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16. Abstract

Graphic Route Information Panel (GRIP) signs use a combination of text, colors, and representative maps of the roadway system to convey real-time roadway congestion location and severity information. The intent of this project was to facilitate the fabrication, installation, and onset of operations of three dynamic travel time signs and one GRIP sign on Interstate 35 (I-35) near Austin, Texas. Unfortunately, FHWA rejected the request-to-experiment with a GRIP sign. This report documents the efforts made and accomplishments achieved under this project.

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INSTALLATION OF DYNAMIC TRAVEL TIME SIGNS AND EFFORTS TO OBTAIN AND TEST A GRAPHICAL ROUTE INFORMATION PANEL (GRIP) SIGN IN AUSTIN

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Project Title: Construction and Installation of Travel Time and Graphical Route Information

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DISCLAIMER

This research was performed in cooperation with the Texas Department of Transportation (TxDOT). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of TxDOT. This report does not constitute a standard, specification, or regulation.

The engineer in charge of the project was Gerald Ullman, P.E. #66876.

The United States Government and the State of Texas do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

ACKNOWLEDGMENTS

This project was conducted in cooperation with TxDOT and FHWA. The authors thank Joe Adams, Charles Koonce, Michael Chacon, John Nevares, and Charlie Farnham of TxDOT for their guidance and oversight during the conduct of this project.

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INTRODUCTION

Graphic Route Information Panel (GRIP) signs use a combination of text, colors, and representative maps of the roadway system to convey real-time roadway congestion location and severity information. Similarly, dynamic travel time signs provide current travel times to a specific destination via one or more routes. Both types of signs aid motorists in making route choice decisions while driving. However, previous research has shown that using GRIP and dynamic travel time signs together in sequence is preferable to a single GRIP sign that includes dynamic travel times on it. The intent of this project was to facilitate the fabrication, installation, and onset of operations of three dynamic travel time signs and one GRIP sign on Interstate 35 (I-35) near Austin, Texas.

The project consisted of eight tasks:

- Task 1. Construct and Install Three Dynamic Travel Time Signs on I-35.
- Task 2. Prepare a Request-to-Experiment (RTE) for FHWA.
- Task 3. Develop GRIP Sign Support Structure Fabrication and Installation Specifications.
- Task 4. Develop GRIP Sign Fabrication Specifications.
- Task 5. Development of Lonestar Data Interface Capabilities for the GRIP Sign.
- Task 6. Construct and Install the GRIP Sign Support Structure.
- Task 7. Construct and Install the GRIP Sign.
- Task 8. Perform the RTE Field Evaluation.

Tasks 4 through 8 were predicated on an assumption that the Federal Highway Administration (FHWA) would approve the installation and testing of a GRIP sign. Unfortunately, FHWA rejected the request-to-experiment with a GRIP sign. By the time this project terminated on May 31, 2015, a decision had not yet been made as to whether TxDOT would make another attempt to obtain FHWA approval, initiate GRIP sign fabrication and installation without FHWA approval, or abandon the effort to fabricate and install a GRIP sign as proposed in Austin.

The remainder of this report documents the efforts made and accomplishments achieved under this project.

CONSTRUCTING AND INSTALLING THREE DYNAMIC TRAVEL TIME SIGNS IN AUSTIN

The dynamic travel time signs (DTTSs) selected for this application are overhead or roadside-mounted guide signs that include an electronic sign inset that provides current travel times from the location of the sign to a selected downstream destination via two possible routes (see Figure 1):

- I-35 through Austin.
- State Highway 130/State Highway 45 (SH 130/SH 45), a toll facility that can be used by vehicles to bypass Austin.

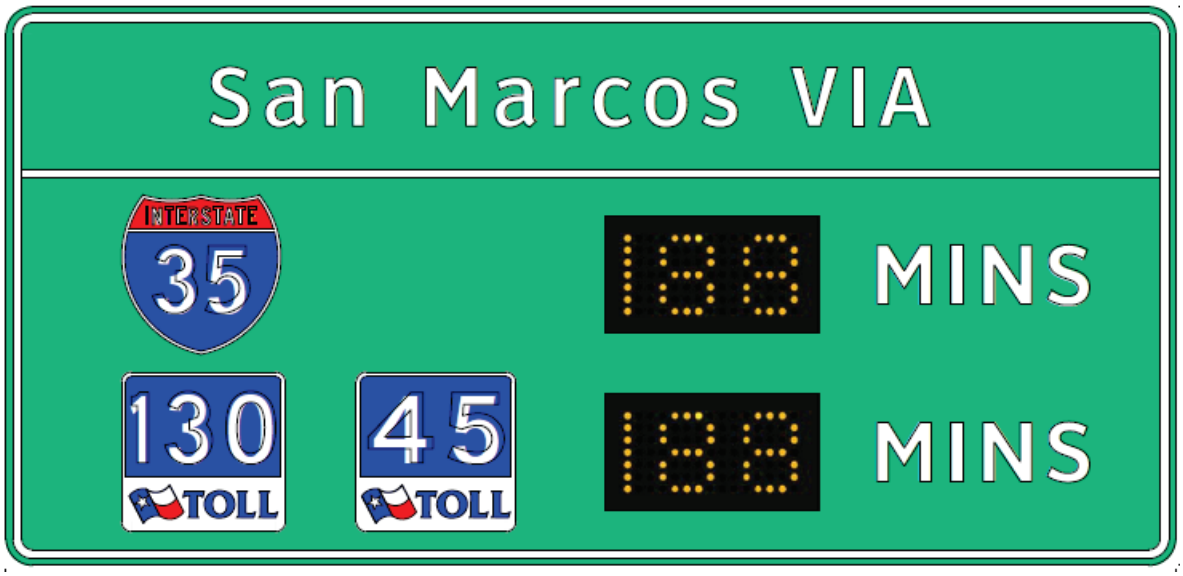


Figure 1. Example of a Dynamic Travel Time Sign to Be Installed on I-35 in Austin.

Site visits conducted in the I-35 corridor yielded three locations where overhead sign bridges (OSBs) already existed that could be used to mount the DTTSs:

- Southbound I-35 prior to the SH 130 interchange near Georgetown (GPS coordinates 30.745937, −97.636651).
- Southbound I-35 prior to the SH 45 interchange in Round Rock that connects with SH 130 (GPS coordinates 30.515811, −97.687757).
- Northbound I-35 prior to the SH 45 interchange near Kyle that also connects with SH 130 (GPS coordinates 30.02644, −97.851073).

Figure 2 illustrates the location of these OSBs. A structural analysis of each OSB was performed based on available drawings to assess their suitability for supporting the DTTS. Unfortunately, the northbound OSB was hit and damaged in winter 2014 (see Figure 3). This required the Austin District to repair the structure and move it 100 ft upstream where new footings for the structure could be constructed. This would not be accomplished during the timeline of the project. A decision was made to install temporary roadside poles 200 ft upstream of the original OSB structure on which to mount the DTTS until the OSB was moved and repaired. Guardrail would be installed around the temporary roadside installation for crashworthiness protection.

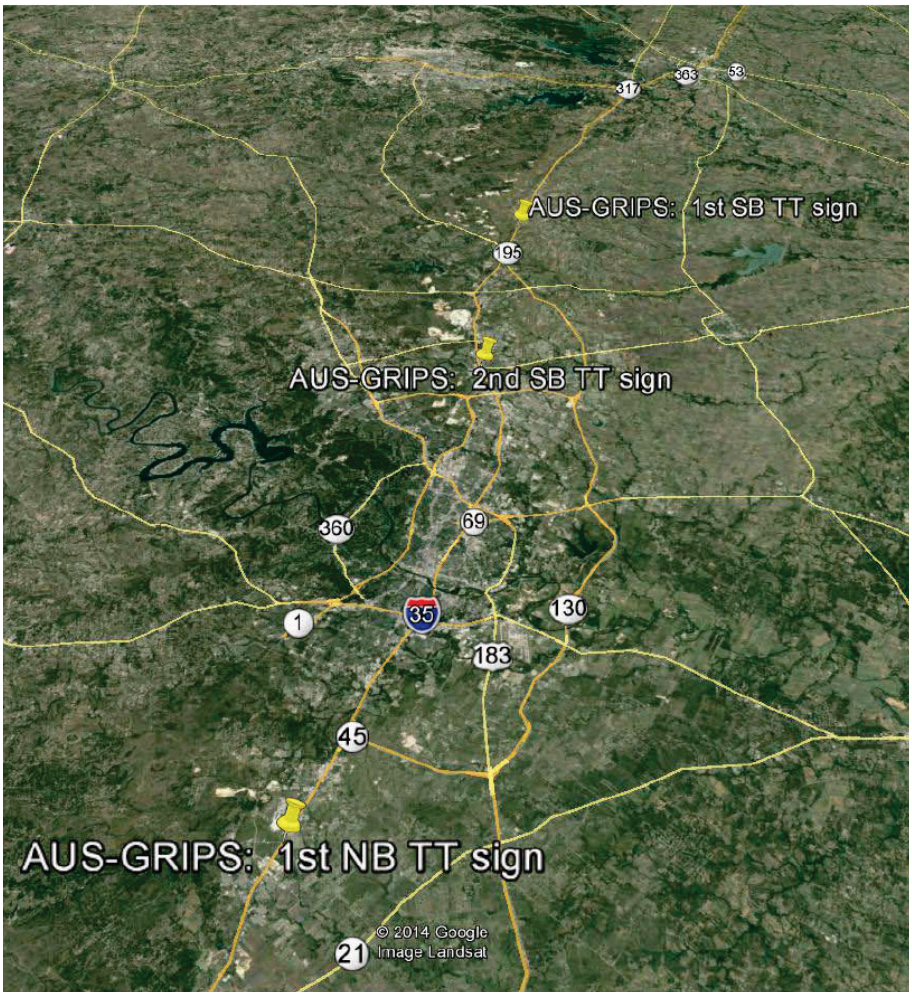


Figure 2. Location of Proposed DTTS Installations.

During the kick-off meeting of the project held in July 2014, a decision was made that the electronic dynamic message sign (DMS) insets to display travel times would need to be able to display up to three digits (the first digit being a 1) in order to accommodate the lengthy travel times through Austin that occasionally occur during peak hours. This requirement could not be accommodated by the existing DMS insets on the statewide ITS equipment contract, so the vendor developed a new inset design (see Figure 4) that would be acceptable to TxDOT. This new design was then added to the statewide contract near the end of August 2014.

Figure 3. Damaged OSB Structure and Footing near Kyle.

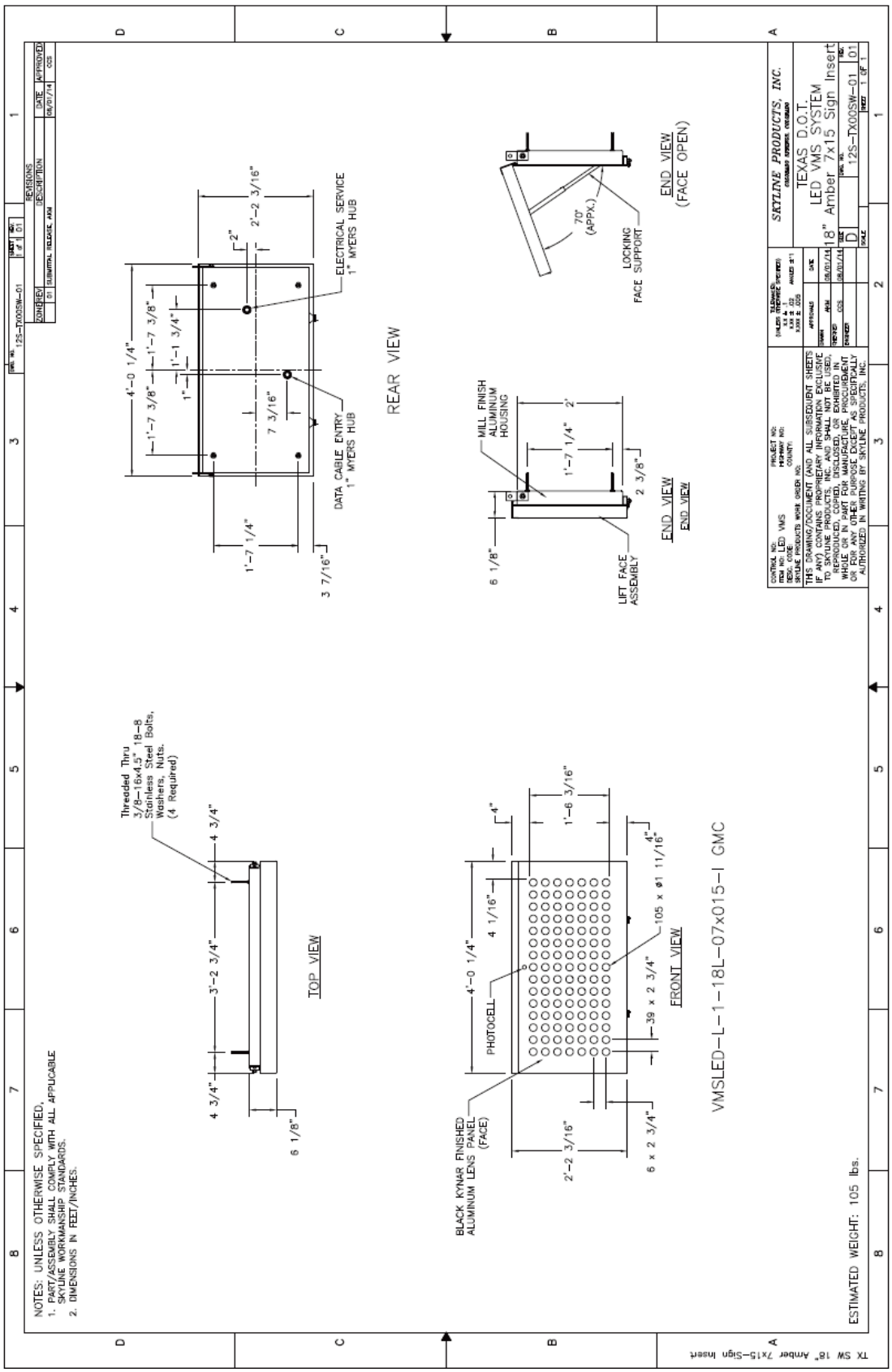


Figure 4. Engineering Drawings for Newly-Designed DMS Insets.

Because the contract was not initiated until late June 2014, it was not possible to get all of the equipment procured during FY 2014. The DMS insets were procured during FY 2014 but the cabinets to hold the DMS controllers could not be procured until early FY 2015. Similarly, fabrication of the guide sign panels that hold the DMS and the necessary site preparations (power drops, conduit and electrical cabling, sign mounting bracket fabrication, etc.) all had to be accomplished using FY 2015 funds.

The DMS inset and controller cabinets were fabricated and sent in March 2015. Acceptance testing was performed, the insets and cabinets approved, and then the equipment was shipped to the vendor that would be handling the site preparation and sign installations. Unfortunately, an extremely wet winter and spring in the Austin area hampered the vendor's efforts to make necessary site visits and measurements and to perform the necessary site preparations. A modification to extend this contract through the end of FY 2015 was discussed during project meetings, but was not formally requested.

In summary, the status of this effort as of the May 31, 2015, termination date of the project was as follows:

- Site locations for three DTTS installations identified.
- A temporary installation site identified immediately upstream of the initially selected OSB structure for the northbound DTTS in Kyle until repairs to the OSB structure and footings are made.
- Procurement and acceptance testing performed of the DMS insets and cabinets for the three DTTS, and shipping of the insets and cabinets to the DTTS installation vendors.
- Site inspections performed of the three sites to estimate preparation work required.
- Estimates of the preparation work prepared for all three sites.
- Utility drop locations identified for two sites (a power drop already exists at the southbound Round Rock location) and suitability of those locations verified with the utility company.

A follow-on project is being initiated to accomplish the following regarding the DTTS installations:

- Complete site preparation work at all three locations.
- Mount and test the operation of the DTTS at all three locations (including the communication of current travel times from Lonestar).

FABRICATING, INSTALLING, AND TESTING A GRIP SIGN ON I-35 IN AUSTIN

A human factors study performed prior to this project led to the recommendation that a GRIP sign configured as shown in Figure 5 be fabricated and tested in the field. The proposed location was on southbound I-35 near Georgetown, Texas, prior to the interchange with SH 130.

Figure 5. Proposed GRIP Sign for Southbound I-35 in Austin.

The following sections document the various activities that were undertaken in order to accomplish a fabrication, installation, and testing of this type of sign.

Development and Submission of a Request-to-Experiment from TxDOT to FHWA

A draft request-to-experiment (RTE) was prepared and submitted to TxDOT (Product 5-9049-P2). TxDOT used the draft RTE to craft an official RTE and submitted it to FHWA in September 2014. FHWA took slightly more than 6 months to reply, but ultimately denied approval of the RTE in April 2015. By the time the termination date of this project was reached, TxDOT had not yet determined if and how to respond to the FHWA denial.

Development of GRIP Sign Support Fabrication and Installation Specifications

An analysis was undertaken to develop a structural support for the proposed GRIP sign dimensions as shown in Figure 5 (24.5 ft by 31.5 ft). A roadside support was designed, consisting of four 14×48 I-beams imbedded in concrete footings. The proposed structural drawings for the support are included in the appendix. Wind loading requirements were the determining factor in the selection of post sizes.

A cost-benefit analysis was to be performed to assess whether it would be more economical to develop the support as a breakaway design, or to provide positive protection around the support. However, because of the post sizes required, a breakaway support option was not available, so the proposed structure would require positive protection to make the installation crashworthy. A cost estimate of the proposed GRIP sign support structure was then prepared. Analyses were performed for three different foundations (low, medium, or high) that would correspond to different soil conditions at the installation site (a soil test will be required to determine which option would be appropriate). Standard TxDOT bid item cost estimates were used in the analysis, and a standard W-beam guardrail was assumed to provide the necessary crash protection. The following bid item cost estimates were used in the analysis:

- Item 647-2001 (structural steel): $4.96/lb.
- Item 416-2018 (24-inch diameter foundation): $130.00/ft.
- Item 416-2020 (36-inch diameter foundation): $200.00/ft.
- Item 540-2002 (metal beam guardrail with steel posts): $22.00/ft.
- Item 540-2005 (anchor terminal for guardrail): $890.00/ea.
- Item 544-2001 (guardrail crashworthy end treatment): $2100.00/ea.

A 36-inch foundation was estimated for the medium- and high-level foundation requirements, and a 24-inch diameter foundation for the low-level foundation requirement. Post steel was estimated at 48 lb/ft for W14-48 members. Post lengths were assumed to be 31.5 ft for the sign, 10 ft between the sign and the ground. The depth of the foundation was 28.7 ft for the high foundation requirement, 14.6 ft for the medium foundation requirement, and 11.6 ft for the low foundation requirement.

Results of the analysis indicated that the support structure for the GRIP sign would cost between $85,680 (for a low foundation strength requirement) and $124,047 (for a high foundation strength requirement).

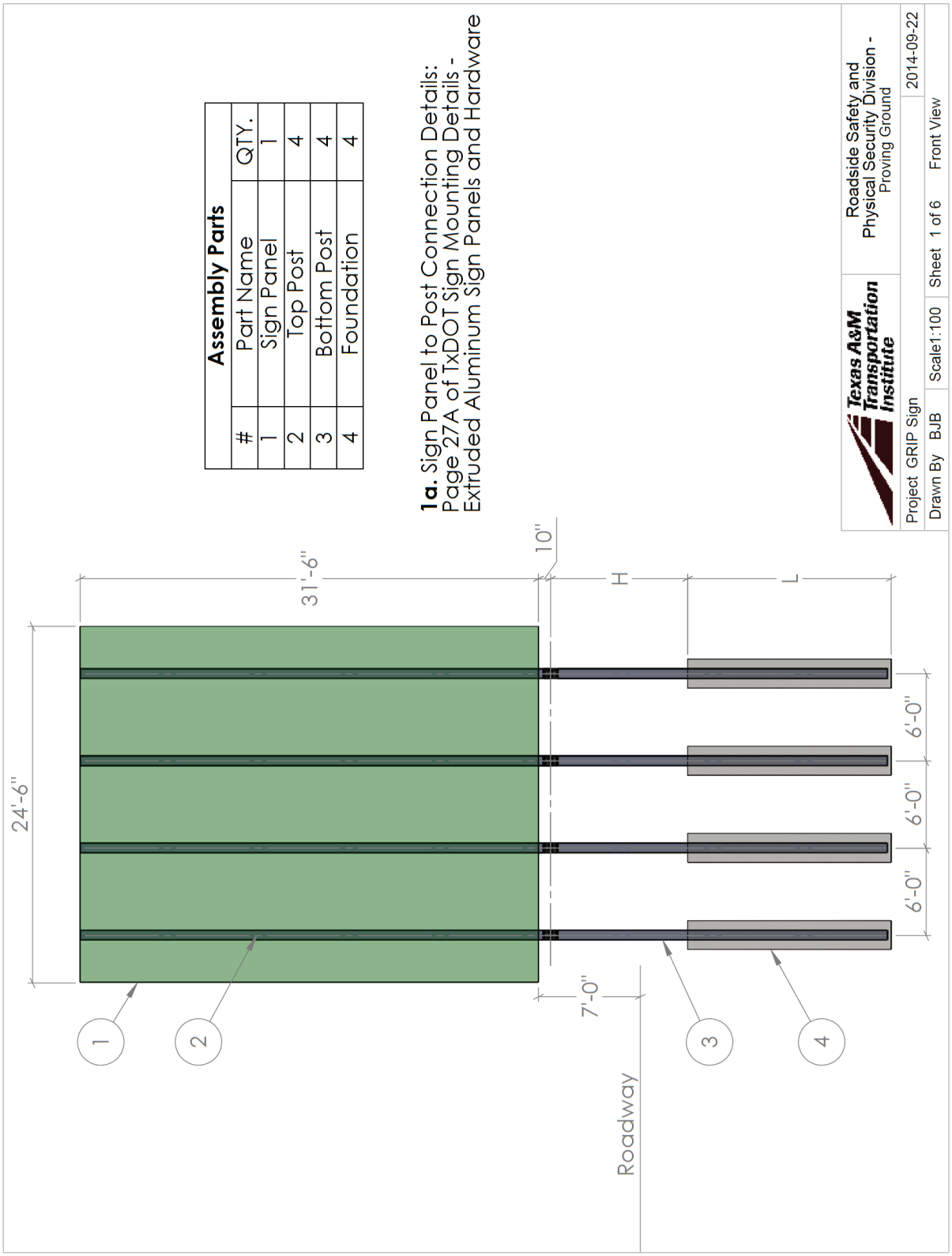
Development of GRIP Sign Fabrication Specifications

Efforts were undertaken to establish a set of functional requirements and design specifications for a GRIP sign fabrication that would ultimately be used in a request-for-proposals from a vendor to build the sign. A number of potential vendors were contacted and concepts discussed for how best to construct and operate a GRIP sign based on data provided by the TxDOT Lonestar system in Austin. Initially, a hybrid sign approach was envisioned as a large guide sign panel with cutouts for the routes where real-time travel conditions would be portrayed via electronic sign elements shown in appropriate colors (green, yellow, or red) through the cutouts. The primary reason for considering this approach was a perceived cost savings over large, full-matrix color DMS or digital billboard signs. Digital billboards are constructed similar to DMS but are less field-hardened than transportation-quality DMS and also are not typically fabricated to communicate via National Transportation Communications for ITS Protocols. However, as time passed waiting for FHWA to rule on the RTE, ongoing communications with various vendors revealed that the prices of full-matrix color DMS and digital billboards were coming down in price to a point where they may be competitive to the original hybrid GRIP sign concept from a cost perspective. A decision was made to construct the RFP as a functional specification and allow vendors to propose whatever technological approach they deemed most responsive to

the RFP and with the greatest chance of being a successful deployment within the time constraints of the project. In addition, a decision was made to include in the RFP the need to construct the appropriate sign support structure appropriate for the GRIP sign design being proposed, and describe how the sign would need to be operated using data from the Lonestar system.

A preliminary set of functional requirements for a GRIP sign were developed, and other basic information that would be required in an RFP were assembled. It was assumed that FHWA might have specific requirements to be met in order to approve the RTE, so a response from FHWA was anticipated prior to the completion of the RFP. Unfortunately, FHWA's RTE denial indicated that the current GRIP design was not acceptable to them for testing purposes. The RTE suggested that TxDOT would need to simplify the design (despite having human factors research results suggesting that the proposed sign was satisfactory) and resubmit if it wanted FHWA approval. A decision from TxDOT did not occur prior to the termination date of this project, and so the preliminary GRIP functional requirements and RFP were not completed or issued.

APPENDIX

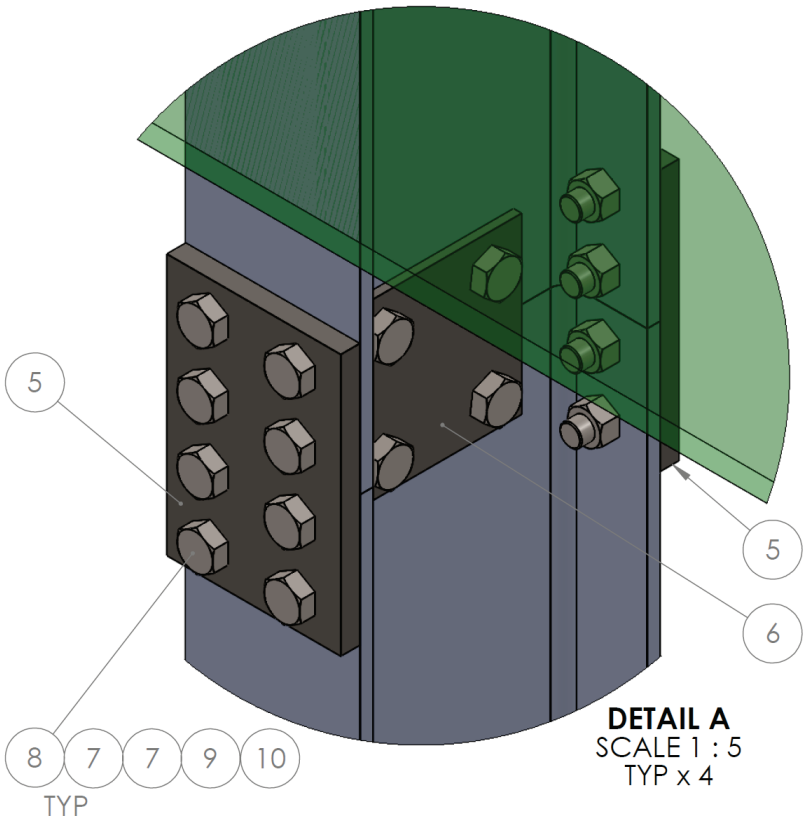

Assembly Parts
| Part Name | QTY.
1 | Sign Panel | 1
2 | Top Post | 4
3 | Bottom Post | 4
4 | Foundation | 4
1a. Sign Panel to Post Connection Details:
Page 27A of TxDOT Sign Mounting Details -
Extruded Aluminum Sign Panels and Hardware
Texas A&M Transportation Institute
Roadside Safety and Physical Security Division - Proving Ground
Project GRIP Sign
2014-09-22
Drawn By BJB
Scale1:100
Sheet 1 of 6
Front View
24'-6"
31'-6"
10"
H
L
6'-0"
6'-0"
6'-0"
7'-0"
Roadway
1
2
3
4

Foundation Options		
Foundation Diameter (ft)	Shear Strength of Soil, c (psf)	Embedded Length of Foundation, L (ft)
2	1000	28.7
	2000	20.1
	3000	16.6
	4000	14.6
	5000	13.3
	6000	12.3
	7000	11.6
3	1000	25.1
	2000	18.4
	3000	15.6
	4000	14.0
	5000	13.0
	6000	12.2
	7000	11.6

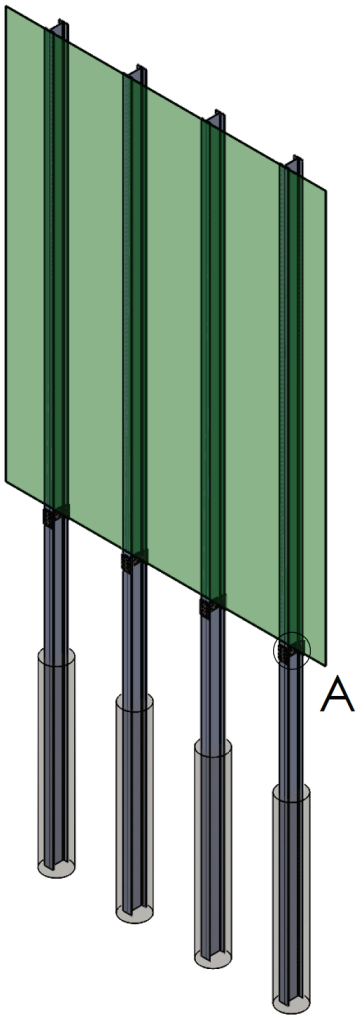
2a. Foundation Detail: Page 27B of TxDOT Sign Mounting Details - Large Roadside Signs Foundation and Stub

2b. Rebar Cage not shown for clearity

Texas A&M Transportation Institute	Roadside Safety and Physical Security Division - Proving Ground		
Project GRIP Sign			2014-09-22
Drawn By BJB	Scale 1:30	Sheet 2 of 6	Foundation



DETAIL A
SCALE 1 : 5
TYP x 4



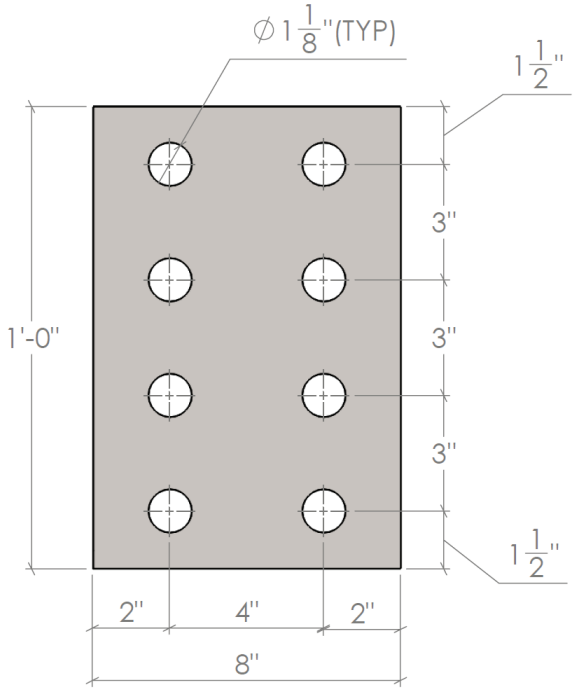
Column Splice Assembly Parts		
#	Part Name	QTY.
5	Flange Plate	8
6	Web Plate	8
7	Washer, 1" flat	160
8	A325 Bolt, 1" x 3-1/4" hex	80
9	Washer, 1" lock	80
10	Nut, 1" hex	80

Texas A&M Transportation Institute

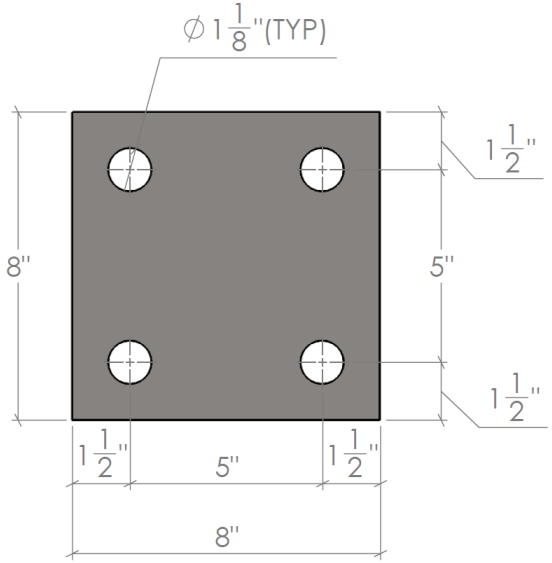
Roadside Safety and Physical Security Division - Proving Ground

Project GRIP Sign			2014-09-22
Drawn By BJB	Scale1:100	Sheet 3 of 6	Column Splice

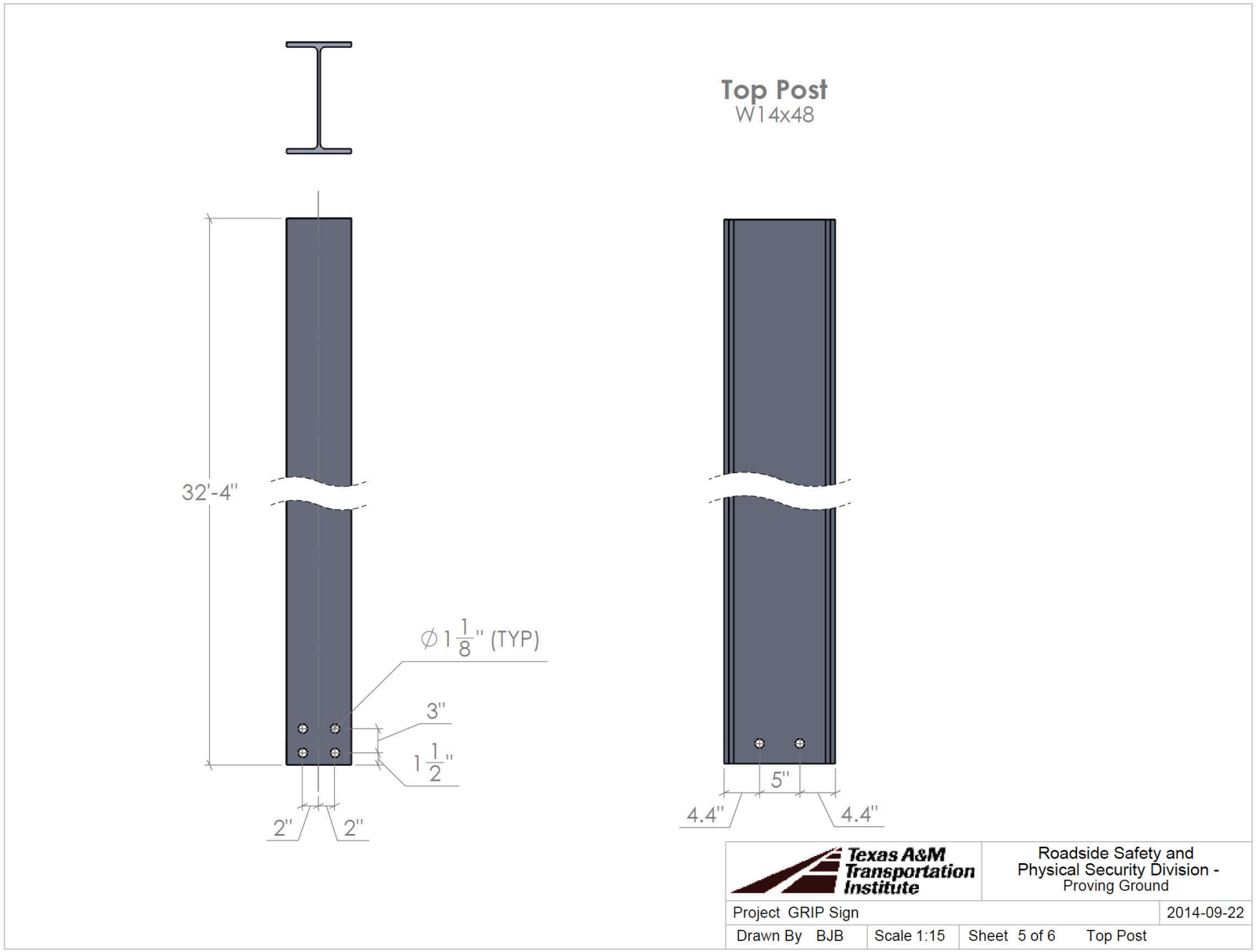
Flange Plate
7/8" Thick (TYP)

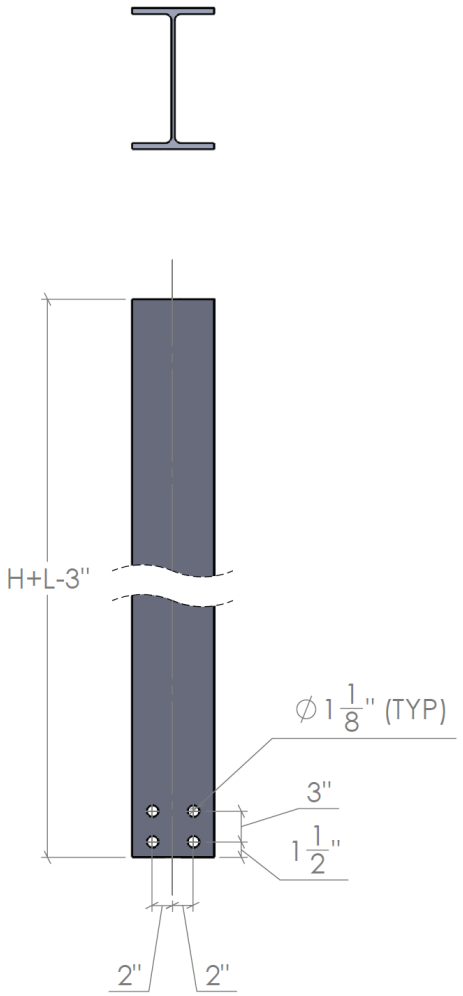


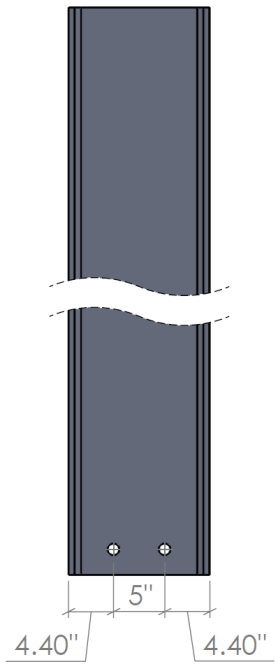
Web Plate
3/8" Thick (TYP)



Texas A&M Transportation Institute		Roadside Safety and Physical Security Division - Proving Ground	
Project GRIP Sign			2014-09-22
Drawn By BJB	Scale 1:4	Sheet 4 of 6	Flange/Web Plates


Top Post
W14x48
32'-4"
∅1 1/8" (TYP)
3"
1 1/2"
2"
2"
5"
4.4"
4.4"
Texas A&M Transportation Institute
Roadside Safety and Physical Security Division - Proving Ground
Project GRIP Sign
2014-09-22
Drawn By BJB
Scale 1:15
Sheet 5 of 6
Top Post





Bottom Post
W14x48

Texas A&M Transportation Institute			Roadside Safety and Physical Security Division - Proving Ground
Project GRIP Sign			2014-09-22
Drawn By BJB	Scale 1:15	Sheet 6 of 6	Bottom Post