depths of about 8½ feet below existing grade (Elev. 28.0 ft., NAVD 83). Beneath the fill, we observed interlayered, hard fat clay, hard lean clay and medium dense silty sand to the maximum depths explored in these borings.

Appendix A includes the Log of Test Borings which contain more detailed descriptions of the subsurface conditions encountered in the borings.

3.3 Groundwater

We did not observe groundwater in any of the borings during drilling. BCI reviewed groundwater level data for nearby wells available at the California Department of Water Resources website (<http://www.water.ca.gov/waterdatalibrary/>). Based on this information, we estimate that the groundwater level at the site fluctuates between about Elev. -25.0 ft. to -35.0 ft., which is at least 50 feet below the existing ground surface at the site. However, relatively shallow perched water may occur within the near-surface soils during the winter and spring months.

Groundwater and perched water levels can fluctuate due to changes in precipitation, irrigation, pumping of wells, and other factors.

4. FIELD AND LABORATORY TESTING

We completed the following laboratory tests on representative soil samples obtained from the exploratory borings:

- Moisture content and dry density (ASTM D2216 / D2937)
- Plasticity Index (ASTM D4318)
- Direct Shear (ASTM D3080)
- Sulfate content (CTM 417), chloride content (CTM 422), pH (CTM 643) and resistivity testing (CTM 643)

During drilling, we performed field pocket penetrometer testing on selected samples of cohesive soil retrieved from the borings. Appendix B contains both the laboratory test results and the field pocket penetrometer test results.

5. SEISMIC DATA AND EVALUATION

5.1 Seismic Data and Geologic Hazards

5.1.1 Ground Motion

BCI used Caltrans ARS Online (Version 2.3.06) to evaluate seismic ground motions at the site. Based on the soil conditions encountered in the borings, and our local experience, we used a Soil Profile Type D with a V_{S30} (Small Strain Shear Wave Velocity) of 270 m/s for the analysis. Our analysis yielded a Peak Ground Acceleration (PGA) of 0.31g, which is controlled by the probabilistic spectrum (probability of exceedance equal to 5% in 50 years, a 975-year return period). A horizontal seismic acceleration coefficient (K_h) of 0.16 (half of the PGA) is appropriate for seismic wall design provided the walls can tolerate seismic movements of 1-inch or more.

5.1.2 Liquefaction

Liquefaction can occur when saturated, loose to medium dense, granular soils (generally within 50 feet of the surface), or specifically defined cohesive soils, are subjected to ground shaking. We consider the potential for detrimental liquefaction to be very low at the site based on the deep groundwater level, the soil encountered in our borings and the relatively low site PGA.

5.1.3 Fault Rupture

Based on the Caltrans ARS Online (V2.3.06) output, the closest seismic source is a portion of the Great Valley 07 (Orestimba) fault located approximately 20.4 miles (32.8 km) to the west. We consider the potential for fault rupture within the project area to be very low.

5.1.4 Seismic Settlement

During a seismic event, ground shaking can cause densification of granular soil above the water table that can result in settlement of the ground surface. We consider the potential for detrimental seismic settlement within the project area to be low for the native soil and properly compacted engineered fill.

5.1.5 Seismic Slope Instability

Based on the relatively low PGA and the soil conditions encountered in the borings, we consider the potential for seismic slope instability of engineered fill slopes constructed at typical allowable gradients of 2H:1V or flatter to be very low.

6. TYPE 1 RETAINING WALL CONCLUSIONS AND RECOMMENDATIONS

BCI evaluated Retaining Walls RW1-RW4 to determine if Caltrans Standard Plan B3-1A (2015) for Type 1 Retaining Walls (Case 1) is suitable for design of the walls. We present our evaluation and global stability analysis results below.

6.1 Evaluation and Suitability of Standard Plan Wall Design

Retaining Wall RW1

Based on information provided by HDR, the spread footing for Retaining Wall RW1 will be founded entirely within the existing 2:1 (horizontal to vertical) embankment fill slope without a bench in front of the wall. Although the wall will be designed for a 6-foot height, the actual height of new embankment fill retained will only be about 2 feet based on a preliminary cross section provided by HDR. In addition, HDR indicated that the closest top edge of the footing will be at least 4 feet (horizontally) away from the finish slope face.

Based on the subsurface conditions encountered in Borings A-15-003 through A-15-005 drilled within the same ramp approach fill, we anticipate that the spread footing foundation material will consist of very stiff to hard lean to fat clay (fill). We anticipate that the unconfined compressive strength of the fill is about 3 tsf or greater based on our pocket penetrometer test results (see Appendix B), which exceeds the shear strength developed using the granular soil properties (friction angle of 34 degrees and unit weight of 120 pcf) used for the standard plan wall design.

In our opinion, Caltrans Standard Plan B3-1A (2015) can be used for Retaining Wall RW1 based on limited retained fill height, planned 4-foot distance from the footing to slope face, and the very stiff to hard soil conditions anticipated at foundation level.

Retaining Walls RW2-RW3

Based on information provided by HDR, the spread footings for Retaining Walls RW2 and RW3 will be founded within the planned 2:1 embankment fill slope, partially on existing and new embankment fill. A level bench (2½ to 4 feet wide) will be constructed in front of the walls.

We anticipate that the unconfined compressive strength of the existing fill and native clay soil is about 3 tsf or greater based on our pocket penetrometer test results (see Appendix B), which exceeds the shear strength developed using the granular soil properties (friction angle of 34 degrees and unit weight of 120 pcf) used for the standard plan wall design. Considering that new fill will be placed, we used the more conservative standard plan soil properties to evaluate foundation bearing and lateral capacity for footings embedded in sloping ground.

To develop the necessary passive resistance (passive wedge) against the face of the footing toe, we recommend that the minimum footing embedment be increased to 3 feet below finish grade in front of the walls, with the top edge of the footing located no closer than 6 feet (horizontally) away from the finish slope face.

BCI evaluated spread footing bearing resistance for the Strength and Extreme Limits States using methods outlined in Section 10 (Foundations) of the AASHTO LRFD Bridge Design Specifications, 6th edition and associated January 2014 California Amendments to these specifications. For our analysis, we used the following:

- Standard plan soil properties (friction angle of 34 degrees and unit weight of 120 pcf).
- Modified bearing capacity factor for footings in cohesionless soil on sloping ground per Figure 10.6.3.1.2c-2 of the above bridge design specifications.
- Effective footing dimensions and loading conditions for standard plan wall heights of 10 and 14 feet, respectively, to capture the variation in proposed wall heights.
- BCI's above recommended minimum footing embedment and footing distance from the slope face to develop the necessary passive resistance.
- A geotechnical resistance factor of 0.45 for strength limit bearing resistance analysis, and a geotechnical resistance factor of 1.0 for the extreme limit case.

Our analysis indicates that the bearing resistance for the proposed walls exceeds the Strength and Extreme Limit State wall loads shown on the standard plan for wall heights of 14 feet or less. We evaluated wall settlement² for the 10-foot and 14-foot high wall case under standard plan service limit state loads and effective footing dimensions, indicating wall settlements will be nominal (less than ¼-inch) at the service limit state. Per Section 5.1.1 of this report, a horizontal seismic acceleration coefficient (Kh) of 0.16 is applicable for the site, which is less than the 0.20 value used for standard plan wall design.

We present the results of our bearing and settlement analysis in Appendix C.

Based on the above analysis, Caltrans Standard Plan B3-1A (2015) can be used for Retaining Walls RW2 and RW3 for heights up to 14 feet, provided our recommended footing embedment and footing distance from the slope face are incorporated into the design. In addition, all new embankment fill placed for slope construction within the retaining wall limits (and 5 feet beyond the ends of the walls) shall be structure backfill meeting the requirements of Section 8.1 of this report.

² Schmertmann's Modified Method for Calculation of Immediate Settlements (1978), Soils and Foundations - Volume II, FHWA NHI-06-089, December 2006.

Retaining Wall RW4

Based on information provided by HDR, the spread footing for Retaining Wall RW4 will be founded near the toe of the new 2:1 embankment fill slope, partially on existing and new embankment fill. A level bench (2½ to 4 feet wide) will be constructed in front of the wall.

Based on our pocket penetrometer results (see Appendix B) for the cohesive soils, and the field blow counts recorded in Borings A-15-001 and A-15-002 for the silty sands, we anticipate that the insitu soil shear strength exceeds the shear strength developed using the granular soil properties (friction angle of 34 degrees and unit weight of 120 pcf) used for the standard plan wall design.

To develop the necessary passive resistance (passive wedge) against the face of the footing toe, we recommend that the minimum footing embedment be increased to 3 feet below finish grade in front of the walls, with the top of the footing located no closer than 6 feet (horizontally) away from the finish slope face.

Based on analysis performed for the taller Retaining Walls RW2 and RW3, Caltrans Standard Plan B3-1A (2015) can be used for Retaining Wall RW4 for heights up to 14 feet, provided our recommended footing embedment and footing distance from the slope face are incorporated into the design. In addition, all new embankment fill placed for slope construction within the retaining wall limits (and 5 feet beyond the ends of the walls) shall be structure backfill meeting the requirements of Section 8.1 of this report.

6.2 Global Stability Analysis

BCI evaluated global stability (static and pseudo-static) of Retaining Wall RW2 (12-foot wall height case) since this represents the tallest (most critical) finish slope with respect to the proposed retaining wall locations. We used the slope stability limit equilibrium program Slide 5.0 by Rocscience Inc. for our analysis. We modeled the existing clayey embankment fill with a unit weight of 125 pcf, cohesion of 2,500 psf and friction angle of zero. We modeled new embankment fill (structure backfill) with a unit weight of 120 pcf, cohesion of zero, and friction angle of 34 degrees. For pseudo-static (seismic analysis), we used a conservative horizontal seismic acceleration coefficient of 0.2g.

Our global stability analysis yielded a static safety factor of 3.7 and pseudo-static safety factor of 2.8, which are above the minimum acceptable safety factors of 1.5 (static) and 1.1 (pseudo-static). The results indicate that Retaining Walls RW1-RW4 should be globally stable.

We present our global stability analysis output in Appendix C.

6.3 Soil Corrosivity

Table 2 presents our soil corrosivity test results.

Table 2: Soil Corrosion Test Summary						
Boring	Sample No.	Depth (ft)	Minimum Resistivity (ohm-cm)	pH	Chloride Content (ppm)	Sulfate Content (ppm)
A-15-002	3	10.5-11.0	380	7.97	125	308
A-15-003	3	6.5-8.0	830	8.11	49	31

Caltrans considers soils corrosive to foundation elements if one or more of the following conditions exist:

- Chloride concentration is 500 parts per million (ppm) or greater,
- Sulfate concentration is 2000 ppm or greater,
- pH is 5.5 or less.

Based on the laboratory test results, the site soils are classified as “non-corrosive” to structural wall elements according Caltrans Corrosion Guidelines (Version 2.0, November 2012).

7. CONSTRUCTION CONSIDERATIONS

7.1 Embankment Settlement Waiting Period

Based on the generally very stiff to hard clay and/or medium dense to dense silty sand encountered in the borings, a settlement waiting period is not required from the end of embankment fill placement to the beginning of retaining wall foundation construction.

7.2 Temporary Excavation and Shoring

The contractor is responsible for design and construction of excavation sloping and shoring in accordance with CalOSHA Standards.

7.3 Perched Water and Over-Optimum Soil Moisture

During the rainy season, infiltrating rain water can pond upon less permeable underlying soil creating a perched water condition. This perched water condition may extend into the late spring or early summer season. If perched groundwater or surface water is encountered, sump pumps may be required to facilitate construction.

Excessively over-optimum (wet) soil conditions can make proper compaction difficult or impossible. Wet soil is commonly encountered during the winter and spring months, or in excavations where groundwater or perched groundwater is encountered.

In general, wet soil can be mitigated by:

- Discing the soil during prolonged periods of warm, dry weather (late spring to early fall months)
- Overexcavation and replacement with drier material
- Lime treatment or stabilization using aggregate and or stabilization fabric

We anticipate that over-optimum (wet) soil conditions, and resulting unstable soil, will exist at the site from late October through late April during normal years. To avoid delays and additional costs to dry and/or stabilize subgrade and fill, we recommend scheduling grading during the drier late spring to early fall months.

If wet, unstable soil is encountered, BCI can observe the conditions and provide more specific mitigation recommendations.

7.4 Erosion

Embankment slopes and areas disrupted by grading are susceptible to erosion from surface runoff. Fill slopes will require erosion control, such as vegetation, and control of surface runoff.

8. EARTHWORK RECOMMENDATIONS AND SPECIFICATIONS

In this section, we present our recommended geotechnical specifications, and special provisions to be used in design and construction of the retaining wall portions of the project. If designers have questions or issues with any of these recommendations, or if conditions are found to be different during construction, contact BCI to determine if additional fieldwork, analysis, or recommendations are required.

Where referenced below, Standard Specifications and Standard Plans refer to the 2015 California Department of Transportation (Caltrans) Standard Specifications and Standard Plans.

Earthwork shall be performed in accordance with Section 19 of the Standard Specifications. Structural Backfill shall conform to Section 19-3 of the Standard Specifications. Clearing and Grubbing shall be performed as described and within the limits provided in Section 16 of the Standard Specifications. In addition, earthwork and structural backfill shall be in accordance with the following special provisions. If a conflict exists between the Standard Specifications and special provisions below, the special provisions govern.

8.1 Special Provision for New Embankment Fill

All new embankment fill placed for slope construction within the retaining wall limits (and 5 feet beyond the ends of the walls) shall be compacted to at least 95 percent, have a Sand Equivalent of not less than 20, and comply with the gradation requirements below:

- 100 percent passing the 3-inch Sieve.
- 90-100 percent passing the 1-inch Sieve.
- 50-100 percent passing the No. 4 Sieve.
- 15-40 percent passing the No. 200 Sieve.

The requirement of Section 19-6.03A of the Standard Specifications for cutting into the existing embankment slope at least 6 feet horizontally as each layer of new embankment fill is placed shall not be waived.

8.2 Special Provision for Footing Excavation Observation

Prior to placing reinforcing steel, all retaining wall spread footing excavations must be observed by a BCI engineer to verify that expected bearing materials have been exposed.

9. RISK MANAGEMENT

Our experience and that of our profession clearly indicates that the risks of costly design, construction, and maintenance problems can be significantly lowered by retaining the geotechnical engineer of record to provide additional services during design and construction. For this project, BCI should be retained to:

- Review and provide comments on the civil plans and specifications prior to construction.
- Monitor construction to check and document our report assumptions. At a minimum, BCI should monitor grading within retaining wall areas, retaining wall footing excavations and retaining wall backfill compaction.
- Update this report if design changes occur, 2 years or more lapses between this report and construction, and/or site conditions have changed.

If we are not retained to perform the above applicable services, we are not responsible for any other party's interpretation of our report, and subsequent addendums, letters, and discussions

10. DIFFERING SITE CONDITIONS AND GDR LIMITATIONS

BCI based this report on the observed site conditions. We assume the soil and groundwater conditions encountered in our borings are representative of the subsurface conditions across the site. Actual conditions between boring locations can be different. If differing site conditions are encountered, contact BCI immediately to provide additional recommendations.

BCI performed services in accordance with generally accepted geotechnical engineering principles and practices currently used in this area. We do not warranty our services.

Our scope did not include evaluation of flood potential or biological pollutants. Contact BCI if you would like an evaluation of one or more of these issues.

The Log of Test Borings are presented in Appendix A. The lines designating the interface between soil types are approximate. The transition between material types may be abrupt or gradual. Our recommendations are based on the final logs, which represent our interpretation of the field logs, general knowledge of the site, and geological conditions.

Modern design and construction are complex, with many regulatory sources/restrictions, involved parties, construction alternatives, etc. It is common to experience changes and delays. The owner should set aside a reasonable contingency fund based on complexities and cost estimates to cover changes and delays.

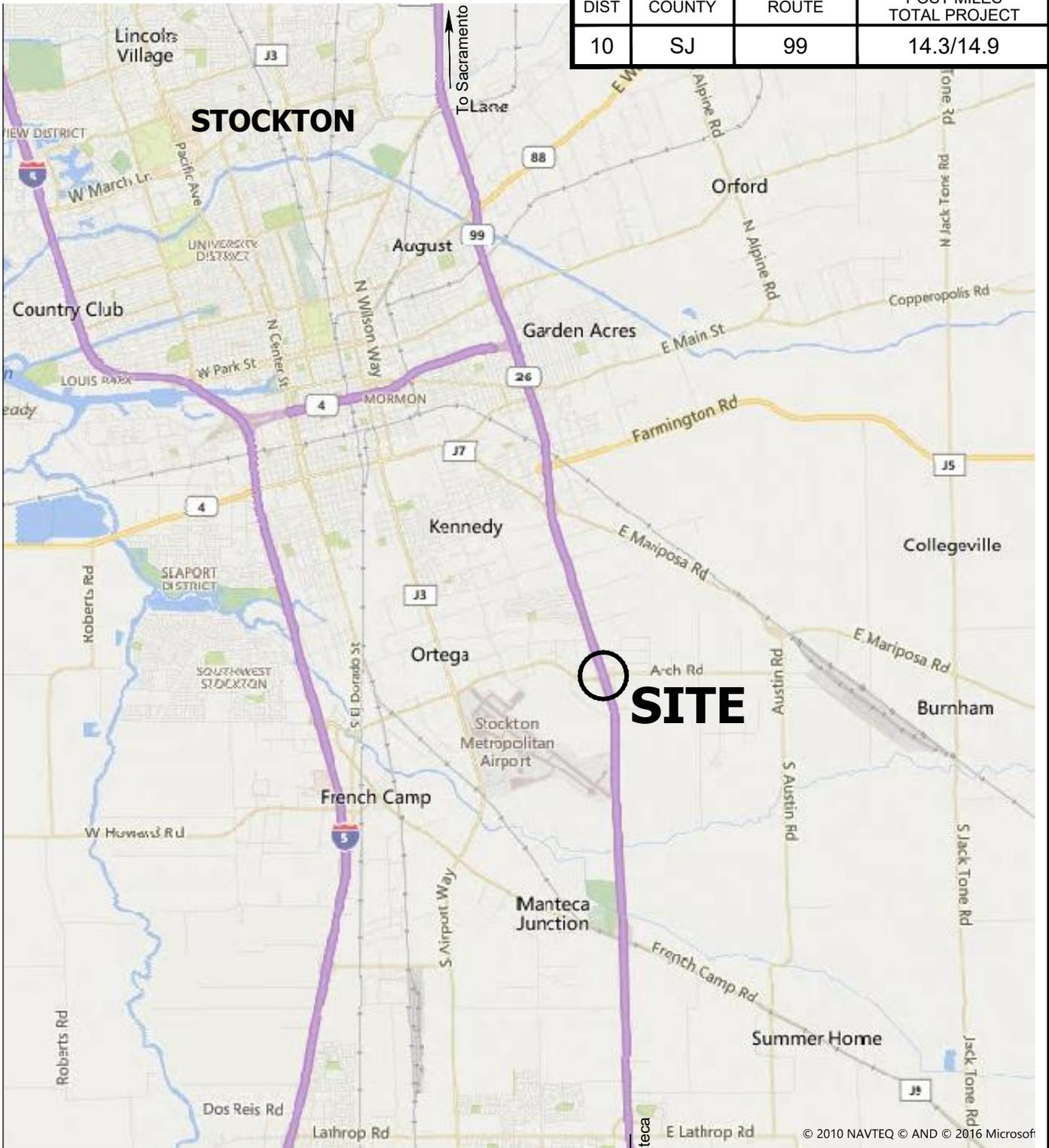
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APPENDIX A

Figure 1 – Vicinity Map
Log of Test Borings-Sheets 1-2



DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT
10	SJ	99	14.3/14.9



NO SCALE

3/28/2016 1201.x Fig1 Arch Road SF-99 Ramp Improvements.dwg



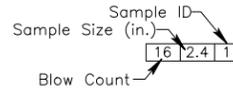
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VICINITY MAP
 Retaining Walls at Route 99/Arch Road
 Interchange, EA 10-1C4214
 San Joaquin County, California

File No. 1201.x
 March 2016
 Figure 1

NOTES:

- Field classification of soils was in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual 2010.
- Legends sheets are not included in plan set. See Caltrans Standard Plans, 2015 Edition, sheets A10F, A10G (soil legends), and A10H (rock legend). Sample ID is shown on the boring log as;
- Standard Penetration Tests were performed in accordance with ASTM D 1586 using an automated drop system. Drill rods were 1 5/8-inch diameter "A"-rods; sampler was driven with brass liners.
- Where indicated by an asterisk (*) the number of blows shown is for only that fraction of the initial 0.5 ft. "seating drive" interval penetrated.
- If laboratory tests are not shown as being performed, the soil descriptions presented in the LOTB are based solely on the visual practices described in the before mentioned Manual.
- The length of each sampled interval is shown graphically on the boring log.
- Consistency of soils shown in () where estimated.
- Groundwater surface (GWS) reflect the fluid level in the borings on the specified date. Groundwater surface is subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at any particular time.
- Boring elevations are approximate and based on "Topography" shown on Layout sheets referenced in note 10 below.
- Plan view developed from Layout Sheets L-1 and L-2, dated 1/8/2016, by HDR Engineering, Inc.



BENCHMARK
 BENCHMARK# 502 ELEV. 30.59 NAVD 83
 DESCRIPTION: KSNCONTROLRBRG,
 NORTHING 2152719.97, EASTING 6353714.81.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
10	SJ	99	14.3/14.9	38	52

REGISTERED CIVIL ENGINEER
 DATE 3/28/16

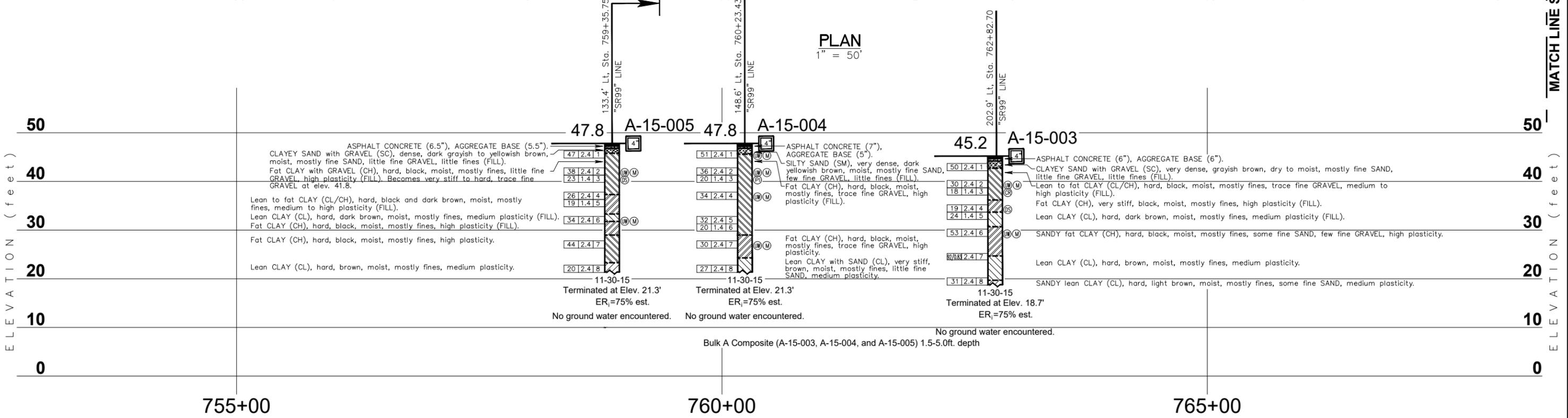
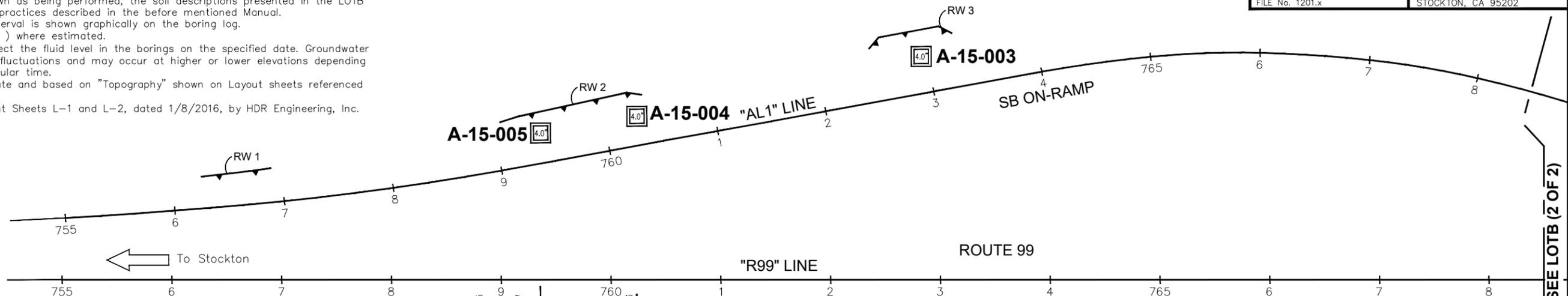
David J. Morrell
 No. 60578
 Exp. 12/31/16
 CIVIL

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

BLACKBURN CONSULTING
 2491 BOATMAN AVENUE
 WEST SACRAMENTO, CA 95691
 FILE No. 1201.x

SAN JOAQUIN COUNCIL OF GOVERNMENTS
 555 E. WEBER AVE.
 STOCKTON, CA 95202



3/28/2016 1201.x Arch Road SR-99 Ramp Improvements LOTB.dwg

MATCH LINE SEE LOTB (2 OF 2) TIME PLOTTED => \$DATE USERNAME => \$USER

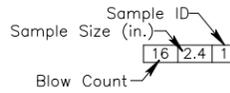
SHEIKH ALAM DESIGN OVERSIGHT	DRAWN BY M. ROBERTSON	K. A. CHAPMAN FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY M. WRIGHT	DATE: NOVEMBER 2015

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	HENRY LUU PROJECT ENGINEER
--------------------------------------------------------------------------------	-------------------------------

BRIDGE NO.	RETAINING WALLS NO. 1, 2, AND 3
POST MILE 14.3/14.9	
LOG OF TEST BORINGS (1 OF 2)	

NOTES:

- Field classification of soils was in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual 2010.
- Legends sheets are not included in plan set. See Caltrans Standard Plans, 2015 Edition, sheets A10F, A10G (soil legends), and A10H (rock legend). Sample ID is shown on the boring log as;
- Standard Penetration Tests were performed in accordance with ASTM D 1586 using an automated drop system. Drill rods were 1 5/8-inch diameter "A"-rods; sampler was driven with brass liners.
- Where indicated by an asterisk (*) the number of blows shown is for only that fraction of the initial 0.5 ft. "seating drive" interval penetrated.
- If laboratory tests are not shown as being performed, the soil descriptions presented in the LOTB are based solely on the visual practices described in the before mentioned Manual.
- The length of each sampled interval is shown graphically on the boring log.
- Consistency of soils shown in () where estimated.
- Groundwater surface (GWS) reflect the fluid level in the borings on the specified date. Groundwater surface is subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at any particular time.
- Boring elevations are approximate and based on "Topography" shown on Layout sheets referenced in note 10 below.
- Plan view developed from Layout Sheets L-1 and L-2, dated 1/8/2016, by HDR Engineering, Inc.



BENCHMARK
 BENCHMARK# 502 ELEV. 30.59 NAVD 83
 DESCRIPTION: KSNCONTROLRBC,
 NORTHING 2152719.97, EASTING 6353714.81.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
10	SJ	99	14.3/14.9	39	52

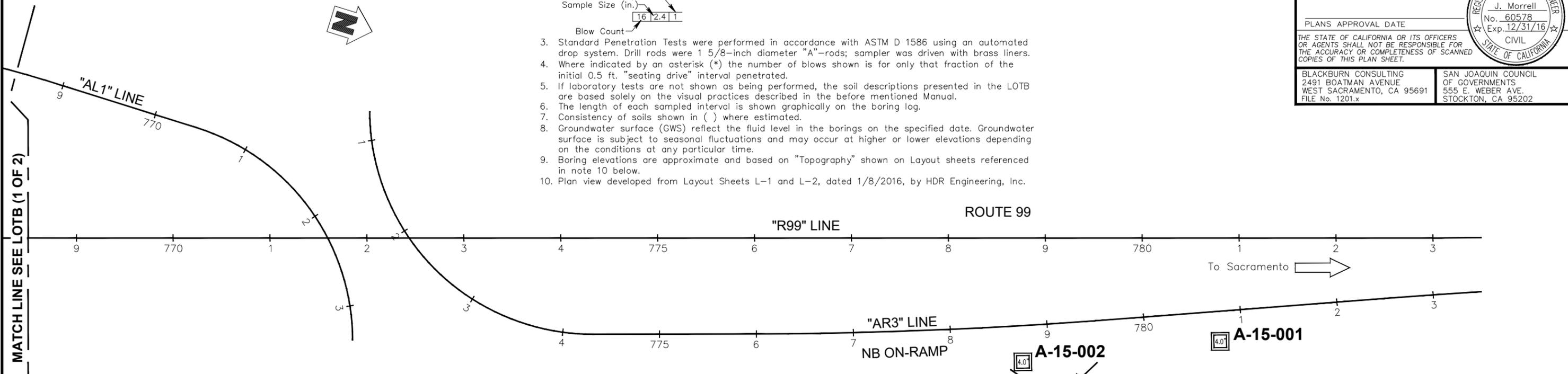
REGISTERED CIVIL ENGINEER **David J. Morrell**
 No. 60578
 Exp. 12/31/16
 CIVIL
 STATE OF CALIFORNIA

PLANS APPROVAL DATE: 3/28/16

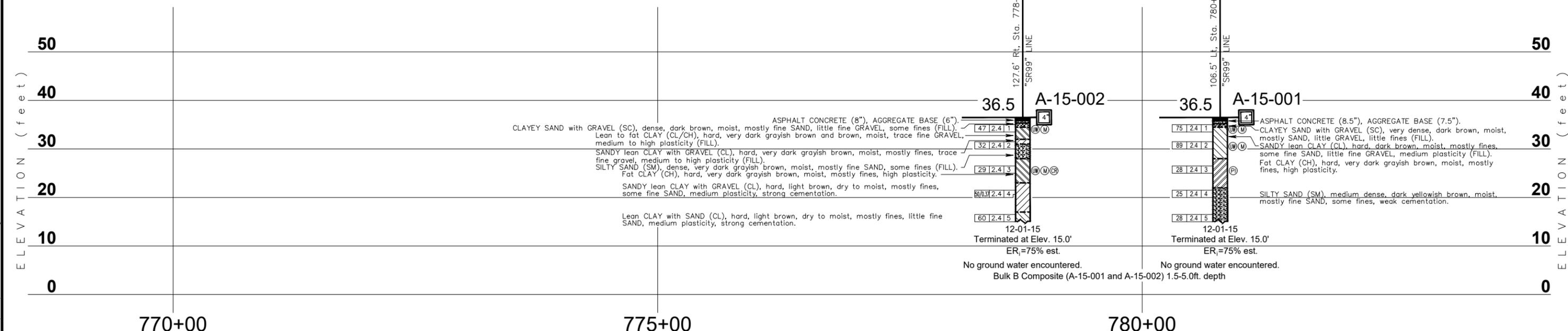
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BLACKBURN CONSULTING
 2491 BOATMAN AVENUE
 WEST SACRAMENTO, CA 95691
 FILE No. 1201.x

SAN JOAQUIN COUNCIL OF GOVERNMENTS
 555 E. WEBER AVE.
 STOCKTON, CA 95202



PLAN
 1" = 50'



PROFILE
 HOR. 1"=50'
 VERT. 1"=10'

3/28/2016 1201.x Arch Road SR=99 Ramp Improvements LOTB.dwg

DATE PLOTTED => \$DATE USERNAME => \$USER

SHEIKH ALAM DESIGN OVERSIGHT	DRAWN BY M. ROBERTSON	K. A. CHAPMAN FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	HENRY LUU PROJECT ENGINEER	BRIDGE NO.	RETAINING WALL NO. 4 LOG OF TEST BORINGS (2 OF 2)
SIGN OFF DATE	CHECKED BY M. WRIGHT	DATE: DECEMBER 2015	PROJECT NUMBER & PHASE: 1015000131	CONTRACT NO.: 10-1C4214	POST MILE 14.3/14.9	

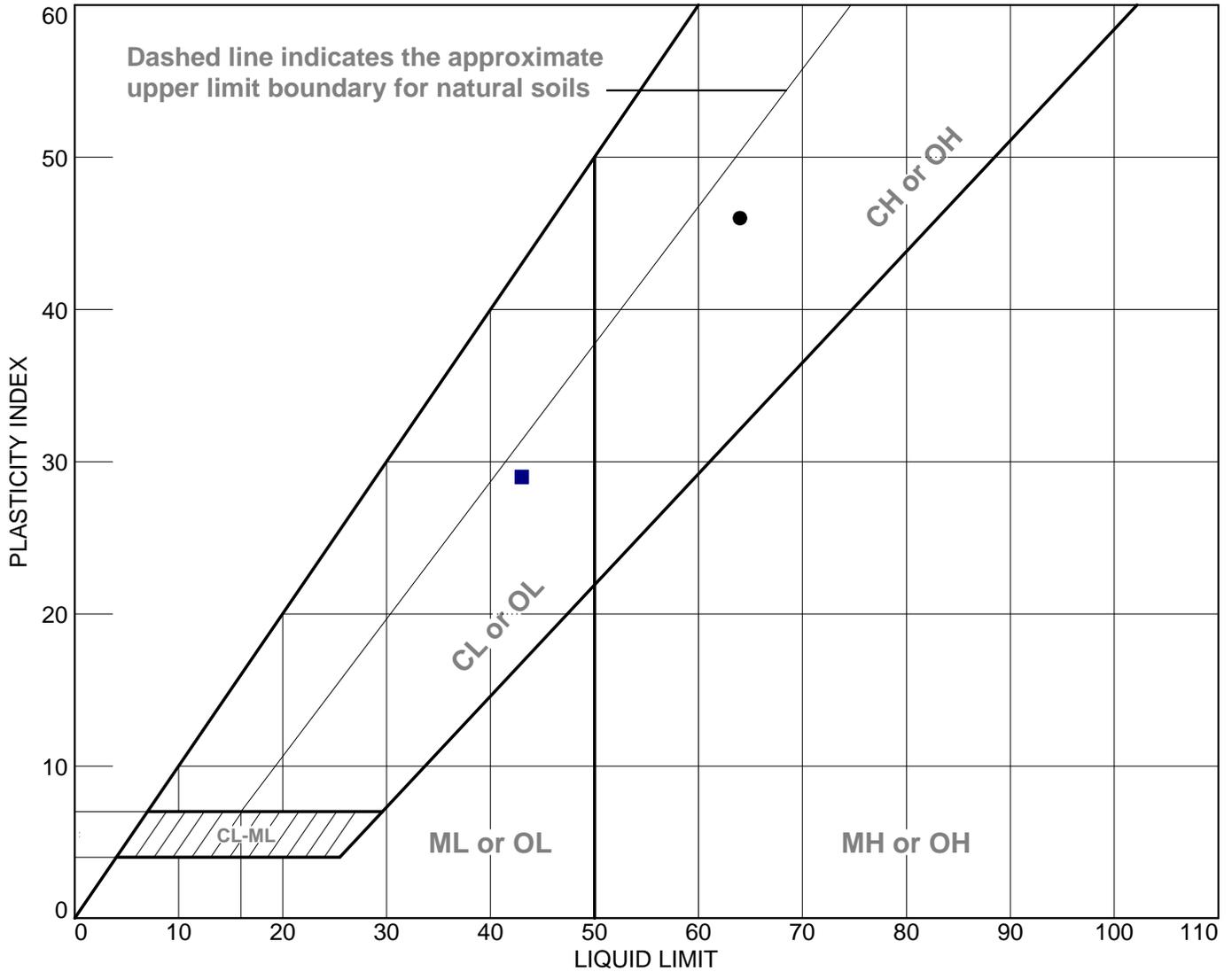
**GEOTECHNICAL DESIGN REPORT
FOR RETAINING WALLS AT ROUTE 99/ARCH ROAD INTERCHANGE
FOR SAN JOAQUIN COUNCIL OF GOVERNMENTS
Arch Road/State Route 99 Ramp Improvements
San Joaquin County, California
*EA 10-1C4214; 10-SJ-99; PM 14.3/14.9***

APPENDIX B

Laboratory Results



LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	A-15-001	3B	10.5-11.0'		18	64	46	CH
■	A-15-004	3	6.5-8.0'		14	43	29	CL

Blackburn Consulting

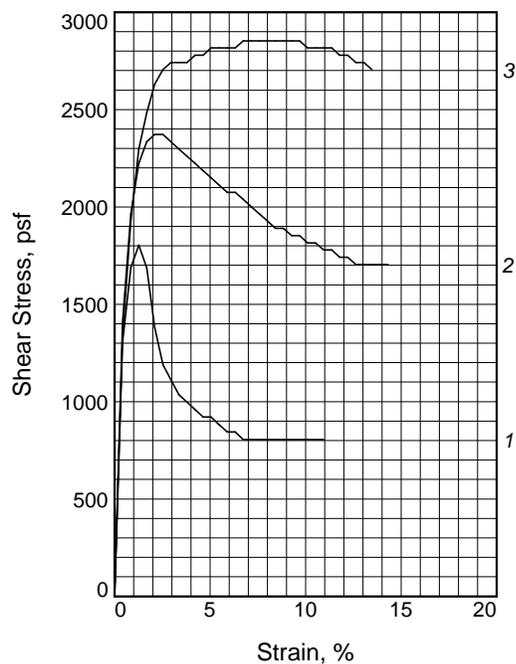
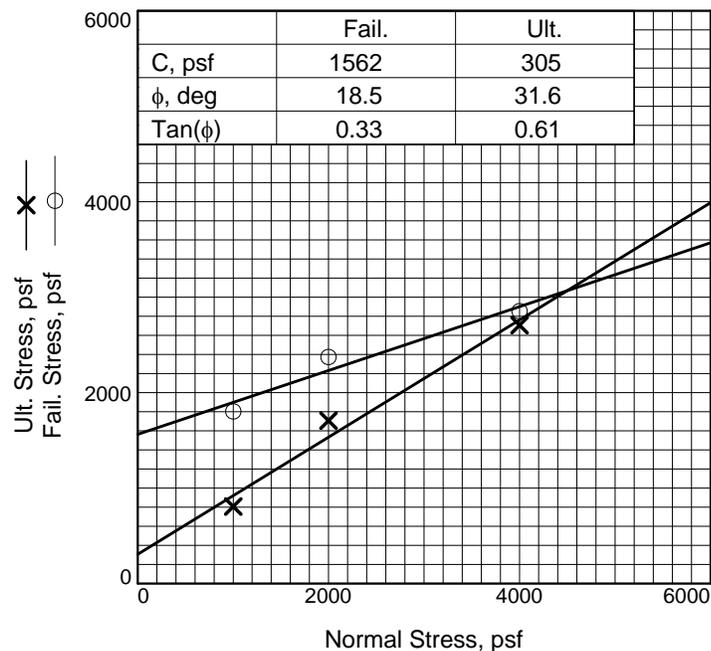
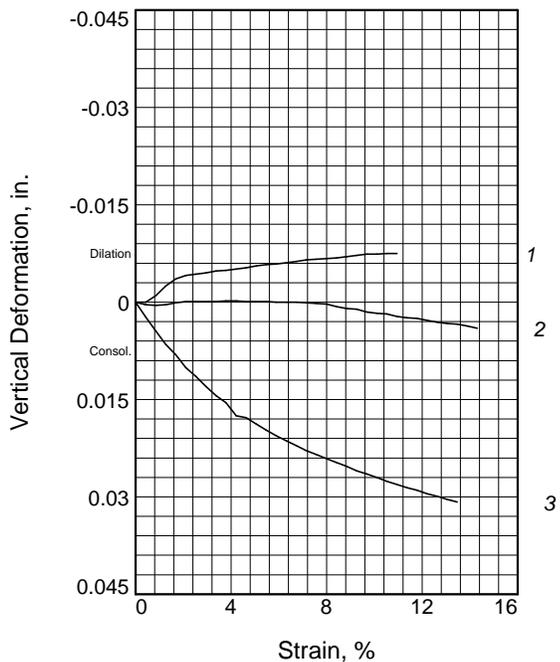
W. Sacramento, CA

Client: HDR Inc.

Project: Arch Rd./SR99 NB and SB Diagonal On-Ramp Widening

Project No.: 1201.x

Figure



Sample No.	1	2	3	
Initial	Water Content, %	17.0	17.0	18.9
	Dry Density, pcf	108.8	108.6	105.8
	Saturation, %	83.5	83.0	86.2
	Void Ratio	0.5486	0.5519	0.5930
	Diameter, in.	2.38	2.38	2.38
	Height, in.	0.94	0.94	0.94
At Test	Water Content, %	20.5	20.0	20.5
	Dry Density, pcf	108.5	109.5	108.5
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5530	0.5394	0.5539
	Diameter, in.	2.38	2.38	2.38
	Height, in.	0.95	0.94	0.92
Normal Stress, psf	1000	2000	4000	
Fail. Stress, psf	1803	2372	2853	
Strain, %	1.3	2.1	6.7	
Ult. Stress, psf	805	1705	2705	
Strain, %	6.7	12.6	13.5	
Strain rate, %/min.	0.05	0.05	0.05	

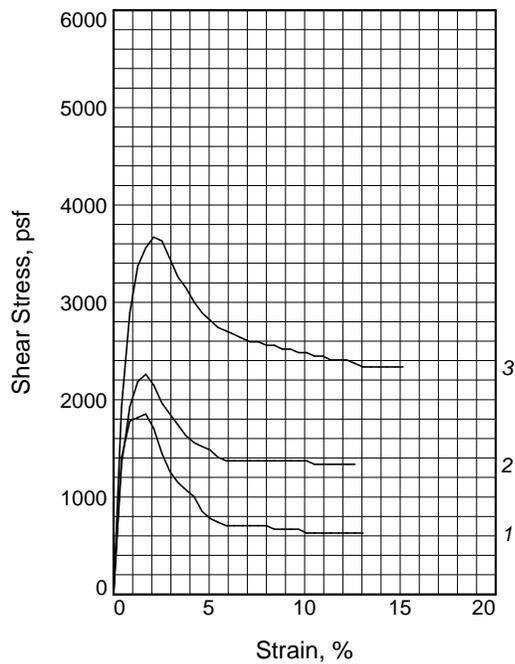
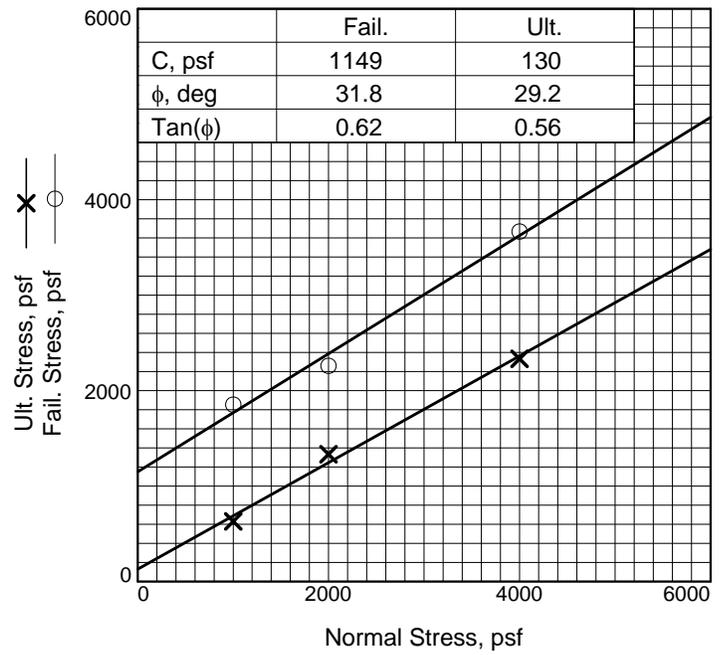
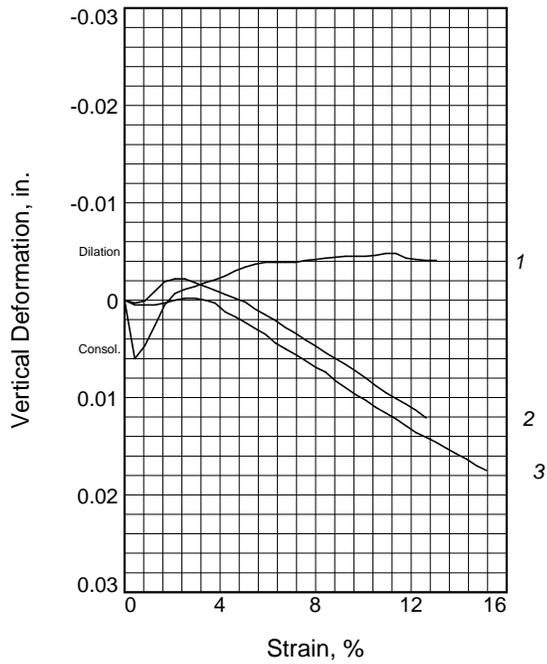
Sample Type: Undisturbed
Description: Fat CLAY, dark yellowish brown

Assumed Specific Gravity= 2.70
Remarks: ASTM D3080
 3rd Point sampled from 4b

Client: HDR Inc.
Project: Arch Rd./SR99 NB and SB Diagonal On-Ramp Widening
Source of Sample: A-15-003 **Depth:** 11.0-11.5'
Sample Number: 4b,c
Proj. No.: 1201.x **Date Sampled:** 11/30/2015

DIRECT SHEAR TEST REPORT
 Blackburn Consulting
 W. Sacramento, CA

Figure _____



Sample No.	1	2	3	
Initial	Water Content, %	17.5	17.5	17.5
	Dry Density, pcf	107.7	105.4	108.6
	Saturation, %	83.4	78.7	85.4
	Void Ratio	0.5652	0.5986	0.5518
	Diameter, in.	2.38	2.38	2.38
	Height, in.	0.94	0.94	0.94
At Test	Water Content, %	20.9	21.8	19.7
	Dry Density, pcf	107.7	106.0	110.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5652	0.5899	0.5318
	Diameter, in.	2.38	2.38	2.38
	Height, in.	0.94	0.94	0.93
Normal Stress, psf	1000	2000	4000	
Fail. Stress, psf	1853	2260	3668	
Strain, %	1.7	1.7	2.1	
Ult. Stress, psf	630	1334	2334	
Strain, %	10.1	10.5	13.1	
Strain rate, %/min.	0.05	0.05	0.05	

Sample Type: Undisturbed
Description: Lean CLAY, dark yellowish brown

Assumed Specific Gravity= 2.70
Remarks: ASTM D3080

Figure _____

Client: HDR Inc.

Project: Arch Rd./SR99 NB and SB Diagonal On-Ramp Widening

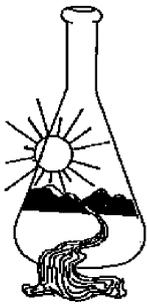
Source of Sample: A-15-005 **Depth:** 11.0-11.5'

Sample Number: 4C

Proj. No.: 1201.x

Date Sampled: 11/30/2015

DIRECT SHEAR TEST REPORT
 Blackburn Consulting
 W. Sacramento, CA



Sunland Analytical
11419 Sunrise Gold Cir.#10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/16/15
Date Submitted 12/09/15

To: David Morrell
Blackburn Consulting
2491 Boatman Ave
West Sacramento, 95691

From: Gene Oliphant, Ph.D. \ Randy Horney 
General Manager \ Lab Manager

The reported analysis was requested for the following:
Location : 1201.X A-15-002 Site ID: 3B
Thank you for your business.

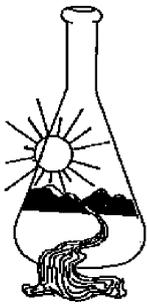
* For future reference to this analysis please use SUN # 70958 - 148036

EVALUATION FOR SOIL CORROSION

Soil pH	7.97		
Minimum Resistivity	0.38	ohm-cm (x1000)	
Chloride	124.5 ppm	0.0125	%
Sulfate-S	307.9 ppm	0.0308	%

METHODS:

pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422



Sunland Analytical
11419 Sunrise Gold Cir.#10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/16/15
Date Submitted 12/09/15

To: David Morrell
Blackburn Consulting
2491 Boatman Ave
West Sacramento, 95691

From: Gene Oliphant, Ph.D. \ Randy Horney 
General Manager \ Lab Manager

The reported analysis was requested for the following:
Location : 1201.X A-15-003 Site ID: 3
Thank you for your business.

* For future reference to this analysis please use SUN # 70958 - 148037

EVALUATION FOR SOIL CORROSION

Soil pH	8.11		
Minimum Resistivity	0.83	ohm-cm (x1000)	
Chloride	49.2 ppm	0.0049	%
Sulfate-S	30.9 ppm	0.0031	%

METHODS:

pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422



Project Name: SR99/Arch Road Ramp Widening

Page 1 of 2

BCI File No: 1201.X

Date: 12/18/2015

Technician: RMS

MOISTURE-DENSITY TESTS

ASTM D 2216 / D 2937

Sample No.	A-15-001-1C	A-15-001-2C	A-15-002-1C	A-15-002-3C	A-15-003-2C	A-15-003-6C
Depth (ft.)	2.5-3.0	6.0-6.5	2.5-3.0	11.0-11.5	6.0-6.5	16.0-16.5
Moisture (%)	9.5	8.7	15.2	21.0	20.9	5.3
Wet Density (pcf)	141.6	143.6	138.3	126.1	132.4	126.5
Dry Density (pcf)	129.3	132.1	120.1	104.2	109.5	120.2
Pocket Pen (tsf)	>>4.5	>>4.5	>4.5	4.4	4.0	4.3

Sample: A-15-001-1C Description: Sandy Lean Clay

Moisture (Appearance): moist Consistency/Cementation:

Sample: A-15-001-2C Description: Sandy Lean Clay

Moisture (Appearance): moist Consistency/Cementation:

Sample: A-15-002-1C Description: Lean to Fat Clay

Moisture (Appearance): moist Consistency/Cementation:

Sample: A-15-002-3C Description: Fat CLAY

Moisture (Appearance): moist Consistency/Cementation:

Sample: A-15-003-2C Description: Lean to Fat Clay

Moisture (Appearance): moist Consistency/Cementation:

Sample: A-15-003-6C Description: Sandy Fat Clay

Moisture (Appearance): dry Consistency/Cementation:

Diameter = 1.44" for 1.5-inch Tubes
 Diameter = 1.938" for 2-inch Tubes

Diameter = 2.43" for 2.5-inch Brass / 2.40" for SS
 Diameter = 2.850" for 3.0-inch Shelby Tubes



Project Name: SR99/Arch Road Ramp Widening
 BCI File No: 1201.X
 Date: 12/18/2015
 Technician: RMS

MOISTURE-DENSITY TESTS

ASTM D 2216 / D 2937

Sample No.	A-15-004-1C	A-15-004-2C	A-15-004-4C	A-15-004-7C	A-15-005-2C	A-15-005-6C
Depth (ft.)	2.5-3.0	6.0-6.5	11.0-11.5	21.0-21.5	6.0-6.5	16.0-16.5
Moisture (%)	5.6	14.3	19.8	14.3	12.8	21.8
Wet Density (pcf)	130.2	133.4	129.8	132.8	130.1	125.6
Dry Density (pcf)	123.3	116.7	108.4	116.2	115.4	103.1
Pocket Pen (tsf)	2.6	2.3	3.8	>4.5	3.2	3.9

Sample:	A-15-004-1C	Description:	Fat CLAY
Moisture (Appearance):	dry	Consistency/Cementation:	
Sample:	A-15-004-2C	Description:	Fat CLAY
Moisture (Appearance):	moist	Consistency/Cementation:	
Sample:	A-15-004-4C	Description:	Fat CLAY
Moisture (Appearance):	moist	Consistency/Cementation:	Lensing
Sample:	A-15-004-7C	Description:	Fat CLAY
Moisture (Appearance):	moist	Consistency/Cementation:	
Sample:	A-15-005-2C	Description:	Fat CLAY with Gravel
Moisture (Appearance):	moist	Consistency/Cementation:	
Sample:	A-15-005-6C	Description:	Fat CLAY
Moisture (Appearance):	moist	Consistency/Cementation:	

Diameter = 1.44" for 1.5-inch Tubes
 Diameter = 1.938" for 2-inch Tubes

Diameter = 2.43" for 2.5-inch Brass / 2.40" for SS
 Diameter = 2.850" for 3.0-inch Shelby Tubes



Project Name: Arch Road/SR 99 Ramp Improvements
 Project No: 1201.X

FIELD POCKET PENETROMETER TEST RESULTS

Boring Number	Date Tested	Depth (ft.)	Unconfined Compressive Strength (TSF)
A-15-001	12/1/2015	2.5	>4.5
		6.0	>4.5
		11.0	4.0
A-15-002	12/1/2015	2.5	>4.5
		11.0	>4.5
		15.5	>4.5
		21.0	>4.5
A-15-003	11/30/2015	3.0	4.25
		6.0	>4.5
		11.0	3.25
		16.0	>4.5
		21.0	>4.5
A-15-004	11/30/2015	26.0	>4.5
		3.0	>4.5
		6.0	>4.5
		8.0	>4.5
		11.0	4.5
		16.0	3.5
A-15-005	11/30/2015	21.0	>4.5
		26.0	2.5
		3.0	>4.5
		6.5	4.0
		8.0	>4.5
		11.5	>4.5
		13.0	>4.5
16.0	>4.5		
21.0	>4.5		
26.0	>4.5		

**GEOTECHNICAL DESIGN REPORT
FOR RETAINING WALLS AT ROUTE 99/ARCH ROAD INTERCHANGE
FOR SAN JOAQUIN COUNCIL OF GOVERNMENTS
Arch Road/State Route 99 Ramp Improvements
San Joaquin County, California
*EA 10-1C4214; 10-SJ-99; PM 14.3/14.9***

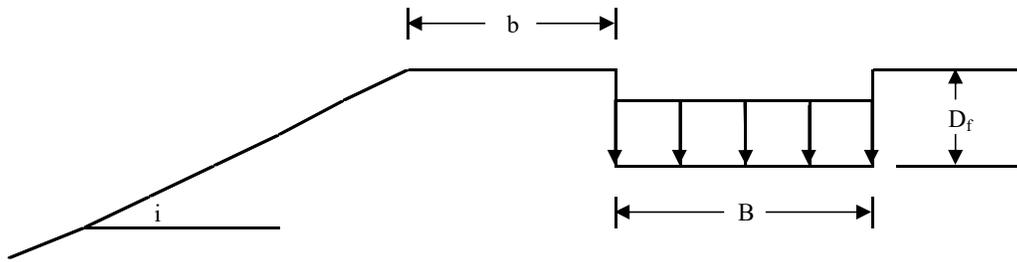
APPENDIX C

Engineering Analysis Results



Modified Bearing Capacity Factor for Footing Adjacent to Sloping Ground after Meyerhof (1957)

Date: 1/21/2016
 Project: Arch Rd/SR99 Ramp Widening
 Support: RETAINING WALLS RW2 AND RW3 (10' Height Case)
 Boring: A-15-004 and A-15-005
 BCI No.: 1201.X
 By: DJM



Input Parameters:

Depth to Bottom of Footing, $D_f = 3.00$ feet
 Footing Width, $B = 3.00$ feet
 Footing to Slope Distance, $b = 2.00$ feet
 Slope Inclination, $i = 26.6$ degrees
 $D_f/B = 1.00$ ($D/B \leq 1$)
 $b/B = 0.67$

Soil Unit Weight, $\gamma = 120$ (pcf)
 Friction Angle, $\phi = 34$ ($\phi \geq 30^\circ$)
 Cohesion, $c = 0$ (psf)

By Interpolation:

At $D_f/B = 0$

ϕ	$N_{\gamma q}$
30	8.9
34	20.8
40	38.6

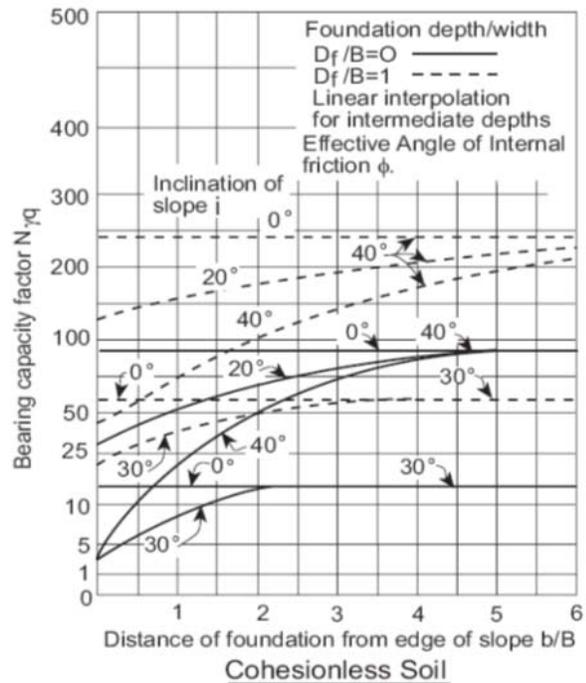
D_f/B	$N_{\gamma q}$
0.00	20.8
1.00	69.5
1.00	69.5

At $D_f/B = 1$

ϕ	$N_{\gamma q}$
30	36.6
34	69.5
40	118.8

Modified Bearing Capacity Factor:

$N_{\gamma q} = 69.5$



Reference: AASHTO LRFD Bridge Design Specifications, 6th Edition (2012).

Figure 10.6.3.1.2c-2 Modified Bearing Capacity Factors for Footing in Cohesionless Soils and Adjacent to Sloping Ground after Meyerhof (1957).

Nominal Bearing Resistance and Immediate Settlement Worksheet (LRFD)

Date: 1/21/2016
 Project: Arch Rd/SR99 Ramp Widening
 BCI No: 1201.X

Support: RETAINING WALLS RW2 AND RW3 (10' Height Case)
 Boring: A-15-004 and A-15-005
 By: DJM
 Check by: PFF Date: 1/28/16

	Effective Footing Width, B_f (feet)		Effective Footing Length, L_f (feet)
LRFD Service Limit State I Vertical Load (kips):	1286	6.0	134.0
LRFD Strength Limit State Load (kips):	1327	3.0	134.0
LRFD Extreme Event Limit State Load (kips):	1412	3.1	134.0

Ground Surface Elevation (feet):	40.0	(equal to footing bottom for a footing in fill above ex. grd. surface)
Ground Water Elevation (feet):	-25.0	
Depth to Ground Water (feet):	65.0	
Depth of footing (feet):	3.5	(for settlement analysis)
Time to Settlement (t):	0.1	

Bottom Footing Elevation (feet):	36.5	
Finished Grade (feet):	40.0	
Depth to Ground Water (feet):	65.0	(for bearing resistance analysis)
Depth of footing (feet):	3.5	
γ (pcf) =	120	Soil Parameters at base of footing
ϕ (degrees) =	34	
c (psf) =	0	
Resistance Factor (ϕ_b) =	0.45	

Permissible Settlement: 1.0 inch

Layer	Soil Description	Depth Bottom Layer (feet)	Layer Thickness (feet)	Top Elev. (feet)	Bottom Elev. (feet)	Soil Unit Weight (pcf)	Soil Type (1, 2, 3, or 4)	N_{160}	Es (tsf)	or Estimated Es (tsf)
1	CL/CH	25	25	40.0	15.0	125				500
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

Soil Types

- 1) Silts, sandy silts, slightly cohesive mixtures
- 2) Clean fine to medium sands and slightly silty sands
- 3) Coarse sands and sands with little gravel
- 4) Sandy gravel and gravels

Gross Nominal Bearing Resistance	Factored Gross Nominal Bearing Resistance
q_n (ksf)	q_R (ksf)
12.51	5.63

Gross Uniform Bearing Stress (Service Limit)	Net Bearing Stress (q'_o) (ksf)	Gross Uniform Bearing Stress (Strength Limit)	Gross Uniform Bearing Stress (Extreme Limit)
q_o (ksf)	q'_o (ksf)	q_o (ksf)	q_o (ksf)
1.60	1.16	3.30	3.40

Service Limit State Settlement Check	
1 inch	
q'_o (ksf)	q_{pn} (ksf)
1.16	14.90
OKAY	

Permissible Net Contact Stress	Permissible Gross Contact Stress	Immediate Settlement
q_{pn} (ksf)	q_{pg} (ksf)	S_i (inches)
14.90	15.34	1.00

Immediate Settlement under Net Bearing Stress due to Service Limit I State Load Combination
S_i (inches)
0.05

The Net Bearing Stress (q'_o) due to LRFD Service I load combination is used to evaluate footing settlement.

Strength Limit State Bearing Capacity Check	
q_o (ksf)	q_R (ksf)
3.30	5.63
OKAY	

References

- 1) Caltrans, Memo To Designers 4-1 Spread Footings, April 2008.
- 2) Nominal Bearing Resistance Equation (10.6.3.1.2a-1)
AASHTO LRFD Bridge Design Specifications, 6th Edition, 2012.
- 3) Schmertmann's Modified Method for Calculation of Immediate Settlements (1978),
Soils and Foundations - Volume II, FHWA NHI-06-089, December 2006.
- 4) Elastic Constants of Various Soils (Table C10.4.6.3-1)
AASHTO LRFD Bridge Design Specifications, 6th Edition, 2012.

Extreme Limit State Bearing Capacity Check	
q_o (ksf)	q_R (ksf)
3.40	5.63
OKAY	

The Gross Uniform Bearing Stress is equivalent to the Design Load.

Modified Bearing Capacity Factor for Footing Adjacent to Sloping Ground after Meyerhof (1957)

Date: 1/21/2016

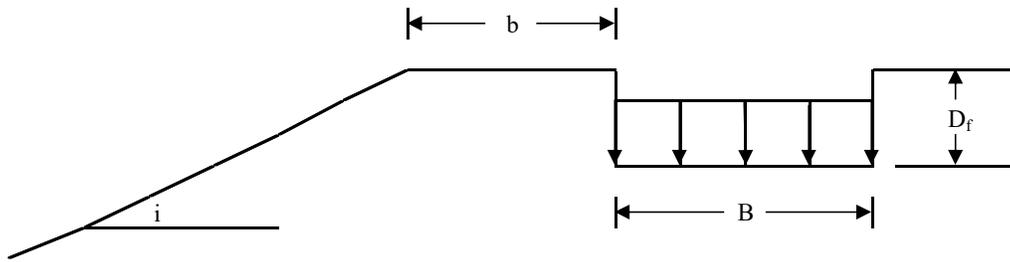
Project: Arch Rd/SR99 Ramp Widening

Support: RETAINING WALLS RW2 AND RW3 (14' Height Case)

Boring: A-15-003

BCI No.: 1201.X

By: DJM



Input Parameters:

Depth to Bottom of Footing, $D_f = 3.50$ feet

Footing Width, $B = 4.30$ feet

Footing to Slope Distance, $b = 2.00$ feet

Slope Inclination, $i = 26.6$ degrees

$D_f/B = 0.81$ ($D/B \leq 1$)

$b/B = 0.47$

Soil Unit Weight, $\gamma = 120$ (pcf)

Friction Angle, $\phi = 34$ ($\phi \geq 30^\circ$)

Cohesion, $c = 0$ (psf)

By Interpolation:

At $D_f/B = 0$

ϕ	$N_{\gamma q}$
30	7.1
34	17.7
40	33.5

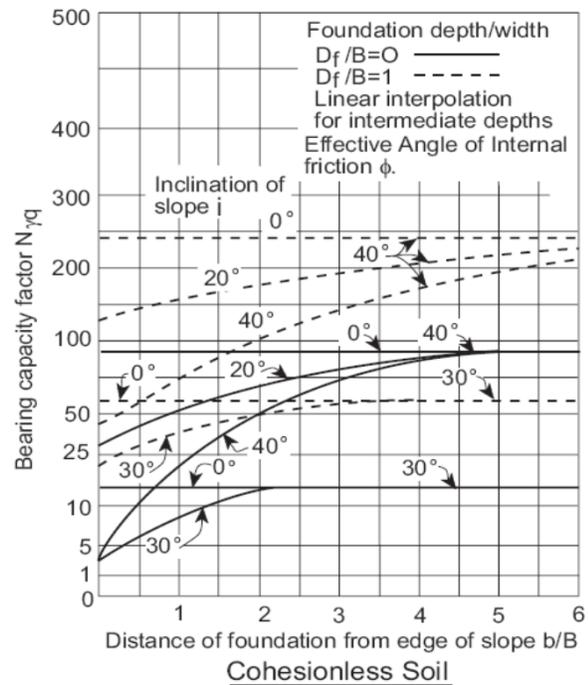
D_f/B	$N_{\gamma q}$
0.00	17.7
0.81	56.5
1.00	65.4

At $D_f/B = 1$

ϕ	$N_{\gamma q}$
30	34.3
34	65.4
40	112.0

Modified Bearing Capacity Factor:

$N_{\gamma q} = 56.5$



Reference: AASHTO LRFD Bridge Design
Specifications, 6th Edition, 2012.

Figure 10.6.3.1.2c-2 Modified Bearing Capacity Factors for Footing in Cohesionless
Soils and Adjacent to Sloping Ground after Meyerhof (1957).

Nominal Bearing Resistance and Immediate Settlement Worksheet (LRFD)

Date: 1/21/2016
 Project: Arch Rd/SR99 Ramp Widening
 BCI No: 1201.X

Support: RETAINING WALLS RW2 AND RW3 (14' Height Case)
 Boring: A-15-003
 By: DJM
 Check by: PFF Date: 1/28/16

	Effective Footing Width, B_f (feet)	Effective Footing Length, L_f (feet)
LRFD Service Limit State I Vertical Load (kips):	1213	77.0
LRFD Strength Limit State Load (kips):	1258	77.0
LRFD Extreme Event Limit State Load (kips):	1306	77.0

Ground Surface Elevation (feet):	35.0	(equal to footing bottom for a footing in fill above ex. grnd. surface)
Ground Water Elevation (feet):	-25.0	
Depth to Ground Water (feet):	60.0	
Depth of footing (feet):	3.5	(for settlement analysis)
Time to Settlement (t):	0.1	

Bottom Footing Elevation (feet):	31.5	
Finished Grade (feet):	35.0	
Depth to Ground Water (feet):	60.0	(for bearing resistance analysis)
Depth of footing (feet):	3.5	
γ (pcf) =	120	Soil Parameters at base of footing
ϕ (degrees) =	34	
c (psf) =	0	
Resistance Factor (ϕ_b) =	0.45	

Permissible Settlement: 1.0 inch

Layer	Soil Description	Depth Bottom Layer (feet)	Layer Thickness (feet)	Top Elev. (feet)	Bottom Elev. (feet)	Soil Unit Weight (pcf)	Soil Type (1, 2, 3, or 4)	N_{160}	or Estimated Es (tsf)
1	CL/CH	25	25	35.0	10.0	125			500
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

Soil Types

- 1) Silts, sandy silts, slightly cohesive mixtures
- 2) Clean fine to medium sands and slightly silty sands
- 3) Coarse sands and sands with little gravel
- 4) Sandy gravel and gravels

Gross Nominal Bearing Resistance	Factored Gross Nominal Bearing Resistance
q_n (ksf)	q_R (ksf)
14.58	6.56

Gross Uniform Bearing Stress (Service Limit)	Net Bearing Stress	Gross Uniform Bearing Stress (Strength Limit)	Gross Uniform Bearing Stress (Extreme Limit)
q_o (ksf)	$q'o$ (ksf)	q_o (ksf)	q_o (ksf)
2.10	1.66	3.80	5.30

Service Limit State Settlement Check	
1 inch	
q'_o (ksf)	q_{pn} (ksf)
1.66	11.50
OKAY	

Permissible Net Contact Stress	Permissible Gross Contact Stress	Immediate Settlement
q_{pn} (ksf)	q_{pg} (ksf)	S_i (inches)
11.50	11.94	0.99

Immediate Settlement under Net Bearing Stress due to Service Limit I State Load Combination
S_p (inches)
0.10

The Net Bearing Stress (q'_o) due to LRFD Service I load combination is used to evaluate footing settlement.

Strength Limit State Bearing Capacity Check	
q_o (ksf)	q_R (ksf)
3.80	6.56
OKAY	

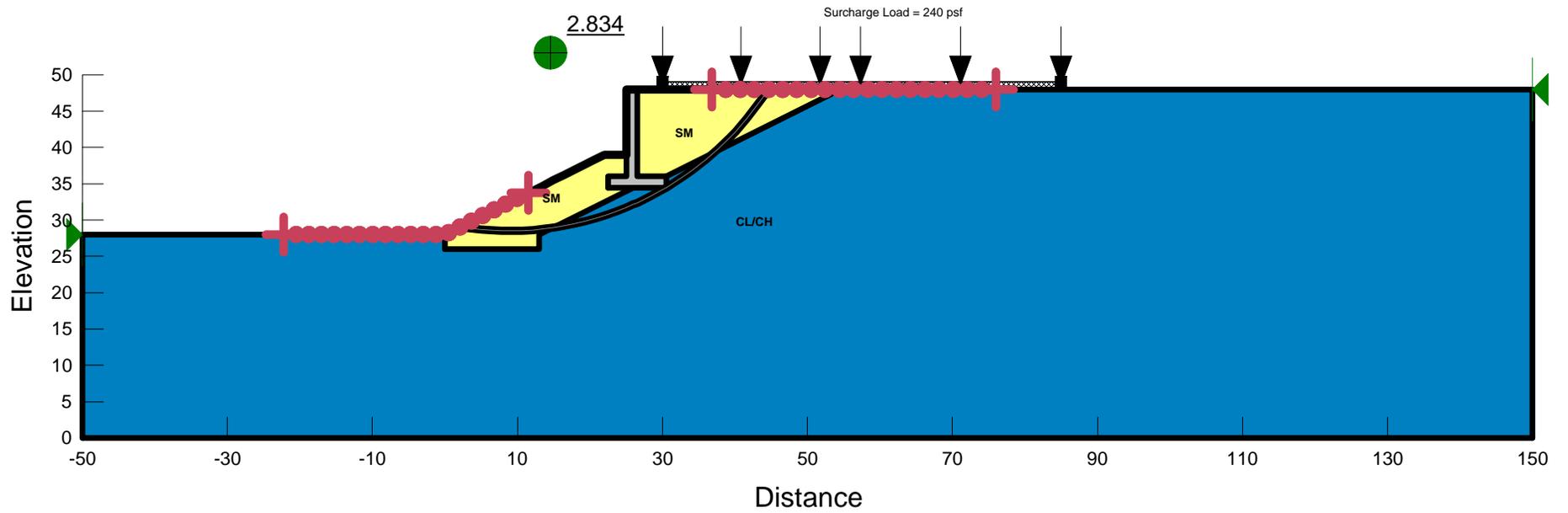
References

- 1) Caltrans, Memo To Designers 4-1 Spread Footings, April 2008.
- 2) Nominal Bearing Resistance Equation (10.6.3.1.2a-1) AASHTO LRFD Bridge Design Specifications, 6th Edition, 2012.
- 3) Schmertmann's Modified Method for Calculation of Immediate Settlements (1978), Soils and Foundations - Volume II, FHWA NHI-06-089, December 2006.
- 4) Elastic Constants of Various Soils (Table C10.4.6.3-1) AASHTO LRFD Bridge Design Specifications, 6th Edition, 2012.

Extreme Limit State Bearing Capacity Check	
q_o (ksf)	q_R (ksf)
5.30	6.56
OKAY	

The Gross Uniform Bearing Stress is equivalent to the Design Load.

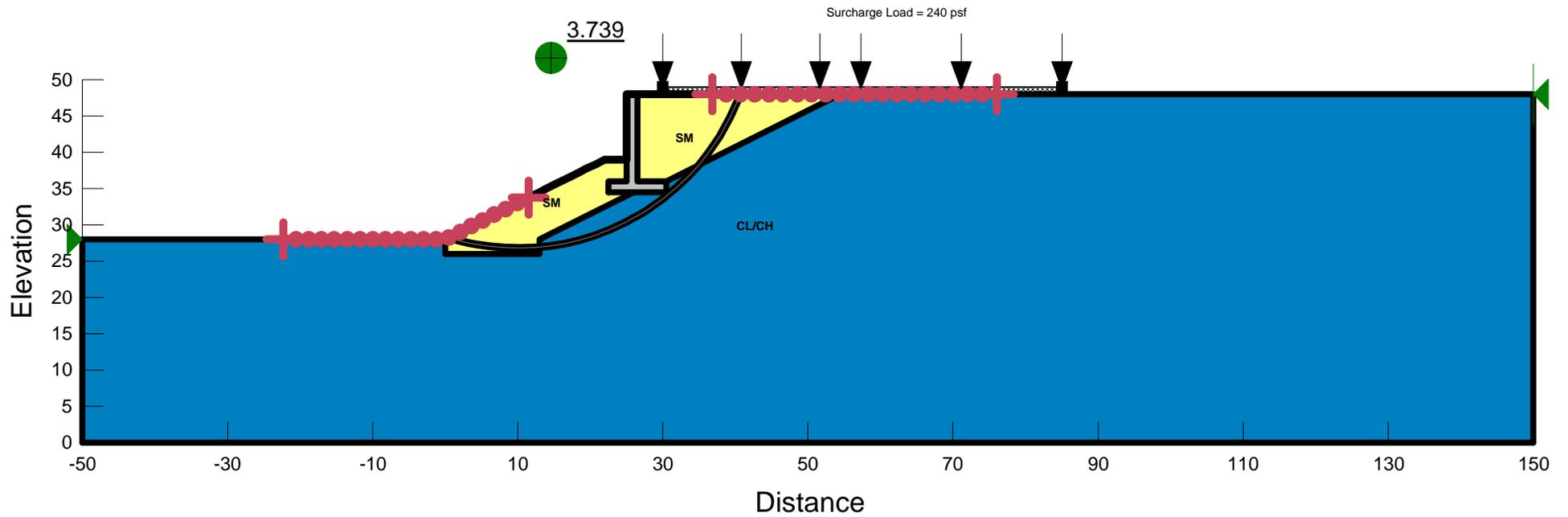
1201.X Arch Rd/SR99 Ramp Widening
 Retaining Wall No. 2 Global Stability Analysis
 Pseudo-Static Slope Stability $K_h = 0.2g$



Material Name, Unit Weight, Effective Cohesion, Effective Friction Angle

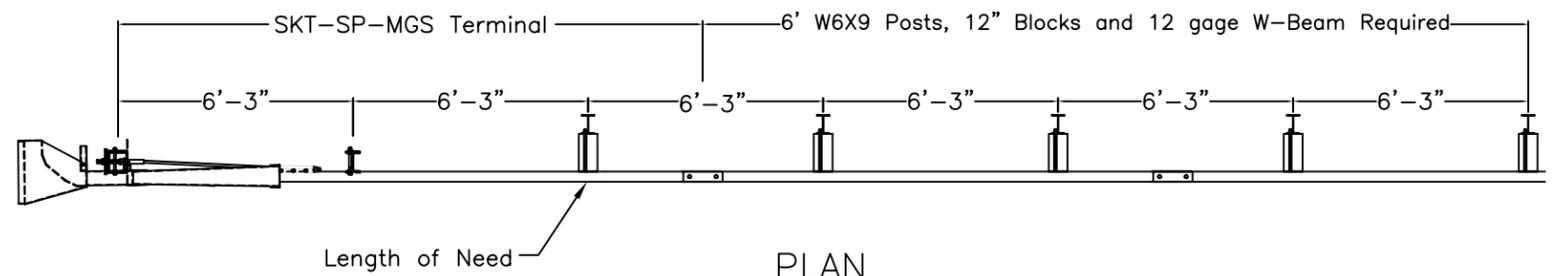
Concrete Footing	150 pcf	35000 psf	30 °
New Embankment Fill, Silty Sand	120 pcf	0 psf	34 °
Lean Clay/Fat Clay	125 pcf	2500 psf	0 °

1201.X Arch Rd/SR99 Ramp Widening
 Retaining Wall No. 2 Global Stability Analysis
 Static Slope Stability

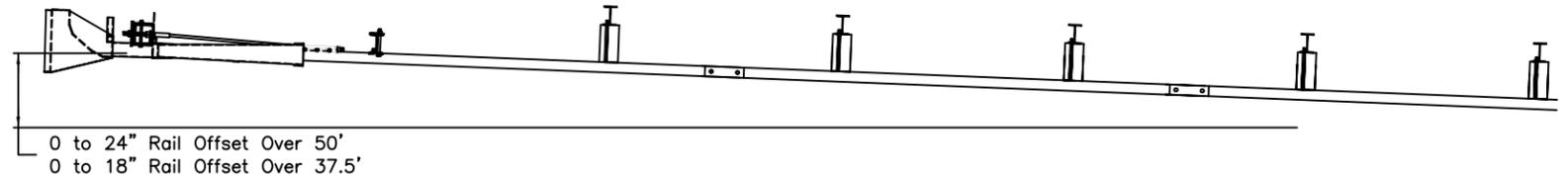
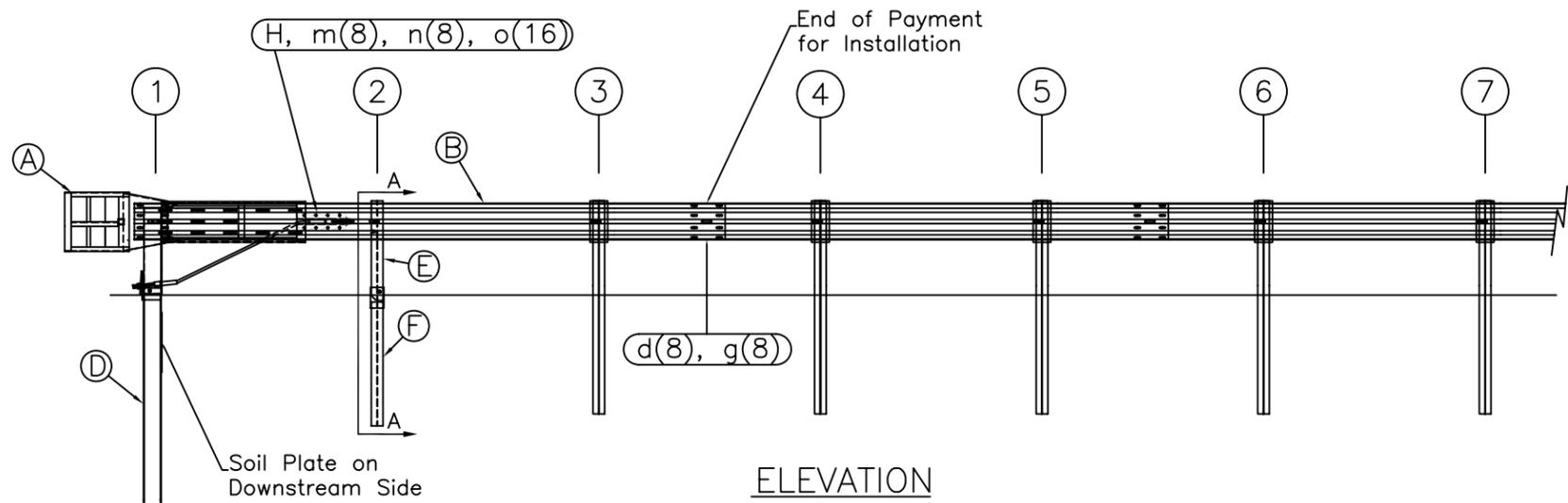


Material Name, Unit Weight, Effective Cohesion, Effective Friction Angle

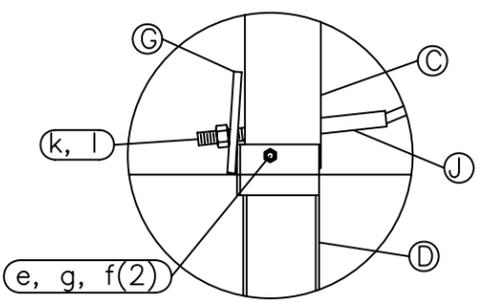
Concrete Footing	150 pcf	35000 psf	30 °
New Embankment Fill, Silty Sand	120 pcf	0 psf	34 °
Lean Clay/Fat Clay	125 pcf	2500 psf	0 °



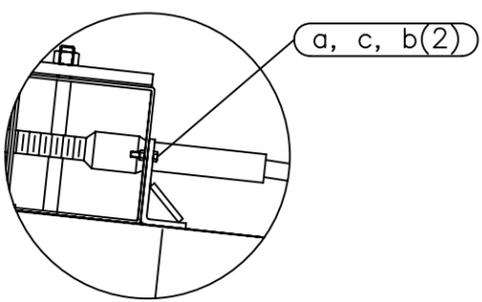
TRAFFIC →



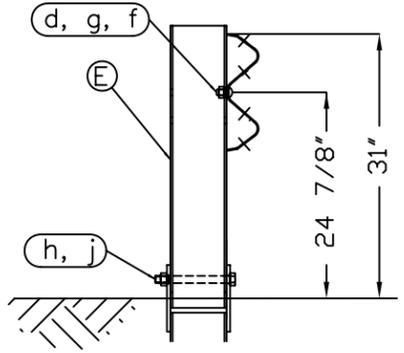
OPTIONAL FLARED INSTALLATION
25:1 maximum flare rate



Post #1 Connection Detail



Impact Head Connection Detail



SECTION A-A
Post #2

ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	IMPACT HEAD	S3000
B	1	W-BEAM GUARDRAIL END SECTION, 12 Ga.	MGS-SF1303
C	1	FIRST POST TOP (6X6X $\frac{1}{2}$ " Tube)	TPHP1A
D	1	FIRST POST BOTTOM (6' W6X15)	TPHP1B
E	1	SECOND POST ASSEMBLY TOP	UHP2A
F	1	SECOND POST ASSEMBLY BOTTOM	HP3B
G	1	BEARING PLATE	E750
H	1	CABLE ANCHOR BOX	S760
J	1	BCT CABLE ANCHOR ASSEMBLY	E770

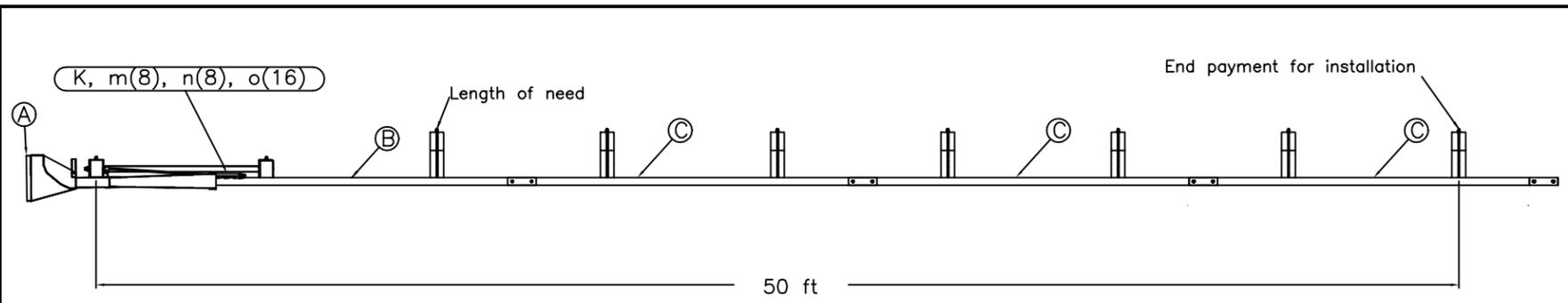
HARDWARE (ALL DIMENSIONS IN INCHES)			
a	2	5/16 x 1 HEX BOLT GRD 5	B5160104A
b	4	5/16 WASHER	W0516
c	2	5/16 HEX NUT	N0516
d	9	5/8 Dia. x 1 1/4 SPLICE BOLT (POST #2)	B580122
e	1	5/8 Dia. x 9 HEX BOLT GRD 5	B580904A
f	3	5/8 WASHER	W050
g	10	5/8 Dia. H.G.R NUT	N050
h	1	3/4 Dia. x 8 1/2 HEX BOLT GRD A449	B340854A
j	1	3/4 Dia. HEX NUT	N030
k	2	1 ANCHOR CABLE HEX NUT	N100
l	2	1 ANCHOR CABLE WASHER	W100
m	8	CABLE ANCHOR BOX SHOULDER BOLT	SB58A
n	8	1/2 A325 STRUCTURAL NUT	N055A
o	16	1 1/16 OD x 9/16 ID A325 STR. WASHER	W050A

GENERAL NOTES:

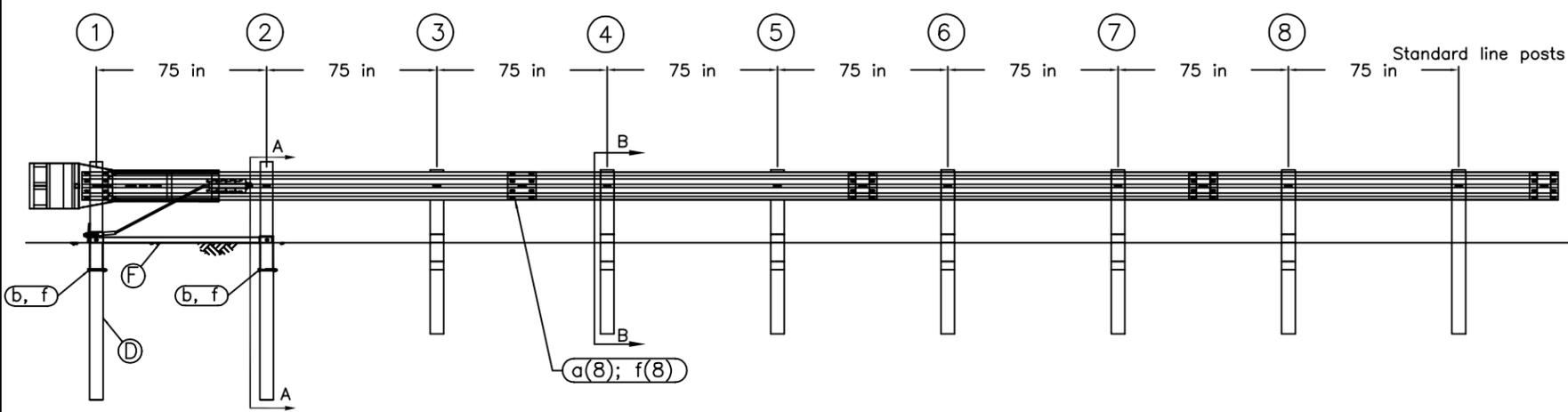
- All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
- The lower sections of the Posts 1&2 shall not protrude more than 4 in above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
- The lower sections of the hinged posts should not be driven with the upper post attached. If the post is placed in a drilled hole, the backfill material must be satisfactorily compacted to prevent settlement.
- When competent rock is encountered, a 12" \varnothing post hole, 20 in. deep cored into the rock surface may be used if approved by the engineer for post 1. Granular material will be placed in the bottom of the hole, approximately 2.5" deep to provide drainage. The first post can be field cut to length, placed in the hole and backfilled with suitable backfill. The soil plate may be trimmed if required.
- A site evaluation should be considered if there is less than 25' between the outlet side of the terminal and any adjacent driving lane.
- The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.



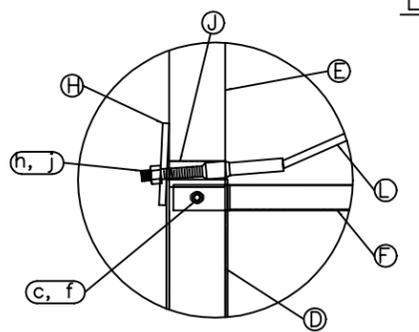
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Drawing Name: SKT-SP-S-MGS		By:	JRR
		Scale:	None
		Rev:	0



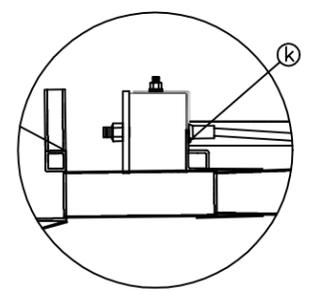
TRAFFIC → PLAN



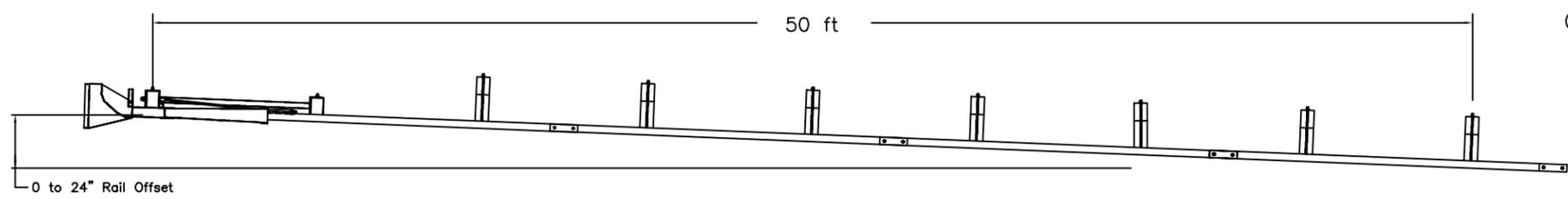
ELEVATION



POST #1 CONNECTION DETAIL



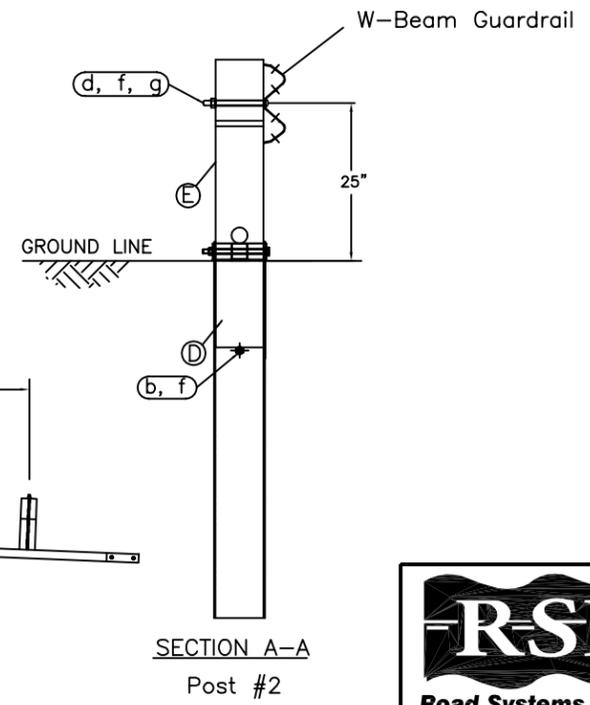
IMPACT HEAD CONNECTION DETAIL



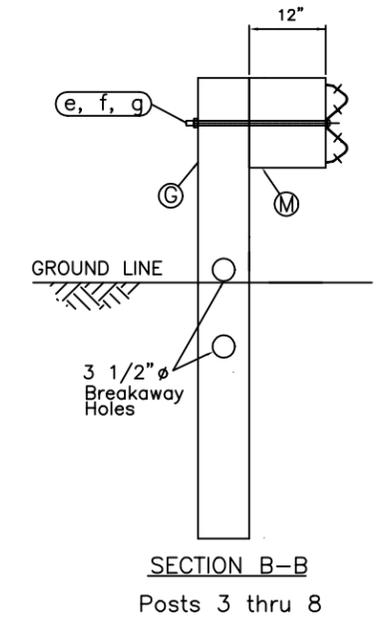
OPTIONAL FLARED INSTALLATION
25:1 maximum flare rate

- GENERAL NOTES:
1. Breakaway posts are required with the SKT.
 2. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
 3. The SKT can be flared at a rate of up to 25:1 to prevent the impact head from encroaching on the shoulder.
 4. The foundation tubes shall not protrude more than 4" above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
 5. When rock is encountered, a 12" Ø post hole, 20" into the rock surface may be used if approved by the engineer. Granular material will be placed in the bottom of the hole, approximately 2.5" deep to provide drainage. The first two posts can be field cut to length, placed in the hole and backfilled with adequately compacted material excavated from the hole.
 6. The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.
 7. A site evaluation should be considered if there is less than 25' between the outlet side of the terminal and any adjacent driving lane.
 8. The soil tubes may be driven with an approved driving head. They shall not be driven with the post in the tube.
 9. The wood blockouts should be "toe-nailed" to the rectangular wood posts to prevent them from turning when the wood shrinks.

ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	IMPACT HEAD	S3000
B	1	W-BEAM GUARDRAIL END SECTION, 12 Ga.	S1303 MGS
C	3	W-BEAM GUARDRAIL, 12 Ga.	G1203 MGS
D	2	FOUNDATION TUBE	E731
E	2	BCT WOOD POST	P650 MGS
F	1	GROUND STRUT	E780
G	6	CRT WOOD POST	P671 MGS
H	1	BEARING PLATE	E750
J	1	PIPE SLEEVE	E740
K	1	CABLE ANCHOR BOX	S760
L	1	BCT CABLE ANCHOR ASSEMBLY	E770
M	6	MGS TIMBER BLOCKOUT OR EQUIV.	P618
HARDWARE (ALL DIMENSIONS IN INCHES)			
a	24	5/8Ø x 1 1/4 SPLICE BOLT	B580122
b	2	5/8Ø x 7 1/2 HEX BOLT	B580754
c	2	5/8Ø x 10 HEX BOLT	B581004
d	1	5/8Ø x 10 H.G.R. BOLT	B581002
e	6	5/8Ø x 22 H.G.R. BOLT	B582202
f	35	5/8Ø H.G.R. NUT	N050
g	7	H.G.R. WASHER	W050
h	2	1 ANCHOR CABLE HEX NUT	N100
j	2	1 ANCHOR CABLE WASHER	W100
k	2	3/8 x 3 LAG SCREW	E350
m	8	CABLE ANCHOR BOX SHOULDER BOLT	SB58A
n	8	1/2 A325 STRUCTURAL NUT	N055A
o	16	1 1/16 OD x 9/16 ID A325 STR. WASHER	W050A



SECTION A-A
Post #2



SECTION B-B
Posts 3 thru 8

RSI
Road Systems, Inc.
Big Spring, TX
Phone: 432-263-2435
or Phone: 330-346-0721

Sequential Kinking Terminal
SKT - Assembly

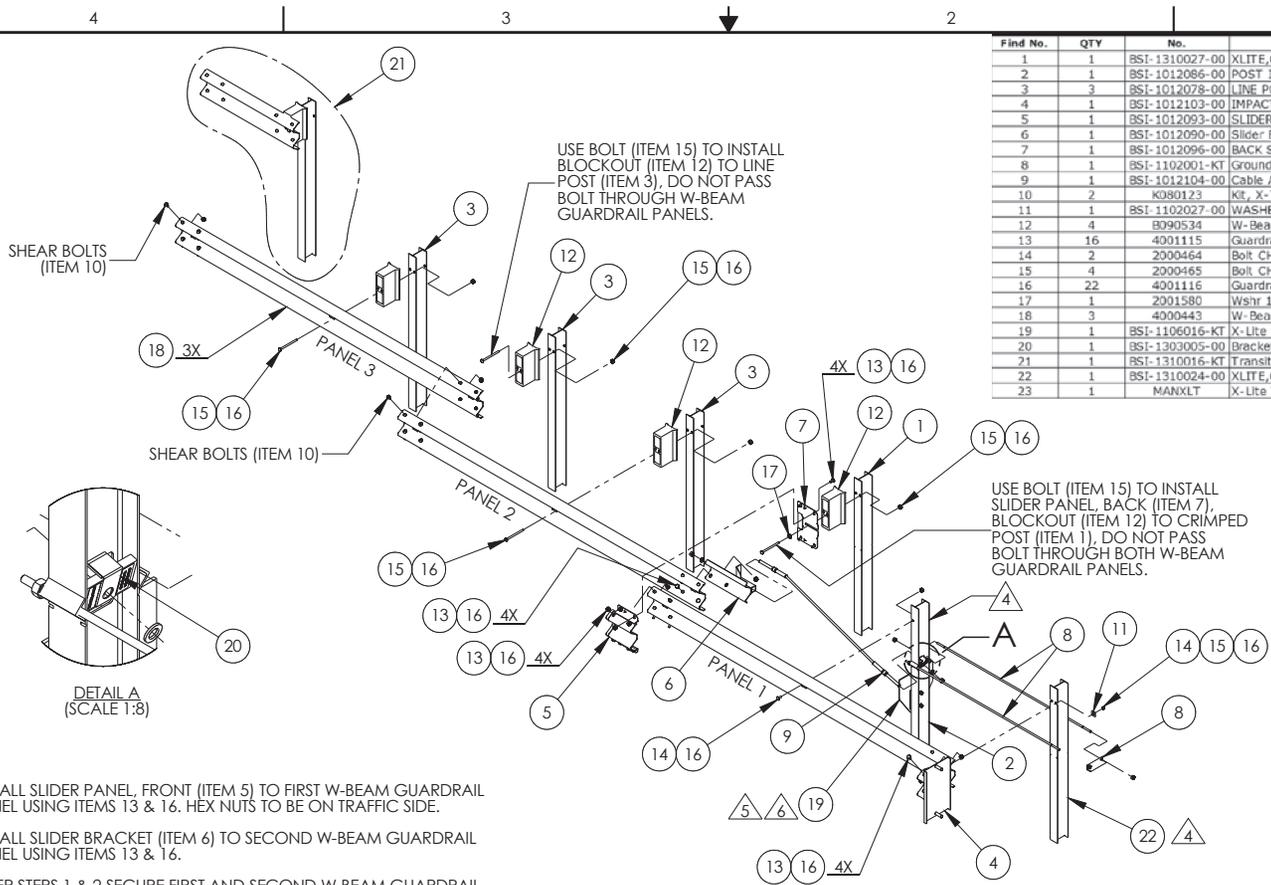
Midwest Guardrail System
Wood Post System

Drawing Name: SKT-MGS-W-US Scale: NONE

Sheet: A1
Date: 12/01/04
By: JRR
Rev: 0

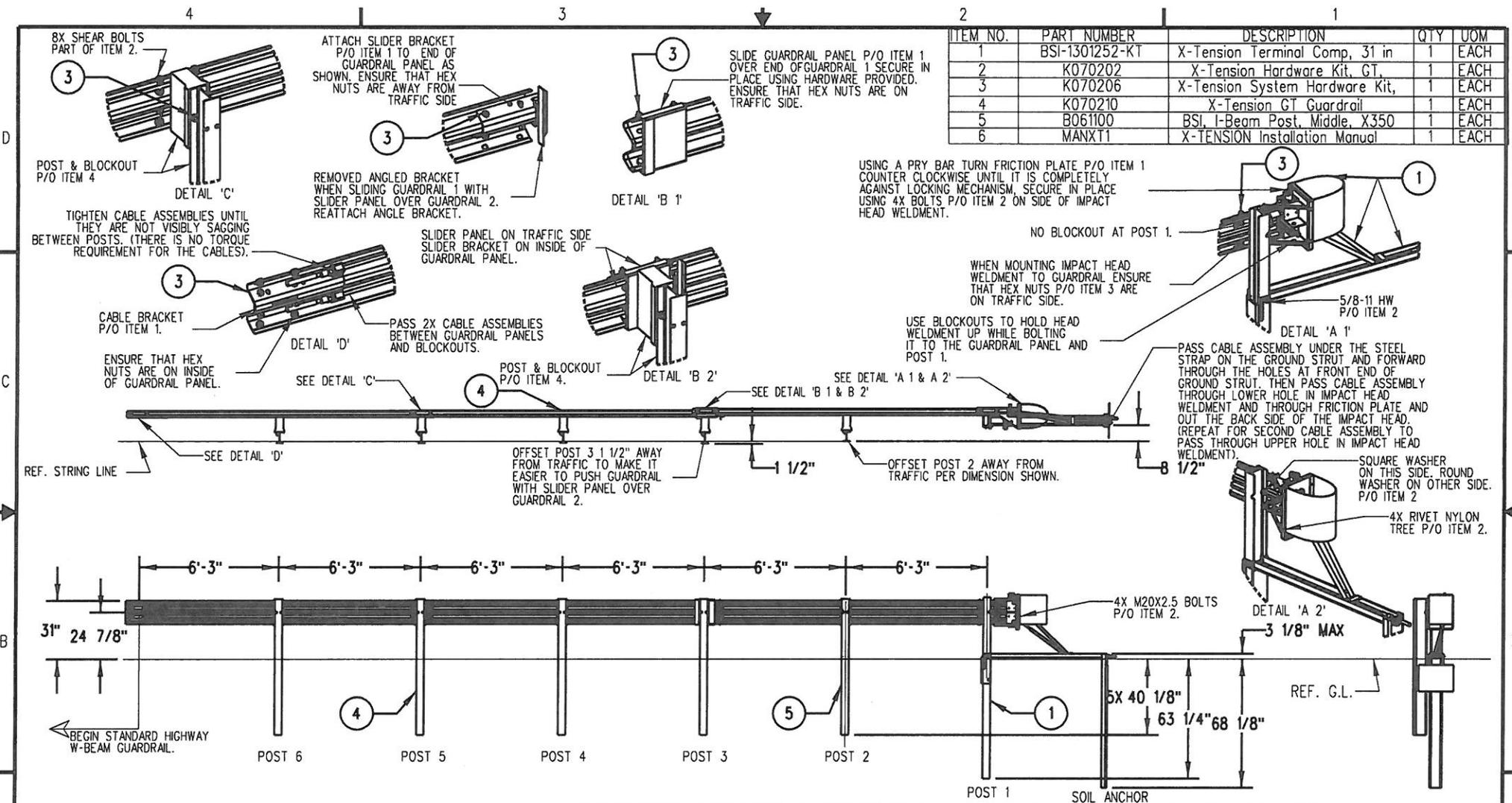
Appendix A - System Configuration, 37' 6" MGS

Find No.	QTY	No.	Description	UOM
1	1	BSI-1310027-00	XLITE, CRIMPED POST HOLES, GALV	EA
2	1	BSI-1012066-00	POST II, X-LITE, GALV	EA
3	3	BSI-1012078-00	LINE POST, X-LITE, GALV	EA
4	1	BSI-1012103-00	IMPACT HEAD, X-LITE, GALV	EA
5	1	BSI-1012093-00	SLIDER PANEL, FRONT, X-LITE, GALV	EA
6	1	BSI-1012090-00	Slider Bracket, X-Lite	EA
7	1	BSI-1012096-00	BACK SLIDER PANEL, X-LITE, GALV	EA
8	1	BSI-1102001-KT	Ground Strut Kit, X-Lite	EA
9	1	BSI-1012104-00	Cable Anchor Assembly, X-Lite	EA
10	2	KD80123	Kit, X-Tension Shear Bolt,	EA
11	1	BSI-1102027-00	WASHER, SQUARE, X-LITE, GALV	EA
12	4	B090534	W-Beam Composite Blockout Bin,	EA
13	16	4001115	Guardrail Bolt 5/8-11x 1 1/4	EA
14	2	2000464	Bolt CH 5/8-11x1 1/2 Gr5 MGal	EA
15	4	2000465	Bolt CH 5/8-11x9 Gr5 MGal	EA
16	22	4001116	Guardrail Nut Recessed 5/8-11	EA
17	1	2001580	Wshr 1 F436 Structural Gal	EA
18	3	4000443	W-Beam Guardrail RWM02a	EA
19	1	BSI-1106016-KT	X-Lite Soil Plate Kit	EA
20	1	BSI-1303005-00	Bracket, X-Lite, Cable Retenti	EA
21	1	BSI-1310016-KT	Transition Kit, MGS, X-Lite	EA
22	1	BSI-1310024-00	XLITE, CRIMPED POST SLOTS, GALV	EA
23	1	MANXLT	X-Lite Tangent Installation	EA



1. INSTALL SLIDER PANEL, FRONT (ITEM 5) TO FIRST W-BEAM GUARDRAIL PANEL USING ITEMS 13 & 16. HEX NUTS TO BE ON TRAFFIC SIDE.
2. INSTALL SLIDER BRACKET (ITEM 6) TO SECOND W-BEAM GUARDRAIL PANEL USING ITEMS 13 & 16.
3. AFTER STEPS 1 & 2 SECURE FIRST AND SECOND W-BEAM GUARDRAIL PANEL USING ITEMS 7, 13 & 16. HEX NUTS TO BE ON TRAFFIC SIDE.
4. SLOT ON POSTS 1 AND 2 TO FACE GUARDRAIL PANEL.
5. IF ROCK OR STIFF SOIL IS ENCOUNTERED, THE POST AND SOIL PLATE MAY BE INSTALLED BY AUGERING AND BACKFILLING THE HOLE. EXTRA CARE MUST BE TAKEN TO PREVENT SETTLEMENT OR LATERAL DISPLACEMENT OF THE POST. BACKFILL MATERIAL SHALL BE COMPACTED TO OPTIMUM COMPACTION.
6. IF ROCK IS ENCOUNTERED, THE SOIL PLATE MAY BE MODIFIED IF APPROVED BY THE PROJECT ENGINEER.

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APPROVALS DRAWN BY: JMT DRAWN DATE: 10/09/2013 APPRD BY: GAD APPRD DATE: 10/09/13		THIRD ANGLE PROJECTION INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5-1994 DO NOT SCALE DRAWING		TITLE: X-LITE SYSTEM ASSEMBLY, TANGENT, TRANSITION TO MGS SIZE: B DWG NO.: XLTSUS-MGS SCALE: 1:40 SHEET: 1 OF 2	
				REV: B	

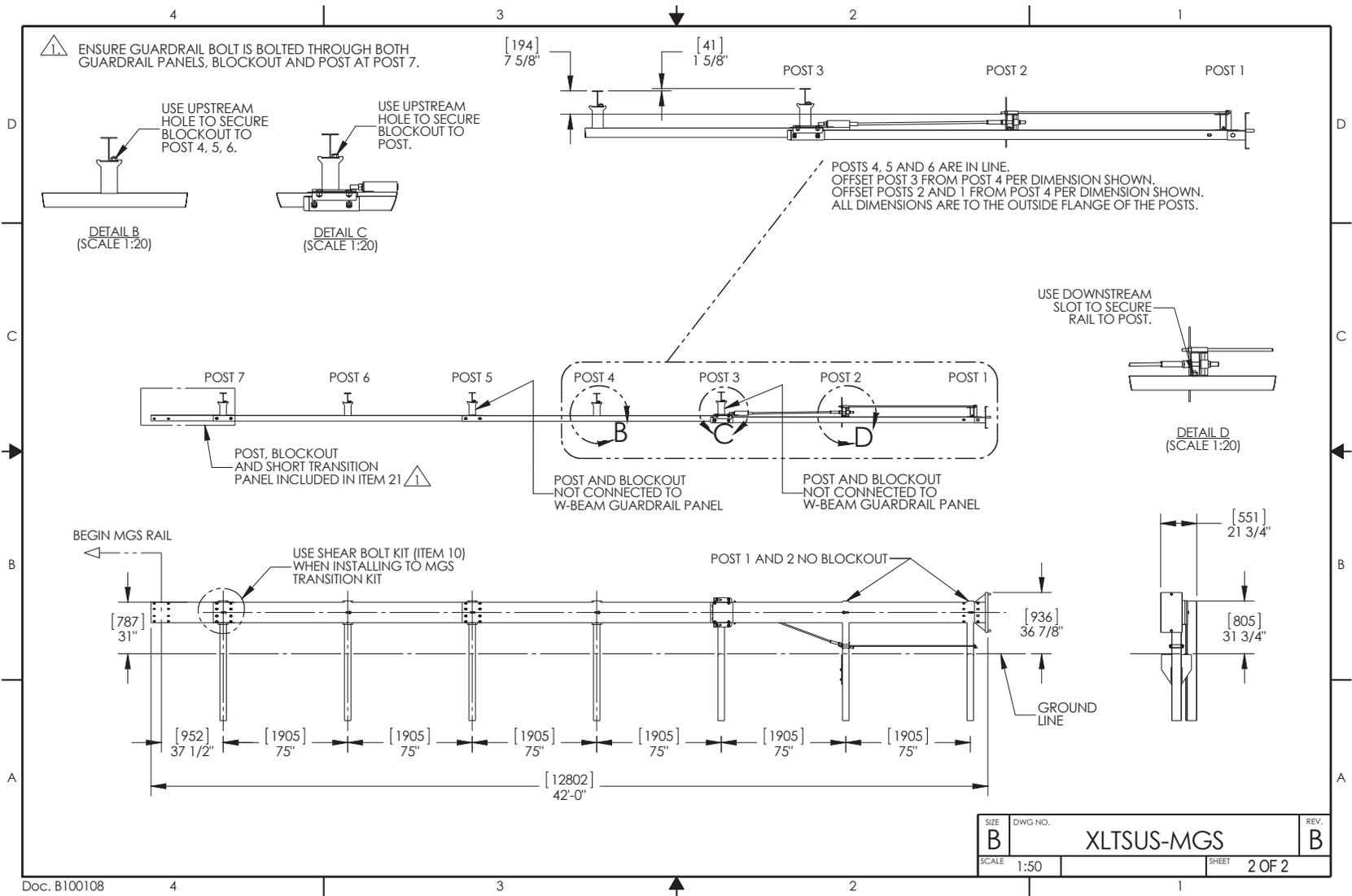


ITEM NO.	PART NUMBER	DESCRIPTION	QTY	UOM
1	BSI-1301252-KT	X-Tension Terminal Comp, 31 in	1	EACH
2	K070202	X-Tension Hardware Kit, GT.	1	EACH
3	K070206	X-Tension System Hardware Kit,	1	EACH
4	K070210	X-Tension GT Guardrail	1	EACH
5	B061100	BSL I-Beam Post, Middle, X350	1	EACH
6	MANXT1	X-TENSION Installation Manual	1	EACH

- NOTES: UNLESS OTHERWISE SPECIFIED.
- SYSTEM TO BE INSTALLED PER MANUFACTURER SPECIFICATIONS.
 - ONLY TIGHTEN THE CABLE ASSEMBLIES USING THE NUTS AT THE CABLE BRACKET (SEE DETAIL 'D'). DO NOT TIGHTEN THE CABLES AT THE FRONT OF THE GROUND ANCHOR.
 - WHEN DRIVING STEEL POST, ENSURE THAT A DRIVING CAP WITH TIMBER OR PLASTIC INSERT IS USED TO PREVENT DAMAGE TO THE GALVANIZING TO THE TOP OF THE POST.

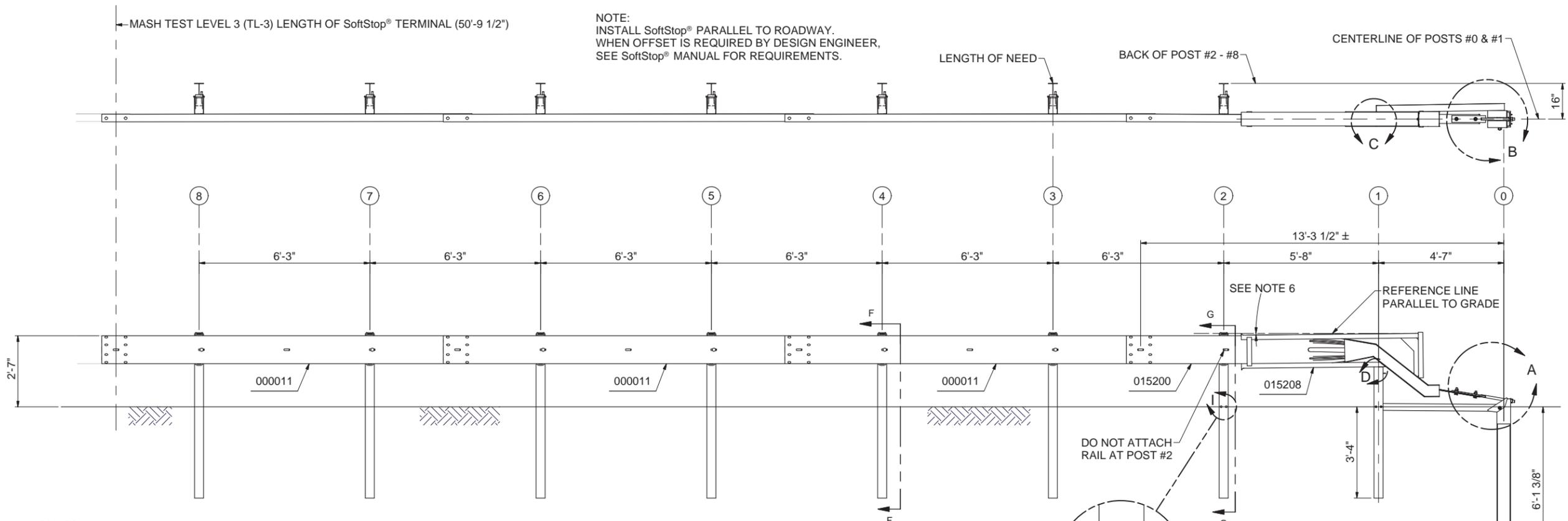
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APPROVALS <small>DRAWN BY: NMV</small> <small>DRAWN DATE: 2/08/13</small> <small>APPR'D BY: JMT</small> <small>APPR'D DATE: 2/08/13</small>				<small>THIRD ANGLE PROJECTION</small> 		<small>TITLE</small> X-TENSION GUARDRAIL TERMINAL SYSTEM STEEL POST WITH COMPOSITE BLOCKOUT 31" RAIL HEIGHT	
<small>REV</small> <small>ECN*</small> <small>DATE</small>		<small>SCALE</small> 1:50		<small>SIZE</small> B		<small>DWG NO.</small> XTGTSS5	
<small>DO NOT SCALE DRAWING</small>				<small>REV</small> <small>ECN*</small> <small>DATE</small>		<small>SHEET</small> 1 OF 1	

Appendix A - System Configuration, 37' 6" MGS

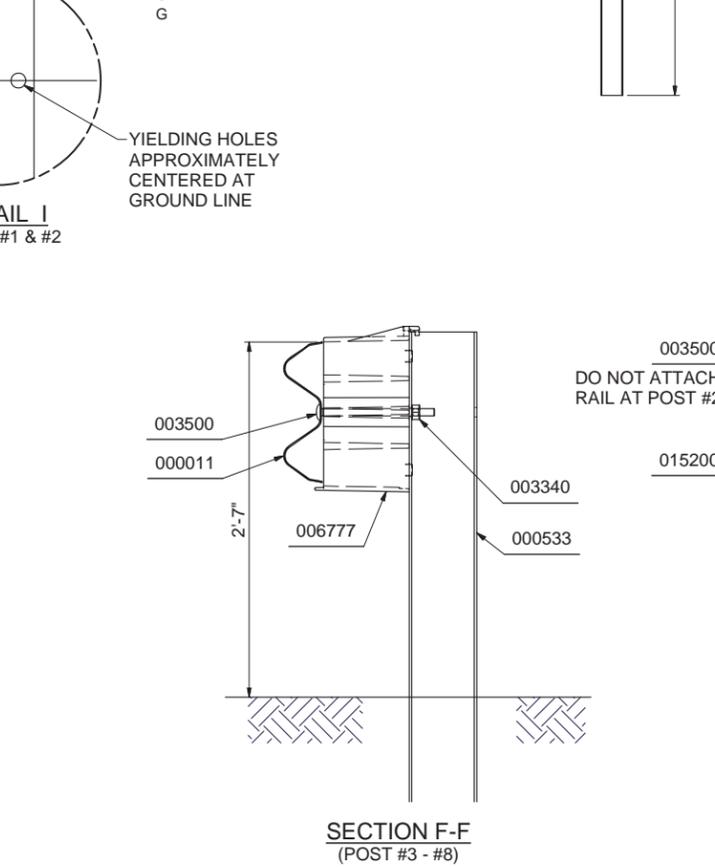
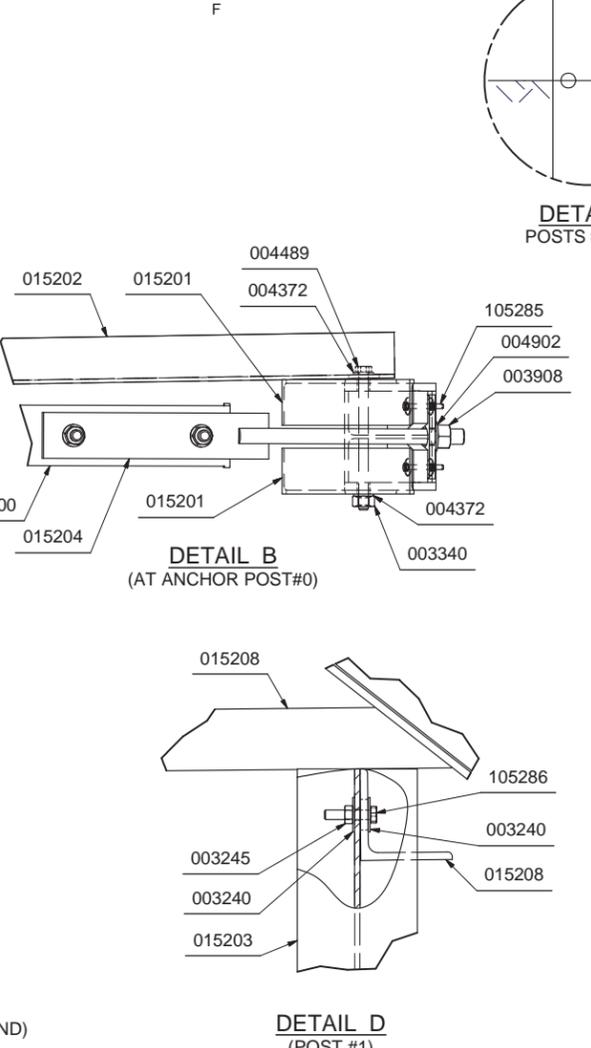
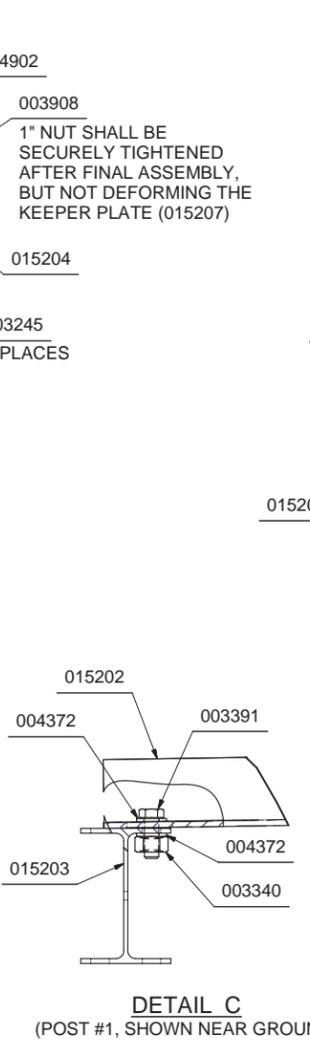
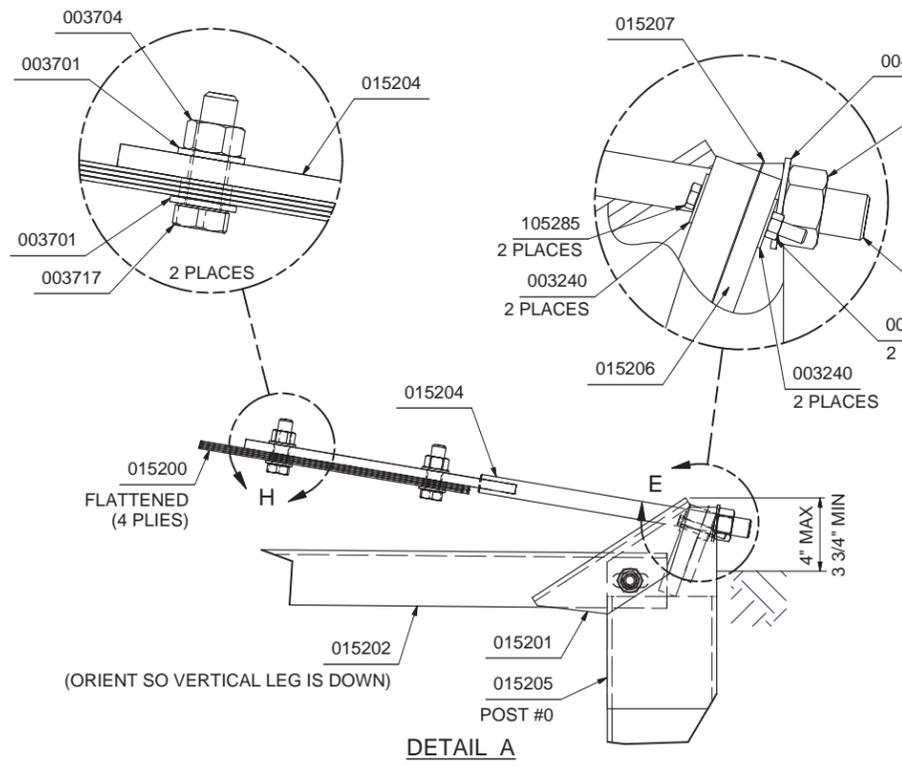


Appendix A -Bill of Materials - X-Lite Tangent, MGS 37' 6"

Item	Description	Full System	Kit Only
BSI-1310024-00	XLITE,CRIMPED POST SLOTS,GALV	1.00	1.00
BSI-1310027-00	XLITE,CRIMPED POST HOLES,GALV	1.00	1.00
BSI-1012086-00	POST II, X-LITE, GALV	1.00	1.00
BSI-1012078-00	LINE POST,X-LITE,GALV	3.00	-
BSI-1012103-00	IMPACT HEAD,X-LITE, GALV	1.00	1.00
BSI-1012093-00	SLIDER PANEL,FRONT,XLITE,GALV	1.00	1.00
BSI-1012090-00	Slider Bracket, X-Lite	1.00	1.00
BSI-1012096-00	BACK SLIDER PANEL,X-LITE,GALV	1.00	1.00
BSI-1012097-00	Ground Strut, X-Lite	2.00	2.00
BSI-1012098-00	Ground Strut Angle	1.00	1.00
BSI-1012104-00	Cable Anchor Assembly, X-Lite	1.00	1.00
K080123	Kit, X-Tension Shear Bolt,	2.00	2.00
BSI-1102027-00	WASHER,SQUARE,X-LITE,GALV	1.00	1.00
B090534	W-Beam Composite Blockout 8in,	4.00	-
4001115	Guardrail Bolt 5/8-11x 1 1/4	16.00	-
2000464	Bolt CH 5/8-11x1 1/2 Gr5 MGal	2.00	-
2000465	Bolt CH 5/8-11x9 Gr5 MGal	4.00	-
4001116	Guardrail Nut Recessed 5/8-11	26.00	-
2001580	Wshr 1" F436 Structural	1.00	-
4000443	W-Beam Guardrail RWM02a	3.00	-
BSI-1312100-00	Soil Plate	1.00	1.00
2000220	C-Scr HH 5/8-11x3 1/2 Gr5 MGal	2.00	2.00
2001636	Wshr 5/8 F436 Struct MGal	4.00	4.00
2000312	Nut HX 5/8-11 Gr5 Mgal	2.00	1.00
BSI-1303005-00	Bracket, X-Lite, Cable Retenti	1.00	1.00
BSI-1310016-KT	Transition Kit, MGS, X-Lite	1.00	1.00

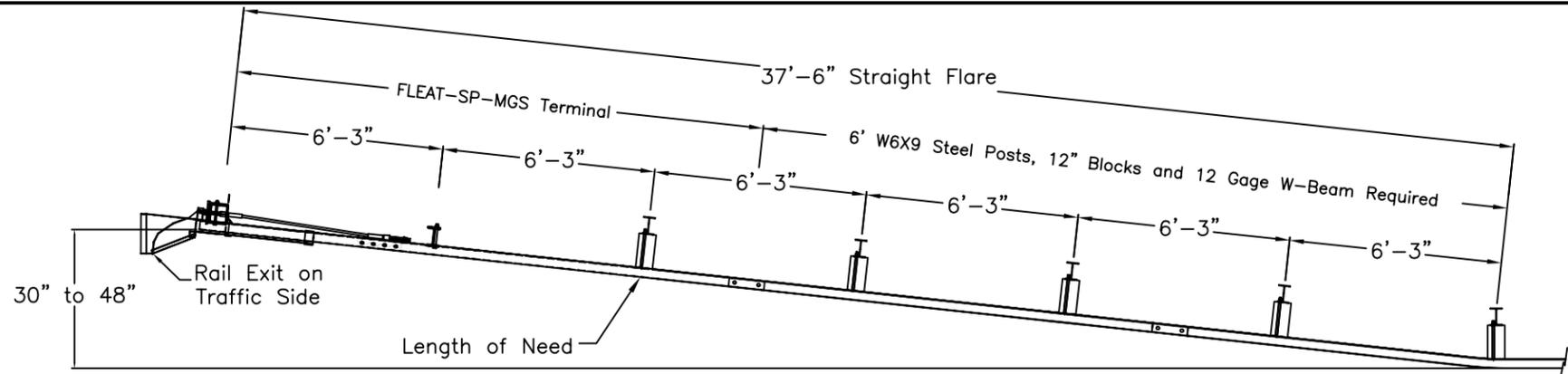


PARTS LIST		
PART NO.	QTY.	DESCRIPTION
000011	3	12/12/6/3/1.5/S
000533	6	6'0 POST - W6 x 8.5
006777	7	KING BLOCK
015000	1	6'0 SYT PST/8.5/31" GR HT
015200	1	SFST-ANCHOR G.RAIL 12'-6"
015201	2	SFST-ANCHOR ANGLE
015202	1	SFST-ANGLE STRUT
015203	1	SFST-POST#1 SYTP
015204	1	SFST-ANCHOR PADDLE
015205	1	SFST-POST#0
015206	1	SFST-PLATE WASHER
015207	1	SFST-KEEPER PLATE
015208	1	SFST-IMPACT HEAD
- HARDWARE -		
003240	6	5/16 ROUND WASHER WIDE
003245	3	5/16 HEX NUT
003340	41	5/8" GR HEX NUT
003360	32	5/8"X1.25" GR BOLT
003391	1	5/8"X1.75" HEX BOLT A325
003500	7	5/8 GUARD RAIL BOLT x 10"
003701	4	3/4" ROUND WASHER F436
003704	2	3/4" HVY HEX NUT A563 DH
003717	2	3/4"X2.5" HEX BOLT A325
003908	1	1" HVY HEX NUT A563 DH
004372	4	5/8" WASHER F436
004489	1	5/8"X9" HEX BOLT A325
004902	1	1" ROUND WASHER F436
105285	2	5/16"X2.5" HEX BOLT GRD 5
105286	1	5/16"X1.5" HEX BOLT GRD 5

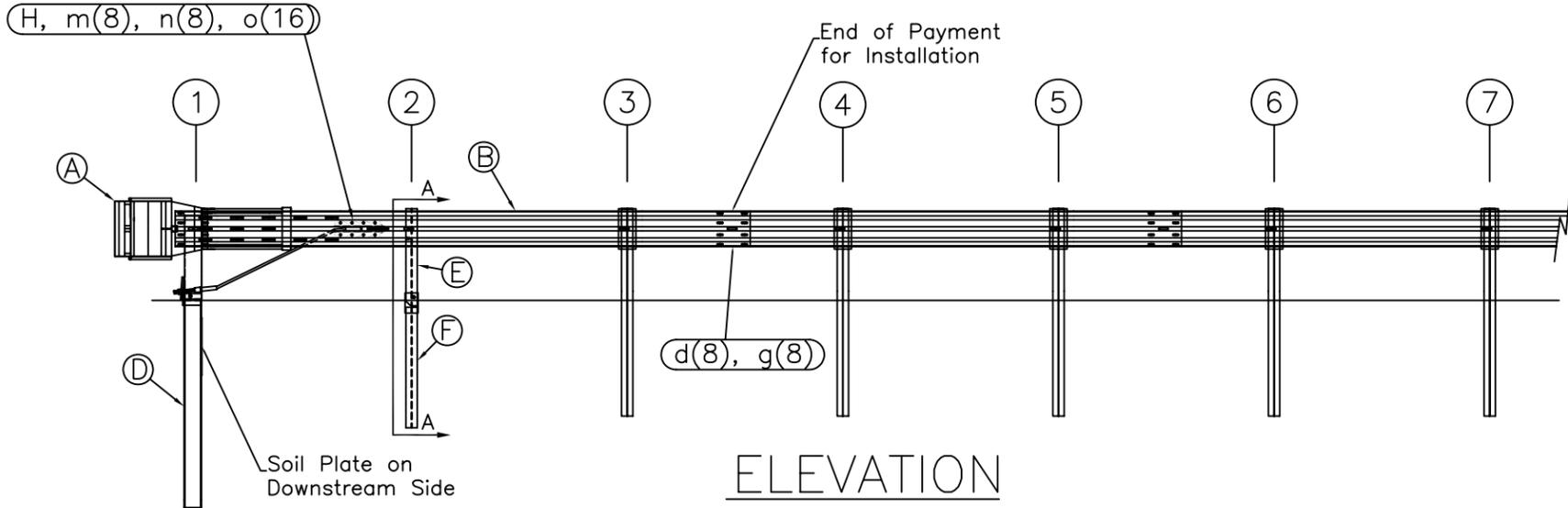


- NOTES:
- REFER TO SoftStop® ASSEMBLY MANUAL.
 - PROPER SITE GRADING SHOULD BE ACCOMPLISHED IN ACCORDANCE WITH LOCAL SPECIFYING AGENCY GUIDELINES AND THE AASHTO ROADSIDE DESIGN GUIDE.
 - DO NOT ATTACH THE SoftStop® DIRECTLY TO A RIGID BARRIER.
 - UNDER NO CIRCUMSTANCES SHALL THE GUARDRAIL WITHIN THE SoftStop® BE CURVED.
 - MANUFACTURER SUGGESTS CUSTOMER TO PROVIDE REFLECTORIZATION OF THE TERMINAL.
 - IT IS ACCEPTABLE TO INSTALL THE SoftStop® IMPACT HEAD PARALLEL TO THE GRADE LINE OR WITH AN UPWARD TILT. SEE SoftStop® ASSEMBLY MANUAL FOR SPECIFIC DETAILS.

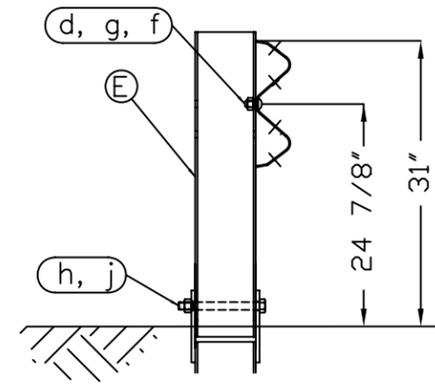
MATERIAL: SEE PARTS LIST	DRAWN: BT	DATE: 11/14/2012	TOLERANCES PER CEMC-THP-SF-001, UNLESS OTHERWISE SPECIFIED. DO NOT SCALE DRAWING	SoftStop® TERMINAL (8" BLOCKS) PLAN, ELEVATION & SECTION MASH TEST LEVEL 3 (TL-3) P/N: 500646B	
FINISH: N/A	CHECKED: BS	DATE: 11/14/2012			
ESTIMATED WEIGHT: 1221.7 lbmass	UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN FEET/INCHES. DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.		DRIVING: SS 646	SHEET: 1 of 1	© 2012-2015 Trinity Highway Products, LLC. All rights reserved. CEMC-THP-FE-052 Rev B, 9/15/2015



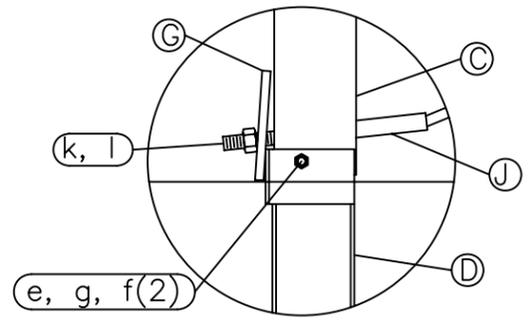
PLAN



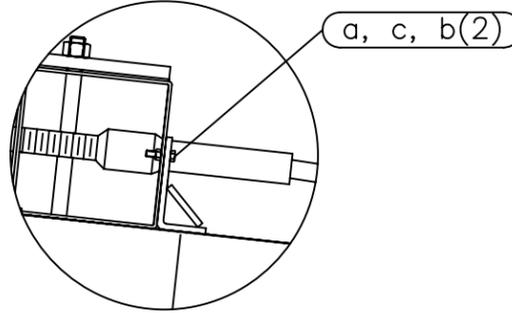
ELEVATION



SECTION A-A
Post #2



Post #1 Connection Detail



Impact Head Connection Detail

ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	IMPACT HEAD	F3000
B	1	W-BEAM GUARDRAIL END SECTION, 12 Ga.	MGS-SF1303
C	1	FIRST POST TOP (6X6X $\frac{1}{8}$ " Tube)	TPHP1A
D	1	FIRST POST BOTTOM (6' W6X15)	TPHP1B
E	1	SECOND POST ASSEMBLY TOP	UHP2A
F	1	SECOND POST ASSEMBLY BOTTOM	HP3B
G	1	BEARING PLATE	E750
H	1	CABLE ANCHOR BOX	S760
J	1	BCT CABLE ANCHOR ASSEMBLY	E770

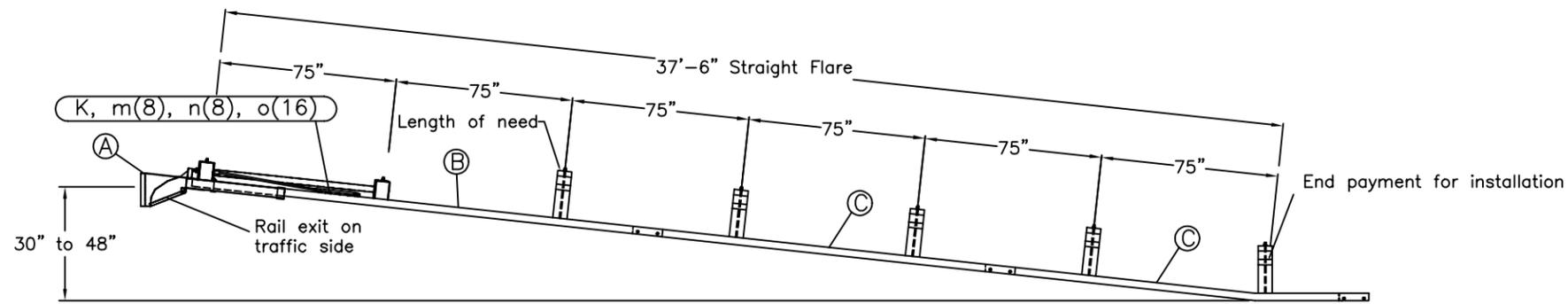
HARDWARE (ALL DIMENSIONS IN INCHES)			
a	2	5/16 x 1 HEX BOLT GRD 5	B5160104A
b	4	5/16 WASHER	W0516
c	2	5/16 HEX NUT	N0516
d	9	5/8 Dia. x 1 1/4 SPLICE BOLT (POST #2)	B580122
e	1	5/8 Dia. x 9 HEX BOLT GRD 5	B580904A
f	3	5/8 WASHER	W050
g	10	5/8 Dia. H.G.R NUT	N050
h	1	3/4 Dia. x 8 1/2 HEX BOLT GRD A449	B340854A
j	1	3/4 Dia. HEX NUT	N030
k	2	1 ANCHOR CABLE HEX NUT	N100
l	2	1 ANCHOR CABLE WASHER	W100
m	8	CABLE ANCHOR BOX SHOULDER BOLT	SB58A
n	8	1/2 A325 STRUCTURAL NUT	N055A
o	16	1 1/16 OD x 9/16 ID A325 STR. WASHER	W050A

GENERAL NOTES:

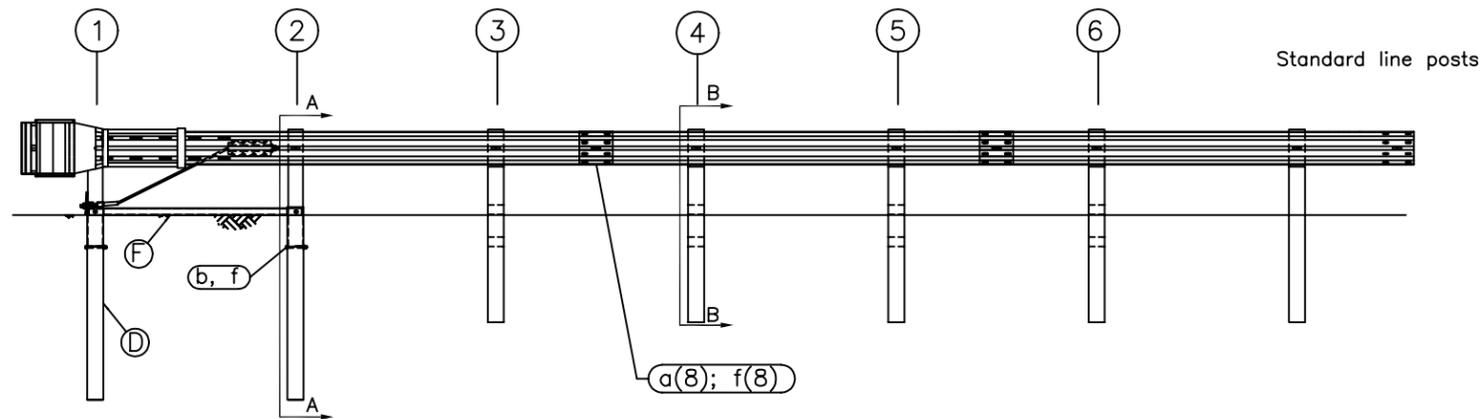
- All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
- The lower sections of the Posts 1&2 shall not protrude more than 4 in above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
- The lower sections of the hinged posts should not be driven with the upper post attached. If the post is placed in a drilled hole, the backfill material must be satisfactorily compacted to prevent settlement.
- When competent rock is encountered, a 12" \varnothing post hole, 20 in. deep cored into the rock surface may be used if approved by the engineer for post 1. Granular material will be placed in the bottom of the hole, approximately 2.5" deep to provide drainage. The first post can be field cut to length, placed in the hole and backfilled with suitable backfill. The soil plate may be trimmed if required.
- The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.

Big Spring, TX
Phone: 432-263-2435
or Phone: 330-346-0721

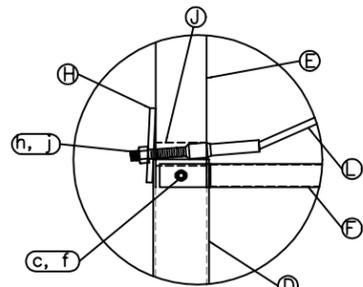
FLEAT-SP-MGS Terminal Midwest Guardrail System 31" Top of Rail		Sheet:	1
		Date:	02/24/10
Drawing Name: FLT-SP-S-MGS		By:	JRR
		Scale:	None
		Rev:	0



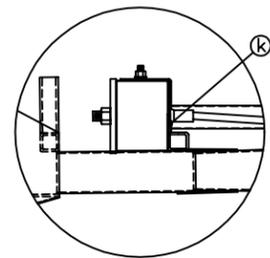
TRAFFIC → PLAN



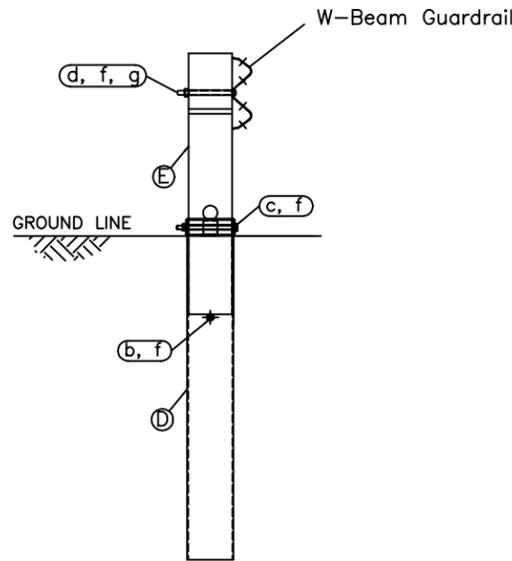
ELEVATION



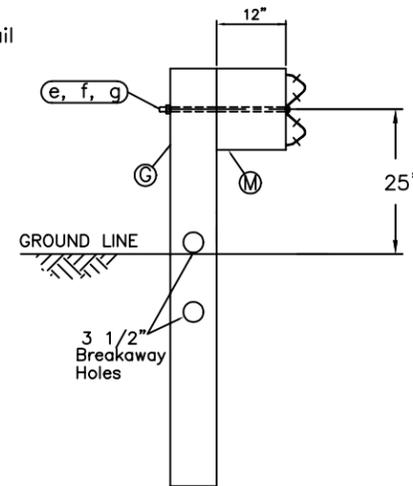
POST #1 CONNECTION DETAILS



IMPACT HEAD CONNECTION DETAIL



SECTION A-A
Post #2



SECTION B-B
Posts 3 thru 6

ITEM	QTY	BILL OF MATERIALS	ITEM NO.
A	1	IMPACT HEAD	F3000
B	1	W-BEAM GUARDRAIL END SECTION, 12 Ga.	F1303 MGS
C	2	W-BEAM GUARDRAIL, 12 Ga.	G1203 MGS
D	2	FOUNDATION TUBE	E731
E	2	BCT WOOD POST	P650 MGS
F	1	GROUND STRUT	E780
G	4	CRT WOOD POST	P671 MGS
H	1	BEARING PLATE	E750
J	1	PIPE SLEEVE	E740
K	1	CABLE ANCHOR BOX	S760
L	1	BCT CABLE ANCHOR ASSEMBLY	E770
M	4	MGS TIMBER BLOCKOUT OR RECYC. EQUIV.	P618
HARDWARE (ALL DIMENSIONS IN INCHES)			
a	16	5/8 ϕ x 1 1/4 SPLICE BOLT	B580122
b	2	5/8 ϕ x 7 1/2 HEX BOLT	B580754
c	2	5/8 ϕ x 10 HEX BOLT	B581004
d	1	5/8 ϕ x 10 H.G.R. BOLT	B581002
e	4	5/8 ϕ x 22 H.G.R. BOLT	B582202
f	25	5/8 ϕ H.G.R. NUT	N050
g	5	H.G.R. WASHER	W050
h	1	ANCHOR CABLE HEX NUT	N100
j	2	ANCHOR CABLE WASHER	W100
k	2	3/8 x 3 LAG SCREW	E350
m	8	CABLE ANCHOR BOX SHOULDER BOLT	SB58A
n	8	1/2 A325 STRUCTURAL NUT	N055A
o	16	1 1/16 OD x 9/16 ID A325 STR. WASHER	W050A

GENERAL NOTES:

- Breakaway posts are required with the FLEAT.
- All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
- The foundation tubes shall not protrude more than 4 in above the ground (measured along a 5' cord). Site grading may be necessary to meet this requirement.
- When rock is encountered, a 12" ϕ post hole, 20 in into the rock surface may be used if approved by the engineer. Granular material will be placed in the bottom of the hole, approximately 2.5" deep to provide drainage. The first two posts can be field cut to length, placed in the hole and backfilled with adequately compacted material excavated from the hole.
- The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.
- The soil tubes may be driven with an approved driving head. They shall not be driven with the post in the tube.
- The wood blockouts should be "toe-nailed" to the rectangular wood posts to prevent them from turning when the wood shrinks.



Road Systems, Inc.

Big Spring, TX
Phone: 432-263-2435
or Phone: 330-346-0721

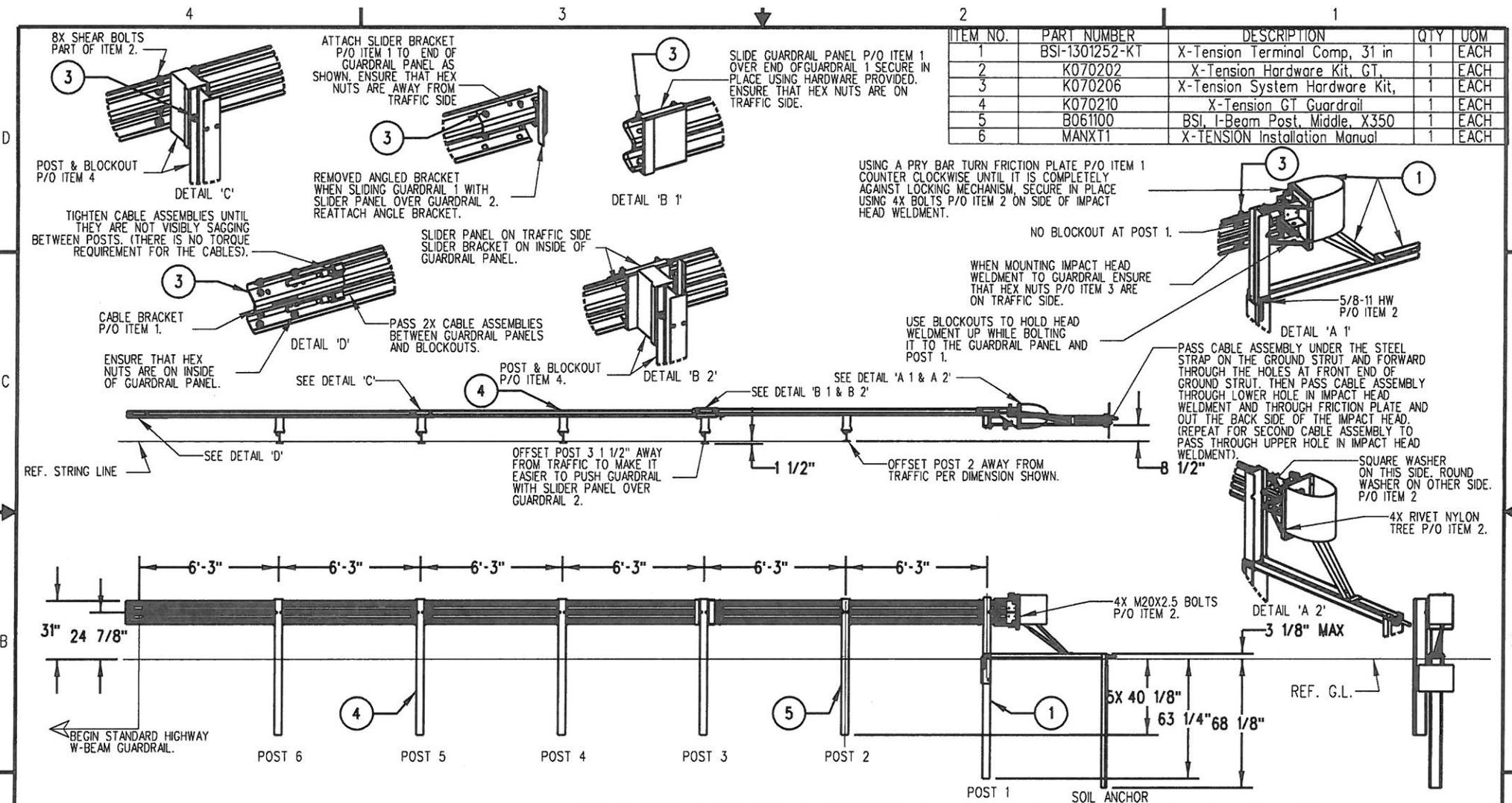
Flared Energy Absorbing
Terminal - FLEAT Assembly
Midwest Guardrail System

Wood Post System

Drawing Name:
FLT-MGS-W-US

Scale:
None

Sheet:
A1
Date:
12/01/2004
By:
JRR
Rev:
0



ITEM NO.	PART NUMBER	DESCRIPTION	QTY	UOM
1	BSI-1301252-KT	X-Tension Terminal Comp, 31 in	1	EACH
2	K070202	X-Tension Hardware Kit, GT.	1	EACH
3	K070206	X-Tension System Hardware Kit,	1	EACH
4	K070210	X-Tension GT Guardrail	1	EACH
5	B061100	BSL I-Beam Post, Middle, X350	1	EACH
6	MANXT1	X-TENSION Installation Manual	1	EACH

- NOTES: UNLESS OTHERWISE SPECIFIED.
- SYSTEM TO BE INSTALLED PER MANUFACTURER SPECIFICATIONS.
 - ONLY TIGHTEN THE CABLE ASSEMBLIES USING THE NUTS AT THE CABLE BRACKET (SEE DETAIL 'D'). DO NOT TIGHTEN THE CABLES AT THE FRONT OF THE GROUND ANCHOR.
 - WHEN DRIVING STEEL POST, ENSURE THAT A DRIVING CAP WITH TIMBER OR PLASTIC INSERT IS USED TO PREVENT DAMAGE TO THE GALVANIZING TO THE TOP OF THE POST.

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APPROVALS				TITLE X-TENSION GUARDRAIL TERMINAL SYSTEM STEEL POST WITH COMPOSITE BLOCKOUT 31" RAIL HEIGHT			
<small>DRAWN BY:</small> NMV <small>DRAWN DATE:</small> 2/08/13 <small>APPR'D BY:</small> JMT <small>APPR'D DATE:</small> 2/08/13	<small>THIRD ANGLE PROJECTION</small> 	<small>REV</small> 2067 <small>DATE</small> 03/02/13 <small>REV</small> 2022 <small>DATE</small> 2/08/13	<small>SCALE</small> 1:50	<small>SIZE</small> B <small>DWG NO.</small> XTGTSS5	<small>REV.</small> B	<small>SHEET</small> 1 OF 1	

Existing ITS Elements 10-1C421X SJ 99 014.000/023.000

CO	RTE	PREFIX	POSTMILE	SUFFIX	DIR	LOCATION	ELEMENT	ID	CONTROLLER	DETECTION TYPE	NOTE	PROJECT
SJ	99		014.289		S	N/O On Ramp from Arch Rd	TMS			MVDS		
SJ	99		014.289		S	On Ramp from Arch Rd	TMS			MVDS		
SJ	99		014.466		N	Off Ramp to Arch Rd	TMS			Loops		
SJ	99		014.518		N	S/O Arch Rd	TMS			Loops		0E612X
SJ	99		014.518		S	S/O Arch Rd	TMS			Loops		0E612X
SJ	99		014.518		S	On from Arch Rd	TMS			Loops		0E612X
SJ	99		014.560			Arch Road	Signal			Loops		
SJ	99		014.710		S	Off Ramp to Arch Rd	TMS			Loops		
SJ	99		014.809		N	On Ramp from Arch Rd	TMS			MVDS		
SJ	99		014.883		S	N/O Arch Rd	TMS			Loops		
SJ	99		014.883		N	N/O Arch Rd	TMS			Loops		
SJ	99		016.500		S	JCT Rte 4	CCTV			N/A		
SJ	99		016.500			NB @ Mariposa Road	Signal			Loops		
SJ	99		016.740			SB @ Mariposa Road	Signal			Loops		
SJ	99		016.810			Mariposa West Frontage	Signal			Loops		
SJ	99		017.139		S	Farmington Rd On Ramp	TMS			Loops		
SJ	99		017.198		S	N/O Farmington Rd Off Ramp	TMS			Loops		
SJ	99		017.200		S	N/O Farmington Road	CCTV			N/A		
SJ	99		017.200		S	N/O Farmington Rd	CMS			N/A		
SJ	99		017.370			NB @ Golden Gate Ave	Signal			Loops		
SJ	99		017.500			SB @ Golden Gate Ave	Signal			Loops		
SJ	99		017.500			Stockton Maintenance Yard	HAR			N/A	Stockton WQFQ815 1670	
SJ	99		018.674			Crosstown	RWIS	365007		N/A		
SJ	99		018.683		Both	S/O Jct Rte 4 West	TMS	95		Piezos/Loops	Census Station	
SJ	99		018.683		Both	N/O Jct Rte 4 West	TMS	96		Piezos/Loops	Census Station	
SJ	99		019.110		S	S/O On Ramp from EB Fremont St/Rte 26 East	TMS			Loops		
SJ	99		019.280			SB @ State Route 26 (Fremont Street)	Signal			Loops		
SJ	99		019.290			NB @ State Route 26 (Fremont Street)	Signal			Loops		
SJ	99		019.290		Both	N/o Jct Rte 26 East	TMS	282		Loops	Census Station	
SJ	99		019.365		S	S/O On Ramp from WB Fremont St/Rte 26 East	TMS			Loops		
SJ	99		019.400		N	N/O Fremont St	TMS	10107010	10107000	Loops		
SJ	99		019.400		N	On from Fremont St	TMS	10107110	10107000	Loops		
SJ	99		019.510		N	N/O Fremont	CCTV			N/A		
SJ	99		019.510		N	N/O Fremont St	CMS			N/A		
SJ	99		019.603		N	N/O Fremont St	TMS			Loops		
SJ	99		019.603		S	N/O Fremont St	TMS			Loops		
SJ	99		019.750		N	Fremont St	RWIS	365008		N/A		
SJ	99		019.868		N	S/O Waterloo Rd	TMS			Loops		
SJ	99		020.107		S	S/O On Ramp from EB Waterloo Rd/Rte 88	TMS			Loops		
SJ	99		020.120		S	S/O Waterloo Rd	CCTV			N/A		

CO	RTE	PREFIX	POSTMILE	SUFFIX	DIR	LOCATION	ELEMENT	ID	CONTROLLER	DETECTION TYPE	NOTE	PROJECT
SJ	99		020.120		S	S/O Rte 88	CMS				N/A	
SJ	99		020.120		S	S/O Rte 88	TMS				Loops	
SJ	99		020.149		N	S/O Waterloo Rd	TMS				Loops	
SJ	99		020.340			SB @ Waterloo Road	Signal				Loops	
SJ	99		020.350			NB @Waterloo Road	Signal				Loops	
SJ	99		020.392		S	S/O Off Ramp to Waterloo Rd/Rte 88	TMS				Loops	
SJ	99		020.397		N	N/O Waterloo Rd	TMS				Loops	
SJ	99		020.414		N	N/O Rte 88/ Waterloo Rd	TMS	10107410	10107400		Loops	
SJ	99		020.414		N	On from Rte 88/Waterloo Rd	TMS	10107510	10107500		Loops	
SJ	99		020.603		S	S/O On Ramp from Cherokee Rd	TMS				Loops	
SJ	99		020.605		N	N/O Waterloo Rd	TMS				Loops	
SJ	99		020.802		N	S/O Off Ramp to Cherokee Rd	TMS				Loops	
SJ	99		020.849		S	S/O Cherokee Rd OC	TMS				Loops	
SJ	99		020.849		S	Off Ramp to Cherokee Rd	TMS				Loops	
SJ	99		020.849		S	On Ramp from Cherokee Rd	TMS				Loops	
SJ	99		020.880			NB @ Cherokee Road	Signal				Loops	
SJ	99		020.890			SB @ Cherokee Road	Signal				Loops	
SJ	99		020.936		N	Off Ramp to Cherokee Rd	TMS				MVDS	
SJ	99		020.988		N	N/O Cherokee Rd OC	TMS	10107210	10107200		Loops	
SJ	99		020.988		N	On from Cherokee Rd	TMS	10107310	10107200		Loops	
SJ	99		021.046		N	On Ramp from Cherokee Rd	TMS				MVDS	
SJ	99		021.137		S	N/O Cherokee Rd OC	TMS				Loops	
SJ	99		021.153		N	N/O On Ramp from Cherokee Rd	TMS				Loops	
SJ	99		021.353		N	S/O Wilson Way OC	TMS				Loops	
SJ	99		021.353		S	S/O Wilson Way OC	TMS				Loops	
SJ	99		021.611		N	S/O Wilson Way OC	TMS				Loops	
SJ	99		021.611		S	S/O Wilson Way OC	TMS				Loops	
SJ	99		021.674		Both	Wilson Way	TMS	115			Loops	Census Station
SJ	99		021.846			Wilson Way	RWIS	365009			N/A	
SJ	99		021.846		N	N/O Off Ramp to Wilson Way	TMS				Loops	
SJ	99		021.856		S	S/O Calaveras River OC	TMS				Loops	
SJ	99		022.086		N	N/O Off Ramp to Wilson Way	TMS				Loops	
SJ	99		022.099		S	S/O Hammer Lane OC	TMS				Loops	
SJ	99		022.128		N	N/O Wilson Way	CMS	39			N/A	
SJ	99		022.177		S	S/O Hammer Ln	CMS	12			N/A	
SJ	99		022.361		N	S/O On Ramp from Hammer Lane	TMS				Loops	
SJ	99		022.500		S	S/O Hammer Lane	CCTV				N/A	
SJ	99		022.599		N	S/O On Ramp from Hammer Lane	TMS				Loops	
SJ	99		022.842			Hammer Lane	RWIS	365011			N/A	
SJ	99		022.842		N	S/O Off Ramp to Hammer Lane	TMS				Loops	
SJ	99		022.910			SB @ Hammer Lane	Signal				Loops	
SJ	99		022.922		Both	Hammer Lane	TMS	265			Piezos/Loops	Census Station

CO	RTE	PREFIX	POSTMILE	SUFFIX	DIR	LOCATION	ELEMENT	ID	CONTROLLER	DETECTION TYPE	NOTE	PROJECT
SJ	99		022.930			NB @ Hammer Lane	Signal				Loops	
SJ	99		023.050		N	N/O E. Hammer Lane OC	TMS	10107610	10107600		Loops	
SJ	99		023.050		N	On from Hammer Lane	TMS	10107710	10107600		Loops	