

# **RFP APPENDIX 1: Reference 1**



## **BAIFA Express Lane Network Toll Collection System**

### **Glossary of Acronyms, Terms and Definitions**

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## 1. Acronyms

**AASHTO:** American Association of State Highway and Transportation Officials

**ACL:** Access Control List

**ACR:** Attenuation to Crosstalk Radio

**ACTC:** Alameda County Transportation Commission

**AGM:** Absorbed Glass Mat

**ALPR:** Automatic License Plate Recognition

**ANSI:** American National Standards Institute

**API:** Application Programming Interfaces

**ARS:** Average Response Time

**ARP:** Address Resolution Protocol

**ASCII:** American Standard Code for Information Exchange

**ASTM:** American Society for Testing and Materials

**ATCAS II:** Advanced Toll Collection and Accounting System (for the seven BATA-operated toll bridges)

**ATA:** American Trucking Association

**ATMS:** Advanced Traffic Management System

**AVC:** Automatic Vehicle Classification

**AVD:** Automatic Vehicle Detection

**AVI:** Automatic Vehicle Identification

**AWG:** American Wire Gauge

**BAIFA:** Bay Area Infrastructure Financing Authority

**BART:** Bay Area Rapid Transit

**BATA:** Bay Area Toll Authority

**BAVU:** Bay Area Video Upgrade (Project)

**Caltrans:** California Department of Transportation

**CCTV:** Closed-Circuit Television

**CDR:** Critical Design Review

**CHP:** California Highway Patrol

**CNG:** Compressed Natural Gas

**CFR:** Code of Federal Regulations

**COS:** Class of Service

**COSO:** Committee of Sponsoring Organizations

**COTS:** Commercial Off-the-Shelf

**CSR:** Customer Service Representative

**CTOC:** California Toll Operators Committee

**DBE:** Disadvantaged Business Enterprise

**DBMS:** Database Management System

**DMV:** Department of Motor Vehicles

**DSRC:** Dedicated Short Range Communications

**DVAS:** Digital Video Auditing System

**EIA:** Electronic Industries Alliance

**EL:** Express Lanes

**ELN:** Express Lane Network

**EMI:** Electromagnetic Interference

**ETC:** Electronic Toll Collection

**ETOL:** Electronic Toll

**FAT:** Factory Acceptance Test

**FCC:** Federal Communications Commission

**FHWA:** Federal Highways Administration

**FSP:** Freeway Service Patrol

**FTE:** Full-time Equivalent

**FTP:** File Transfer Protocol

**GAAP:** Generally Accepted Accounting Principles

**GBIC:** Gigabit Interface Converter

**GP:** General Purpose Lanes

**GPS:** Global Positioning System

**GUI:** Graphical User Interface

**HASB:** High Airspeed Blowing

**HDPE:** High Density Polyethylene Duct

**HOV:** High Occupancy Vehicle

**HUB:** Historically Underutilized Business

**HTTPS:** Hypertext Transfer Protocol Secure  
**IBT:** Image Based Trip Transaction  
**ICEA:** Insulated Cable Engineers Association  
**ICD:** Interface Control Document  
**ICM:** Integrated Corridor Management  
**IEEE:** Institute of Electrical and Electronic Engineers  
**IGMP:** Internet Group Management Protocol  
**ILEV:** Inherently Low Emission Vehicle  
**IP:** Internet Protocol  
**ISO:** International Organization for Standardization  
**ITOL:** Image Toll  
**ITS:** Intelligent Transportation System  
**KPI:** Key Performance Indicator  
**LAN:** Local Area Network  
**LC:** Lucent Connector  
**LED:** Light Emitting Diode  
**LLDP:** Link Layer Discovery Protocol  
**LOS:** Levels of Service  
**LPN:** License Plate Number  
**LTOL:** License Plate Toll  
**MAC:** Media Access Control  
**MAN:** Metropolitan Area Network  
**MCS:** Microwave Communications Systems  
**MDPE:** Medium Density Polyethylene Duct  
**MEES:** Managed Ethernet Edge Switch  
**MetroE:** Metropolitan Wide Ethernet Service  
**MIMO:** Multiple Input Multiple Output  
**MOMS:** Maintenance Online Management System  
**MOT:** Maintenance of Traffic  
**MMR:** Monthly Maintenance Report  
**MPLS:** Multiprotocol Label Switching

**MSSQL:** Microsoft SQL DBMS

**MTC:** Metropolitan Transportation Commission

**MUTCD:** Manual on Uniform Traffic Control Devices

**NEC:** National Electric Code

**NECA:** National Electrical Contractors Association

**NEMA:** National Electrical Manufacturers Association

**NEPA:** National Environmental Policy Act

**NESC:** National Electrical Safety Code

**NFPA:** National Fire Protection Association

**NMS:** Network Management System

**NRTL:** a National Recognized Testing Laboratory

**NTP:** Network Time Protocol

**NTP:** Notice to Proceed

**OADM:** Optical Add Drop Multiplexer

**OABL:** Observation Area Beacon Light

**OBL:** Overhead Beacon Light

**OCR:** Optical Character Recognition

**OEM:** Original Equipment Manufacturer

**OFDM:** Orthogonal Frequency Division Multiplexing

**OFIT:** On-site First Installation Test

**ONETOL:** One-Time Payment Toll

**ORT:** Open Road Tolling

**OSHA:** Occupational Safety and Health Administration

**OSPF:** Open Shortest Path First

**OTDR:** Optical Time Domain Reflectometer

**PDA:** Project Development Agreement

**PDD:** Preliminary Design Document

**PDF:** Portable Document Format

**PDR:** Preliminary Design Review

**PE:** Professional Engineer

**PeMS:** Caltrans Freeway Performance Measurement System

**PG&E:** Pacific Gas and Electric Company

**PIA:** Public Information Act

**PII:** Personally Identifiable Information

**PIM:** Protocol Independent Multicast

**PMP:** Project Management Plan

**PoE:** Power Over Ethernet

**PS&E:** Plans, Specifications, and Estimates

**PTFE:** Polytetrafluoroethylene

**PTZ:** Pan/Tilt/Zoom

**PZEV:** Partial Zero Emissions Vehicle

**QA:** Quality Assurance

**QC:** Quality Control

**QMP:** Quality Management Plan

**QoS:** Quality of Service

**RAM:** Random Access Memory

**RCSC:** Regional Customer Service Center

**RDBMS:** Relational Database Management System

**RFC:** Request for Comments

**RFID:** Radio Frequency Identification

**RFP:** Request for Proposals

**RMON:** Remote Monitoring

**RSTP:** Rapid Spanning Tree Protocol

**RTM:** Requirements Traceability Matrix

**SLD:** Straight Line Diagram

**SDD:** System Design Document

**SDP:** Software Development Plan

**SEMP:** Systems Engineering Management Plan

**SFOBB:** San Francisco-Oakland Bay Bridge

**SFTP:** Secure File Transfer Protocol

**SFP:** Small Form-Factor Pluggable Transceiver

**SLA:** Service-Level Agreement

**SMFO:** Single-Mode Fiber-Optic Cable

**SMON:** Switch Monitoring

**SMP:** System Maintenance Plan

**SNMP:** Simple Network Management Protocol

**SONET:** Synchronous Optical Networking

**SOV:** Single Occupancy Vehicle

**SQL:** Structured Query Language

**SSH:** Secure Shell

**SSL:** Secure Socket Layer

**STA:** Solano Transportation Authority

**T&R:** Traffic and Revenue

**TBD:** To Be Determined

**TCS:** Toll Collection System

**TFTP:** Trivial File Transfer Protocol

**TIA:** Telecommunications Industry Association

**TMC:** Traffic Management Center

**TMS:** Traffic Monitoring System

**ToS:** Type of Service

**TSF:** Tag Status File

**TSI:** Toll System Integrator

**UL:** Underwriters Laboratories

**UPS:** Uninterruptable Power Supply

**VES:** Violation Enforcement System

**VLAN:** Virtual Local Area Network

**VPN:** Virtual Private Network

**VTA:** Santa Clara Valley Transportation Authority

**VTMS:** Variable Toll Message Sign

**VTOL:** Violation Toll

**WAN:** Wide Area Network

**WBS:** Work Breakdown Structure

## 2. Terms & Definitions

This document captures terms and terminologies to be used for the BAIFA Express Lane Network. This document will be updated as terms are defined through requirements gathering and development.

Term	Definition
Account Type	Any of the account types available from and maintained by the FasTrak RCSC. Currently account types include: FasTrak, License Plate, One-Time Payment, and Violation.
Advanced Toll Collection and Accounting System (ATCAS II)	Toll collection and accounting system for all BATA bridges.
Agreement	The written agreement executed by BAIFA and the TSI which sets forth the rights and obligations of both parties in connection with the Scope of Work.
Anomaly	Trip Transaction that the TCS has designated for special tracking due to processing Business Rules.
Automatic License Plate Recognition (ALPR)	System for automatic processing of images using Optical Character Recognition and/or vehicle signature for vehicle identification.
Automatic Vehicle Detection and Automatic Vehicle Classification (AVD/AVC)	A system that is able to automatically detect and separately recognize vehicles traveling through toll lanes as well as automatically classify vehicle types.
Automatic Vehicle Identification (AVI) System	A system consisting of radio frequency antenna(s) and reader equipment installed in a toll lane, along with a compatible transponder mounted in a vehicle, for automatic unique identification of the vehicle upon the electronic read of the transponder as it passes through the Toll Point.
Backhaul Network	The BATA/BAIFA Backhaul Network comprises intermediate links and provides for communications between the Corridors, the primary and secondary Host sites, and the primary and secondary Toll Roadway Operations Center sites.
BAIFA Express Lane Network (ELN)	The Express Lane Network that is operated by BAIFA.
Bay Area Express Lanes System	All express lanes operated by various entities in the Bay Area (including BAIFA) to form one continuous network in the region.
Bay Area Infrastructure Financing Authority (BAIFA)	The Bay Area Infrastructure Financing Authority (BAIFA) is a Joint Powers Authority between the Metropolitan Transportation Commission and the Bay Area Toll Authority, which was created to plan, develop, operate and finance transportation projects, including express lanes.
California Highway Patrol (CHP) Observation Areas	Areas on the corridors located in the center median for use by law enforcement.

<b>Term</b>	<b>Definition</b>
California Toll Operators Committee (CTOC)	An organization composed of California's toll facility operators/owners. CTOC is used to indicate when a transponder, license plate number, or accounts is registered through "away" agencies instead of the Bay Area FasTrak RCSC.
Civil Contractor	The Civil Contractor responsible for the construction of the ELN civil infrastructure.
Communications End to End Test	This test is a complete series of tests of the communications media and connectivity conducted before OFIT and each of the Operations Tests.
Corridor	A continuous stretch of the express lane roadway operated by the same operator and containing predefined start and end points.
Corridor Test	The Corridor test shall focus on functionality that could not be tested in previous on-site tests or functionality that changes when a full Corridor exists. This test will include actual vehicles driving to create Lane Transactions in many combinations. It will also include Lane Transactions created in various failure modes.
Day	Means calendar days unless otherwise expressly specified.
Discount	The percentage reduction in the toll rate from the SOV toll rate to the HOV 2 or HOV 3+ toll rates.
Dynamic Message Signs (DMS)	Electronic signs used to convey timely and important information to motorists, particularly during emergencies and ongoing activities. Also known as variable message signs and changeable message signs. Also see VTMS.
Dynamic Pricing	A toll rate structure that fluctuates based on traffic conditions to manage congestion through a supply/demand model.
Electronic Toll (ETOL)	A transaction that posts by transponder ID to a FasTrak account maintained by the FasTrak RCSC. The toll amount is deducted from the account's prepaid balance.
Electronic Toll Collection (ETC)	A method of toll collection that is fully electronic by utilizing only toll transponders to collect payment. Includes radio frequency ID-based (RFID) automatic vehicle identification (AVI) technology, as well as dedicated short range communications (DSRC).
End to End Test	To verify all system functionality, especially the ability to interact as specified with external entities through the external interfaces and web portals.
Exception	Lane Transaction which cannot be matched to a Trip Transaction because of lack of information or processing business rules.
Equipment Location Site	A physical location where BAIFA-owned TCS equipment is installed, operated or maintained. Also referred to as "Site."

<b>Term</b>	<b>Definition</b>
Factory Acceptance Test (FAT)	To verify that all functional elements of the Toll Collection System (TCS) are present and comply with the requirements of the contract at the TSI's site prior to installation.
FasTrak Regional Customer Service Center (RCSC)	The customer service center and back office system that supports toll accounts, transaction processing, payment processing, image review, violation processing, and customer service for FasTrak customers of BAIFA, BATA and other Bay Area agencies. Also referred to as the Bay Area FasTrak RCSC.
FasTrak Tag/Transponder	<p>The brand name for the physical device that that is mounted to a vehicle for the purpose of toll payment through automatic vehicle identification using Title 21 protocol.</p> <p>Standard FasTrak transponder – A Title 21 compliant transponder for use inside the vehicle.</p> <p>External FasTrak transponder – A Title 21 compliant transponder designed for external use. Also referred to as a “bumper tag” since the device is intended to be installed onto the vehicle’s bumper.</p> <p>Switchable FasTrak transponder – A specially-encoded Title 21 compliant transponder that contains a mechanism for a customer to declare the number of occupants in the vehicle in real-time.</p>
FasTrak Account Holder	A FasTrak, License Plate, or One-Time Payment account, registered with the FasTrak RCSC.
Fault Tolerant	Describes a system, network or component designed so that, in the event of a failure, a backup system, network, component or procedure can immediately take its place with no loss of service. Fault tolerance can be provided with hardware, software, physical network connections or provided by some combination.
First Zone Test	To verify proper system operation and functional elements with test vehicles while operating the first installed Zone with Host. This test will focus on Trip Building and Toll Rate Assignment functionality.
Graphical User Interface (GUI)	A software screen and menu representation that allows users to input, retrieve, add, and modify data, and perform actions.
Guaranteed Date	The date by which Milestone delivery is required.
Hardware	Collectively, the physical components of the TCS, including, but not limited to, receivers, transmitters, readers, antenna, coaxial hardline, routers, servers, computers, telecommunications, enclosures, and other similar devices. The term Hardware may also be used collectively to describe the physical aspects of the telecommunications network infrastructure.
High Occupancy Vehicle (HOV)	A vehicle with sufficient passengers to qualify for the HOV discount on the express lanes or the designation for a lane in which a certain number of vehicles is required for use or for discounted tolls.

<b>Term</b>	<b>Definition</b>
Host	TCS component that receives and processes lane level data to form Trip Transactions, and supports monitoring and maintenance of the equipment, systems and subsystems of the TCS. The Host includes functionality to assign toll rates, determine pricing, and build Trip Transactions. The Host includes the system and user interfaces with BAIFA systems and system and user interfaces with third-party systems.
Image Based Trip Transaction (IBT)	An IBT is any Trip Transaction with which the Host does not associate a valid transponder. The Trip Transactions may post to any Account Type based on the LPN associated with that Trip Transaction.
Image Toll (ITOL)	An Image Based Trip Transaction that posts to a customer's FasTrak account when the FasTrak RCSC associates that license plate number with a FasTrak account.
Interface Control Document (ICD)	A document that defines the file formats and related Business Rules for exchanging or processing data between two or more interfacing systems.
Invoice Account	A RCSC initiated account type in which an invoice is sent to a customer on a periodic basis to collect tolls based on license plate images.
Lane Controller	The component of the Toll Collection System that manages and automates the real-time control of Read Point equipment and receives data from related equipment, systems and sub-systems.
Lane Mode	A Lane Mode is a configuration of the TCS's operational parameters and settings.
Lane Transaction	A uniquely identified record of activity, including transponder and license plate images, created as a result of a vehicle traveling through a Read Point.
License Plate (LP) Account	A customer-initiated account at the FasTrak RCSC that allows payment of tolls electronically through license plate identification. No transponders are issued for License Plate Accounts.
License Plate Toll (LTOL)	A transaction that posts by license plate number and state to a valid License Plate Account at the FasTrak RCSC. The toll amount, plus any applicable transaction fee, is either deducted from the account's prepaid balance or charged to a credit card on file.
Limited Access	Limited Access is when access to/from the express lanes is allowed only at designated locations, typically through at-grade access openings that can serve ingress, egress, or combined ingress and egress. Striping or physical barriers prevent movement between the express lane and the adjacent general purpose lanes between access locations. Limited access is designated by a solid double stripe pavement marking.
Metro-E	Common abbreviation for Metropolitan-area Ethernet. Metro-E is used by service providers to connect subscribers to a larger service network or the Internet.
Milestone	Completion of a set of Work for which BAIFA approval is needed in order to receive payment.

<b>Term</b>	<b>Definition</b>
One-Time Payment (OTP) Account	A customer-initiated account at the FasTrak RCSC that allows payment of tolls electronically through license plate identification. OTPs are short-term and do not require personal information. No transponders are issued for One-Time Payments.
One-Time Payment Toll (ONETOL)	A transaction that posts by license plate number and state to a valid One-Time Payment account at the FasTrak RCSC. The toll amount, plus any applicable transaction fee, is either deducted from the account's prepaid balance or charged to a credit card on file.
Onsite First Installation Test (OFIT)	To verify proper system operation and functional elements with test vehicles while operating the first installed equipment site with Host. Test objectives are similar to the Factory Acceptance Tests.
Open/Continuous Access	Open/Continuous Access is when access to/from the express lane is not restricted to designated locations. Instead, vehicles are able to enter and exit the express lane at any point. Skip stripe pavement markings designate express lanes with Continuous Access.
Operations Test	To verify the installed operational accuracy, performance, reliability, and audit capability of the Toll Collection System (TCS). The Operations Test is performed after commencement of tolling for each Corridor under live traffic conditions.
Pay-By-Plate	Pay-by-Plate refers to the set of products that support License Plate Accounts, One-Time Payment Accounts, and Invoice Accounts. This should not be confused with the CTOC term 'pay by plate' which refers to FasTrak ITOLs posting to CTOC (Away agency) accounts.
Posting Day	The calendar day on which a Trip Transaction posted to an account at the FasTrak RCSC as reported through the FasTrak RCSC interface.
Qualifying Event	A deliverable or activity required of the TSI to meet an associated Milestone and the requirements thereof as defined by the Agreement.
Read Point	Read Points are locations where the TCS detects vehicles, reads transponders, and captures images in order to create Lane Transactions.
Recovery Schedule	A Project Schedule that has been revised to change the sequencing and/or duration of activities, in order to return the Project Schedule to a condition that will meet the Guaranteed Date(s).
Revenue Day	An accounting period containing transactions with entry points within the 24 hours of a calendar day.
Roadside Network	The Roadside Network is comprised of Corridor communications between tolling elements on the roadside and with the Backhaul Network.
Roadway Operations	Operational activities that manage traffic to maintain maximum performance of the express lanes, monitor express lane activity through user interfaces to the TCS, and respond to incidents and issues using manual controls or system overrides provided through TCS user interfaces.

<b>Term</b>	<b>Definition</b>
Secondary Host Site	Fully-functional redundant site to the primary Host site. The Secondary Host Site will be fully equipped with current databases, servers, switches and other equipment to replace the Host in the event of a catastrophic event at the primary Host site.
Segment	A subset of a Corridor between 'major destinations' containing several Zones.
Sign Controller	The component of the TCS that controls what is displayed on VTMS panels that broadcast tolling information to motorists and manage communications with the Host.
Site	See "Equipment Location Site."
Site Commissioning Test	To verify in separate tests that each installation is performed properly, that the equipment and interfaces function properly, and have been properly integrated with the Toll Collection System (TCS).
Source Code	The term "Source Code" means the computer programming code (other than binary code) and any procedural code such as job control language, which may be printed out or displayed in human readable form.
Source Code Documentation	The term "Source Code Documentation" means all documentation reasonably necessary or desirable to allow for compiling and testing of the source code, including without limitation a list of applicable proprietary software development tools, license(s) to all applicable Intellectual Property, detail on any permitted third party commercially available software used in conjunction with the system (including name, version, sub-version number and release date), documentation on how any permitted third party commercially available software is linked to the system software, and documentation showing the identities of and most current available contact information for one or more qualified programmers who had or have responsibility for the creation of the source code at issue and the methodology such that they can explain the source code and the methodology and otherwise be used as system references.
Switchable Transponder	Any transponder with a mechanism for a customer to declare the number of occupants in their vehicle in real-time.
Synchronous Optical Networking (SONET)	The technology used by Caltrans for trunk communications. SONET is based on time domain multiplexing and requires highly accurate clocks to send data at specific time periods. Since SONET is a transport technology, it allows for transmission of a variety of protocols.
System Acceptance Test	To verify the performance of the entire Toll Collection System (TCS) over a continuous test period. The system-wide System Acceptance Test is performed in a manner similar to the Operations Test.

<b>Term</b>	<b>Definition</b>
System Availability	The percentage of time that the TCS and any subsystem, hardware, device, component, or process is able to perform in full accordance with its functional and performance requirements with regard to a particular aspect of its overall operation.
Tag Status File	The file sent from the RCSC to the TCS Host containing the status of all home and CTOC transponders.
Title 21	The specification standard used by the State of California for high speed, open lane electronic toll collection and traffic management applications.
Toll Collection System (TCS)	The complete, functioning, electronic toll system that includes all hardware, software, system and user interfaces, electrical and communications equipment, and various technologies to manage traffic, monitor operations, facilitate toll collection, and report on System Data collected by the TCS.  TCS may also refer to an unspecified component or subsystem of the TSI's technical solution that performs a function being identified in the requirements. The TCS may also be referred to as "toll system" or "system" within applicable context.
Toll Roadway Operations Center	Location where BAIFA operators will monitor the ELN operations.
Toll System Integrator (TSI)	The contractor responsible for designing, developing, installing, and testing the TCS.
Tolling Commencement	The day toll revenue collection and operations begin using the TCS provided by the TSI.
Trip	The passage of a vehicle through an express lane Corridor from the point where the vehicle enters the express lane at an authorized entry location until it exits the express lane at an exit location. A Trip may include a single Segment/Zone/Read Point or multiple (but contiguous) Segments/Zones/Read Points.
Trip Building	The process within the TCS at the Host where Lane Transactions are processed to create Trip Transactions in order to charge tolls to vehicles making Trips in the express lane.
Trip Transaction	The package of information formed by the Host identifying a Trip made by a vehicle and the toll assigned to that Trip. The following modifiers can be added to Trip Transactions: <ul style="list-style-type: none"> <li>• Tagged – Trip Transactions associated with a valid FasTrak transponder</li> <li>• Image Based – Trip Transactions with without a valid FasTrak transponder, sent to the FasTrak RCSC with VES images</li> <li>• Rejected - Trip Transactions which the FasTrak RCSC cannot post to an account or pursue with a violation notice</li> <li>• Posted – Trip Transactions which the FasTrak RCSC posted to an account</li> </ul>
Variable Pricing	Variable pricing is a set of toll rates that change depending on the time of day.

<b>Term</b>	<b>Definition</b>
Variable Toll Message Sign (VTMS)	An electronic dynamic message sign used along the express lane to display the toll rate at the time of passage through a Read Point.
Vehicle Occupancy Requirement	The number of passengers required to be in a vehicle for it to be eligible for HOV-discounted travel, provided a switchable transponder is present and appropriately declared. The Vehicle Occupancy Requirement is either HOV 2 or HOV 3+ for each Corridor.
Violation Enforcement System (VES)	The system that captures images of vehicle license plates on the facility and associates them with the correct Lane Transactions, for vehicles without a valid transponder.
Violation Notice	A notice issued for failing to pay a toll due by establishing and maintaining a valid transponder- or plate- based account with the FasTrak RCSC. Violation Notices can include one or more transactions.
Violation Toll (VTOL)	A Trip Transaction flagged as an IBT at the Host but converted to an ETC Trip Transaction by the FasTrak RCSC based on a change in the transponder status to 'valid transponder' made at the FasTrak RCSC.
Work	All of the services, materials, equipment, and documentation required to be provided by the TSI under the Agreement and in conjunction with the Scope of Work.
Zone	A Zone consists of a set of contiguous Read Points in a single direction of travel with a single toll rate.

## RFP APPENDIX 1: Reference 2



### BAIFA Express Lane Network Toll Collection System

#### Diagrams, Drawings and Schematics

A	Tolling Location Details
B	Caltrans Standard Details
C	SLD Rollup
D	Typicals
E	Conduit Inventory Table

BAIFA Express Lane Network Toll Collection System

**Appendix 1, Reference 2**

**Diagrams, Drawings and Schematics**

**A: Tolling Location Details**

## QUANTITIES BY CORRIDOR

Project/Facility	Estimated Read Points	Estimated VTMS Points	Estimated CCTV Points	Estimated TMS Points	Estimated Backhaul Hub Points
I-80	17	14	12	17	2
I-680	25	19	19	25	3
I-880	47	33	31	47	3
SR 84	2	1	4	2	1
SR 92	3	2	4	3	1
<b>TOTALS =</b>	<b>94</b>	<b>69</b>	<b>70</b>	<b>94</b>	<b>10</b>

**I-680 Toll Equipment Location Table**

Location					Device Codes							
Route	Direction	Milepost	Station	Zone	CCTV	FasTrack Static Sign	Overhead Static Sign	Read Point	Traffic Monitoring System	VTMS	Backhaul Network Hub	
I-680	NB	20.22	478+50		0	0	0	0	0	0	1	
I-680	NB	20.29	485+60		1	0	1	0	0	0	0	
I-680	NB	20.56	499+48		0	0	0	0	0	1	0	
I-680	NB	20.85	514+82		0	0	1	0	0	0	0	
I-680	NB	21.34	540+54		1	0	1	0	0	0	0	
I-680	NB	21.49	548+41		0	0	0	1	1	0	0	
I-680	SB	0.46	593+61		1	0	1	0	0	0	0	
I-680	NB	0.70	606+10		0	0	0	0	0	1	0	
I-680	NB	1.07	625+44		0	1	0	1	1	0	0	
I-680	SB	1.07	625+44		0	0	0	1	1	1	0	
I-680	SB	1.09	626+50		1	0	0	0	0	0	0	
I-680	NB	1.70	658+98		0	1	0	1	1	0	0	
I-680	SB	1.70	658+98		0	1	0	1	1	0	0	
I-680	NB	2.09	679+57		1	0	0	0	0	0	0	
I-680	NB	2.33	692+02		0	0	0	1	1	1	0	
I-680	SB	2.36	693+52		0	0	0	1	1	1	0	
I-680	SB	2.59	705+66		1	0	0	0	0	0	0	
I-680	SB	3.16	736+18		0	1	0	1	1	0	0	
I-680	NB	3.16	736+18		0	1	0	1	1	0	0	
I-680	SB	3.61	759+50		0	0	0	0	0	1	0	
I-680	SB	3.78	768+48		1	0	0	0	0	0	0	
I-680	NB	3.95	777+75		0	0	0	0	0	1	0	
I-680	SB	4.25	793+54		0	1	0	1	1	0	0	
I-680	NB	4.38	799+98		0	1	0	1	1	0	0	
I-680	SB	4.60	812+00		0	0	0	0	0	1	0	
I-680	SB	4.63	813+58		1	0	0	0	0	0	0	
I-680	NB	5.29	848+43		1	0	0	0	0	0	0	
I-680	NB	5.33	850+39		0	0	0	0	0	1	0	
I-680	SB	5.34	851+17		0	1	0	1	1	0	0	
I-680	NB	6.25	899+03		1	1	0	1	1	0	0	
I-680	SB	6.28	900+53		0	0	0	1	1	1	0	
I-680	NB	7.21	949+63		1	0	0	0	0	0	0	
I-680	NB	7.25	950+86		0	0	0	1	1	1	0	
I-680	SB	7.25	950+86		0	1	0	1	1	0	0	
I-680	SB	7.55	966+24		0	0	0	0	0	1	0	
I-680	SB	7.60	968+88		1	0	0	0	0	0	0	
I-680	NB	8.11	995+81		1	0	0	0	0	0	0	
I-680	NB	8.16	998+52		0	0	0	0	0	1	0	
I-680	NB	8.44	1013+17		0	1	0	1	1	0	0	
I-680	SB	8.44	1013+17		0	1	0	1	1	0	0	
I-680	NB	9.25	1055+94		1	0	0	0	0	0	0	
I-680	NB	9.30	1059+00		0	0	0	0	0	1	0	
I-680	SB	9.30	1059+00		0	0	0	1	1	1	0	
I-680	SB	9.80	1085+40		1	0	0	0	0	0	0	
I-680	NB	10.14	1103+14		0	1	0	1	1	0	0	
I-680	SB	10.35	1114+31		0	0	0	1	1	1	0	
I-680	NB	10.53	1123+81		1	0	0	0	0	0	0	
I-680	NB	10.71	1133+07		0	0	0	0	0	1	0	
I-680	NB	11.27	1162+60		0	1	0	1	1	0	0	
I-680	SB	11.27	1162+60		0	1	0	1	1	0	0	
I-680	NB	11.48	1173+70		0	0	1	0	0	0	0	
I-680	SB	11.75	1188+03		1	1	0	1	1	0	0	
I-680	SB	12.18	1211+03		0	0	0	0	0	1	0	
I-680	SB	12.60	1233+08		0	0	0	1	1	0	0	
I-680	SB	12.77	1241+30		1	0	1	0	0	0	0	
I-680	SB	13.27	1272+30		0	0	1	0	0	0	0	
I-680	SB	13.53	1287+92		0	0	0	0	0	1	0	
I-680	SB	13.78	1301+36		1	0	1	0	0	0	0	
I-680	NB	14.41	1334+47		0	0	0	0	0	0	1	
I-680	NB	24.60	344+00		0	0	0	0	0	0	1	

**I-880 Toll Equipment Location Table**

Location					Device Codes						
Route	Direction	Milepost	Station	Zone	CCTV	FasTrack Static Sign	Overhead Static Sign	Read Point	Traffic Monitoring System	VTMS	Backhaul Network Hub
I-880	NB	7.60	1006+37		1	0	1	0	0	0	0
I-880	NB	7.85	1019+57		0	0	0	0	0	1	0
I-880	NB	8.10	1032+77		0	0	1	0	0	0	0
I-880	SB	8.60	1059+17		1	0	1	0	0	0	0
I-880	NB	8.60	1059+17		0	0	1	1	1	0	0
I-880	NB	8.70	1064+45		0	1	0	1	1	0	0
I-880	SB	9.80	1122+53		0	0	0	0	0	1	0
I-880	SB	9.85	1125+17		1	0	0	0	0	0	0
I-880	NB	10.00	1133+09		0	0	0	0	0	1	0
I-880	SB	10.50	1159+54		0	1	0	1	1	0	0
I-880	NB	10.50	1159+45		1	1	0	1	1	0	0
I-880	SB	0.90	1206+97		1	0	0	0	0	0	0
I-880	SB	1.00	1212+47		0	0	0	1	1	1	0
I-880	NB	1.00	1212+32		0	0	0	1	1	1	0
I-880	NB	1.50	1238+72		1	0	0	0	0	0	0
I-880	NB	1.90	1259+92		0	0	0	0	0	1	0
I-880	SB	2.50	1277+16		0	1	0	1	1	0	0
I-880	NB	2.50	1277+01		1	0	0	1	1	0	0
I-880	NB	2.82	1293+97		0	0	0	0	0	1	0
I-880	SB	2.93	1299+84		0	0	0	0	0	1	0
I-880	NB	3.25	1316+68		1	0	1	0	0	0	0
I-880	SB	3.51	1330+66		0	1	0	1	1	0	0
I-880	NB	3.51	1330+51		0	1	0	1	1	0	0
I-880	SB	4.45	1380+62		0	0	0	1	1	1	0
I-880	NB	4.45	1380+47		0	1	0	1	1	0	0
I-880	SB	4.50	1383+11		1	0	0	0	0	0	0
I-880	NB	TBD	TBD		0	0	0	0	0	0	1
I-880	NB	5.30	1425+06		0	1	0	1	1	0	0
I-880	SB	5.33	1426+56		1	1	0	1	1	0	0
I-880	SB	5.87	1455+09		0	0	0	0	0	1	0
I-880	NB	5.87	1454+94		0	0	0	0	0	1	0
I-880	SB	6.52	1489+41		0	1	0	1	1	0	0
I-880	NB	6.52	1489+26		1	1	0	1	1	0	0
I-880	NB	7.10	1519+96		0	0	0	1	1	1	0
I-880	NB	7.50	1541+08		1	0	0	0	0	0	0
I-880	SB	7.70	1551+64		0	1	0	1	1	0	0
I-880	NB	8.00	1567+48		0	0	0	1	1	1	0
I-880	SB	9.00	1620+36		1	1	0	1	1	0	0
I-880	NB	9.00	1620+21		0	1	0	1	1	0	0
I-880	SB	9.12	1626+56		0	0	1	0	0	0	0
I-880	SB	9.50	1646+68		0	0	0	0	0	1	0
I-880	NB	9.90	1667+80		1	0	0	0	0	0	0
I-880	NB	9.95	1670+27		0	0	0	1	1	1	0
I-880	SB	9.97	1671+76		0	0	1	1	1	0	0
I-880	NB	10.40	1694+20		0	1	0	1	1	0	0
I-880	SB	10.55	1701+71		0	0	0	0	0	1	0
I-880	NB	11.00	1725+47		1	0	0	0	0	0	0
I-880	NB	11.05	1727+72		0	0	0	0	0	1	0
I-880	SB	11.21	1737+08		0	1	0	1	1	0	0
I-880	NB	11.44	1748+89		0	1	0	1	1	0	0
I-880	SB	11.70	1762+84		0	0	0	0	0	1	0
I-880	SB	11.71	1763+37		1	0	0	0	0	0	0
I-880	NB	12.18	1788+19		0	0	0	1	1	1	0
I-880	SB	12.25	1791+90		0	1	0	1	1	0	0
I-880	SB	12.60	1810+39		0	0	0	0	0	1	0
I-880	NB	12.94	1828+31		1	0	1	1	1	0	0
I-880	NB	13.40	1854+66		0	0	0	0	0	1	0
I-880	SB	13.50	1857+88		0	1	0	1	1	0	0
I-880	NB	13.90	1879+00		0	0	1	0	0	0	0
I-880	SB	14.02	1885+32		0	0	0	0	0	1	0
I-880	NB	14.02	1885+17		0	1	0	1	1	0	0
I-880	SB	14.05	1886+75		1	0	0	0	0	0	0

**I-880 Toll Equipment Location Table**

Location					Device Codes						
Route	Direction	Milepost	Station	Zone	CCTV	FasTrack Static Sign	Overhead Static Sign	Read Point	Traffic Monitoring System	VTMS	Backhaul Network Hub
I-880	SB	14.65	1918+60		0	1	0	1	1	0	0
I-880	NB	14.95	1934+44		1	0	0	0	0	0	0
I-880	SB	15.00	1937+23		0	0	0	0	0	1	0
I-880	NB	15.00	1937+08		0	0	0	0	0	1	0
I-880	NB	15.20	1947+64		1	1	0	1	1	0	0
I-880	SB	15.80	1979+40		0	0	0	1	1	1	0
I-880	NB	15.80	1979+25		0	0	1	0	0	0	0
I-880	NB	15.91	1984+92		1	1	0	1	1	0	0
I-880	SB	16.50	2016+28		0	0	0	1	1	1	0
I-880	NB	TBD	TBD		0	0	0	0	0	0	1
I-880	NB	16.93	2039+01		1	1	0	1	1	0	0
I-880	SB	17.46	2067+19		0	1	0	1	1	0	0
I-880	SB	17.89	2089+94		0	0	0	0	0	1	0
I-880	NB	17.89	2089+79		0	1	0	1	1	0	0
I-880	SB	17.90	2090+32		1	0	0	0	0	0	0
I-880	SB	18.64	2129+27		0	1	0	1	1	0	0
I-880	NB	18.64	2129+12		0	1	0	1	1	0	0
I-880	NB	19.14	2155+81		0	0	1	0	0	0	0
I-880	SB	19.40	2169+40		1	1	0	1	1	0	0
I-880	SB	20.90	2248+60		1	1	0	1	1	0	0
I-880	SB	20.95	2251+26		0	0	1	0	0	0	0
I-880	SB	21.40	2275+00		0	0	0	0	0	1	0
I-880	SB	22.00	2306+68		1	0	0	1	1	1	0
I-880	SB	22.50	2333+08		1	0	0	0	0	1	0
I-880	SB	23.00	2359+48		0	0	0	1	1	1	0
I-880	SB	23.05	2362+12		1	0	0	0	0	0	0
I-880	NB	TBD	TBD		0	0	0	0	0	0	1
I-880	SB	24.00	2412+29		1	1	0	1	1	0	0
I-880	SB	24.45	2436+14		0	0	0	0	0	1	0
I-880	SB	25.11	2471+29		1	0	0	1	1	0	0
I-880	SB	25.30	2480+93		0	1	0	0	0	0	0
I-880	SB	25.80	2507+33		0	0	1	0	0	0	0
I-880	SB	26.10	2523+17		0	0	0	0	0	1	0
I-880	SB	26.30	2533+73		1	1	1	0	0	0	0

**SR 84 DUMBARTON BRIDGE APPROACH Toll Equipment Location Table**

Location					Device Codes						
Route	Direction	Milepost	Station	Zone	CCTV	FasTrack Static Sign	Overhead Static Sign	Read Point	Traffic Monitoring System	VTMS	Backhaul Network Hub
SR-84	WB	3.21			0	0	0	0	0	0	1
SR-84	WB	3.88			1	1	0	1	1	0	0
SR-84	WB	4.72			1	1	0	1	1	0	0
SR-84	WB	5.07			0	0	1	0	0	0	0
SR-84	WB	5.57			1	0	1	0	0	0	0
SR-84	WB	5.82			0	0	0	0	0	1	0
SR-84	WB	6.00			0	0	1	0	0	0	0
SR-84	WB	6.08			1	0	1	0	0	0	0

**SR 92 SAN MATEO BRIDGE APPROACH Toll Equipment Location Table**

Location					Device Codes						
<i>Route</i>	<i>Direction</i>	<i>Milepost</i>	<i>Station</i>	<i>Zone</i>	<i>CCTV</i>	<i>FasTrack Static Sign</i>	<i>Overhead Static Sign</i>	<i>Read Point</i>	<i>Traffic Monitoring System</i>	<i>VTMS</i>	<i>Backhaul Network Hub</i>
SR-92	WB	2.64			0	0	0	0	0	0	1
SR-92	WB	3.35			1	1	0	1	1	0	0
SR-92	WB	4.01			0	0	0	0	0	1	0
SR-92	WB	4.50			1	1	0	1	1	0	0
SR-92	WB	5.41			1	1	0	1	1	0	0
SR-92	WB	5.61			0	0	1	0	0	0	0
SR-92	WB	6.14			0	0	1	0	0	1	0
SR-92	WB	6.20			1	0	0	0	0	0	0

**I-80 Toll Equipment Location Table**

Location					Device Codes						
Route	Direction	Milepost	Station	Zone	CCTV	FasTrack Static Sign	Overhead Static Sign	Read Point	Traffic Monitoring System	VTMS	Backhaul Network Hub
I-80	TBD	TBD	TBD		0	0	0	0	0	0	1
I-80	TBD	TBD	TBD		0	0	0	0	0	0	1
I-80	EB	10.45	70+30		1	0	1	0	0	0	0
I-80	EB	10.70	83+50		0	0	0	0	0	1	0
I-80	EB	10.95	96+70		0	0	1	0	0	0	0
I-80	EB	11.45	123+10		1	0	1	0	0	0	0
I-80	EB	11.62	132+00		0	0	0	1	1	0	0
I-80	EB	12.11	157+95		0	0	0	1	1	1	0
I-80	WB	12.38	172+00		1	0	1	1	1	0	0
I-80	EB	12.67	187+65		0	0	0	0	0	1	0
I-80	WB	12.73	190+50		0	1	0	1	1	0	0
I-80	WB	12.87	197+70		0	0	1	0	0	0	0
I-80	EB	13.25	218+00		1	1	0	1	1	0	0
I-80	WB	13.25	218+00		0	1	0	1	1	0	0
I-80	WB	13.86	250+00		0	0	0	0	0	1	0
I-80	EB	14.05	260+03		1	0	0	0	0	0	0
I-80	EB	14.11	263+50		0	0	0	0	0	1	0
I-80	EB	14.41	279+50		0	1	0	1	1	0	0
I-80	WB	14.41	279+50		0	1	0	1	1	0	0
I-80	WB	14.72	295+35		0	0	0	0	0	1	0
I-80	EB	15.20	320+95		0	1	0	1	1	0	0
I-80	WB	15.23	322+45		1	1	0	1	1	0	0
I-80	WB	15.88	357+00		0	0	0	0	0	1	0
I-80	EB	15.92	359+11		1	0	0	0	0	0	0
I-80	EB	15.96	361+50		0	0	0	0	0	1	0
I-80	EB	16.80	405+40		0	1	0	1	1	0	0
I-80	WB	16.88	410+00		1	1	0	1	1	0	0
I-80	EB	17.45	440+00		0	0	0	0	0	1	0
I-80	WB	17.48	441+60		0	0	0	0	0	1	0
I-80	EB	17.60	447+94		1	0	0	0	0	0	0
I-80	WB	18.12	475+20		0	1	0	1	1	0	0
I-80	EB	18.15	477+00		0	1	0	1	1	0	0
I-80	WB	18.63	502+00		0	0	0	0	0	1	0
I-80	WB	18.75	508+34		1	0	0	0	0	0	0
I-80	EB	18.85	513+50		0	0	0	0	0	1	0
I-80	WB	18.97	519+80		0	1	0	1	1	0	0
I-80	EB	19.32	538+60		0	1	0	1	1	0	0
I-80	WB	19.35	540+00		0	0	0	0	0	1	0
I-80	EB	19.80	563+83		1	0	0	0	0	0	0
I-80	WB	19.80	563+83		0	0	0	1	1	0	0
I-80	WB	20.02	574+39		0	0	1	0	0	0	0
I-80	WB	20.50	599+73		0	0	1	0	0	0	0
I-80	WB	20.80	615+57		0	0	0	0	0	1	0
I-80	WB	21.12	632+47		1	0	1	0	0	0	0

BAIFA Express Lane Network Toll Collection System

**Appendix 1, Reference 2**

**Diagrams, Drawings and Schematics**

**B: Caltrans Standard Details**

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS

  
 REGISTERED CIVIL ENGINEER  
 May 20, 2011  
 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.

REGISTERED PROFESSIONAL ENGINEER  
 Jeff C. Kopley  
 No. 53361  
 Exp. 6-30-11  
 CIVIL  
 STATE OF CALIFORNIA

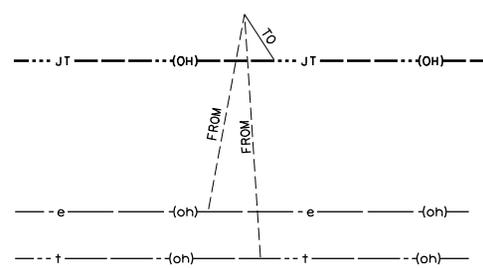
**SUBSURFACE FACILITIES**

- W—W—W— NEW WATER
- w--w--w-- Exist WATER
- G---G--- NEW NATURAL GAS
- g--g--g-- Exist NATURAL GAS
- S---S--- NEW SEWER
- s--s--s-- Exist SEWER
- E---E--- NEW ELECTRICAL
- e--e--e-- Exist ELECTRICAL
- T---T--- NEW TELEPHONE
- t--t--t-- Exist TELEPHONE
- GS---GS--- NEW GASOLINE
- gs--gs--gs-- Exist GASOLINE
- O---O--- NEW OIL
- o--o--o-- Exist OIL
- TV---TV--- NEW TELEVISION
- tv--tv--tv-- Exist TELEVISION
- ST---ST--- NEW STEAM
- st--st--st-- Exist STEAM
- TC---TC--- NEW TELEMETER CABLE
- tc--tc--tc-- Exist TELEMETER CABLE
- SD---SD--- NEW STORM DRAIN
- sd--sd--sd-- Exist STORM DRAIN
- FO---FO--- NEW FIBER OPTIC
- fo--fo--fo-- Exist FIBER OPTIC
- JT---JT--- NEW JOINT TRENCH
- jt--jt--jt-- Exist JOINT TRENCH

**OVERHEAD FACILITIES**

- E---(OH)---E--- NEW ELECTRICAL
- e--(oh)--e-- Exist ELECTRICAL
- TC---(OH)---TC--- NEW TELEMETER CABLE
- tc--(oh)--tc-- Exist TELEMETER CABLE
- T---(OH)---T--- NEW TELEPHONE
- t--(oh)--t-- Exist TELEPHONE
- TV---(OH)---TV--- NEW TELEVISION
- tv--(oh)--tv-- Exist TELEVISION
- FO---(OH)---FO--- NEW FIBER OPTIC
- fo--(oh)--fo-- Exist FIBER OPTIC
- JT---(OH)---JT--- NEW JOINT OVERHEAD
- jt--(oh)--jt-- Exist JOINT OVERHEAD

**SHOWING THE RELOCATION OF EXISTING FACILITIES TO THE NEW LOCATION**



**ABANDONED FACILITY**

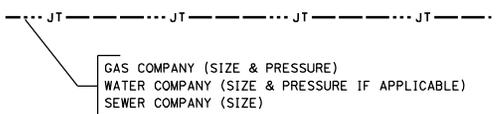
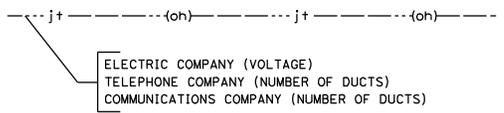


**NOTE:**

IDENTIFY (LABEL) THE OWNER OF EACH FACILITY PLUS THE SIZE, PRESSURE AND VOLTAGE (IF APPLICABLE) FOR ALL FACILITIES (WHETHER PART OF A JOINT OVERHEAD, JOINT TRENCH OR SOLO INSTALLATION).

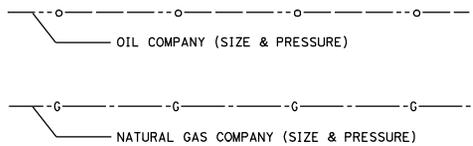
THE TYPE OF FACILITY IS IDENTIFIED BY THE SYMOLOGY OF THE LINE STYLE CHOSEN (SEE LINE STYLES ON THIS STANDARD PLAN SHEET).

**JOINT OVERHEAD/TRENCH**



WHEN USING THE JOINT OVERHEAD OR JOINT TRENCH SYMOLOGY (SEE THE CALTRANS LINE STYLES ON THIS PAGE), USE A BRACKET TO GROUP AND LABEL ALL THE FACILITIES ASSOCIATED WITH THE JOINT OVERHEAD OR TRENCH (SEE THE EXAMPLES ABOVE).

**SOLO FACILITY**



STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**LINES AND SYMBOLS**  
**(SHEET 2 OF 3)**

NO SCALE

**A10D**

**ELECTROLIERS**

STANDARD TYPES	DESCRIPTION
15, 15D	HIGH MAST LIGHT POLE
15 STRUCTURE	DOUBLE ARM LIGHTING STANDARD
21, 21D STRUCTURE	EXISTING ELECTROLIER
30	ELECTROLIER FOUNDATION (FUTURE INSTALLATION)
31	
32	
35	
36-20A	

**NOTES:**

- Luminaires shall be 310 W HPS when installed on Type 21, 21D, 30, 31, 32, 35 and 36-20A Standards, unless otherwise specified. Luminaires shall be 200 W HPS when installed on other type standards or poles, unless otherwise specified.
- Luminaires shall be the cutoff type, ANSI Type III medium cutoff lighting distribution, unless otherwise specified.
- Variations noted adjacent to symbol on project plans.

ELECTROLIER (SEE PROJECT NOTES OR PROJECT PLANS)  
 LUMINAIRE ON WOOD POLE

**LEGEND:**

AB	ABANDON. IF APPLIED TO CONDUIT, REMOVE CONDUCTORS.
BC	INSTALL PULL BOX IN EXISTING CONDUIT RUN.
BP	PEDESTRIAN BARRICADE, TYPE AS INDICATED ON PLAN.
CB	INSTALL CONDUIT INTO EXISTING PULL BOX.
CC	CONNECT NEW AND EXISTING CONDUIT. REMOVE EXISTING CONDUCTORS AND INSTALL CONDUCTORS AS INDICATED.
CF	CONDUIT TO REMAIN FOR FUTURE USE. REMOVE CONDUCTORS. INSTALL PULL WIRE OR ROPE.
DH	DETECTOR HANDHOLE.
FA	FOUNDATION TO BE ABANDONED.
IS	INSTALL SIGN ON SIGNAL MAST ARM.
NS	NO SLIP BASE ON STANDARD.
PEC	PHOTOELECTRIC CONTROL.
PEU	PHOTOELECTRIC UNIT.
RC	EQUIPMENT OR MATERIAL TO BE REMOVED AND BECOME THE PROPERTY OF THE CONTRACTOR.
RE	REMOVE ELECTROLIER, FUSES AND BALLAST. TAPE ENDS OF CONDUCTORS.
RL	RELOCATE EQUIPMENT.
RR	REMOVE AND REUSE EQUIPMENT.
RS	REMOVE AND SALVAGE EQUIPMENT.
SC	SPLICE NEW TO EXISTING CONDUCTORS.
SD	SERVICE DISCONNECT.
TSP	TELEPHONE SERVICE POINT.

**ABBREVIATIONS AND EQUIPMENT DESIGNATIONS**

NEW	EXISTING	DESCRIPTION
BBS	bbs	BATTERY BACKUP SYSTEM
BC	bc	BOLT CIRCLE
C	C	CONDUIT
CB	CB	CIRCUIT BREAKER
CCTV	cctv	CLOSED CIRCUIT TELEVISION
CKT	ckt	CIRCUIT
CMS	cms	CHANGEABLE MESSAGE SIGN
CTID	ctid	CALTRANS IDENTIFICATION COMMUNICATION
COMM	comm	COMMUNICATION
DLC	dlc	LOOP DETECTOR LEAD-IN CABLE
EMS	ems	EXTINGUISHABLE MESSAGE SIGN
EVC	evc	EMERGENCY VEHICLE CABLE
EVD	evd	EMERGENCY VEHICLE DETECTOR
FB	fb	FLASHING BEACON WITHOUT SLIP BASE
FBCA	fbca	FLASHING BEACON CONTROL ASSEMBLY
FBS	fb	FLASHING BEACON WITH SLIP BASE
FO	fo	FIBER OPTIC
G	G	GROUND (EQUIPMENT GROUNDING CONDUCTOR)
GB	GB	GROUND BUS
GFCI	GFCI	GROUND FAULT CIRCUIT INTERRUPTER
HAR	har	HIGHWAY ADVISORY RADIO
HEX	hex	HEXAGONAL
HPS	hps	HIGH PRESSURE SODIUM
IISNS	iisns	INTERNALLY ILLUMINATED STREET NAME SIGN
ISL	isl	INDUCTION SIGN LIGHTING
LED	led	LIGHT EMITTING DIODE
LMA	lma	LUMINAIRE MAST ARM
LPS	lps	LOW PRESSURE SODIUM
LTG	ltg	LIGHTING
LUM	lum	LUMINAIRE
M	M	METERED
MAT	mat	MAST ARM MOUNTING VEHICLE SIGNAL FACES, TOP ATTACHMENT
MAS	mas	MAST ARM MOUNTING VEHICLE SIGNAL FACES, SIDE ATTACHMENT
MAS-4A	mas-4A	MAST ARM MOUNTING VEHICLE SIGNAL FACES, SIDE ATTACHMENT - 4 SIGNAL SECTION
MAS-4B	mas-4B	
MAS-4C	mas-4C	
MAS-5A	mas-5A	MAST ARM MOUNTING VEHICLE SIGNAL FACES, SIDE ATTACHMENT - 5 SIGNAL SECTION
MAS-5B	mas-5B	
mc	mc	MERCURY CONTACTOR
M/M	m/m	MULTIPLE TO MULTIPLE TRANSFORMER
MT	mt	CONDUIT WITH PULL WIRE OR ROPE ONLY
MTG	mtg	MOUNTING
mv	mv	MERCURY VAPOR LIGHTING FIXTURE
MVDS	mvds	MICROWAVE VEHICLE DETECTION SYSTEM
N	N	NEUTRAL (GROUNDED CONDUCTOR)
NB	NC	NEUTRAL BUS
NC	NO	NORMALLY CLOSE
NO	NO	NORMALLY OPEN
P	P	POLE (CIRCUIT BREAKER)
PB	pb	PULL BOX
PEC	pec	PHOTOELECTRIC CONTROL (TYPE I, II, III, IV OR X AS SHOWN)
PED	ped	PEDESTRIAN
PEU	peu	PHOTOELECTRIC UNIT
PPB	ppb	PEDESTRIAN PUSH BUTTON
RL	RL	RELOCATED EQUIPMENT
RM	rm	RAMP METERING
RWIS	rwis	ROADSIDE WEATHER INFORMATION SYSTEM
SB	sb	SLIP BASE
SBI	sbi	SLIP BASE INSERT
SIC	sic	SIGNAL INTERCONNECT CABLE
SIG	sig	SIGNAL
SMA	sma	SIGNAL MAST ARM
SNS	sns	STREET NAME SIGN
SP	sp	SERVICE POINT
TDC	tdc	TELEPHONE DEMARCATION CABINET
TMS	tms	TRAFFIC MONITORING STATION
TOS	tos	TRAFFIC OPERATIONS SYSTEM
UM	UM	UNMETERED
VEH	veh	VEHICLE
VIVDS	vivds	VIDEO IMAGE VEHICLE DETECTION SYSTEM
WIM	wim	WEIGH-IN-MOTION
XFMR	xfmr	TRANSFORMER

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*Jeffery G. McRae*  
 REGISTERED ELECTRICAL ENGINEER  
 No. E14512  
 Exp. 6-30-12  
 PROFESSIONAL ENGINEER  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE

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**SOFFIT AND WALL MOUNTED LUMINAIRES**

	PENDANT, 70 W HPS UNLESS OTHERWISE SPECIFIED.
	FLUSH, 70 W HPS UNLESS OTHERWISE SPECIFIED.
	WALL SURFACE, 70 W HPS UNLESS OTHERWISE SPECIFIED.
	EXISTING SOFFIT OR WALL LUMINAIRE TO REMAIN UNMODIFIED.
	EXISTING SOFFIT OR WALL LUMINAIRE TO BE MODIFIED AS SPECIFIED.

**NOTE:**

Arrow indicates "street side" of luminaire.

COMMONLY USED SYMBOLS FOR UNITED STATES CUSTOMARY UNITS OF MEASUREMENT:

SYMBOL USED	DEFINITIONS
Ω	OHMS
min	MINUTE
s	SECOND
bps	BITS PER SECOND
Bps	BYTES PER SECOND
A	AMPERE
V	VOLT
V <sub>(dc)</sub>	VOLT (DIRECT CURRENT)
V <sub>(ac)</sub>	VOLT (ALTERNATING CURRENT)
FC	FOOT - CANDLE
W	WATTS
VA	VOLT-AMPERE
M	MEGA
K	KILO
m	MILLI
μ	MICRO
P	PICO
Hz	HERTZ

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**ELECTRICAL SYSTEMS (LEGEND, NOTES AND ABBREVIATIONS)**

NO SCALE

ES-1A

**CONDUIT**

NEW	EXISTING	
---	---	LIGHTING CONDUIT, UNLESS OTHERWISE INDICATED OR NOTED
---	---	TRAFFIC SIGNAL CONDUIT
C---	c---	COMMUNICATION CONDUIT
T---	t---	TELEPHONE CONDUIT
F---	f---	FIRE ALARM CONDUIT
FO---	fo---	FIBER OPTIC CONDUIT
---	---	CONDUIT TERMINATION
		CONDUIT RISER ATTACHED TO THE STRUCTURE OR SERVICE POLE

**SERVICE EQUIPMENT**

NEW	EXISTING	
OH	oh	OVERHEAD LINES
U	U	WOOD POLE, "U" INDICATES UTILITY OWNED
		POLE GUY WITH ANCHOR
		UTILITY TRANSFORMER - GROUND MOUNTED
		SERVICE EQUIPMENT ENCLOSURE TYPE
		SERVICE EQUIPMENT ENCLOSURE DOOR INDICATES FRONT OF ENCLOSURE
T	T	TELEPHONE DEMARCATION CABINET

**POLE-MOUNTED SERVICE DESIGNATION**



**SIGNAL EQUIPMENT**

NEW	EXISTING	
		PEDESTRIAN SIGNAL FACE
		PEDESTRIAN PUSH BUTTON POST
		PEDESTRIAN BARRICADE
		VEHICLE SIGNAL FACE (WITH BACKPLATE, 3-SECTION: RED, YELLOW AND GREEN)
		VEHICLE SIGNAL FACE WITH ANGLE VISORS
		MODIFICATIONS OF BASIC SYMBOLS: "L" INDICATES ALL NON-ARROW SECTIONS LOUVERED "LG" INDICATES LOUVERED GREEN SECTION ONLY "PV" INDICATES 12" PROGRAMMED VISIBILITY SECTIONS "8" INDICATES ALL 8" SECTIONS (ONLY WHEN SPECIFIED)
		TYPE 15TS AND VEHICLE SIGNAL FACE
		TYPE 21TS AND VEHICLE SIGNAL FACE
		VEHICLE SIGNAL FACE CONSISTING OF RED, YELLOW AND GREEN LEFT ARROW SECTIONS
		VEHICLE SIGNAL FACE CONSISTING OF RED AND YELLOW SECTIONS WITH AN UP GREEN ARROW SECTION
		VEHICLE SIGNAL FACE (5 SECTION) CONSISTING OF RED, YELLOW AND GREEN SECTIONS WITH YELLOW AND GREEN RIGHT ARROW SECTIONS
		TYPE 1 STANDARD WITH ATTACHED VEHICLE SIGNAL FACES
		STANDARD WITH A SIGNAL MAST ARM, ATTACHED VEHICLE SIGNAL FACES AND INTERNALLY ILLUMINATED STREET NAME SIGN
		TYPE 33 STANDARD, LEFT-TURN VEHICLE SIGNAL FACES AND SIGNS
		STANDARD WITH LUMINAIRE AND SIGNAL MAST ARMS AND ATTACHED VEHICLE SIGNAL FACES
		CANTILEVER FLASHING BEACON TYPE 9 FRAME, WITH A SIGN UNLESS OTHERWISE SPECIFIED OR INDICATED
		TYPE 15-FBS STANDARD WITH TWO VEHICLE SIGNAL FACE SECTIONS WITH LENS, BACKPLATE AND VISOR WITH A SIGN. "Y" INDICATES YELLOW INDICATION
		FLASHING BEACON, ONE VEHICLE SIGNAL FACE SECTION WITH LENS, BACKPLATE AND VISOR. "R" INDICATES RED INDICATION, "Y" INDICATES YELLOW INDICATION
		CONTROLLER ASSEMBLY. DOOR INDICATES FRONT OF CABINET

**SIGNAL EQUIPMENT Cont**

NEW	EXISTING	
		GUARD POST
		TYPE 1 STANDARD WITH "METER ON" SIGN
		EMERGENCY VEHICLE DETECTOR

**NOTES:**

1. All signal sections shall be 12" unless shown otherwise.
2. Signal heads shall be provided with backplates unless shown otherwise.
3. Signal indication shall be LED.

**ILLUMINATED OVERHEAD SIGN**

NEW	EXISTING	
		SINGLE POST, SINGLE ILLUMINATED SIGN, BALANCED BUTTERFLY
		SINGLE POST, DOUBLE ILLUMINATED SIGN, BALANCED BUTTERFLY
		SINGLE POST, SINGLE ILLUMINATED SIGN, FULL CANTILEVER
		DOUBLE POST, SINGLE ILLUMINATED SIGN
		SINGLE ILLUMINATED SIGN MOUNTED ON STRUCTURE
		DOUBLE POST, SINGLE ILLUMINATED SIGN WITH ELECTROLIZER

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**ELECTRICAL SYSTEMS  
(LEGEND, NOTES AND ABBREVIATIONS)**

NO SCALE

ES-1B

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Jeffrey G. McFar  
REGISTERED ELECTRICAL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

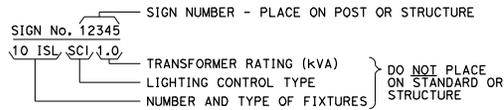
Jeffrey G. McFar  
No. E14512  
Exp. 6-30-12  
REGISTERED PROFESSIONAL ENGINEER  
ELECTRICAL  
STATE OF CALIFORNIA

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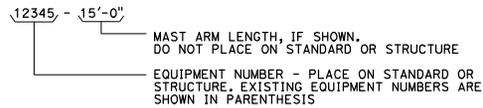
D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
<i>Jeffery G. McRae</i> REGISTERED ELECTRICAL ENGINEER					
May 20, 2011 PLANS APPROVAL DATE					
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### EQUIPMENT IDENTIFICATION

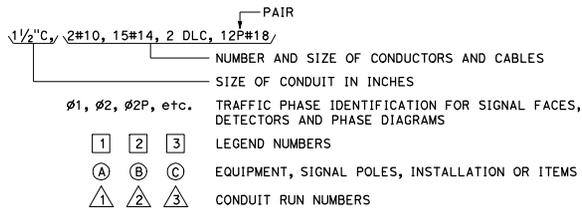
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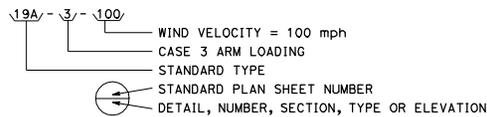
#### ELECTROLIER OR EQUIPMENT IDENTIFICATION NUMBER:



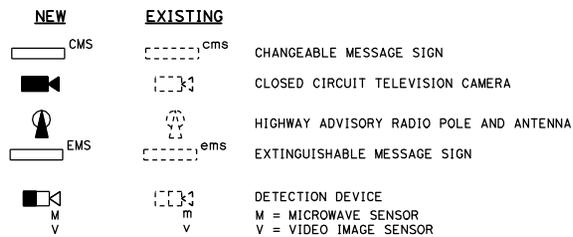
#### CONDUIT AND CONDUCTOR IDENTIFICATION:



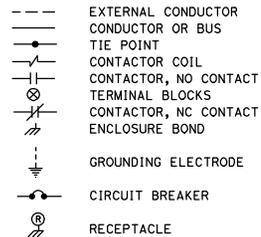
#### SIGNAL AND LIGHTING STANDARD (TYPICAL DESIGNATION):



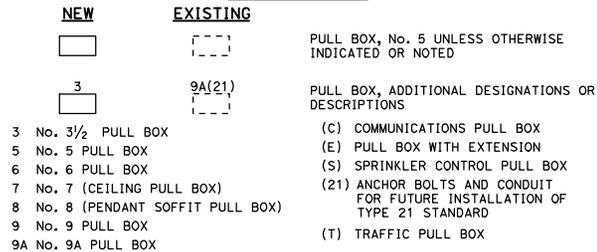
### MISCELLANEOUS EQUIPMENT



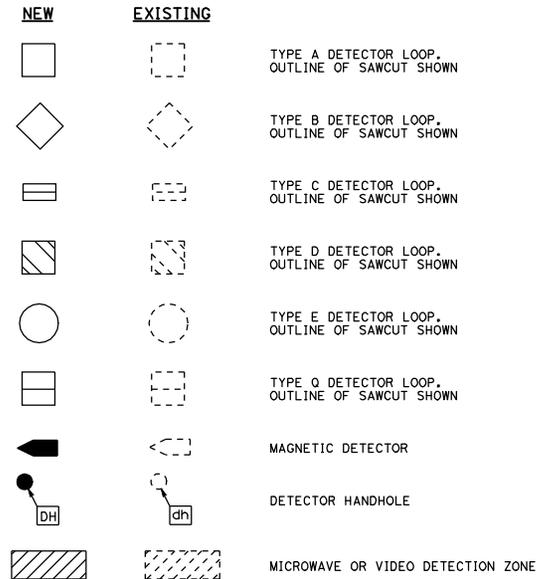
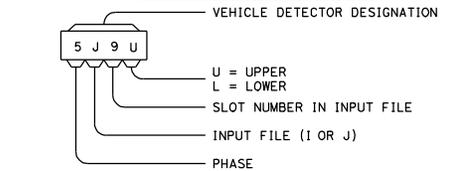
### WIRING DIAGRAM LEGEND



### PULL BOXES



### VEHICLE DETECTORS



STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION

## ELECTRICAL SYSTEMS (LEGEND, NOTES AND ABBREVIATIONS)

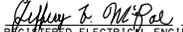
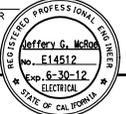
NO SCALE

ES-1C

2010 STANDARD PLAN ES-1C

**NOTES:**

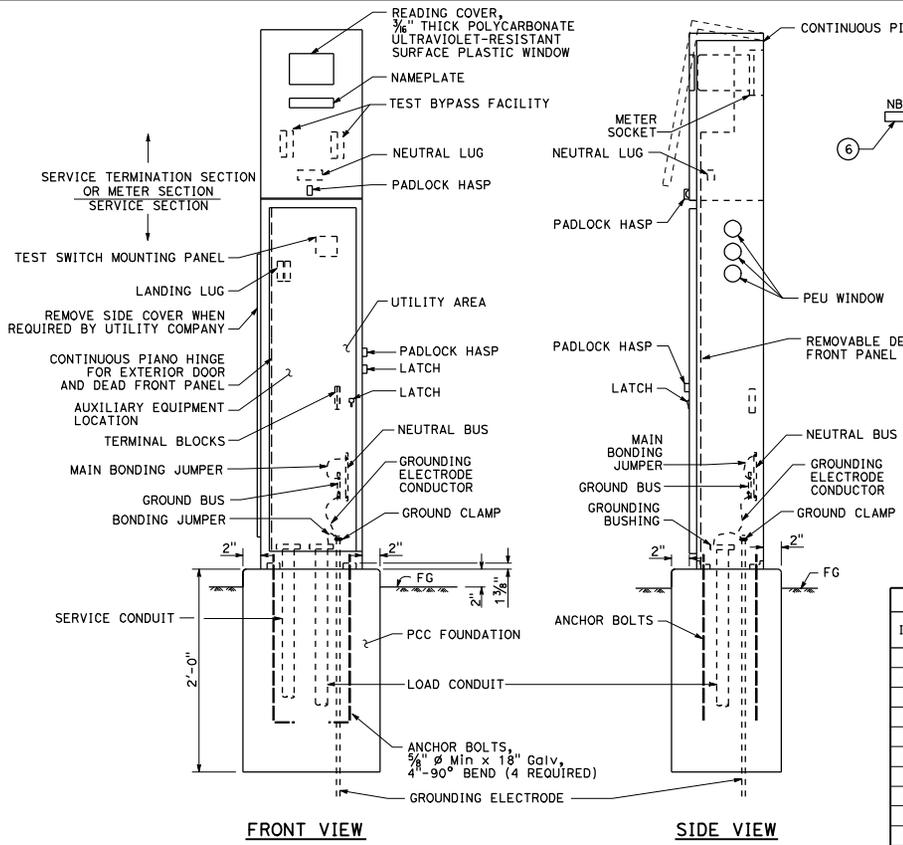
1. Service equipment enclosure and metering equipment shall meet the requirements of the service utility. The meter area shall have a sealable, lockable, weathertight cover that can be removed without the use of tools.
2. Service equipment enclosure shall be factory wired.
3. The dead front panel on Type III service equipment enclosure shall have a continuous stainless steel or aluminum piano hinge. This panel or dead front panel shall be secured with a latch or captive screws. No live parts shall be mounted on this panel or the dead front panel.
4. The exterior door shall have provisions for padlocking. The padlock hole shall be a minimum diameter of  $\frac{3}{16}$ ".
5. An enclosure housing a transformer of more than one kVA shall have effective screened ventilation louvers of not less than 50 square inches for each louver. Screen shall be stainless steel No. 304, with a No. 10 size mesh. Framed screen shall be secured with at least four bolts.
6. Fasteners on the exterior of the enclosure shall be vandal-resistant and shall not be removable from the exterior. Exterior screws, nuts, bolts and washers shall be stainless steel.
7. Landing lugs for incoming service conductors shall be compatible with either copper or aluminum conductors sized to suit the conductors shown on the plan. Landing lugs shall be copper or tin-plated aluminum. Live parts of electrical equipment must be guarded against accidental contact. Neutral bus shall be rated for 125 A and be suitable for copper or aluminum conductors unless otherwise specified. The terminal shall include but not be limited to:
  - a. Incoming terminals (landing lugs)
  - b. Neutral lugs
  - c. Solid neutral terminal strip
8. At least 6 standard single pole circuit breaker spaces,  $\frac{3}{4}$ " nominal, shall be provided for branch circuits. Circuit breaker interiors shall be copper. Interiors of enclosure shall accept plug-in or cable-in/cable-out circuit breakers.
9. Control wiring shall be 600 V, 14 stranded machine tool wire. Where subject to flexing, 19 strand wire shall be used.
10. Main bus shall be rated for 125 A and shall be tin-plated copper.
11. A plastic laminated wiring diagram shall be provided with brass mounting eyelets, shall be attached to the inside of the enclosure and shall be affixed to the interior with a UL or ETL approved method.
12. An engraved phenolic nameplate indicating the function of the circuit or the device shall be installed with stainless steel rivets or stainless steel screws:
  - a. Adjacent to the breaker on the dead front panel with  $\frac{1}{8}$ " characters, minimum.
  - b. Adjacent to the device on the back panel with  $\frac{1}{8}$ " characters, minimum.
  - c. At the top exterior of the door panel indicating system number, voltage level and number of phases with  $\frac{3}{16}$ " characters, minimum.
13. The plan shows the approximate location of devices within the enclosure. Components may be rearranged, however, the "working" clearances within the service equipment enclosure shall be maintained.
14. In unpaved areas a raised portland cement concrete pad 2'-0" x 4" x width of foundation shall be constructed in front of new service equipment enclosure installation. Pad shall be set to elevation of foundation.
15. Internal bus, where shown, is typical only. Alternative design of proposed service equipment enclosure shall be submitted to the Engineer for approval.
16. Plug-in circuit breakers may be mounted in the vertical or horizontal position. Cable-in/cable-out circuit breakers shall be mounted in the vertical position.
17. Type III-AF and Type III-BF service equipment enclosures shall have the meter viewing windows located on the front side of the service equipment enclosures.
18. Type III-AR and Type III-BR service equipment enclosure shall be similarly constructed as Type III-AF and Type III-BF respectively, except the meter viewing windows shall be located on the back side of the service equipment enclosures.
19. Minimum clearance shall be required for front and back of service equipment enclosure per National Electrical Code, Article 110.26, "Spaces About Electric Equipment (600 Volts, nominal or less)."

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
 REGISTERED ELECTRICAL ENGINEER					
May 20, 2011 PLANS APPROVAL DATE					
					
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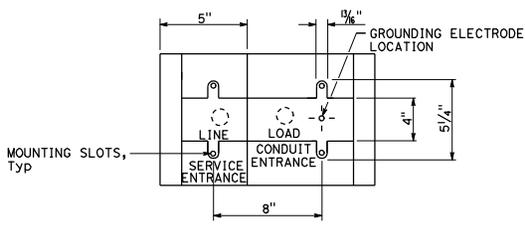
STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
(SERVICE EQUIPMENT NOTES  
TYPE III SERIES)**

NO SCALE

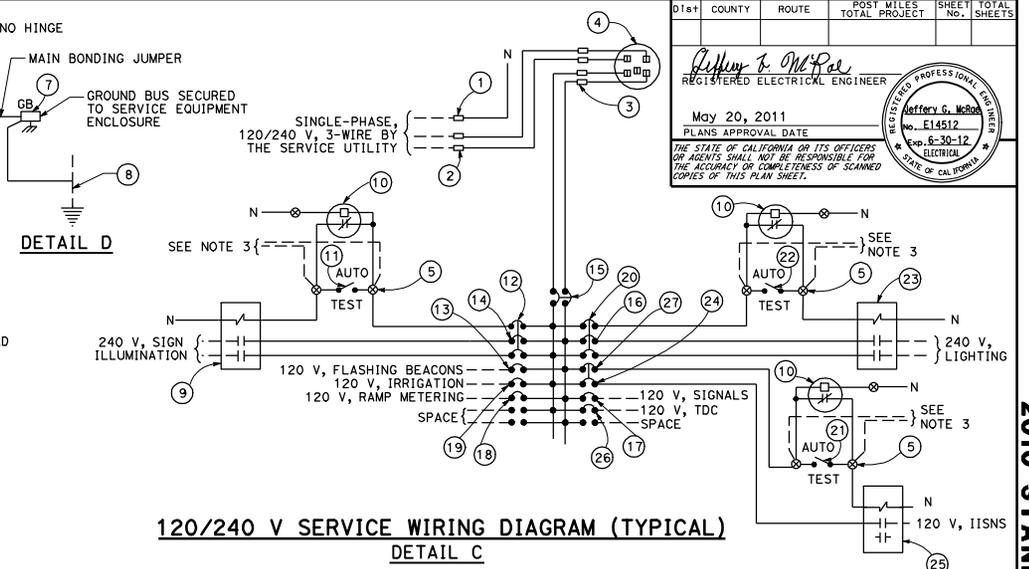
**ES-2C**



**TYPE III-AF SERVICE EQUIPMENT ENCLOSURE (TYPICAL)**  
**DETAIL A**



**BASE FOR TYPE III-A SERVICE EQUIPMENT ENCLOSURE**  
**DETAIL B**



**120/240 V SERVICE WIRING DIAGRAM (TYPICAL)**  
**DETAIL C**

TYPE III-A SERVICE EQUIPMENT ENCLOSURE LEGEND (120/240 V)					
ITEM	COMPONENT	NAMEPLATE DESCRIPTION	ITEM	COMPONENT	NAMEPLATE DESCRIPTION
1	NEUTRAL LUG		14	30 A, 240 V, 2P, CB	SIGN ILLUMINATION
2	LANDING LUG (NOTE 6)		15	100 A, 240 V, 2P, CB	MAIN BREAKER
3	TEST BYPASS FACILITY		16	30 A, 240 V, 2P, CB	LIGHTING
4	METER SOCKET AND SUPPORT		17	50 A, 120 V, 1P, CB	SIGNALS
5	TERMINAL BLOCKS		18	30 A, 120 V, 1P, CB	RAMP METERING
6	NEUTRAL BUS		19	20 A, 120 V, 1P, CB	IRRIGATION
7	GROUND BUS		20	15 A, 120 V, 1P, CB	LIGHTING CONTROL
8	GROUNDING ELECTRODE		21	15 A, 1P, TEST SWITCH	IISNS TEST SWITCH
9	30 A, 2P, NO CONTACTOR	SIGN ILLUMINATION	22	15 A, 1P, TEST SWITCH	LIGHTING TEST SWITCH
10	PHOTOELECTRIC UNIT (NOTE 7)	PEU	23	60 A, 2P, NO CONTACTOR	LIGHTING
11	15 A, 1P, TEST SWITCH	SIGN ILLUMINATION TEST SWITCH	24	15 A, 120 V, 1P, CB	IISNS
12	15 A, 120 V, 1P, CB	SIGN ILLUMINATION CONTROL	25	30 A, 2P, NO CONTACTOR	IISNS
13	15 A, 120 V, 1P, CB	FLASHING BEACON	26	20 A, 120 V, 1P, CB	TELEPHONE DEMARCATION CABINET
			27	15 A, 120 V, 1P, CB	IISNS CONTROL

- NOTES:**
- Voltage ratings of service equipment shall conform to the service voltages indicated on the plans.
  - Unless otherwise indicated on the plans, service equipment items shall be provided for each service equipment enclosure as shown.
  - Connect to remote test switch mounted on lighting standards, sign post or structure when required.
  - Items 1 and 6 shall be isolated from the service equipment enclosure.
  - Meter sockets shall be 5 clip type.
  - The landing lug shall be suitable for multiple conductors.
  - Type I photoelectric control shall be used unless otherwise indicated on the plans.
  - Item 12, 20 and 27 shall be ganged operated CB.

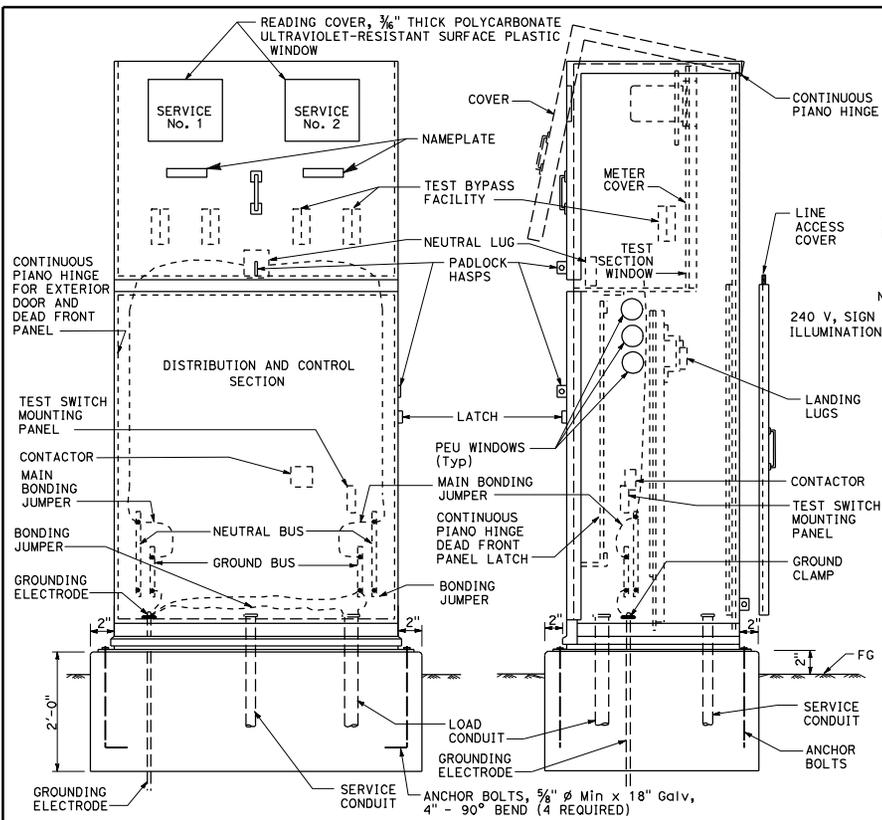
D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
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**Jeffrey G. McRae**  
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 No. E14512  
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 PROFESSIONAL ENGINEER  
 STATE OF CALIFORNIA

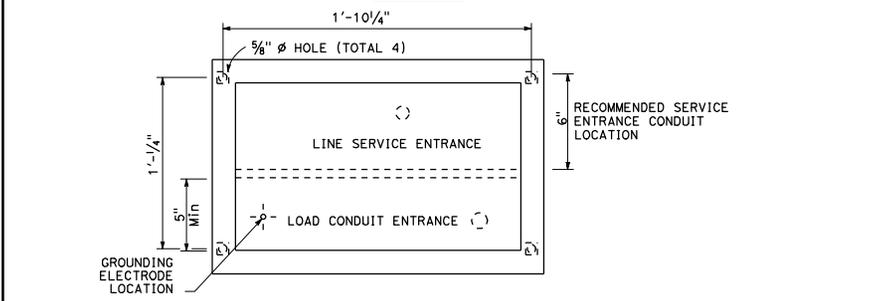
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STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (SERVICE EQUIPMENT ENCLOSURE  
 AND TYPICAL WIRING DIAGRAM,  
 TYPE III - A SERIES)**

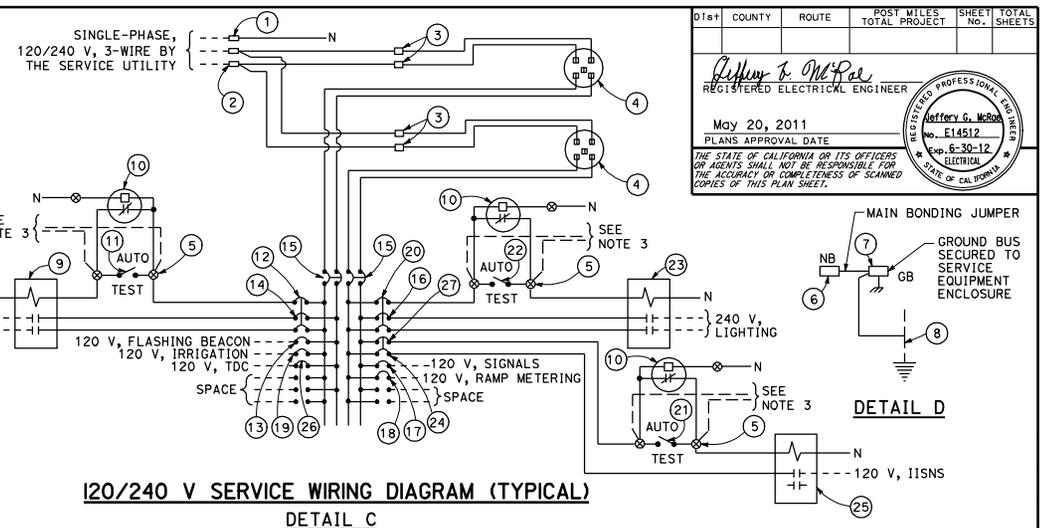
NO SCALE



**FRONT VIEW**  
**SIDE VIEW**  
**TYPE III-CF SERVICE EQUIPMENT ENCLOSURE (TYPICAL)**  
**DETAIL A**



**BASE FOR TYPE III-C SERVICE EQUIPMENT ENCLOSURE**  
**DETAIL B**



**120/240 V SERVICE WIRING DIAGRAM (TYPICAL)**  
**DETAIL C**

**TYPE III-C SERVICE EQUIPMENT ENCLOSURE LEGEND (120/240 V)**

ITEM	COMPONENT	NAMEPLATE DESCRIPTION	ITEM	COMPONENT	NAMEPLATE DESCRIPTION
(1)	NEUTRAL LUG		(14)	30 A, 240 V, 2P, CB	SIGN ILLUMINATION
(2)	LANDING LUG (NOTE 6)		(15)	100 A, 240 V, 2P, CB	MAIN BREAKER
(3)	TEST BYPASS FACILITY		(16)	30 A, 240 V, 2P, CB	LIGHTING
(4)	METER SOCKET AND SUPPORT		(17)	50 A, 120 V, 1P, CB	SIGNALS
(5)	TERMINAL BLOCKS		(18)	30 A, 120 V, 1P, CB	RAMP METERING
(6)	NEUTRAL BUS		(19)	20 A, 120 V, 1P, CB	IRRIGATION
(7)	GROUND BUS		(20)	15 A, 120 V, 1P, CB	LIGHTING CONTROL
(8)	GROUNDING ELECTRODE		(21)	15 A, 1P, TEST SWITCH	IISNS TEST SWITCH
(9)	30 A, 2P, NO CONTACTOR	SIGN ILLUMINATION	(22)	15 A, 1P, TEST SWITCH	LIGHTING TEST SWITCH
(10)	PHOTOELECTRIC UNIT (NOTE 7)	PEU	(23)	60 A, 2P, NO CONTACTOR	LIGHTING
(11)	15 A, 1P, TEST SWITCH	SIGN ILLUMINATION TEST SWITCH	(24)	15 A, 120 V, 1P, CB	IISNS
(12)	15 A, 120 V, 1P, CB	SIGN ILLUMINATION CONTROL	(25)	30 A, 2P, NO CONTACTOR	IISNS
(13)	15 A, 120 V, 1P, CB	FLASHING BEACON	(26)	20 A, 120 V, 1P, CB	TELEPHONE DEMARCATION CABINET
			(27)	15 A, 120 V, 1P, CB	IISNS CONTROL

- NOTES:**
- Voltage ratings of service equipment shall conform to the service voltages indicated on the plans.
  - Unless otherwise indicated on the plans, service equipment items shall be provided for each service equipment enclosure as shown.
  - Connect to remote test switch mounted on lighting standards, sign post or structure when required.
  - Items (1) and (6) shall be isolated from the service equipment enclosure.
  - Meter sockets shall be 5 clip type.
  - The landing lug shall be suitable for multiple conductors.
  - Type I photoelectric control shall be used unless otherwise indicated on the plans.
  - Item (2), (20) and (27) shall be ganged operated CB.

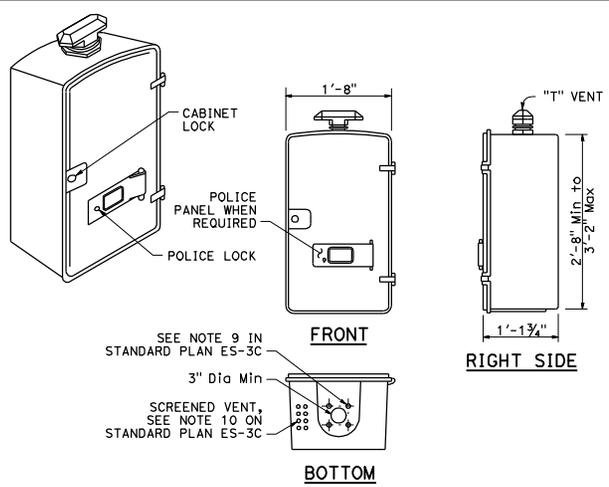
D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET TOTAL SHEETS
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**Jeffrey G. McFar**  
 REGISTERED ELECTRICAL ENGINEER  
 No. E14512  
 Exp. 6-30-12  
 PROFESSIONAL ENGINEER  
 STATE OF CALIFORNIA

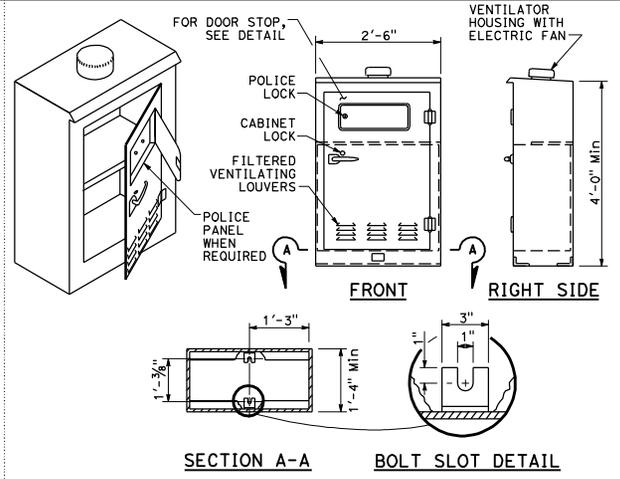
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STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS**  
**(SERVICE EQUIPMENT ENCLOSURE AND**  
**TYPICAL WIRING DIAGRAM**  
**TYPE III-C SERIES)**

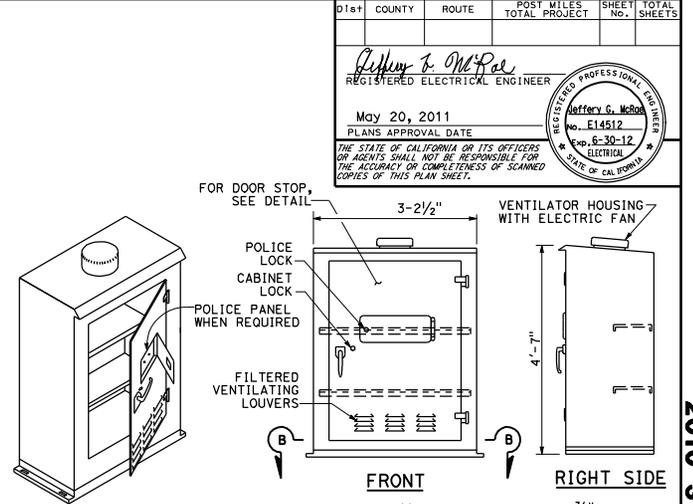
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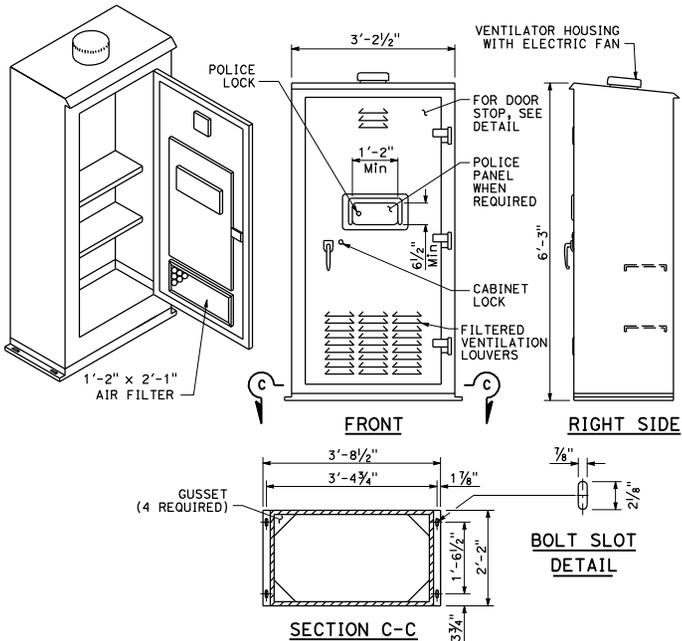
**TYPE G CABINET**



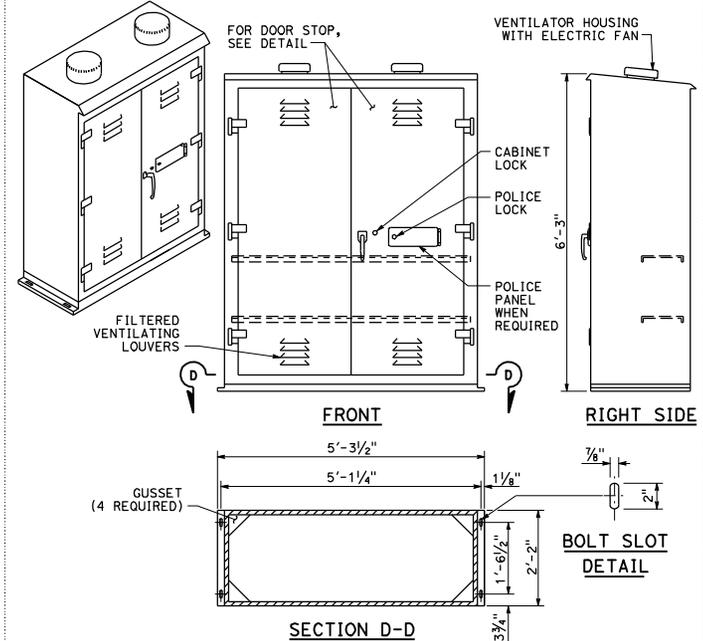
**TYPE M CABINET**



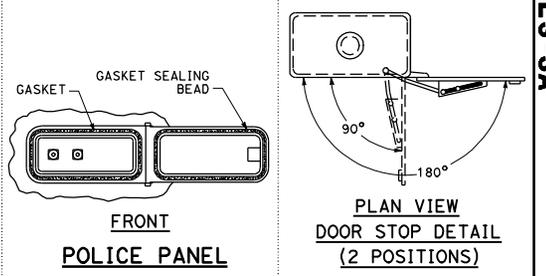
**TYPE P CABINET**



**TYPE R CABINET**



**TYPE S CABINET**



STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
(CONTROLLER CABINET  
DETAILS)**  
NO SCALE

D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
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*Jeffery G. McPar*  
REGISTERED ELECTRICAL ENGINEER  
No. E14512  
Exp. 6-30-12  
STATE OF CALIFORNIA

May 20, 2011  
PLANS APPROVAL DATE

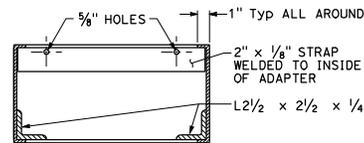
REGISTERED PROFESSIONAL ENGINEER  
Jeffery G. McPar  
No. E14512  
Exp. 6-30-12  
STATE OF CALIFORNIA

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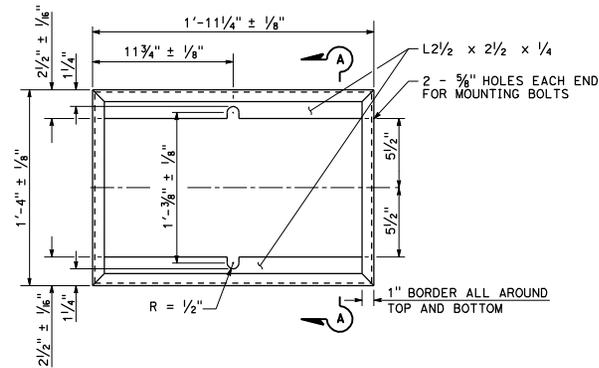
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*Jeffery G. McFar*  
 REGISTERED ELECTRICAL ENGINEER  
 No. E14512  
 Exp. 6-30-12  
 ELECTRICAL  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE  
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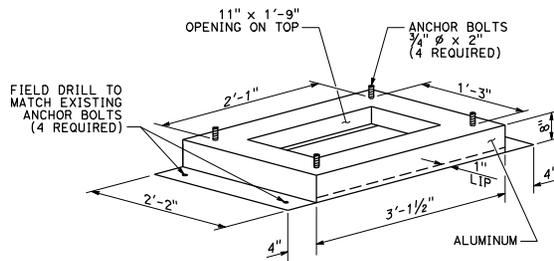
SECTION A-A



TOP VIEW

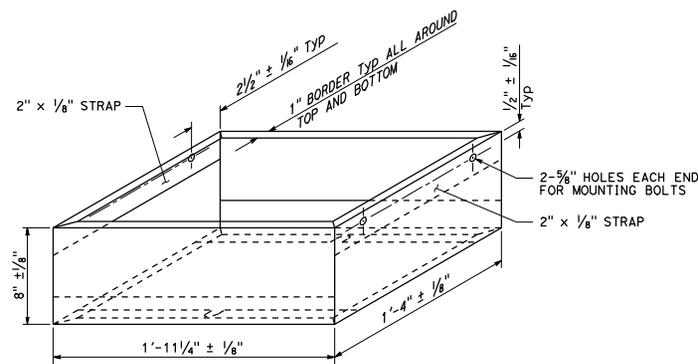
**NOTES:**

1. Material: 0.188" thickness aluminum plate.
2. Mount adapter on Type P or Type R cabinet foundation.
3. Mount adapter on Type M cabinet foundation.
4. Mounting bolts shall be 3/8"  $\phi$  minimum size.



**TYPE PR CABINET ADAPTER**

See Notes 1 and 2



**TYPE M CABINET ADAPTER**

See Notes 1, 3 and 4

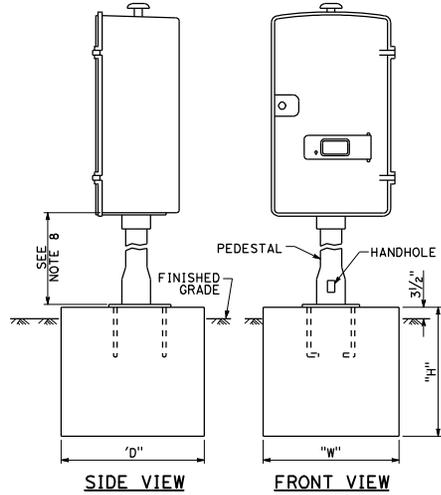
STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (CONTROLLER CABINET ADAPTER  
 DETAILS)**

NO SCALE

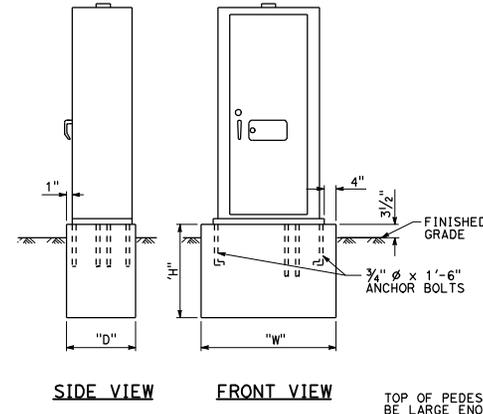
**ES-3B**

**NOTES:**

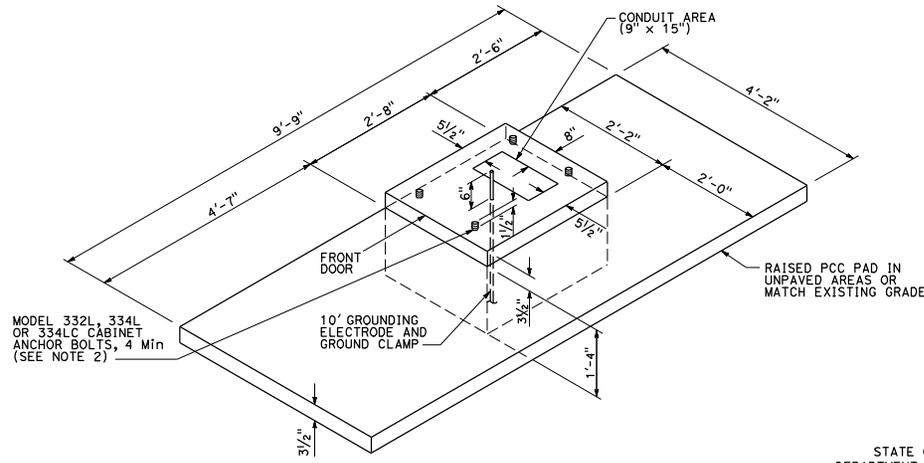
1. Cabinet dimensions are nominal.
2. Foundation shall be located to provide 2'-0" minimum clearance between face of curb and any portion of cabinet.
3. Type G, M, P, R, S and Model 336L cabinets shall be installed with the back toward the nearest lane of traffic.
4. The controller cabinet ground bus shall be bonded to the controller equipment enclosure.
5. In unpaved areas, a raised portland cement concrete pad shall be constructed in front of each controller cabinet. The pad shall be 3'-0" x 3'-0" x 4" for a Type G cabinet and shall be 3'-0" x 4" thick x width of foundation for Type M, P, R, S and Model 336L cabinets.
6. In unpaved areas, the top of foundation for Type G, P, R and S cabinets shall be 6" above surrounding grade. Top of foundation for Type M or Model 336L cabinet shall be 1'-6" above surrounding grade.
7. In sidewalks and other paved areas, top of foundation for Type G cabinet shall be level with surrounding grade. Top of foundation for Type P, R and S cabinets shall be 3/2" above surrounding grade.
8. The steel pedestal, base plate, bolt circle and foundation for Type G cabinet shall be the same as that shown for a Type 1-C Standard (see E5-7B). Pedestal shall be 2'-1" to 2'-6" in length. Anchor bolts shall be 3/4"  $\phi$  x 1'-6" with a 2" - 90° bend. Four bolts required per cabinet.
9. Type G cabinet shall be provided with a slipfitter to permit mounting an 4 1/2" outside diameter pedestal. Slipfitter shall be bolted to bottom of the cabinet.
10. Type G cabinet shall be provided with 8 screened, rain tight holes, 1/2" diameter or larger, in the bottom of the cabinet.
11. A 1" drain shall be provided through the foundation of a Type M or Model 336L cabinet. Drain pipe shall be screened.
12. See Table for cabinet and foundation dimensions; "D" = Depth, "H" = Height and "W" = Width.
13. Cabinet shelves shall be adjustable for vertical spacing and shall be removable. Type M, P, R and S cabinets shall be provided with a minimum of two shelves.
14. Anchor bolts for Type M, P, R, S and Model 336L cabinets shall be 3/4"  $\phi$  x 1'-6" with a 2" - 90° bend.
15. An approved mastic or caulking compound shall be placed on the foundation prior to placing the cabinet to seal openings between bottom of cabinet and foundation.
16. Controller units, plug-mounted equipment, shelf-mounted equipment and wall-mounted equipment shall be located to permit safe and easy removal or replacement without removing any other piece of equipment.
17. Cabinet fan may be installed at an alternate location near the top of the cabinet when approved by the Engineer.
18. Where telephone interconnect is required, a minimum of 5" clear vertical space shall be provided inside the cabinet for the equipment.
19. Telephone interconnect conductors shall be enclosed in a 3/4" or larger conduit through the foundation. Type 4 conduit shall be used to separate telephone and power conductors in cabinets and pedestals.
20. For Model 332L, 334L, 334LC and 336L cabinets details, see "Traffic signal controller equipment specifications".
21. For Model 332L, 334L and 334LC without a battery backup system.



**FOUNDATION FOR  
TYPE G CABINET  
DETAIL A**



**FOUNDATION FOR  
TYPE P, R AND S CABINETS  
DETAIL B**



**FOUNDATION DETAIL  
DETAIL D**

D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
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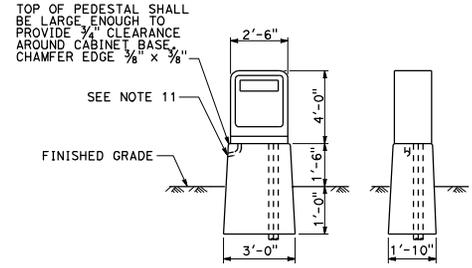
*Jeffery G. McRae*  
REGISTERED ELECTRICAL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER  
*Jeffery G. McRae*  
No. E14512  
Exp. 6-30-12  
ELECTRICAL  
STATE OF CALIFORNIA

CABINET TYPE	FOUNDATION		
	"W"	"H"	"D"
G	2'-0"	3'-6"	2'-0"
M	3'-2"	2'-6"	1'-6"
P	4'-4 1/2"	1'-6"	2'-4"
R	4'-2"	1'-6"	2'-4"
S	5'-11 1/2"	1'-6"	2'-4"



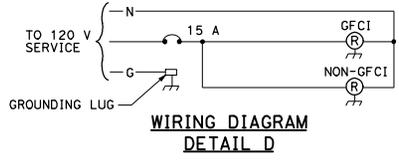
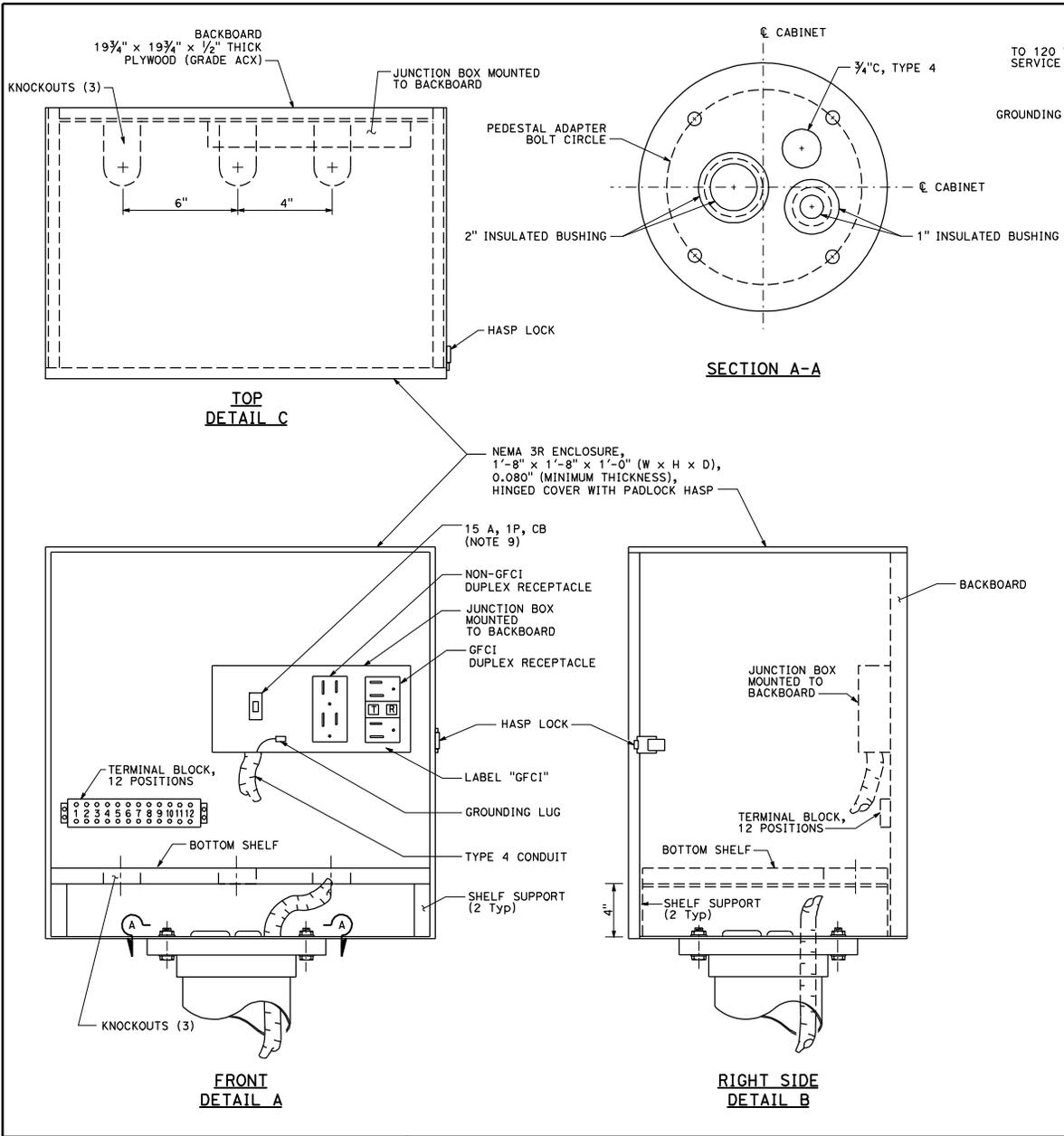
**FRONT VIEW SIDE VIEW  
PEDESTAL FOUNDATION  
FOR TYPE M OR  
MODEL 336L CABINET  
DETAIL C**

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**ELECTRICAL SYSTEMS  
(CONTROLLER CABINET FOUNDATION DETAILS)**

NO SCALE

**ES-3C**



D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
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*Jeffery G. McBoo*  
REGISTERED ELECTRICAL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

Jeffery G. McBoo  
No. E14512  
Exp. 6-30-12  
ELECTRICAL  
STATE OF CALIFORNIA

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- NOTES:**
- Telephone demarcation cabinet shall be furnished with mounting boards, outlet boxes, circuit breaker and outlet plates. Dimensions are nominal.
  - Telephone demarcation cabinet shall be installed with the back toward the nearest lane of traffic.
  - All conduits shall be bonded to the enclosure.
  - In unpaved areas, the top of foundation for the telephone demarcation cabinet shall be 6" above surrounding grade.
  - In sidewalks and other paved areas, top of foundation for the telephone demarcation cabinet shall be level with finished grade.
  - The steel pedestal, base plate, bolt circle and foundation for the telephone demarcation cabinet shall be the same as that shown for a Type 1-C Standard. The steel pedestal shall be 2'-1" to 2'-6" in length. Anchor bolts shall be 3/4"  $\phi$  x 1'-6" with a 2" - 90° bend. Four bolts required per cabinet.
  - Telephone demarcation cabinet shall be provided with a slip fitter to permit mounting on 4 1/2" outside diameter pedestal. Slip fitter shall be bolted to bottom of cabinet.
  - Telephone interconnect conductors shall be enclosed in a 3/4" C or larger conduit through the foundation. Type 4 conduit shall be used to separate telephone and power conductors in the cabinet and pedestal.
  - Install circuit breaker inside the junction box. The circuit breaker should be operated externally without opening the junction cover.
  - For termination Cabinet:
    - Mount cabinet on Type G cabinet pedestal (see ES-3C).
    - Use Type G cabinet foundation.

**FASTENER SCHEDULE**

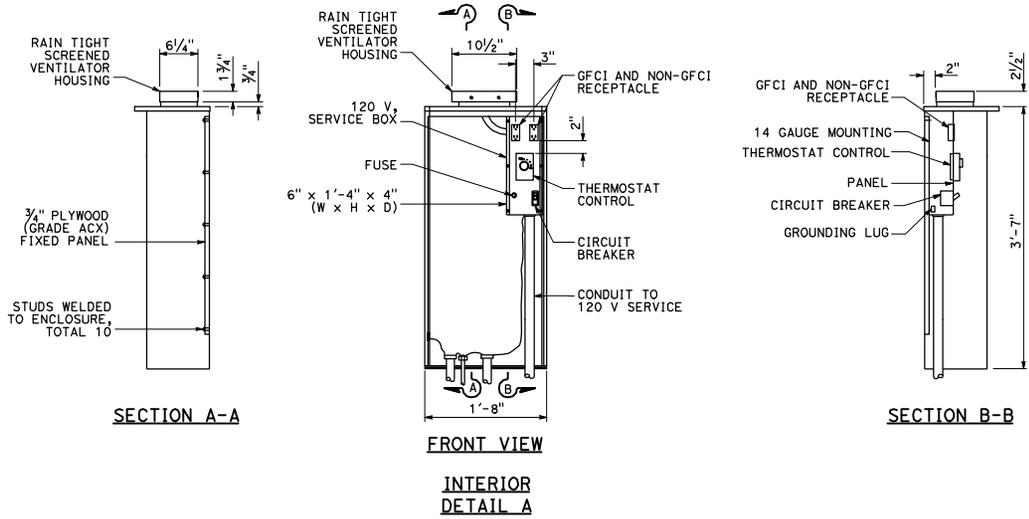
BACKBOARD	4 - 3/4" (LENGTH) WOOD SCREWS
2 SHELF SUPPORTS	4 - 3/4" (LENGTH) WOOD SCREWS
JUNCTION BOX	4 - 1/2" (LENGTH) WOOD SCREWS
TERMINAL BLOCK	4 - 3/4" (LENGTH) WOOD SCREWS

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**ELECTRICAL SYSTEMS  
(TELEPHONE DEMARCATION  
CABINET, TYPE A)**

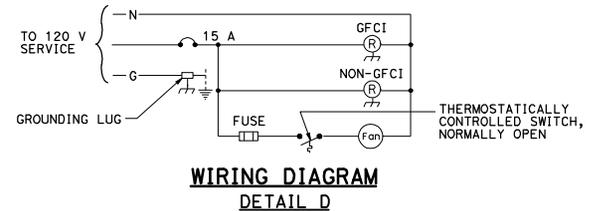
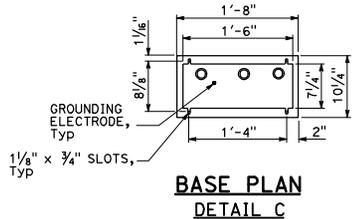
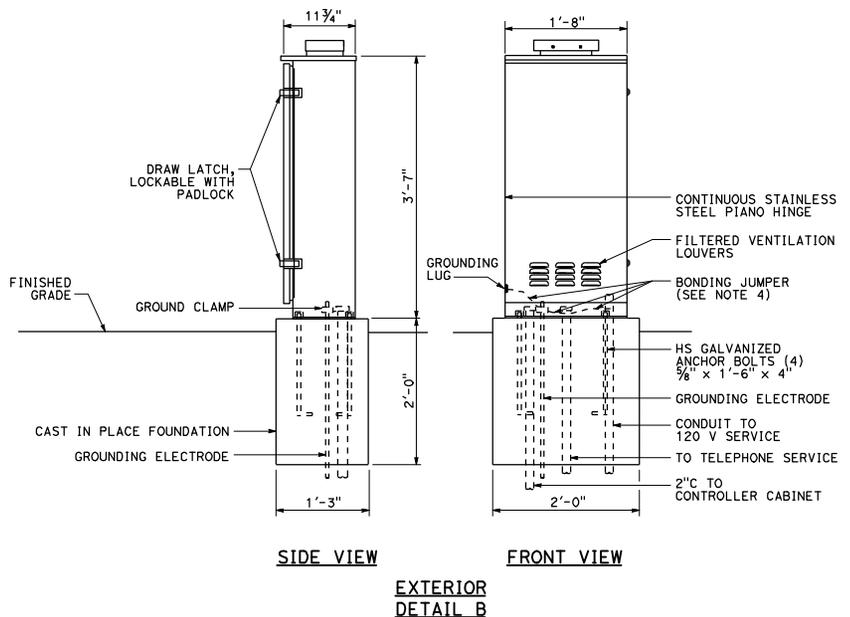
NO SCALE

D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET TOTAL NO. SHEETS
<i>Jeffery G. McBoo</i> REGISTERED ELECTRICAL ENGINEER No. E14512 Exp. 6-30-12 STATE OF CALIFORNIA				
May 20, 2011 PLANS APPROVAL DATE				
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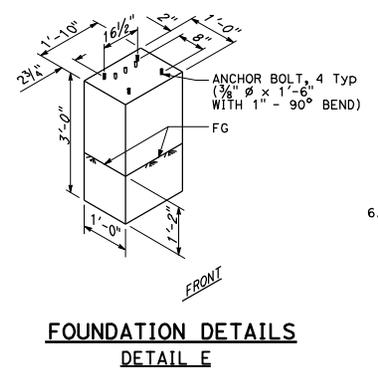
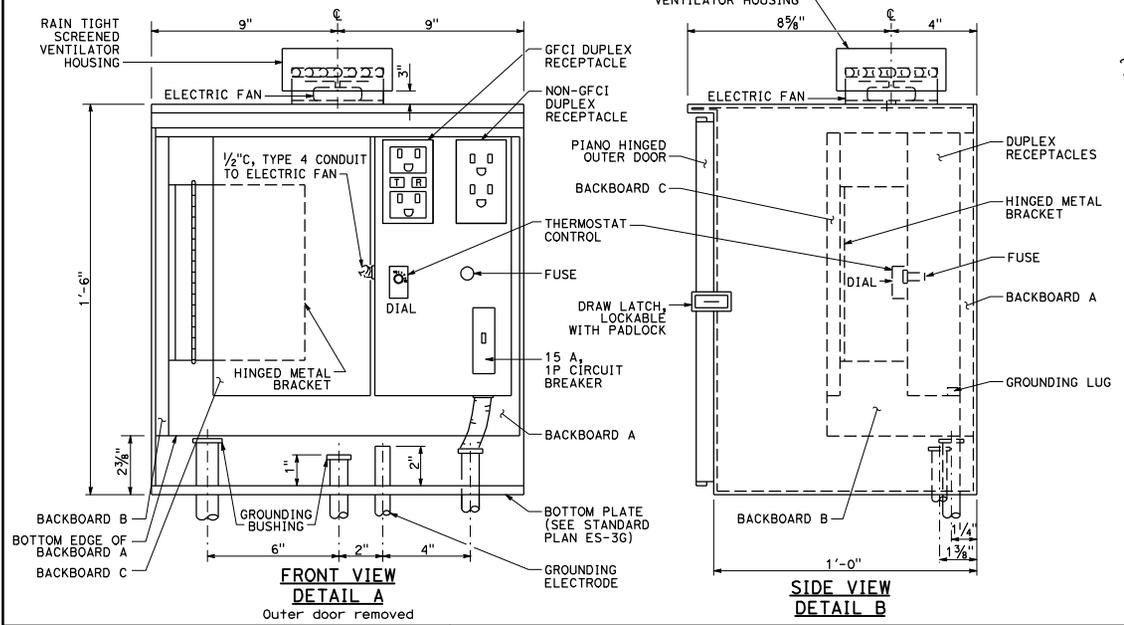
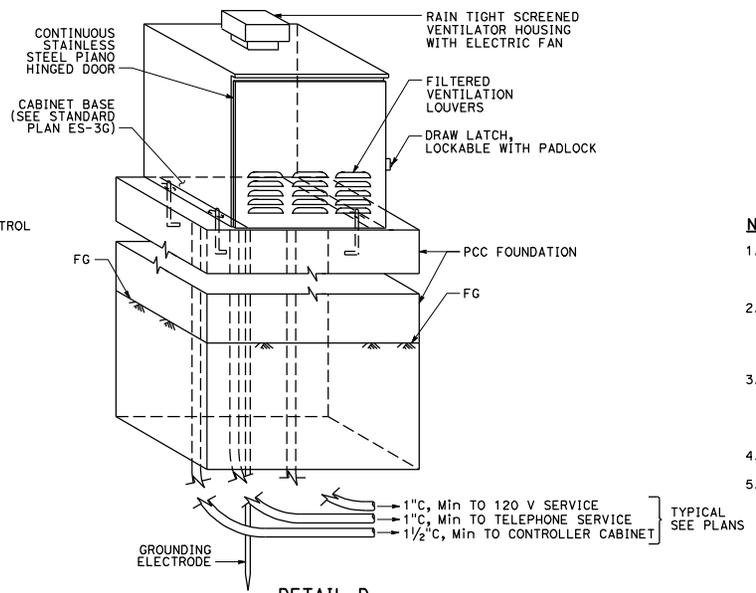
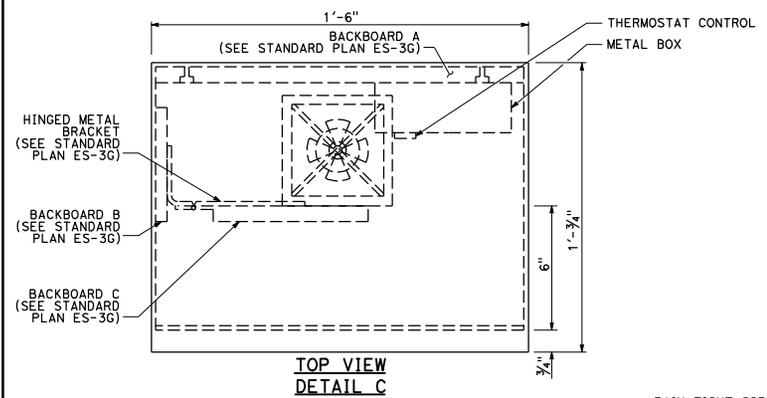
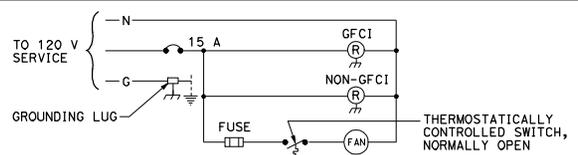


**NOTES:**

1. Telephone demarcation cabinet shall be furnished with a mounting panel, outlets, circuit breaker and dead front plates in place. Dimensions are nominal.
2. An approved mastic or caulking compound shall be placed on the foundation prior to placing the cabinet to seal openings between the bottom of the cabinet and the foundation.
3. In unpaved areas, a raised PCC pad shall be placed in front of the telephone demarcation cabinet. Pad shall be 2'-0" x 1'-10" x 4" thick, with 2" above the finished grade.
4. All conduits shall be bonded to the enclosure.
5. Telephone demarcation cabinet:
  - a. Material shall be anodized aluminum (1/8" thick).
  - b. Fabrication shall conform to the requirements in Section 86-3.04 of the Standard Specifications.
  - c. The exterior door shall be side hung and secured with a draw latch, lockable with a padlock. The padlock hole shall be a minimum diameter of 7/8" to receive a padlock.
  - d. Ventilation louvers shall be located on the door.
  - e. Fan shall be mounted in a ventilator housing.
  - f. Fan shall be thermostatically controlled and adjustable to turn on between 80 °F and 130 °F.
  - g. Fan circuit shall be fused at 175 percent of the fan motor capacity.
  - h. Fan capacity shall be at least 25 cubic feet per minute.
  - i. Fasten fixed mounting panels with nuts, lock and flat washers to 3/16" ø x 1" studs welded to enclosure.



STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (TELEPHONE DEMARCATION  
 CABINET, TYPE B)**  
 NO SCALE



D16+	COUNTY	ROUTE	POST MILES	SHEET TOTAL
			TOTAL PROJECT	NO. SHEETS

*Jeffery G. McBoo*  
REGISTERED ELECTRICAL ENGINEER  
No. E14512  
Exp. 6-30-12

May 20, 2011  
PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER  
Jeffery G. McBoo  
No. E14512  
Exp. 6-30-12  
ELECTRICAL  
STATE OF CALIFORNIA

- NOTES:**
- Telephone demarcation cabinet shall be furnished with mounting boards, thermostat, fan, outlet box, circuit breaker and outlet plate. Dimensions are nominal.
  - An approved mastic or caulking compound shall be placed on the foundation prior to placing the cabinet to seal openings between bottom of cabinet and foundation.
  - In unpaved areas, a raised PCC pad shall be placed in front of the telephone demarcation cabinet. Pad shall be 1'-10" x 3'-0" x 4" thick, with 2" above the finished grade.
  - All conduits shall be bonded to the enclosure.
  - Telephone demarcation cabinet:
    - Material shall be anodized aluminum (1/8" thick).
    - Fabrication shall conform to the requirements in Section 86-3.04 of the Standard Specifications.
    - Ventilation louvers shall be located in door.
    - Door shall be secured with a draw latch, lockable with a padlock.
    - Fan shall be mounted in a ventilator housing.
    - Fan capacity shall be at least 25 cubic feet per minute.
    - Fan shall be thermostatically controlled and adjustable to turn on between 80 °F and 130 °F.
    - Fan circuit shall be fused at 175 percent of the fan motor capacity.
  - Hardware for fastening of mounting boards:
    - Fasten backboard A and backboard B to telephone demarcation cabinet with 3/16" dia x 3/4" stainless steel carriage bolts (8 required).
    - Fasten hinged metal bracket to backboard B and backboard C to hinged metal bracket with number No. 10 x 3/4" wood screws (9 required).

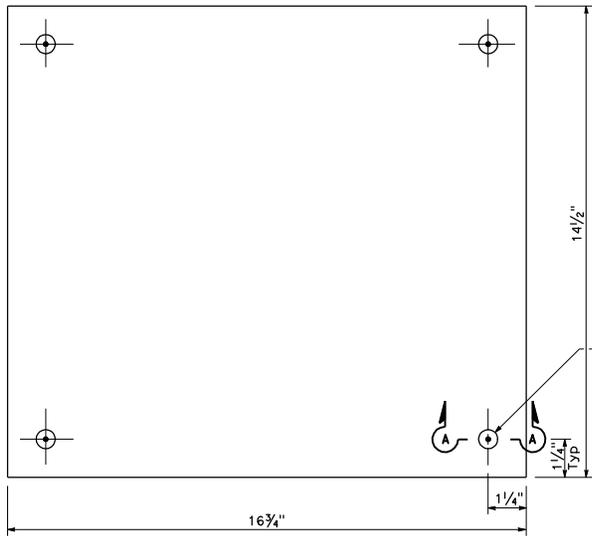
STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**ELECTRICAL SYSTEMS  
(TELEPHONE DEMARCATION  
CABINET, TYPE C)**

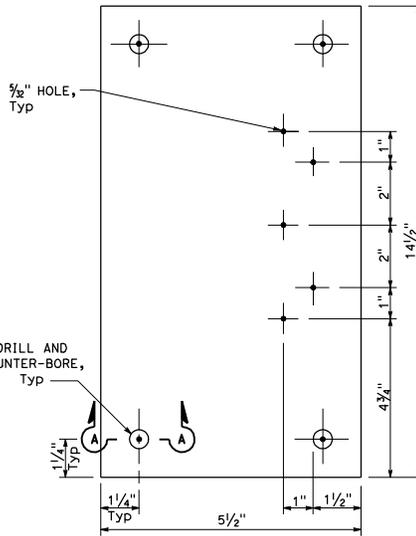
NO SCALE

**ES-3F**

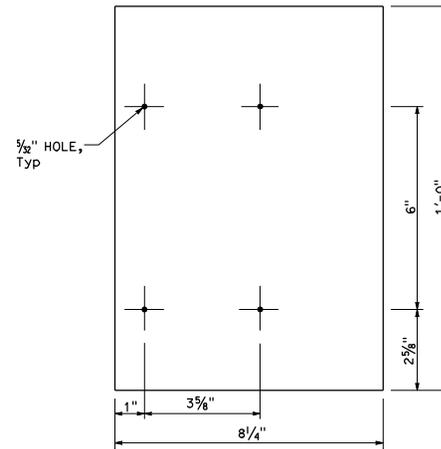
2010 STANDARD PLAN ES-3F



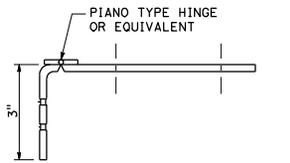
**BACKBOARD A  
DETAIL A**



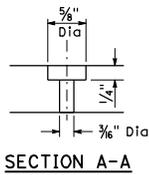
**BACKBOARD B  
DETAIL B**



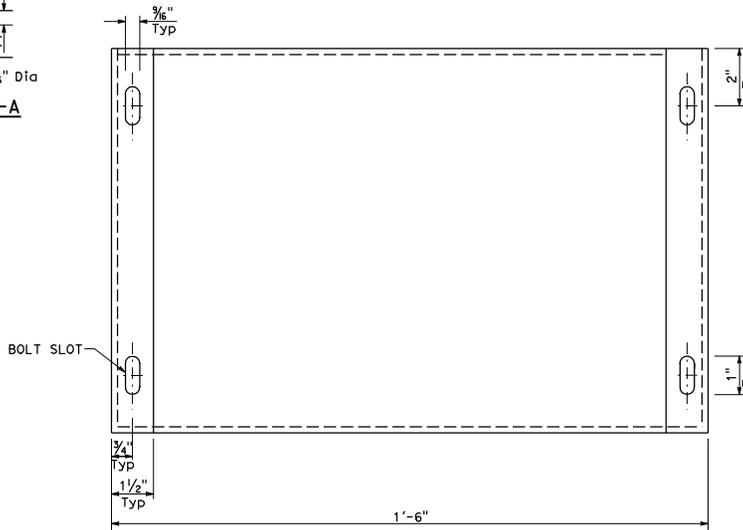
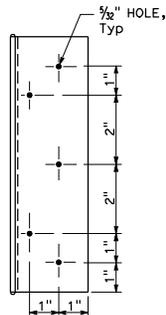
**BACKBOARD C  
DETAIL C**



**HINGED METAL BRACKET  
DETAIL D**



**SECTION A-A**



**CABINET BASE  
DETAIL E**

D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*Jeffery G. McRae*  
 REGISTERED ELECTRICAL ENGINEER

May 20, 2011  
 PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER  
 Jeffery G. McRae  
 No. E14512  
 Exp. 6-30-12  
 ELECTRICAL  
 STATE OF CALIFORNIA

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**NOTES:**

1. Backboard shall be 3/4" plywood (Grade ACX).
2. Base mounting frame shall be constructed with 0.134" galvanized steel.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (TELEPHONE DEMARCATION  
 CABINET, TYPE C DETAILS)**

NO SCALE

**ES-3G**

LUMINAIRE MAST ARM DATA			
M PROJECTED LENGTH	N RISE	Min OD AT POLE	NOMINAL THICKNESS
15'-0"	4'-9"±	4 1/4"	0.1196"
20'-0"	2'-6"±	5"	0.1793"

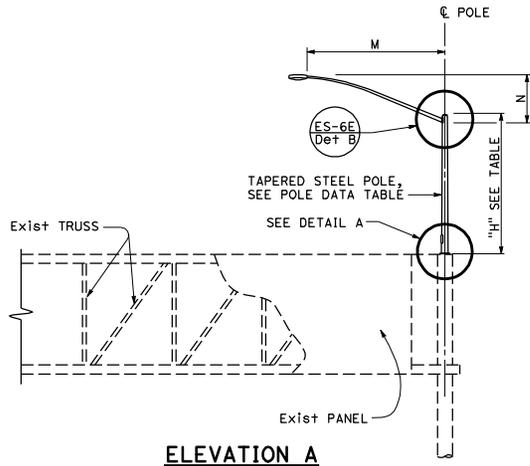
POLE DATA				
POLE EXTENSION TYPE	HEIGHT "H"	Min OD		THICKNESS
		BASE	TOP	
5	5'-0"	6 1/2"	5 1/8"	0.1793"
10	10'-0"	7 1/4"		

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

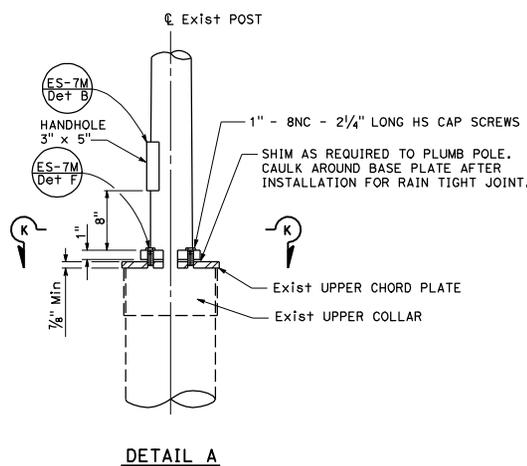

  
 Stanley P. Johnson  
 REGISTERED CIVIL ENGINEER  
 May 20, 2011  
 PLANS APPROVAL DATE  
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**NOTES:**

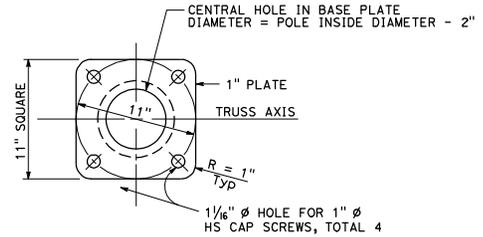
- The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.
- Bolt hole locations may vary at the discretion of the Engineer.
- Wind Loading (Fastest Mile): 80 mph AASHTO.
- See Std Plan S-13.
- Unit stresses (Structural Steel):
  - a. fy = 55,000 psi tapered steel tube (pole)
  - b. fy = 50,000 psi unless otherwise noted



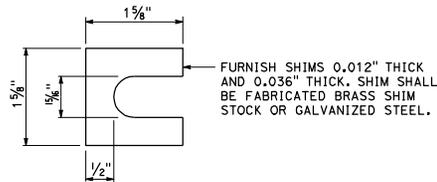
**ELEVATION A**



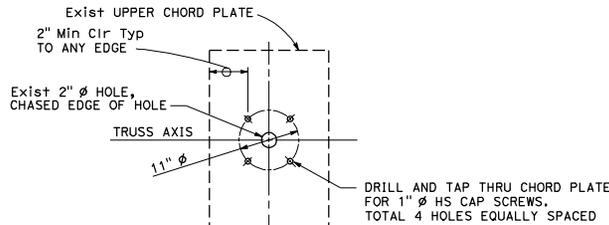
**DETAIL A**



**SECTION K-K**



**SHIM DETAIL  
DETAIL B**

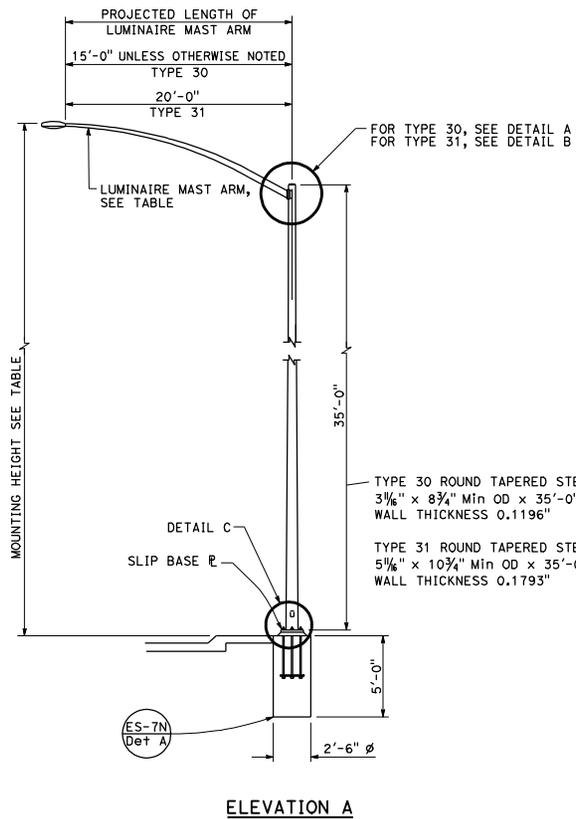


**UPPER CHORD PLATE  
DETAIL C**  
See Note 4

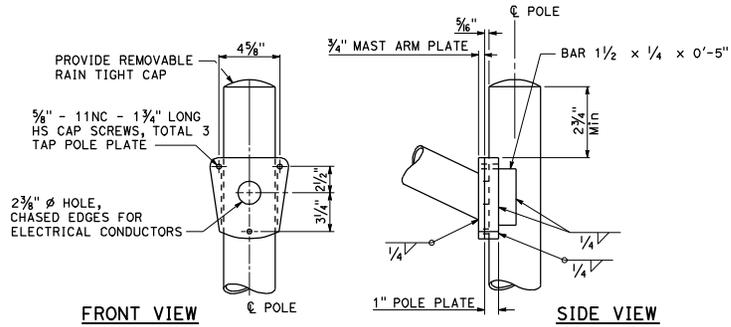
STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (LIGHTING STANDARD,  
 TYPES 5 AND 10,  
 OVERHEAD SIGN MOUNTED)**  
 NO SCALE

LUMINAIRE MAST ARM DATA			
PROJECTED LENGTH	THICKNESS	MINIMUM OD AT POLE	MOUNTING HEIGHT
* 6'-0"	0.1196"	3 1/4"	36'-9"±
* 8'-0"		3 1/2"	37'-3"±
* 10'-0"		3 3/4"	38'-0"±
* 12'-0"		4"	39'-0"±
* 15'-0"	0.1793"	4 1/4"	39'-6"±
** 20'-0"		5"	37'-0"±

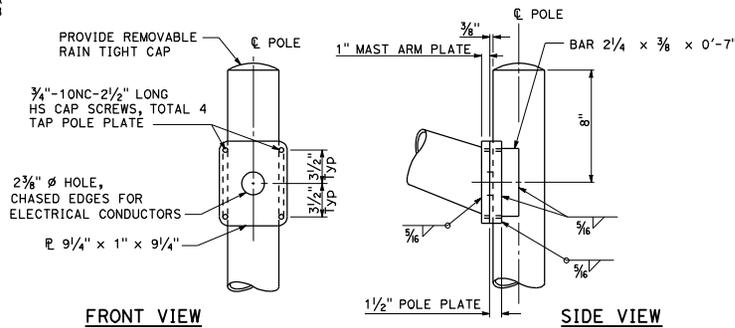
\* TYPE 30  
\*\* TYPE 31



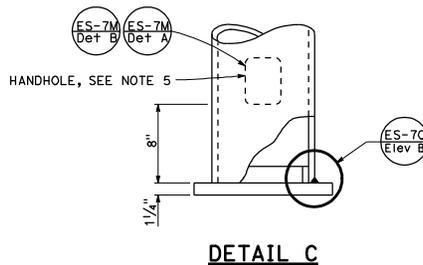
ELEVATION A



TYPE 30  
DETAIL A



TYPE 31  
DETAIL B



DETAIL C

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

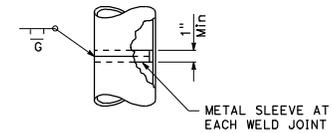
May 20, 2011  
PLANS APPROVAL DATE

Stanley P. Johnson  
No. CS793  
Exp. 3-31-12  
CIVIL  
STATE OF CALIFORNIA

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**NOTES:**

1. Sheet steel shall have a minimum yield of 48,000 psi.
2. For slip base details see Standard Plan ES-6F.
3. For Type 30 fixed base use Type 15 base plate and foundation shown on Standard Plan ES-6A. Use 1/4" Dia x 3'-6" anchor bolts.
4. For Type 31 fixed base use Type 32 base plate, anchor bolts and foundation on Standard Plan ES-6G.
5. Handhole shall be located on the downstream side of traffic.
6. For additional notes and details, see Standard Plans ES-7M and ES-7N.

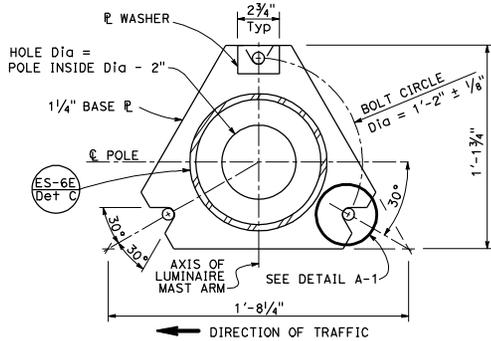


POLE SPLICE

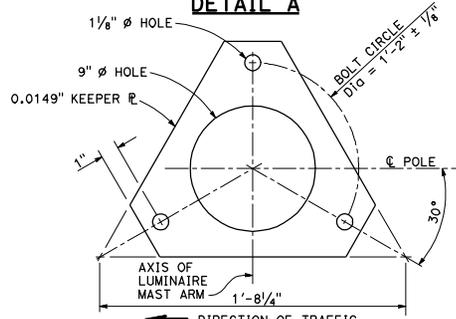
STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
(LIGHTING STANDARD,  
TYPES 30 AND 31)**

NO SCALE

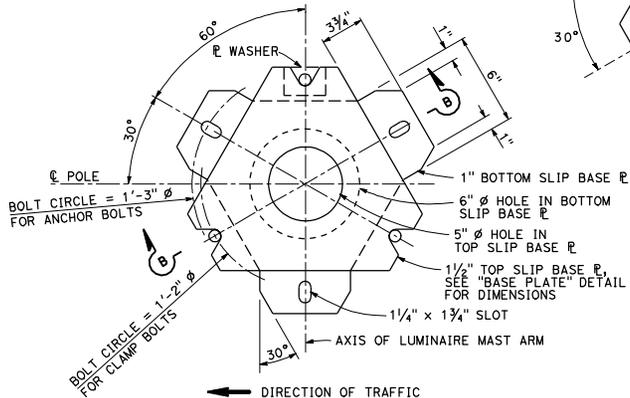
ES-6E



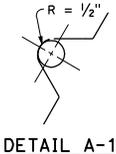
**BASE PLATE  
DETAIL A**



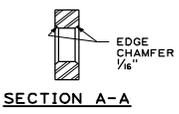
**KEEPER PLATE  
DETAIL B**



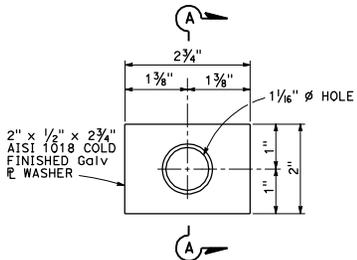
**BOTTOM PLATE  
DETAIL C**



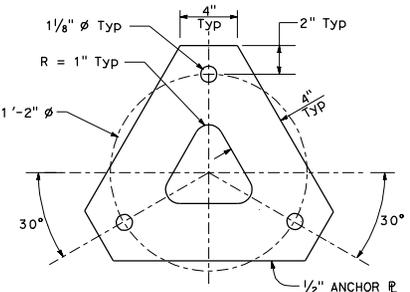
**DETAIL A-1**



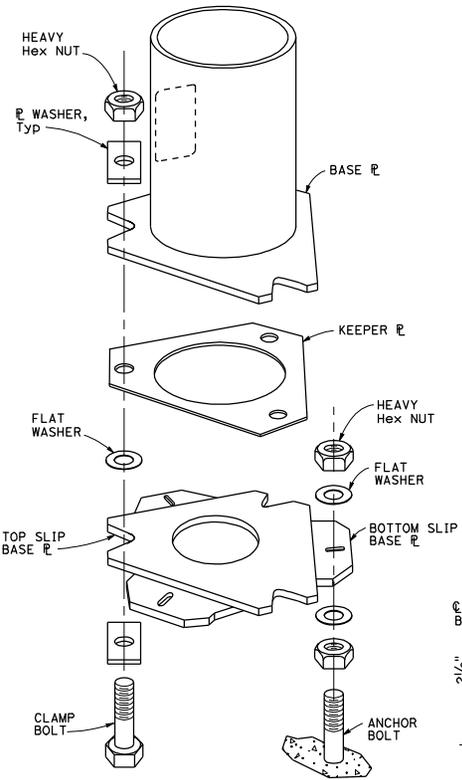
**SECTION A-A**



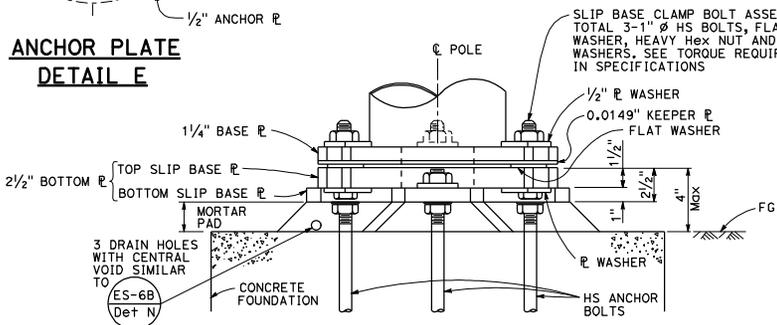
**PLATE WASHER  
DETAIL D**



**ANCHOR PLATE  
DETAIL E**



**SLIP BASE DETAIL  
DETAIL F**



**SLIP BASE  
ELEVATION A**

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

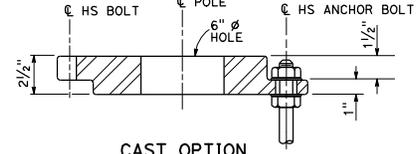
Stanley P. Johnson  
 REGISTERED CIVIL ENGINEER  
 No. CS793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE

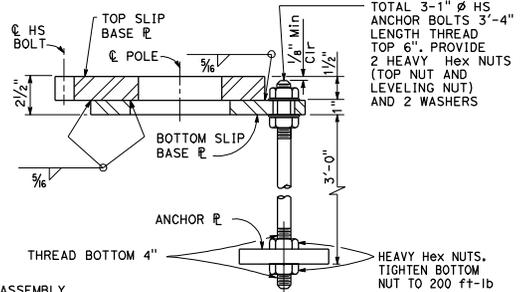
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

**NOTES:**

- 1" diameter HS anchor bolts. For clamp bolts, see specifications.
- Conduit shall not protrude more than 2" above top of foundation.
- Handhole shall be located on the downstream side of traffic.
- For Type 30 fixed base and for Type 31 fixed base, see Notes 3 and 4 on Standard Plan ES-6E.



**CAST OPTION**

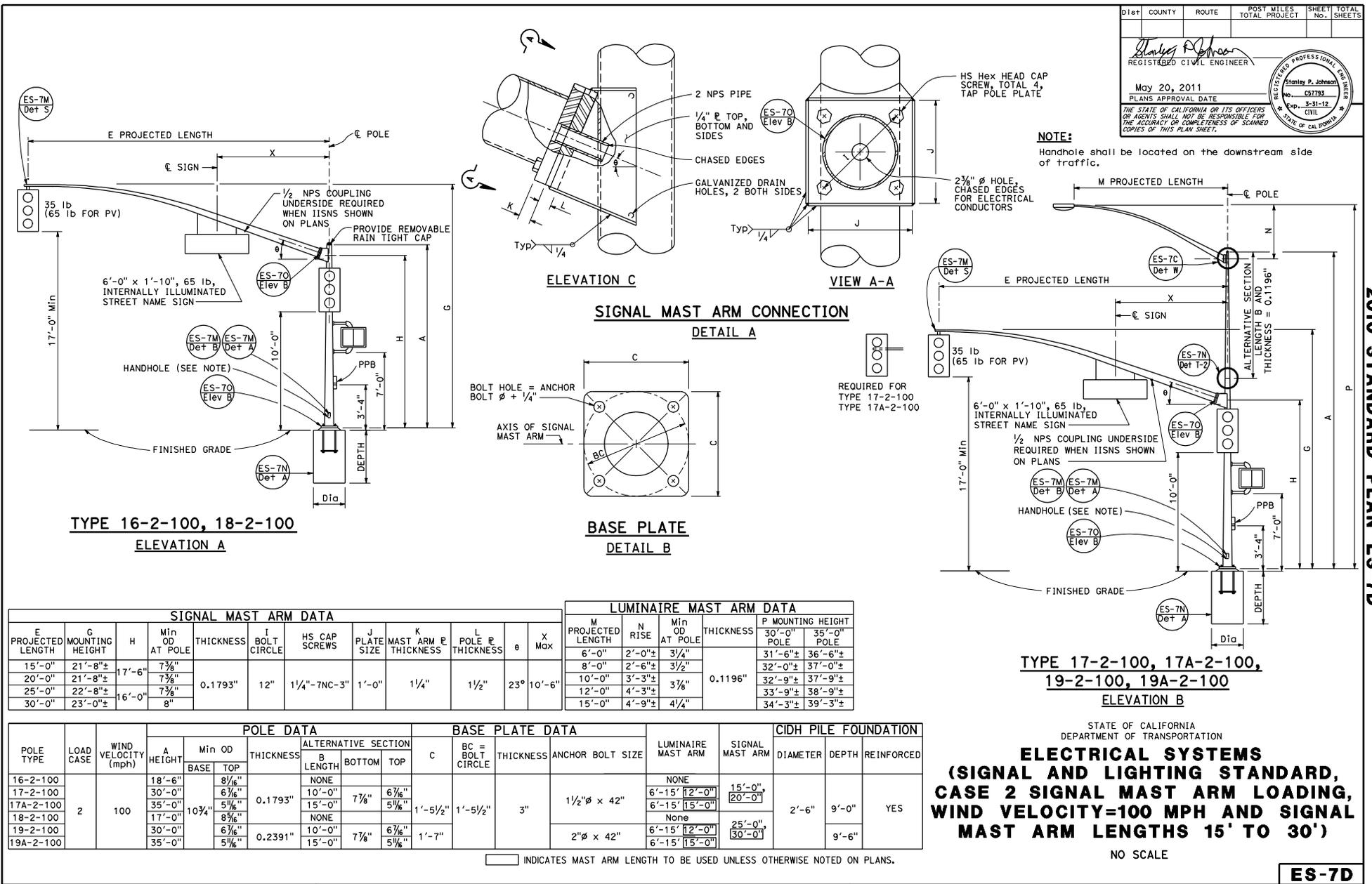


**WELDED OPTION  
SECTION B-B**

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (LIGHTING STANDARD,  
 SLIP BASE PLATE)**

NO SCALE

**ES-6F**



DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
------	--------	-------	--------------------------	-----------	--------------

**Stanley P. Johnson**  
 REGISTERED CIVIL ENGINEER  
 No. C8793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE  
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**NOTE:**  
Handhole shall be located on the downstream side of traffic.

E PROJECTED LENGTH	G MOUNTING HEIGHT	H	Min OD AT POLE	THICKNESS	I BOLT CIRCLE	HS CAP SCREWS	J PLATE SIZE	K MAST ARM THICKNESS	L POLE THICKNESS	θ	X Max
15'-0"	21'-8"±	17'-6"	7 3/8"	0.1793"	12"	1 1/4"-7NC-3"	1'-0"	1/4"	1 1/2"	23°	10'-6"
20'-0"	21'-8"±	17'-6"	7 3/8"								10'-0"
25'-0"	22'-8"±	16'-0"	7 3/8"								10'-0"
25'-0"	22'-8"±	16'-0"	7 3/8"								10'-0"
30'-0"	23'-0"±	16'-0"	8"								10'-0"

M PROJECTED LENGTH	N RISE	Min OD AT POLE	THICKNESS	P MOUNTING HEIGHT
6'-0"	2'-0"±	3 1/4"	0.1196"	30'-0" POLE
8'-0"	2'-6"±	3 1/2"		31'-6"±
10'-0"	3'-3"±	3 3/4"		32'-0"±
12'-0"	4'-3"±	3 3/4"		32'-9"±
15'-0"	4'-9"±	4 1/4"		33'-9"±

POLE TYPE	LOAD CASE	WIND VELOCITY (mph)	POLE DATA				BASE PLATE DATA				CIDH PILE FOUNDATION								
			A HEIGHT	Min OD BASE	Min OD TOP	THICKNESS	B LENGTH	BOTTOM	TOP	C	THICKNESS	ANCHOR BOLT SIZE	LUMINAIRE MAST ARM	SIGNAL MAST ARM	DIAMETER	DEPTH	REINFORCED		
16-2-100	2	100	18'-6"	8 1/8"	10 3/4"	0.1793"	NONE	7 7/8"	6 7/8"	1'-5 1/2"	1'-5 1/2"	3"	1 1/2"φ x 42"	NONE	15'-0", 20'-0"	2'-6"	9'-0"	YES	
17-2-100			30'-0"	6 7/8"			10'-0"							NONE					6'-15" [12'-0"]
17A-2-100			35'-0"	5 1/8"			15'-0"							6'-15" [15'-0"]					
18-2-100			17'-0"	8 3/8"			NONE							NONE					NONE
19-2-100			30'-0"	6 7/8"			10'-0"							6'-15" [12'-0"]					
19A-2-100	35'-0"	5 1/8"	15'-0"	6'-15" [15'-0"]															

**TYPE 17-2-100, 17A-2-100, 19-2-100, 19A-2-100 ELEVATION B**

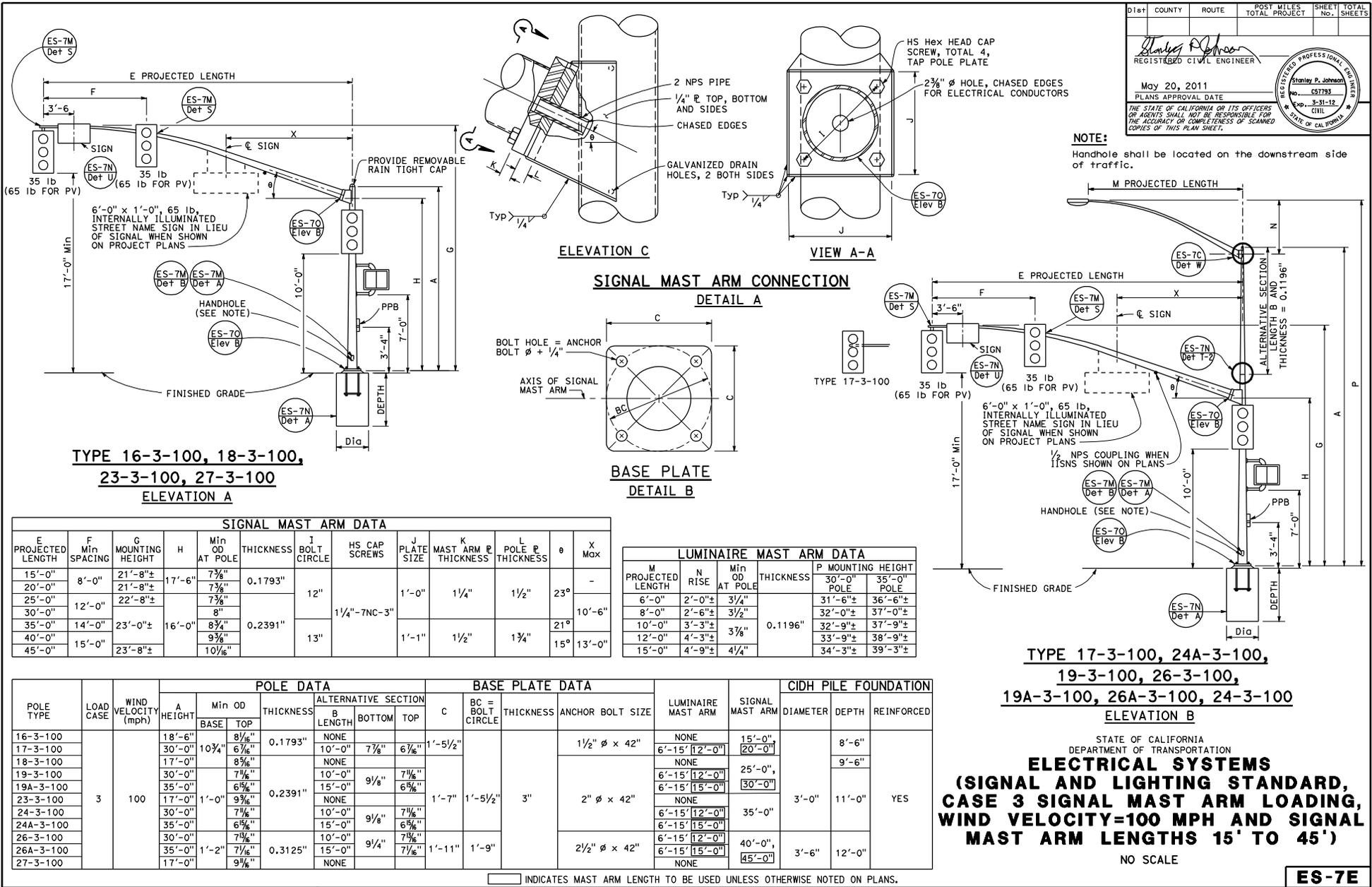
STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**ELECTRICAL SYSTEMS  
(SIGNAL AND LIGHTING STANDARD,  
CASE 2 SIGNAL MAST ARM LOADING,  
WIND VELOCITY=100 MPH AND SIGNAL  
MAST ARM LENGTHS 15' TO 30')**

NO SCALE

**ES-7D**

2010 STANDARD PLAN ES-7D



DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
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Stanley P. Johnson  
 REGISTERED CIVIL ENGINEER  
 No. C8793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE

NOTE:  
 Handhole shall be located on the downstream side of traffic.

2010 STANDARD PLAN ES-7E

INDICATES MAST ARM LENGTH TO BE USED UNLESS OTHERWISE NOTED ON PLANS.

ES-7E

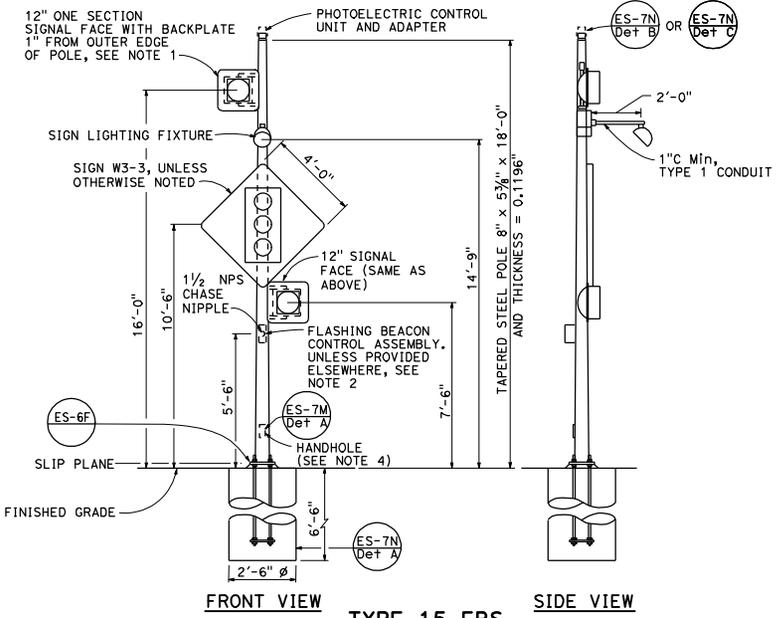
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

**Stanley P. Johnson**  
 REGISTERED CIVIL ENGINEER  
 No. CS793  
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 STATE OF CALIFORNIA

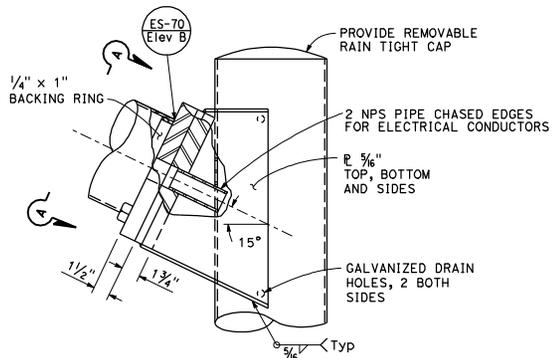
May 20, 2011  
 PLANS APPROVAL DATE  
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**NOTES:**

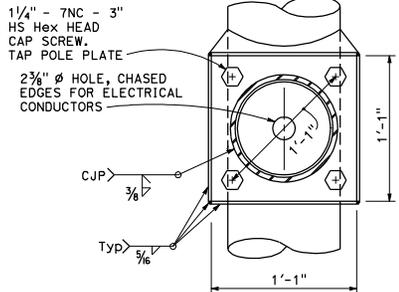
1. See Standard Plans ES-4A and ES-4D for attachment fitting details.
2. For wiring diagram, see Standard Plan ES-14B.
3. For additional notes and details, see Standard Plans ES-7M and ES-7N.
4. Handhole shall be located on the downstream side of traffic.
5. See project plans for type of standard to be installed.



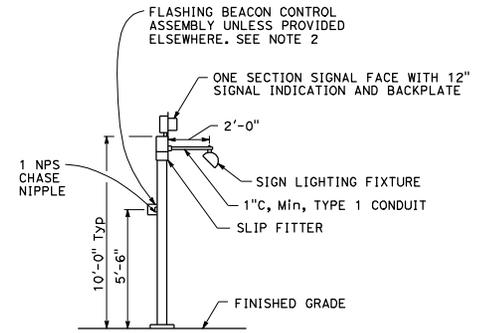
**TYPE 15-FBS**  
**ADVANCE FLASHING BEACON WITH SLIP BASE INSTALLATION**  
**DETAIL A**



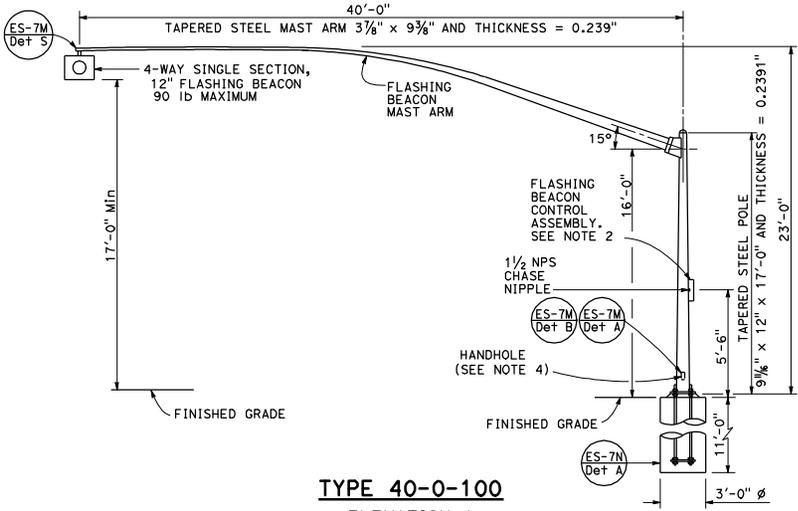
**ELEVATION B**



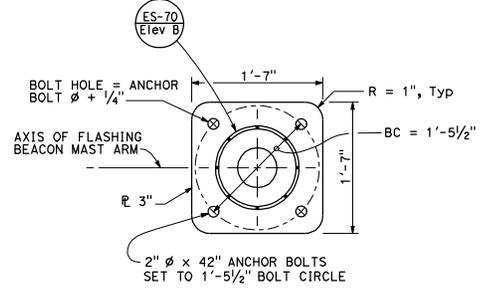
**VIEW A-A**  
**FLASHING BEACON MAST ARM CONNECTION DETAIL**  
**DETAIL B**



**TYPE 1-A, 1-B, 1-C AND 1-D**  
**ADVANCE FLASHING BEACON INSTALLATION**  
**DETAIL D**  
 See Note 5



**TYPE 40-0-100**  
**ELEVATION A**

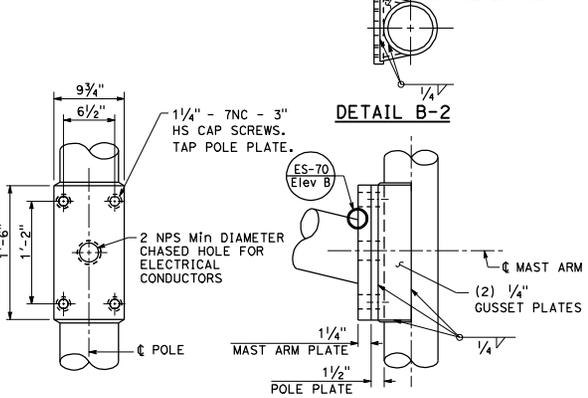


**BASE PLATE**  
**DETAIL C**

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS**  
**(FLASHING BEACON)**  
 NO SCALE

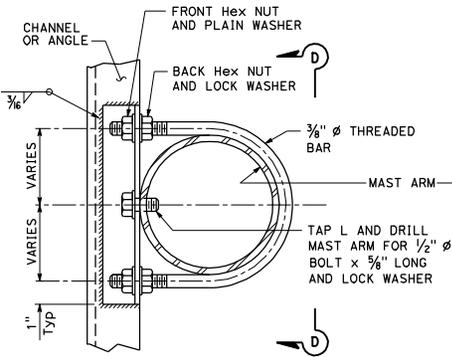


1/4" FLANGE PLATE ON POLE AND MAST ARM  
1/4" GUSSET PLATE (TOP AND BOTTOM)



**FLASHING BEACON MAST ARM CONNECTION DETAILS**

DETAIL B-1

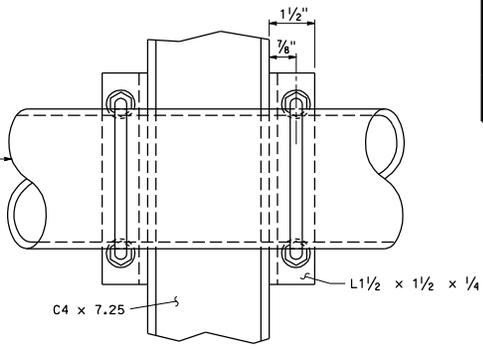


DETAIL B-3

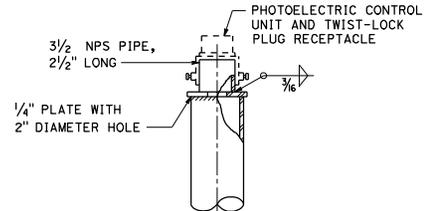
NOTE: Tighten front Hex nuts first, then tighten back Hex nuts.

**SIGN FRAME MOUNTING DETAILS**

All types  
DETAIL B

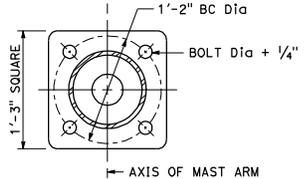


VIEW D-D

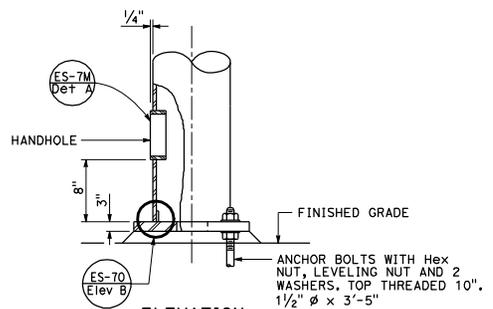


**POLE TOP DETAIL**

DETAIL E



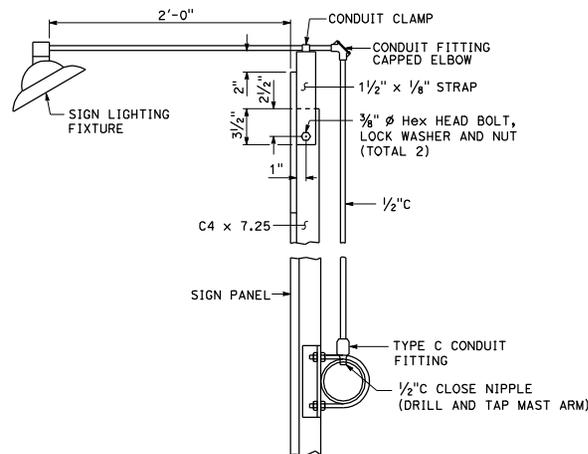
PLAN



ELEVATION

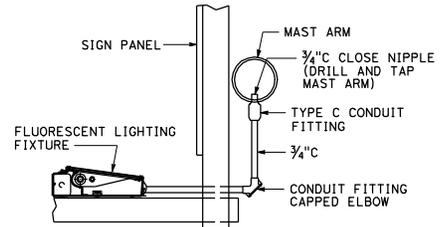
**BASE PLATE AND ANCHORAGE DETAIL**

DETAIL C



**SIGN LIGHTING FIXTURE TYPES 9A AND 9B**

DETAIL D



**SIGN LIGHTING FIXTURE TYPE 9 FRAME**

DETAIL F

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
(FLASHING BEACON WITH  
TYPE 9, 9A AND 9B SIGN)**  
NO SCALE

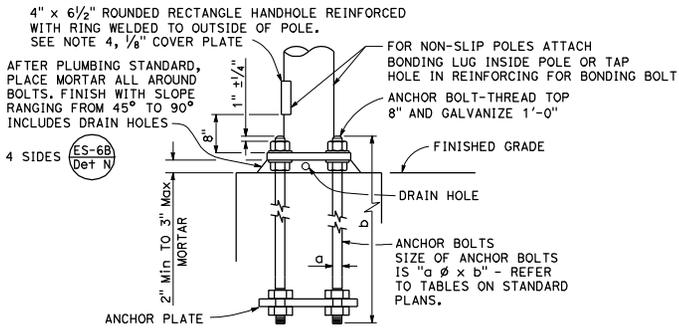
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

Stanley P. Johnson  
No. CS793  
Exp. 3-31-12  
CIVIL  
STATE OF CALIFORNIA

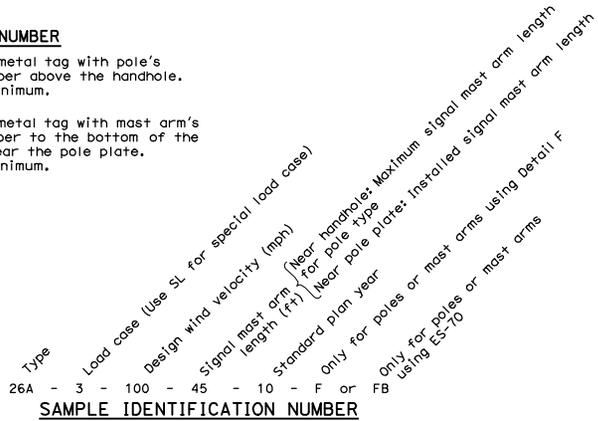
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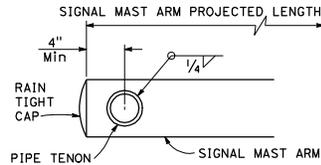
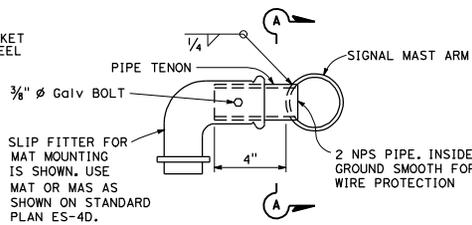
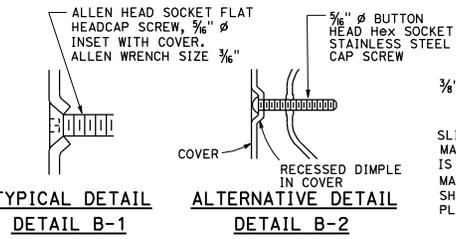
**HANDHOLE AND ANCHORAGE**  
**DETAIL A**

**IDENTIFICATION NUMBER**

1. Attach a stamped metal tag with pole's identification number above the handhole. 1/4" high number, minimum.
2. Attach a stamped metal tag with mast arm's identification number to the bottom of the signal mast arm near the pole plate. 1/4" high number, minimum.

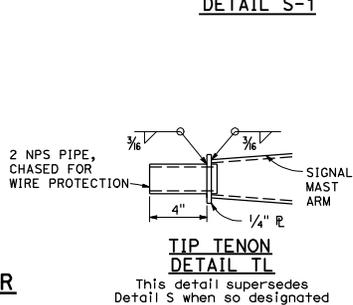
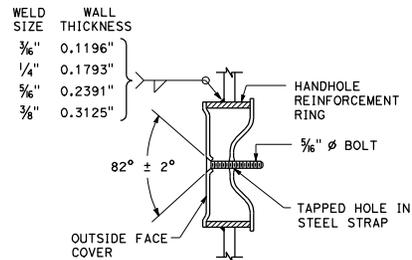


**SAMPLE IDENTIFICATION NUMBER**

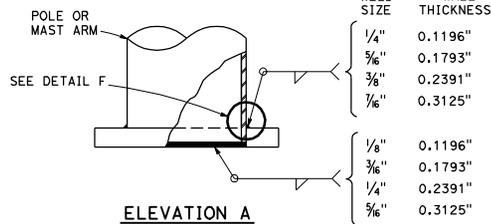
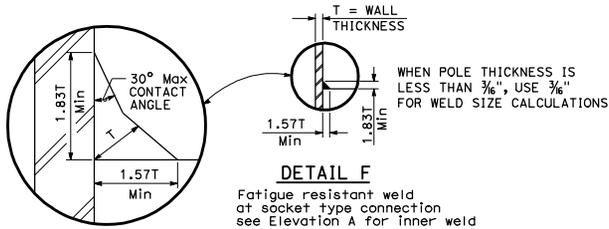
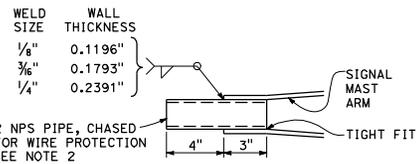


**NOTES:**

1. Provide a hex nut, leveling nut and 2 washers for each bolt.
2. Luminaire mast arms shall be round, tapered steel tubes, taper of 0.1375" to 0.143-inch per foot with an end section 2 3/8" OD for mounting hardware. Extensions of 2 NPS Standard pipe and 7" long may be used at the option of the manufacturer. When low pressure sodium luminaires are required, the extension shall be 1'-3".
3. Signal mast arms shall be round, tapered steel tubes, maximum taper 0.143-inch per foot.
4. Handhole reinforcement ring shall be 1/4" x 2" for 0.1196" to 0.2391" thick poles, 3/8" x 2" for 0.3125" thick poles.
5. Handholes shall be located on the downstream side of traffic.
6. Detail F, fatigue resistant weld, is required at socket welded signal mast arm plate and pole base plate.
7. Cap screws shall be tightened by the turn-of-nut method 1/3 turn from a snug tight condition. No washer will be required.
8. During pole installation, the post shall be raked as necessary with the use of leveling nuts to provide a plumb pole axis.
9. Outside diameter, wall thickness, and corresponding section properties of poles and mast arms as shown in the Standard Plans are minimums. Unless otherwise specified, alternative sections shall require approval by the Engineer.
10. Wind Loading (3 seconds gust): 100 mph
11. Unit Stresses (Structural steel):  
f<sub>y</sub> = 55,000 psi (tapered steel tube and anchor bolts)  
f<sub>y</sub> = 50,000 psi (unless otherwise noted)
12. Unit Stresses (Reinforced concrete):  
f'c = 3,625 psi  
f<sub>y</sub> = 60,000 psi



**PIPE TENONS**  
**DETAIL S**



STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**ELECTRICAL SYSTEMS**  
**(SIGNAL AND LIGHTING STANDARD,**  
**DETAIL No. 1)**

NO SCALE

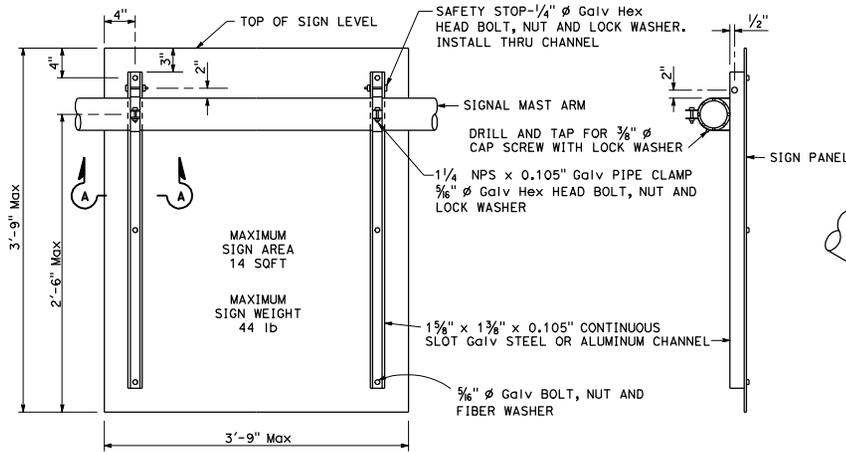
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

Stanley P. Johnson  
No. CS793  
Exp. 3-31-12  
CIVIL  
REGISTERED PROFESSIONAL ENGINEER  
STATE OF CALIFORNIA

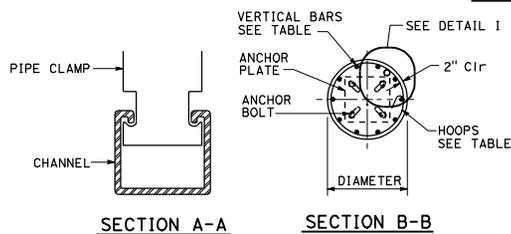
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REAR VIEW

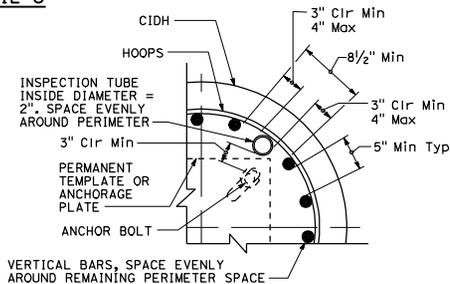
SIDE VIEW

**SIGN MOUNTING DETAILS  
DETAIL U**



SECTION A-A

SECTION B-B

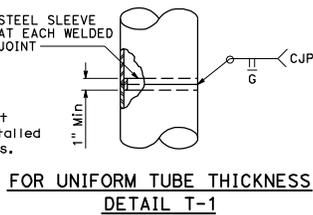


**INSPECTION TUBE PLACEMENT  
DETAIL I**

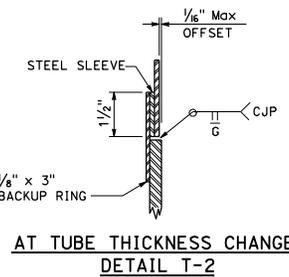
**CIDH REINFORCING AND INSPECTION TUBE SCHEDULE**

CIDH DIAMETER	VERTICAL BARS	HOOPS (WELDED)	INSPECTION TUBE
2 ft	8-#5	#4 AT 6	2
2.5 ft	10-#6	#4 AT 6	2
3 ft	12-#7	#5 AT 6	4*
3.5 ft	14-#8	#5 AT 6	4
4 ft	18-#9	2-#4 AT 7	5
5 ft	22-#10	2-#5 AT 7	6
6 ft	26-#11	2-#6 AT 7	7

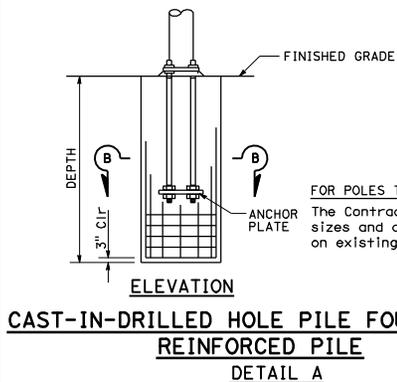
\* FOR SLIP BASE VERSIONS WITH 3 ANCHOR BOLTS USE 3 INSPECTION TUBES.



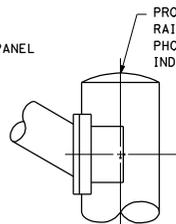
**POLE SPLICES  
DETAIL T**



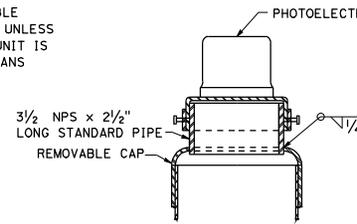
**AT TUBE THICKNESS CHANGE  
DETAIL T-2**



**CAST-IN-DRILLED HOLE PILE FOUNDATION,  
REINFORCED PILE  
DETAIL A**

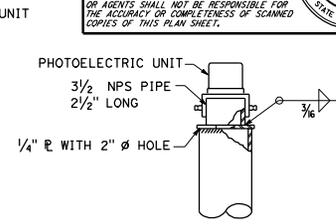


STANDARD TOP  
DETAIL B-1

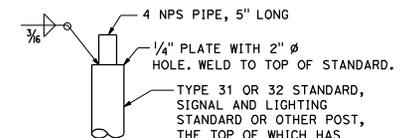


MOUNTING ADAPTER FOR  
PHOTOELECTRIC UNIT  
DETAIL B-2

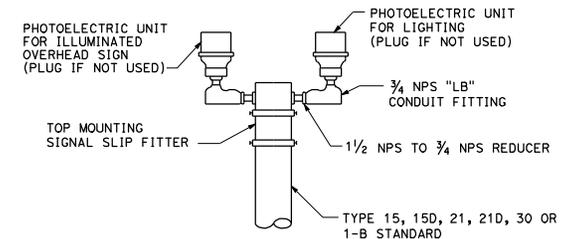
**POLE TOP DETAILS  
DETAIL B**



ALTERNATIVE  
MOUNTING ADAPTER  
DETAIL B-3



DETAIL C-1



**DUAL PHOTOELECTRIC UNIT MOUNTING DETAIL  
DETAIL C**

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
(SIGNAL AND LIGHTING STANDARD,  
DETAIL No. 2)**  
NO SCALE

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

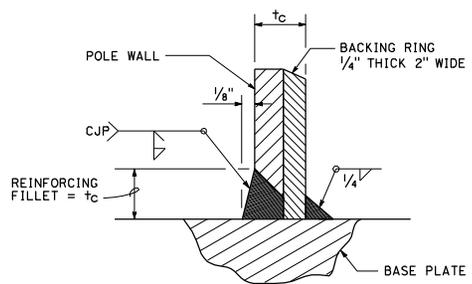
Stanley P. Johnson  
No. CS793  
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CIVIL  
STATE OF CALIFORNIA

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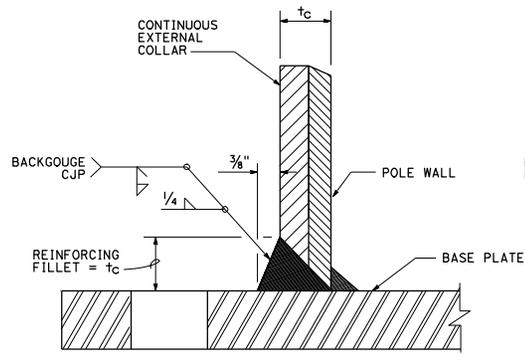
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

**Stanley P. Johnson**  
 REGISTERED CIVIL ENGINEER  
 No. CS793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

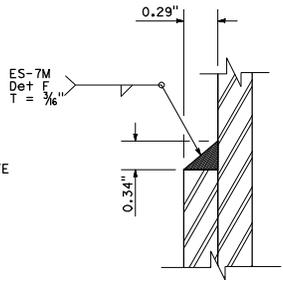
May 20, 2011  
 PLANS APPROVAL DATE  
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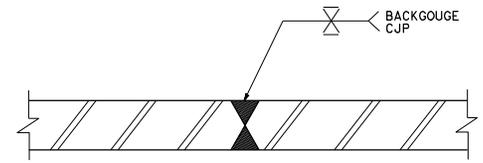
**DETAIL B**



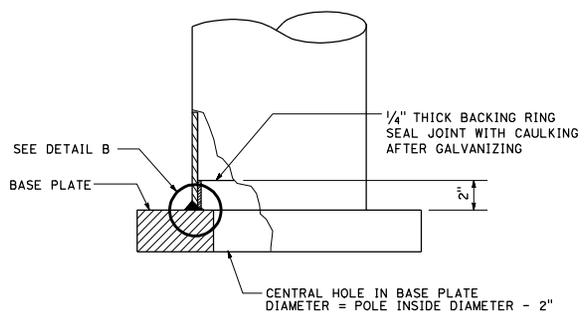
**DETAIL C1**



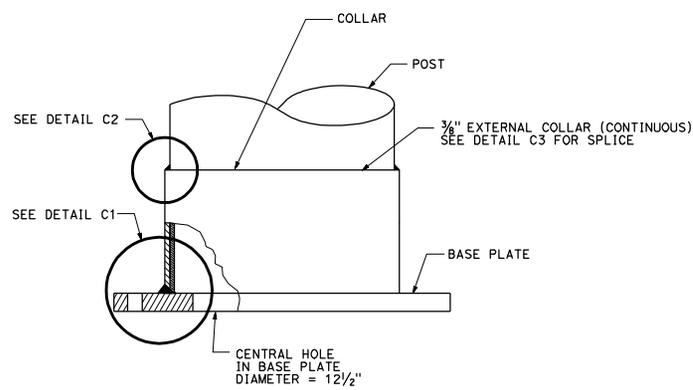
**DETAIL C2**



**DETAIL C3**

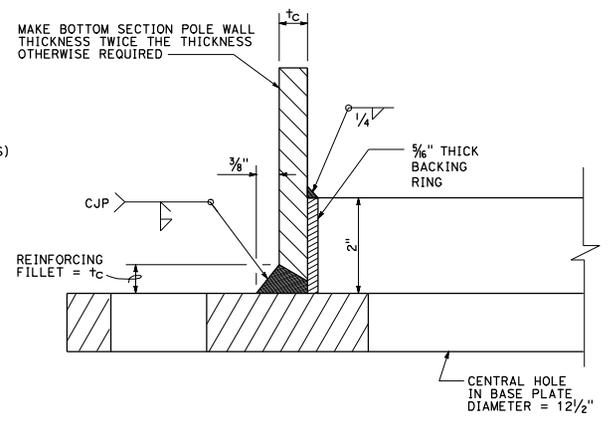


**ELEVATION B**



**ELEVATION C**

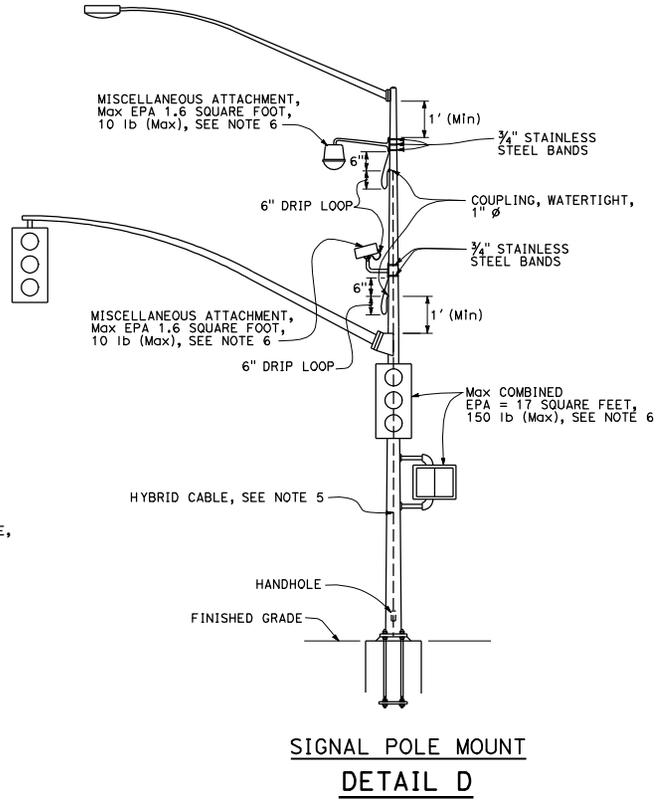
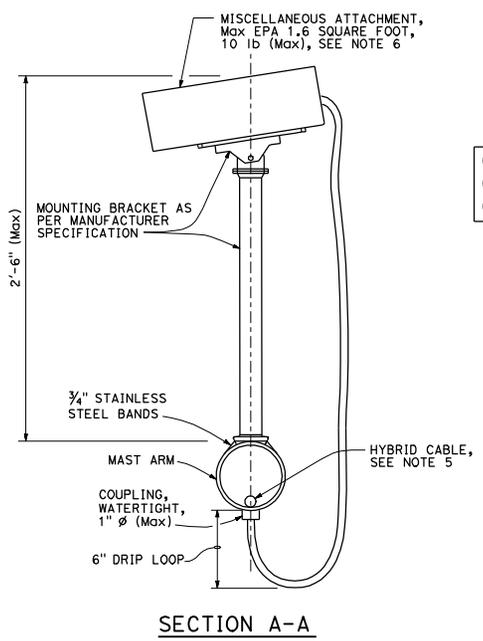
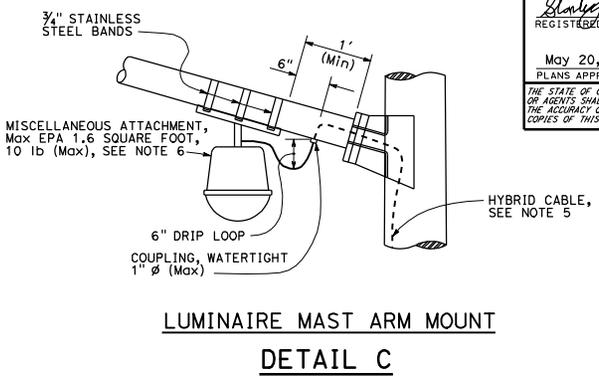
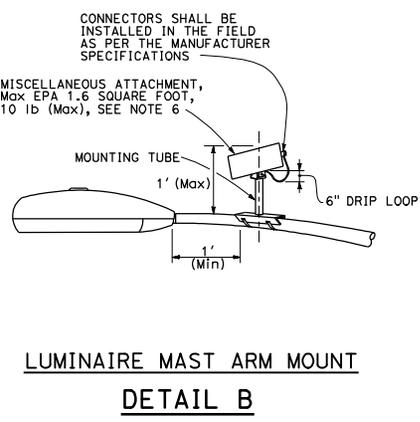
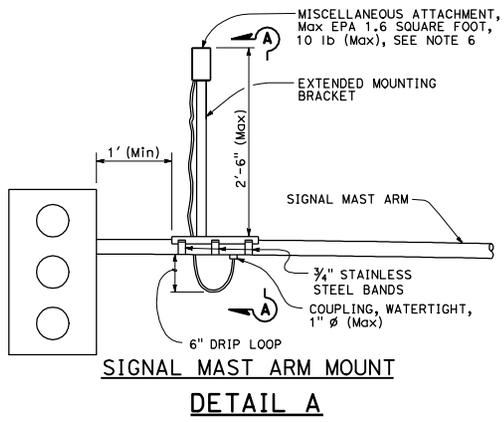
For alternative base, see Detail C4



**DETAIL C4**

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS**  
**(SIGNAL AND LIGHTING STANDARD, DETAIL No. 3)**  
 NO SCALE

**ES-70**



**NOTES:**

1. Exact mounting location of miscellaneous attachment and bracket shall be approved by the Engineer per manufacturer's recommendation.
2. Location of cable entrances on signal pole shall be a minimum of 1' from any flange or base plate.
3. Hybrid cable entrances on signal pole shall be drilled for weathertight coupling as required.
4. Hybrid cable shall have a drip loop at the entrance into signal pole, luminaire mast arm and signal mast arm.
5. A single hybrid cable shall run continuous and shall not be twisted from the miscellaneous attachment to the controller cabinet. No splices shall be allowed.
6. Use the manufacturer's Effective Projected Area (EPA) for miscellaneous attachment. The maximum EPA for each miscellaneous attachment shall be 1.6 square feet.
7. Maximum of two miscellaneous attachments per traffic signal structure.
8. Maximum of one miscellaneous attachment per mast arm.
9. Miscellaneous attachment shall be mounted using clamping devices.

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
(SIGNAL AND LIGHTING,  
MISCELLANEOUS ATTACHMENT)**  
NO SCALE

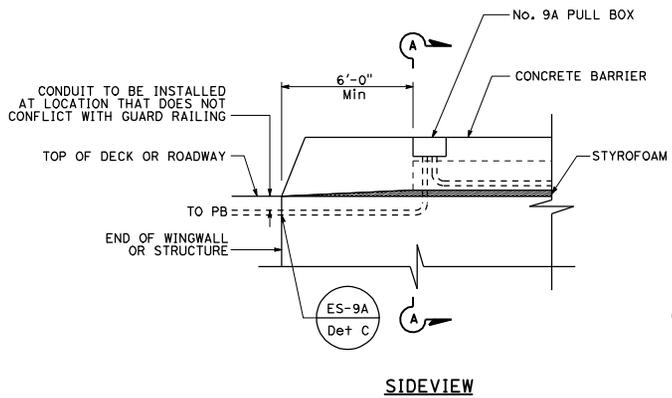
ES-7R

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

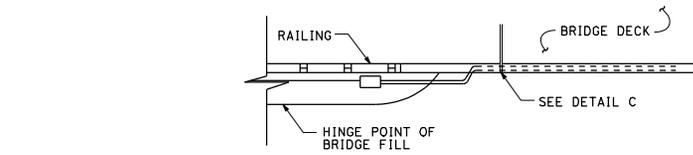
*Stanley P. Johnson*  
REGISTERED CIVIL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

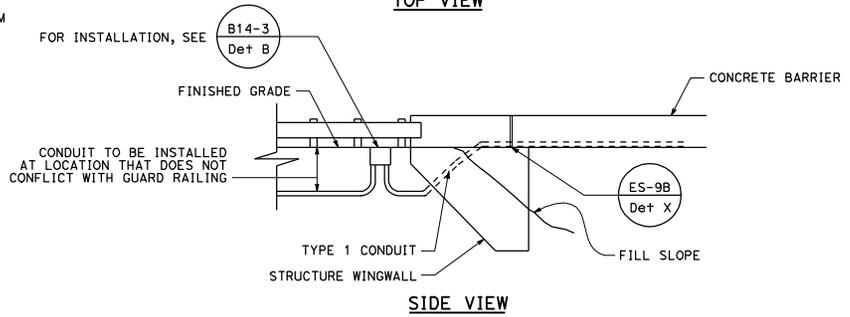
Stanley P. Johnson  
No. CS793  
Exp. 3-31-12  
CIVIL  
STATE OF CALIFORNIA



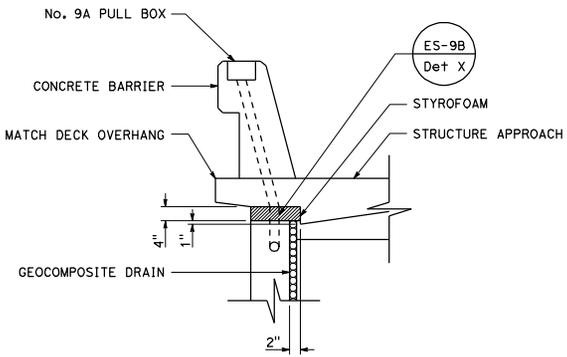
**SIDEVIEW**



**TOP VIEW**



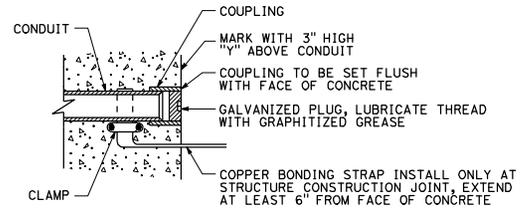
**SIDE VIEW**



**SECTION A-A**

**CONDUIT TERMINATION  
DETAIL A**

**CONDUIT TERMINATION  
DETAIL I**



**CONDUIT TERMINATION  
DETAIL C**

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

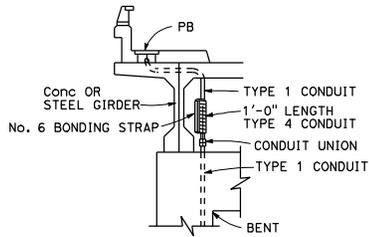
May 20, 2011  
 PLANS APPROVAL DATE  
 REGISTERED ELECTRICAL ENGINEER  
 Jeffery G. McRae  
 No. E14512  
 Exp. 6-30-12  
 ELECTRICAL  
 STATE OF CALIFORNIA

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (STRUCTURE PULL BOX  
 INSTALLATIONS)**

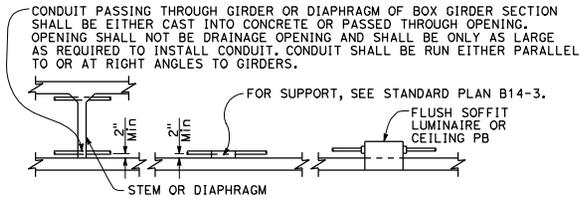
NO SCALE

**ES-9A**

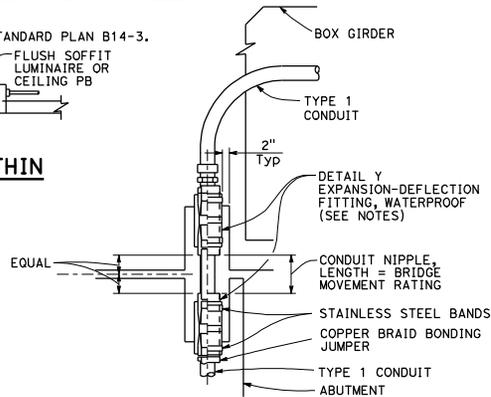
2010 STANDARD PLAN ES-9A



**CONDUIT RISER CONNECTION**  
**DETAIL R**

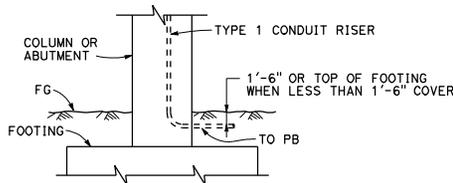


**CONDUIT INSTALLATION WITHIN BOX GIRDER SECTIONS**  
**DETAIL S**

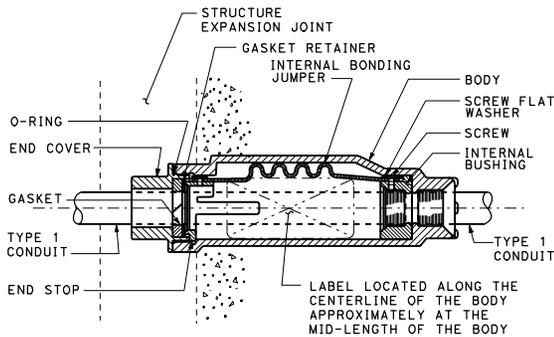


- NOTES:**
1. Fitting and pocket required only where movement can occur between girder and abutment.
  2. Fill pocket around fitting with resilient waterproof compound.

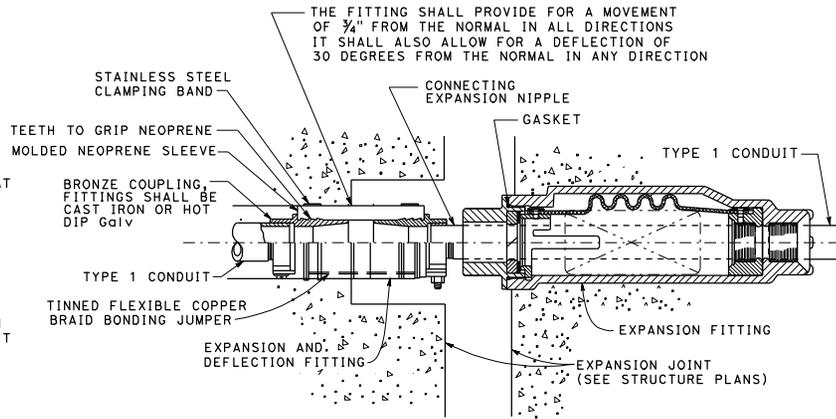
**CONDUIT RISER CONNECTION AT COLUMN, ABUTMENT OR STRUCTURE WING WALL**  
**DETAIL U**



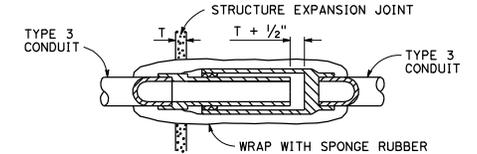
**LOWER END OF CONDUIT RISER AT COLUMN OR ABUTMENT**  
**DETAIL T**



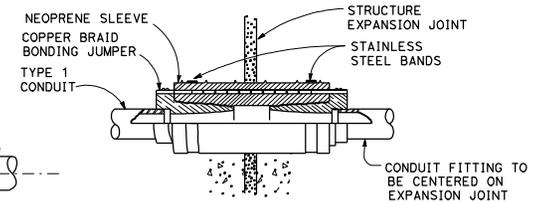
**CONDUIT EXPANSION FITTING**  
**DETAIL X**



**COMBINATION EXPANSION-DEFLECTION FITTINGS METALLIC CONDUIT INSTALLATION**  
**DETAIL XY**



**NON-METALLIC CONDUIT EXPANSION FITTING INSTALLATION DETAIL**  
**DETAIL V**  
To be used only when shown or specified on Project Plans



**CONDUIT EXPANSION-DEFLECTION FITTING**  
**DETAIL Y**

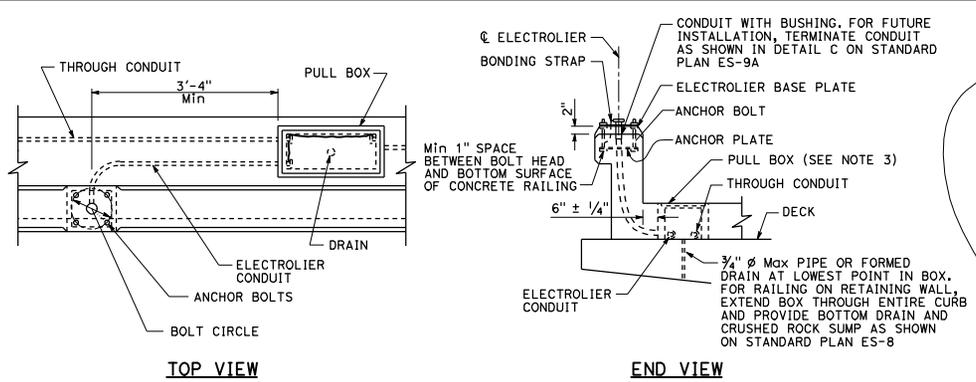
STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS (CONDUIT RISER AND EXPANSION FITTING, STRUCTURE INSTALLATIONS)**  
NO SCALE

**ES-9B**

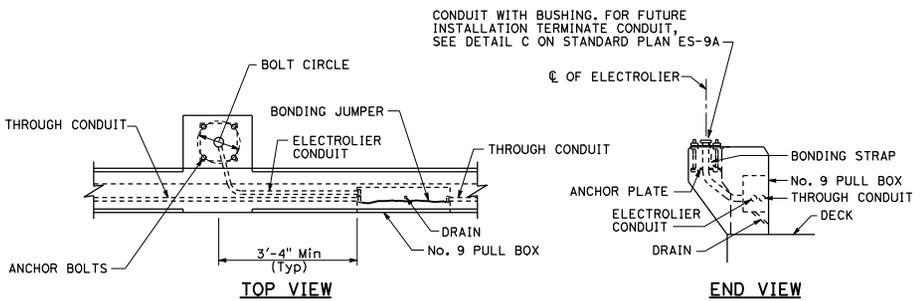
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*James A. L. ...*  
 REGISTERED ELECTRICAL ENGINEER  
 No. E11803  
 Exp. 9-30-12  
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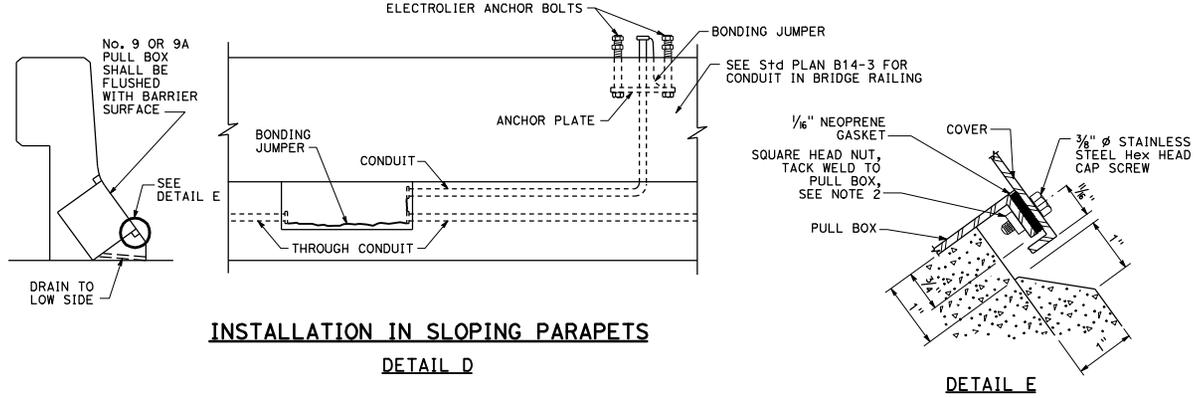




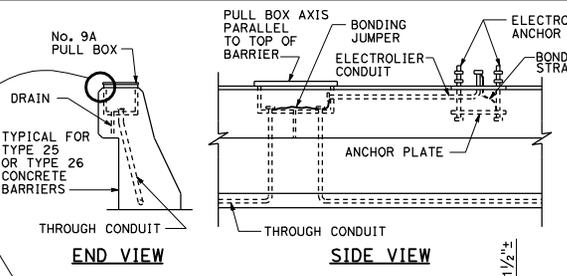
**TOP VIEW**  
**END VIEW**  
**No. 3/2, 5 OR 6 PULL BOX INSTALLATION**  
**DETAIL A**



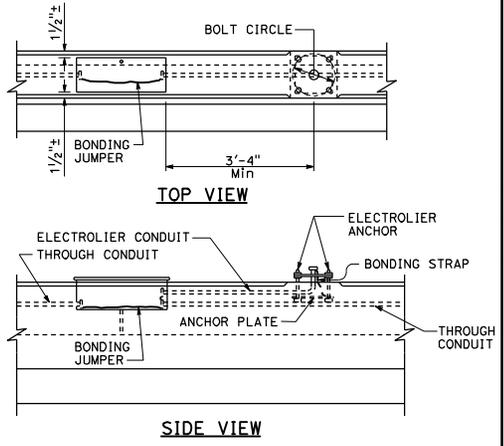
**TOP VIEW**  
**END VIEW**  
**No. 9 PULL BOX INSTALLATION**  
**DETAIL B**



**INSTALLATION IN SLOPING PARAPETS**  
**DETAIL D**  
**DETAIL E**



**END VIEW**  
**SIDE VIEW**



**TOP VIEW**  
**SIDE VIEW**  
**No. 9A PULL BOX INSTALLATION**  
**DETAIL C**

**NOTES:**

1. Axis of pull box shall be parallel to top of barrier, sidewalk or railing.
2. See railing sheet for reinforcement and structural details at electroliers and pull boxes.
3. Top of pull boxes in sidewalk areas shall be flush with sidewalk. Modify base of pull box as required.
4. Boxes inside of vertical barrier or railing shall be closed during pouring of PCC with 1/4" plywood of sufficient size to provide 1:1 chamfer on 3 sides of cover. Upper edge of plywood shall fit against lower edge of raintight hood.
5. Use drain in center if box is horizontal, or at low end if box is inclined. When box is mounted in sloping parapet 1/2" elongated drain hole inside at center or near end as required for drainage.
6. For electrolier anchorage bolts and grouting details, see Standard Plan ES-6B.
7. See Standard Plan B14-3 for conduit in concrete barrier.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION

**ELECTRICAL SYSTEMS**  
**(STRUCTURE PULL BOX**  
**INSTALLATIONS)**

NO SCALE

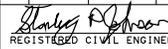
**ES-9D**

D16+	COUNTY	ROUTE	POST MILES	SHEET	TOTAL
			TOTAL PROJECT	NO.	SHEETS

*Jeffrey G. McBoo*  
 REGISTERED ELECTRICAL ENGINEER  
 No. E14512  
 Exp. 6-30-12  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE  
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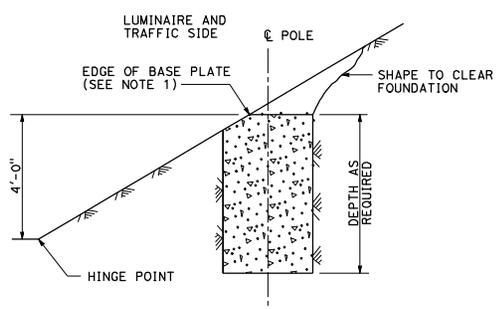
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

  
 REGISTERED CIVIL ENGINEER

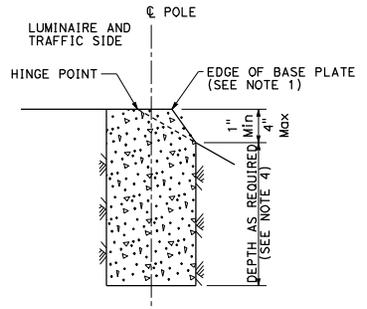
May 20, 2011  
 PLANS APPROVAL DATE



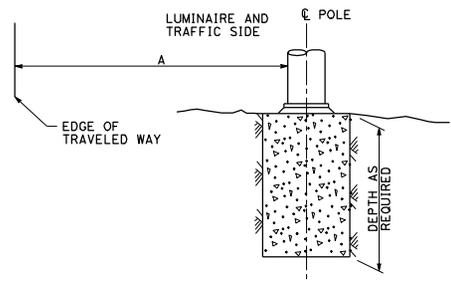
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CUT SLOPES  
STEEPER THAN 4:1,  
LESS THAN 2:1  
DETAIL A-1  
 See Note 2 and 3



FILL SLOPES  
STEEPER THAN 4:1,  
LESS THAN 2:1  
DETAIL A-2  
 See Note 2 and 3



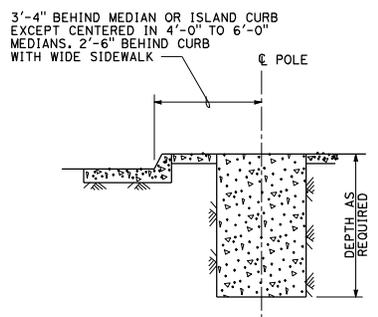
FLAT SECTIONS, CUT OR FILL SLOPES  
4:1 OR FLATTER  
DETAIL A-3  
 See Note 2

STANDARD TYPE	SETBACK (DIMENSION A)
32	30'-0" (Min)
31, 36-20A	20'-0" (Min)
15, 15D, 15-SB, 21, 21D, 30	ARM LENGTH (Min)

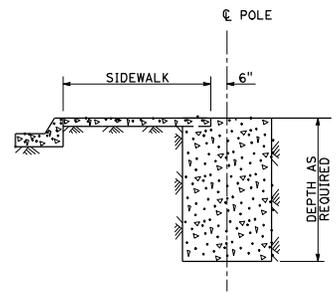
FOUNDATIONS ADJACENT TO ALL ROADWAYS EXCEPT  
IN SIDEWALK, MEDIAN AND ISLAND AREAS  
DETAIL A

NOTES:

- Where a portion of the foundation is above grade, the top edges shall have a 1" chamfer.
- Slopes shall be horizontal to vertical ratio (Horizontal : Vertical).
- Horizontal setbacks on cut and fill slopes steeper than 4:1 shall not exceed the distance shown for flat sections.
- CIDH embedment depth shall be increased beyond standard depths by the diameter of the CIDH.



MEDIAN, ISLAND  
OR WIDE SIDEWALK  
DETAIL B-1  
 7' Wide and wider



NARROW SIDEWALK  
DETAIL B-2  
 Less than 7' wide

FOUNDATIONS IN SIDEWALK, MEDIAN AND ISLAND AREAS  
DETAIL B

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS**  
**(FOUNDATION INSTALLATIONS)**  
 NO SCALE

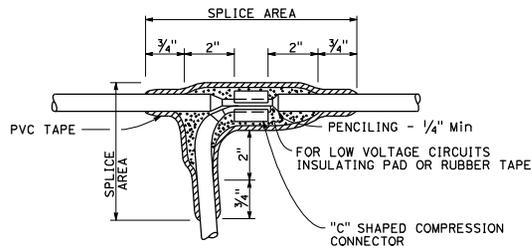
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*Jeffery G. McRae*  
 REGISTERED ELECTRICAL ENGINEER

May 20, 2011  
 PLANS APPROVAL DATE

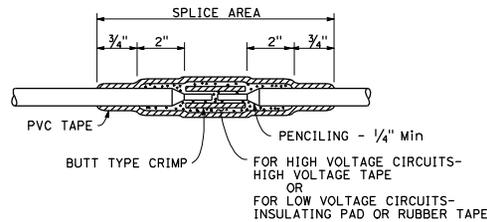
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REGISTERED PROFESSIONAL ENGINEER  
 Jeffery G. McRae  
 No. E14512  
 Exp. 6-30-12  
 ELECTRICAL  
 STATE OF CALIFORNIA



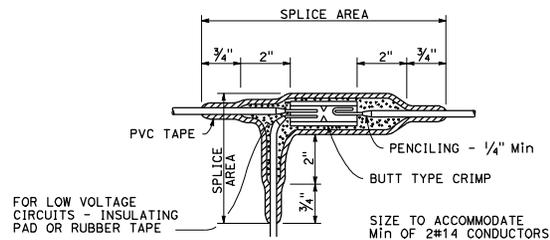
**TYPE C SPLICE**

See Note 3



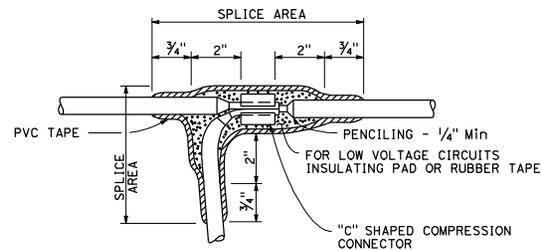
**TYPE S SPLICE**

See Note 4



**TYPE ST SPLICE**

See Note 5



**TYPE T SPLICE**

See Note 5

**NOTES:**

1. Dimensions are minimum.
2. Rubber tapes shall be rolled after application.
3. Between 1 free-end and 1 through conductor.
4. Between 2 free-end conductors.
5. Between 3 free-end conductors.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (SPlicing DETAILS)**

NO SCALE

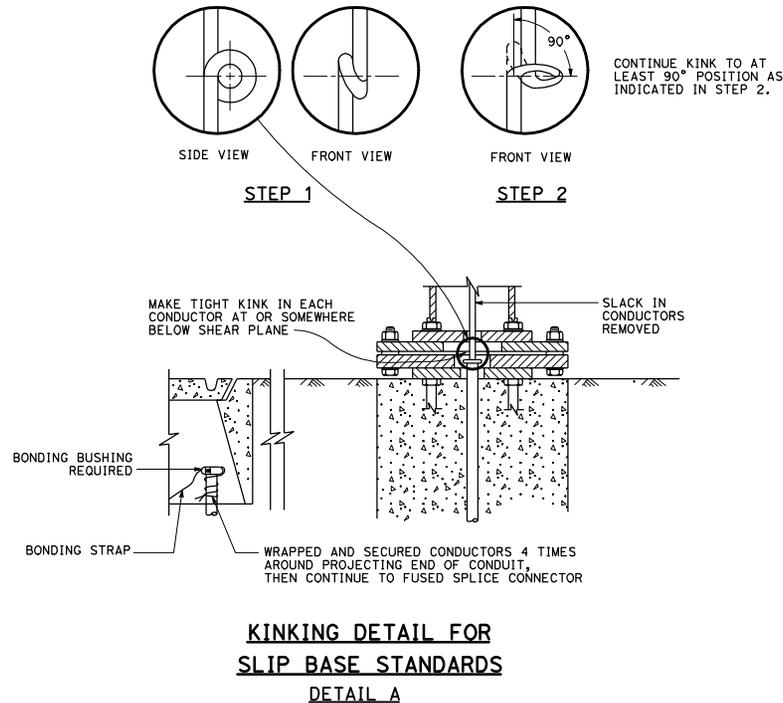
**ES-13A**

CIRCUIT VOLTAGE	FUSE VOLTAGE RATING	FUSE CURRENT RATING																	
		HPS LAMP BALLAST								LOW PRESSURE SODIUM BALLAST						INDUCTION SIGN LIGHTING	SINGLE PHASE (TWO WIRE) TRANSFORMERS (PRIMARY SIDE)		
		70 W	100 W	150 W	200 W	250 W	310 W	400 W	1000 W	35 W	55 W	90 W	135 W	180 W	85 W	1 kVA	2 kVA	3 kVA	
120 V	250 V	5 A	5 A	5 A	5 A	5 A	5 A	5 A	-	5 A	5 A	5 A	5 A	5 A	5 A	10 A	20 A	30 A	
240 V	250 V	5 A	5 A	5 A	5 A	5 A	5 A	5 A	5 A	3 A	3 A	3 A	5 A	5 A	5 A	6 A	10 A	20 A	
480 V	500-600 V	5 A	5 A	5 A	5 A	5 A	5 A	5 A	5 A	2 A	2 A	2 A	3 A	3 A	1 A (SEE NOTE 2)	3 A	6 A	10 A	

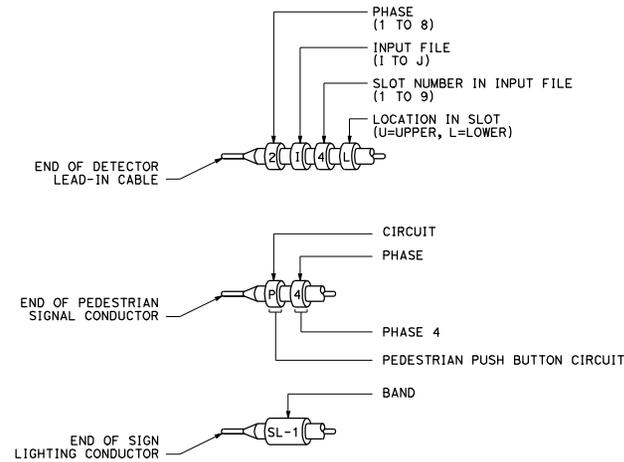
**NOTES:**

1. Primary lines of multiple ballasts shall be provided with fused connectors. Fuse ratings shall be as noted above.
2. See Standard Plan ES-15D, Type SC3 control.

**FUSE RATINGS FOR FUSED CONNECTORS  
LUMINAIRE BALLAST FUSING**



**KINKING DETAIL FOR  
SLIP BASE STANDARDS  
DETAIL A**



**TYPICAL BANDING OF CONDUCTOR ENDS  
DETAIL B**

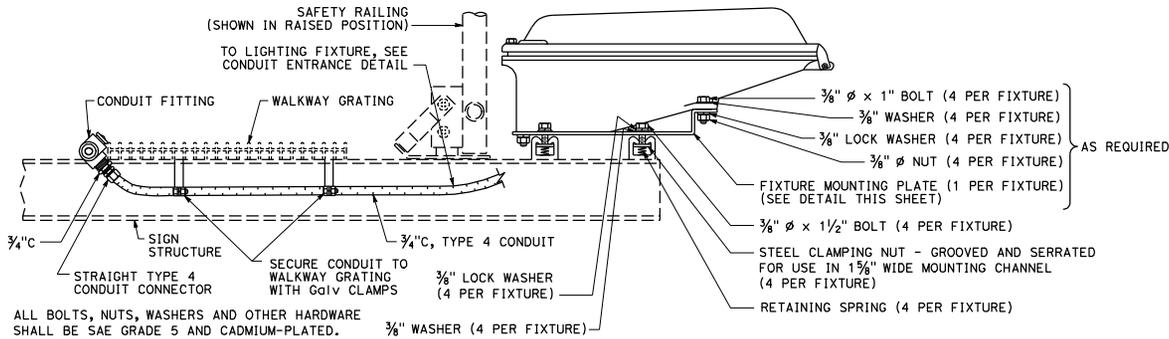
STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
(FUSE RATING, KINKING AND  
BANDING DETAIL)**

NO SCALE

**ES-13B**

D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
<i>Jeffrey G. McBoo</i> REGISTERED ELECTRICAL ENGINEER PROFESSIONAL ENGINEER No. E14512 Exp. 6-30-12 ELECTRICAL STATE OF CALIFORNIA					
May 20, 2011 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.					

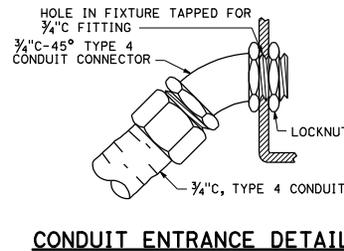
LENGTH OF PANEL	NUMBER OF FIXTURES (EACH)	FIXTURE SPACING SEE NOTES
5'-0"	1	2'-6"
6'-0"		3'-0"
7'-0"		3'-6"
8'-0"		4'-0"
9'-0"		4'-6"
10'-0"		5'-0"
11'-0"		5'-6"
12'-0"		6'-0"
13'-0"		6'-6"
14'-0"		7'-0"
15'-0"	7'-6"	
16'-0"	8'-0"	
17'-0"	2	4'-3":8'-6"
18'-0"		4'-6":9'-0"
19'-0"		4'-9":9'-6"
20'-0"		5'-0":10'-0"
21'-0"		5'-3":10'-6"
22'-0"		5'-6":11'-0"
23'-0"		5'-9":11'-6"
24'-0"		6'-0":12'-0"
25'-0"		6'-3":12'-6"
26'-0"		6'-6":13'-0"
27'-0"	6'-9":13'-6"	
28'-0"	7'-0":14'-0"	
29'-0"	7'-3":14'-6"	
30'-0"	7'-6":15'-0"	
31'-0"	7'-9":15'-6"	
32'-0"	3	8'-0":16'-0"
33'-0"		5'-6":11'-0"
34'-0"		5'-8":11'-4"
35'-0"		5'-10":11'-8"
36'-0"		6'-0":12'-0"
37'-0"		6'-2":12'-4"
38'-0"		6'-4":12'-8"
39'-0"		6'-6":13'-0"
40'-0"		6'-8":13'-4"
41'-0"		6'-10":13'-8"
42'-0"	7'-0":14'-0"	
43'-0"	7'-2":14'-4"	
44'-0"	7'-4":14'-8"	
45'-0"	7'-6":15'-0"	
46'-0"	7'-8":15'-4"	
47'-0"	7'-10":15'-8"	
48'-0"	8'-0":16'-0"	
49'-0"	4	6'-11/2":12'-3"
50'-0"		6'-3":12'-6"
51'-0"		6'-4 1/2":12'-9"
52'-0"		6'-6":13'-0"
53'-0"		6'-7 1/2":13'-3"
54'-0"		6'-9":13'-6"
55'-0"		6'-10 1/2":13'-9"
56'-0"		7'-0":14'-0"
57'-0"		7'-1 1/2":14'-3"
58'-0"		7'-3":14'-6"
59'-0"	7'-4 1/2":14'-9"	
60'-0"	7'-6":15'-0"	
61'-0"	7'-7 1/2":15'-3"	
62'-0"	7'-9":15'-6"	
63'-0"	7'-10 1/2":15'-9"	
64'-0"	8'-0":16'-0"	



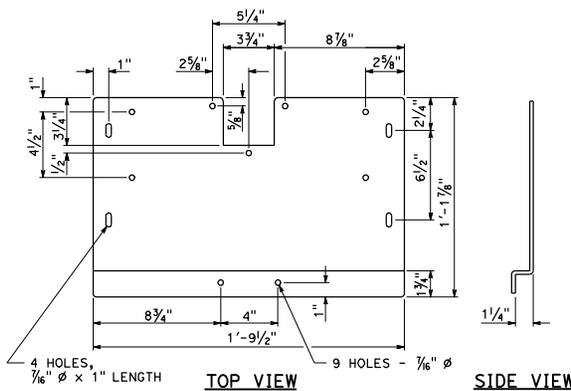
**LIGHTING FIXTURE MOUNTING DETAIL (TYPICAL)**

**NOTES:**

1. The first number listed is the dimension from the edge of the sign panel to the center of the end-most fixture. The second number listed is the dimension between centers of successive fixtures.
2. Where adjacent sign panels are spaced 1'-0" or less the combination of these panels (and spaces) shall be considered a single panel.
3. Physical configuration and mounting details may vary from what is shown.



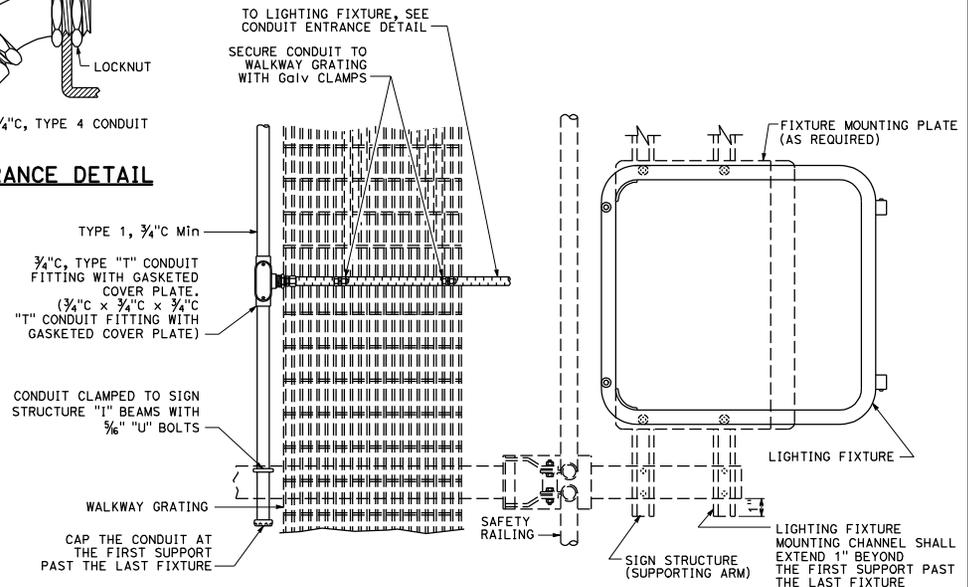
**CONDUIT ENTRANCE DETAIL**



**SIGN ILLUMINATION FIXTURE MOUNTING PLATE (TYPICAL)**

**NOTES:**

1. Material: 0.135" hot-dip galvanized sheet steel after fabrication.
2. Left side is symmetrical with right side.

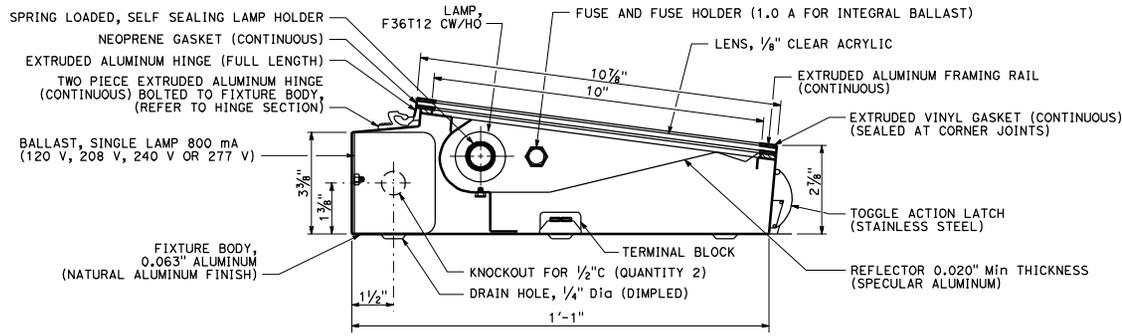


STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
(SIGN ILLUMINATION EQUIPMENT)**  
NO SCALE

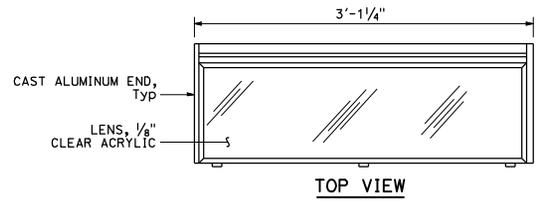
D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
------	--------	-------	-----------------------------	-----------	--------------

*Jeffery G. McRae*  
 REGISTERED ELECTRICAL ENGINEER  
 PLANS APPROVAL DATE: May 20, 2011  
 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.

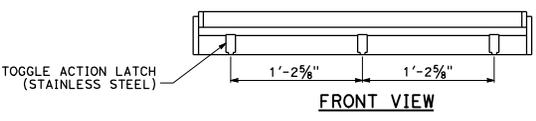
PROFESSIONAL ENGINEER  
 Jeffery G. McRae  
 No. E14512  
 Exp. 6-30-12  
 ELECTRICAL  
 STATE OF CALIFORNIA



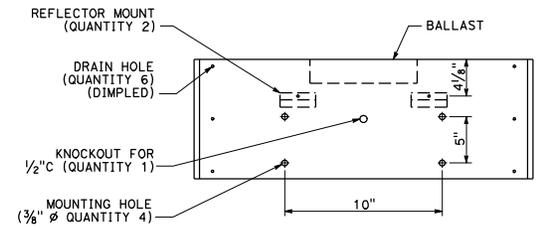
**SECTION-LIGHTING FIXTURE**



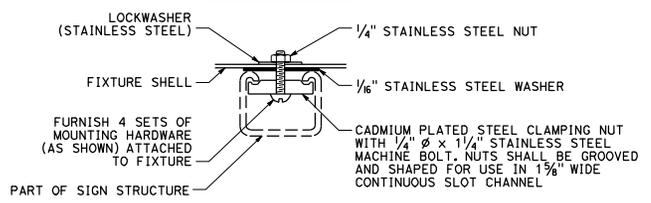
**TOP VIEW**



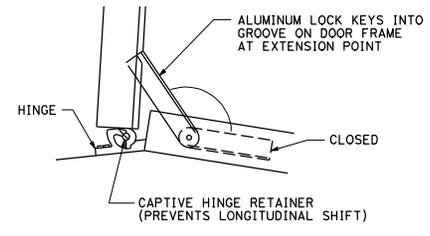
**FRONT VIEW**



**MOUNTING VIEW**



**FIXTURE MOUNTING  
ON CONTINUOUS SLOT CHANNEL  
DETAIL M**



**HINGE SECTION**

SIGN LOAD (WATTS) AND FUSING		
1 LAMP AND BALLAST	- 75 W	1 A
2 LAMPS AND BALLAST	- 150 W	2.5 A
3 LAMPS AND BALLAST	- 225 W	3 A

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*Jeffery G. McRae*  
 REGISTERED ELECTRICAL ENGINEER  
 No. E14512  
 Exp. 6-30-12  
 ELECTRICAL  
 STATE OF CALIFORNIA

May 20, 2011  
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**NOTES:**

1. Conduit shall be secured to nearest member using one-hole galvanized malleable iron or steel straps at 5'-0" maximum centers and brass machine screws tapped into the member.
2. Ballasts and terminal boards shall be marked with legible symbols. Conductors shall be tagged and their identification marked on the corresponding terminal on the terminal board as shown on the typical fixture wiring diagram. An alternative cover design shall be submitted for approval.
3. Ballast shall be one, two or three lamp types as required, rated at 800 mA.
4. Each ballast shall be fused with 1/4" x 1/4" slow-blow glass tube fuse.
5. Fuseholder shall be a panel mounted type.
6. The fixture shall have an integral ballast.

STATE OF CALIFORNIA  
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**ELECTRICAL SYSTEMS  
 (36" FLUORESCENT SIGN  
 ILLUMINATION EQUIPMENT)**

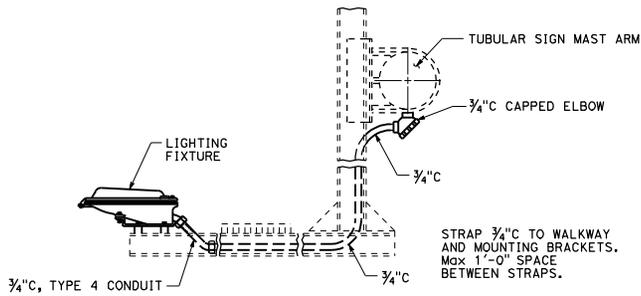
NO SCALE

**ES-15B**

D16+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

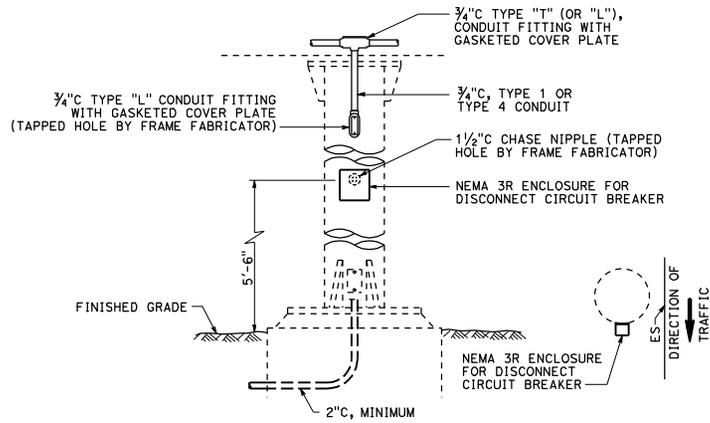
*Jeffrey G. McRae*  
 REGISTERED ELECTRICAL ENGINEER  
 PROFESSIONAL ENGINEER  
 No. E14512  
 Exp. 6-30-12  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE  
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**TYPICAL SIGN ILLUMINATION EQUIPMENT  
INSTALLATION FOR OVERHEAD SIGNS TUBULAR**

DETAIL A

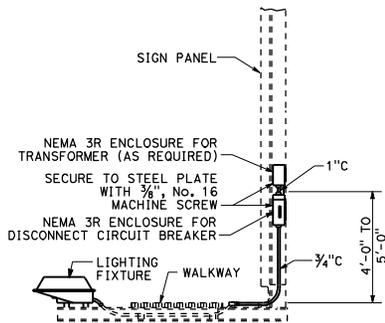


**TYPICAL SIGN ILLUMINATION EQUIPMENT  
INSTALLATION FOR OVERHEAD SIGNS ROUND POST**

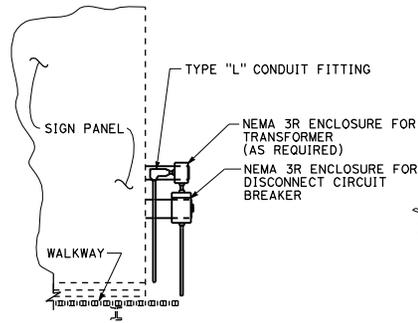
DETAIL B

**NOTES:**

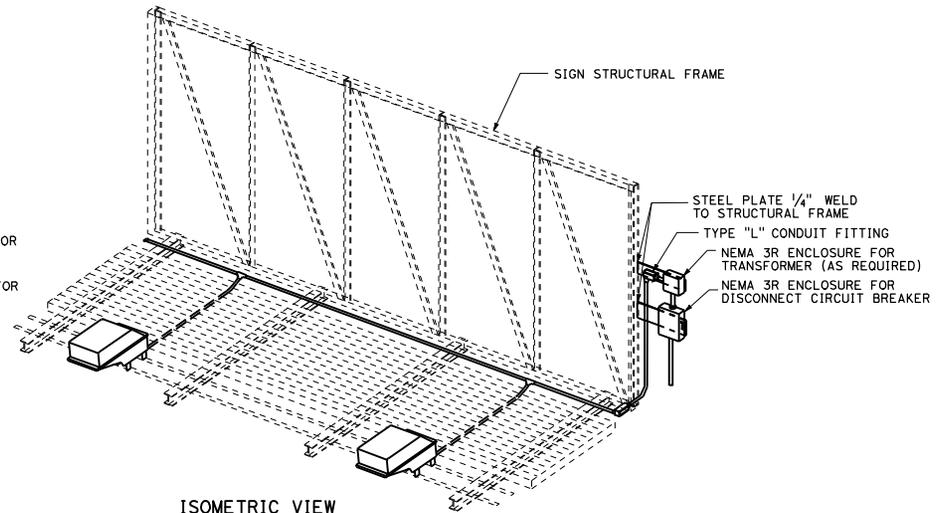
1. Type 4 conduit shall be secured to the nearest walkway bracket using one-hole galvanized malleable iron or steel straps and brass machine screws tapped into the bracket.
2. See Overhead Signs Standard Plans for overhead signs and frame juncture details for photoelectric unit installation.
3. Enclosures and straps shall be secured by 3/8 inch maximum size screws.
4. Contactor and test switch enclosures shall be readily accessible from the sign walkway.



SIDE VIEW



FRONT VIEW



ISOMETRIC VIEW

**TYPICAL SIGN ILLUMINATION EQUIPMENT  
INSTALLATION FOR OVERHEAD SIGNS  
BRIDGE MOUNTED**

DETAIL C  
See Note 4

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (SIGN ILLUMINATION EQUIPMENT)**

NO SCALE

**ES-15C**

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

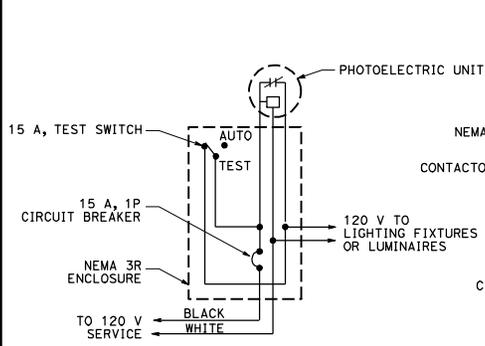
*Jeffery G. McRae*  
 REGISTERED ELECTRICAL ENGINEER  
 No. E14512  
 Exp. 6-30-12  
 PROFESSIONAL ENGINEER  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE

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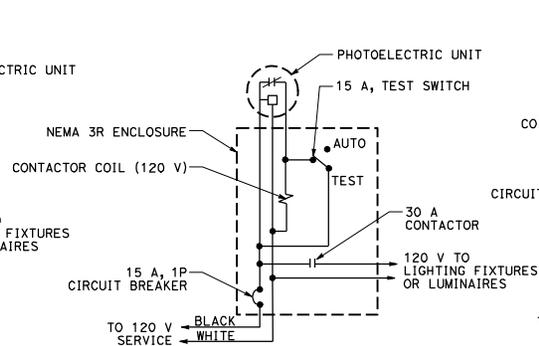
**NOTE:**

1. Type SC1A, SC2A, SC3A controls are similar to Types SC1, SC2 and SC3 controls respectively except test switch and wiring are not required.



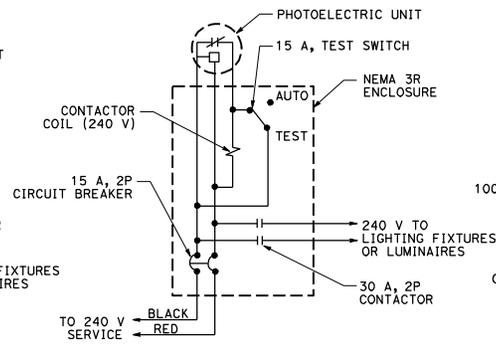
**TYPE LC1 CONTROL**

For 120 V unswitched circuit with no more than 1000 W load.



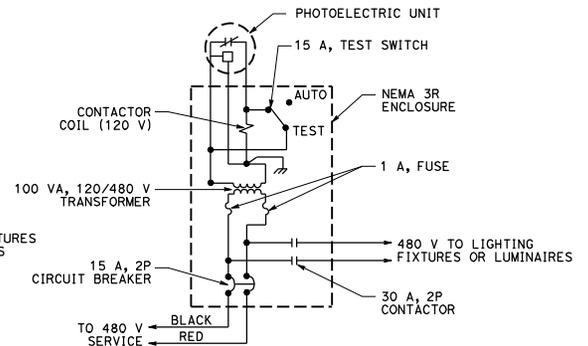
**TYPE LC2 CONTROL**

For 120 V unswitched circuit



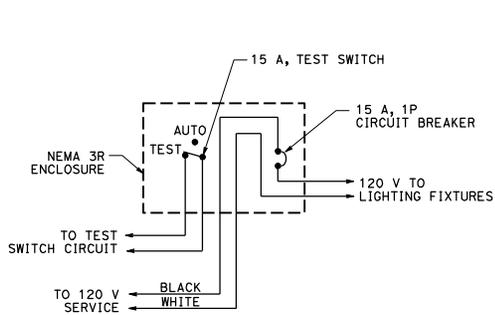
**TYPE LC3 CONTROL**

For 240 V unswitched circuits



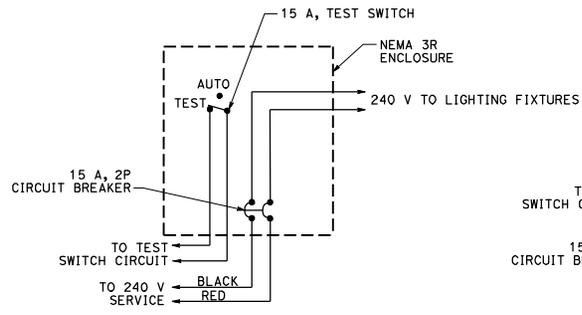
**TYPE LC4 CONTROL**

For 480 V unswitched circuits



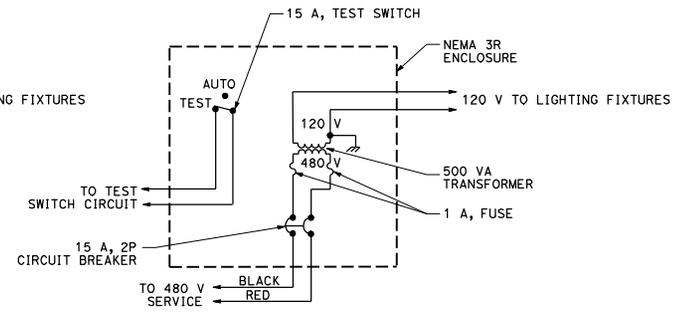
**TYPE SC1 CONTROL**

For 120 V switched circuit, see Note 1 for Type SC1A



**TYPE SC2 CONTROL**

For 240 V switched circuit, see Note 1 for Type SC2A



**TYPE SC3 CONTROL**

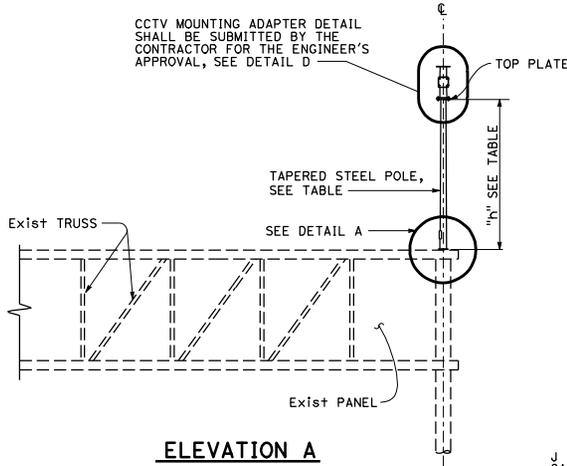
For 480 V switched sign circuit, see Note 1 for Type SC3A

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**ELECTRICAL SYSTEMS  
 (LIGHTING AND SIGN  
 ILLUMINATION CONTROL)**  
 NO SCALE

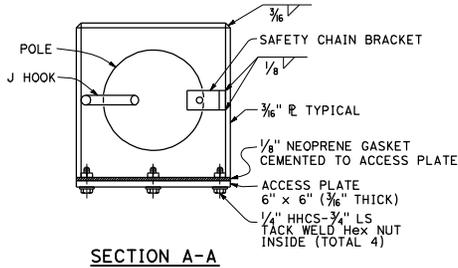
**ES-15D**

POLE EXTENSION TYPE	POLE DATA				HANDHOLE SIZE
	HEIGHT "h"	Min OD		THICKNESS	
		BASE	TOP		
CCTV 5	5'	4 $\frac{3}{8}$ "	3 $\frac{3}{4}$ "	0.1793"	3" x 5"
CCTV 10	10'	5 $\frac{1}{4}$ "			
CCTV 15	15'	5 $\frac{5}{8}$ "			

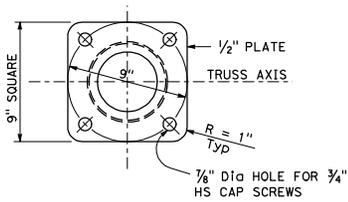
CCTV MOUNTING ADAPTER DETAIL SHALL BE SUBMITTED BY THE CONTRACTOR FOR THE ENGINEER'S APPROVAL, SEE DETAIL D



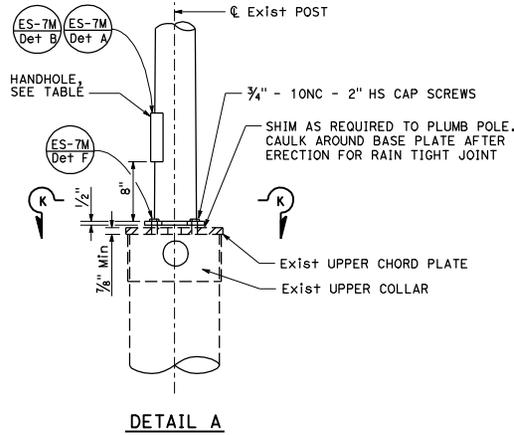
**ELEVATION A**



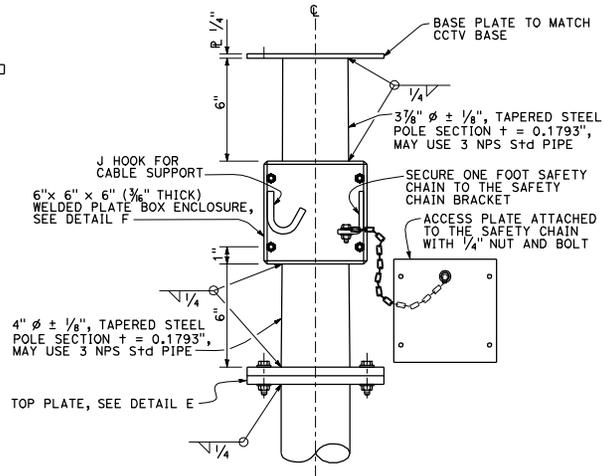
**SECTION A-A**



**SECTION K-K**



**DETAIL A**

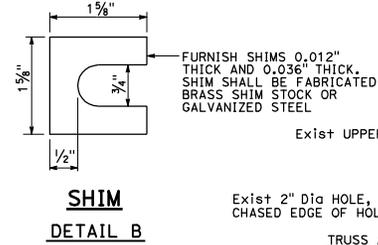


**CLOSED CIRCUIT TELEVISION MOUNTING ADAPTER**

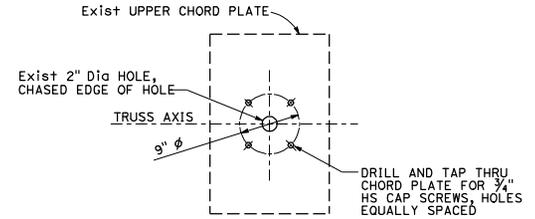
**DETAIL D**

**NOTES:**

- The Contractor shall verify controlling field dimensions before ordering or fabricating any material.
- Bolt hole locations may vary at the discretion of the Engineer.
- See Std Plan S13.
- Wind Loadings (3-second gust) : 100 mph.
- Unit Stresses (Structural Steel):
  - fy = 55,000 psi (tapered steel tube)
  - fy = 50,000 psi (unless otherwise noted)



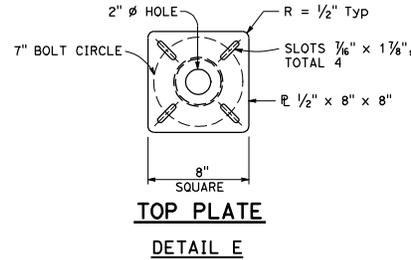
**SHIM  
DETAIL B**



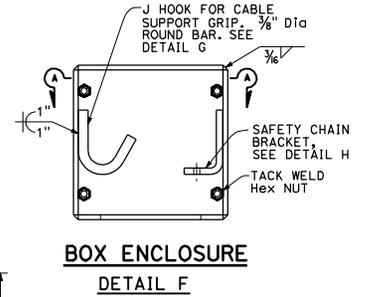
**UPPER CHORD PLATE**

**DETAIL C**

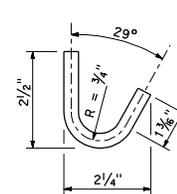
See Note 3



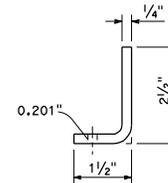
**TOP PLATE  
DETAIL E**



**BOX ENCLOSURE  
DETAIL F**



**J HOOK  
DETAIL G**



**SAFETY CHAIN BRACKET  
DETAIL H**

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**ELECTRICAL SYSTEMS  
(CLOSED CIRCUIT TELEVISION,  
5' TO 15' OVERHEAD SIGN MOUNTED POLE)**

NO SCALE

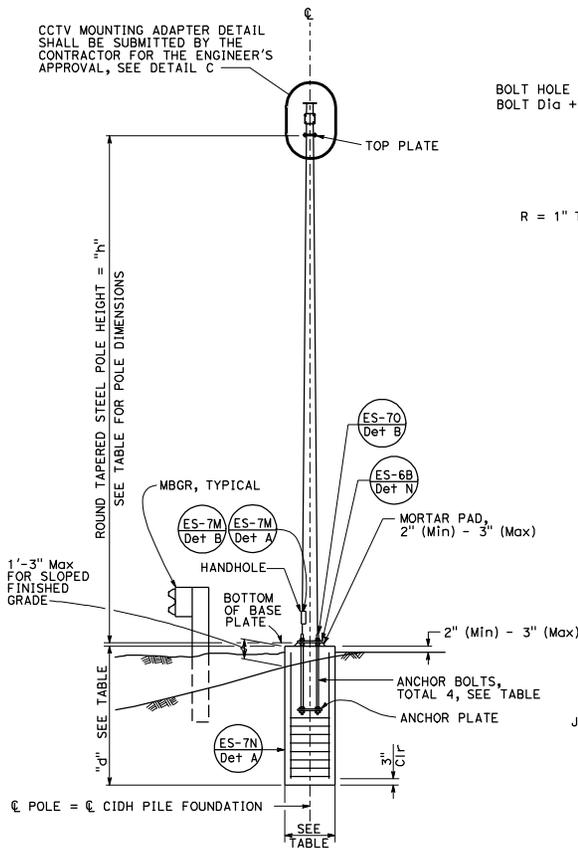
POLE TYPE	POLE DATA				BASE PLATE DATA				CIDH	
	HEIGHT "h"	Min OD		THICKNESS	"c"	THICKNESS	ANCHOR BOLT SIZE	BC = BOLT CIRCLE	Dia	"d"
		BASE	TOP							
CCTV 25	25'	7 3/8"	3 3/4"	0.1793"	1'-1"	1"	1 1/2" $\phi$ x 36"	1 1/2"	2'-6"	7'-0"
CCTV 30	30'	8"			1'-1 1/2"			1'-0"		7'-6"
CCTV 35	35'	8 5/8"			1'-2"			1'-1"		8'-0"
CCTV 40	40'	9 3/8"			1'-1 1/2"			1'-1 1/2"		8'-0"
CCTV 45	45'	10"			1'-3"			1'-2"		8'-6"

DIST	COUNTY	ROUTE	POST MILES	SHEET	TOTAL
			TOTAL PROJECT	NO.	SHEETS

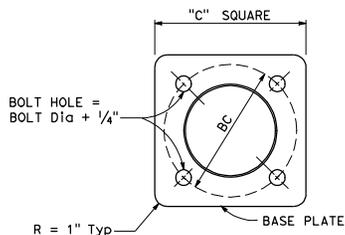
Stanley P. Johnson  
 REGISTERED CIVIL ENGINEER  
 No. CS793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE  
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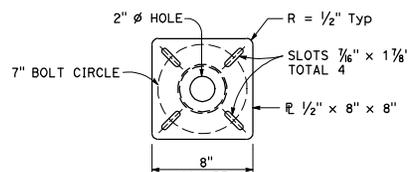
CCTV MOUNTING ADAPTER DETAIL SHALL BE SUBMITTED BY THE CONTRACTOR FOR THE ENGINEER'S APPROVAL, SEE DETAIL C



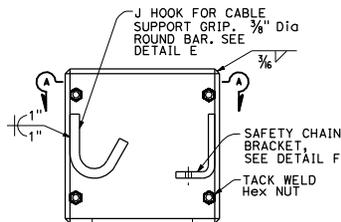
**ELEVATION A**



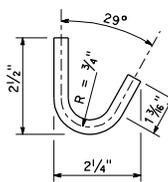
**BASE PLATE  
DETAIL A**



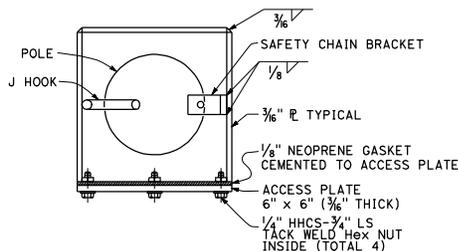
**TOP PLATE  
DETAIL B**



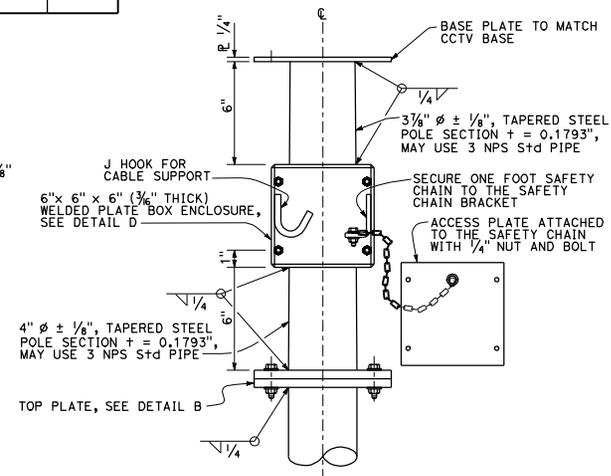
**BOX ENCLOSURE  
DETAIL D**



**J HOOK  
DETAIL E**



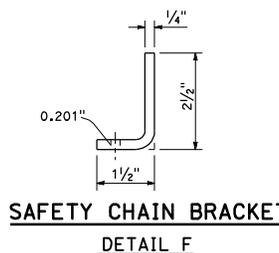
**SECTION A-A**



**CLOSED CIRCUIT TELEVISION MOUNTING ADAPTER  
DETAIL C**

**NOTES:**

- The Contractor shall verify controlling field dimensions before ordering or fabricating any material.
- During pole installation, the post shall be raked as necessary with the use of leveling nuts to provide a plumb pole axis.
- Wind Loadings (3-second gust): 100 mph
- Unit Stresses (Structural Steel):  
 a.  $f_y = 55,000$  psi (tapered steel tube and anchor bolts)  
 b.  $f_y = 50,000$  psi (unless otherwise noted)
- Unit Stresses (Reinforced Concrete):  
 a.  $f'_c = 3,625$  psi  
 b.  $f_y = 60,000$  psi



**SAFETY CHAIN BRACKET  
DETAIL F**

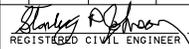
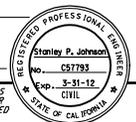
STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (CLOSED CIRCUIT TELEVISION,  
 25' TO 45' POLE)**

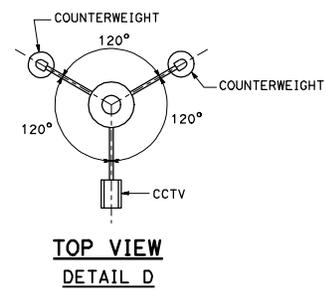
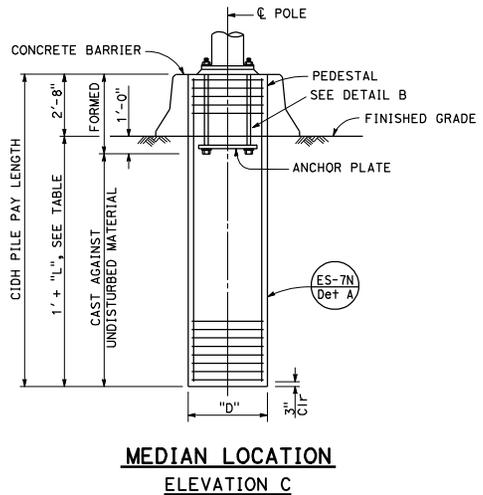
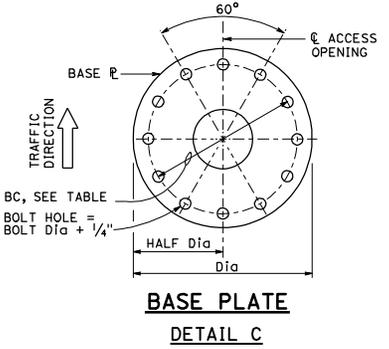
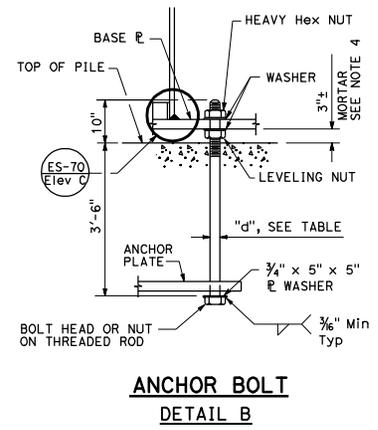
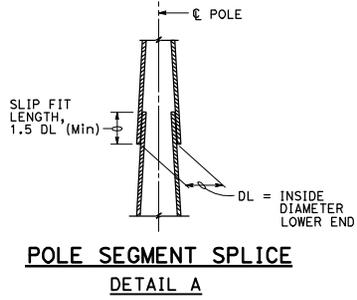
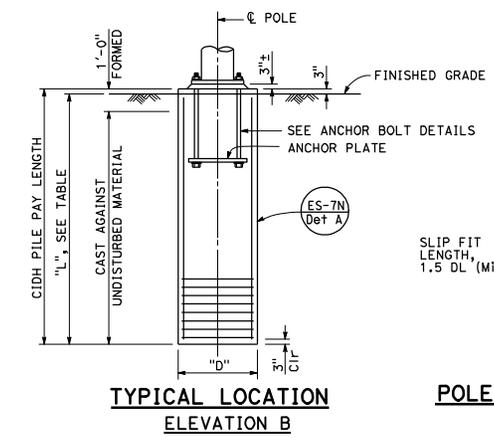
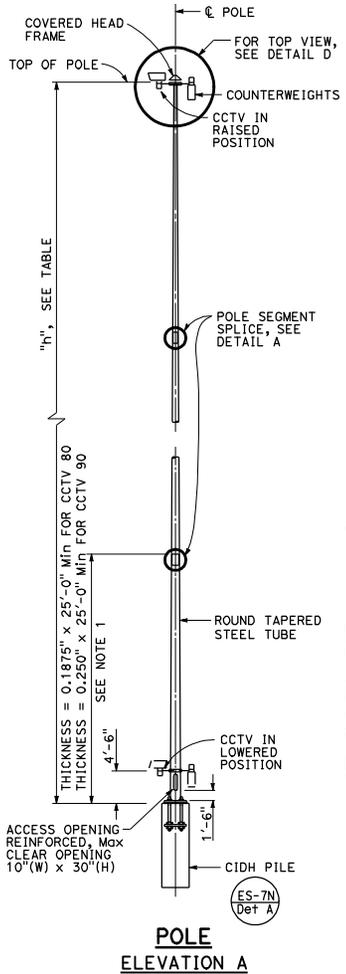
NO SCALE

**ES-16B**

POLE TYPE	POLE DATA				BASE PLATE DATA				CIDH PILE DATA			
	HEIGHT "h"	Min OD		Min THICKNESS	Dia	THICKNESS	ANCHOR BOLT SIZE		BC = BOLT CIRCLE	"D"	"L"	PILE Reinf
		BASE	TOP				TOTAL	"d"				
HM CCTV 50	50'	18"	9 3/4"	0.3125" *	28"	3"	12	1 1/2"	23"	3'-6"	12'	13 - #7
HM CCTV 60	60'	20"	10 1/4"		30"				25"	4'-0"	13'	
HM CCTV 70	70'	22"	10 5/8"		33"				27"	14'		
HM CCTV 80	80'	24"	11 1/8"	0.375" *	35"			29"				
HM CCTV 90	90'											

\* LOWER POLE SEGMENT THICKNESS, SEE POLE DETAILS

D18+	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
 REGISTERED CIVIL ENGINEER					
May 20, 2011 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.					



**NOTES:**

1. Pole details shall suit the lowering device and this foundation plan. Pole details shall be submitted to the Engineer for approval.
2. For closed circuit television details, see Electrical Plans.
3. Foundation design is based on a maximum wind velocity of 80 mph.
4. For central void and drain holes in mortar, see Standard Plan ES-6B detail N.
5. Wind Loadings (fastest mile): 80 mph
6. Unit Stress (Structural Steel):  
 fy = 55,000 psi (tapered steel tube)  
 fy = 50,000 psi (unless otherwise noted)
7. Access opening shall be located on the downstream side of traffic unless otherwise determined by the Engineer.

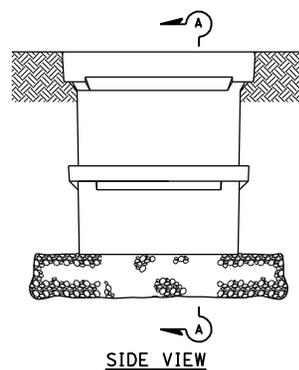
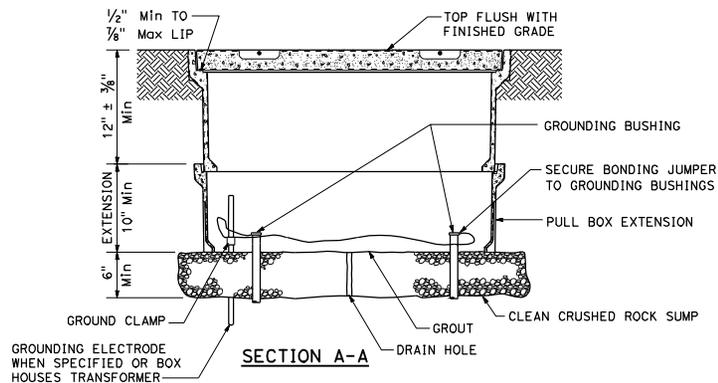
STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS  
 (CLOSED CIRCUIT TELEVISION,  
 50' TO 90' HIGH MAST POLE)**

NO SCALE

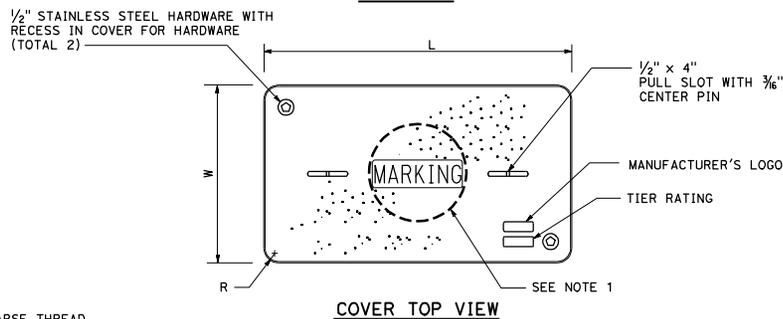
**ES-16C**

2010 STANDARD PLAN ES-16C

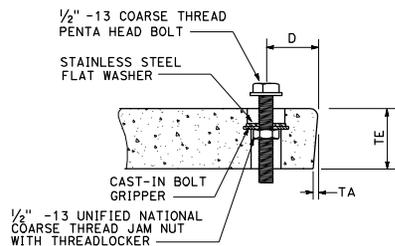




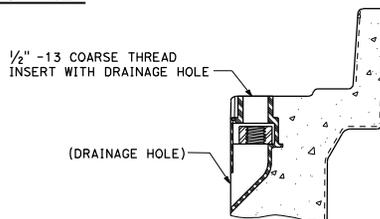
**INSTALLATION DETAILS**  
**DETAIL A**



**COVER TOP VIEW**



**TYPICAL COVER CAPTIVE BOLT**  
OR SIMILAR



**TYPICAL THREADED INSERT**  
OR SIMILAR

PULL BOX	PULL BOX			COVER						
	MINIMUM DEPTH BOX	MINIMUM DEPTH EXTENSION	MAXIMUM WEIGHT	L	W	R	TE	TA	D	MAXIMUM WEIGHT
No. 3/2	12"	N/A	40 lb	1' - 3 3/8"	10 1/8"	1 3/8"	2"	1/8"	1 3/4"	30 lb
No. 5	12"	10"	55 lb	1' - 11 1/4"	1' - 1 3/4"	1 3/8"	2"	1/8"	1 3/4"	60 lb
No. 6	12"	10"	70 lb	2' - 6 1/2"	1' - 5 1/2"	1 3/8"	2"	1/8"	2"	85 lb

**DIMENSION TABLE**

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*Jeffery G. McBoo*  
REGISTERED ELECTRICAL ENGINEER

January 20, 2012  
PLANS APPROVAL DATE

Jeffery G. McBoo  
No. E14512  
Exp. 6-30-12  
REGISTERED PROFESSIONAL ENGINEER  
ELECTRICAL  
STATE OF CALIFORNIA

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

**NOTES ON PULL BOXES:**

- Pull box covers must be marked as follows: "SERVICE" Service circuits between service point and service disconnect; "SPRINKLER-CONTROL" sprinkler control circuits, 50 V or less; "CALTRANS" on all pull boxes, except pull boxes marked "SPRINKLER-CONTROL"; and "TELEPHONE" telephone service;
  - No. 3/2 pull box.
    - "SIGNAL" - Traffic signal circuits with or without street or sign lighting circuits.
    - "ST LIGHTING" - Street or sign lighting circuits where voltage is under 600 V.
  - No. 5, 6, 9 or 9A pull box.
    - "TRAFFIC SIGNAL" - Traffic signal circuits with or without street or sign lighting circuits.
    - "STREET LIGHTING" - Street or sign lighting circuits where voltage is under 600 V.
    - "STREET LIGHTING-HIGH VOLTAGE" - Street or sign lighting circuits where voltage is above 600 V.
    - "IRRIGATION" - Circuits to irrigation controller 120 V or more.
    - "RAMP METER" - Ramp meter circuits.
    - "COUNT STATION" - Count or speed monitor circuits.
    - "COMMUNICATIONS" - Communication circuits.
    - "TOS COMMUNICATIONS" - TOS communication line.
    - "TOS POWER" - TOS power.
    - "TDC POWER" - Telephone demarcation cabinet power.
    - "CCTV" - Closed circuit television circuits.
    - "TMS" - Traffic monitoring station circuits.
    - "CMS" - Changeable message sign circuits.
    - "HAR" - Highway advisory radio circuits.
- The nominal dimensions of the opening in which the cover sets must be the same as the cover dimensions (L and W) plus 1/8" or greater.
- Covers and boxes must be interchangeable with California Standard. When interchanged with a standard, the top surfaces must be flush within 1/8". Top outside radius of covers and pull boxes must have a 1/8" radius.
- Pull box extension may be another pull box as long as the bottom edge of the pull box can fit into the cover opening.

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS**  
**(PULL BOX)**  
NO SCALE

RSP ES-8A DATED JANUARY 20, 2012 SUPPLEMENTS THE  
STANDARD PLANS BOOK DATED 2010.

**REVISED STANDARD PLAN RSP ES-8A**

2010 REVISED STANDARD PLAN RSP ES-8A

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

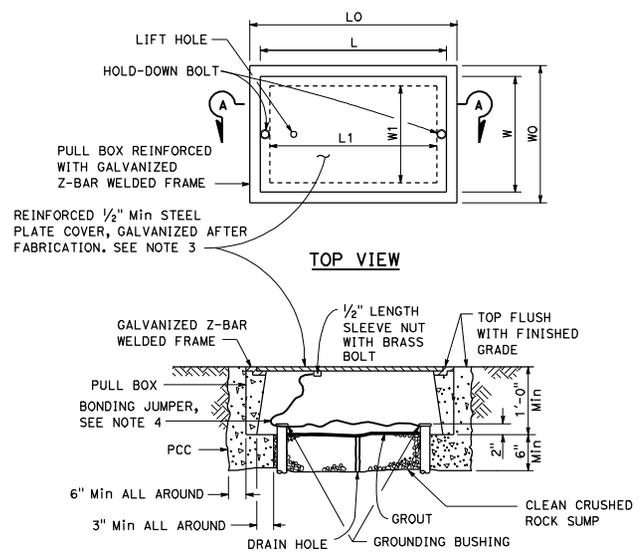
*Jeffrey G. McBoo*  
REGISTERED ELECTRICAL ENGINEER

January 20, 2012  
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER  
Jeffrey G. McBoo  
No. E14512  
Exp. 6-30-12  
ELECTRICAL  
STATE OF CALIFORNIA

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TO ACCOMPANY PLANS DATED \_\_\_\_\_



**SECTION A-A**  
**No. 3 1/2(T), No. 5(T) AND**  
**No. 6(T) TRAFFIC PULL BOX**

**NOTES ON PULL BOXES:**

- Traffic pull box shall be provided with steel cover and special concrete footing. Steel cover shall have embossed non-skid pattern.
- Steel reinforcing shall be as regularly used in the standard products of the respective manufacturer.
- Pull box covers must be marked as follows: "SERVICE" Service circuits between service point and service disconnect; "SPRINKLER-CONTROL" Sprinkler control circuits, 50 V or less; "CALTRANS" On all pull boxes, except pull boxes marked "SPRINKLER-CONTROL"; and "TELEPHONE" Telephone service.
  - No. 3 1/2(T) pull box.
    - "SIGNAL" - Traffic signal circuits with or without street or sign lighting circuits.
    - "ST LIGHTING" - Street or sign lighting circuits where voltage is under 600 V.
  - No. 5(T) or 6(T) pull box.
    - "TRAFFIC SIGNAL" - Traffic signal circuits with or without street or sign lighting circuits.
    - "STREET LIGHTING" - Street or sign lighting circuits where voltage is under 600 V.
    - "STREET LIGHTING-HIGH VOLTAGE" - Street or sign lighting circuits where voltage is above 600 V.
    - "IRRIGATION" - Circuits to irrigation controller 120 V or more.
    - "RAMP METER" - Ramp meter circuits.
    - "COUNT STATION" - Count or speed monitor circuits.
    - "COMMUNICATION" - Communication circuits.
    - "TOS COMMUNICATIONS" - TOS communications line.
    - "TOS POWER" - TOS power.
    - "TDC POWER" - Telephone demarcation cabinet power.
    - "CCTV" - Closed circuit television circuits.
    - "TMS" - Traffic monitoring station circuits.
    - "CMS" - Changeable message sign circuits.
    - "HAR" - Highway advisory radio circuits.
- Bonding jumper for metal covers shall be 3' long, minimum.
- The nominal dimensions of the opening in which the cover sets must be the same as the cover dimensions except the length and width dimensions shall be 1/8" greater.
- Covers and boxes must be interchangeable with California standard male and female gages. When interchanged with a standard male or female gage, the top surfaces must be flush within 1/8".

PULL BOX	BOX						COVER				
	MINIMUM * THICKNESS	MINIMUM DEPTH BOX AND EXTENSION	WO	LO	L1	W1	L **	W **	R	EDGE THICKNESS	EDGE TAPER
No. 3 1/2(T)	1 1/2"	1'-0"	1'-5" ± 1"	1'-8 3/4" ±	1'-2 1/2" ±	10 3/8" ± 1"	1'-8" ±	1'-1 3/4" ±	0"	1/2"	NONE
No. 5(T)	1 3/4"	1'-0"	1'-11 1/2" ± 1"	2'-5 1/2" ±	1'-7" ±	1'-1" ± 1"	2'-3" ±	1'-4" ±	0"	1/2"	NONE
No. 6(T)	2"	1'-0"	2'-6" ± 1"	2'-11 1/2" ±	1'-11 1/2" ±	1'-5" ± 1"	2'-9" ±	1'-8" ±	0"	1/2"	NONE

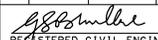
\* EXCLUDING CONDUIT WEB      \*\* TOP DIMENSION

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**ELECTRICAL SYSTEMS**  
**(TRAFFIC RATED PULL BOX)**  
NO SCALE

RSP ES-8B DATED JANUARY 20, 2012 SUPPLEMENTS THE  
STANDARD PLANS BOOK DATED 2010.

**REVISED STANDARD PLAN RSP ES-8B**

2010 REVISED STANDARD PLAN RSP ES-8B

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
 REGISTERED CIVIL ENGINEER					
April 19, 2013 PLANS APPROVAL DATE					
					
<small>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.</small>					

TO ACCOMPANY PLANS DATED \_\_\_\_\_

TABLE 1

SPEED (S)	MINIMUM TAPER LENGTH * FOR WIDTH OF OFFSET 12 FEET (W)				MAXIMUM CHANNELIZING DEVICE SPACING		
	TANGENT 2L	MERGING L	SHIFTING L/2	SHOULDER L/3	X	Y	Z **
					TAPER	TANGENT	CONFLICT
mph	ft	ft	ft	ft	ft	ft	ft
20	160	80	40	27	20	40	10
25	250	125	63	42	25	50	12
30	360	180	90	60	30	60	15
35	490	245	123	82	35	70	17
40	640	320	160	107	40	80	20
45	1080	540	270	180	45	90	22
50	1200	600	300	200	50	100	25
55	1320	660	330	220	55	110	27
60	1440	720	360	240	60	120	30
65	1560	780	390	260	65	130	32
70	1680	840	420	280	70	140	35

\* - For other offsets, use the following merging taper length formula for L:  
 For speed of 40 mph or less,  $L = WS^2/60$   
 For speed of 45 mph or more,  $L = WS$

Where: L = Taper length in feet

W = Width of offset in feet

S = Posted speed limit, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed in mph

\*\* - Use for taper and tangent sections where there are no pavement markings or where there is a conflict between existing pavement markings and channelizers (CA).

TABLE 2

SPEED *	Min D **	DOWNGRADE Min D ***		
		-3%	-6%	-9%
		ft	ft	ft
mph	ft	ft	ft	ft
20	115	116	120	126
25	155	158	165	173
30	200	205	215	227
35	250	257	271	287
40	305	315	333	354
45	360	378	400	427
50	425	446	474	507
55	495	520	553	593
60	570	598	638	686
65	645	682	728	785
70	730	771	825	891

\* - Speed is posted speed limit, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed in mph

\*\* - Longitudinal buffer space or flagger station spacing

\*\*\* - Use on sustained downgrade steeper than -3 percent and longer than 1 mile.

TABLE 3

ROAD TYPE	DISTANCE BETWEEN SIGNS *		
	A	B	C
	ft	ft	ft
URBAN - 25 mph OR LESS	100	100	100
URBAN - MORE THAN 25 mph TO 40 mph	250	250	250
URBAN - MORE THAN 40 mph	350	350	350
RURAL	500	500	500
EXPRESSWAY / FREEWAY	1000	1500	2640

\* - The distances are approximate, are intended for guidance purposes only, and should be applied with engineering judgment. These distances should be adjusted by the Engineer for field conditions, if necessary, by increasing or decreasing the recommended distances.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**TRAFFIC CONTROL SYSTEM  
 FOR LANE CLOSURE ON  
 FREEWAYS AND EXPRESSWAYS**

NO SCALE

RSP T9 DATED APRIL 19, 2013 SUPPLEMENTS THE STANDARD PLANS BOOK DATED 2010.

**REVISED STANDARD PLAN RSP T9**

2010 REVISED STANDARD PLAN RSP T9

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

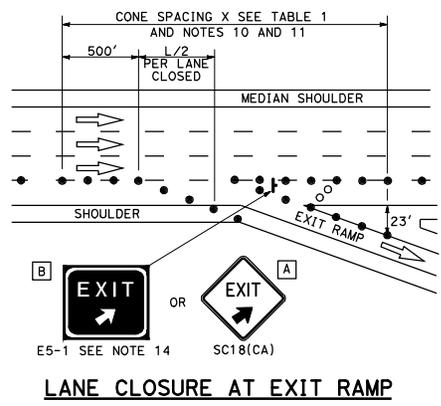
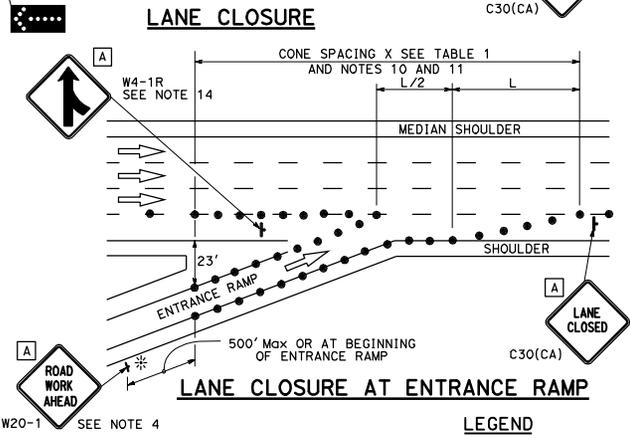
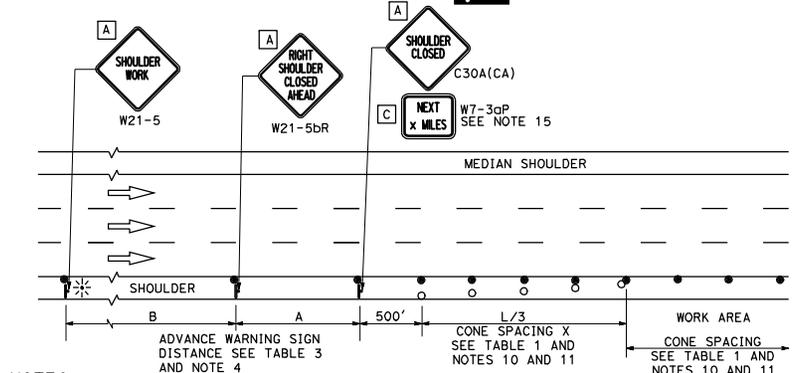
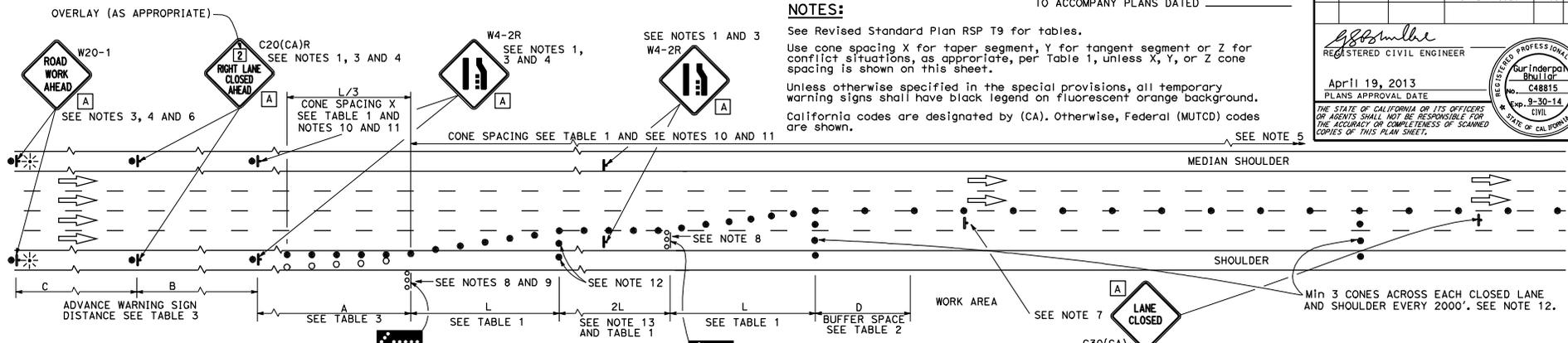
April 19, 2013  
 PLANS APPROVAL DATE

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TO ACCOMPANY PLANS DATED \_\_\_\_\_

**NOTES:**

See Revised Standard Plan RSP T9 for tables.  
 Use cone spacing X for taper segment, Y for tangent segment or Z for conflict situations, as appropriate, per Table 1, unless X, Y, or Z cone spacing is shown on this sheet.  
 Unless otherwise specified in the special provisions, all temporary warning signs shall have black legend on fluorescent orange background.  
 California codes are designated by (CA). Otherwise, Federal (MUTCD) codes are shown.



- NOTES:**
- Median lane closures shall conform to the details as shown except that C20(CA)L and W4-2L signs shall be used.
  - At least one person shall be assigned to provide full time maintenance of traffic control devices for lane closures.
  - Duplicate sign installations are not required:
    - On opposite shoulder if at least one-half of the available lanes remain open to traffic.
    - In the median if the width of the median shoulder is less than 8' and the outside lanes are to be closed.
  - Each advance warning sign on each side of the roadway shall be equipped with at least two flags for daytime closure. Each flag shall be at least 16" x 16" in size and shall be orange or fluorescent red-orange in color. Flashing beacons shall be placed at the locations indicated for lane closure during hours of darkness.
  - A G20-2 "END ROAD WORK" sign, with minimum size of 48" x 24" as appropriate, shall be placed at the end of the lane closure unless the end of work area is obvious or ends within a larger project's limits.

- SHOULDER CLOSURE**
- If the W20-1 sign would follow within 2000' of a stationary W20-1 or G20-1 "ROAD WORK NEXT \_\_\_\_\_ MILES", use a C20(CA) sign for the first advance warning sign.
  - Place a C30(CA) sign every 2000' throughout length of lane closure.
  - One flashing arrow sign for each lane closed. The flashing arrow signs shall be Type I.
  - A minimum 1500' of sight distance shall be provided where possible for vehicles approaching the first flashing arrow sign. Lane closures shall not begin at top of crest vertical curve or on a horizontal curve.
  - All cones used for lane closures during the hours of darkness shall be fitted with retroreflective bands (or sleeves) as specified in the specifications.
  - Portable delineators, placed at one-half the spacing indicated for traffic cones may be used instead of cones for daytime closures only.

- Unless otherwise specified in the special provisions, a minimum of 3 cones shall be placed transversely across each closed lane and shoulder at each location where a taper across a traffic lane ends and every 2000' as shown on the "Lane Closure" detail. Two Type II barricades may be used instead of the 3 cones. The transverse alignment of the cones or barricades on the closed shoulder may be shifted from the transverse alignment to provide access to the work.
- Unless otherwise specified in the special provisions, the 2L tangent shown along lane lines shall be used between the L tapers required for each closed traffic lane.
- Unless otherwise specified in the special provisions, the E5-1 or SC18(CA) and W4-1 signs shall be used as shown.
- A W7-3aP "NEXT \_\_\_\_\_ MILES" plaque must be used if the shoulder closure extends beyond the distance that can be perceived by road users.

**LEGEND**

- TRAFFIC CONE
- TRAFFIC CONE (OPTIONAL TAPER)
- ⊥ TEMPORARY TRAFFIC CONTROL SIGN
- FLASHING ARROW SIGN (FAS)
- FAS SUPPORT OR TRAILER
- PORTABLE FLASHING BEACON

**SIGN PANEL SIZE (Min)**

- A 48" x 48"
- B 72" x 60"
- C 36" x 30"

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**TRAFFIC CONTROL SYSTEM  
 FOR LANE CLOSURE ON  
 FREEWAYS AND EXPRESSWAYS**  
 NO SCALE

RSP T10 DATED APRIL 19, 2013 SUPERSEDES STANDARD PLAN T10  
 DATED MAY 20, 2011 - PAGE 237 OF THE STANDARD PLANS BOOK DATED 2010.  
**REVISED STANDARD PLAN RSP T10**

# TYPICAL RAMP CLOSURES

## SIGN PANEL SIZE (Min)

- A 48" x 48"
- B 48" x 30"
- C 36" x 36"
- D 48" x 36"

## LEGEND

- TRAFFIC CONE
- ⊥ TEMPORARY TRAFFIC CONTROL SIGN
- ⚡ BARRICADES
- ⚡ PORTABLE FLASHING BEACON

## NOTES:

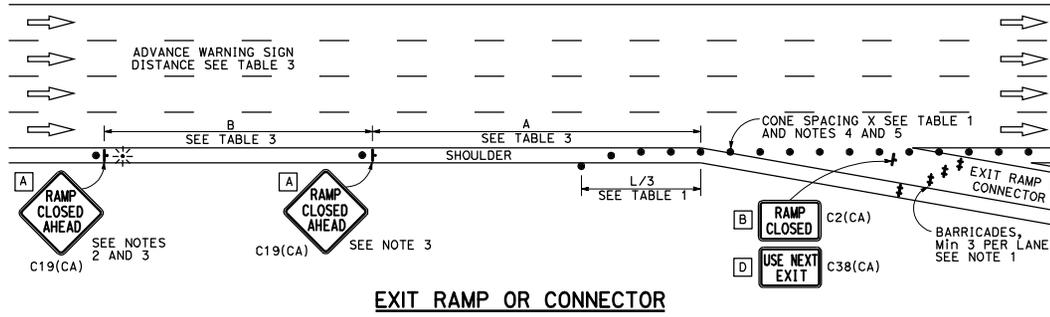
1. Barricades shall be Type I, II, or III for closures lasting one week or less and Type III for closures lasting longer than one week.
2. In addition to placing the C19(CA) "RAMP CLOSED AHEAD" and C30(CA) "RAMP CLOSED" signs, black on orange overlay plates with the word "CLOSED" may be mounted, as directed by the Engineer, on all guide signs that refer to the closed ramp. The letter size on the overlay shall be the same as the guide sign.
3. Each advance C19(CA) "RAMP CLOSED AHEAD" sign shall be equipped with at least two flags for daytime closure. Each flag shall be at least 16" x 16" in size and shall be orange or fluorescent red-orange in color. A flashing beacon shall be placed on top of the first C19(CA) sign during hours of darkness.
4. All cones used for ramp closures during the hours of darkness shall be fitted with retroreflective bands (or sleeves) as specified in the specifications.
5. Portable delineators, placed at one-half the spacing indicated for traffic cones, may be used instead of cones for daytime ramp closures only.
6. At least one person shall be assigned to provide full time maintenance of traffic control devices, unless otherwise directed by the Engineer.
7. The existing "EXIT" signs shall be covered during ramp closures.
8. A minimum of 3 cones shall be placed transversely across each closed lane and shoulder.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

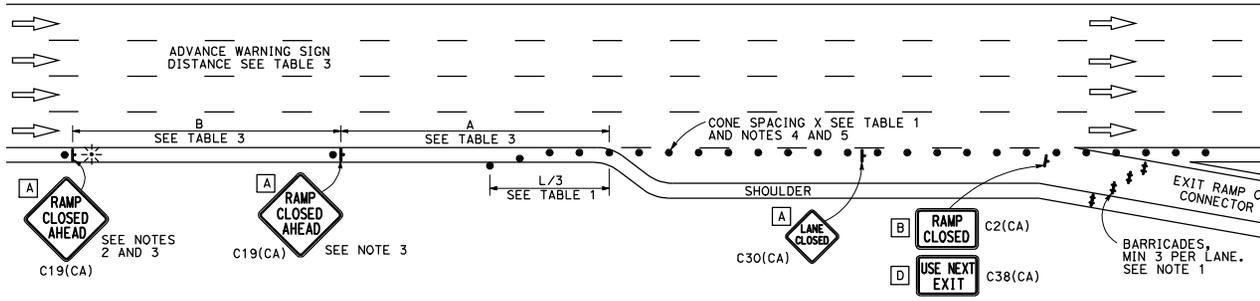
*Richard Phillips*  
 REGISTERED CIVIL ENGINEER  
 No. C48815  
 Exp. 9-30-14  
 STATE OF CALIFORNIA

APRIL 19, 2013  
 PLANS APPROVAL DATE  
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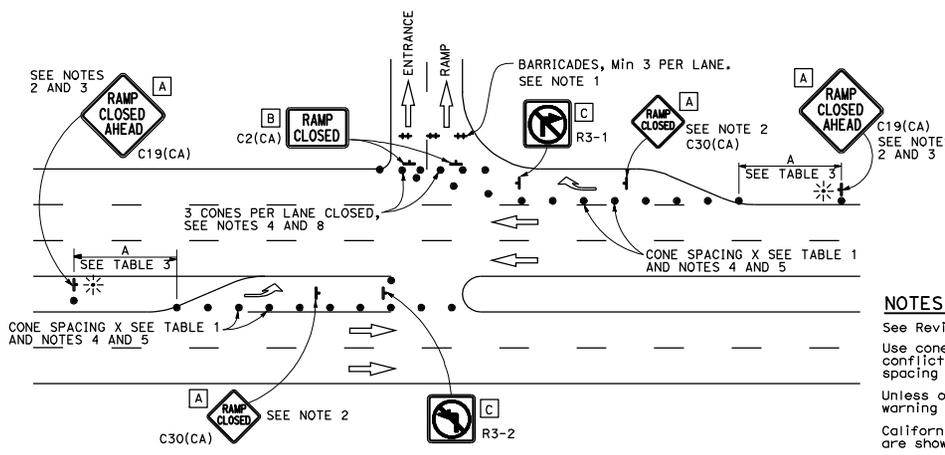
TO ACCOMPANY PLANS DATED \_\_\_\_\_



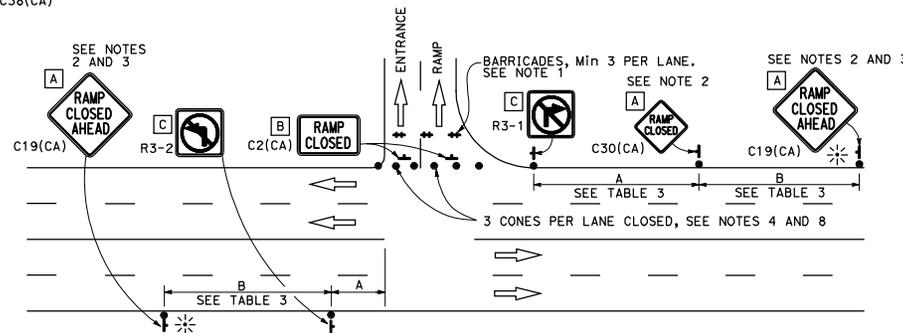
EXIT RAMP OR CONNECTOR



EXIT RAMP OR CONNECTOR WITH ADDITIONAL LANE



ENTRANCE RAMP WITH TURNING POCKETS



ENTRANCE RAMP WITHOUT TURNING POCKETS

## NOTES:

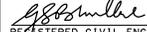
- See Revised Standard Plan RSP T9 for tables.
- Use cone spacing X for taper segment, Y for tangent segment or Z for conflict situations, as appropriate, per Table 1, unless X, Y, or Z cone spacing is shown on this sheet.
- Unless otherwise specified in the special provisions, all temporary warning signs shall have black legend on fluorescent orange background.
- California codes are designated by (CA). Otherwise, Federal (MUTCD) codes are shown.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**TRAFFIC CONTROL SYSTEM  
 FOR RAMP CLOSURE**  
 NO SCALE

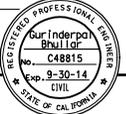
RSP T14 DATED APRIL 19, 2013 SUPERSEDES STANDARD PLAN T14  
 DATED MAY 20, 2011 - PAGE 242 OF THE STANDARD PLANS BOOK DATED 2010.  
**REVISED STANDARD PLAN RSP T14**

2010 REVISED STANDARD PLAN RSP T14

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

  
 REGISTERED CIVIL ENGINEER

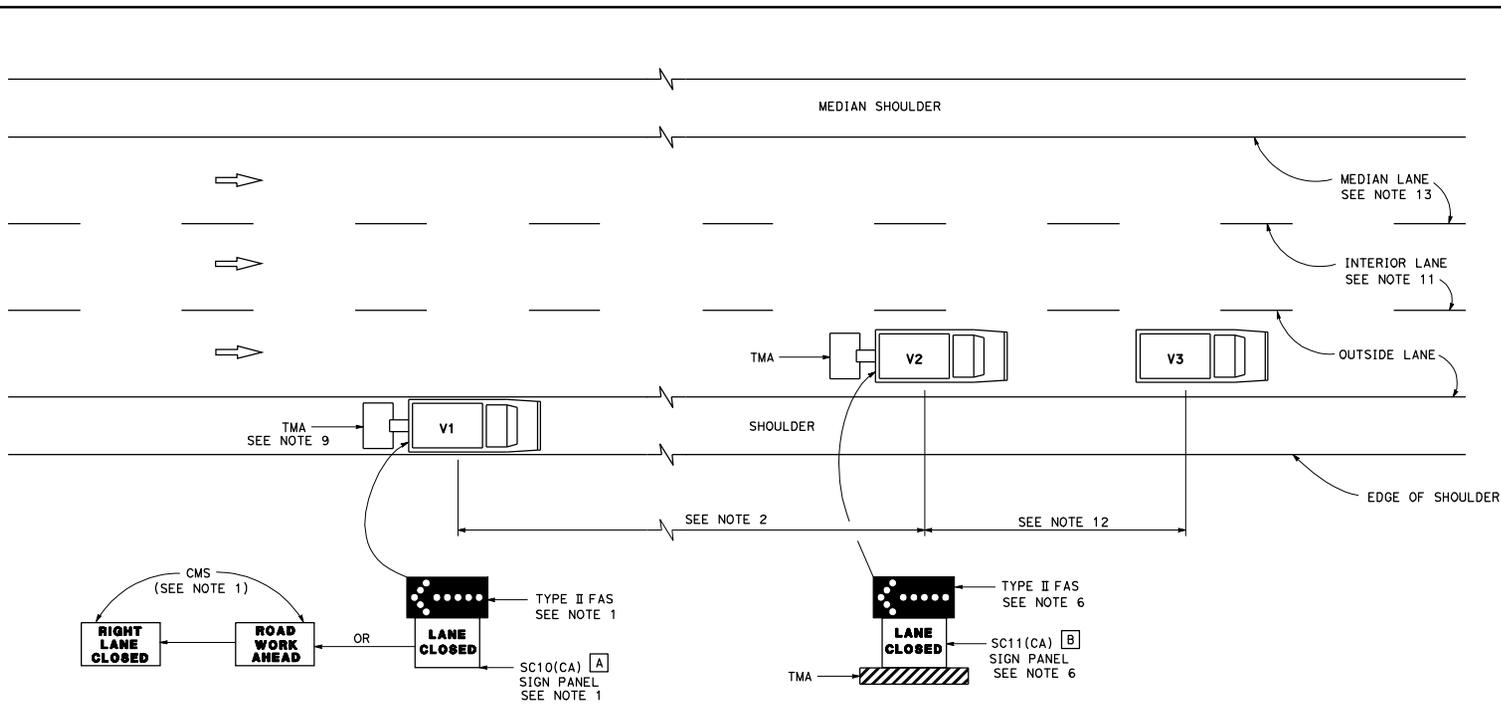
APRIL 19, 2013  
 PLANS APPROVAL DATE

  
 No. C48815  
 Exp. 9-30-14  
 CIVIL

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TO ACCOMPANY PLANS DATED \_\_\_\_\_

2010 REVISED STANDARD PLAN RSP T15



**SIGN PANEL SIZE (Min)**

- A 66" x 36"
- B 54" x 42"

**LEGEND**

- V1 SIGN VEHICLE
- V2 SHADOW VEHICLE
- V3 WORK/APPLICATION VEHICLE
-  FLASHING ARROW SIGN (FAS)
- CMS CHANGEABLE MESSAGE SIGN
- TMA TRUCK-MOUNTED ATTENUATOR

**MOVING LANE CLOSURE ON MEDIAN LANE OR OUTSIDE LANE OF MULTILANE HIGHWAYS**

**NOTES:**

1. Either a changeable message sign or a SC10(CA) sign panel and a Type II flashing arrow sign shall be mounted on the rear of sign vehicle V1. The changeable message sign shall be sequenced to show the "ROAD WORK AHEAD" message first, followed by the "RIGHT LANE CLOSED" message. For median lane closure, the flashing arrow symbol shall be reversed with the arrowhead on the right and the changeable message sign shall show "LEFT LANE CLOSED".
2. If traffic queues develop, sign vehicle V1 should be positioned upstream from the end of queue. Sign vehicle V1 shall be positioned where highly visible when shoulders are not available.
3. A minimum sight distance of 1500' should be provided in advance of sign vehicle V1.
4. Sign vehicle V1 should remain at the beginning of horizontal or vertical curves until the other vehicles (V2 and V3) are far enough beyond the curve to resume the minimum sight distance of 1500'.
5. Vehicle-mounted sign panels shall have Type III or above retroreflective sheeting, black on white, or black on fluorescent orange, with 6" minimum series D letters per Caltrans sign specifications.
6. Shadow vehicle V2 shall be equipped with a truck-mounted attenuator. The sign panel shown and a Type II flashing arrow sign shall be mounted on the rear of shadow vehicle V2. For median lane closure the flashing arrow sign symbol shall be displayed with the arrowhead on the right.
7. All vehicles used for lane closures shall be equipped with two-way radios, and the vehicle operators shall maintain communication during the work or application operation.
8. All vehicles shall be equipped with flashing or rotating amber lights.
9. If sign vehicle V1 encroaches into the traffic lane due to insufficient shoulder width, sign vehicle V1 shall be equipped with a truck-mounted attenuator. Sign vehicle V1 shall stay as close to the edge of shoulder as practicable.
10. Where workers would be on foot in the work area, a stationary type lane closure (Revised Standard Plan T10, T11, etc., as applicable) shall be used instead of this plan.
11. For moving lane closure on interior lane of multilane highways, use Revised Standard Plan T16.
12. The spacing between work vehicle(s) and the shadow vehicles, and between each shadow vehicle should be minimized to deter road users from driving in between.
13. When the work/application vehicle V3 occupies the median lane, sign vehicle V1 should drive in the median shoulder and indicate left lane closed ahead.

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**TRAFFIC CONTROL SYSTEM FOR MOVING LANE CLOSURE ON MULTILANE HIGHWAYS**

NO SCALE

RSP T15 DATED APRIL 19, 2013 SUPERSEDES STANDARD PLAN T15 DATED MAY 20, 2011 - PAGE 243 OF THE STANDARD PLANS BOOK DATED 2010.

**REVISED STANDARD PLAN RSP T15**

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*[Signature]*  
 REGISTERED CIVIL ENGINEER  
 April 19, 2013  
 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.

REGISTERED PROFESSIONAL ENGINEER  
 Our Interpoc  
 Brian  
 No. C48815  
 Exp. 9-30-14  
 CIVIL  
 STATE OF CALIFORNIA

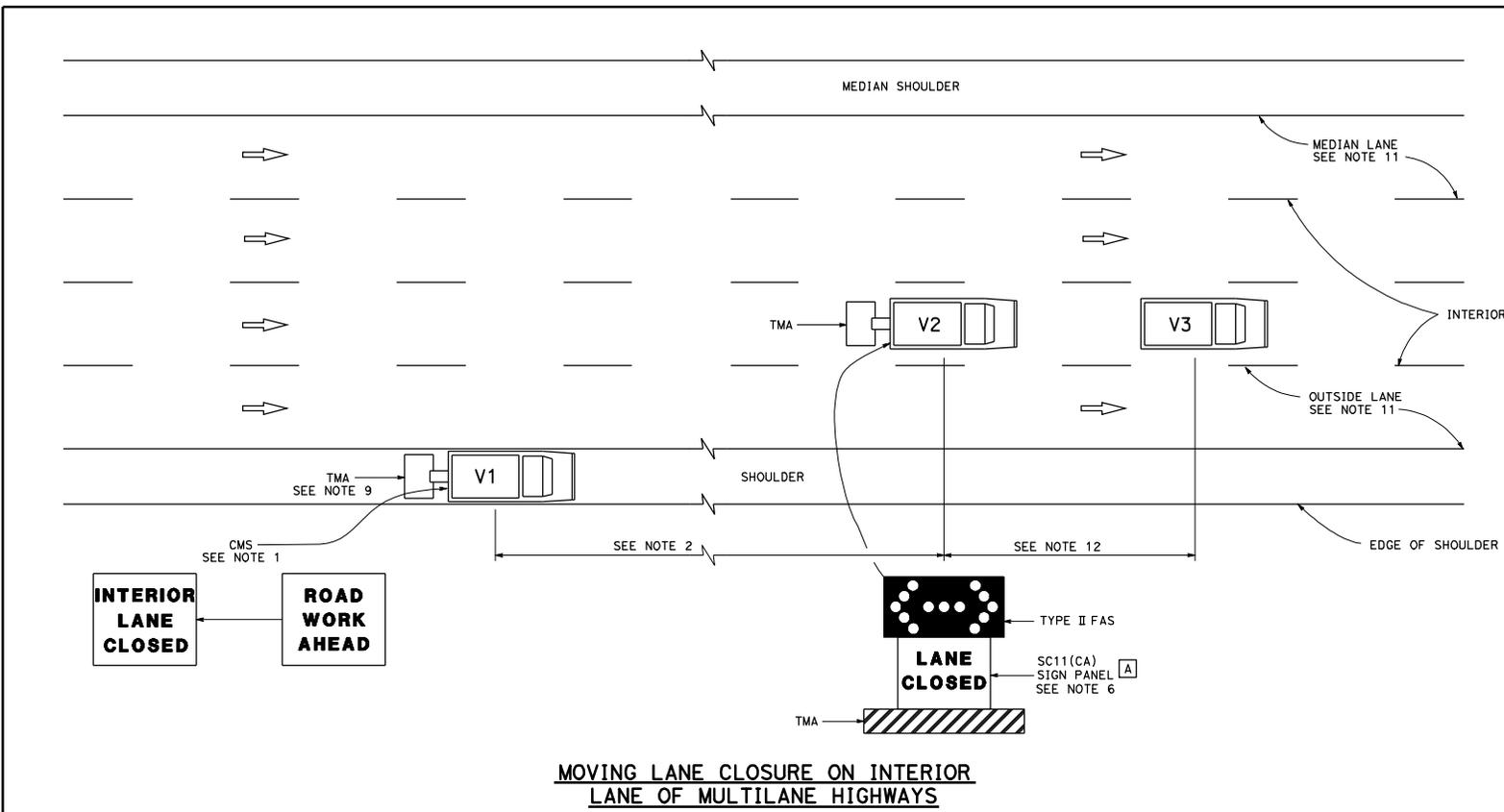
TO ACCOMPANY PLANS DATED \_\_\_\_\_

**SIGN PANEL SIZE (Min)**

A 54" x 42"

**LEGEND**

- V1 SIGN VEHICLE
- V2 SHADOW VEHICLE
- V3 WORK/APPLICATION VEHICLE
- [Flashing Arrow Symbol] FLASHING ARROW SIGN (FAS) IN FLASHING DOUBLE ARROW MODE
- CMS CHANGEABLE MESSAGE SIGN
- TMA TRUCK-MOUNTED ATTENUATOR



**MOVING LANE CLOSURE ON INTERIOR LANE OF MULTILANE HIGHWAYS**

**NOTES:**

1. A changeable message sign shall be mounted on the rear of sign vehicle V1. The changeable message sign shall be sequenced to show the "ROAD WORK AHEAD" message first, followed by the "INTERIOR LANE CLOSED" message. The message "CENTER LANE CLOSED" may be used in place of the "INTERIOR LANE CLOSED" message.
2. If traffic queues develop, sign vehicle V1 should be positioned upstream from the end of queue. Sign vehicle V1 shall be positioned where highly visible when shoulders are not available.
3. A minimum sight distance of 1500' should be provided in advance of sign vehicle V1.
4. Sign vehicle V1 should remain at the beginning of horizontal or vertical curves until the other vehicles (V2 and V3) are far enough beyond the curve to resume the minimum sight distance of 1500'.
5. Vehicle-mounted sign panels shall have Type III or above retroreflective sheeting, black on white, or black on fluorescent orange, with 6" minimum series D letters per Caltrans sign specifications.
6. Shadow vehicle V2 shall be equipped with a truck-mounted attenuator. The sign panel shown and a Type II flashing arrow sign shall be mounted on the rear of shadow vehicle V2.
7. All vehicles used for lane closures shall be equipped with two-way radios, and the vehicle operators shall maintain communication during the work or application operation.
8. All vehicles shall be equipped with flashing or rotating amber lights.
9. If sign vehicle V1 encroaches into the traffic lane due to insufficient shoulder width, sign vehicle V1 shall be equipped with a truck-mounted attenuator. Sign vehicle V1 shall stay as close to the edge of shoulder as practicable.
10. Where workers would be on foot in the work area, a stationary type lane closure (Revised Standard Plan T10, T11 etc., as applicable) shall be used instead of this plan.
11. For moving lane closure on median lane or outside lane of multilane highways, use Revised Standard Plan T15.
12. The spacing between work vehicle(s) and the shadow vehicles, and between each shadow vehicle should be minimized to deter road users from driving in between.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**TRAFFIC CONTROL SYSTEM  
 FOR MOVING LANE CLOSURE  
 ON MULTILANE HIGHWAYS**  
 NO SCALE

RSP T16 DATED APRIL 19, 2013 SUPERSEDES STANDARD PLAN T16 DATED MAY 20, 2011 - PAGE 244 OF THE STANDARD PLANS BOOK DATED 2010.

**REVISED STANDARD PLAN RSP T16**

2010 REVISED STANDARD PLAN RSP T16

**INSTRUCTIONS TO FABRICATOR**

**PROJECT PLANS SHOW:**

1. Sign structure location.
2. Length of structure frame.
3. Panel size and locations on structure.
4. Walkway length for two post signs.
5. Post type and height to bottom of frame.
6. Base plate elevation.
7. Footing elevation or location of pile foundation.
8. Photoelectric unit location if required.

REFER TO THE FOLLOWING STANDARD PLANS FOR DETAILS NOT SHOWN ON PROJECT PLANS:

Sheet No.	SHEET NAME
S1	Overhead Signs-Truss, Instructions and Examples
S2	Overhead Signs-Truss, Single Post Type, Post Types II to IX
S3	Overhead Signs-Truss, Single Post Type, Base Plate and Anchorage Details
S4	Overhead Signs-Truss, Single Post Type, Structural Frame Members Details No. 1
S5	Overhead Signs-Truss, Single Post Type, Structural Frame Members Details No. 2
S6	Overhead Signs-Truss, Gusset Plate Details
S7	Overhead Signs-Truss, Single Post Type, Square Pedestal Pile Foundation
S8	Overhead Signs-Truss, Single Post Type, Round Pedestal Pile Foundation
S9	Overhead Signs-Truss, Two Post Type, Post Types I-S through VIII-S
S10	Overhead Signs-Truss, Two Post Type, Base Plate and Anchorage Details
S11	Overhead Signs-Truss, Two Post Type, Structural Frame Members
S12	Overhead Signs-Truss, Structural Frame Details
S13	Overhead Signs-Truss, Frame Juncture Details
S14	Overhead Signs-Truss, Two Post Type, Square Pedestal Pile Foundation
S15	Overhead Signs-Truss, Two Post Type, Round Pedestal Pile Foundation
S16	Overhead Signs, Walkway Details No. 1
S17	Overhead Signs, Walkway Details No. 2
S17A	Overhead Signs, Walkway Details No. 3
S18	Overhead Signs, Walkway Safety Railing Details
S19	Overhead Signs-Truss, Sign Mounting Details, Laminated Panel-Type A
S20	Overhead Signs, Steel Frames, Removable Sign Panel Frames
S21	Overhead Signs, Removable Sign Panel Frames, Mounting Details
S22	Overhead Signs-Truss, Removable Sign Panel Frames, 9'-2" and 10'-0" Sign Panels

**WALKWAY BRACKETS:**

Space all walkway brackets maintaining uniform spacing where possible. Maximum spacing shall not exceed 5'-6".

**LIGHTING FIXTURE SUPPORTS:**

Where distance from walkway bracket to end of sign panel exceeds 1'-4", extend lighting fixture supports to next walkway bracket. See Example No. 2.

**WALKWAY AND SAFETY RAILING:**

Walkway to be continuous for entire length of frame for single post signs. For two post signs, see Project Plans. Safety railing to protect entire walkway, but continuous for no more than 11'-0" in one unit.

**GENERAL NOTES:**

**LOADING:**

**WIND LOADING:**

Normal to face of sign: 40.3 psf on 100% Truss surface area (i.e. 100% panel coverage).

Transverse to face of sign: 20% of normal force.

**WALKWAY LOADING:**

Dead load +500 LB concentrated live load.

**UNIT STRESSES:**

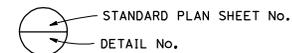
STRUCTURAL STEEL:  $f_y = 36,000$  psi  
 REINFORCED CONCRETE:  $f_y = 60,000$  psi  
 $f'_c = 3600$  psi  
 FOOTING SOIL PRESSURE: 2.5 ksf (spread footing)

**MINIMUM CLEARANCE**

Vertical roadway clearance 18'-0" (bottom of walkway system)

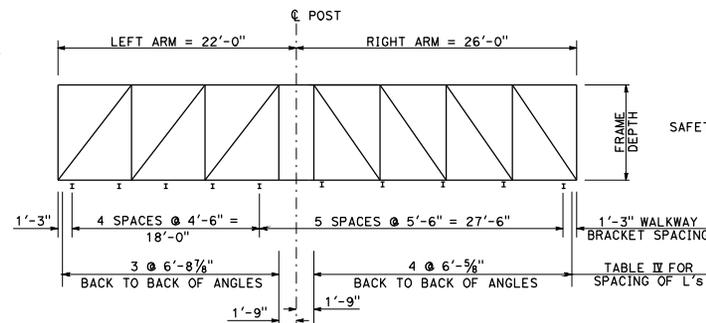
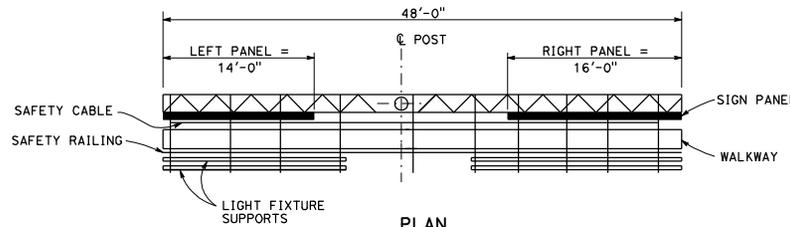
**WELDING:**

All welding continuous unless otherwise noted on the plans.



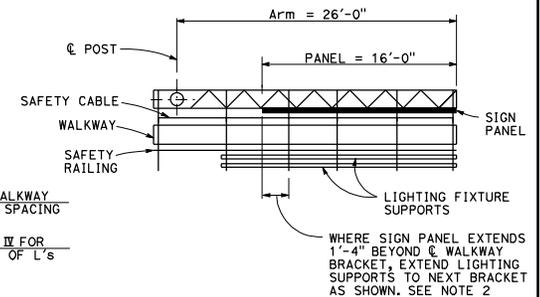
**NOTES:**

1. Signs are shown and dimensioned looking in the direction of traffic. Double faced signs are shown and dimensioned looking ahead along stationing.
2. Mandatory dimension limit.



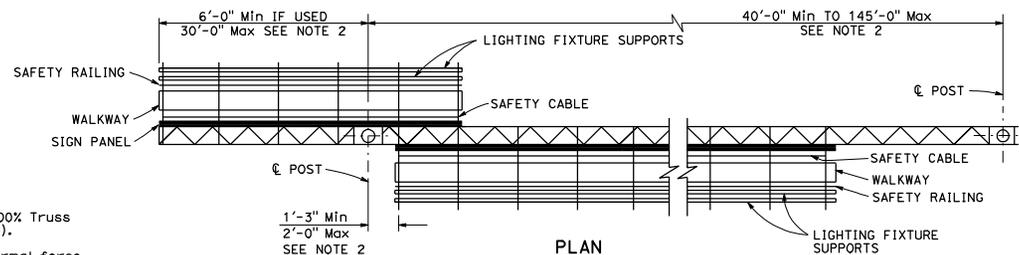
**UNBALANCED SINGLE POST TYPE**

Example No. 1



**CANTILEVER SINGLE POST TYPE**

Example No. 2



**TWO POST TYPE WITH CANTILEVER (PART DOUBLE-FACED)**

Example No. 3

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

**OVERHEAD SIGNS-TRUSS INSTRUCTIONS AND EXAMPLES**

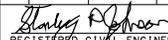
NO SCALE

**S1**

334

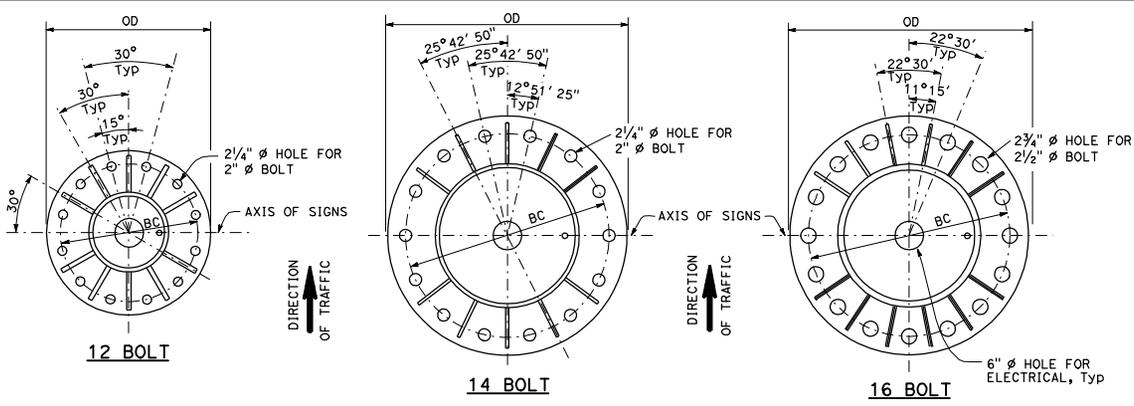
2010 STANDARD PLAN S1

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

  
 REGISTERED CIVIL ENGINEER  
 No. CS783  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 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.





**BASE PLATE DETAILS  
SINGLE POST TYPE**

BC = Bolt Circle Diameter

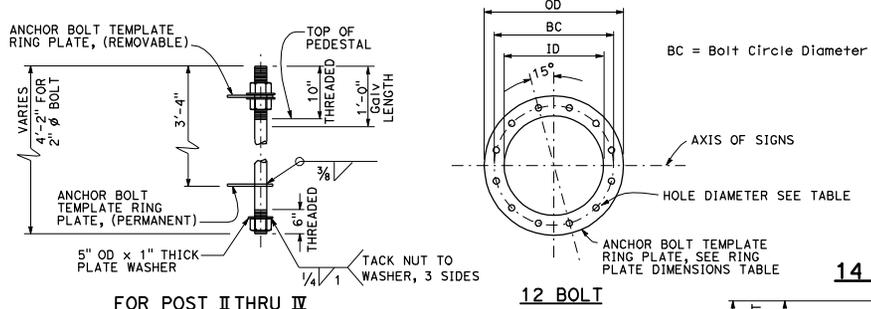
**SINGLE POST TRUSS**

POST TYPE No.	PIPE		BASE R OD AND THICKNESS	ANCHOR BOLTS	
	NPS	THICKNESS		BOLT CIRCLE Dia	BOLT TOTALS AND Dia OF BOLT
II	14	1/2"	2'-10" x 2"	2'-0"	12-2"
III	16		2'-10" x 2"	2'-0"	12-2"
IV	18		2'-10" x 2"	2'-0"	12-2"
V	20		3'-5" x 2 1/2"	2'-10"	14-2"
VI	24		3'-6" x 2 1/2"		16-2 1/2"
VII	24	3/4"	3'-6" x 2 1/2"		
VIII	24	3/4"	3'-6" x 3 1/2"		
IX	24	3/4"	3'-6" x 3 1/2"		

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER  
 No. C57793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE  
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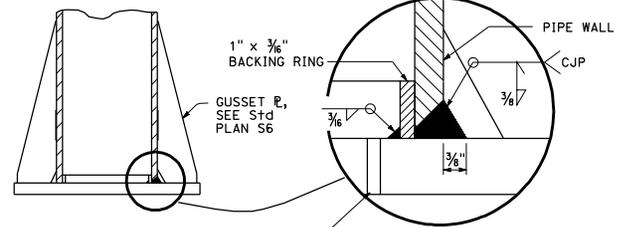


**FOR POST II THRU IV  
12 BOLT PATTERN**

**ANCHOR BOLT TEMPLATE**

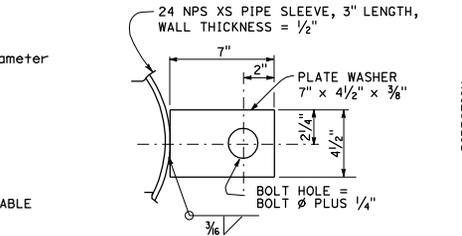
**ANCHOR BOLT TEMPLATE ASSEMBLY**

**NOTE:** One bolt shown only. Other bolts same configuration around ring plate.

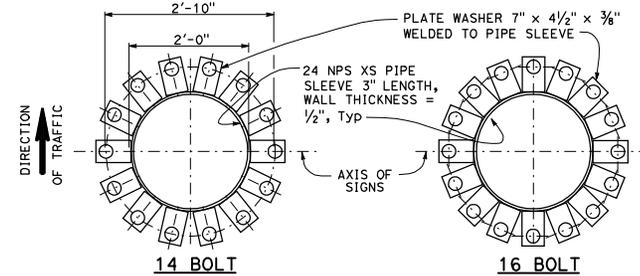


**POST TO BASE PLATE  
CONNECTION DETAIL**

1/4" Ø GALVANIZING DRAIN HOLE, TYP, 1/4" CLEAR OF BACKING RING

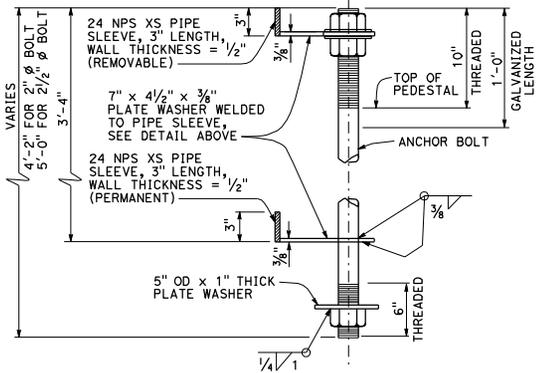


**PLATE WASHER DETAIL FOR  
14 AND 16 BOLT TEMPLATE PATTERN**



**ANCHOR BOLT TEMPLATE**

Template to match base plate anchor bolt pattern. (Option: Template similar to ring plate type can be used in lieu of plate washer type).



**ANCHOR BOLT TEMPLATE ASSEMBLY  
FOR 14 AND 16 BOLT PATTERN**

**NOTE:** One bolt shown only. Other bolts same configuration around pipe sleeve.

**RING PLATE DIMENSIONS**

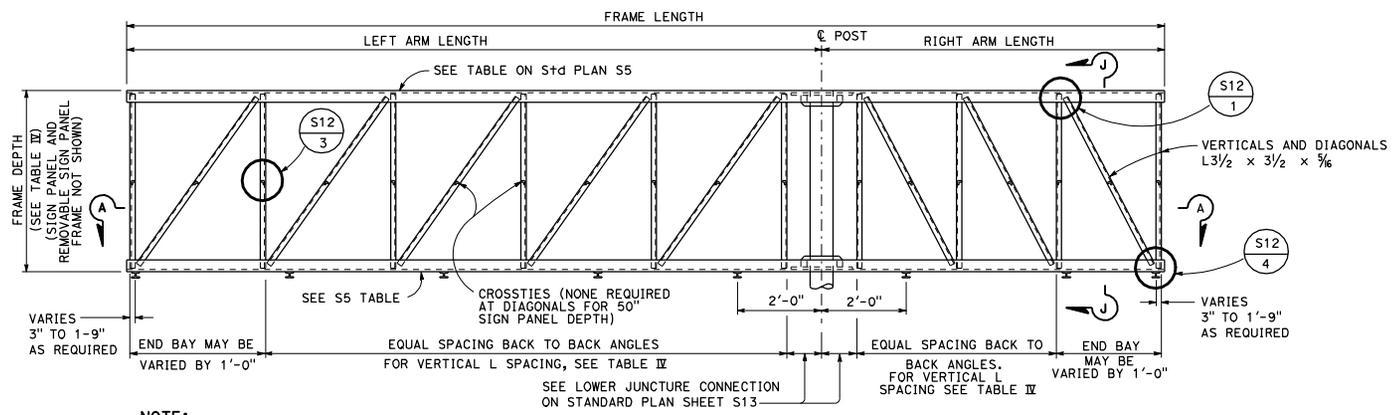
No. OF BOLTS	OD	BC	ID	HOLE Dia	PERMANENT TEMPLATE THICKNESS	TEMPORARY TEMPLATE THICKNESS
12	2'-1"	2'-0"	1'-9"	2 1/8" Max	5/8"	1/2"
14	3'-1"	2'-10"	2'-7"	2 1/8" Max	5/8"	1/2"
16	3'-2"	2'-10"	2'-6"	2 3/8" Max	3/4"	1/2"

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
 SINGLE POST TYPE  
 BASE PLATE AND  
 ANCHORAGE DETAILS**  
 NO SCALE

DIST	COUNTY	ROUTE	POST MILES	SHEET	TOTAL
			TOTAL PROJECT	No.	SHEETS

Stanley P. Johnson  
 REGISTERED CIVIL ENGINEER  
 No. CS793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE  
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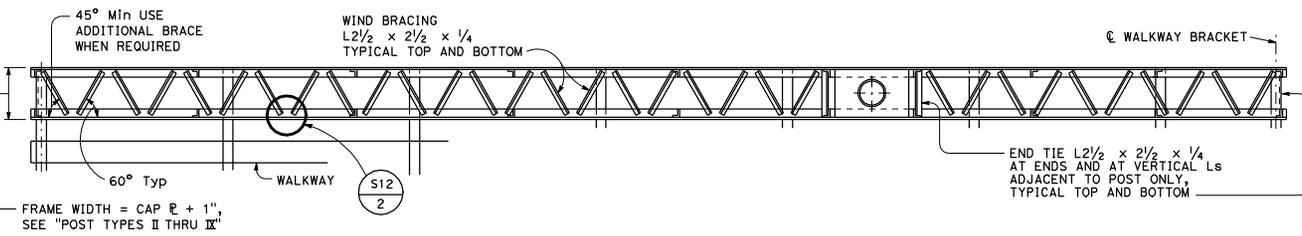


**NOTE:**  
 1. Left arm may be shorter, longer or equal to right arm length.

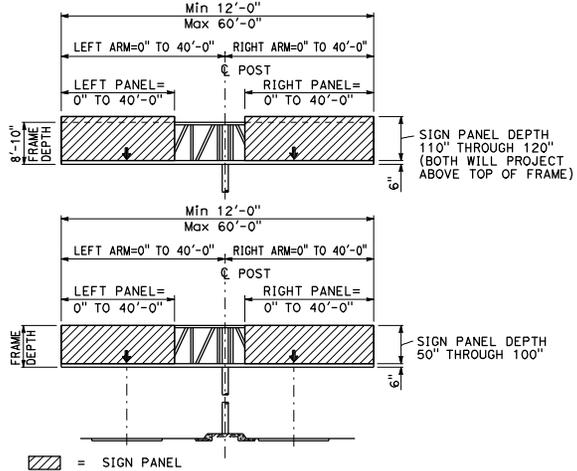
**ELEVATION**

**TABLE IV**

SIGN PANEL DEPTH	FRAME DEPTH	MAXIMUM VERTICAL L SPACING	SEE NOTE 6
50"	4'-8"	4'-6"	4'-0"
60"	5'-6"	5'-0"	4'-0"
70"	6'-4"	5'-6"	4'-0"
80"	7'-2"	6'-0"	5'-0"
90"	8'-0"	7'-0"	5'-0"
100"	8'-10"		6'-0"
110"	8'-10"		6'-0"
120"	8'-10"		6'-0"

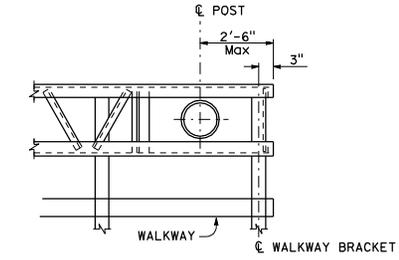


**SECTION A-A**

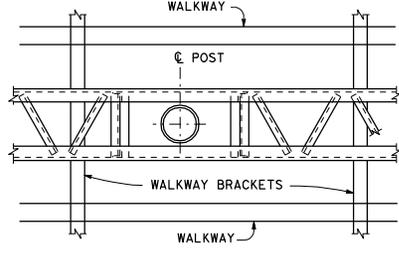


**RANGE OF STRUCTURE SIZES**

- NOTES:**
1. For connection of frame to post see S13.
  2. For walkway details see S16 and S17.
  3. For walkway length see S1.
  4. Minimum length of frame = 12'-0".
  5. Maximum length of frame = 60'-0".
  6. Diagonal not required if arm length is equal to or less than shown in this column see table IV.
  7. For Section J-J, See Std Plan S12.



**PART PLAN OF CANTILEVER TYPE AT POST**



**PART PLAN OF DOUBLE FACED TYPE AT POST**

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
 SINGLE POST TYPE  
 STRUCTURAL FRAME MEMBERS  
 DETAILS No. 1**  
 NO SCALE

SPAN L <sub>1</sub> + L <sub>2</sub>	50" SIGN PANEL DEPTH					
	FRAME DEPTH	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	TOP AND BOTTOM WIND BRACING L's
12'-0"	4'-8"	SEE NOTE	5 x 5 x 1/2	3 1/2 x 3 1/2 x 5/8	3 1/2 x 3 1/2 x 5/8	2 1/2 x 2 1/2 x 1/4
OVER 12'-0" TO 20'-0"			5 x 5 x 1/2			
OVER 20'-0" TO 30'-0"			5 x 5 x 1/2			
OVER 30'-0" TO 40'-0"			6 x 6 x 1/2			
OVER 40'-0" TO 50'-0"			6 x 6 x 1/2			
OVER 50'-0" TO 60'-0"			6 x 6 x 1/2			

SPAN L <sub>1</sub> + L <sub>2</sub>	60" SIGN PANEL DEPTH					
	FRAME DEPTH	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	TOP AND BOTTOM WIND BRACING L's
12'-0"	5'-6"	SEE NOTE	5 x 5 x 1/2	3 1/2 x 3 1/2 x 5/8	3 1/2 x 3 1/2 x 5/8	2 1/2 x 2 1/2 x 1/4
OVER 12'-0" TO 20'-0"			5 x 5 x 1/2			
OVER 20'-0" TO 30'-0"			5 x 5 x 1/2			
OVER 30'-0" TO 40'-0"			6 x 6 x 1/2			
OVER 40'-0" TO 50'-0"			6 x 6 x 1/2			
OVER 50'-0" TO 60'-0"			6 x 6 x 1/2			

SPAN L <sub>1</sub> + L <sub>2</sub>	70" SIGN PANEL DEPTH					
	FRAME DEPTH	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	TOP AND BOTTOM WIND BRACING L's
12'-0"	6'-4"	SEE NOTE	5 x 5 x 1/2	3 1/2 x 3 1/2 x 5/8	3 1/2 x 3 1/2 x 5/8	2 1/2 x 2 1/2 x 1/4
OVER 12'-0" TO 20'-0"			5 x 5 x 1/2			
OVER 20'-0" TO 30'-0"			5 x 5 x 1/2			
OVER 30'-0" TO 40'-0"			6 x 6 x 1/2			
OVER 40'-0" TO 50'-0"			6 x 6 x 1/2			
OVER 50'-0" TO 60'-0"			6 x 6 x 1/2			

SPAN L <sub>1</sub> + L <sub>2</sub>	80" SIGN PANEL DEPTH					
	FRAME DEPTH	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	TOP AND BOTTOM WIND BRACING L's
12'-0"	7'-2"	SEE NOTE	5 x 5 x 1/2	3 1/2 x 3 1/2 x 5/8	3 1/2 x 3 1/2 x 5/8	2 1/2 x 2 1/2 x 1/4
OVER 12'-0" TO 20'-0"			5 x 5 x 1/2			
OVER 20'-0" TO 30'-0"			5 x 5 x 1/2			
OVER 30'-0" TO 40'-0"			6 x 6 x 1/2			
OVER 40'-0" TO 50'-0"			6 x 6 x 1/2			
OVER 50'-0" TO 60'-0"			6 x 6 x 1/2			

SPAN L <sub>1</sub> + L <sub>2</sub>	90" SIGN PANEL DEPTH					
	FRAME DEPTH	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	TOP AND BOTTOM WIND BRACING L's
12'-0"	8'-0"	SEE NOTE	5 x 5 x 1/2	3 1/2 x 3 1/2 x 5/8	3 1/2 x 3 1/2 x 5/8	2 1/2 x 2 1/2 x 1/4
OVER 12'-0" TO 20'-0"			5 x 5 x 1/2			
OVER 20'-0" TO 30'-0"			5 x 5 x 1/2			
OVER 30'-0" TO 40'-0"			6 x 6 x 1/2			
OVER 40'-0" TO 50'-0"			6 x 6 x 1/2			
OVER 50'-0" TO 60'-0"			6 x 6 x 1/2			

SPAN L <sub>1</sub> + L <sub>2</sub>	100" SIGN PANEL DEPTH					
	FRAME DEPTH	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	TOP AND BOTTOM WIND BRACING L's
12'-0"	8'-10"	SEE NOTE	5 x 5 x 1/2	3 1/2 x 3 1/2 x 5/8	3 1/2 x 3 1/2 x 5/8	2 1/2 x 2 1/2 x 1/4
OVER 12'-0" TO 20'-0"			5 x 5 x 1/2			
OVER 20'-0" TO 30'-0"			5 x 5 x 1/2			
OVER 30'-0" TO 40'-0"			6 x 6 x 1/2			
OVER 40'-0" TO 50'-0"			6 x 6 x 1/2			
OVER 50'-0" TO 60'-0"			6 x 6 x 1/2			

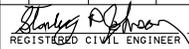
SPAN L <sub>1</sub> + L <sub>2</sub>	110" SIGN PANEL DEPTH					
	FRAME DEPTH	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	TOP AND BOTTOM WIND BRACING L's
12'-0"	8'-10"	SEE NOTE	5 x 5 x 1/2	3 1/2 x 3 1/2 x 5/8	3 1/2 x 3 1/2 x 5/8	2 1/2 x 2 1/2 x 1/4
OVER 12'-0" TO 20'-0"			5 x 5 x 1/2			
OVER 20'-0" TO 30'-0"			5 x 5 x 1/2			
OVER 30'-0" TO 40'-0"			6 x 6 x 1/2			
OVER 40'-0" TO 50'-0"			6 x 6 x 1/2			
OVER 50'-0" TO 60'-0"			6 x 6 x 1/2			

SPAN L <sub>1</sub> + L <sub>2</sub>	120" SIGN PANEL DEPTH					
	FRAME DEPTH	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	TOP AND BOTTOM WIND BRACING L's
12'-0"	8'-10"	SEE NOTE	5 x 5 x 1/2	3 1/2 x 3 1/2 x 5/8	3 1/2 x 3 1/2 x 5/8	2 1/2 x 2 1/2 x 1/4
OVER 12'-0" TO 20'-0"			5 x 5 x 1/2			
OVER 20'-0" TO 30'-0"			5 x 5 x 1/2			
OVER 30'-0" TO 40'-0"			6 x 6 x 1/2			
OVER 40'-0" TO 50'-0"			6 x 6 x 1/2			
OVER 50'-0" TO 60'-0"			6 x 6 x 1/2			

**NOTES:**

1. Frame width = Pipe Dia plus 2 x shorter L leg plus 1".
2. Frame length L<sub>1</sub> = Left arm length.
3. Frame length L<sub>2</sub> = right arm length.
4. For full cantilever, short arm used to compute L<sub>1</sub> + L<sub>2</sub> on this sheet shall be taken as 2'-6".

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET TOTAL SHEETS

  
 REGISTERED CIVIL ENGINEER  
 No. CS793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 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.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
 SINGLE POST TYPE  
 STRUCTURAL FRAME MEMBERS  
 DETAILS No. 2**

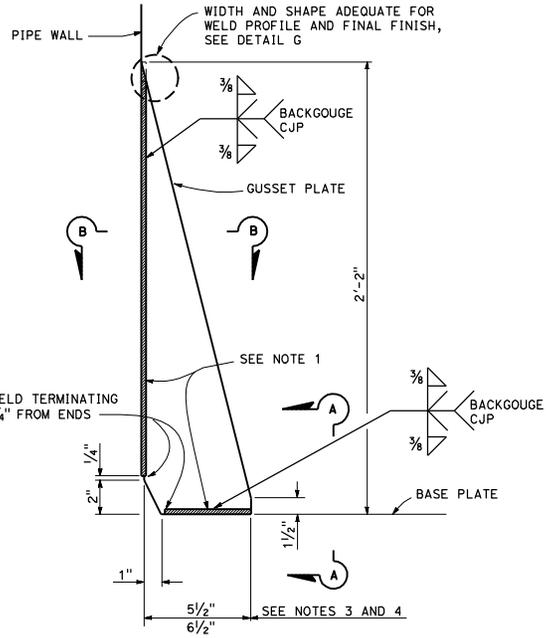
NO SCALE

**S5**

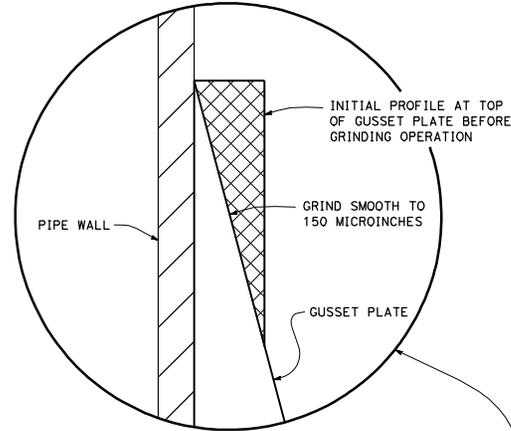
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

**Stanley P. Johnson**  
 REGISTERED CIVIL ENGINEER  
 No. CS7793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

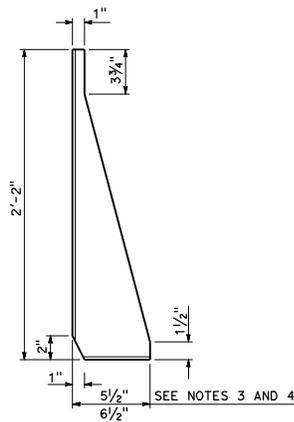
May 20, 2011  
 PLANS APPROVAL DATE  
 THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.



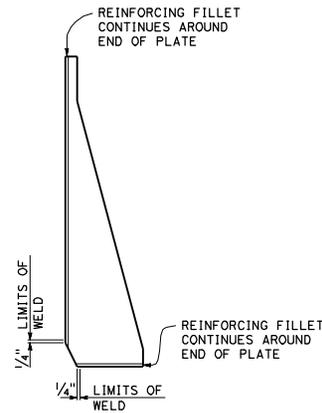
**WELD DETAILS**



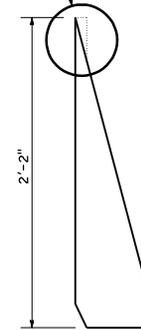
**DETAIL G**



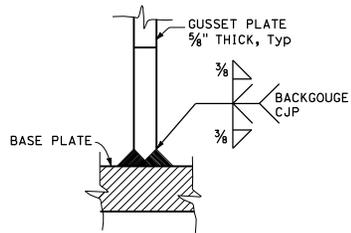
**GUSSET PLATE**  
(Initial Shape)



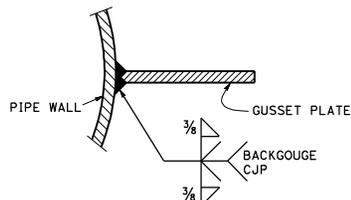
**GUSSET PLATE WELDING**  
(See Weld Details)



**GUSSET PLATE GRINDING**  
(See Details G)



**SECTION A-A**



**SECTION B-B**

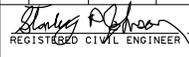
**NOTES:**

1. All gussets to be same height.
2. Provide a smooth transition from gusset plate to tube.
3. 5/2" for post Types I-S through V-S.
4. 6/2" for post Type VI-S and VII-S, single post trusses and tubular.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
 GUSSET PLATE DETAILS**

NO SCALE

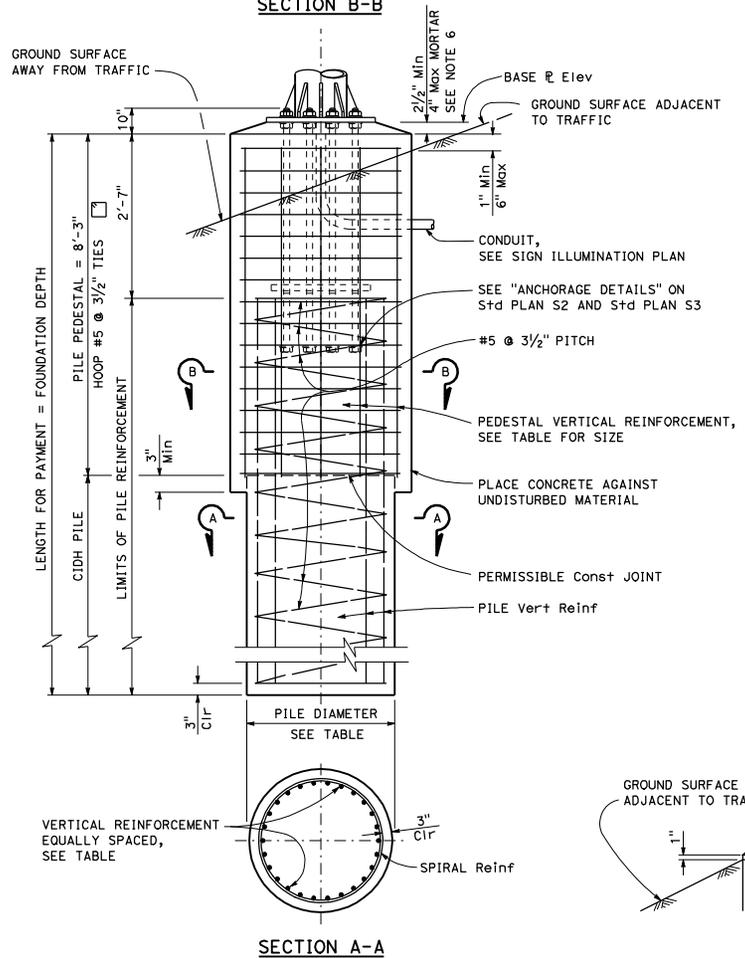
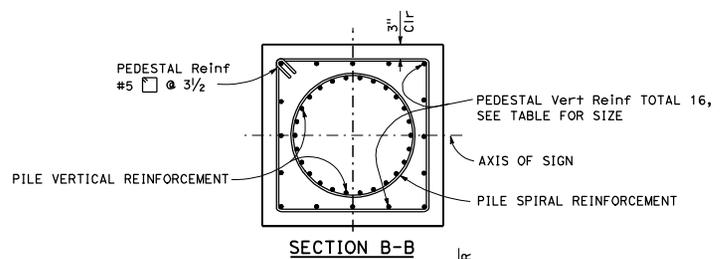
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

  
 REGISTERED CIVIL ENGINEER

May 20, 2011  
 PLANS APPROVAL DATE



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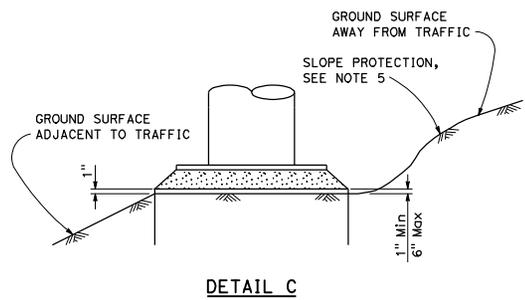


POST TYPE No.	ANCHOR BOLTS			SQUARE PILE PEDESTAL					CIDH PILE				FOUNDATION DEPTH * *		
	BOLT CIRCLE	BOLT TOTAL AND Dia	TOTAL LENGTH	PEDESTAL SQUARE ONE SIDE	VERTICAL REINFORCING		HOOP		PILE Dia		VERTICAL REINFORCING			SPIRAL	
					TOTAL	BAR SIZE	# OF BARS EACH FACE	BAR SIZE	SPACING	TOTAL	BAR SIZE	BAR SIZE			PITCH
II	2'-0"	12'-2"	4'-2"	5'-3"	16	#10	5	#5	3 1/2"	4'-6"	26	#10	#5	3 1/2"	14'-9"
III	2'-0"	12'-2"													16'-0"
IV	2'-0"	12'-2"													18'-0"
V	2'-10"	14'-2"													19'-0"
VI		16'-2 1/2"	5'-0"	5'-9"		#11				5'-0"	28	#11			22'-0"
VII															23'-0"
VIII															25'-0"
IX															25'-0"

\* \* Use Foundation Depth shown in table unless otherwise shown on the Project Plans.

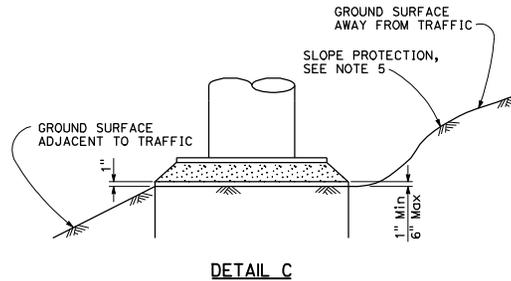
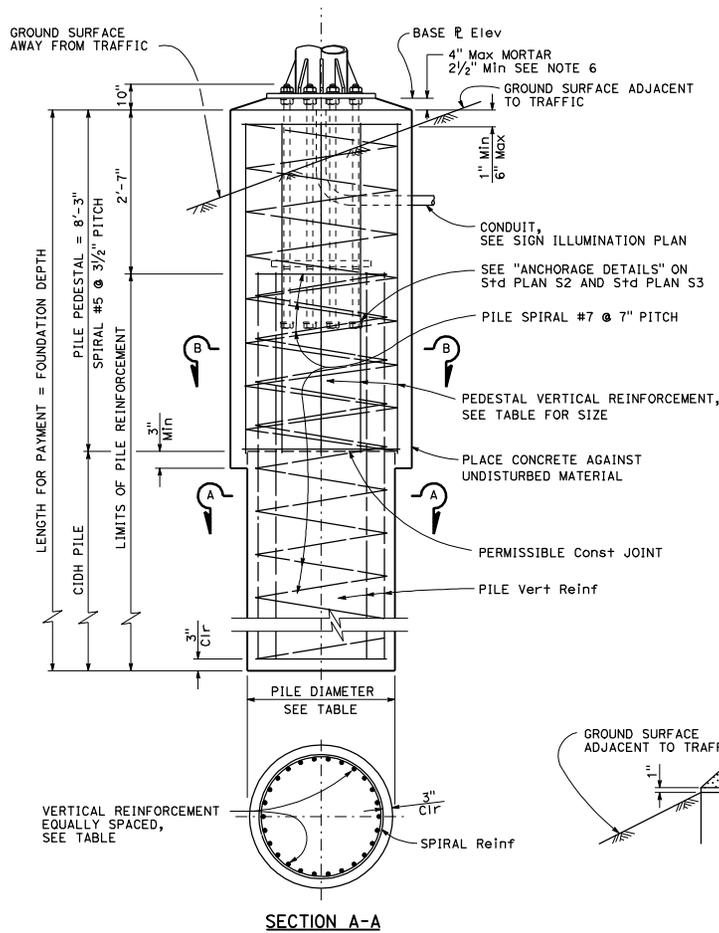
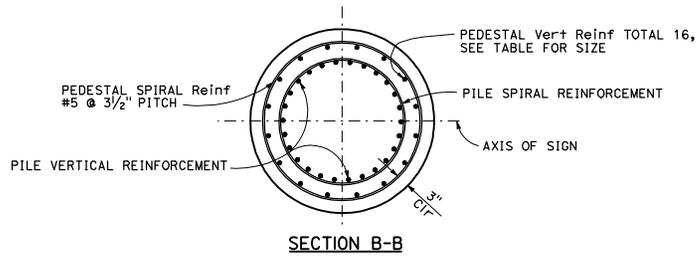
**NOTES:**

1. For anchor bolt layout, see Standard Plan S3.
2. For "Base E elevation" see Project Plans.
3. Prior to erection of the post, backfill which is equivalent to the surrounding material shall be in place.
4. Pedestal shall be formed 6" minimum below ground surface. Remainder to be placed against undisturbed material.
5. Slope protection required when indicated on the Project Plans.
6. For drain holes and central void in mortar, see Standard Plan ES-68 Detail N.



STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
 SINGLE POST TYPE  
 SQUARE PEDESTAL PILE FOUNDATION**

NO SCALE



POST TYPE No.	ANCHOR BOLTS			ROUND PILE PEDESTAL				CIDH PILE				FOUNDATION DEPTH **		
	BOLT CIRCLE	BOLT TOTAL AND Dia	TOTAL LENGTH	Dia	VERTICAL REINFORCING		SPIRAL		PILE Dia	VERTICAL REINFORCING			SPIRAL	
					TOTAL	BAR SIZE	BAR SIZE	PITCH		TOTAL	BAR SIZE		BAR SIZE	PITCH
II	2'-0"	12-2"	4'-2"	5'-3"	16	#10	#5	3 1/2"	4'-6"	26	#10	#5	3 1/2"	14'-9"
III	2'-0"	12-2"												16'-0"
IV	2'-0"	12-2"												18'-0"
V	2'-10"	14-2"												19'-0"
VI		16-2 1/2"	5'-0"	5'-9"		#11			5'-0"	28	#11			22'-0"
VII														23'-0"
VIII														25'-0"
IX														25'-0"

\*\* Use Foundation Depth shown in table unless otherwise shown on the Project Plans.

**NOTES:**

1. For anchor bolt layout, see Standard Plan S3.
2. For "Base E elevation" see Project Plans.
3. Prior to erection of the post, backfill which is equivalent to the surrounding material shall be in place.
4. Pedestal shall be formed 6" minimum below ground surface. Remainder to be placed against undisturbed material.
5. Slope protection required when indicated on the Project Plans.
6. For drain holes and central void in mortar see Standard Plan ES-6B detail N.

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
SINGLE POST TYPE  
ROUND PEDESTAL PILE FOUNDATION**

NO SCALE

**S8**

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

Stanley P. Johnson  
No. CS793  
Exp. 3-31-12  
CIVIL  
REGISTERED PROFESSIONAL ENGINEER  
STATE OF CALIFORNIA

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**NOTES:**

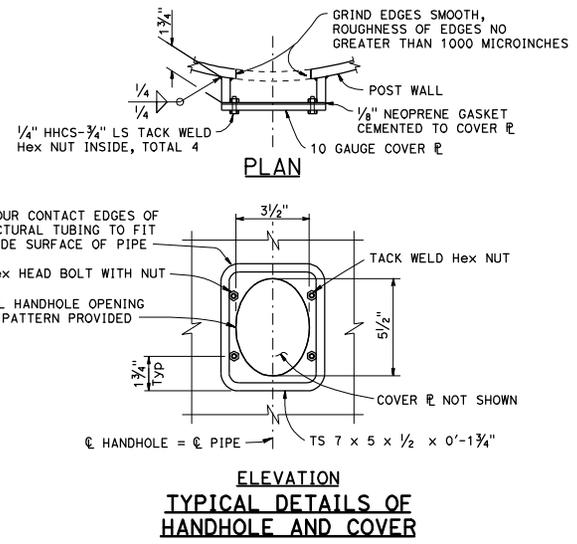
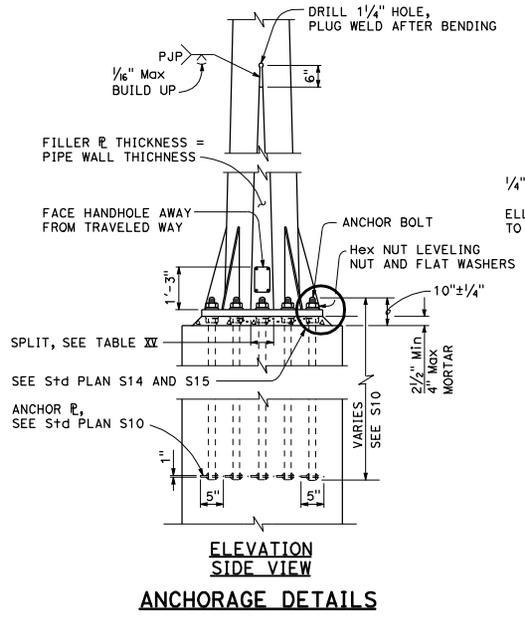
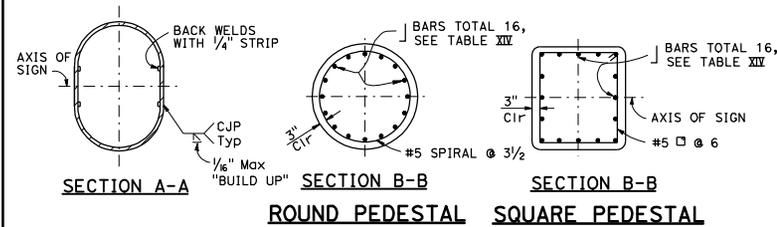
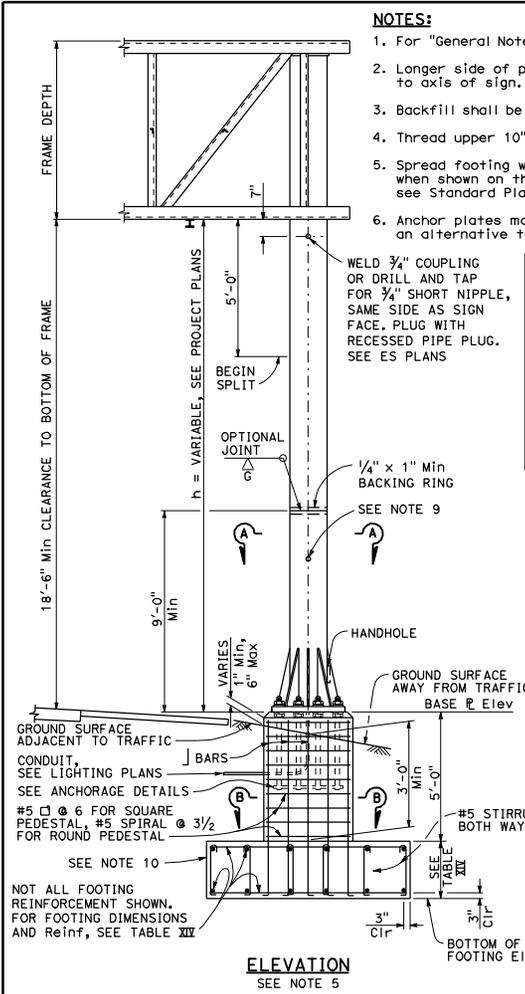
1. For "General Notes" see Standard Plan S1.
2. Longer side of post and footing (longitudinal) shall be normal to axis of sign.
3. Backfill shall be in place prior to erection of post.
4. Thread upper 10" of anchor bolts and galvanize upper 1'-0".
5. Spread footing with square pedestal shown, use pile foundation when shown on the Project Plans. For pile foundation details, see Standard Plans S14 and S15.
6. Anchor plates may be retained with Hex nut or formed head as an alternative to details shown.
7. When foundation is located on a steep slope with exposed face of concrete adjacent to traffic, see "Detail C" on Standard Plan S14 and S15.
8. Slope protection required when indicated on Project Plans.
9. Weld coupling or drill and tap for 1/2" C chase nipple, perpendicular to sign panel axis away from approaching traffic. Plug with recessed pipe plug. See Standard Plan ES-15C.
10. Excavate to neat lines and place concrete against undisturbed material.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET TOTAL SHEETS

Stanley P. Johnson  
 REGISTERED CIVIL ENGINEER  
 May 20, 2011  
 PLANS APPROVAL DATE  
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**TABLE XIV**

POST TYPE	PIPE			ROUND PEDESTAL				SQUARE PEDESTAL				SPREAD FOOTING							
	NPS	THICKNESS	SPLIT	PEDESTAL SIZE	VERTICAL J-BARS		SPIRAL	PEDESTAL SIZE	VERTICAL J-BARS		HOOP		(SEE NOTE 2)						
					EQUALLY SPACED TOTAL	BAR SIZE			EQUALLY SPACED TOTAL	BAR SIZE	# OF BARS EA FACE	BAR SIZE	SPACING	REINFORCEMENT WIDTH		LONGITUDINAL		FOOTING STIRRUPS	
I-S	14	1/2"	5"	5'-3"	16	#10	#5	3 1/2"	5'-3"	16	#10	5	6"	7'-0" x 13'-0" x 2'-6"	14-#6	14-#7	10-#9	10-#9	#5 @ 12
II-S	16		6"											7'-0" x 13'-0" x 2'-6"	14-#6	14-#7	10-#9	10-#9	
III-S	18		7"											7'-0" x 13'-0" x 2'-6"	14-#6	14-#7	11-#9	11-#9	
IV-S	20		8"											8'-0" x 14'-0" x 2'-6"	15-#7	15-#7	12-#9	12-#11	
V-S	24		8"	5'-9"			#11		5'-9"					8'-0" x 16'-0" x 3'-0"	17-#7	17-#7	12-#9	12-#11	
VI-S	24	3/32"	10"	5'-9"			#11		5'-9"					9'-0" x 17'-0" x 3'-0"	18-#7	18-#7	12-#9	12-#11	
VII-S	24	3/32"	10"	5'-9"			#11		5'-9"					10'-0" x 18'-0" x 3'-0"	19-#7	19-#7	13-#9	13-#11	



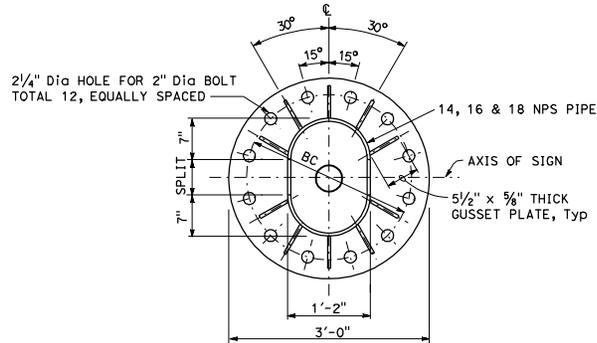
STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS**  
**TWO POST TYPE**  
**POST TYPES I-S THROUGH VII-S**  
 NO SCALE

342

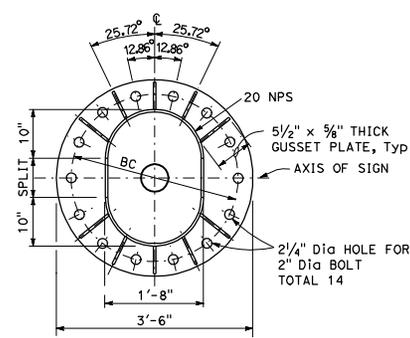
2010 STANDARD PLAN S9

**TWO POST TRUSS**

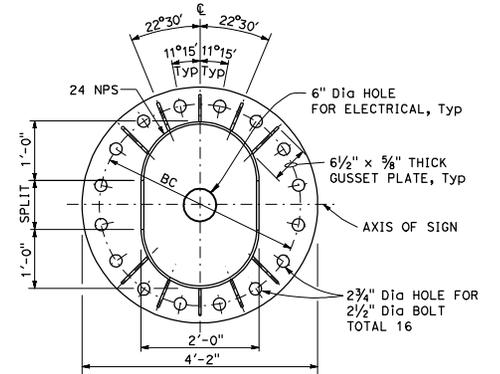
POST TYPE	PIPE			BASE Ø, OD AND THICKNESS	ANCHOR		
	NPS	THICKNESS	SPLIT		BOLT CIRCLE	BOLT TOTALS AND Dia	LENGTH
I-S	14	1/2"	5"	3'-1" x 2"	2'-4"	12-2"	4'-2"
II-S	16		6"	3'-1" x 2"	2'-4"	12-2"	
III-S	18		7"	3'-2" x 2"	2'-7"	12-2"	
IV-S	20		8"	3'-5" x 2"	2'-10"	14-2"	
V-S	24		8"	4'-0" x 2"	3'-2"	16-2 1/2"	5'-0"
VI-S	24	3/32"	10"	4'-3" x 2 1/2"	3'-5"	16-2 1/2"	5'-0"
VII-S	24	3/32"	10"	4'-3" x 2 1/2"	3'-5"	16-2 1/2"	5'-0"



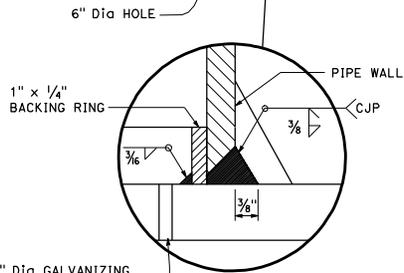
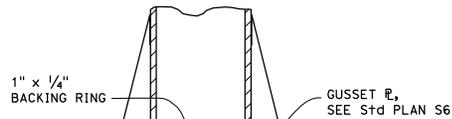
**12 BOLTS**  
Type I-S shown



**14 BOLTS**  
**BASE PLATE DETAILS**  
**TWO POST TYPE**



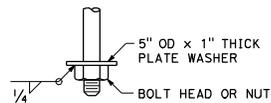
**16 BOLTS**  
Type VI-S shown



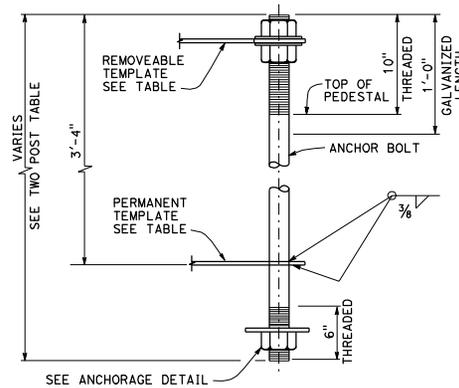
**POST TO BASE PLATE CONNECTION DETAIL**

**TEMPLATE DIMENSIONS**

No. OF BOLTS	OD	ID	HOLE Dia	PERMANENT TEMPLATE THICKNESS	TEMPORARY TEMPLATE THICKNESS
12	BC+3"	BC-3"	2 1/8" Max	5/8"	1/2"
14	BC+3"	BC-3"	2 1/8" Max	5/8"	1/2"
16	BC+4"	BC-4"	2 3/8" Max	3/4"	1/2"



**ANCHORAGE DETAIL**



**ANCHOR BOLT TEMPLATE ASSEMBLY**

**NOTE:** One bolt shown only. Other bolts same configuration around pipe sleeve. Template to match base plate anchor bolt pattern.

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS**  
**TWO POST TYPE**  
**BASE PLATE AND**  
**ANCHORAGE DETAILS**

NO SCALE

**S10**

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

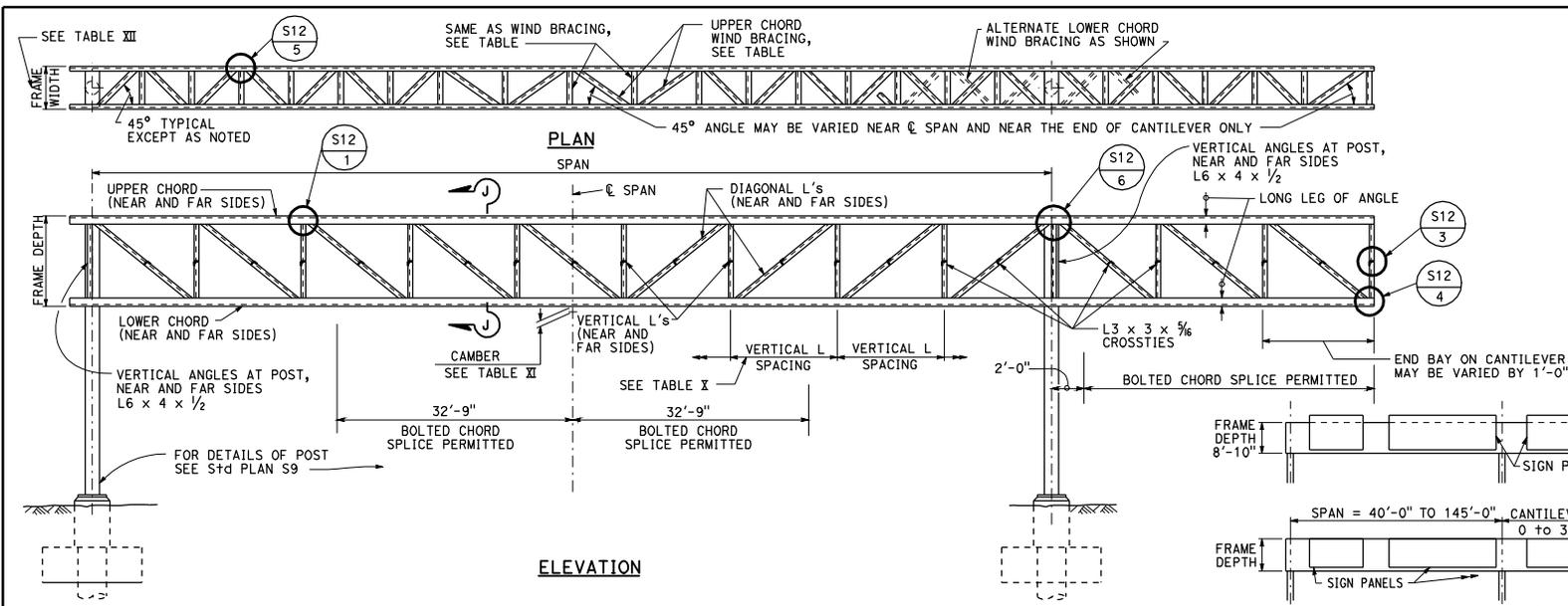
Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE  
May 20, 2011

Stanley P. Johnson  
No. CS7393  
Exp. 3-31-12  
CIVIL  
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER

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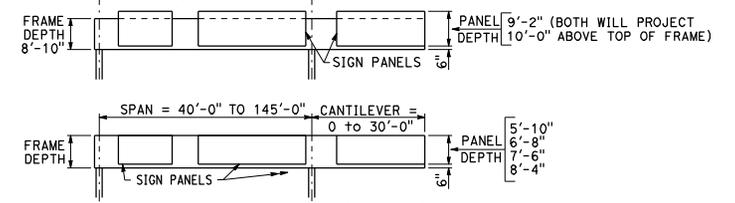


DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

**Stanley P. Johnson**  
 REGISTERED CIVIL ENGINEER  
 No. C8793  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE

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Right cantilever shown. Cantilever may be left or right.

SPAN	70" PANEL DEPTH					80" PANEL DEPTH					90" PANEL DEPTH				
	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	WIND BRACING L's	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	WIND BRACING L's	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	WIND BRACING L's
40'-0"-50'-0"	3'-0"	5 x 3/2 x 3/8	3/2 x 3/2 x 3/8	3/2 x 3/2 x 3/8	2 1/2 x 2 1/2 x 1/4	3'-0"	5 x 3/2 x 3/8	3/2 x 3/2 x 3/8	3/2 x 3/2 x 3/8	2 1/2 x 2 1/2 x 1/4	3'-0"	5 x 3/2 x 3/8	3/2 x 3/2 x 3/8	3/2 x 3/2 x 3/8	2 1/2 x 2 1/2 x 1/4
51'-0"-60'-0"		5 x 3/2 x 3/8					5 x 3/2 x 3/8					5 x 3/2 x 3/8			
61'-0"-70'-0"		5 x 3/2 x 3/8					5 x 3/2 x 3/8					5 x 3/2 x 3/8			
71'-0"-80'-0"		6 x 4 x 1/2					6 x 4 x 1/2					6 x 4 x 1/2			
81'-0"-90'-0"		6 x 4 x 1/2					6 x 4 x 1/2					6 x 4 x 1/2			
91'-0"-100'-0"		6 x 4 x 1/2					6 x 4 x 1/2					6 x 4 x 1/2			
101'-0"-110'-0"		8 x 4 x 3/4					8 x 4 x 3/4					8 x 4 x 3/4			3 x 3 x 3/8
111'-0"-120'-0"															
121'-0"-130'-0"											3'-6"				
131'-0"-145'-0"													3/2 x 3/2 x 3/8	3/2 x 3/2 x 3/8	

**RANGE OF STRUCTURE SIZES**

PANEL DEPTH	FRAME DEPTH	Max VERTICAL L SPACING	CAMBER FOR FABRICATION AT & SPAN	
			SPAN	CAMBER
70"	6'-4"	6'-0"	40'-0" TO 50'-0"	1/16"
80"	7'-2"	6'-0"	51'-0" TO 100'-0"	2/8"
90"	8'-0"	7'-6"	101'-0" TO 145'-0"	3/4"
100"	8'-10"			
110"	8'-10"			
120"	8'-10"			

Camber to approximate parabola. Camber of cantilever arm = 1/2" for arms greater than 10'-0"

TABLE I

TABLE II

SPAN	100" PANEL DEPTH					110" AND 120" PANEL DEPTH				
	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	WIND BRACING L's	FRAME WIDTH	CHORD L's	VERTICAL L's	DIAGONAL L's	WIND BRACING L's
40'-0"-50'-0"	3'-0"	5 x 3/2 x 3/8	3/2 x 3/2 x 3/8	3/2 x 3/2 x 3/8	2 1/2 x 2 1/2 x 1/4	3'-0"	5 x 3/2 x 3/8	3/2 x 3/2 x 3/8	3/2 x 3/2 x 3/8	2 1/2 x 2 1/2 x 1/4
51'-0"-60'-0"		5 x 3/2 x 3/8					5 x 3/2 x 3/8			2 1/2 x 2 1/2 x 1/4
61'-0"-70'-0"		5 x 3/2 x 3/8					5 x 3/2 x 3/8			2 1/2 x 2 1/2 x 1/4
71'-0"-80'-0"		6 x 4 x 1/2					6 x 4 x 1/2			3 x 3 x 3/8
81'-0"-90'-0"		6 x 4 x 1/2					6 x 4 x 1/2			
91'-0"-100'-0"		6 x 4 x 1/2				3'-6"	6 x 4 x 1/2			
101'-0"-110'-0"	3'-6"	8 x 4 x 3/4			3 x 3 x 3/8		8 x 4 x 3/4			
111'-0"-120'-0"							8 x 4 x 3/4			
121'-0"-130'-0"							8 x 4 x 3/4			
131'-0"-145'-0"							8 x 6 x 3/4			

TABLE III

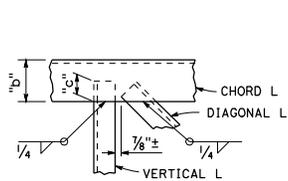
**NOTES:**

1. Frame widths shown are nominal. These widths may be varied by 1/4" to standardize fabrication methods.
2. Walkway brackets not shown. Locate first interior bracket 2'-8" Max from & of post.
3. For Section J-J, See Std Plan S12.

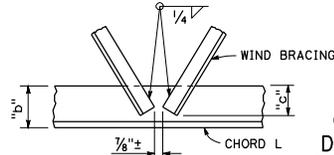
STANDARD PLAN SHEET No.  
 DETAIL No.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
 TWO POST TYPE  
 STRUCTURAL FRAME MEMBERS**

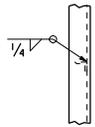
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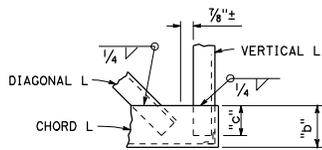
DETAIL 1



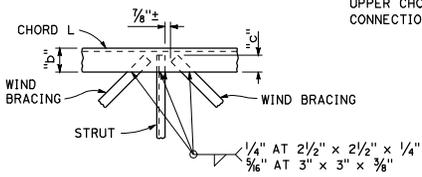
DETAIL 2



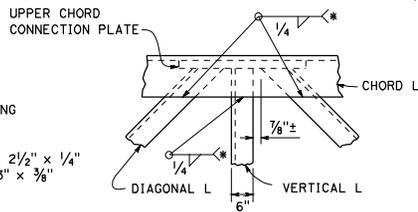
DETAIL 3



DETAIL 4

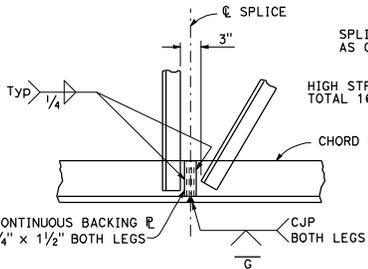


DETAIL 5

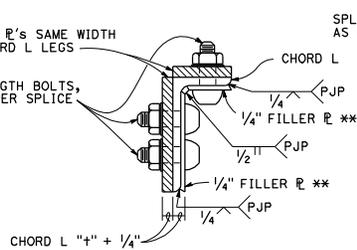


DETAIL 6

\* Welds are to upper chord connection plate and chord angle.



WELDED CHORD SPLICE

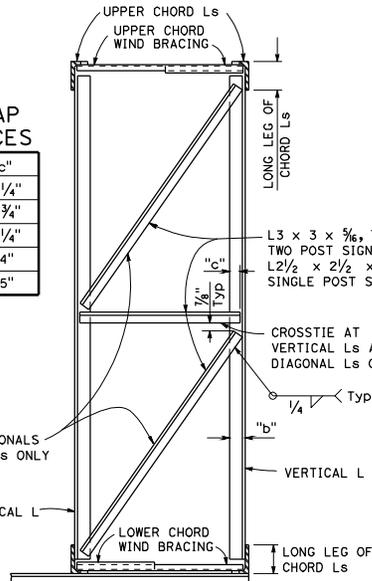


SECTION T-T  
TWO POST SIGNS

\*\* 5/16" Filler at 3/4" thick chord angle

OVERLAP DISTANCES

"b"	"c"
3 1/2"	2 1/4"
4"	2 3/4"
5"	3 1/4"
6"	4"
8"	5"



TYPICAL SECTION J-J

NOTE:  
Diagonal Ls in plane of truss not shown. Bracing shown is at all vertical Ls of truss.

BOLTED CHORD SPLICE  
TWO POST SIGNS

CHORD L	NOMINAL BOLT DIAMETER	"a"
5 x 3 1/2 x 3/8	3/4"	2 1/2"
6 x 4 x 1/2	7/8"	3"
8 x 4 x 3/4	1 1/4"	3 3/4"
8 x 6 x 3/4	1 1/4"	3 3/4"

SINGLE POST SIGNS

CHORD L	NOMINAL BOLT DIAMETER	"a"
5 x 5 x 1/2	7/8"	3"
6 x 6 x 1/2	7/8"	3"

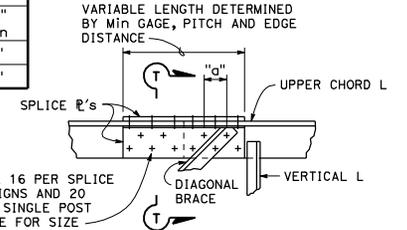
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

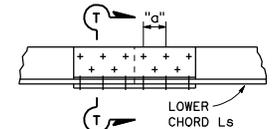
May 20, 2011  
PLANS APPROVAL DATE

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Stanley P. Johnson  
No. C8793  
Exp. 3-31-12  
CIVIL  
STATE OF CALIFORNIA



SPLICE WITH DIAGONAL ANGLE

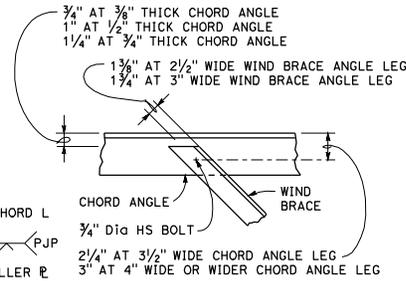


SPLICE WITHOUT DIAGONAL ANGLE  
BOLTED CHORD SPLICE

SPLICE NOTES:

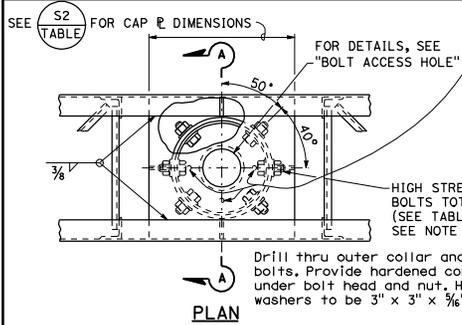
Location of Splices:  
The splice shall be located so as not to interfere with mounting the walkway brackets or the clip angles for the removable sign panel frame. For two post type see also S11.

Filler  $\epsilon$  :  
The plates welded to the angle legs on the inside shall be welded before drilling the bolt holes. The plates shall be the same length as the cover plates. The plates are not necessary on the single post signs if the splice is located over 1/3 of the cantilever length from the post. Alternative splice details may be used if approved by the Engineer.



BOLTED WIND BRACE DETAIL  
Each end of wind brace at bolted chord splice

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
STRUCTURAL FRAME DETAILS**  
NO SCALE



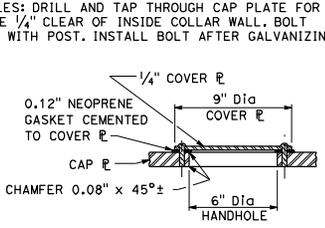
PLAN

OPTIONAL GALVANIZING DRAIN HOLES: DRILL AND TAP THROUGH CAP PLATE FOR 3/8" Max Dia BOLT. HOLE SHALL BE 1/4" CLEAR OF INSIDE COLLAR WALL. BOLT LENGTH SIZED NOT TO INTERFERE WITH POST. INSTALL BOLT AFTER GALVANIZING.

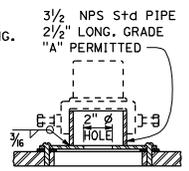
POST TYPE	BOLT SIZE
II	3/8"
III	1"
IV	1 1/8"
V	1 1/8"
VI	1 1/4"
VII	1 1/4"
VIII	1 1/2"
IX	1 1/2"

HIGH STRENGTH BOLTS TOTAL 6 (SEE TABLE VIII FOR SIZE), SEE NOTE 3

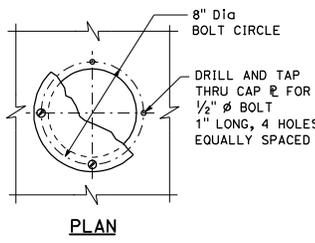
Drill thru outer collar and post wall for bolts. Provide hardened contoured washers under bolt head and nut. Hardened contoured washers to be 3" x 3" x 3/8" Min. Grind face to fit.



SECTION Without photoelectric unit



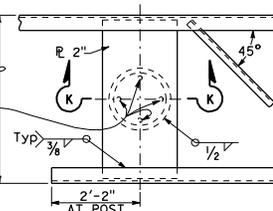
SECTION With photoelectric unit



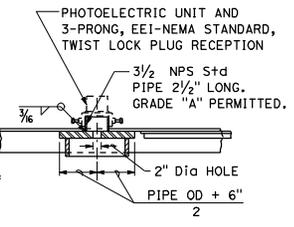
PLAN

**BOLT-ACCESS HOLE SINGLE POST TYPE**

R LENGTH = FRAME WIDTH LESS THICKNESS OF CHORD ANGLES, CHAMFER TO FIT CHORD FILLETS.

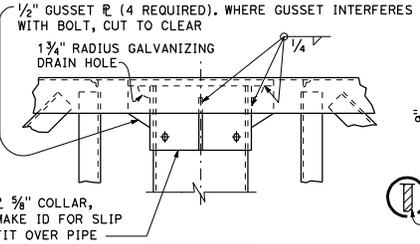


SECTION K-K Without photoelectric unit



SECTION K-K With photoelectric unit

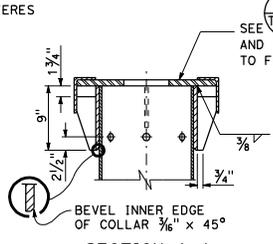
**UPPER CHORD CONNECTION TO POST TWO POST TYPE**



ELEVATION

SECTION A-A

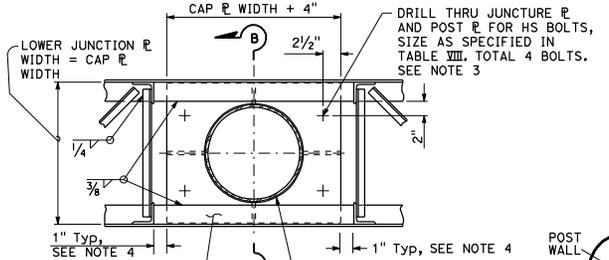
OPTIONAL GALVANIZING DRAIN HOLES: DRILL AND TAP THROUGH CAP PLATE FOR 3/8" Max Dia BOLT. HOLE SHALL BE 1/4" CLEAR OF INSIDE COLLAR WALL. BOLT LENGTH SIZED NOT TO INTERFERE WITH POST. INSTALL BOLT AFTER GALVANIZING.



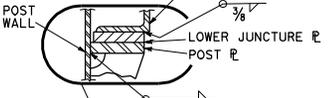
SEE TABLE FOR CAP PLATE SIZE AND THICKNESS, CHAMFER TO FIT CHORD FILLETS

**NOTES: (SINGLE POST TYPE)**

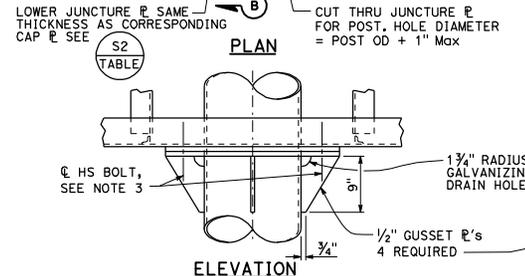
- In all cases, truss shall be supported at lower juncture connection. Bearing surface shall be finished true.
- Post to truss connections shall be fitted in shop.
- High strength bolts shall be snug tighten. Torque requirements are waived.
- See Part Plan of Cantilever Type at post on Standard Plan S4.



PLAN

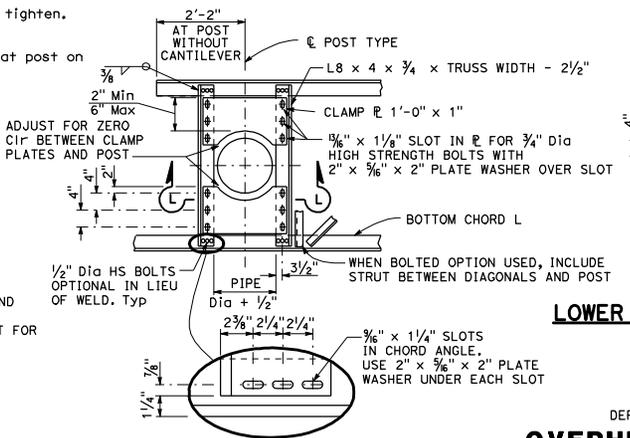


SECTION B-B

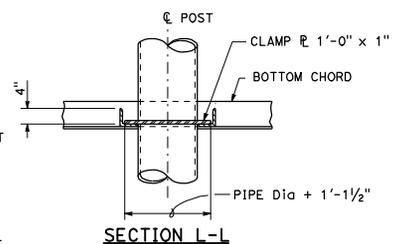


ELEVATION

**LOWER JUNCTURE CONNECTION SINGLE POST TYPE**



**LOWER CHORD CONNECTION TO POST TWO POST TYPE**



SECTION L-L

**OVERHEAD SIGNS-TRUSS FRAME JUNCTURE DETAILS**

NO SCALE

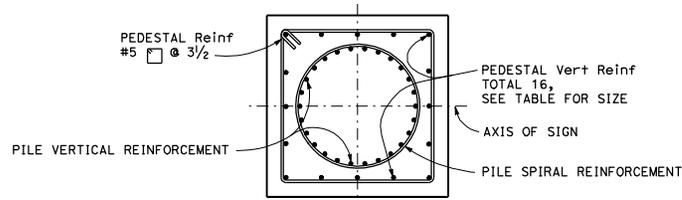
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

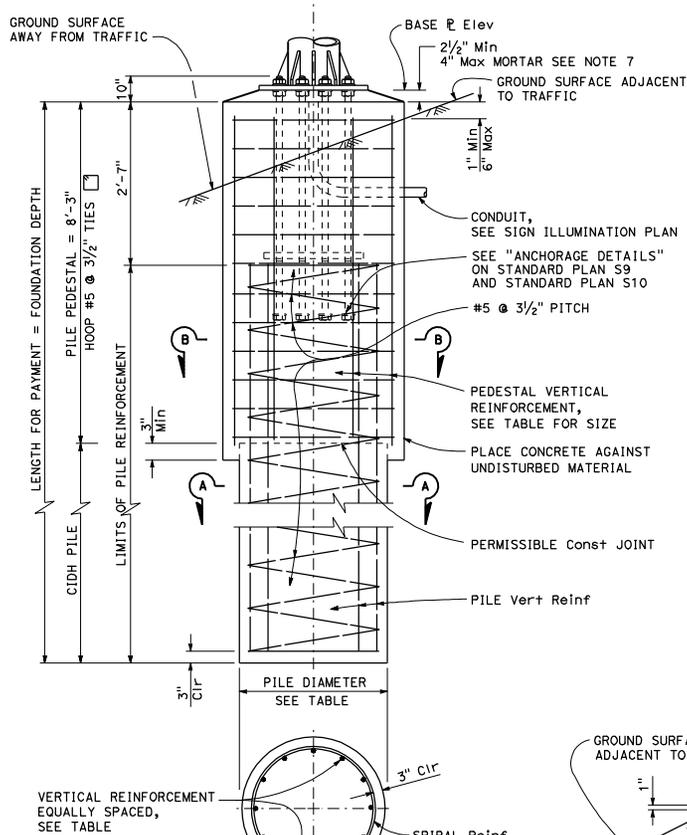
May 20, 2011  
PLANS APPROVAL DATE

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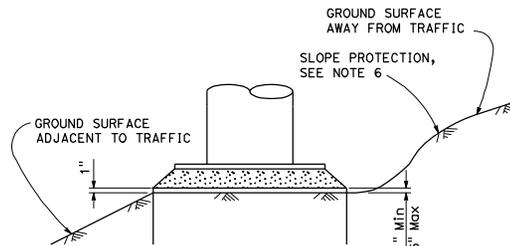
REGISTERED PROFESSIONAL ENGINEER  
Stanley P. Johnson  
No. CS793  
Exp. 3-31-12  
CIVIL  
STATE OF CALIFORNIA



SECTION B-B



SECTION A-A



DETAIL C

POST TYPE	ANCHOR BOLTS				SQUARE PILE PEDESTAL				CIDH PILE				FOUNDATION DEPTH **			
	TOTAL	Di <sub>a</sub>	BOLT CIRCLE	TOTAL LENGTH	PEDESTAL SQUARE ONE SIDE	VERTICAL REINFORCING TOTAL	BAR SIZE	# OF BARS EACH FACE	BAR SIZE	SPACING	PILE Di <sub>a</sub>	VERTICAL REINFORCING TOTAL		BAR SIZE	BAR SIZE	PITCH
I-S	12	2"	2'-4"	4'-2"	5'-3"	16	#10	5	#5	3 1/2"	4'-6"	26	#10	#5	3 1/2"	18'-0"
II-S	12		2'-4"													19'-8"
III-S	12		2'-7"													23'-0"
IV-S	14		2'-10"													23'-0"
V-S	16	2 1/2"	3'-2"	5'-0"	5'-10"		#11				5'-0"	28	#11			26'-3"
VI-S	16	2 1/2"	3'-5"	5'-0"	5'-10"		#11				5'-0"	28	#11			27'-10"
VII-S	16	2 1/2"	3'-5"	5'-0"	5'-10"		#11				5'-0"	28	#11			27'-10"

\*\* Use Foundation Depth shown in table unless otherwise shown on the Project Plans.

NOTES:

1. For anchor bolt layout, see Standard Plan S10.
2. For "Base E elevation" see Project Plans.
3. Longer side of post shall be normal to axis of sign.
4. Prior to erection of the post, backfill which is equivalent to the surrounding material, shall be in place.
5. Pedestal shall be formed 6" Min below ground surface. Remainder to be placed against undisturbed material.
6. Slope protection required when indicated on the Project Plans.
7. For drain holes and central void in mortar see Standard Plan ES-6B detail N.

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
TWO POST TYPE  
SQUARE PEDESTAL PILE FOUNDATION**

NO SCALE

**S14**

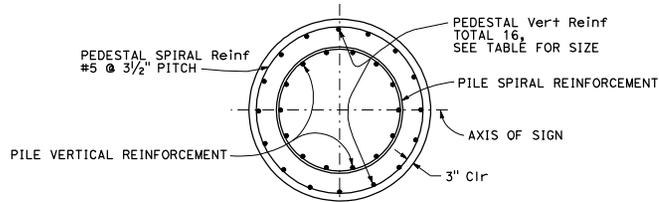
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

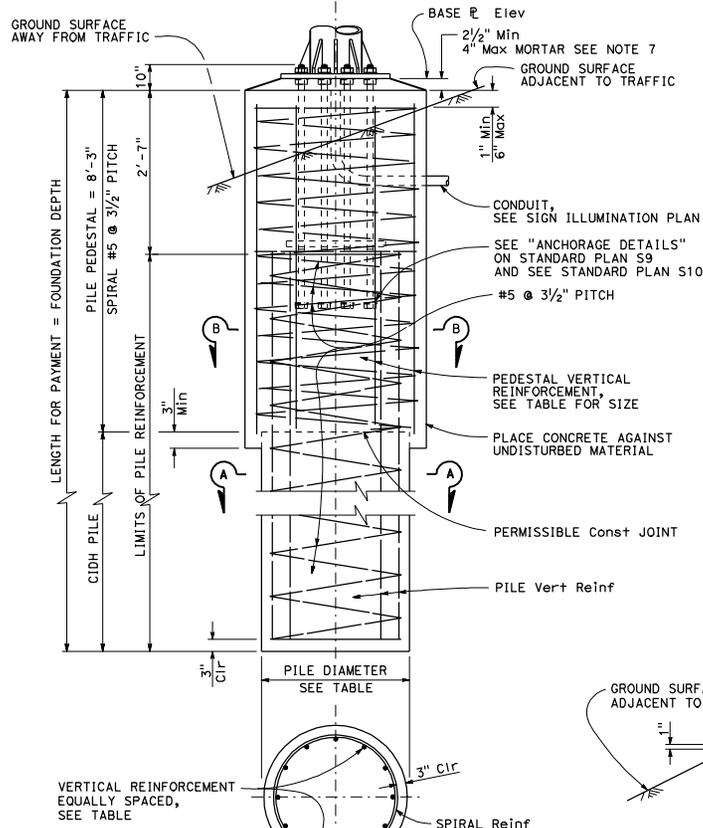
May 20, 2011  
PLANS APPROVAL DATE

Stanley P. Johnson  
No. CS7793  
Exp. 3-31-12  
REGISTERED PROFESSIONAL ENGINEER  
CIVIL  
STATE OF CALIFORNIA

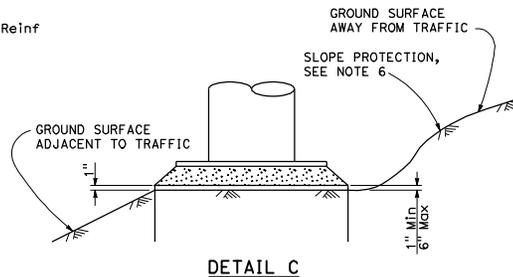
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SECTION B-B



SECTION A-A



DETAIL C

POST TYPE	ANCHOR BOLTS				ROUND PILE PEDESTAL				CIDH PILE				FOUNDATION DEPTH **
	TOTAL	Dia	BOLT CIRCLE	TOTAL LENGTH	Dia	VERTICAL REINFORCING		SPIRAL	PILE Dia	VERTICAL REINFORCING		SPIRAL	
						BAR SIZE	BAR SIZE			BAR SIZE	PITCH		
I-S	12	2"	2'-4"	4'-2"	5'-3"	#10	#5	3/2"	4'-6"	#10	#5	3/2"	18'-0"
II-S	12	2"	2'-4"	4'-2"	5'-3"	#10	#5	3/2"	4'-6"	#10	#5	3/2"	19'-8"
III-S	12	2"	2'-7"	4'-2"	5'-3"	#10	#5	3/2"	4'-6"	#10	#5	3/2"	23'-0"
IV-S	14	2"	2'-10"	4'-2"	5'-3"	#10	#5	3/2"	4'-6"	#10	#5	3/2"	23'-0"
V-S	16	2 1/2"	3'-2"	5'-0"	5'-9"	#11	#5	3/2"	5'-0"	#11	#5	3/2"	26'-3"
VI-S	16	2 1/2"	3'-5"	5'-0"	5'-9"	#11	#5	3/2"	5'-0"	#11	#5	3/2"	27'-10"
VII-S	16	2 1/2"	3'-5"	5'-0"	5'-9"	#11	#5	3/2"	5'-0"	#11	#5	3/2"	27'-10"

\*\* Use Foundation Depth shown in table unless otherwise shown on the Project Plans.

NOTES:

- For anchor bolt layout, see Standard Plan S10.
- For "Base R elevation" see Project Plans.
- Longer side of post shall be normal to axis of sign.
- Prior to erection of the post, backfill which is equivalent to the surrounding material, shall be in place.
- Pedestal shall be formed 6" Min below ground surface. Remainder to be placed against undisturbed material.
- Slope protection required when indicated on the Project Plans.
- For drain holes and central void in mortar see Standard Plan ES-6B detail N.

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
TWO POST TYPE  
ROUND PEDESTAL PILE FOUNDATION**

NO SCALE

S15

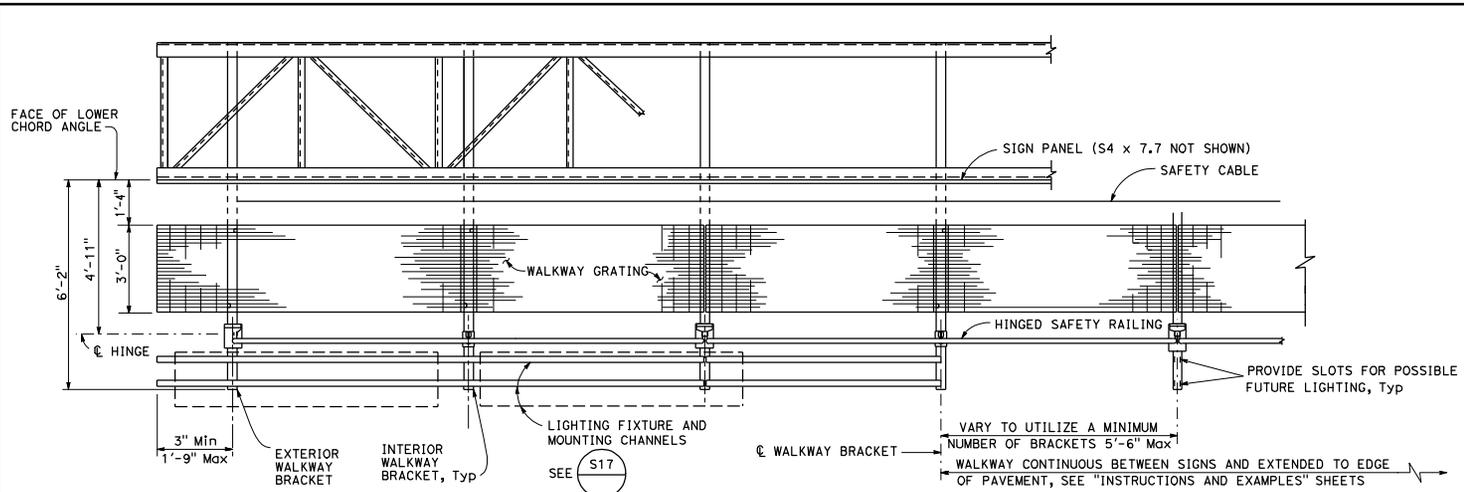
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

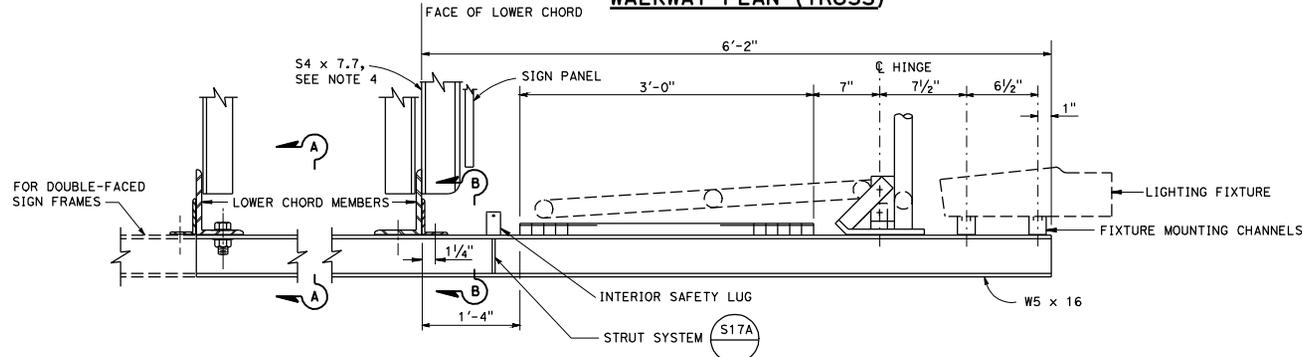
May 20, 2011  
PLANS APPROVAL DATE

Stanley P. Johnson  
No. CS793  
Exp. 3-31-12  
REGISTERED PROFESSIONAL ENGINEER  
CIVIL  
STATE OF CALIFORNIA

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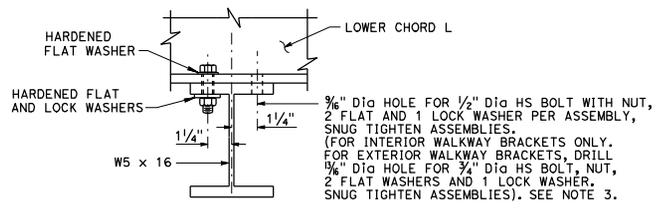


**WALKWAY PLAN (TRUSS)**

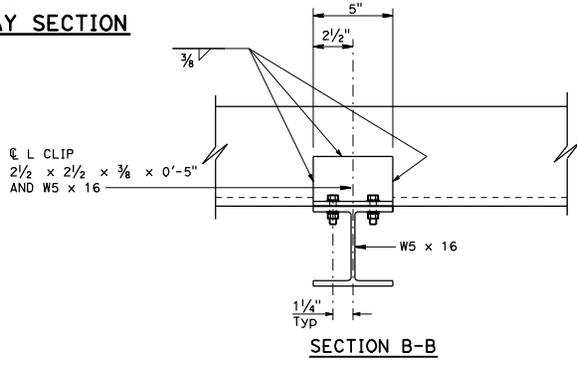


**TRUSS**

**TYPICAL WALKWAY SECTION**



**SECTION A-A**

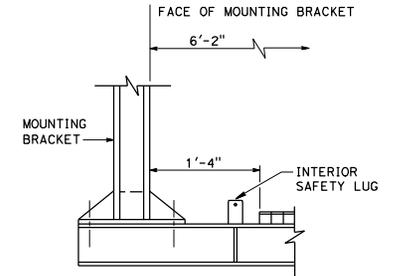


**SECTION B-B**

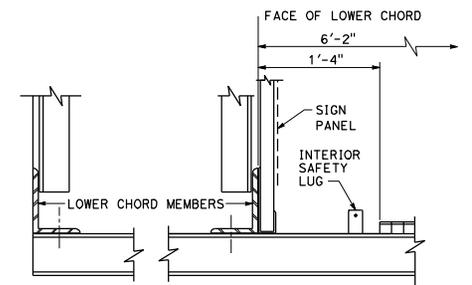
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

**Stanley P. Johnson**  
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May 20, 2011  
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**TUBULAR AND BRIDGE MOUNTED**

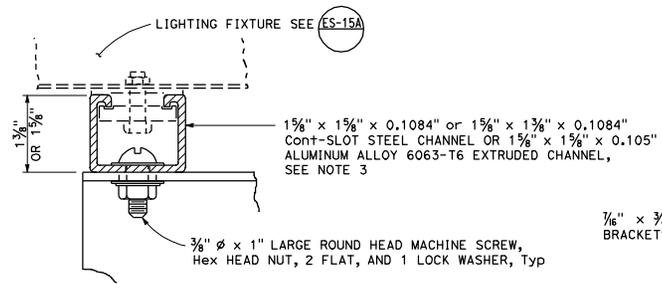


**BOX BEAM CLOSED TRUSS**

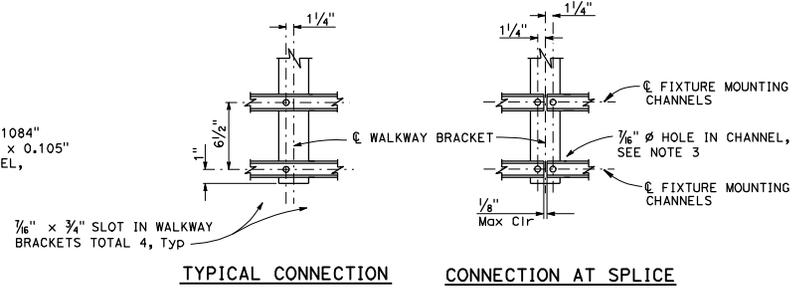
- NOTES:**
1. For spacing of lighting fixtures, see Standard Plan ES-15A.
  2. For safety lug details, see Standard Plan S17.
  3. For double faced sign frames with double walkways, use a total 8 bolt assemblies per bracket.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS  
 WALKWAY DETAILS No. 1**  
 NO SCALE

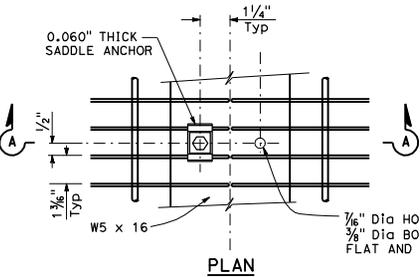
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
 REGISTERED CIVIL ENGINEER					
May 20, 2011 PLANS APPROVAL DATE					
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.					
					



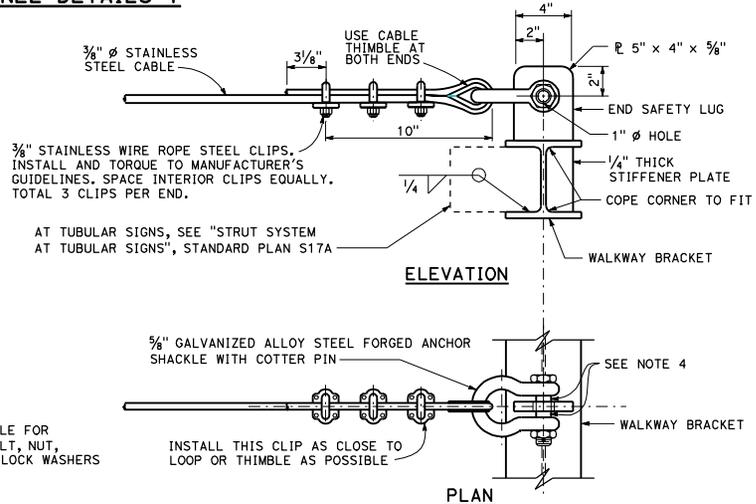
**LIGHTING FIXTURE MOUNTING CHANNEL DETAILS 1**



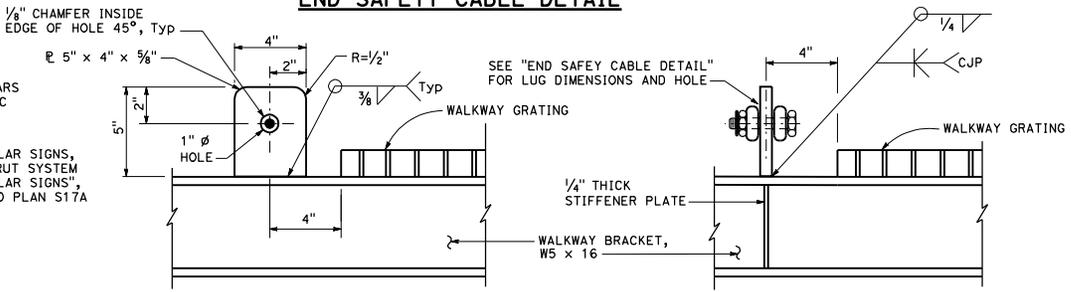
**LIGHTING FIXTURE MOUNTING CHANNEL DETAILS 2**



**SECTION A-A**  
**WALKWAY GRATING DETAILS**  
Shown at splice



**END SAFETY CABLE DETAIL**



**INTERIOR SAFETY LUG DETAIL**  
(At every walkway bracket between exterior walkway brackets)

**END SAFETY LUG DETAIL**  
(At exterior walkway brackets)

- NOTES:**
1. Welded type grating shall have 1/4" x 1/8" bearing bars at 1 3/8" centers with 1/4" diameter (or equal) cross bars at 4" centers. If mechanical lock grating is used, it shall be equal in strength to the welded type. Alternate hold-down clips may be submitted for approval.
  2. Walkway grating and light fixture mounting channels to be continuous (no splices) over as many walkway brackets as practical and consistent with fabrication, ease of handling and assembly.
  3. Contractor may substitute 1 5/8" x 1 5/8" x .1084" cont-slot steel channel with pre-punched slots not larger than 1 1/2" x 3". Slots shall be at bottom of channel and shall be parallel to channel. Slots shall be spaced not closer than 4" center to center.
  4. Place an equal amount of washers on each side to align cable with end lug without restricting shackle bolt rotation or contacting cable.

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS**  
**WALKWAY DETAILS No. 2**  
NO SCALE

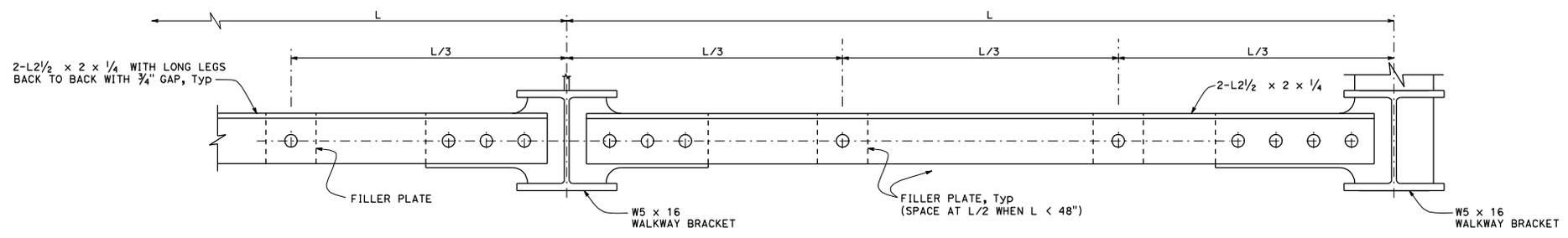
351

2010 STANDARD PLAN S17A

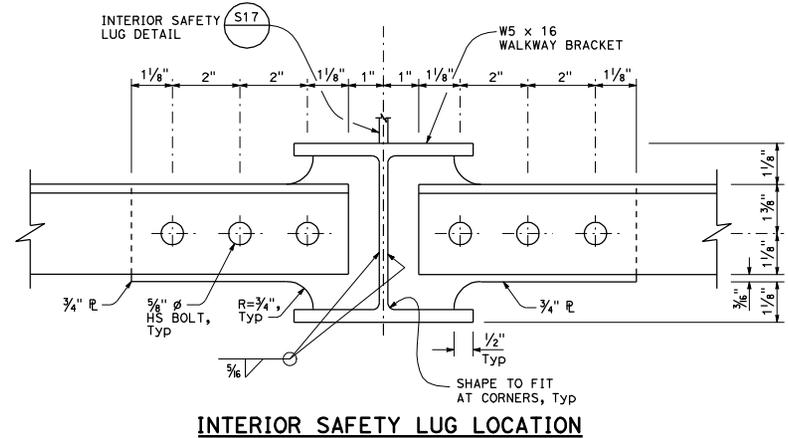
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*Stanley P. Johnson*  
 REGISTERED CIVIL ENGINEER  
 No. CS7393  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

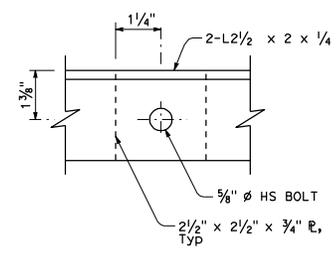
May 20, 2011  
 PLANS APPROVAL DATE  
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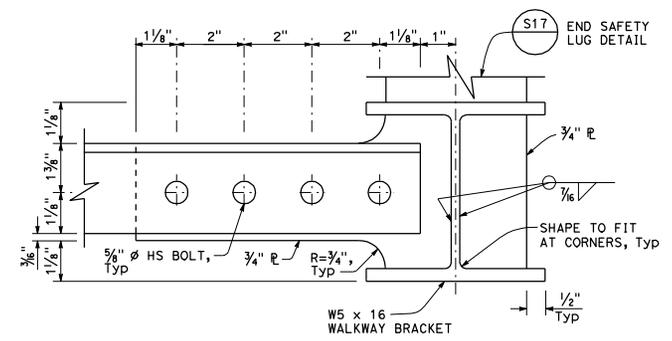
**STRUT SYSTEM AT TUBULAR SIGNS**  
 (Continuous between end safety lug locations)



**INTERIOR SAFETY LUG LOCATION**



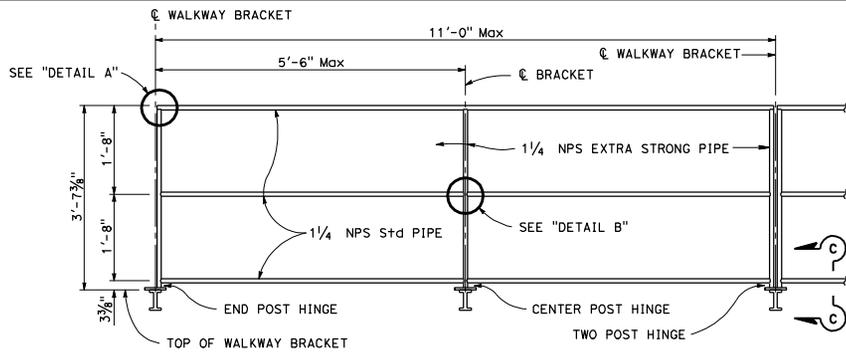
**FILLER PLATE**



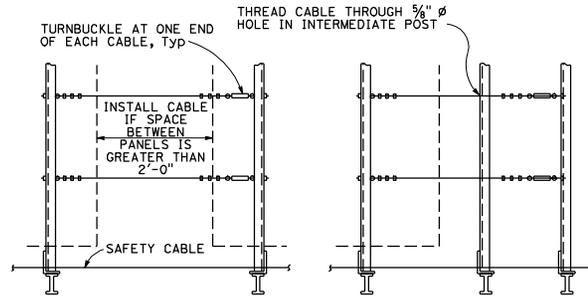
**END SAFETY LUG LOCATION**

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS**  
**WALKWAY DETAILS No. 3**  
 NO SCALE

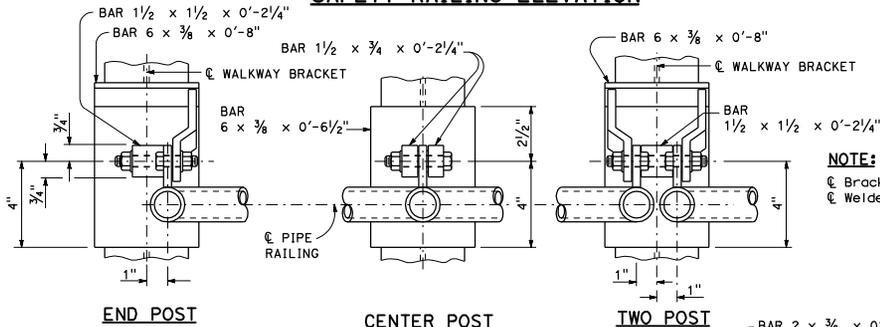
**S17A**



**SAFETY RAILING ELEVATION**

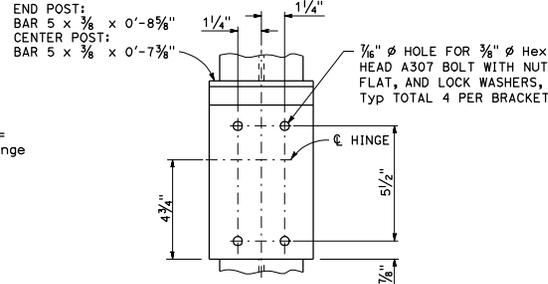


**UPPER SAFETY CABLE ELEVATION**  
For tubular structures

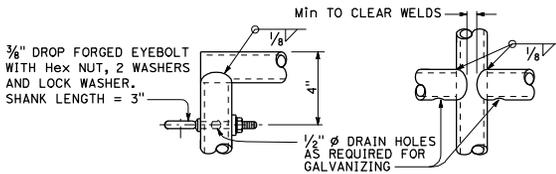


**WELDED HINGE - PLAN**

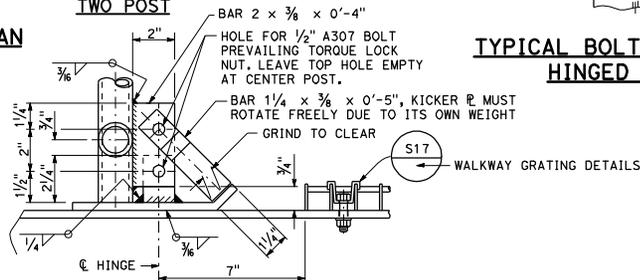
**NOTE:**  
⊕ Bracket =  
⊕ Welded hinge



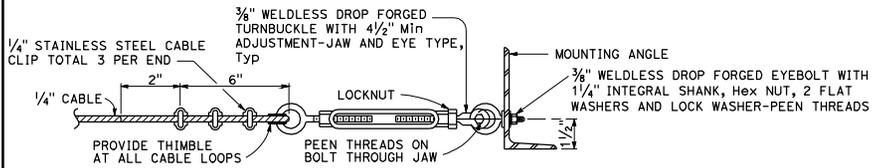
**TYPICAL BOLTED (ALTERNATIVE) HINGED CONNECTION**



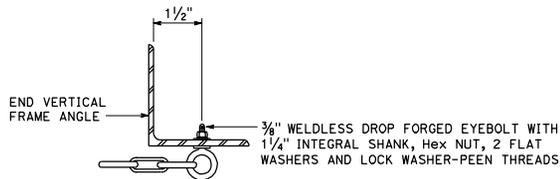
**NOTE:** Alternative venting methods may be used if approved by the Engineer.



**SECTION C-C**



**TURNBUCKLE DETAILS**

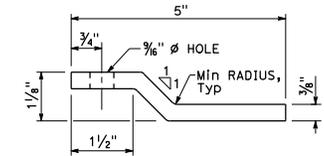


**VIEW Z-Z**

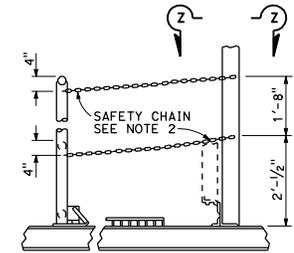
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

**Stanley P. Johnson**  
 REGISTERED CIVIL ENGINEER  
 No. CS7933  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

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**PLAN - KICKER BAR**



**CHAIN ASSEMBLY**

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS  
 WALKWAY SAFETY  
 RAILING DETAILS**

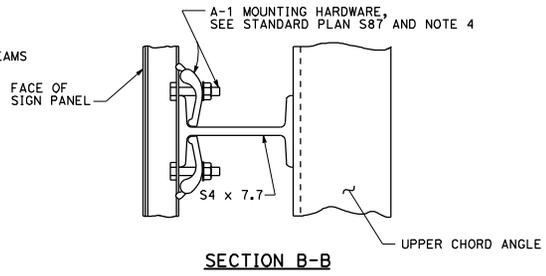
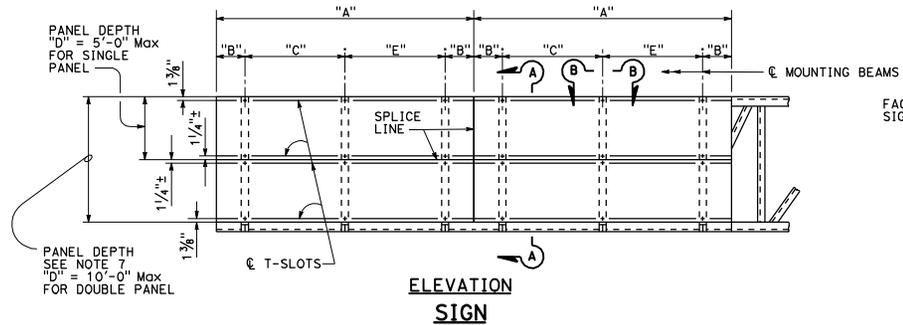
NO SCALE

**S18**

DIST	COUNTY	ROUTE	POST MILES	SHEET TOTAL
			TOTAL PROJECT	NO. SHEETS

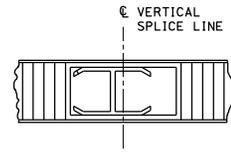
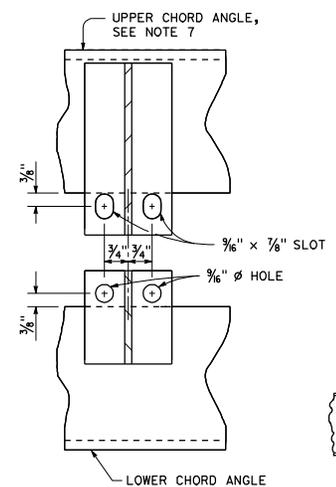
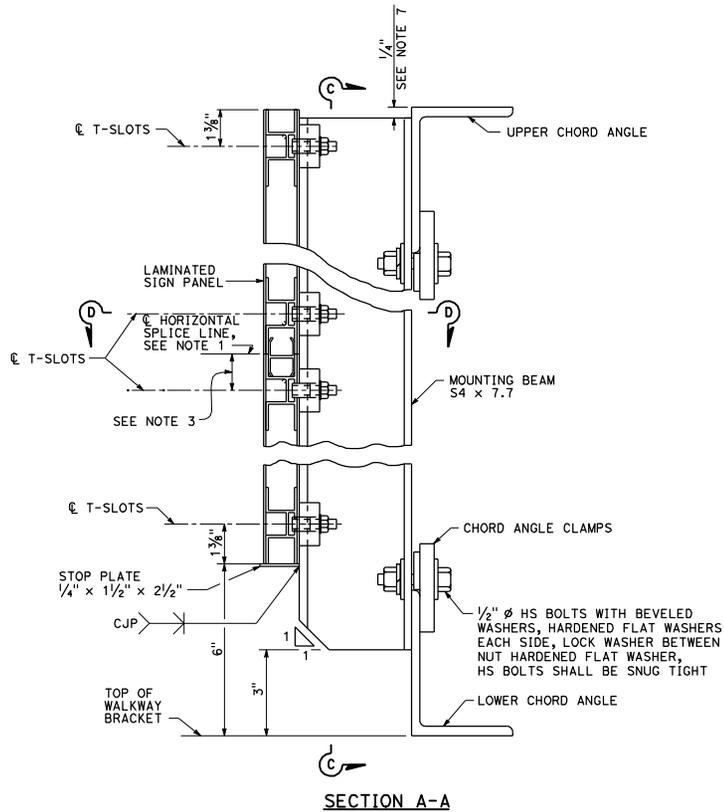
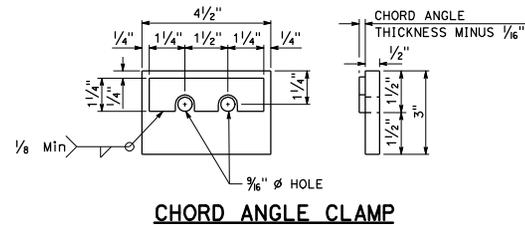
  
 REGISTERED CIVIL ENGINEER  
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 Exp. 3-31-12  
 STATE OF CALIFORNIA

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MOUNTING BEAM SPACING TABLE

SIGN PANEL LENGTH *	NUMBER MOUNTING BEAMS	SIGN PANEL OVERHANG		
		"B"	"C"	"E"
5'-0"	2	9"	3'-6"	
6'-0"		1'-0"	4'-0"	
7'-0"		1'-3"	4'-6"	
8'-0"		1'-6"	5'-0"	
9'-0"		1'-10"	5'-6"	
10'-0"		2'-0"	6'-0"	
11'-0"		2'-0"	7'-0"	
12'-0"		2'-6"	7'-0"	
13'-0"		2'-6"	8'-0"	
14'-0"		2'-6"	9'-0"	
15'-0"		3'-0"	9'-0"	
16'-0"	3	6"	7'-6"	7'-6"
17'-0"		1'-0"	7'-6"	7'-6"
18'-0"		1'-0"	8'-0"	8'-0"
19'-0"		1'-0"	8'-6"	8'-6"
20'-0"		1'-6"	8'-6"	8'-6"
21'-0"		1'-6"	9'-0"	9'-0"
22'-0"		2'-0"	9'-0"	9'-0"
23'-0"		2'-6"	9'-0"	9'-0"
24'-0"		3'-0"	9'-0"	9'-0"

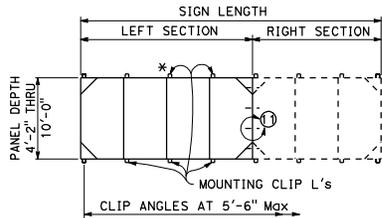


\* Signs longer than 24'-0" are fabricated and mounted as adjoining single panels. The location of the vertical splice line will be determined by the Engineer.

NOTES:

- The location of the horizontal splice line is dependent on the Contractor for signs greater than 60" in depth.
- Mounting bolts and clamps are required on each side of the horizontal splice lines at each support beam.
- Dimension varies from panel to panel. Average value approximate 1 1/4".
- Torque stainless steel sign panel mounting bolts to 100 inch-pounds.
- Chord angle clamp to be galvanized after fabrication.
- The Contractor shall verify all dependent dimensions in the field before ordering or fabricating any material.
- 9'-2" and 10'-0" sign panel along with the mounting beams will project above the top chord truss member 10" and 1'-8" respectively. Attachment details shall be the same.

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
 SIGN MOUNTING DETAILS  
 LAMINATED PANEL-TYPE A**  
 NO SCALE



**REMOVABLE FRAME  
GREATER THAN 20'-0"**

\* 9'-2" & 10'-0" sign panel frames will project above the topchord of the truss. In these cases the top clips shall be bolted to vertical frame members. See Standard Plan S22 for details.

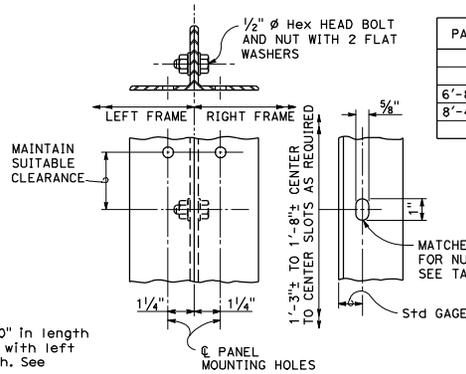
SIGN LENGTH	LEFT SECTION	RIGHT SECTION
22'-0"	12'-0"	10'-0"
24'-0"	12'-0"	12'-0"
26'-0"	12'-0"	14'-0"
28'-0"	16'-0"	12'-0"
30'-0"	16'-0"	14'-0"
32'-0"	16'-0"	16'-0"
34'-0"	16'-0"	18'-0"
36'-0"	20'-0"	16'-0"
38'-0"	20'-0"	18'-0"
40'-0"	20'-0"	20'-0"

**NOTES:**

Frames for signs greater than 20'-0" in length shall be fabricated in two sections with left section a multiple of 4'-0" in length. See table above.

Sections shall be hoisted into place individually and bolted together as per detail 11 prior to tightening of mounting clip bolts.

Bolting two sections together and hoisting simultaneously will not be permitted.



**DETAIL 11  
FRAME TO FRAME  
CONNECTION DETAILS**

PANEL DEPTH	No. OF SLOTS
4'-2"	2
5'-10"	3
6'-8" AND 7'-6"	4
8'-4" AND 9'-2"	5
10'-0"	6

**NOTES:**

Panel mounting holes not shown. Panel lengths available in 2'-0" increments.

MATCHED SLOTS IN END L'S. FOR NUMBER REQUIRED, SEE TABLE ABOVE

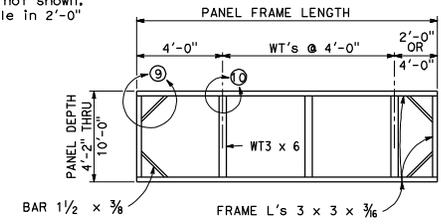
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET TOTAL SHEETS

Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

Stanley P. Johnson  
No. C51793  
Exp. 3-31-12  
CIVIL ENGINEER PROFESSIONAL SERVICES  
STATE OF CALIFORNIA

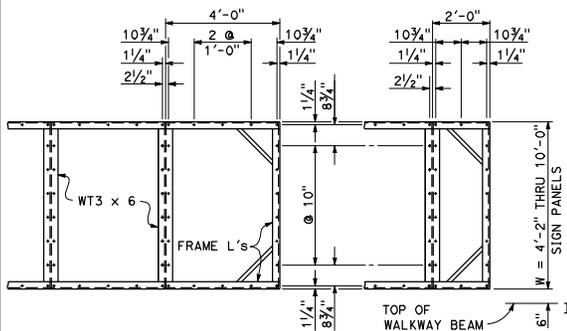
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**TYPICAL REMOVABLE FRAME  
(4'-0" thru 20'-0")**

**NOTES:**

1. Frames shall be all-welded construction.
2. Panel mounting holes shall be drilled by template. Sign panel may be considered as a template.
3. Drilled and tapped holes 1/4" may be used where interference due to welds or structural members is encountered.
4. WT3 x 6 shall be flush with faces of frame angles.
5. Mounting clip angles shall be located such as to allow the top and bottom frame angles of the removable sign panel to lie on a straight horizontal line.
6. Holes for mounting removable sign panel frame may be slotted 1" maximum parallel to the axis of the sign.
7. WT3 x 6 may be crimped at ends to join frame angles. Fillet weld all around.

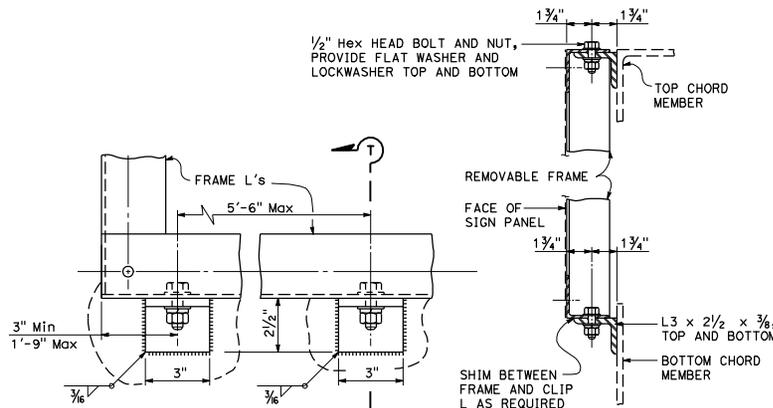


**TYPICAL 4'-0" PANEL      TYPICAL 2'-0" PANEL**

All holes 1/2" diameter maximum.

**MOUNTING HOLE SPACING  
SIGN PANEL & FRAME**

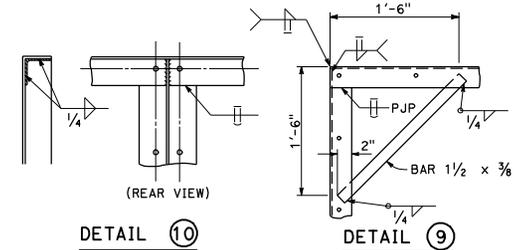
Hole spacing is for single sheet sign panels. For Overhead Formed Panels refer to "Removable Sign Panel Frames, Mounting Details" Sheet.



**FRAME MOUNTING DETAILS**

Details shown apply for sign panel frames ≤ 8'-4" deep. Mounting details for deeper panels shown on Standard Plan S22.

**SECTION T-T**



**DETAIL 10**

**DETAIL 9**

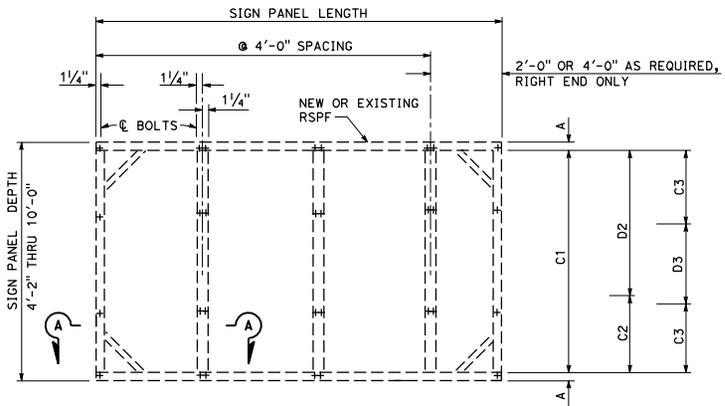
**TYPICAL FRAME JOINT DETAILS**

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS  
STEEL FRAMES  
REMOVABLE SIGN PANEL FRAMES**

NO SCALE

**S20**

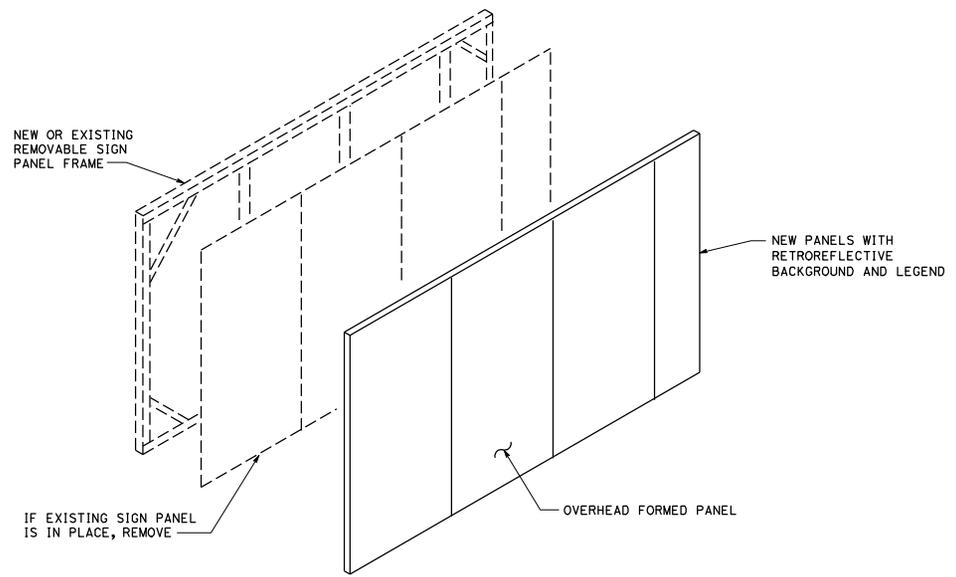
355



ELEVATION VIEW

**NEW OR EXISTING REMOVABLE SIGN PANEL FRAME MOUNTING HOLE SPACING**

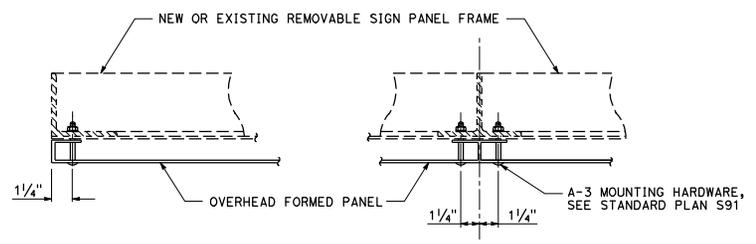
**NOTE:**  
Sign panel mounting holes 1/2"  $\phi$  maximum for 3/8"  $\phi$  bolts.



**NOTE:**  
The Contractor shall verify all dependent dimensions in the field before ordering or fabricating any material.

MOUNTING BOLT SPACING							
PANEL DEPTH	A	1 SPACE		2 SPACE		3 SPACE	
		C1	C2	D2	C3	D3	C3
50"	1 1/4"	3'-11 1/2"					
60"			2'-4 3/4"	2'-4 3/4"			
70"			1'-6 3/4"	4'-3/4"			
80"			3'-2 3/4"	3'-2 3/4"			
90"			3'-2 3/4"	4'-3/4"			
100"			4'-3/4"	4'-3/4"			
110"					3'-2 3/4"	2'-6"	3'-2 3/4"
120"	1 1/4"				4'-3/4"	1'-8"	4'-3/4"

TABLE 1



CORNER DETAIL

PANEL CONNECTION

SECTION A-A

**NOTES:**  
When constructing a new frame:  
(1) Refer to Standard Plan Sheet S20 for structural details.  
(2) Sign panels shall be considered as a template for drilling holes for mounting bolts.

STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS  
REMOVABLE SIGN PANEL FRAMES  
MOUNTING DETAILS**

NO SCALE

**S21**

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

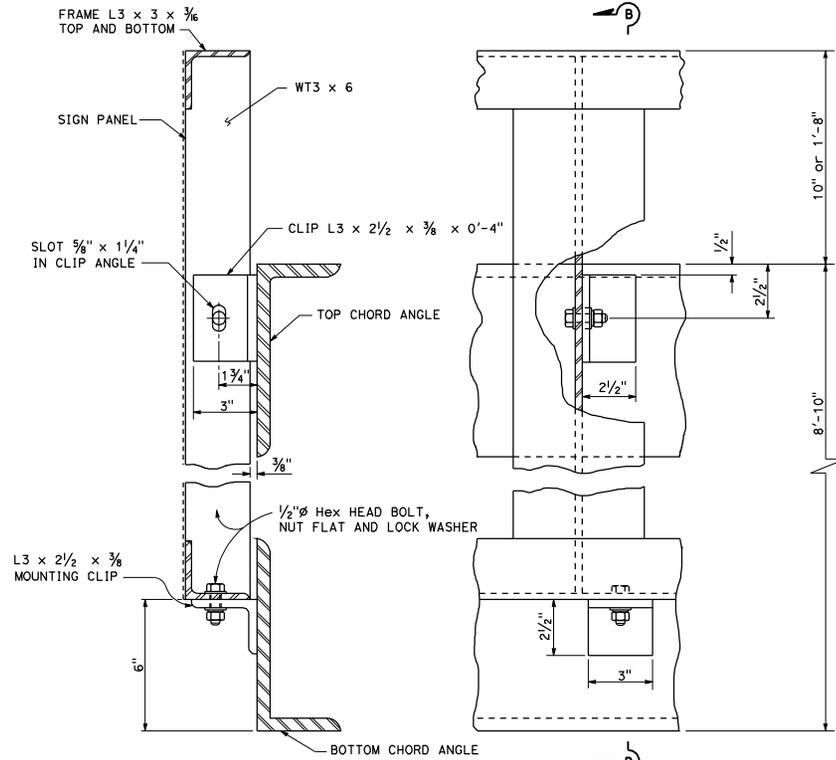
Stanley P. Johnson  
REGISTERED CIVIL ENGINEER

May 20, 2011  
PLANS APPROVAL DATE

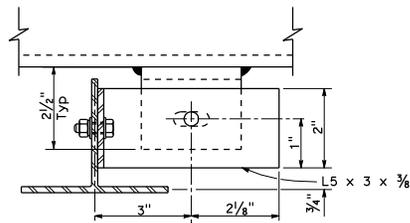
Stanley P. Johnson  
No. CS793  
Exp. 3-31-12  
CIVIL  
STATE OF CALIFORNIA

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2010 STANDARD PLAN S21



**SECTION B-B ELEVATION VIEW  
STEEL REMOVABLE SIGN PANEL FRAMES**



**BOLTED ALTERNATIVE CONNECTION AT TOP CHORD**  
For details not shown, see Sections C-C and D-D.

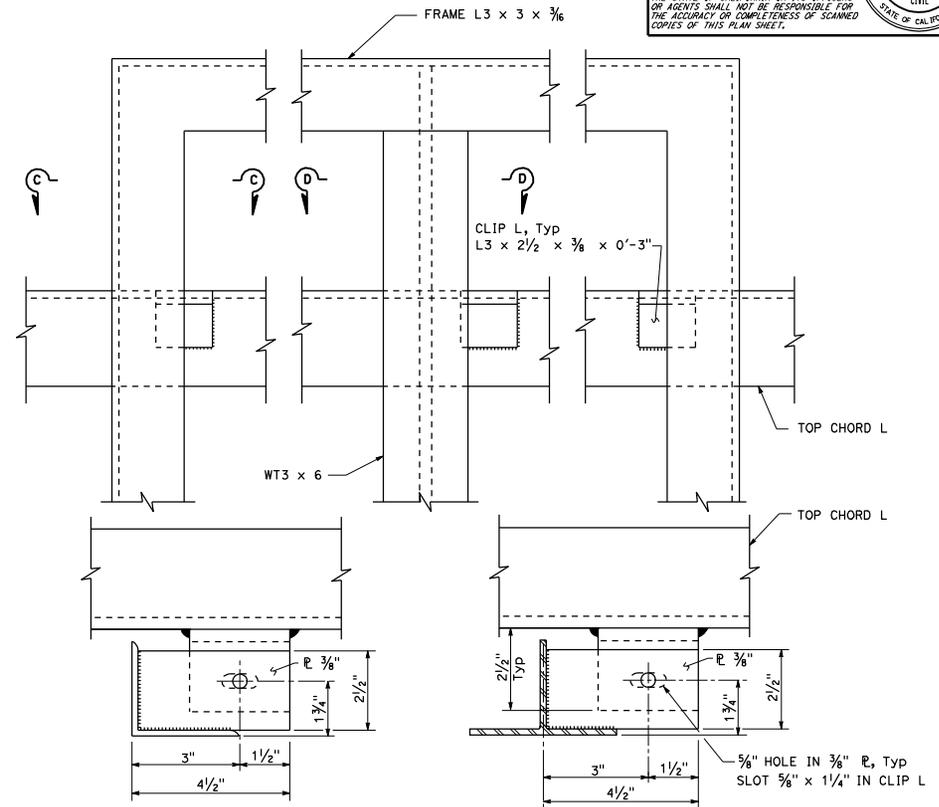
**NOTES:**

1. For Steel Removable Sign Panel Frame details see Standard Plan S20.
2. Minimum fillet weld is 1/4" for clip angles welded to chord member of truss.
3. Maximum spacing of bottom clip angle is 5'-6".
4. Top clips required for each vertical member of Removable Sign Panel Frame.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

*Stanley P. Johnson*  
 REGISTERED CIVIL ENGINEER  
 No. CS7893  
 Exp. 3-31-12  
 CIVIL  
 STATE OF CALIFORNIA

May 20, 2011  
 PLANS APPROVAL DATE  
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**SECTION C-C SECTION D-D  
ALTERNATIVE CONNECTION AT TOP CHORD**

STATE OF CALIFORNIA  
 DEPARTMENT OF TRANSPORTATION  
**OVERHEAD SIGNS-TRUSS  
 REMOVABLE SIGN PANEL FRAMES  
 110" AND 120"  
 SIGN PANELS**  
 NO SCALE

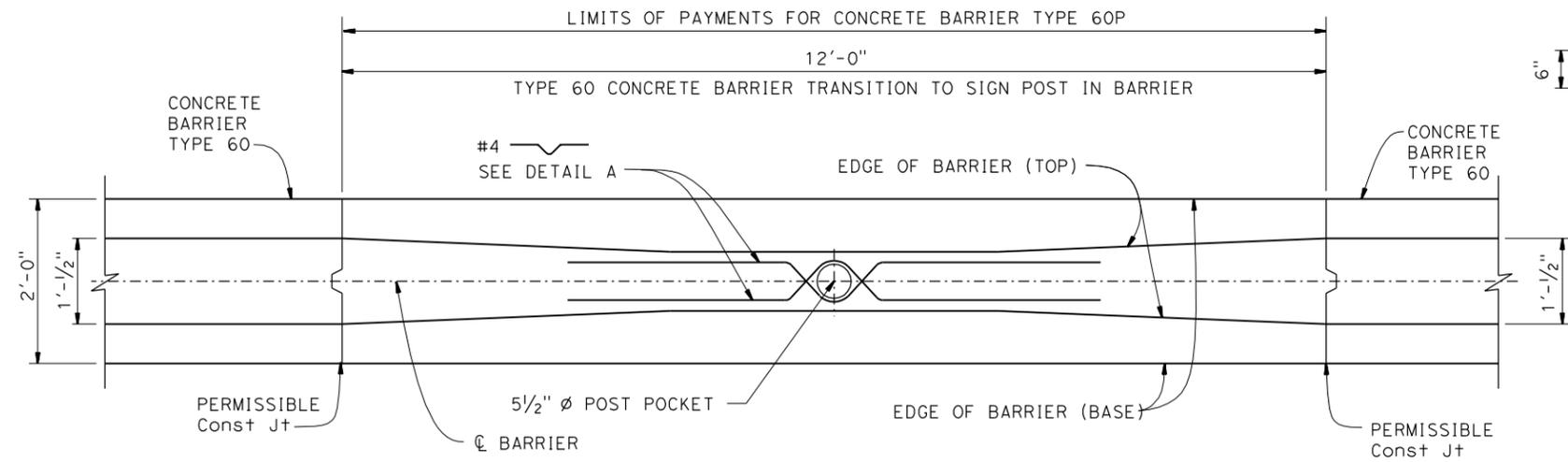
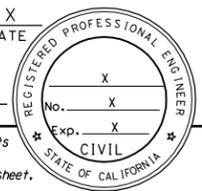
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X	X	X	X	X	X

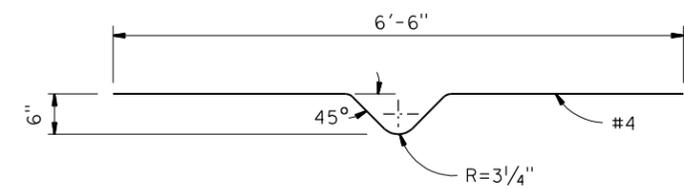
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PLANS APPROVAL DATE			

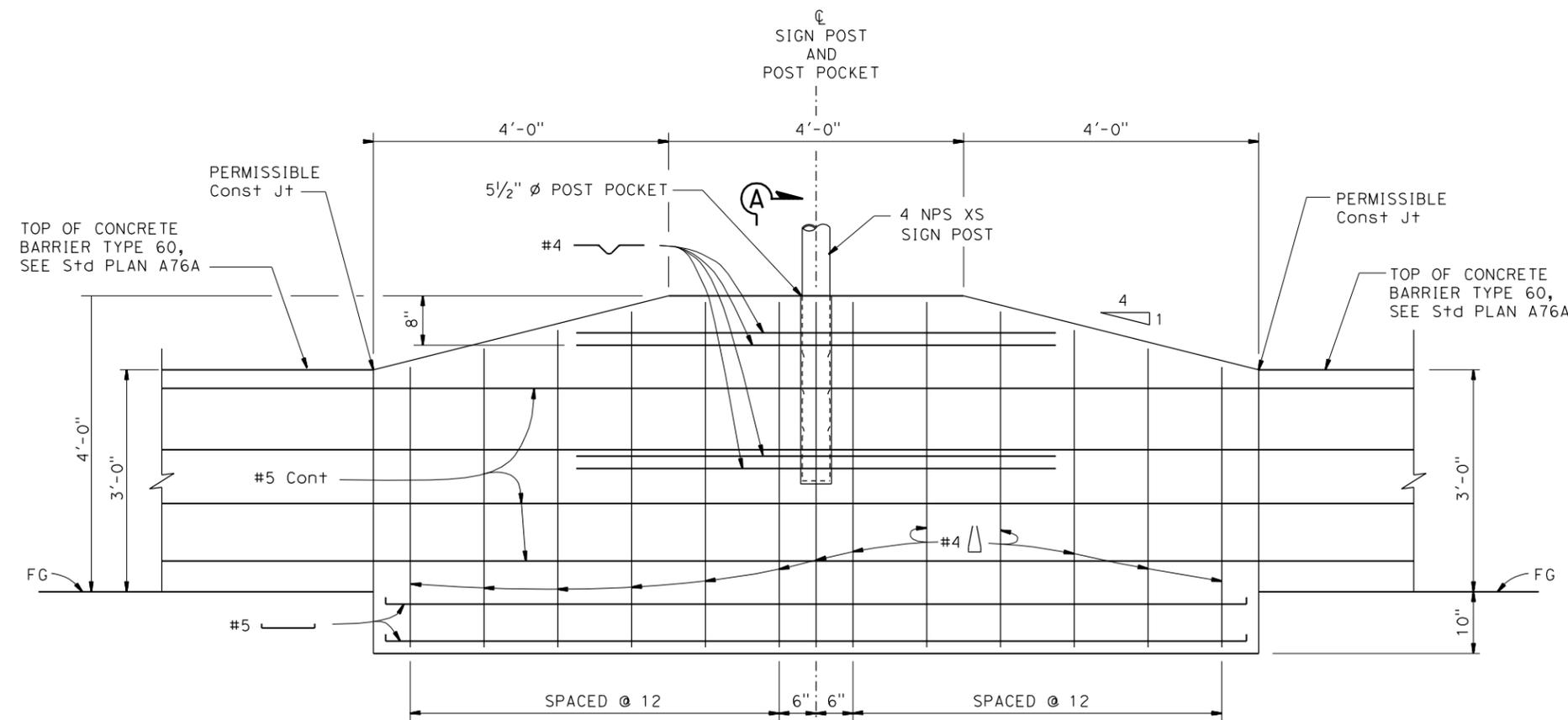
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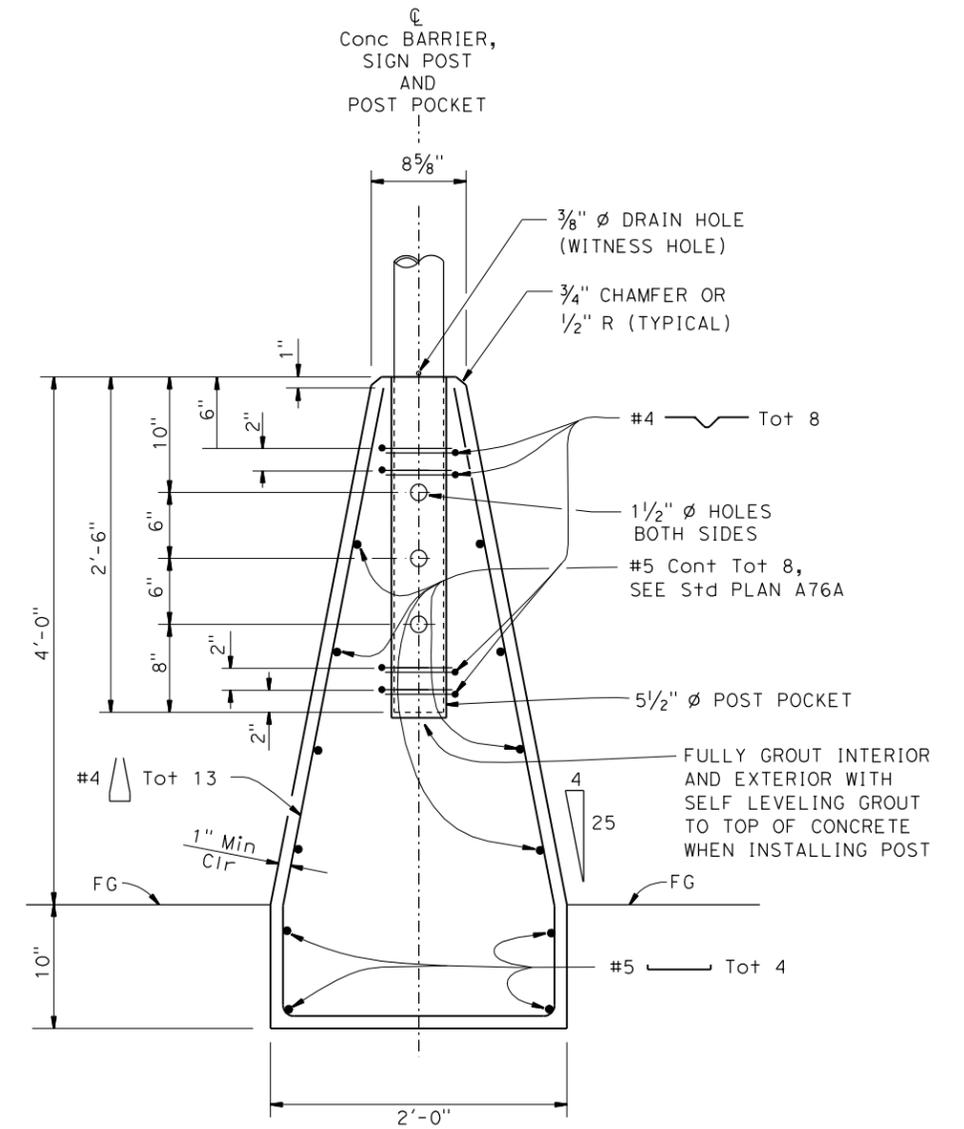
**PLAN**



**DETAIL A**



**ELEVATION**



**SECTION A-A**

NO SCALE

STANDARD DRAWING	
FILE NO. <b>xs16-075</b>	APPROVAL DATE <u>July 2012</u>

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	
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DIVISION OF ENGINEERING SERVICES	
BRIDGE NO.	X
POST MILE	X

X	
<b>CONCRETE BARRIER TYPE 60P</b>	

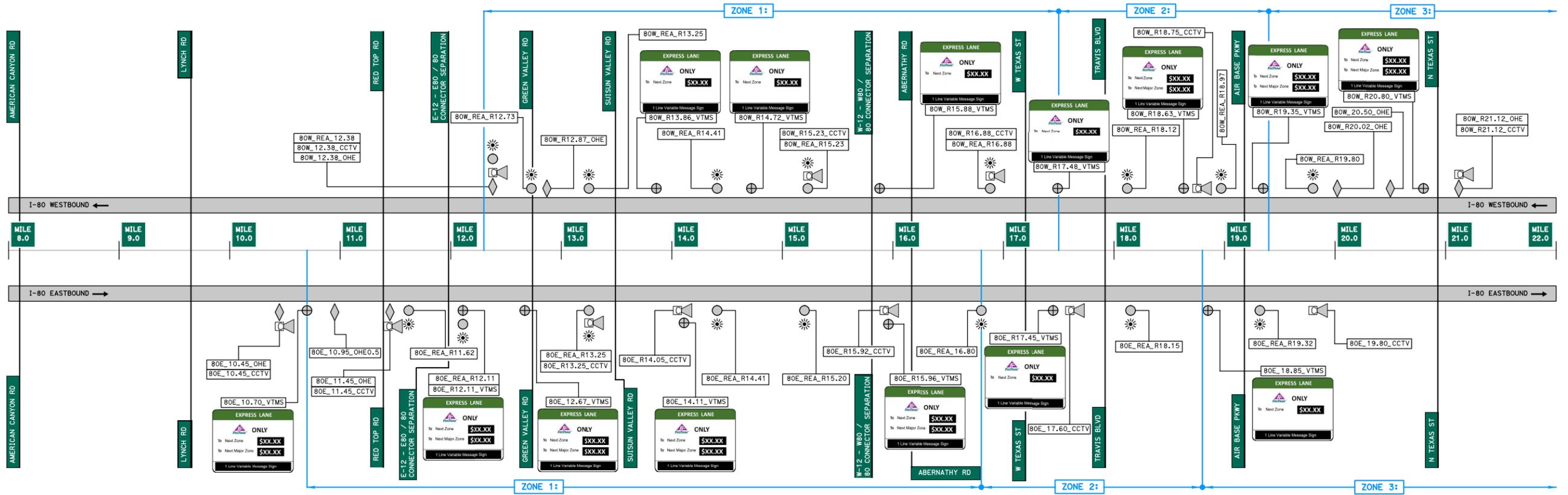
BAIFA Express Lane Network Toll Collection System

**Appendix 1, Reference 2**

**Diagrams, Drawings and Schematics**

## **C: Straight Line Diagrams**





**LEGEND:**

- ▭ GENERAL PURPOSE LANE (GL)
- ▭ EXPRESS LANE (EL) - RESTRICTED ACCESS
- READERS (READ POINTS) / VES Cameras / TMS
- ZONE LIMIT
- ⊕ MILE MARKER
- ⊕ VTMS
- EXPRS END OF MANAGED LANE
- △ HUB SWITCH
- ◇ OVERHEAD
- ⊗ DO NOT CROSS DOUBLE WHITE LINE
- ⊠ CCTV
- ⊛ BEACONS

**ABBREVIATION LEGEND:**

- CCTV Camera = Closed Circuit Television
- OHE = Overhead Static Sign
- REA = Read Points
- TMS = Traffic Monitoring System
- VTMS = Variable Toll Message Sign

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

**ATKINS**

475 Sansome Street, Suite 2000  
San Francisco, CA 94111  
(415) 362-1500 www.atkinsglobal.com

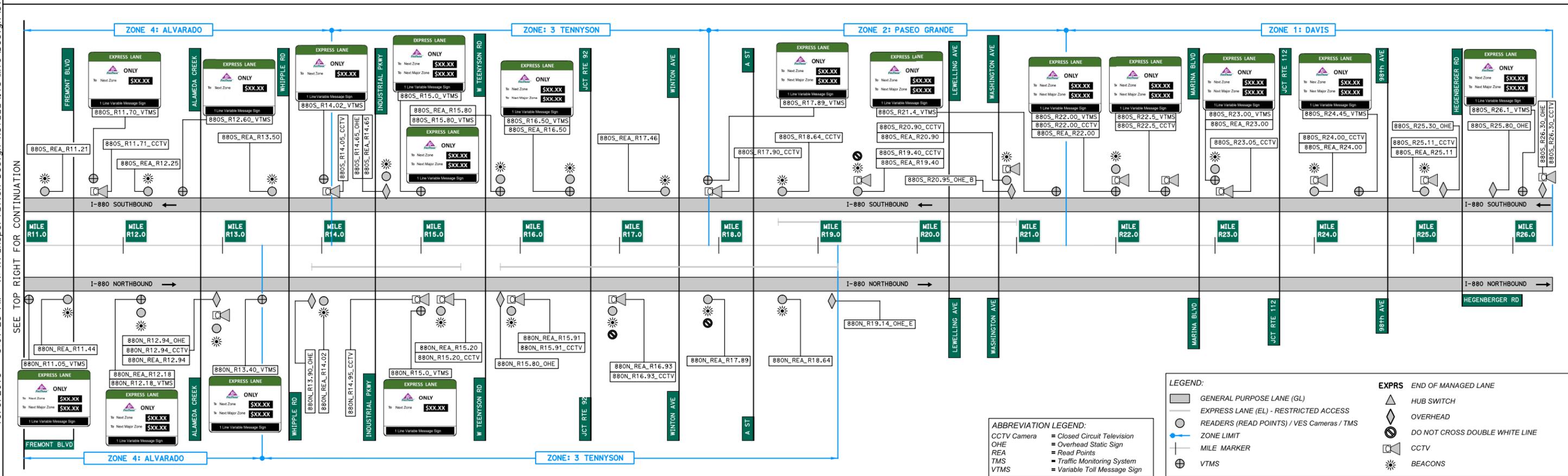
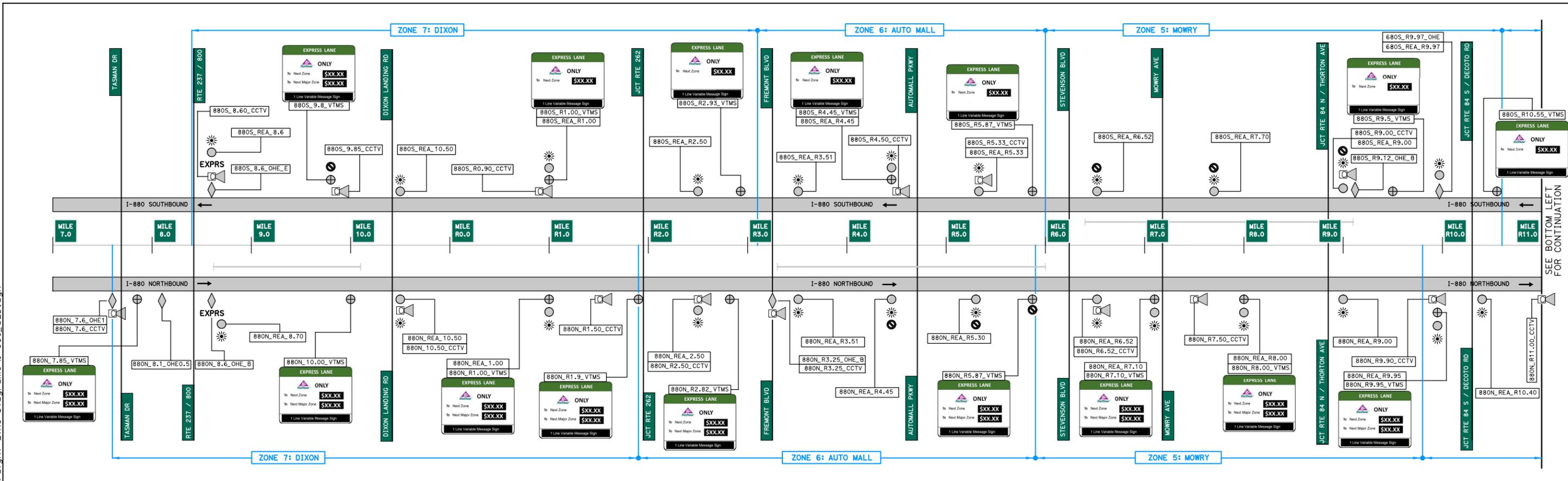
PROJECT NO.

I-80 STRAIGHT LINE DIAGRAMS

SHEET NO.

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19309



**LEGEND:**

- GENERAL PURPOSE LANE (GL)
- EXPRESS LANE (EL) - RESTRICTED ACCESS
- READERS (READ POINTS) / VES Cameras / TMS
- ZONE LIMIT
- MILE MARKER
- VTMS

**ABBREVIATION LEGEND:**

- CCTV Camera = Closed Circuit Television
- OHE = Overhead Static Sign
- REA = Read Points
- TMS = Traffic Monitoring System
- VTMS = Variable Toll Message Sign

**EXPRS** END OF MANAGED LANE

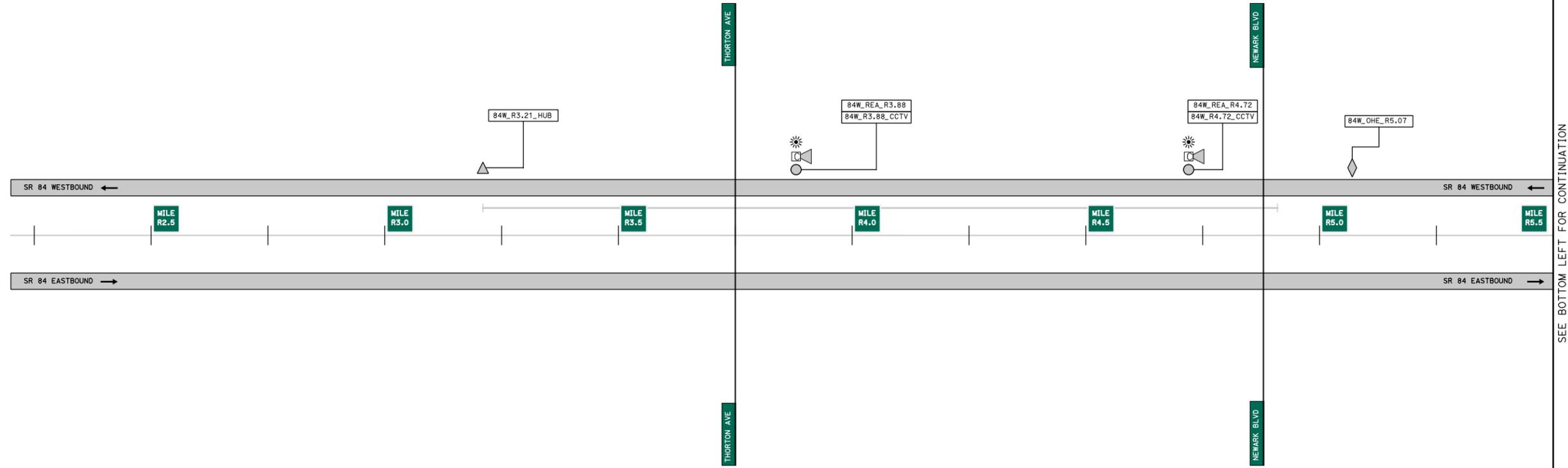
- HUB SWITCH
- OVERHEAD
- DO NOT CROSS DOUBLE WHITE LINE
- CCTV
- BEACONS

REVISIONS		REVISIONS	
DATE	DESCRIPTION	DATE	DESCRIPTION

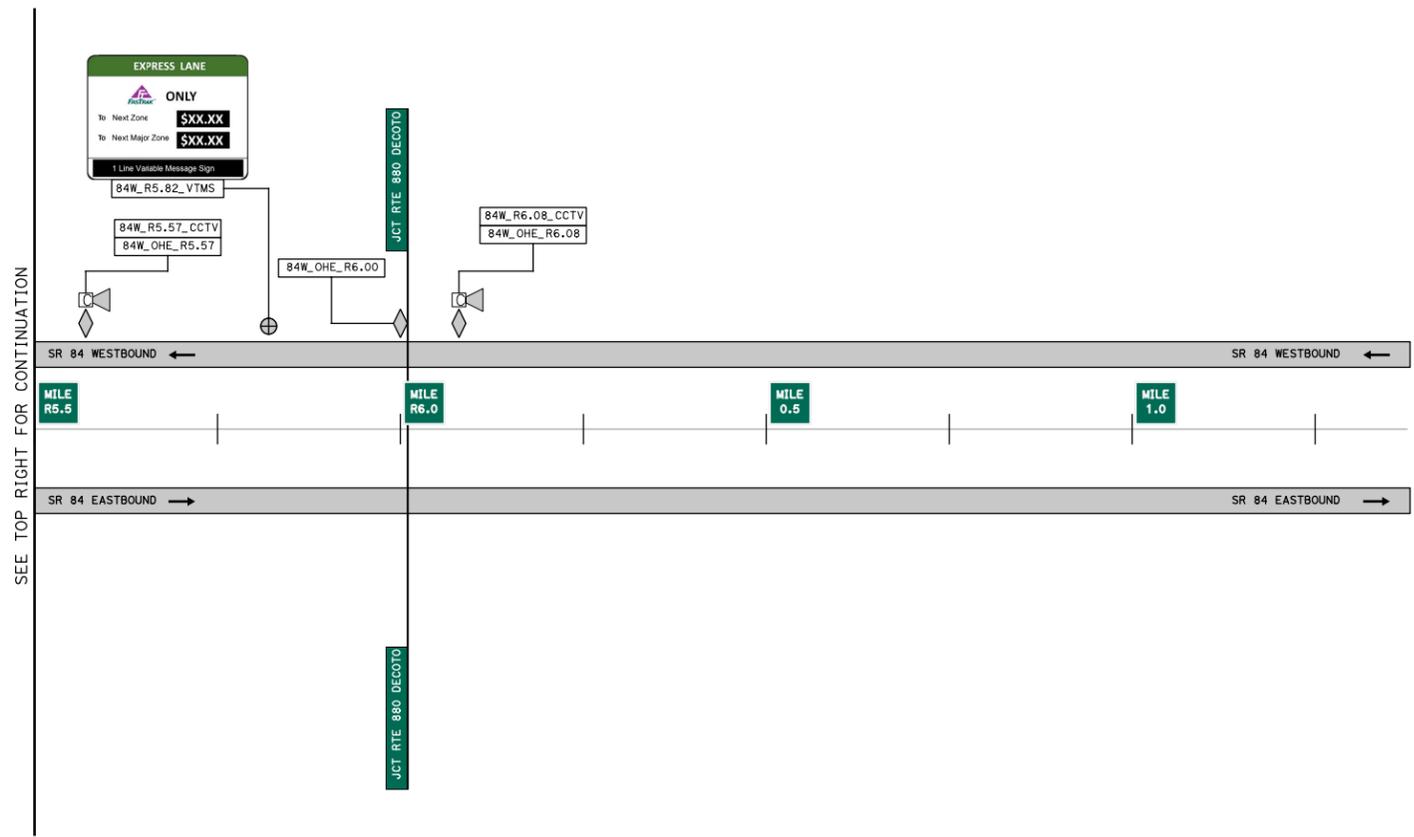
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PROJECT NO.	I-880 STRAIGHT LINE DIAGRAMS	SHEET NO.
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SEE BOTTOM LEFT FOR CONTINUATION



SEE TOP RIGHT FOR CONTINUATION

**ABBREVIATION LEGEND:**  
 CCTV Camera = Closed Circuit Television  
 OHE = Overhead Static Sign  
 REA = Read Points  
 TMS = Traffic Monitoring System  
 VTMS = Variable Toll Message Sign

**LEGEND:**

- GENERAL PURPOSE LANE (GL)
- EXPRESS LANE (EL) - RESTRICTED ACCESS
- READERS (READ POINTS) / VES Cameras / TMS
- ZONE LIMIT
- MILE MARKER
- ⊕ VTMS
- EXPRS**
- △ END OF MANAGED LANE
- ◇ HUB SWITCH
- ◇ OVERHEAD
- ⊘ DO NOT CROSS DOUBLE WHITE LINE
- ⊠ CCTV
- ☀ BEACONS

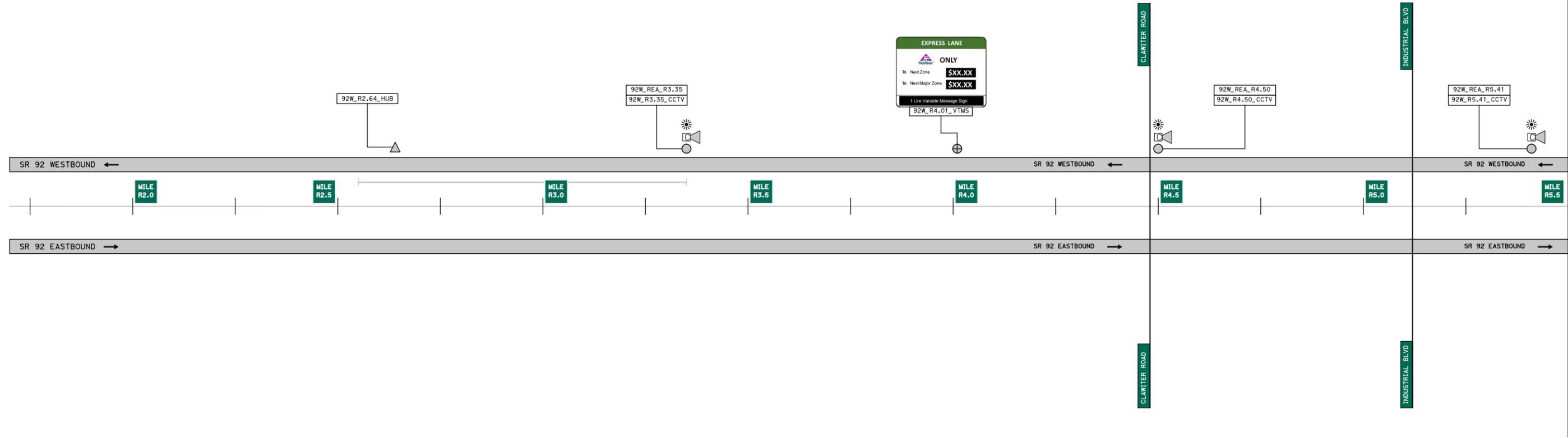
REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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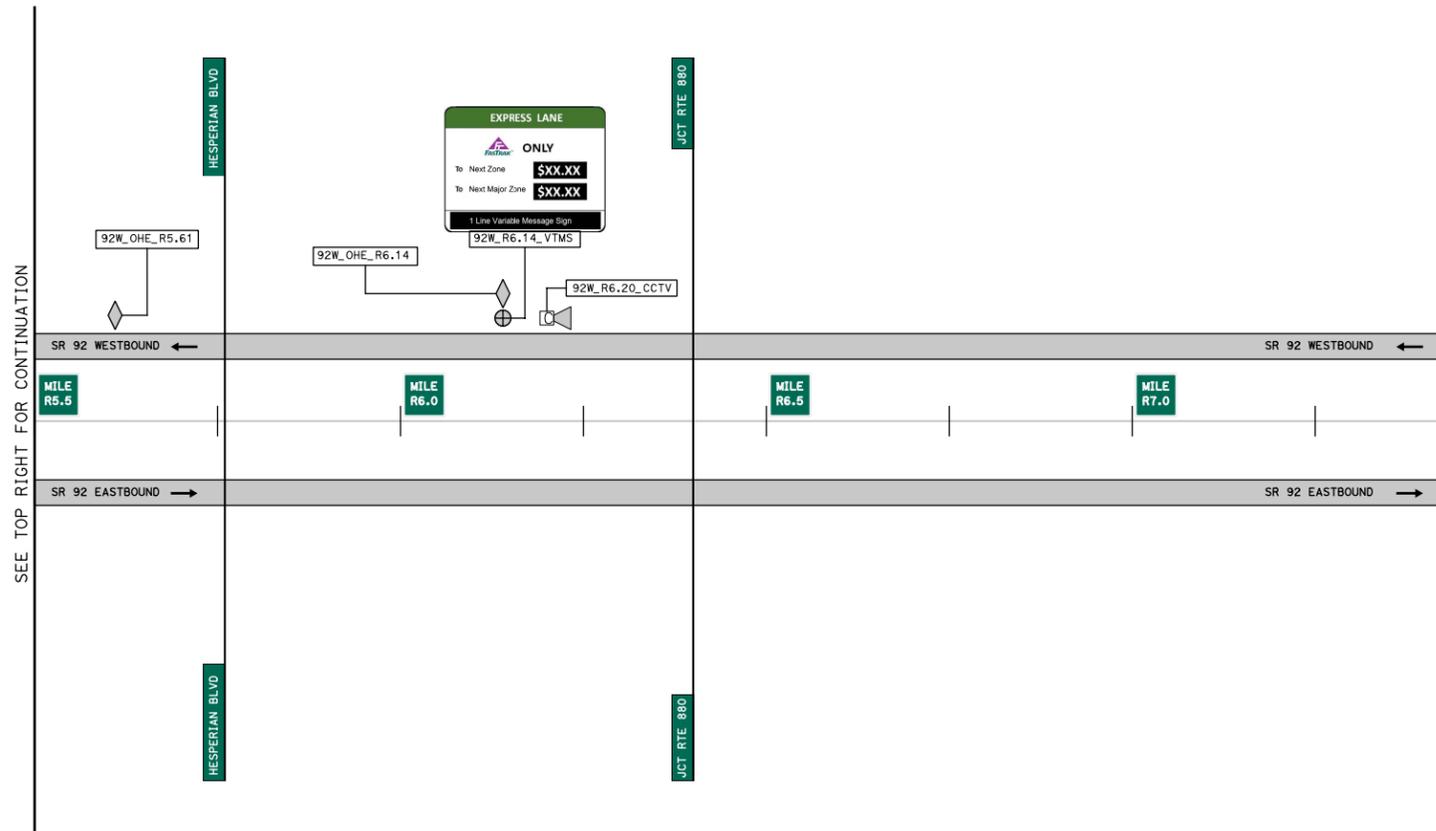
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SEE TOP RIGHT FOR CONTINUATION

**ABBREVIATION LEGEND:**  
 CCTV Camera = Closed Circuit Television  
 OHE = Overhead Static Sign  
 REA = Read Points  
 TMS = Traffic Monitoring System  
 VTMS = Variable Toll Message Sign

**LEGEND:**  
 [Grey Box] GENERAL PURPOSE LANE (GL)  
 [Green Box] EXPRESS LANE (EL) - RESTRICTED ACCESS  
 [Circle with dot] READERS (READ POINTS) / VES Cameras / TMS  
 [Blue Line] ZONE LIMIT  
 [Vertical Tick] MILE MARKER  
 [Circle with cross] VTMS  
**EXPRS**  
 [Triangle] END OF MANAGED LANE  
 [Diamond] HUB SWITCH  
 [Diamond] OVERHEAD  
 [Circle with slash] DO NOT CROSS DOUBLE WHITE LINE  
 [Speaker] CCTV  
 [Starburst] BEACONS

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REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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PROJECT NO.

SR-92 STRAIGHT LINE DIAGRAMS

SHEET NO.

BAIFA Express Lane Network Toll Collection System

**Appendix 1, Reference 2**

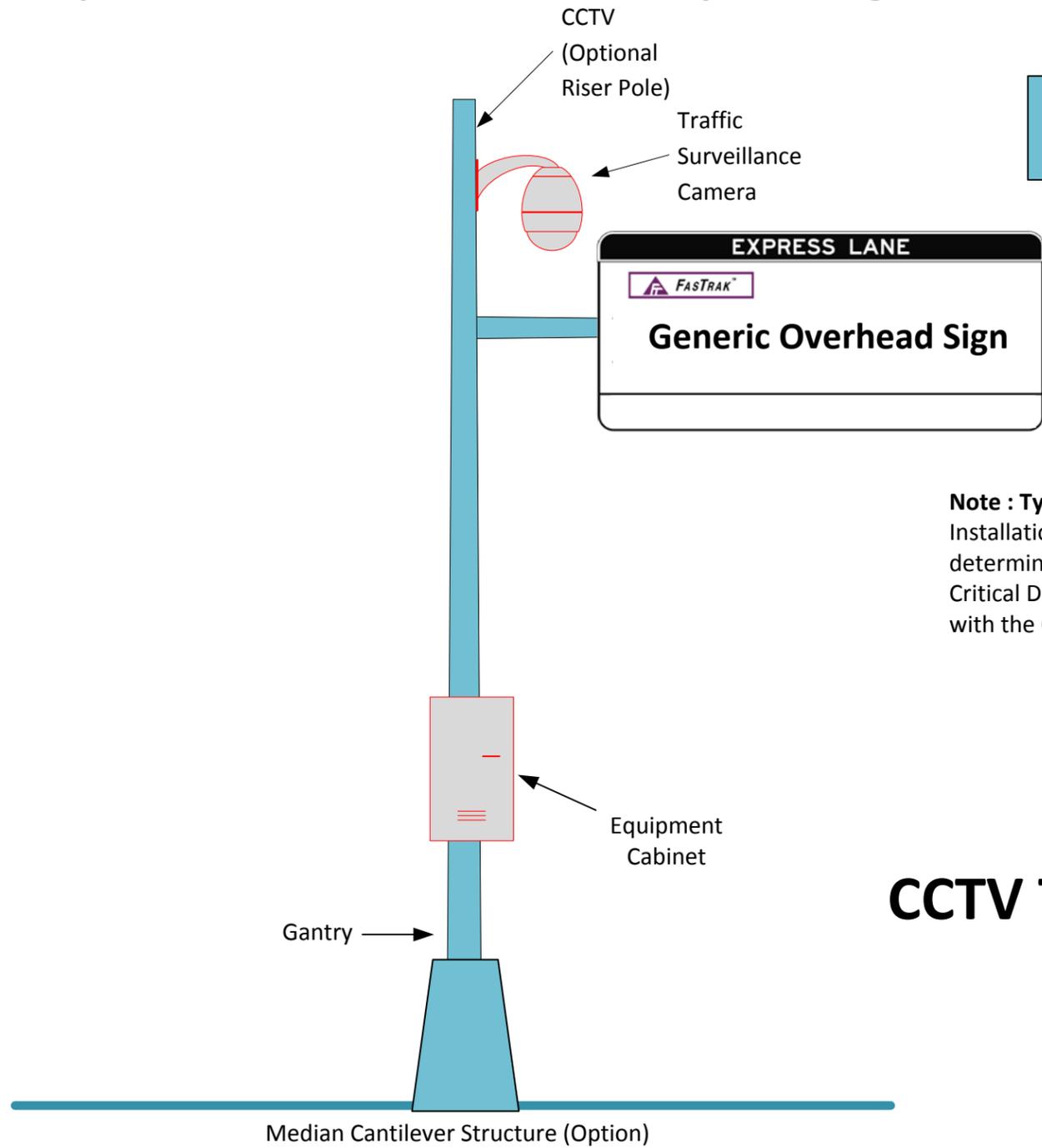
**Diagrams, Drawings and Schematics**

**D: Typicals**

# Scope of Work Demarcation: Civil vs. Toll System Integrator

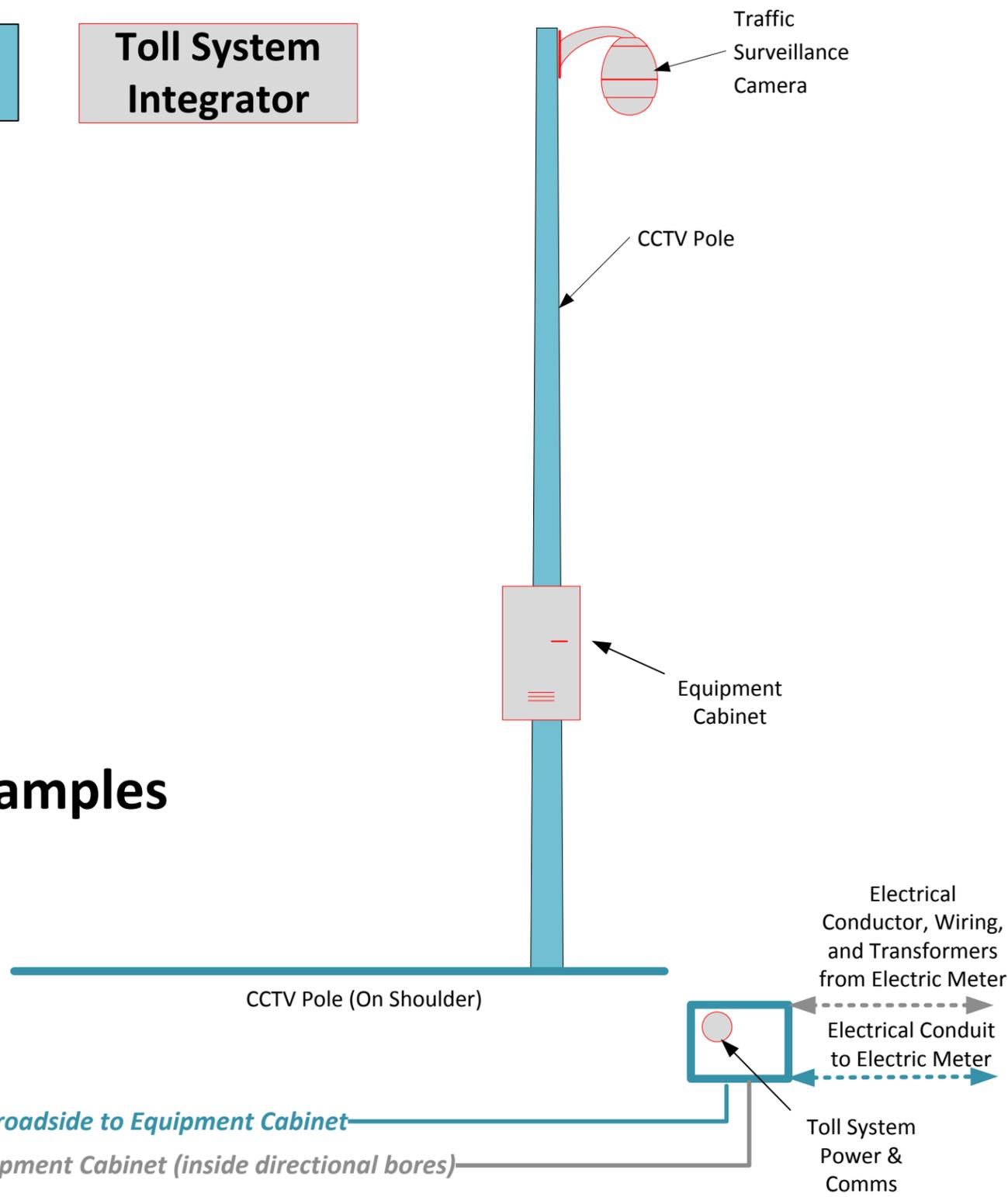
**Civil Contractor**

**Toll System Integrator**



**Note : Typical CCTV Pole types.**  
Installation shall be field determined based on the final Critical Design and coordination with the Civil Design.

## CCTV Typical Examples



**Note :** Intended for illustrative purposes only. Alternative configurations for mounting equipment are not reflected. Terminology for equipment may vary.

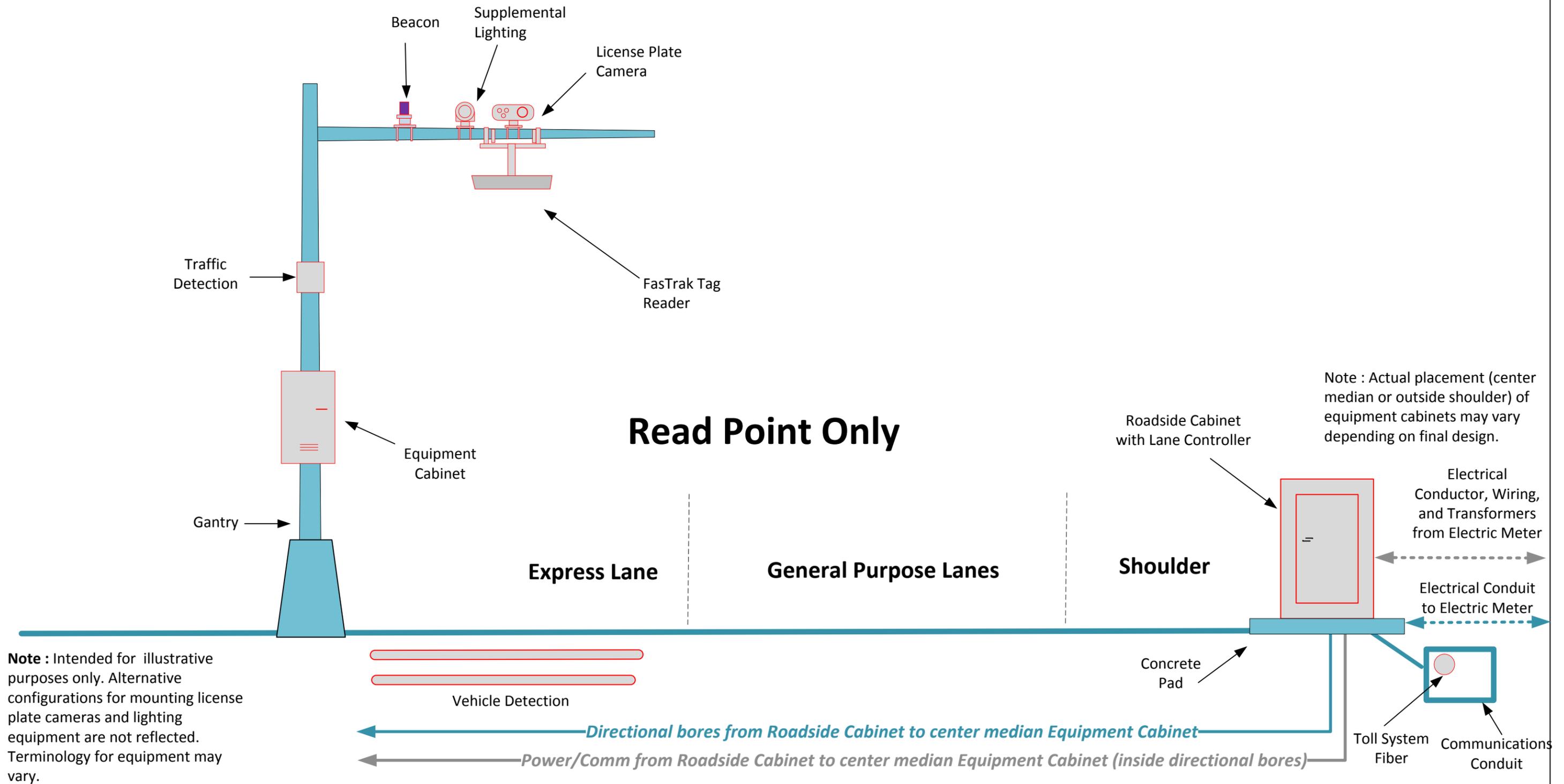
No.	DATE	ISSUE / REVISION	SUBMITTED BY:	PROJECT	TITLE	PAGE
1	10/9/13	Draft RFP	<b>ATKINS</b> One Market, Spear Tower Suite 3600 San Francisco, CA 94105	BAIFA Express Lanes	<b>CCTV Typical Examples</b>	
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# Scope of Work Demarcation: Civil vs. Toll System Integrator

**Civil Contractor**

**Toll System Integrator**

## Read Point Only



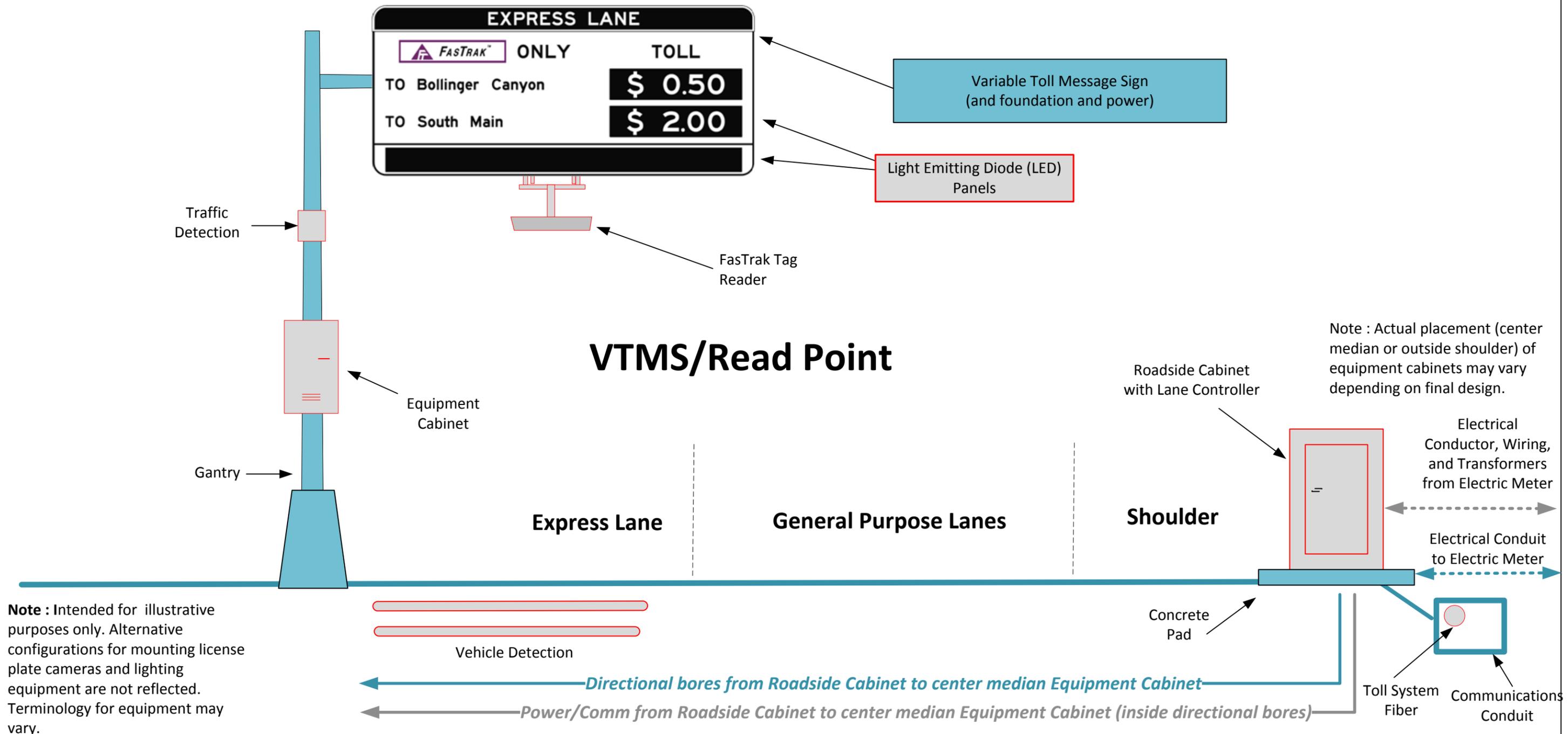
**Note :** Intended for illustrative purposes only. Alternative configurations for mounting license plate cameras and lighting equipment are not reflected. Terminology for equipment may vary.

No.	DATE	ISSUE / REVISION	SUBMITTED BY:	PROJECT	TITLE	PAGE	
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						SCALE	None

# Scope of Work Demarcation: Civil vs. Toll System Integrator

**Civil Contractor**

**Toll System Integrator**



No.	DATE	ISSUE / REVISION
	10/09/13	Draft RFP

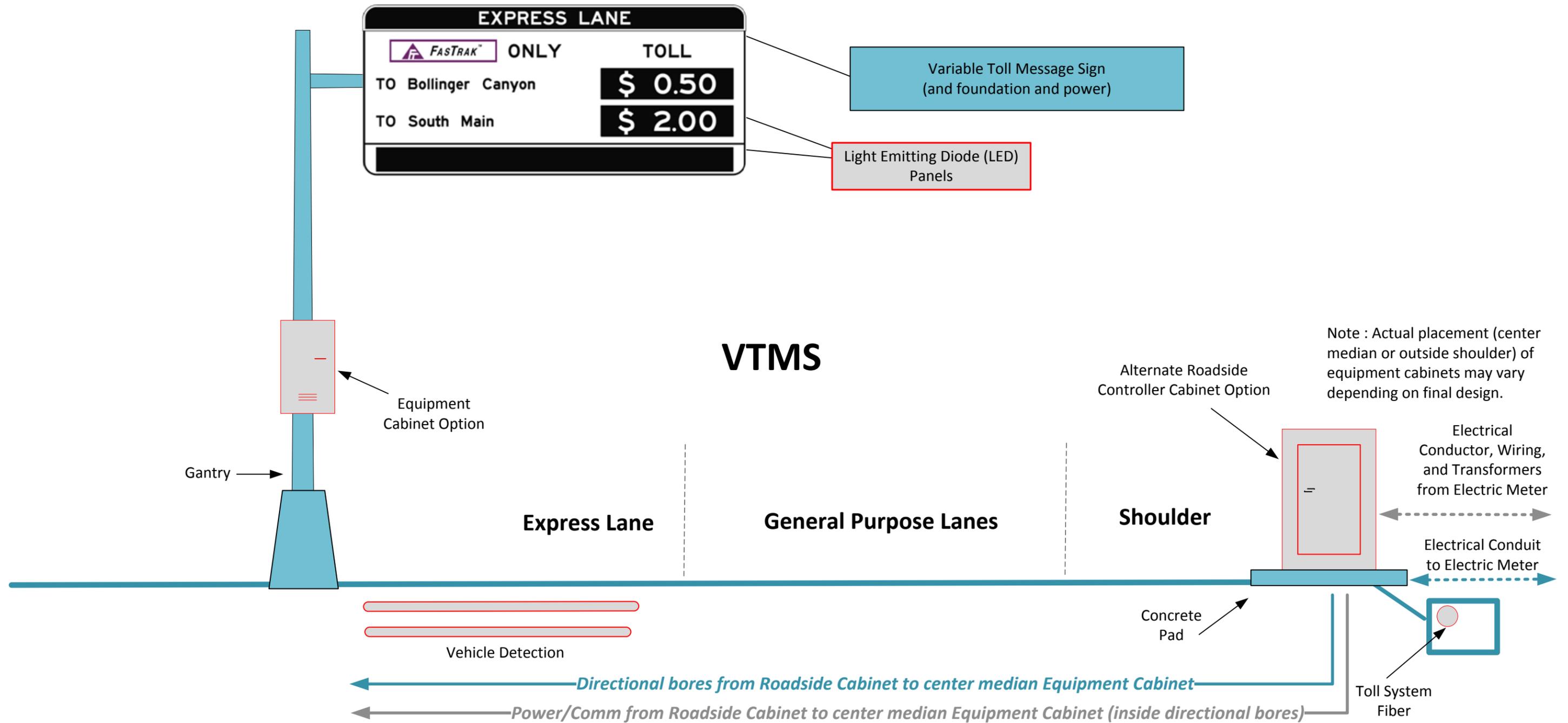
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PROJECT  
**BAIFA Express Lanes**

TITLE	PAGE
<b>VTMS/Read Point</b>	
SCALE None	

Scope of Work Demarcation: Civil vs. Toll System Integrator

**Civil Contractor**      **Toll System Integrator**



No.	DATE	ISSUE / REVISION
	10/09/13	Draft RFP

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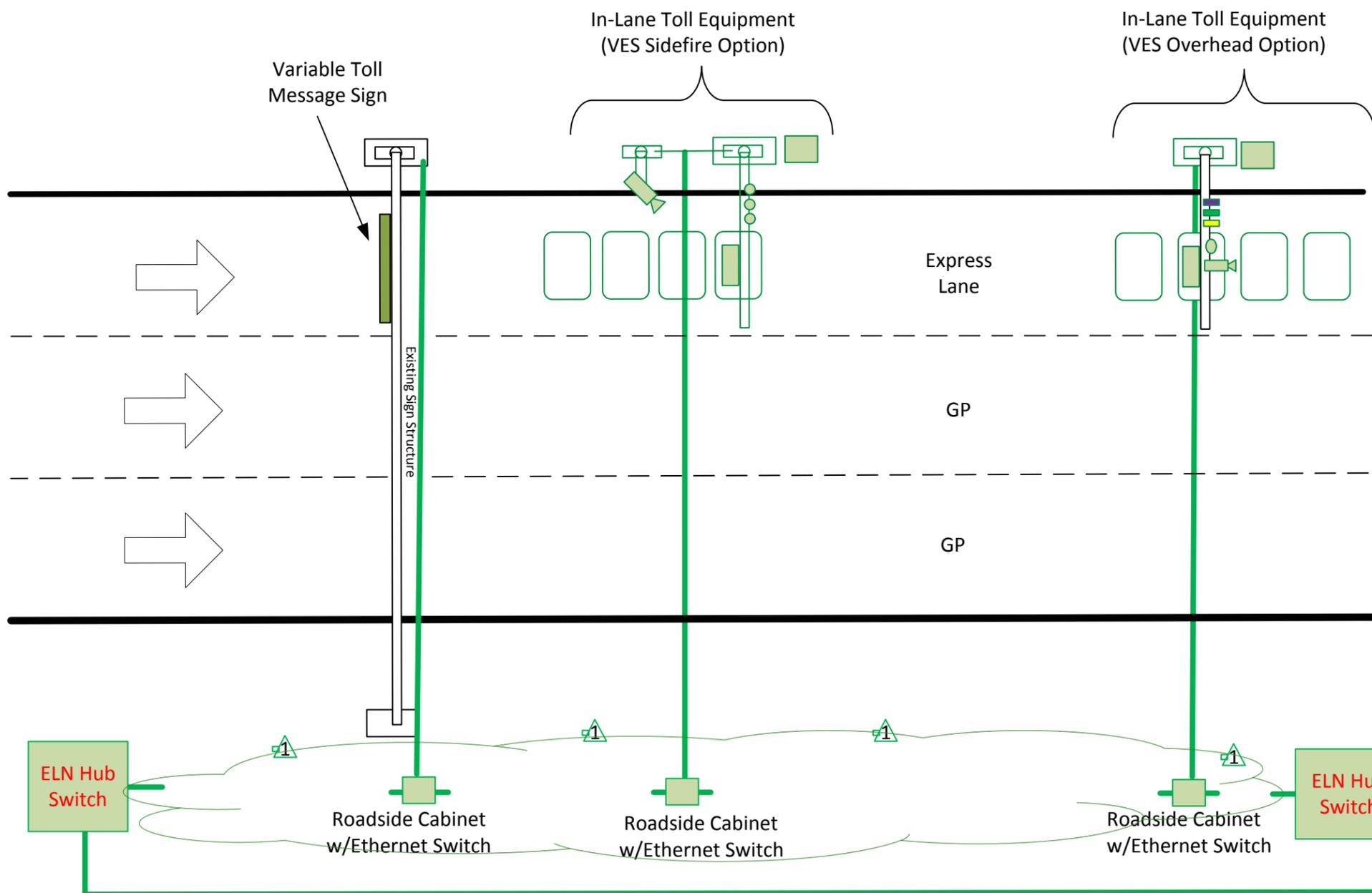
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San Francisco, CA 94105

PROJECT

**BAIFA Express Lanes**

TITLE	
<b>VTMS</b>	
<b>Civil vs. Toll System Integrator</b>	
SCALE	PAGE
None	

# Communication Responsibility Demarcation



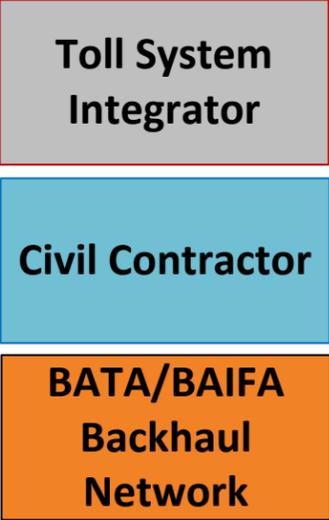
Toll equipment communications and Corridor Roadside Network will be designed, installed and maintained by TSI. Civil work for trenching and conduit installation will be done by a civil contractor.

**Legend**

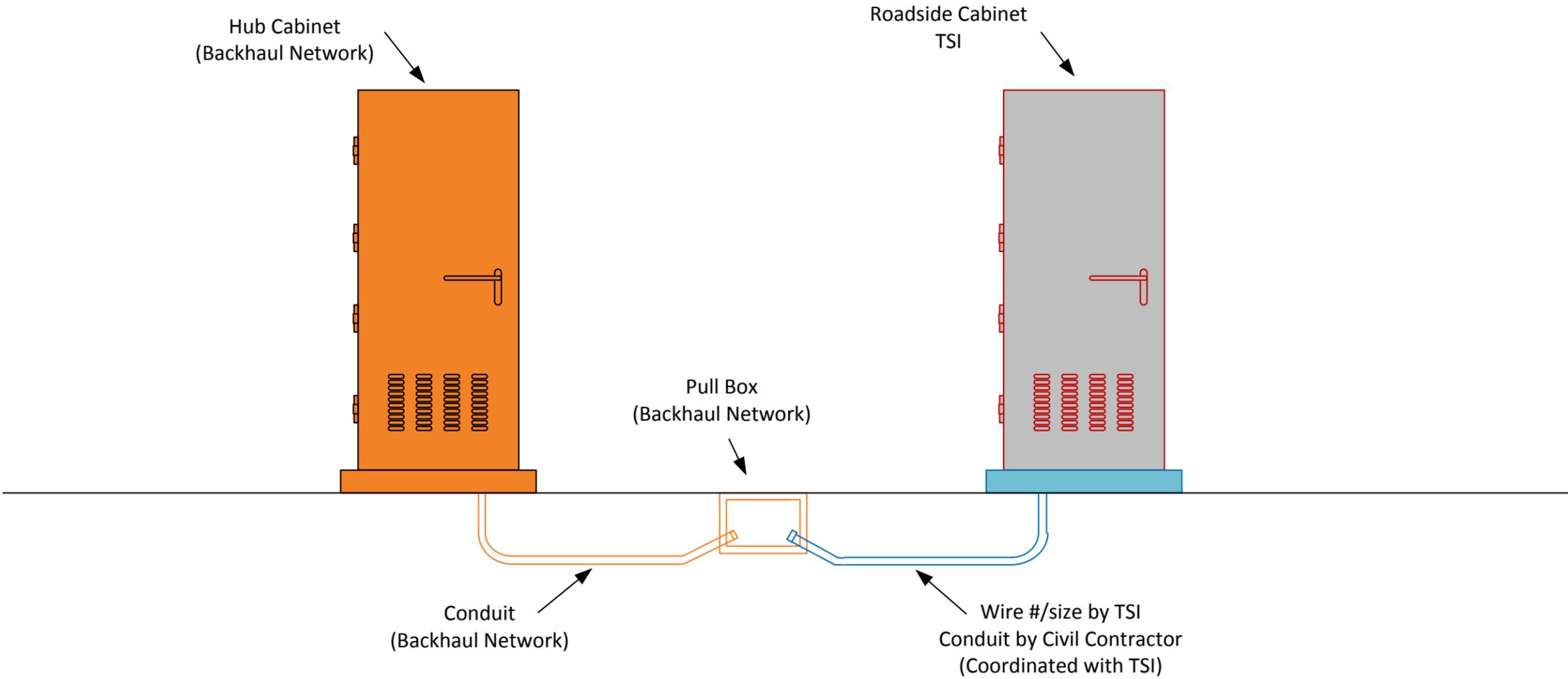
- Toll Systems Communications
- In-lane toll equipment and Roadside Network
- Backhaul Network (By Others)
- From the demarcation hub/switch on the Roadside Network to the Host sites and to the RCSC
- TSI Equipment

⚠ Roadside Network Communications by TSI. Connection shall be by various methods as determined in the Critical Design.

No.	DATE	ISSUE / REVISION	SUBMITTED BY:	PROJECT	TITLE	PAGE
	10/09/13	Draft RFP	<b>ATKINS</b> One Market, Spear Tower Suite 3600 San Francisco, CA 94105	BAIFA Express Lanes	<b>Communication Responsibility Demarcation</b>	
					SCALE: None	



- NOTES:**
1. The TSI shall coordinate with applicable stakeholders for physical access to Backhaul Network corridor communications infrastructure to make necessary connections to the Backhaul Network.
  2. All cabinet and network components shall be furnished and installed with their respective project (TSI or Backhaul Network). This includes connections to electrical service, site preparation, and civil infrastructure necessary for the installation of cabinets and pull boxes.

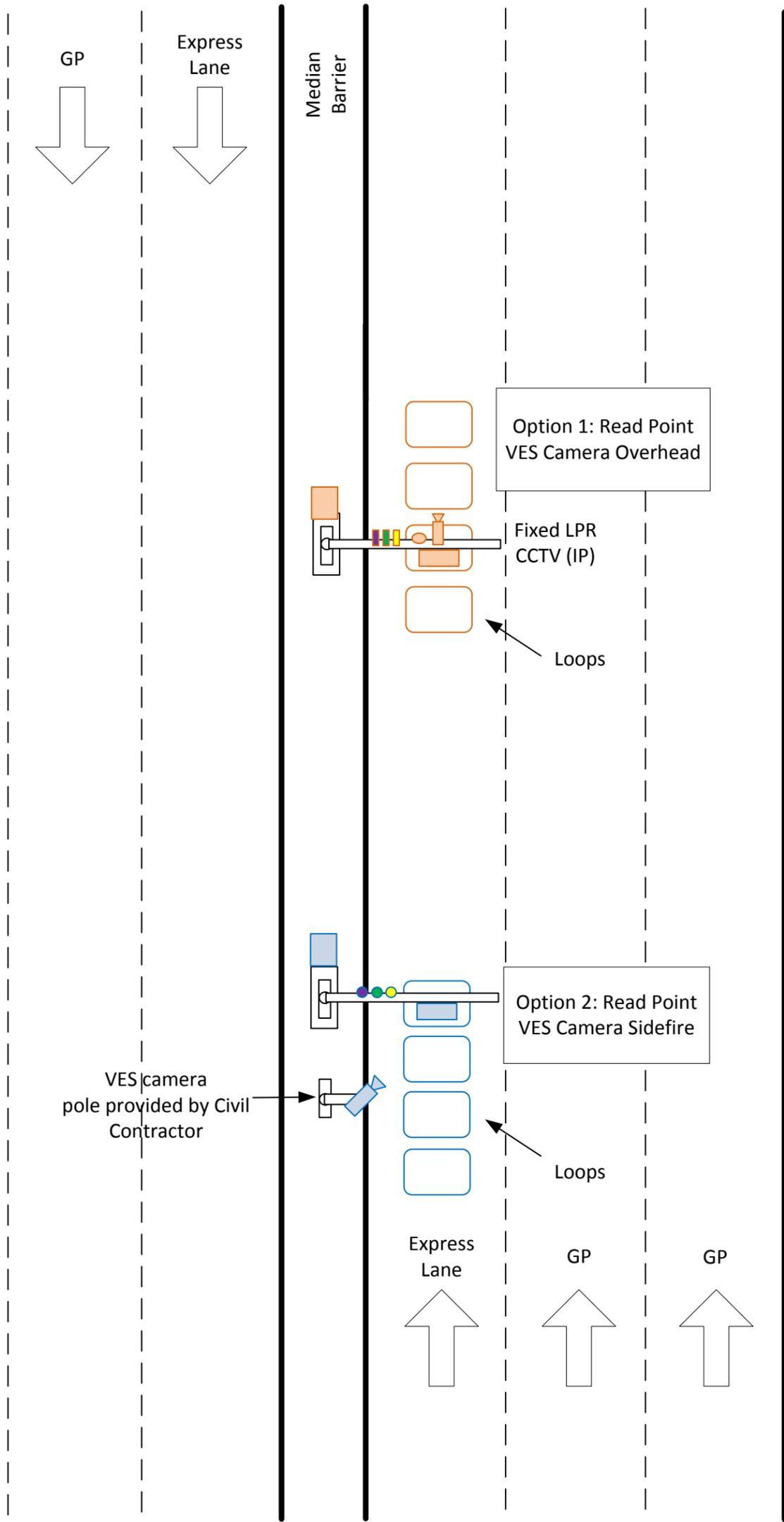


No.	DATE	ISSUE / REVISION
	10/09/13	Draft RFP

SUBMITTED BY:  
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 Suite 3600  
 San Francisco, CA 94105

PROJECT  
**BAIFA Express Lanes**

TITLE	<b>Communication Hub</b>	
SCALE	None	PAGE



Optional Read Point equipment mounting configurations. Design to be determined during Critical Design and coordination with the civil design

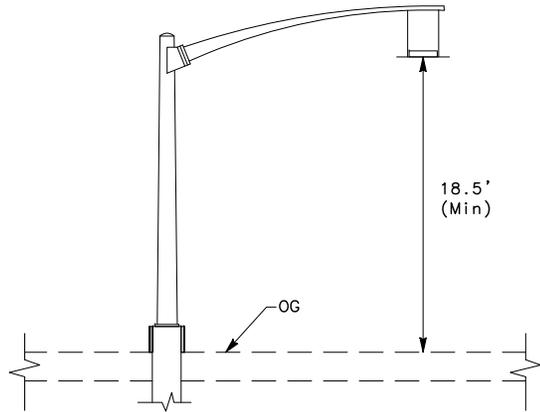
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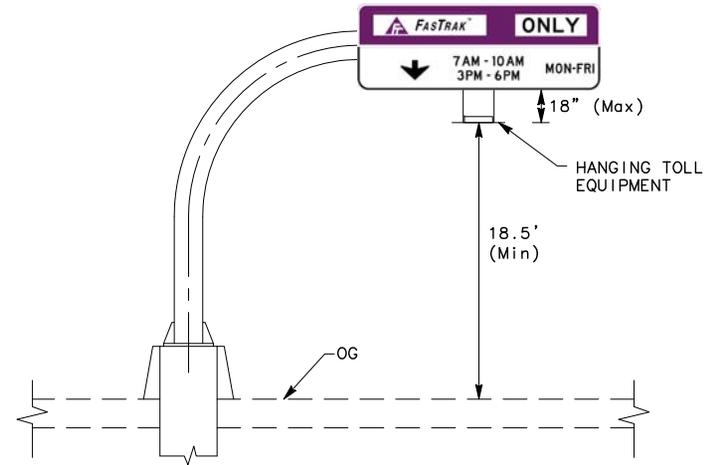
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**ATKINS** One Market, Spear Tower,  
 Suite 3600  
 San Francisco, CA 94105

PROJECT  
**BAIFA Express Lanes**

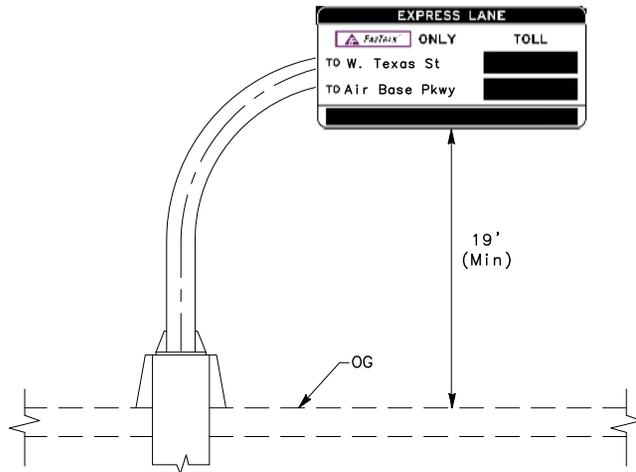
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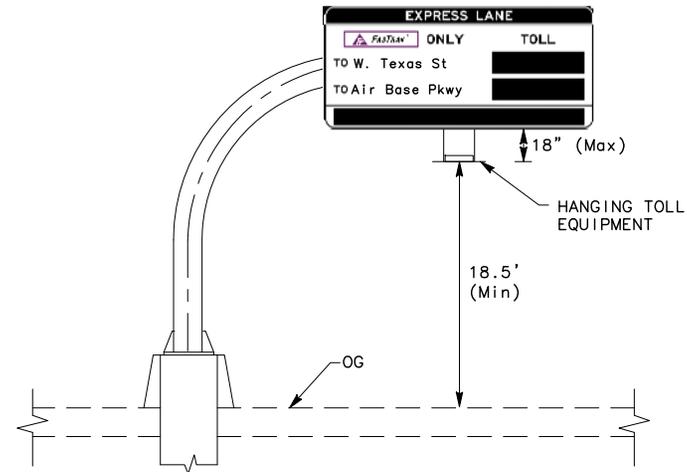
**TOLL GANTRY ONLY**



**OVERHEAD SIGN STRUCTURE WITH READER (TUBULAR)**



**OVERHEAD SIGN STRUCTURE - VTMS (TUBULAR)**



**OVERHEAD SIGN STRUCTURE - VTMS WITH READER (TUBULAR)**

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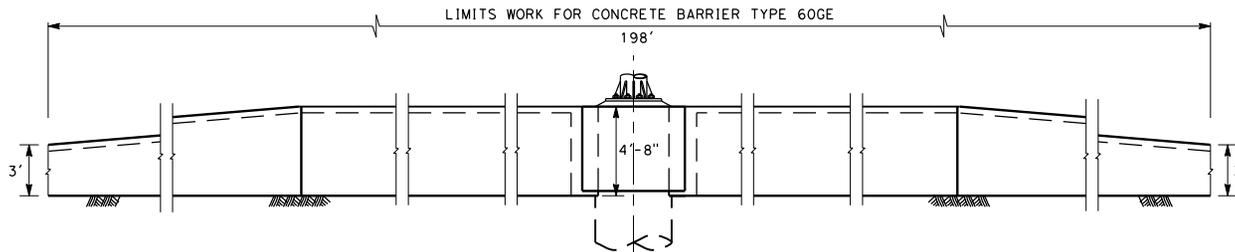
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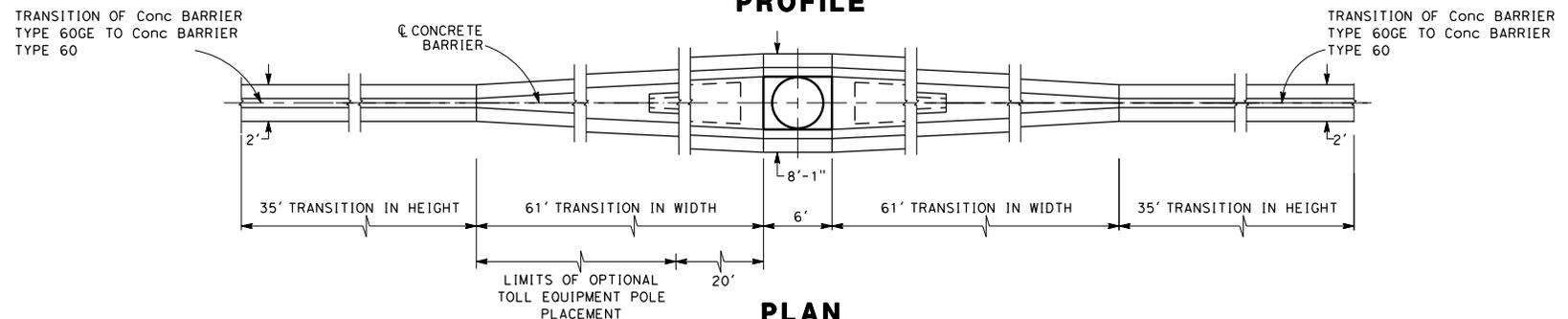
**MARK THOMAS & COMPANY, INC.**  
Providing Engineering, Surveying, and Planning Services  
1960 ZANKER ROAD  
SAN JOSE, CA 95112 (408) 453-5373

SEPTEMBER 2013  
**OVERHEAD SIGN STRUCTURE CONFIGURATIONS**  
**MTC EXPRESS LANE NETWORK - PHASE 1 PA & ED**

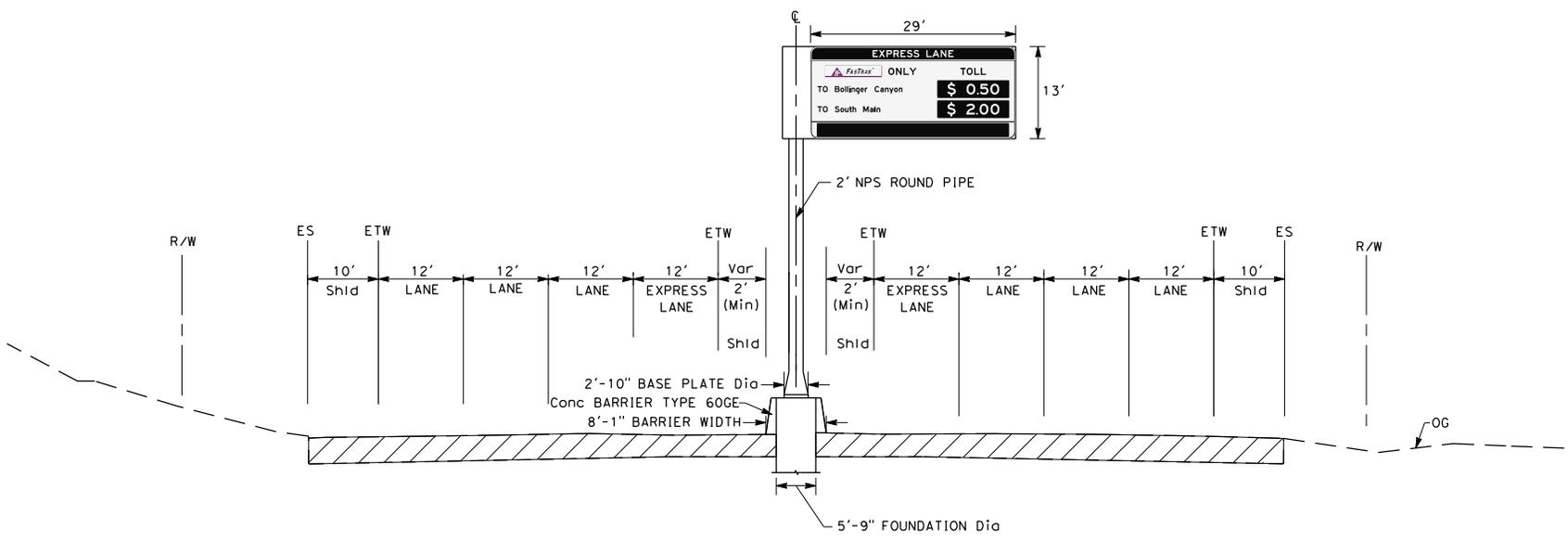
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**PROFILE**



**PLAN**



**SECTION**

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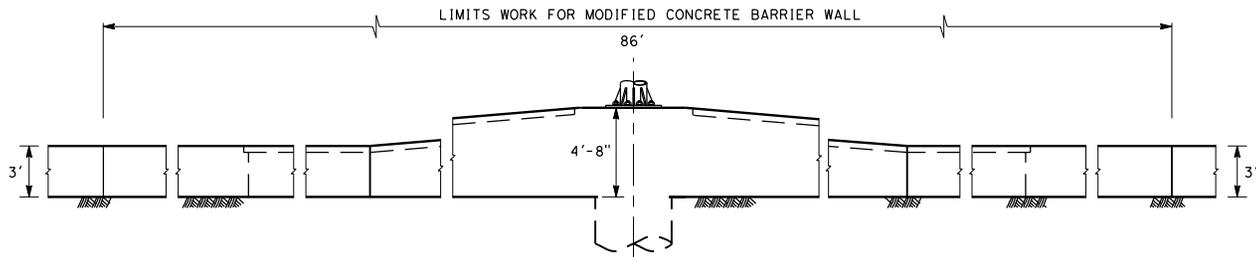
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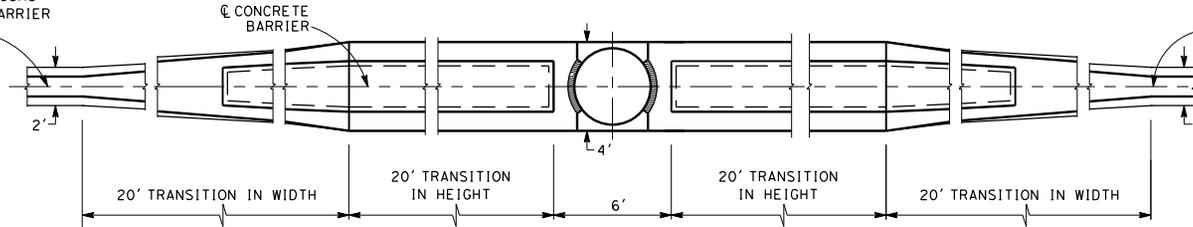
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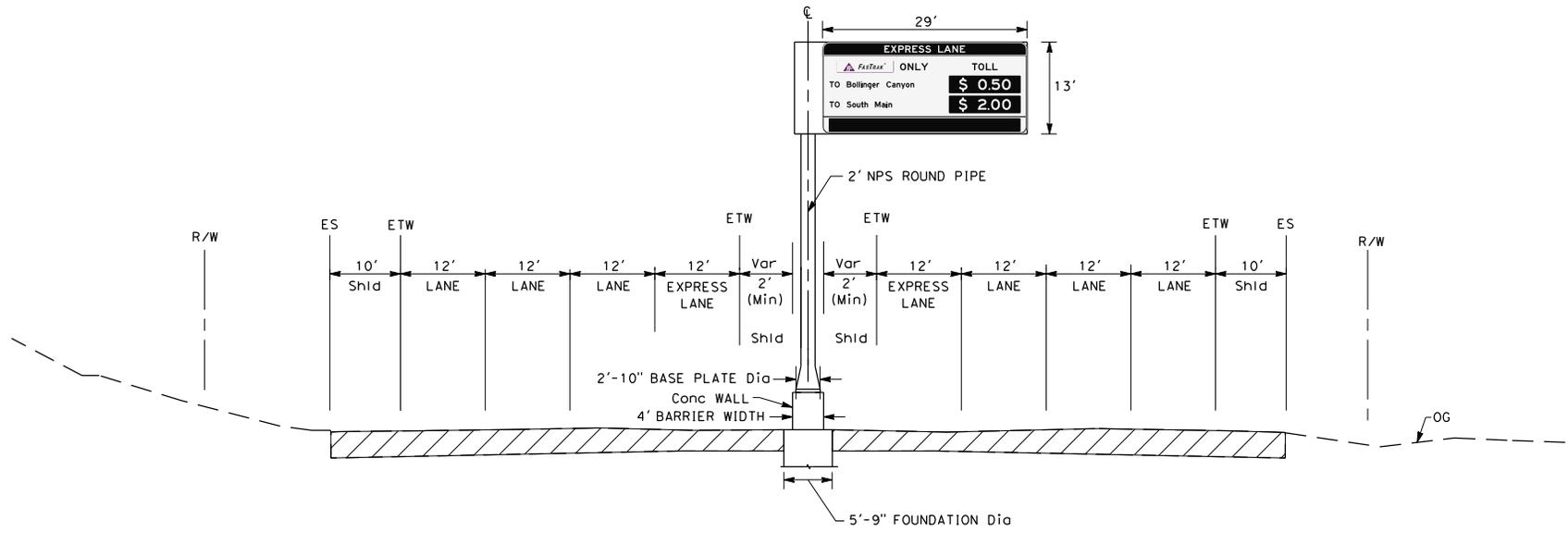
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TRANSITION OF MODIFIED Conc BARRIER WALL TO Conc BARRIER TYPE 60



TRANSITION OF MODIFIED Conc BARRIER WALL TO Conc BARRIER TYPE 60

**PLAN**



**SECTION**

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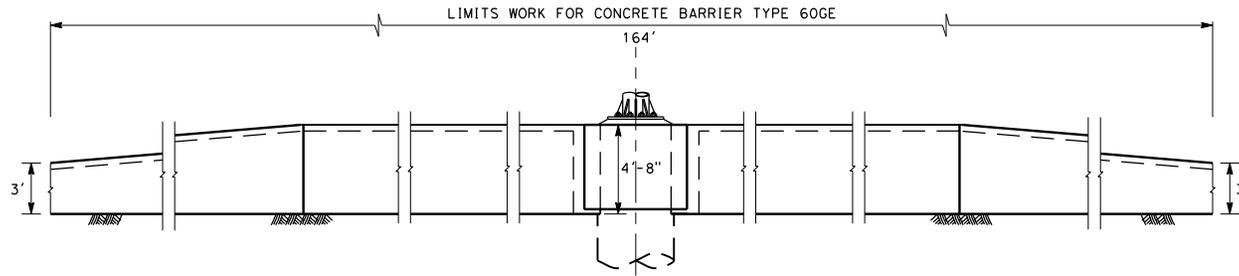
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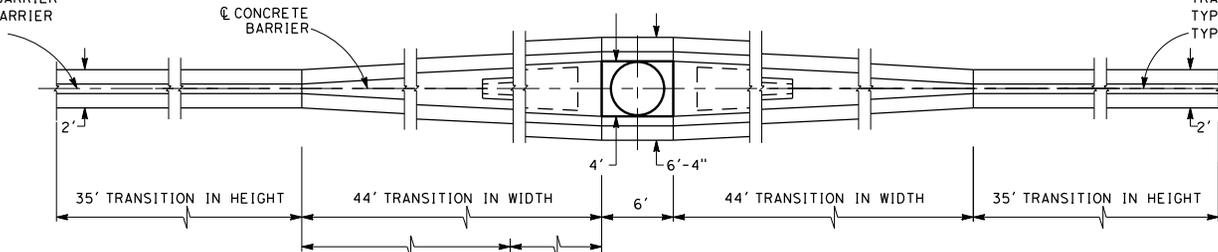
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**PROFILE**

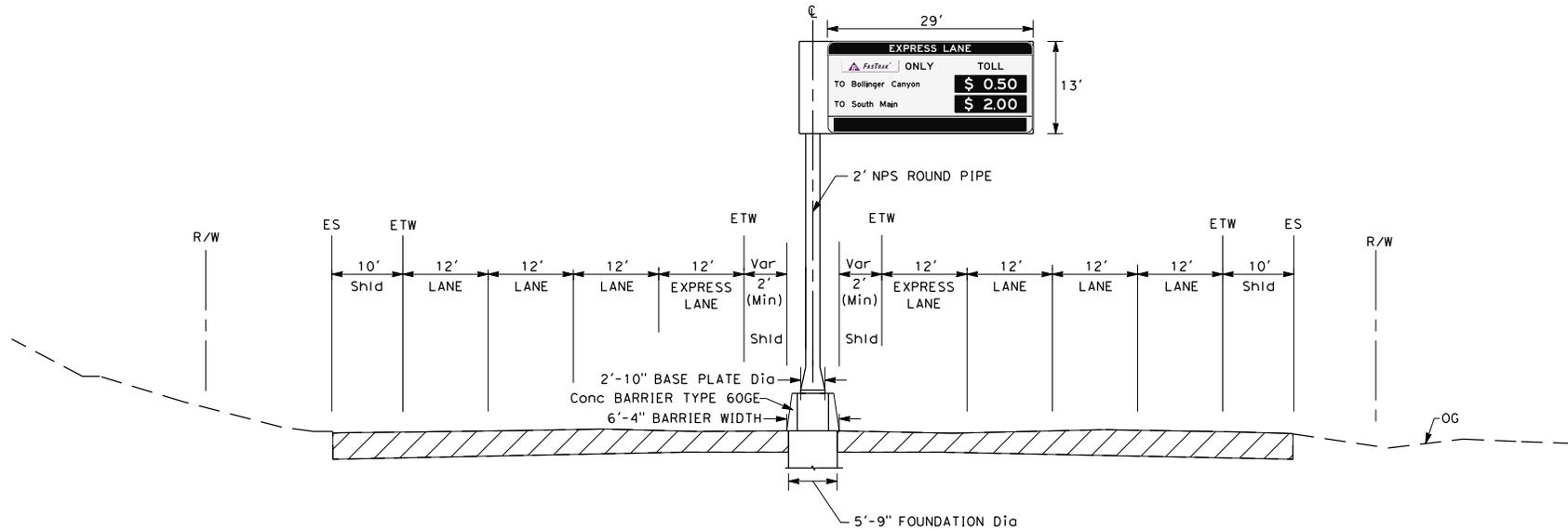
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TRANSITION OF Conc BARRIER TYPE 60GE TO Conc BARRIER TYPE 60

LIMITS OF OPTIONAL TOLL EQUIPMENT POLE PLACEMENT

**PLAN**



**SECTION**

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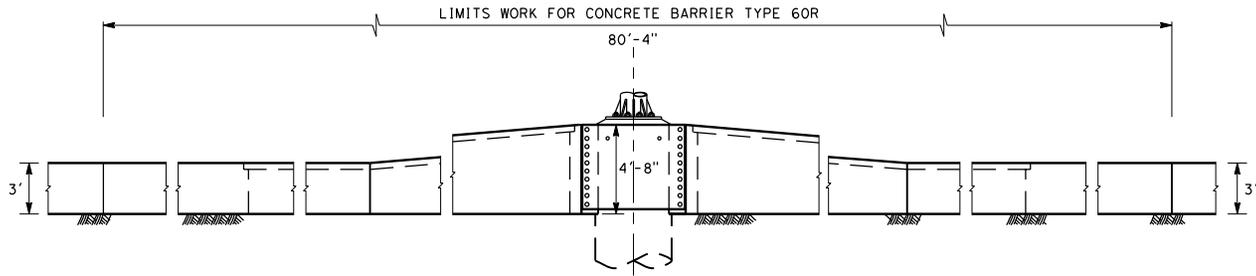
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MTC EXPRESS LANE NETWORK - PHASE 1 PA & ED**

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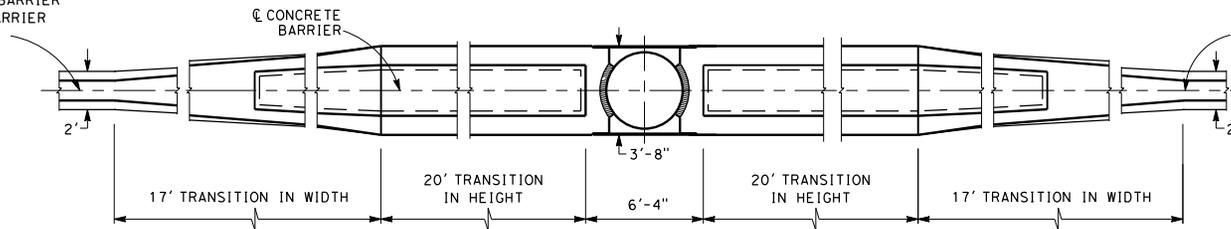
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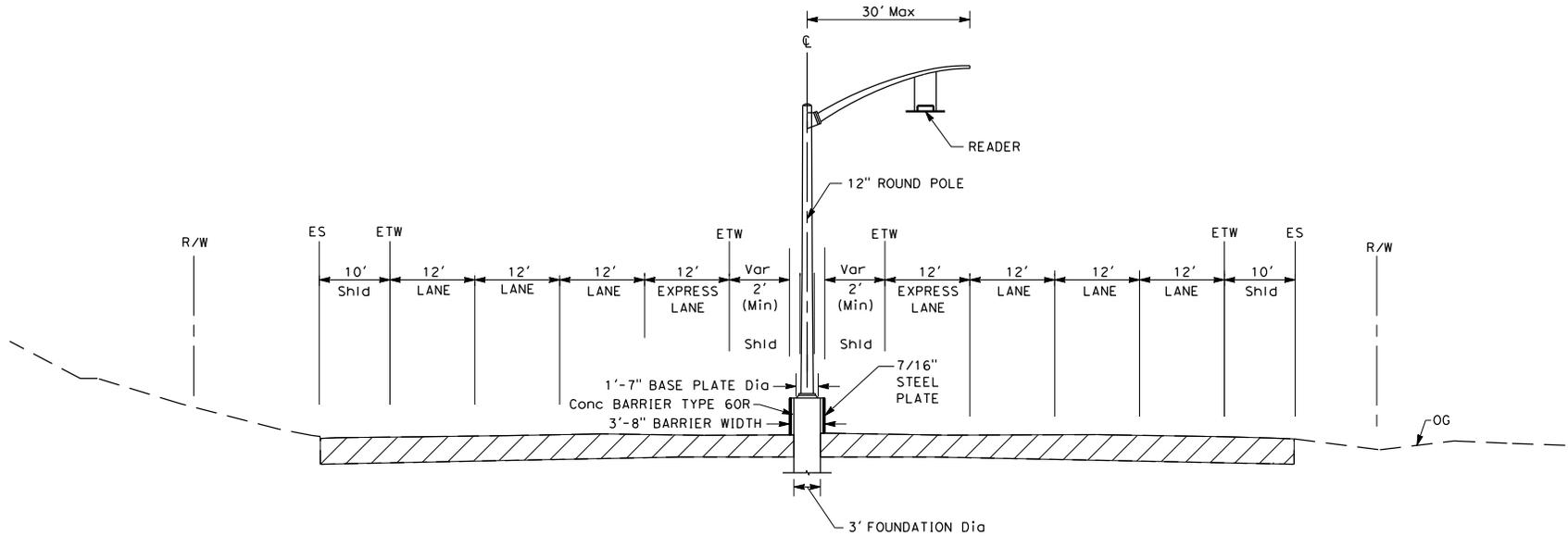
**PROFILE**

TRANSITION OF Conc BARRIER TYPE 60R TO Conc BARRIER TYPE 60

TRANSITION OF Conc BARRIER TYPE 60R TO Conc BARRIER TYPE 60



**PLAN**



**SECTION**

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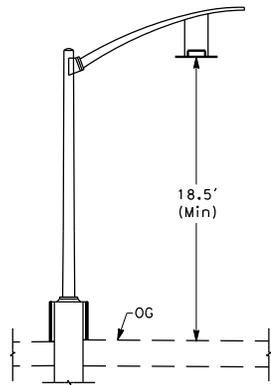
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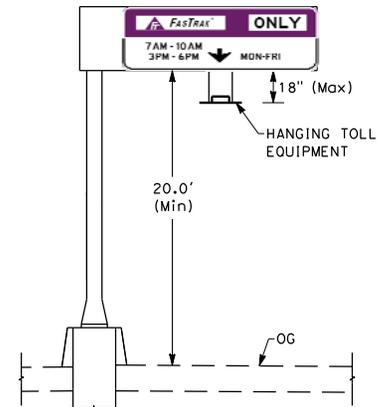
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OVERHEAD SIGN FOUNDATION OPTION 3 (TOLL GANTRY ONLY)  
MTC EXPRESS LANE NETWORK - PHASE 1 PA & ED

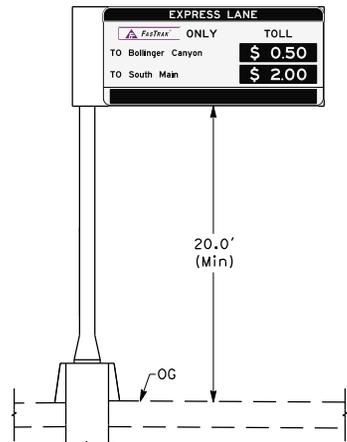
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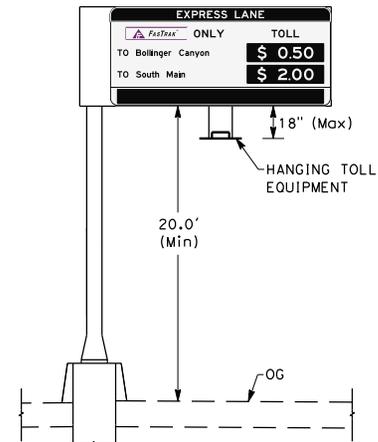
**TOLL GANTRY ONLY**



**OVERHEAD SIGN STRUCTURE WITH READER (TRUSS)**



**OVERHEAD SIGN STRUCTURE - VTMS (TRUSS)**



**OVERHEAD SIGN STRUCTURE - VTMS WITH READER (TRUSS)**

**NOT TO SCALE**



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# BAIFA Express Lane Network Toll Collection System

## Appendix 1, Reference 2

### Diagrams, Drawings and Schematics

# E: Conduit Inventory Table

**NOTE:** This reference document lists the segments that have been identified as potentially available conduit sites for communications installation. The conduit inventory is being inspected for viability, which is expected for completion by the time the Final RFP is released.

<b>Corridor</b>	<b>Section</b>	<b>Length (mi.)</b>	<b>Roadside Conduit</b>
I-680	I-580 (East Dublin) to Alcosta Blvd.	0.4	Caltrans 3-3" conduits
	Alcosta Blvd. to Route 24 (Walnut Creek)	14.3	Caltrans 3-3" conduits
	.2 miles north of Davis Street to Hegenberger Road	1.5	Caltrans 4-1.5" conduits
	.4 miles south of Marina Blvd to .3 miles north of Davis St.	1.4	Caltrans 4-1.5" conduits
	98th Avenue Interchange	0.8	Caltrans 1-2" conduits
	San Leandro Creek to Davis St.	0.7	Caltrans 3-3" conduits
	Davis St. to Lewelling St.	3.3	Caltrans 3-3" conduits
	Lewelling St. to Hesperian Blvd.	0.25	Caltrans 3-3" conduits
	Hesperian Blvd. to West A St.	1.65	Caltrans 3-3" conduits
	North of Tennyson Rd. to south of Winton Ave.	2.1	Caltrans 3-3" conduits
	North of Tennyson Rd. to Alvarado-Niles Rd.	1.7	Caltrans 3-3" conduits
	Alvarado-Niles Rd. to Industrial Blvd.	1.5	Caltrans 3-3" conduits
	.2 miles south of Alvarado-Niles Rd. to .4 miles south of Decoto Rd./SR 84	2.9	Caltrans 3-3" conduits
	.3 miles north of Paseo Padre Pkwy to Patterson Slough	0.6	Caltrans 3-3" conduits
.4 miles south of Decoto Rd./SR 84 to Thornton Ave.	1.6	Caltrans 3-3" conduits	
I-880	Thornton Ave. to Mowry Ave.	1.6	Caltrans 3-3" conduits
	Mowry Ave. to .3 miles north of Mission Blvd.	4.4	Caltrans 3-3" conduits
	Old Bayshore Hwy to Hwy 237	4.6	Caltrans 4-1.5" conduits
SR 84	CA 101 to Dumbarton Toll Plaza	7.28	2" Conduit
SR 92	CA 101 to San Mateo Toll Plaza	9.86	2" Conduit

## RFP APPENDIX 1: Reference 3



### BAIFA Express Lane Network Toll Collection System

## Communications Network Conceptual Pre-Design

**NOTE:** BAIFA provides this information as guidance. The communications network details described in this document provide conceptual guidance to support the delivery of a fully operational roadside communications network for the Express Lane Network (ELN) project. The intent of this document is not to mandate a particular design or implementation process but to establish BAIFA's high-level expectations for system integration best practices that are not detailed as part Attachment A-1, System Requirements.

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# Introduction

The information contained in this document supplements Attachment A-1, *System Requirements*, and provides additional guidance concerning the design and construction of the communications network to deliver a fully-operational roadside communications network to support the Express Lane Network (ELN) project. Provided by The Bay Area Infrastructure Financing Authority (BAIFA), the intent of this document is not to mandate a particular design or implementation process but to establish BAIFA's high-level expectations for TSI best practices that are not detailed as part of the system requirements in Attachment A-1. In addition, this guidance document may directly or indirectly reference requirements found in other RFP bid package documents (i.e. RFP APPENDIX 1: Attachment A-1, *System Requirements*, etc...). Where there are any conflicts with existing requirements, the Toll Systems Integrator (TSI) shall defer to the System Requirements. BAIFA recognizes that the entire toll system solution proposed by each prospective bidder is unique to the bidder. Therefore, the characteristics, methods and designs detailed herein are expected to differ where the TSI adds greater value and innovation to meet or exceed the communications needs of the BAIFA ELN project.

## Communications Overview

### 1. General

The communications network to support the ELN consists of:

- Device to roadside cabinet
- Roadside cabinet to Corridor layer 3 managed Ethernet switch
- Regional backhaul communications to link a Corridor to the primary and secondary Hosts

The ELN overall system communications network described herein leverages existing California Department of Transportation (Caltrans), Bay Area Rapid Transit (BART), Silicon Valley ITS, and Bay Area Toll Authority (BATA) communications infrastructure where available. BATA will construct, maintain, and make available the regional Backhaul Network that provides a communications path to a variety of projects using a mixture of fiber-optic cable and leased line infrastructure. This network shall be referred to as the "Backhaul Network". The Backhaul Network is expected to be implemented before the TSI begins testing of the TSI provided express lane network communications from the roadside to the primary and secondary Hosts. The Backhaul Network will include redundant connections to all Corridors. The TSI design provides fault tolerant connections that cannot result in a single point of failure to the Backhaul Network. If the TSI design includes subdividing a roadside network into smaller networks, then that design maintains fault tolerant connections that cannot result in a single point of failure to the Backhaul Network.

The "Roadside Network" provides communications and network services to the toll collection system sites along a Corridor. It connects the in-lane toll collection system devices for local communications to the Backhaul Network. At the primary and secondary "Host" sites, communications support data center needs, and interface to external systems including the Backhaul Network. Communications equipment is also needed at the

“Operations Center”, located at the Caltrans Traffic Management Center (TMC), in order to support tolling roadway operations.

## 2. Existing Infrastructure

The communications infrastructure leverages:

- Existing conduit for fiber-optic cable owned by Caltrans along:
  - Portions of I-880 from Davis Street in San Leandro to Highway 237
  - I-680 from the Caltrans East Dublin hub at I-580 to the Caltrans hub at Walnut Creek
- Existing fiber-optic cable for the Silicon Valley ITS Program fiber-optic cable, owned and maintained by the City of San Jose, from the San Jose Traffic TMC to the Fremont BART station
- Four existing strands of BART fiber-optic cable assigned to Caltrans that will be used to connect the Backhaul Network to BAIFA and to the primary and secondary Host sites. The communications on those four strands comprise a Caltrans regional SONET OC-192 network.

See Appendix 1 for the existing infrastructure and conceptual alternatives, by Corridor.

The communications infrastructure utilizes existing conduit owned by Caltrans, the City of San Jose, BART, and BAIFA and new fiber-optic cable will be installed in those conduits.

In the server rooms at the primary and secondary Hosts, existing communications racks will be provided for the TSI for their exclusive use.

## 3. Proposed Communications Network

Civil work along the corridor, including, but not limited to, the installation of structures, pads, conduit and pull boxes, is to be performed by others via a separate civil procurement. The installation of backhaul communications and civil work supporting the backhaul communications will also be performed via a separate procurement.

The communications architecture includes TSI-provided Ethernet edge switches to communicate with roadside cabinets along the Corridor. The Ethernet edge switches are connected to TSI-provided Layer 3 Ethernet switches along the Corridor.

The Layer 3 Ethernet switches connect over 10-Gigabit backhaul links to the primary ELN Host and disaster recovery sites. For sites that do not have available fiber, the Backhaul Network will connect to the primary and disaster recovery Host sites via a leased line connection. At ELN primary and secondary Host sites, there are Layer 3 Ethernet core switch(es) to provide complete redundancy and fail-over. This 10-gigabit regional backhaul communications will be constructed by others.

The Roadside Network is a Gigabit Ethernet network at the Ethernet edge switch level and provides line speeds of up to 10Gbps at the Layer 3 switch level to support the ELN project. It consists of a mixture of single-mode fiber-optic cable, wireless Ethernet bridges, Ethernet microwave, and leased line communications.

The TSI installs new trunk fiber-optic cable in existing conduit as shown in *Reference 2E, Conduit Inventory Table*.

Fiber-optic cable proposed in this project may be shared with Caltrans.

In other locations, existing small BAIFA and Caltrans fiber-optic cables at the San Mateo and Dumbarton toll plazas may be replaced with new trunk fiber-optic cable and that cable is shared with Caltrans.

At the ELN primary and secondary Host sites, the TSI provides and configures Layer 3 Ethernet core switches.

The TSI-provided network includes fault tolerance functionality and capabilities, protection from single points of failure, automatic fail-over, and other protection capabilities as needed.

Access to the roadside communications network from the BAIFA Backhaul Network is provided through TSI Layer 3 Ethernet switches connecting the provided Layer 3 Ethernet switches to BAIFA.

All connections from the TSI provided Ethernet core data center switches to the BAIFA backhaul Layer 3 Ethernet switches:

- Provide fault tolerance functionality and capabilities;
- Is protected from single points of failure, and
- Operates at line speeds to support the ELN project.

The TSI will include all network hardware and software necessary to provide connectivity including access, distribution, and core network functionality, including but not limited to, routing, switching, security, and Quality of Service (QoS).

The TSI is responsible for providing and configuring Ethernet Edge switches and Layer 3 Ethernet switches with all necessary protocols and functionality to implement communications between all elements of the TSI-provided tolling system, external systems, and the Backhaul Network.

Appendix 2 depicts the conceptual layout of the network including the Backhaul Network.

## Communications Design

The TSI is responsible for coordinating work with the Civil Contractor for installation of cabinets and equipment. Working with BAIFA staff, the TSI is responsible for coordinating work with the Pacific Gas and Electric (PG&E) Company for electrical service connections and the TSI is also responsible for coordinating work with the CALNET vendor for leased communication connections. The TSI is responsible for coordinating with BAIFA staff for Backhaul Network access, data center access and any resulting connectivity. The TSI will prepare communications design plans.

All work within the Caltrans right-of-way complies with Caltrans requirements and BAIFA's encroachment permits issued by Caltrans.

The TSI utilizes existing conduit or conduit being installed by the Civil Contractor to install fiber-optic cable. As-built plans and a summary report of the proofed or tested conduits will be provided to the TSI when available.

For those areas where conduit exists, the TSI installs fiber-optic cable. For those areas where there is no conduit suitable for trunk fiber-optic cable and environmental clearance cannot be obtained as shown in *References 4-6, Civil Design Documents*, the TSI will need to design the communications system to:

- Bridge the gaps
- Create a network with fault tolerant connections that cannot result in a single point of failure connecting to the Backhaul Network

The TSI is responsible for all activities pertaining to the use of wireless spectrum including acquisition and licensing. All communications equipment, hardware, software, operating systems, PG&E service agreements, leased line service agreements, warranties and licensing agreements are subject to BAIFA review and approval and has BAIFA listed as the owner.

All costs, capital and operating, are included in the Proposal. This includes any leased communications.

As part of the system design, the TSI will develop bandwidth, optical link budget, and other necessary calculations for links on the network and at the interfaces with regional Backhaul Network.

As part of the bid package, the TSI will submit a high level network communications plan including detailed information on the following items:

- Class of networking device
- Protocols proposed by the TSI and network protection schemes proposed for use by the TSI
- Specification of Uninterruptable Power Supply (UPS)
- Ethernet switches, routers and firewalls
- Fiber-optic cable
- All proposed ancillary hardware and labor to support the installation
- Splicing, testing and connectivity of fiber-optic cables provided by the TSI

Information on manufacturer, type, and quantity should be included for the above-listed items as appropriate.

The TSI-developed communications plan distinguishes between fiber, leased, wireless and microwave connectivity, approach to planning, designing, installing, implementing, operating and maintaining the communications network, including management, security and disaster recovery. All lifecycle costs, including capital and operating costs are to be included. The operating costs should include leased line connectivity. As part of the design review, the TSI will further develop the network communications plan for review and approval by BAIFA.

The TSI may use wireless, microwave, other Ethernet based technologies, or leased line communications, to bridge those areas that do not have conduit available to install fiber-optic cable provided:

- Bandwidth requirements are met,
- Environmental clearance can be obtained
- Caltrans and BAIFA approval can be obtained

# Communications Hardware and Infrastructure Guidelines

## 4. Overview of Guidelines

This section describes basic guidelines should the TSI choose to use the technologies presented below. The guidelines include details on the furnishing and installation of the Roadside Network infrastructure, devices, and software necessary to create the Roadside Network and integrate it into the BAIFA's existing Backhaul Network. This section also covers the furnishing and installation of ancillary equipment and materials required to complete the installation and make the networks ready for use by BAIFA or BAIFA's clients.

- 4.1 Furnish all required network devices, software, cables, and components necessary for the new network. Items to be furnished include, but are not limited to:
  - 4.1.1 Layer 3 Ethernet core switches
  - 4.1.2 Layer 3 Ethernet switches
  - 4.1.3 Ethernet edge switches
  - 4.1.4 Power cables
  - 4.1.5 Gigabit Interface Converters (GBICs)
  - 4.1.6 Fiber-optic trunk cables
  - 4.1.7 Fiber-optic drop cables
  - 4.1.8 Fiber-optic patch cords
  - 4.1.9 Fiber-optic interconnect centers, fiber-optic splice enclosures, and all necessary hardware
  - 4.1.10 Items required for modification of existing splice enclosures
  - 4.1.11 Category 6 Ethernet patch cords
  - 4.1.12 Items required for Cable management
  - 4.1.13 Additional shelves for existing racks or cabinets as needed to house the TSI specified equipment
  - 4.1.14 Marking devices including cable tags
  - 4.1.15 Miscellaneous hardware, or other parts/pieces necessary for a complete installation.
- 4.2 Using existing and new network infrastructure and new racks or cabinets, install all network devices, software, cables, and components necessary for the new network. Installation includes, but is not limited to:

- 4.2.1 Coordination with other contractors and BAIFA to ensure sufficient fiber terminations, electrical power, outlets, and rack space
- 4.2.2 Coordination with other contractors and BAIFA to ensure sufficient reliable power for all network devices, with UPS power backup for core switching platforms and network devices
- 4.2.3 Installation of cable management
- 4.2.4 Installation of network devices
- 4.2.5 Installation of fiber-optic trunk cables
- 4.2.6 Installation of fiber-optic drop cables
- 4.2.7 Installation of fiber-optic patch cords from network devices to the existing fiber-optic patch panels
- 4.2.8 Installation of fiber-optic interconnect centers, fiber-optic splice enclosures, and all necessary hardware
- 4.2.9 Installation of Category 6 Ethernet patch cords from network devices to the patch panels
- 4.2.10 Installation of power cables for all network devices
- 4.2.11 Installation of cable tags on all data cables
- 4.2.12 Installation , configuration, and testing of network devices
- 4.2.13 Testing of all aspects of the network after installation
- 4.2.14 Furnishing and installing materials to restore the sites to conditions before construction

## 5. General

### 5.1 Environmental

5.1.1 Environmental Specifications: All equipment operates properly during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8., and 2.2.9.

### 5.1.2 Compliance and Certification

5.1.2.1 Regulations: FCC Part 90

5.1.2.2 Safety: UL – USA

- 5.1.3 Surge Protection: Provide surge protection in every ELN device cabinet housing wireless radios.
  - 5.1.3.1 All surge protection devices comply with UL 497A for paired data communications
  - 5.1.3.2 Specialized surge protection devices are provided at the supply side of all low voltage connections to the wireless Ethernet bridges. These connections include Ethernet data cables that comply with Electronic Industries Alliance (EIA) requirements

## 6. Single Mode Fiber-Optic Cable

- 6.1 Furnish, install, and test all underground and outdoor single mode fiber-optic (SMFO) cables and cable terminations. SMFO cable meets or exceeds all Telecommunications Industry Association (TIA)/EIA standards applicable to fiber-optic cables and fiber-optic terminations. SFMO cable length is appropriate for each installation and includes additional spare length for service loops. The SFMO cable will be of type and quality to support the implementation of optical wavelength division multiplexing.
- 6.2 A cable pulling operation plan will be developed and submitted to BAIFA for approval prior to cable pulling operations. Fiber installation and testing plans will be developed and submitted for approval by BAIFA prior to installation, or modification and testing, of all fiber-optic cable and related materials, enclosures, splice centers, kits pigtailed and all hardware required by the TSI for the project. All materials must also meet the additional specifications below.
- 6.3 Materials
  - 6.3.1 Loose tube construction, filled with a water-blocking material, and constructed by a certified International Organization for Standardization (ISO) 9001 or 9002 manufacturer.
  - 6.3.2 Dielectric complying with the requirements of Telecordia Standards 1755.900 except as modified by these specifications:
    - Number of fibers: See Section 4.2.1.1.
    - Cladding diameter: 125 mm ± 1.0 mm.
    - Core-to-cladding offset: ± 0.8 mm.
    - Cladding non-circularity: ± 1.0%.
    - Maximum attenuation: ± 0.40 dB/km at 1310 nm; ± 0.30 dB/km at 1550 nm.
    - Microbend attenuation (1 turn, 32 mm diameter): ± 0.05 dB at 1550 nm.
    - Microbend attenuation (100 turns, 75 mm diameter): ± 0.05 dB at 1310 nm.

- Mode-field diameter (matched cladding): 9.3 ± 0.5 mm at 1310 nm; 10.5 ± 1.0 mm at 1550 nm.
- Maximum chromatic dispersion: ± 3.2 ps/(nm x km) from 1285 nm to 1330 nm and < 18 ps/(nm x km) at 1550 nm.
- Fiber polarization mode dispersion: 0.5 ps/(km) 1/2.
- Fiber coating: Dual layered, UV cured acrylate.
- Coating diameter: 45 mm 10 mm.
- Min storage temperature range: -40° F to 158° F.
- Min operating temperature range: -4° F to 158° F.
- Rated life: Certify a 20-year life expectancy when installed to manufacturer's specifications.

6.3.3 Buffer tubes filled with a non-nutritive to fungus, electrically non-conductive, water-blocking material that is free from dirt and foreign matter. The water-blocking material allows free movement of the fibers, without loss of performance during installation and normal operation including expansion and contraction of the buffer tubes. The water-blocking material is readily removable with conventional nontoxic solvents. Buffer tubes are stranded around a central member using the reverse oscillation or "S-Z" stranding process. The use of filler rods in the fiber-optic cable when required to lend symmetry to the cable section is mandatory.

6.3.4 Tensile strength members designed to minimize cable elongation due to installation forces and temperature variation. Underground fiber-optic cable withstands a 2700N (600 lbf) tensile load where the change in attenuation does not exceed 0.2 dB during loading and 0.1 dB after loading. The cable is rated for an installed tensile service load of 890N (200 lbf) or more.

6.3.5 Fiber-optic cable jacket constructed of a high or medium density polyethylene duct (HDPE/MDPE) jacket that has been applied directly over the tensile strength members and water-blocking material.

6.3.6 One 6-pair polyethylene (PE) 39, 22 American Wire Gauge (AWG) tracer wire is directly adjacent to the cable in the conduit containing the fiber-optic cable in the ELN project to aid in locating the conduit once it is in place.

#### 6.4 Single-Mode Fiber-Optic Drop Cable

6.4.1 SMFO drop cable that meets the material requirements described above for single mode fiber-optic cable will be furnished to provide communications links between splice enclosures and the Ethernet edge switches through interconnect centers mounted in ELN cabinets. Furnished drop cables must contain a minimum of twelve individual fibers.

## 6.4.2 General

- 6.4.2.1 Appendix 1, Reference 2E, Express Lanes Conduit Inventory, lists the segments with existing conduit where fiber-optic cable is installed.
- 6.4.2.2 Cable Labeling Nomenclature: Develop a nomenclature plan for identification of fiber-optic cable in accordance with TIA/EIA standards and industry best practices. Submit the nomenclature plan to BAIFA for approval. Use approved cable nomenclature to create cable tags for the identification of fiber-optic cable. Provide permanent cable tag identification on all test results or fiber related documents provided to BAIFA.
- 6.4.2.3 Install the fiber-optic cable by hand by the manufacturer's recommended procedures. Ensure that at no time the manufacturer's recommended maximum pulling tension is exceeded. Ensure that cable-pulling lubricant used during installation is recommended by the optical fiber cable manufacturer. Provide and store fiber-optic cable at each pull box and splice box to allow for future splices, additions, or repairs to the fiber network. Store the fiber-optic cable without twisting or bending the cable below the minimum bend radius. Store a total of 200 feet of fiber-optic cable in splice vaults, with 100 feet of cable on each side of the cable splice point. Store 50 feet of spare fiber-optic cable in pull boxes.
- 6.4.2.4 Coil 50 feet of slack cable for each cable entering and exiting the splice enclosure in the splice vault or pull box where enclosure is located. Where fiber-optic cables are installed but not immediately spliced, store 50 feet of drop cable and 50 feet of fiber-optic trunk cable inside the manhole or junction box to facilitate subsequent splicing in the splice enclosure. At each ELN cabinet, splice drop cable to trunk cable in the pull box. After termination, coil and store in the base of the equipment cabinet 20 feet of drop cable plus any additional drop cable in excess of what is needed for storage.

## 6.4.3 Single Mode Fiber-Optic Trunk Cable

- 6.4.3.1 Size the trunk cable to include those strands needed for the project plus an additional 60 strands reserved for future use by BAIFA. If the cable size calculation results in less than a full buffer tube, the next larger standard fiber-optic cable size is used.

## 6.4.4 Single Mode Fiber-Optic Drop Cable

- 6.4.4.1 Size the drop cables to include all fiber strands for a redundant network plus 100% spare strands. Round the drop cable size to the next highest standard size cable.

## 7. Ethernet Communications Hardware

Furnish and install Ethernet communications hardware consisting of managed Layer 3 Ethernet core switches, managed Layer 3 Ethernet switches, and managed Ethernet edge switches (MEES), cabinets, and UPS.

### 7.1 Materials

Furnish and install Gigabit Ethernet communications hardware that is compatible with the existing BAIFA Ethernet switched network and Backhaul Network. The existing network consists of a 10/100/1000 Mbps Ethernet network.

#### 7.1.1 General

- 7.1.1.1 The TSI performs link budget analysis to determine the appropriate optical SFP GBIC type required (i.e., LX, ZX, etc.).
- 7.1.1.2 Due to optical budgeting constraints, the TSI will utilize the appropriate Gigabit Interface Converter (GBIC) adapters for all necessary device-to-roadside, roadside-to-roadside connections, and connections from the roadside to the primary and secondary Hosts.
- 7.1.1.3 Mechanical: Ensure that all wiring complies with National Electric Code (NEC) requirements and standards.
  - 7.1.1.3.1 Ensure that every conductive contact surface or pin is gold-plated or made of a noncorrosive, non-rusting, and conductive metal.
  - 7.1.1.3.2 Ensure that all parts are made of corrosion-resistant materials, such as plastic, stainless steel, anodized aluminum, brass, or gold-plated metal.
- 7.1.1.4 Electrical Specifications: Ensure that the MEES equipment operates and power is supplied with 115 volts of alternating current (VAC). If the device requires operating voltages other than 120VAC, supply the required voltage converter.
- 7.1.1.5 Environmental Specifications: All equipment must operate properly during and after being subjected to the environmental testing procedures described in NEMA TS 2, Sections 2.2.7, 2.2.8., and 2.2.9.

#### 7.1.2 Layer 3 Ethernet Switch

- 7.1.2.1 Provide the functions of a Layer 2 Ethernet switch and a Layer 3 router with advanced Class of Service (CoS)/QoS capabilities. Provide integrated and

distributed fault tolerant functionality and capabilities, and single point of failure protection functionality and capabilities.

- 7.1.2.2 Ensure that the Layer 3 Ethernet switch provides wire-speed Gigabit Ethernet connectivity at transmission rates to support the ELN project. Furnish, install, integrate, and test the Layer 3 Ethernet switches as complete compatible assemblies.
- 7.1.2.3 Networking Standards: Ensure that the Layer 3 Ethernet switches comply with all applicable Institute of Electrical and Electronic Engineers (IEEE) networking standards for Ethernet communications, including, but not limited to:
  - 7.1.2.3.1 IEEE 802.1d-2004 / 802.1w standard for Media Access Control (MAC) Bridges used with the Rapid Spanning Tree Protocol (RSTP);
  - 7.1.2.3.2 IEEE 802.1p standard for Cos / Priority Queuing;
  - 7.1.2.3.3 IEEE 802.1q standard for Virtual Local Area Network and Multiple Spanning Tree Protocol (MSTP), previously IEEE 802.1s;
  - 7.1.2.3.4 IEEE 802.1x standard for Port Based Network Access Control;
  - 7.1.2.3.5 IEEE 802.3 standard for local area network) and metropolitan area network (MAN) access and physical layer specifications;
  - 7.1.2.3.6 IEEE 802.3x standard regarding flow control with full duplex operation;
  - 7.1.2.3.7 IEEE 802.3z standard for 1000Base-X;
  - 7.1.2.3.8 IEEE 802.3ab standard for 1000Base-TX;
  - 7.1.2.3.9 IEEE 802.3ad standard for Link Aggregation;
  - 7.1.2.3.10 IEEE 802.3ae standard for 10GBase-X.
- 7.1.2.4 Ensure that the Layer 3 Ethernet switches comply with all applicable Requests for Comments specifications for Ethernet communications, including, but not limited to:
  - 7.1.2.4.1 RFC 5340 specification for Open Shortest Path First (OSPF), version 3;
  - 7.1.2.4.2 RFC 2362 specification for Protocol Independent Multicast – Sparse Mode;

- 7.1.2.4.3 RFC 3973 specification for Protocol Independent Multicast – Dense Mode;
- 7.1.2.4.4 RFC 5798 specification for Virtual Router Redundancy Protocol (VRRP) version 3 that supports IPv4 and IPv6.
- 7.1.2.5 Ensure that the managed Layer 3 Ethernet switches comply with all applicable networking standards for Ethernet communications, including but not limited to:
  - 7.1.2.5.1 RFC 2138 specification for RADIUS authentication;
  - 7.1.2.5.2 RFC 1492 specification for TACACS+;
  - 7.1.2.5.3 Support for Access Control Lists;
  - 7.1.2.5.4 Support for Secure Shell;
  - 7.1.2.5.5 Support for SSL.
- 7.1.2.6 Chassis
  - 7.1.2.6.1 Maximum of 24 EIA rack-units (RU) high.
  - 7.1.2.6.2 Provides for expansion and scalability.
  - 7.1.2.6.3 If a modular/slot/card design is used:
    - 7.1.2.6.3.1 After all modules are installed for the initial requirements, have a minimum of two (2) available and unassigned slots for future expansion.
    - 7.1.2.6.3.2 Backplane that provides a minimum switching capacity up to 256 Gbps.
    - 7.1.2.6.3.3 Redundant switch fabrics.
    - 7.1.2.6.3.4 All modules are hot-swappable.
- 7.1.2.7 Route/Switch Processor/Supervisor
  - 7.1.2.7.1 Provides synchronized dual processor/supervisor cards that provide resilient, self-healing network architecture. High-availability failover from a failed processor/supervisor to redundant processor/supervisor within 3 seconds.
  - 7.1.2.7.2 Each processor card provides a minimum of one management interface for out-of-band management.

- 7.1.2.7.3 Management console port for local personal computer connections and configurations.
- 7.1.2.7.4 Scalable switching capacity up to a minimum of 256 Gbps.
- 7.1.2.8 Ports
  - 7.1.2.8.1 Ensure that all fiber-optic link ports operate at 1,310 or 1,550 nanometers in single mode.
  - 7.1.2.8.2 Ensure that the optical ports are Type LC only.
  - 7.1.2.8.3 Provide Layer 3 Ethernet switches having a minimum of twenty-four (24) optical 1000 Base-X ports capable of transmitting data at 10,000 Megabits per second. Provide optical ports designed for use with a pair of fibers; one fiber transmits data and one fiber receives data.
  - 7.1.2.8.4 The optical ports have an optical power budget of at least 15 dB.
- 7.1.2.9 Copper Ports: The Layer 3 Ethernet switches have three copper ports for management and UPS monitoring.
- 7.1.2.10 Management
  - 7.1.2.10.1 Provide Management of each Layer 3 Ethernet switch individually and as a group for switch configuration, performance monitoring, and troubleshooting.
  - 7.1.2.10.2 Provide Layer 3+ capabilities, including, QoS, Internet Group Management Protocol (IGMP), rate limiting, security filtering, and general management.
  - 7.1.2.10.3 Support Layer 3 routing features including Open Shortest Path First (OSPF) and Protocol Independent Multicast (PIM).
  - 7.1.2.10.4 Fully compatible and interoperable with the trunk Ethernet network interface
  - 7.1.2.10.5 Support a virtual chassis configuration (i.e., stacking) of up to 10 switches.
  - 7.1.2.10.6 Provides Simple Network Management Protocol (SNMP), Remote Monitoring (RMON), switch monitoring (SMON), or the Trivial File Transfer Protocol (TFTP) and Telnet interface support.
  - 7.1.2.10.7 Network Time Protocol for an accurate and consistent timestamp.

7.1.2.10.8 Support port mirroring for troubleshooting purposes when combined with a network analyzer.

7.1.2.10.9 Support of remote and local setup and management via telnet, secure shell (SSH) and secure Web-based Graphical User Interface (GUI).

#### 7.1.2.11 Features

7.1.2.11.1 Comply with all applicable networking standards for Ethernet communications in Section 7.1.1.2. Provide the following additional features:

7.1.2.11.2 Support for Access Control Lists (ACLs);

7.1.2.11.3 SSH;

7.1.2.11.4 Support for SSL.

7.1.2.11.5 Support half and full duplex Ethernet communications.

7.1.2.11.6 Provides port-based VLAN and supports VLAN tagging that meets or exceeds specifications as published in the IEEE 802.1Q standard, and has a minimum 4-kilobit VLAN address table.

7.1.2.11.7 Support of, at a minimum, Version 2 of the IGMP

7.1.2.11.8 Channelization/bundling/link aggregation of physical Ethernet or gigabit Ethernet ports based on IEEE 802.3ad.

7.1.2.11.9 Spanning-Tree Protocol support for redundant backbone connections and a loop-free network.

7.1.2.11.10 VLAN trunk creation supported from any port using IEEE 802.1Q trunking.

7.1.2.11.11 Distribution of routing traffic among multiple paths.

7.1.2.11.12 Provides software upgrade capability that allows for transparent upgrades.

#### 7.1.2.12 Quality of Service (QoS)

7.1.2.12.1 IEEE 802.1p support on all ports.

7.1.2.12.2 Differentiated Services support on all ports.

7.1.2.12.3 Type of Service (ToS) support on all ports.

- 7.1.2.12.4 Minimum of eight hardware queues for classification and queuing of network traffic.
- 7.1.2.12.5 Able to differentiate network traffic based on port, source, destination, VLAN, premarked traffic.
- 7.1.2.12.6 Support for “trusting” of QoS marking on ports.
- 7.1.2.12.7 Ability to cross map and mark traffic based on medium or layer (ToS, IEEE 802.1p).
- 7.1.2.12.8 Provide a QoS mechanism that allows for traffic differentiation of at least eight (8) different types.

#### 7.1.2.13 Alarms

- 7.1.2.13.1 SNMP trap generation and forwarding to network management system.
- 7.1.2.13.2 Multifunction LEDs per port for port status, half-duplex/ full-duplex indication, switch-level status LEDs for system, redundant power supply (RPS), and bandwidth utilization.

#### 7.1.2.14 Security

- 7.1.2.14.1 Supports multilevel access security.
- 7.1.2.14.2 Provides media access control (MAC) address and 802.1x port level security.
- 7.1.2.14.3 ACLs.

#### 7.1.2.15 Power Supply

- 7.1.2.15.1 Redundant load-sharing power supplies.
- 7.1.2.15.2 Rated so that one power supply can supply power to the router/switch if fully populated with modules in every slot.

### 7.1.3 Ethernet Edge Switch

- 7.1.3.1 Furnish and install hardened managed Layer 2 Ethernet edge switch (MEES). Ensure that the MEES provides wire-speed Gigabit Ethernet connectivity at transmission rates of 1000 Megabits per second (Mbps) from the edge device installation location to the Layer 3 Ethernet switch.

### 7.1.3.2 Networking Standards

- 7.1.3.2.1 Ensure that the Layer 2 Ethernet access switch complies with all applicable IEEE networking standards for Ethernet communications, including but not limited to:
- 7.1.3.2.2 IEEE 802.1d-2004 / 802.1w standard for MAC bridges used with the Rapid Spanning Tree Protocol (RSTP);
- 7.1.3.2.3 IEEE 802.1p standard for Class of Service / Priority Queuing;
- 7.1.3.2.4 IEEE 802.1q standard for Virtual Local Area Network and Multiple Spanning Tree Protocol (MSTP), previously IEEE 802.1s;
- 7.1.3.2.5 IEEE 802.1x standard for Port Based Network Access Control;
- 7.1.3.2.6 IEEE 802.3 standard for local area network (LAN) and metropolitan area network (MAN) access and physical layer specifications;
- 7.1.3.2.7 IEEE 802.3u standard for 100Base-T / 100Base-FX;
- 7.1.3.2.8 IEEE 802.3x standard regarding flow control with full duplex operation;
- 7.1.3.2.9 IEEE 802.3z standard for 1000Base-X;
- 7.1.3.2.10 IEEE 802.3ab standard for 1000Base-TX;
- 7.1.3.2.11 IEEE 802.3ad standard for Link Aggregation.
- 7.1.3.2.12 Ensure that the Layer 2 Ethernet access switch complies with all applicable networking standards for Ethernet communications, including but not limited to:
- 7.1.3.2.13 RFC 2138 specification for RADIUS authentication;
- 7.1.3.2.14 RFC 1492 specification for TACACS+;
- 7.1.3.2.15 SSH;
- 7.1.3.2.16 SSL.

### 7.1.3.3 Physical

- 7.1.3.3.1 A minimum of two (2) Gigabit Interface Converter (GBIC)-based 1000Base-X ports for connection to the communications network.

- 7.1.3.3.2 A sufficient number of 10/100/1000BaseT ports with RJ-45 connectors to provide connectivity to all roadside toll system devices requiring a network connection plus 100% additional spare port capacity or a minimum of twenty four (24) 10/100/1000BaseT ports with RJ-45 connectors, whichever is greater.
- 7.1.3.3.3 Management console port for local personal computer connections and configurations.
- 7.1.3.4 Optical Ports
  - 7.1.3.4.1 Operate at 1,310 or 1,550 nanometers in single mode.
  - 7.1.3.4.2 Provide Type LC only. Provide optical ports designed for use with a pair of fibers; one fiber transmits data and one fiber receives data.
  - 7.1.3.4.3 The optical ports have an optical power budget of at least 15 dB.
  - 7.1.3.4.4 Copper Ports: Provide three copper ports for management and UPS monitoring.
- 7.1.3.5 Management
  - 7.1.3.5.1 Provide management of each Layer 2 Ethernet switch individually and as a group for switch configuration, performance monitoring, and troubleshooting.
  - 7.1.3.5.2 Provides SNMP, RMON, or SMON, and the Trivial File Transfer Protocol (TFTP) and Telnet interface support.
  - 7.1.3.5.3 Utilizes Network Time Protocol for an accurate and consistent timestamp.
  - 7.1.3.5.4 Support port mirroring for troubleshooting purposes when combined with a network analyzer.
  - 7.1.3.5.5 Support of remote and local setup and management via telnet, SSH and secure Web-based GUI.
  - 7.1.3.5.6 Provides diagnostic light emitting diodes (LEDs), including link, transmit, receive, and power LEDs.
- 7.1.3.6 Quality of Service (QoS)
  - 7.1.3.6.1 IEEE 802.1p support on all ports.

- 7.1.3.6.2 Provide port-based prioritization.
    - 7.1.3.6.3 Allocate bandwidth based on MAC source address, MAC destinations address, IP source address, IP destination address, and TCP/UDP port number.
  - 7.1.3.7 Alarms
    - 7.1.3.7.1 SNMP trap generation and forwarding to network management system.
    - 7.1.3.7.2 Multifunction LEDs per port for port status, half-duplex/ full-duplex indication, switch-level status LEDs for system, and bandwidth utilization.
  - 7.1.3.8 Security
    - 7.1.3.8.1 Supports multilevel access security.
    - 7.1.3.8.2 Provides MAC address port level security.
- 7.1.4 Cabinets
  - 7.1.4.1 Standards: Ensure that the cabinets comply with the following standards:
    - 7.1.4.1.1 ANSI;
    - 7.1.4.1.2 ASTM;
    - 7.1.4.1.3 IMSA ;
    - 7.1.4.1.4 ISO 9001;
    - 7.1.4.1.5 NEC;
    - 7.1.4.1.6 NEMA TS-2; and
    - 7.1.4.1.7 UL listed.
  - 7.1.4.2 Functional: Furnish Caltrans Type 333 size base-mounted hub cabinets meeting the following minimum requirements:
    - 7.1.4.2.1 Fiber-optic splice center
    - 7.1.4.2.2 Grounding bus bar
    - 7.1.4.2.3 19-inch rack system for mounting of all devices in the cabinet
    - 7.1.4.2.4 Pull-out shelf for laptop and maintenance use

- 7.1.4.2.5 Fluorescent lighting
  - 7.1.4.2.6 Ventilation fans
  - 7.1.4.2.7 120VAC power supply
  - 7.1.4.2.8 120VAC ground fault circuit interrupter (GFCI)-protected duplex outlets for tools
  - 7.1.4.2.9 120VAC surge-protected duplex outlets for equipment
  - 7.1.4.2.10 Lightning and surge protection on incoming and outgoing electrical lines (power and data)
  - 7.1.4.2.11 Managed Ethernet switch
  - 7.1.4.2.12 Network controlled power strip along vertical rail
  - 7.1.4.2.13 UPS with sufficient capacity to hold hub's electrical load for 4 hours
- 7.1.4.3 Physical Features
- 7.1.4.3.1 Provide cabinets that are completely weatherproof to prevent the entry of water. Provide cabinet and door exterior seams that are continuously welded and all exterior welds are smooth.
  - 7.1.4.3.2 Provide rails to create a cage to mount hardware, wiring panels and miscellaneous mounting brackets. Drill and tap the rails for EIA universal spacing.
  - 7.1.4.3.3 Provide rack assemblies that have a removable, standard 19-inch EIA compliant rack.
  - 7.1.4.3.4 Equip each cabinet with an aluminum storage compartment. Provide a top to the storage compartment that is hinged aluminum.
  - 7.1.4.3.5 Provide two (2) removable metal shelves with each cabinet.
- 7.1.4.4 Lighting: Provide the field cabinet with at least one 20-watt fluorescent lamp. Equip the field cabinet with door-actuated switches so that the lamp(s) automatically turn on when either cabinet door is opened and go off when the doors are closed.
- 7.1.4.5 Electrical: Provide a service panel assembly to function as the entry point for AC power to the cabinet and the location for power filtering, transient

suppression, and equipment grounding. Provide AC isolation within the cabinet. Configure cabinet to accept 120VAC from the utility company.

7.1.4.5.1 Provide UL listed surge protection devices according to the UL 1449, 2nd edition standard that comply with the NEMA requirements as detailed in the NEMA LS 1 (1992) standard.

7.1.4.5.2 Furnish an IP enabled power strip to permit powering on, off or rebooting a minimum of four outlets individually. Provide multi-level password security through a web browser.

7.1.4.5.3 Ensure that ground bus bars are fabricated from a copper alloy material compatible with copper wire.

7.1.4.5.4 Mount the ground bus bar on the side of the cabinet wall adjacent to the service panel assembly for the connection of AC neutral wires and chassis ground wires.

#### 7.1.4.6 Ventilation

7.1.4.6.1 Ensure the cabinet assembly can maintain the temperature and humidity within the environmental requirements of the Ethernet switches.

7.1.4.6.2 Environmental Requirements: Ensure the cabinet assembly can maintain the temperature and humidity within the environmental requirements of the hub switches.

## 7.2 Installation

### 7.2.1 General

7.2.1.1 All network devices and software installation work necessary to complete the indicated network, except as specified or indicated otherwise.

7.2.1.2 All work will be done in a neat and professional manner, in accordance with all applicable industry standards and sound engineering practice.

7.2.1.3 All installation and testing will be performed by qualified network technicians with a minimum of three years of experience in the installation and testing of similar equipment.

7.2.1.4 All equipment will be installed, configured, and tested in strict accordance with the original manufacturer's instructions. The manufacturer's printed or verbal recommended installation procedures and instructions for all materials furnished by

the Contractor under this contract will be followed explicitly, unless otherwise directed by BAIFA.

7.2.1.5 All equipment will be placed into operation in accordance with specified function.

7.2.1.6 All equipment chassis will be solidly grounded.

7.2.1.7 Install and wire all equipment in accordance with the Drawings. Any variations are noted on the site copy of Contract Drawings and indicated on the as-built plans.

7.2.1.8 All network devices and software will be free of all known security vulnerabilities, worms, and viruses at the time which testing begins. A physical and logical network design detailing logical configuration including IP addresses of network equipment configured under this contract, VLANs and ports assigned, trunks, aggregated links, routing protocols, spanning tree design, IP subnets, areas and autonomous systems applicable to the routing protocol used, firewall and routing design will be developed and provided to BAIFA for approval before work begins.

7.2.1.9 All wiring is tagged and identified by the use of insulated pre-printed sleeves and follows the project's cable identification scheme. Wire markers identify usage in plain words with sufficient details without abbreviations or codes.

7.2.1.10 Mount equipment in racks or cabinets and bolt securely in place.

7.2.1.11 Install all power cables necessary to connect the network equipment to the local sources of power as indicated.

7.2.1.12 Install all necessary fiber-optic patch cords within individual racks to make all necessary network connections.

7.2.1.13 Install all necessary Ethernet data cables within individual racks to make all necessary network connections.

7.2.1.14 All wiring and cabling, including copper data and power cables, will be neatly labeled, bundled, tie-wrapped, and secured. Wire labels are plastic permanent-type labels. Coordinate wiring and cabling labels with TSI shop drawings.

7.2.1.15 Utilize existing cable management where available. In existing racks that do not have cable management, provide horizontal and vertical slotted duct cable management (with removable covers). Ensure new cable management is compatible with the existing rack.

7.2.1.16 Contractor will perform any upgrades, installation, or maintenance within the coordinated and specified time in the schedule.

## 7.2.2 Layer 3 Ethernet Core Switch

7.2.2.1 Install managed Layer 3 Ethernet core switches at the following locations:

7.2.2.1.1 Benicia Bridge Toll Plaza Server Room

7.2.2.1.2 375 Beale Server Room

7.2.2.1.3 Install Layer 3 Ethernet switches at the following locations:

Route	Location	Notes
I-680	Caltrans/BART Walnut Creek Hub	Primary location for Corridor
I-680	Caltrans/BART East Dublin Hub	Secondary location for Corridor
State Route 84	Dumbarton Toll Plaza Server Room	Primary location for Corridor
State Route 92	San Mateo Toll Plaza Server Room	Primary location for Corridor
Caltrans TMC	Caltrans TMC Server Room	Operations Center

7.2.2.1.4 Install Layer 3 Ethernet switches at other locations to be determined by the TSI design to make a complete redundant network. These locations include:

- I-880: Redundant location to be determined by the TSI design
- I-80 (Solano County): primary and secondary locations

7.2.2.2 Install the Layer 3 Ethernet switches inside a field ELN cabinet except where noted above to be installed in server rooms.

7.2.2.3 Prior to implementation on the live system, provide a copy of the switch configuration for review and approval by the Engineer.

## 7.2.3 Ethernet Edge Switch

7.2.3.1 Install a MEES in each ELN roadside cabinet.

## 7.2.4 Cabinets

7.2.4.1 Install cabinets for Layer 3 switches not located in server rooms or buildings.

7.2.4.2 Install the cabinets for the Layer 3 Ethernet switches on cabinet foundations constructed by others.

7.2.4.3 Equip cabinets with lightning and surge protection.

7.2.4.4 Ground all hub cabinets. Keep the ground wire from the cabinet ground bus bar to the ground rod assembly or array as short as possible. Ensure the ground wire is not in contact with any other part of the cabinet.

## 7.2.5 UPS

- 7.2.5.1 Connect the UPS to both AC power and to its respective Layer 3 Ethernet switch. Configure the UPS or remote monitoring and alarms.

## 8. Network Management Software

The Network Management System (NMS) software provides a simple, intuitive interface to the network administrator for monitoring and maintenance of the TSI network. Furnish and install NMS software that provides configuration, troubleshooting, security, and system monitoring for the TSI communications network.

### 8.1 Features

#### 8.1.1.1 Dashboard

- 8.1.1.1.1 The NMS features a configurable dashboard to provide a summary of key performance indicators including critical issues / alarms and other system details, such as real-time device up/down status, availability reports for user defined reporting periods.

#### 8.1.1.2 Network Topology View

- 8.1.1.2.1 The NMS possesses a GUI that provides a detailed real-time view of the entire BAIFA network. The software has the ability to import a map and provide a dynamic, customizable interface in order to depict accurately the physical location of the devices. The map has the capability to display icons of all network devices used throughout the BAIFA network. The map has the ability to be saved, shared, and printed.

#### 8.1.1.3 Secure Management

- 8.1.1.3.1 The NMS possesses the ability to poll devices in a secure manner via SNMPv3. The NMS allows the user to remotely login to all devices via SSH / HTTPS using the GUI.

#### 8.1.1.4 Network Discovery

- 8.1.1.4.1 The NMS provides automated Layer 2 / 3 discovery of connected devices. The NMS is capable of automatically searching the network for connected devices and providing detailed information such as physical connectivity, asset information, and configuration information. The NMS uses a variety of standard protocols to gather network data including, but not limited to:

- 8.1.1.5 Address Resolution Protocol (ARP);
- 8.1.1.6 SNMP;
- 8.1.1.7 Internet Control Message Protocol (ICMP);
- 8.1.1.8 SSH;
- 8.1.1.9 Link Layer Discovery Protocol (LLDP)
- 8.1.1.10 The NMS uses the network discovery data to update the network topology diagrams with little to no input from the user.
- 8.1.1.11 The NMS captures asset data from all network devices including, but not limited to:
  - 8.1.1.11.1 Manufacturer & Model Number;
  - 8.1.1.11.2 Serial Number;
  - 8.1.1.11.3 Hardware / Software / Firmware versions;
  - 8.1.1.11.4 Power Supplies / Fans.
- 8.1.1.12 The NMS captures configuration data from all network devices including, but not limited to:
  - 8.1.1.12.1 Interfaces;
  - 8.1.1.12.2 Bridge ports;
  - 8.1.1.12.3 Switch ports;
  - 8.1.1.12.4 VLANs;
  - 8.1.1.12.5 Spanning Tree information;
  - 8.1.1.12.6 IP and MAC addresses.
- 8.1.1.13 Network Alerts: All network alerts are displayed on the main page of the web interface and that is capable of being organized by severity. The NMS has the ability to send automatically out network alerts via email or SMS text message based on severity.
- 8.1.1.14 Reporting: The NMS is capable of generating reports of system-wide performance including, but not limited to the following:
  - 8.1.1.14.1 Device Status (Up/Down);
  - 8.1.1.14.2 Link Status (Up/Down);

8.1.1.14.3 Interface Utilization;

8.1.1.14.4 CPU Utilization;

8.1.1.14.5 Memory Utilization.

8.1.1.15 Compatibility: The NMS supports any common network device that supports SNMP v1, SNMP v2, or SNMP v3. Configure the NMS to provide BAIFA/BATA read only access for monitoring purposes.

8.1.1.16 Scalability: The NMS is scalable to allow for future growth of the BAIFA System. The NMS provides for the ability to expand the licenses in the future to continue to monitor new devices as they are added.

8.1.1.16.1 The initial BAIFA deployment contains approximately 350 managed devices.

8.1.1.16.2 The NMS is expandable to handle 700 devices or more with no additional hardware requirements.

8.1.1.16.3 For bidding purposes, the initial deployment is 350 managed devices, with the capability to expand to 700 devices through additional license purchases, which are not required as part of this bid.

8.1.1.17 Layer 2 / 3 network discovery is provided with licenses for up to 350 switches. These switches are inclusive of the 700 network devices described above, but have the added capability of automated network discovery and mapping.

8.1.1.18 Operating System

8.1.1.18.1 The NMS is web-based and compatible with the latest version of the Windows Server Operating System. Any database software that is required to support the NMS is included as incidental with the NMS software.

## 8.2 Installation

8.2.1.1 Install the NMS software on the TSI provided servers and workstations to monitor the TSI provided Ethernet devices.

8.2.1.2 Provide BAIFA/BATA read only capability to monitor the NMS software.

## 9. Wireless Communications

Wireless communications on this project may consist of Ethernet bridge radios to link adjacent device cabinets and microwave radio for communications.

## 9.1 Materials

### 9.1.1 Wireless Ethernet Bridge

- 9.1.1.1 An Ethernet bridge radio system with all necessary hardware in to provide data links between ELN roadside cabinets and the roadside communications network may be used to communicate between roadside cabinets and from device cabinet to roadside cabinet.
- 9.1.1.2 The Ethernet bridge radio system must be full duplex communications between multiple “near line-of-sight” antennas using licensed, spread spectrum technology operating in the 5 GHz unlicensed frequency band and utilize Orthogonal Frequency Division Multiplexing (OFDM). The Ethernet bridge radio system utilizes Multiple Input Multiple Output (MIMO) technology for increased scalability.
- 9.1.1.3 The wireless Ethernet bridge may use flat panel or omni-directional antenna.
- 9.1.1.4 Provide all hardware and mounting brackets required to mount the antennas on existing sign structures or CCTV poles.
- 9.1.1.5 Match banding to metal pole type. Stainless steel is not appropriate for use on galvanized poles. Banding metal must be less than three positions from the pole metal on the galvanic scale or it becomes a rust promoter.
- 9.1.1.6 The wireless Ethernet bridge includes the radio, power supply, power injector, cabling, and connectors, and surge protection. At certain locations, it will be necessary to integrate the radio system with a fiber-optic system.
- 9.1.1.7 The wireless Ethernet bridge meets the following minimum specifications:
  - 9.1.1.7.1 Modulation: Orthogonal Frequency Division Multiplexing (OFDM)
  - 9.1.1.7.2 Antenna: Multiple In / Multiple Out (MIMO)
  - 9.1.1.7.3 Frequency Range: 4.9 – 6.0 GHz that is allocated to transportation
  - 9.1.1.7.4 Configuration and Management:
  - 9.1.1.7.5 Configuration Protocols: Remote SSH, SNMP, FTP
  - 9.1.1.7.6 Software Upgrades: FTP and TFTP download

- 9.1.1.7.7 Diagnostics Tools: Antenna alignment, bandwidth, and frequency usage
  - 9.1.1.7.8 Real-time Link Monitoring: Secure management Interface - real-time signal strength, authentication data, system uptime, data rate, channel selection
  - 9.1.1.7.9 Electrical Power Input: 120VAC input. Power over Ethernet (PoE) low voltage DC
- 9.1.2 Security: The wireless Ethernet bridge supports the following security protocols:
- 9.1.2.1 SSH
  - 9.1.2.2 SSL
  - 9.1.2.3 Management: Simple Network Management Protocol version 3 (SNMP v3)
  - 9.1.2.4 Encryption Algorithm: Advanced Encryption Standard – 128 bit (AES-128) or stronger encryption
  - 9.1.2.5 MAC Address Filtering / Control List
  - 9.1.2.6 IEEE 802.1x / RADIUS Authentication
- 9.1.3 Furnish a coaxial cable shield grounding kit containing components that will adequately bond and ground the cable shield to the pole ground. Ensure the grounding kit complies with MIL-STD-188-124A for coaxial cable and protects the cable from lightning currents in excess of 200kA.
- 9.1.4 Furnish a weatherproofing kit containing components that will protect the coaxial cable shield grounding system against the ingress of moisture and prevent vibrations from loosening the connections.
- 9.1.5 Furnish a coaxial cable power divider for repeater radio sites (if needed). Ensure the power divider accommodates a single primary input RF source and divides/splits the signal (power) equally between two output ports.
- 9.1.6 Microwave Communications
- 9.1.6.1 This section specifies requirements associated with the use microwave communications, to provide communications between roadside cabinets and the Layer 3 Ethernet switches for the transmission of data in areas where fiber-optic cable is not available or feasible.
  - 9.1.6.2 Ensure the MCS operates in the FCC licensed frequency band between 6 – 23 GHz.

- 9.1.6.3 Ensure the MCS supports Ethernet communication.
- 9.1.6.4 The MCS may be either a split mount design or an all outdoor unit (ODU).
- 9.1.6.5 Ensure the complete integration of each MCS station installation and its interoperability with the BAIFA Ethernet network and each of its subsystems and subsystem components.
- 9.1.6.6 Radio: Ensure the microwave radio meets the following minimum requirements:
- 9.1.6.7 Modulation: QPSK, 16QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM.
- 9.1.6.8 Frequency Range: 6 – 23 GHz
- 9.1.6.9 Channel Size: 50 MHz, 40 MHz, 30 MHz, 20 MHz, 10 MHz
- 9.1.6.10 Antenna: Perform path analysis and link calculations to determine the appropriate antenna size required. The microwave antenna is from the same manufacturer as the microwave radio.

## 9.2 Installation

### 9.2.1 Wireless Ethernet Bridge

- 9.2.1.1 The TSI will install the Power-over-Ethernet (PoE) injector, AC Power supply, and Cat 6 surge suppression inside an ELN cabinet.
- 9.2.1.2 The Cat 6 cable is protected via a surge suppressor prior to terminating to the PoE injector inside the pole-mounted cabinet and terminates in the RJ-45 port of the wireless radio unit.
- 9.2.1.3 The TSI will install surge suppression at both ends of the Category 6 Ethernet cable.
- 9.2.1.4 The TSI will install a Cat 6 cable inside the pole mounted cabinet for the interconnect of the PoE injector and MEES.
- 9.2.1.5 The TSI will integrate the wireless Ethernet bridge into the Ethernet network. The TSI submits an Integration Plan, which details integration of the wireless Ethernet bridges into the ELN Ethernet network.
- 9.2.1.6 The Integration Plan will include demonstration that the wireless Ethernet bridges can be monitored and controlled via the ELN Operations Center.
- 9.2.1.7 The TSI configures the following, at a minimum:
  - 9.2.1.7.1 Configure all required VLANs

- 9.2.1.7.2 IP address, subnet, and gateway
- 9.2.1.7.3 SNMP v3
- 9.2.1.7.4 Sntp
- 9.2.1.7.5 Quality of Service (QoS)
- 9.2.1.7.6 IEEE 802.1X (RADIUS)
- 9.2.1.8 Site Survey: Perform a radio path site survey test before installing any equipment. Ensure the test evaluates the Signal Strength (dBm), Fade Margin (dB), Signal-to-Noise Ratio, Data Integrity (poll test), and a complete frequency spectrum scan.
- 9.2.1.9 Ensure the radio path site survey test is performed using the supplied brand of radio equipment to be deployed.
- 9.2.1.10 Provide the test results to BAIFA for review and approval. Submit copies of the test results and color copies of the frequency spectrum scan along with an electronic copy of this information. BAIFA will approve final locations of antennas and any necessary repeater stations
- 9.2.1.11 Radio Licensing: Obtain for BAIFA an FCC 5 GHz permanent fixed point-to-point license for each radio used to implement the wireless Ethernet links included in this project.
- 9.2.1.12 Produce all the required data needed at each radio site to submit the licensing application. Obtain this data once the final location for each radio has been determined through the testing process.
- 9.2.1.13 Submit the licensing application for each radio to the FCC within two (2) weeks of the determination of the final location for the radio. Coordinate with BAIFA thirty (30) days in advance of installation to ensure that the 5 GHz license has been filed and approved with the FCC.
- 9.2.1.14 Configuration: Set up the Wireless Ethernet Bridge for operation in accordance with the manufacturer's recommendations.
- 9.2.1.15 Configure the radios as point-to-point or repeaters as appropriate. Configure them to use the frequencies found to minimize interference.
- 9.2.1.16 Align antennas to receive the maximum signal transfer.
- 9.2.1.17 Implement strong encryption and any other security features offered or as requested by the Engineer.
- 9.2.1.18 Test to ensure that the radios function as intended.

- 9.2.1.19 Software: Furnish units with a Windows<sup>®</sup> compatible software program that uses a GUI to provide “remote programming, radio configuration, remote maintenance, diagnostics and spectrum analyzer” features. Provide software approved by BAIFA that is designed to function with the approved radio.
- 9.2.1.20 Provide configuration software that can be upgraded in the future at no additional charge to the BAIFA. Configuration software permits saving and restoring device configurations.
- 9.2.1.21 Ensure the wireless Ethernet bridge is configurable from a single location (i.e. either end of the radio link) via supplied software
- 9.2.1.22 **Antenna:** Install the antenna in such a manner that avoids conflicts with other utilities (separation distances in accordance with the guidelines of the NESC) and as specified in the antenna manufacturer’s recommendations.
- 9.2.1.23 Secure the antenna mounting hardware to the pole and route the Ethernet cable such that no strain is placed on the connectors. On poles or sign structures provided by others, bond the antenna mounting hardware to the pole ground.
- 9.2.1.24 Install two antennae at a repeater site with a low-loss coaxial cable and antenna cable splitter.
- 9.2.1.25 Secure the antenna to the pole using stainless steel banding hardware or a method approved by BAIFA.
- 9.2.1.26 Antenna Cabling: Install the coaxial cable shield grounding system without damaging the cable shield.
- 9.2.1.27 Install the shield grounding system following the cable manufacturer’s recommendations.
- 9.2.1.28 Install and weatherproof the connection using the appropriate weatherproofing materials and following the manufacturer’s recommendations.
- 9.2.1.29 Cabinet and Electrical Power Wiring: Provide surge protection in ELN device cabinets to comply with the radio manufacturer’s recommendations for these protectors.
- 9.2.1.30 Connect the Ethernet surge protection devices between the Ethernet power injector and the wireless Ethernet bridge.
- 9.2.1.31 Furnish outdoor rated CAT-6 Ethernet cable to be installed between the wireless Ethernet bridges and Ethernet power injector. Provide all necessary Ethernet patch cables and ensure cables are of appropriate length.

- 9.2.1.32 Ensure that installing the Ethernet radios with an Ethernet edge switch does not require any field device modifications with regards to hardware or software.
- 9.2.1.33 Permanently label all cables entering the cabinet.
- 9.2.1.34 Ensure the power supply for the radio system is **NOT** connected to the GFCI receptacle circuit located in the cabinet. Place a copy of all manufacturer equipment specifications and instruction and maintenance manuals in the ELN device cabinet.
- 9.2.1.35 Do not create any new holes in the existing metal poles and transformer bases nor enlarge any existing holes. Do not feed antenna cables through holes or conduits that contain electrical conductors.

## 9.2.2 Microwave Communications

- 9.2.2.1 The coaxial antenna cable is protected via a surge protection device prior to terminating to the IDU.
- 9.2.2.2 Install a Cat 6 cable for the interconnect of the IDU and the MEES.
- 9.2.2.3 Perform a microwave path site survey test before installing any equipment. Ensure the microwave path site survey test is performed using the supplied brand of microwave equipment to be deployed. Provide the test results to BAIFA for review and approval. Submit copies of the test results along with an electronic copy of this information. BAIFA will approve final locations of antennas and any necessary repeater stations.
- 9.2.2.4 The Cat 6 cable will be protected via a surge protection device prior to terminating to the PoE injector.
- 9.2.2.5 Install a Cat 6 cable for the interconnect of the PoE injector and the MEES.
- 9.2.2.6 Submit an Integration Plan, which details integration of the microwave communication system into the BAIFA Ethernet network.
- 9.2.2.7 The integration plan includes demonstration that the microwave communication system can be monitored and controlled via the Operations Center.
- 9.2.2.8 The integration plan includes the following, at a minimum:
- 9.2.2.9 IP address, subnet, and gateway;
- 9.2.2.10 Configure all required VLANs;
- 9.2.2.11 SNMP;

9.2.2.12 QoS; and

9.2.2.13 Applicable security protocols.

## **10. Leased Communications**

### 10.1 General

10.1.1 MTC procures leased data communications services through the CALNET state contract. The present vendors are ATT and Verizon. The TSI may use other leased services if they are available.

10.1.2 Any leased services must be procured through BAIFA at the TSI's expense.

10.1.3 If the TSI desires to use leased communications to connect field devices to the Corridor, the TSI will:

10.1.3.1 Identify the locations where leased data communications service is available at the bandwidth needed,

10.1.3.2 Not create additional environmental impacts,

10.1.4 Additional specifications:

10.1.4.1 All leased data services must be:

10.1.4.2 Ethernet based

10.1.4.3 Supports VLANS

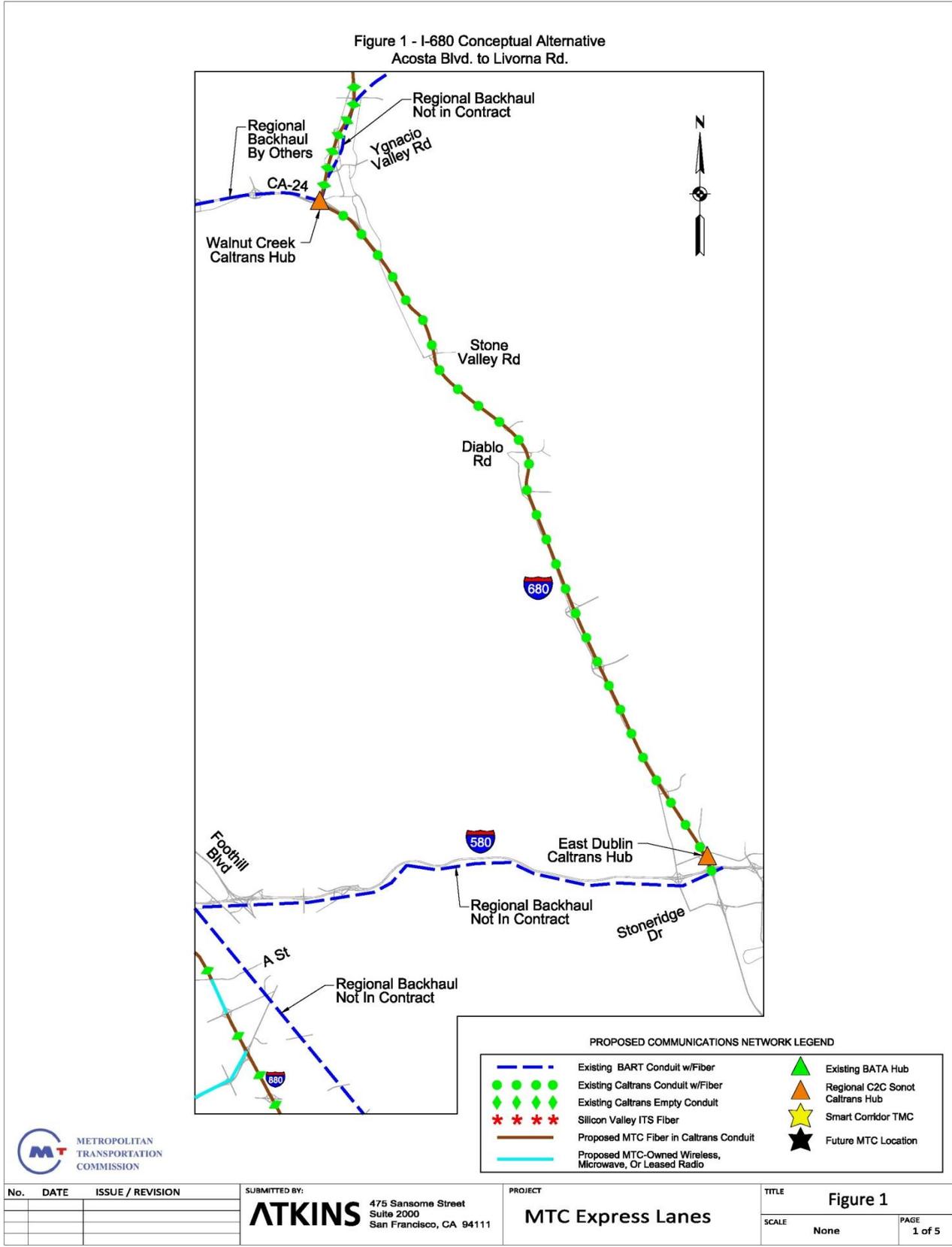
10.1.4.4 Supports bandwidth management and data buffering

10.1.4.5 Five (5) hour backup in the event of power loss

10.1.4.6 No SONET based technology

# Appendix 1

## Figures 1-5



No.	DATE	ISSUE / REVISION

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PROJECT  
**MTC Express Lanes**

TITLE  
**Figure 1**

SCALE  
 None

PAGE  
 1 of 5

Figure 2 - I-880 Conceptual Alternative  
NB & SB Marina to SR 237



PROPOSED COMMUNICATIONS NETWORK LEGEND

	Existing BART Conduit w/Fiber		Existing BATA Hub
	Existing Caltrans Conduit w/Fiber		Regional C2C Sonot Caltrans Hub
	Existing Caltrans Empty Conduit		Smart Corridor TMC
	Silicon Valley ITS Fiber		Future MTC Location
	Proposed MTC Fiber in Caltrans Conduit		
	Proposed MTC-Owned Wireless, Microwave, Or Leased Radio		



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TITLE	<b>Figure 2</b>	
SCALE	None	PAGE
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Figure 3 - I-80 Conceptual Alternative  
American Canyon Rd. to Vaca Valley Pkwy.



PROPOSED COMMUNICATIONS NETWORK LEGEND

	Existing BART Conduit w/Fiber		Existing BATA Hub
	Existing Caltrans Conduit w/Fiber		Regional C2C Sonot Caltrans Hub
	Existing Caltrans Empty Conduit		Smart Corridor TMC
	Silicon Valley ITS Fiber		Future MTC Location
	Proposed MTC Fiber in Caltrans Conduit		
	Proposed MTC-Owned Wireless, Microwave, Or Leased Radio		



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TITLE	Figure 3
SCALE	None
PAGE	3 of 5

Figure 4 - San Francisco-Oakland Bay Bridge & MTC 375 Beale Conceptual Alternative



PROPOSED COMMUNICATIONS NETWORK LEGEND

	Existing BART Conduit w/Fiber		Existing BATA Hub
	Existing Caltrans Conduit w/Fiber		Regional C2C Sonot Caltrans Hub
	Existing Caltrans Empty Conduit		Smart Corridor TMC
	Silicon Valley ITS Fiber		Future MTC Location
	Proposed MTC Fiber in Caltrans Conduit		
	Proposed MTC-Owned Wireless, Microwave, Or Leased Radio		



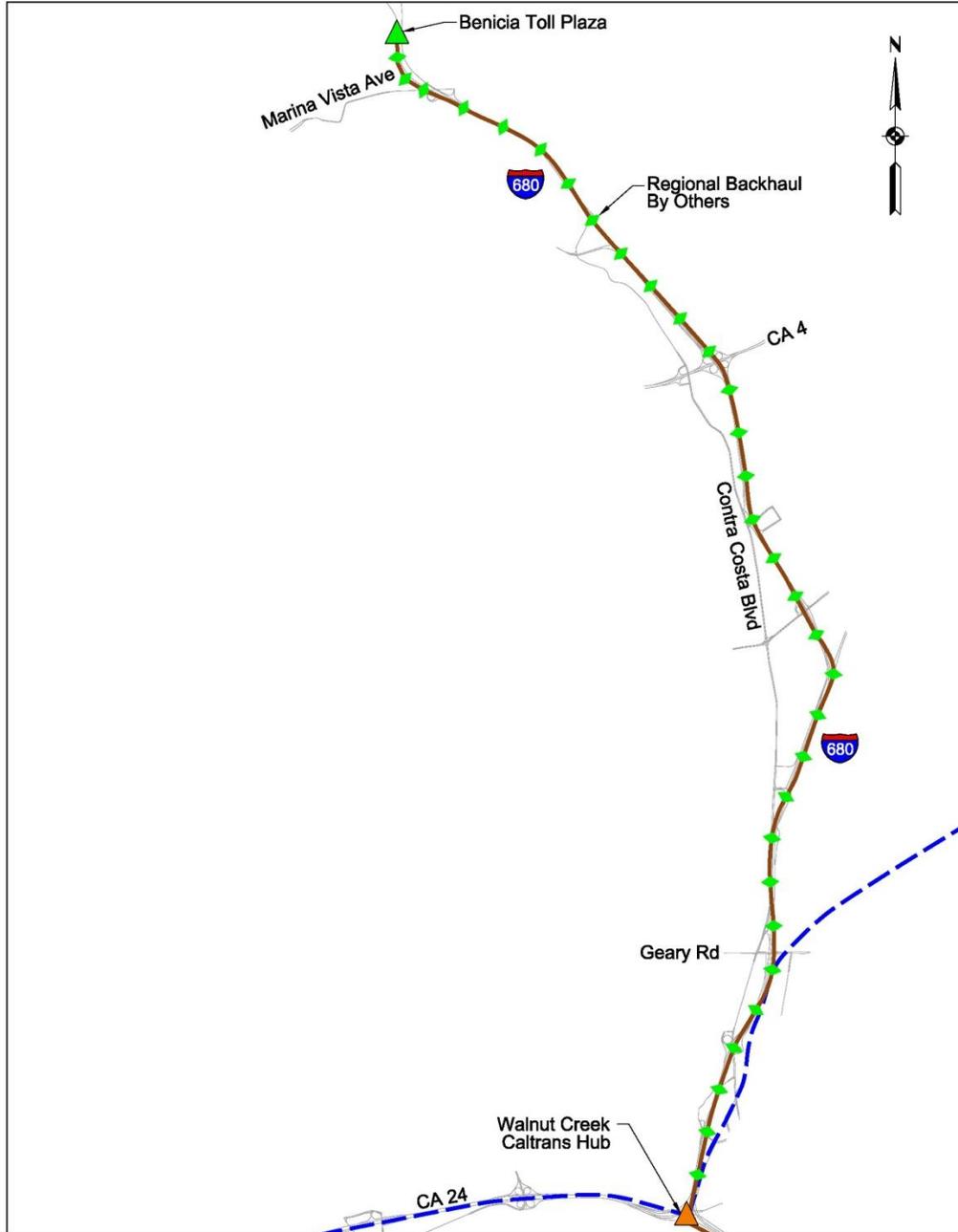
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TITLE	<b>Figure 4</b>	
SCALE	None	PAGE 4 of 5

Figure 5 - Benicia Bridge Conceptual Alternative



PROPOSED COMMUNICATIONS NETWORK LEGEND

	Existing BART Conduit w/Fiber		Existing BATA Hub
	Existing Caltrans Conduit w/Fiber		Regional C2C Sonot Caltrans Hub
	Existing Caltrans Empty Conduit		Smart Corridor TMC
	Silicon Valley ITS Fiber		Future MTC Location
	Proposed MTC Fiber in Caltrans Conduit		
	Proposed MTC-Owned Wireless, Microwave, Or Leased Radio		



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# Appendix 2

## Figure 6

