DEVELOPMENT AND EXPERIMENTAL TESTING OF PRESS-BRAKE-FORMED STEEL TUB GIRDERS FOR SHORT SPAN BRIDGE APPLICATIONS

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VOLUME VII: FIELD EVALUATION OF A MODULAR PRESS-BRAKE-FORMED STEEL TUB GIRDER IN AN APPLICATION THAT INCLUDES SKEW AND SUPERELEVATION

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ABSTRACT

FIELD EVALUATION OF A MODULAR PRESS-BRAKE-FORMED STEEL TUB GIRDER IN AN APPLICATION THAT INCLUDES SKEW AND SUPERELEVATION

The Short Span Steel Bridge Alliance (SSSBA) is a group of bridge and culvert industry leaders (including steel manufacturers, fabricators, service centers, coaters, researchers, and representatives of related associations and government organizations) who have joined together to provide educational information on the design and construction of short span steel bridges in installations up to 140'-0" in length. A technical working group from within the SSSBA developed the notion for the modular shallow press-brake-formed steel tub girder as a solution for the short span steel bridge market.

After extensive testing at West Virginia University and multiple successful field demonstrations, members of the SSSBA collaborated with the West Virginia Division of Highways to arrange implementation of this system. The Fourteen Mile Bridge located in Lincoln County, West Virginia, was chosen as a prime candidate to demonstrate the system due to the significant superelevation and skew present. Upon completion of the Fourteen Mile Bridge, researchers from Marshall University and West Virginia University traveled to the bridge site to perform a live load field test.

This study presents the results and evaluation from experimental and analytical testing of the Fourteen Mile Bridge. Additionally, the research methods for both the experimental and analytical testing are outlined. Live load distribution factors were computed from the experimental and analytical data and compared to those computed following the AASHTO LRFD specifications. The results of this comparison reflect that the AASHTO LRFD specifications are conservative in the analysis of press-brake-formed tub girders. This report also includes an initial qualitative examination of bracing configurations for non-composite press-brake-formed tub girders. The results provide the basis for extending the work towards a closer investigation to determine the best practices of bracing.

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND / OVERVIEW

The Short Span Steel Bridge Alliance (SSSBA) is a group of bridge and culvert industry leaders (including steel manufacturers, fabricators, service centers, coaters, researchers, and representatives of related associations and government organizations) who have joined together to provide educational information on the design and construction of short span steel bridges in installations up to 140'-0" in length. The idea of the modular press-brake-formed steel tub girder was developed by a technical working group within the SSSBA. Initial research and testing began in the fall of 2011. After extensive laboratory demonstrations, the first implementation was installed in Buchanan County, Iowa in 2016. Following successful performance, a second bridge was installed in Muskingum County, Ohio the following year. The third bridge to employ this technology and the first to use a precast reinforced concrete deck in conjunction with the press-brake-formed tub girders is West Virginia State Project No. S322-37-3.29 00 along State Route 37 near Ranger, West Virginia (referred to hereafter as the Fourteen Mile Bridge). The Fourteen Mile Bridge is also unique due to both a skew and significant superelevation present. After completion of the Fourteen Mile Bridge, researchers from Marshall University (MU) and West Virginia University (WVU) traveled to the bridge site to perform a live load field test.

Strain data was recorded during the live load field test and the experimental results were compared to results from a finite element model developed to validate field data. 2017 American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications (hereafter referred to as AASHTO LRFD specifications) were applied and live load distribution factors (LLDFs) were computed for experimental data, analytical data, and AASHTO LRFD specifications.

This report also includes efforts to examine the effectiveness of bracing configurations of the non-composite press-brake-formed tub girder. When combined with a cast-in-place reinforced concrete deck, the non-composite section must resist the full construction load of the fresh concrete. It is imperative geometric imperfections be considered in order to account for second order amplification effects.

1.2 PROJECT SCOPE & OBJECTIVES

The scope of this report was to evaluate the field performance of a modular press-brake-formed steel tub girder bridge topped with a precast reinforced concrete deck in Lincoln County, West Virginia. This study also served to determine what effect skew and superelevation may have on the distribution of live load to each girder. A live load field test was performed, a finite element model was developed to verify the recorded data, and the results were used to compute LLDFs. This report also includes an initial qualitative investigation into the torsional response of the non-composite press-brake-formed tub girder under construction loading. The following objectives were assessed:

- A discussion of previous work relating to the implementation and design of press-brake-formed tub girders
- A brief review of the sections of the current AASHTO LRFD specifications relevant to the design of press-brake-formed steel tub girders and LLDFs
- An overview of the design and construction of the Fourteen Mile Bridge, in addition to the accelerated bridge construction methods employed
- An explanation of the research methodology and the field test performed on the Fourteen Mile Bridge with a description of the procedures used for the field testing and the finite element analysis completed
- A summary of the results and conclusions after comparing the experimental data, analytical data, and values determined following the AASHTO LRFD specifications
- A brief qualitative evaluation of the non-composite behavior of steel press-brake-formed tub girders with different interior and exterior bracing configurations under construction loading

1.3 REPORT ORGANIZATION

The organization of this report is as follows:

- Chapter 2:
    - This chapter discusses previous work on cold-bent steel tub girders. Also, current AASHTO LRFD specifications for steel box girders are reviewed.
- Chapter 3:
    - This chapter documents the design and construction of the composite press-brake-formed tub girder modules along with the installation of the Fourteen Mile Bridge in Lincoln County, West Virginia.
- Chapter 4:
    - This chapter details research methods utilized in the evaluation of the Fourteen Mile Bridge and discussion of equipment used during the physical load testing.
- Chapter 5:
    - This chapter describes the structure instrumentation and testing procedures for the live load field test performed on the Fourteen Mile Bridge.
- Chapter 6:
    - This chapter discusses a qualitative assessment of the non-composite behavior of press-brake-formed tub girders when varying bracing systems are employed.
- Chapter 7:
    - This chapter compares the results of the field test to the finite element analysis. This includes a comparison of the LLDFs determined by the field data, analytical model, and AASHTO LRFD specifications.
- Chapter 8:
    - This chapter summarizes the findings of this study and provides recommendations for future work in this field of research.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter begins with an overview of previous work on cold-bent steel tub girders for utilization in bridge applications. Additionally, a summary of research performed by WVU in the area of design and evaluation of press-brake-formed steel tub girders will be discussed. This chapter concludes with a review of articles relevant to the design of tub girder bridges from the current 2017 AASHTO LRFD specifications.

2.2 PREVIOUS APPLICATIONS OF COLD-BENT STEEL GIRDERS

Cold-bent steel has been used in a variety of ways in bridge girders for several decades. Recent initiatives have encouraged further innovation and research to standardize a system of cold-bent girders for use in short span bridge applications. This section reviews previous research on the use of cold-bent steel girders in bridge applications.

2.2.1 Prefabricated Press-Formed Steel T-Box Girder Bridge System (Taly & Gangarao, 1979)

Taly and Gangarao (1979) performed early development of cold formed steel box girder systems. Two alternatives were proposed in the research: 1) An all steel deck and box girder assembly, and 2) A steel box girder topped with a pre-cast, prestressed, concrete deck. The girders were comprised of grade A36 steel plate bent into a trapezoidal shape. Shear studs were welded to the plates embedded in the pre-cast concrete planks, and plates were welded to the top flanges of the box girder. This enabled composite action between the steel box and the concrete deck. Load transfer between adjacent girders was achieved through shear keys and weld ties (Figure 2.1) and filled with a nonshrink grout.

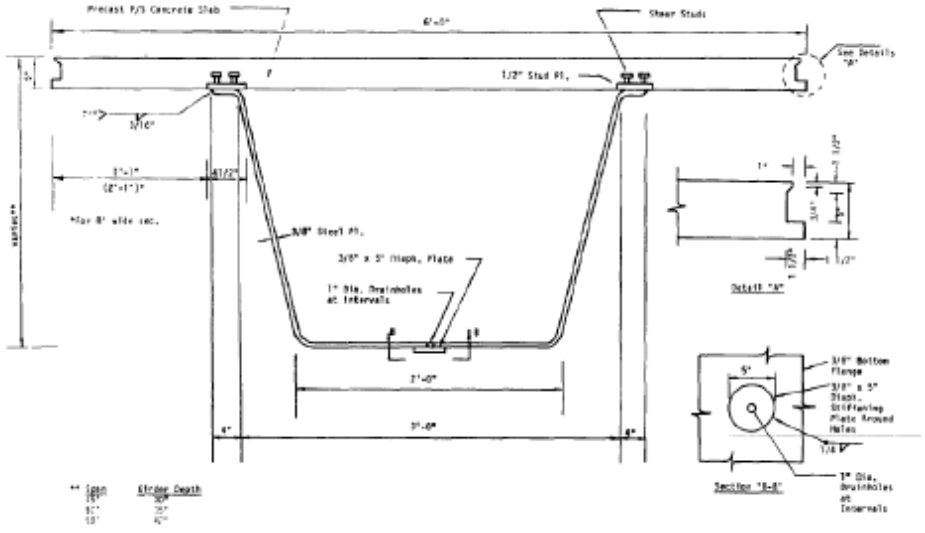

Figure 2:1: T-Box Girder System, Typical Girder Section with 5" Pre-cast, Prestressed Concrete Slab (Taly & Gangarao, 1979)

The box girders can be designed at a variety of depths to meet different span requirements, and the small size of each unit makes transportation to the site easier. Most fabrication for each unit can be completed offsite, greatly reducing the necessary time for construction on site. The low weight of the units requires less crane capacity and improves handling and erection characteristics.

2.2.2 Composite Girders with Cold Formed Steel U-sections (Nakamura, 2002)

Nakamura (2002) investigated the use of cold formed U-shape girders in continuous spans. The girders were cold formed from a single steel sheet, and a reinforced concrete slab was used for a deck (Figure 2.2). In the middle of the span where the positive bending moment was greatest, shear studs were welded to the top flange of the girder to allow composite action with the deck. Concern arose over the supports where the bridge was in negative bending, and the reinforced concrete deck was placed into tension. To prevent buckling, the U-section acted as a mold and was filled with reinforced concrete with prestressing bars. This increased dead load affected weight at the supports but did not affect the bending moment as the load was concentrated near the ends.

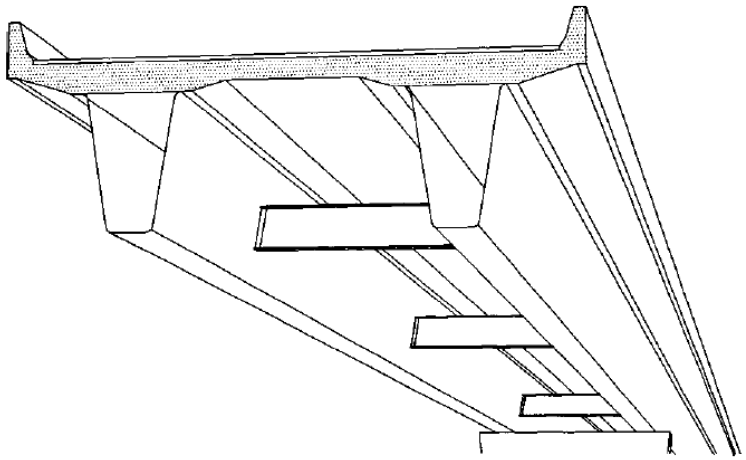

Figure 2:2: Nakamura's Proposed Bridge System (Nakamura, 2002)

Testing of the bending characteristics of this type of beam was performed on several specimens. The girder model performed similarly to typical composite beams on the positive bending sections, and the girder behaved as a prestressed beam near the supports in the regions of positive bending. It was also determined that the system was economical. Though a variety of materials were used to make each module, including structural steel, reinforced concrete, and prestressed concrete, savings from reduced fabrication improved the feasibility of the system.

2.2.3 Folded Plate Girders (Developed at the University of Nebraska)

Research performed at the University of Nebraska-Lincoln investigated rebar detailing between adjacent modules and non-composite behavior during construction of a trapezoidal, cold-bent plate box girder open at the bottom. Figure 2.3 presents an example cross section of the girder and a composite deck. The fabrication process to make each girder used readily available equipment and produced a consistent product in a limited amount of time. The inclusion of an open bottom improved the ease of inspection inside of the girder. Glaser (2010) determined the deformation under construction load was stable and the use of horizontal tie plates connected to each bottom flange serve to maintain the shape of the girder. Burner (2010) investigated the detailing of the reinforcement in the closure pour region and found that in addition to being resistant to fatigue, the hooked bar was more cost effective than the headed bar.

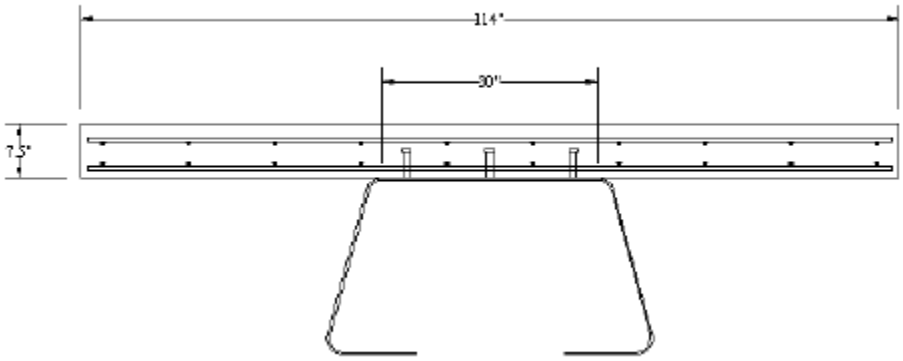

Figure 2:3: Folded Plate Girder and Composite Deck Cross Section (Burner, 2010)

2.2.4 Texas Department of Transportation Rapid Economical Bridge Replacement

The Texas Department of Transportation developed a standardized bridge system employing box girders as part of a large-scale corridor improvement of Interstate 35. FM 3267 was one of the bridges determined to be replaced (Chandar et al., 2010). To enable bridge replacements of large spans without creating height restrictions, shallow box girders were chosen due to the member's structural efficiency. Because of the lightweight nature of box girders, no bent caps were required for the pier columns, which helped maintain the original elevation of the bridge. The box girders were used in conjunction with a cast-in-place reinforced concrete deck. The design for each girder was standardized to reduced design and fabrications costs. As shown in Figure 2.4, the box girders were made up of several sizes of plate welded together to form a modular unit.

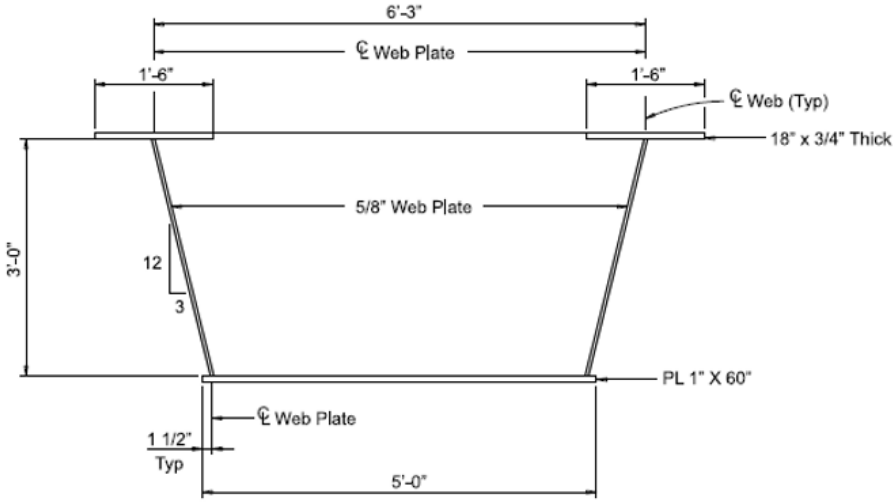

Figure 2:4: Cross Section of Box Girder from Bridge FM 3267 (Chandar et al., 2010)

2.3 PREVIOUS RESEARCH AT WVU ON PRESS-BRAKE-FORMED STEEL TUB GIRDERS

Research on press-brake-formed tub girders at WVU began in 2011 after researchers collaborated with the SSSBA to develop the modular cold formed box girder. This section describes the previous research performed at WVU concerning press-brake-formed tub girders.

2.3.1 Development and Feasibility Assessment of Shallow Press-Brake-Formed Steel Tub Girders for Short-Span Bridge Applications (Michaelson 2014)

Initial research at WVU on press-brake-formed tub girders was performed by Michaelson (2014) and the focus was to expand and refine the development of the modular notion from the SSSBA. The original concept included a cold-formed tub girder made composite with a precast deck. Each modular unit could be transported by truck to the bridge site to allow for accelerated bridge construction (ABC). In order to keep the system economical, an emphasis would be placed on utilizing plate sizes commonly available from mills.

To first grasp an understanding of the behavior of the shallow press-brake-formed tub girder, section properties were determined, and an iterative routine was developed in Microsoft

Excel and MATLAB. Several variables, such as web slope, bend radii, and top flange width, were kept constant across all the configurations to better compare the effect of varying plate width and thickness. Initial designs considered six standard plate widths (60”, 72”, 84”, 96”, 108”, 120”) and three standard thicknesses (7/16”, 1/2”, 5/8”). Yield moments were calculated for each plate width and plotted as a function of depth of the unit to determine the optimal cross section for each configuration (Figure 2.5).

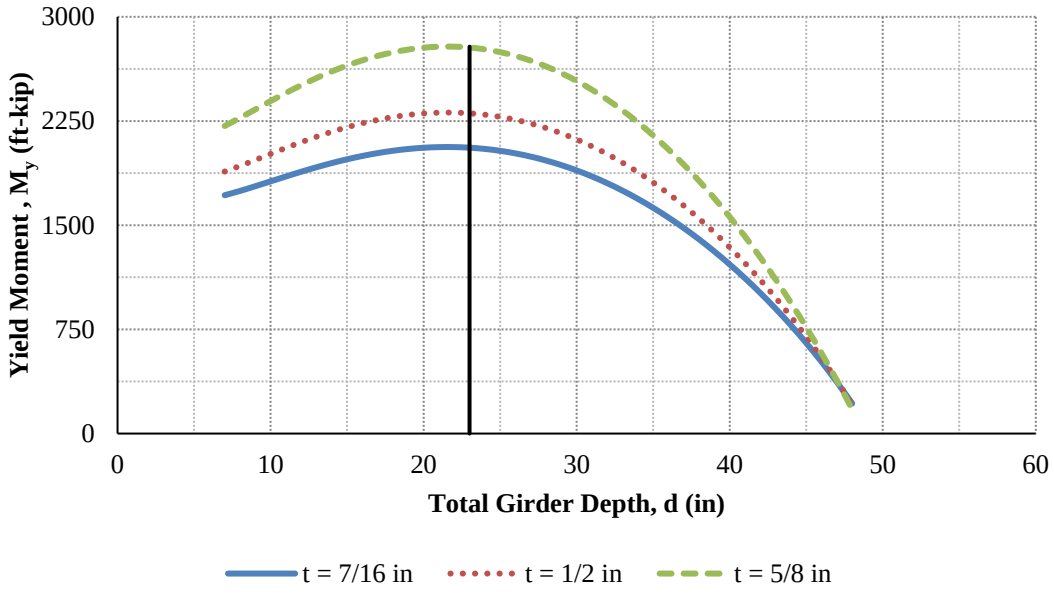

Figure 2:5: Design Comparison of 84” Wide Standard Mill Plate (Michaelson, 2014)

Once a methodology was selected for determining the geometry of the cross-section, experimental flexural testing was performed to assess composite and non-composite behavior. Four specimens were fabricated, each from 84” x 7/16” x 480” plate. To test the girders to failure, a deck thickness less than the AASHTO minimum 8” was employed. Experiments one and two used HPS-50 steel with a composite cast-in-place deck (Figure 2.6), while experiments three and four used HPS-50W weathering steel and HPS-50 steel hot-dip galvanized as a surface treatment, respectively.

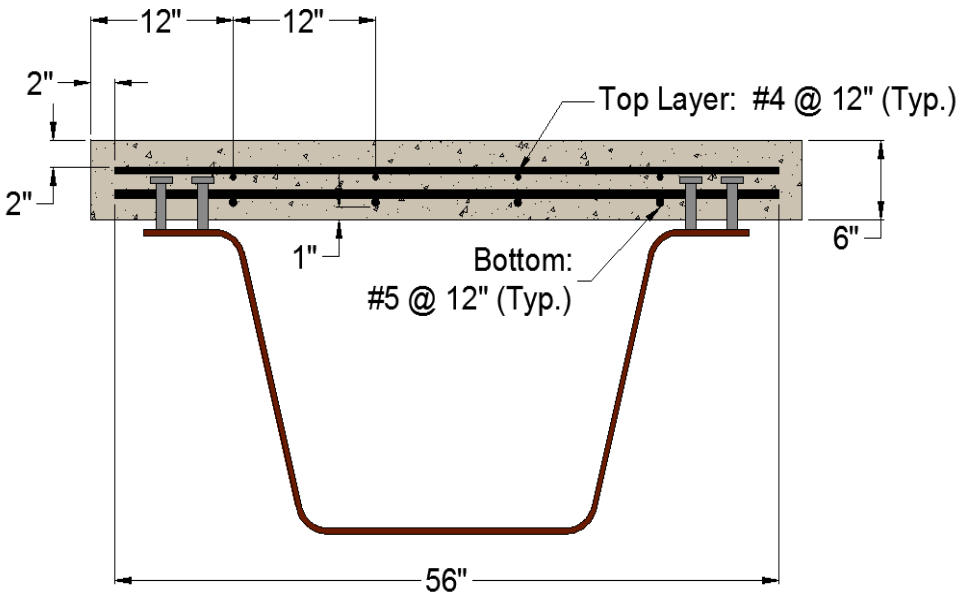

Figure 2:6: Typical Section, Composite Test Specimen (Michaelson, 2014)

Load was applied at the midspan of each specimen with a servo-hydraulic actuator and spreader beam and the displacement was increased in 0.05" increments until the specimen had reached failure. The composite specimens failed in ductility at approximately 304 kips (Figure 2.7). The non-composite specimens failed due to excessive lateral deflection and twist at relatively low-level loads as seen in Figure 2.8. This is not a significant issue as the intent of the system is to be topped with a precast deck.

Figure 2:7: Typical Ductile Failure of Composite Girder Section (Michaelson, 2014)

Figure 2:8: Typical Lateral Failure of Non-Composite Girder Section (Michaelson, 2014)

To verify the experimental testing, finite element models were developed and benchmarked against previous laboratory results. To fully capture the non-composite behavior, the model was adapted to consider second order effects due to geometric imperfections and residual stresses. A strain-compatibility approach was developed to assess each girder's capacity. The model was simulated for each experiment and little discrepancy existed between the experimental and analytical data (Figure 2.9).

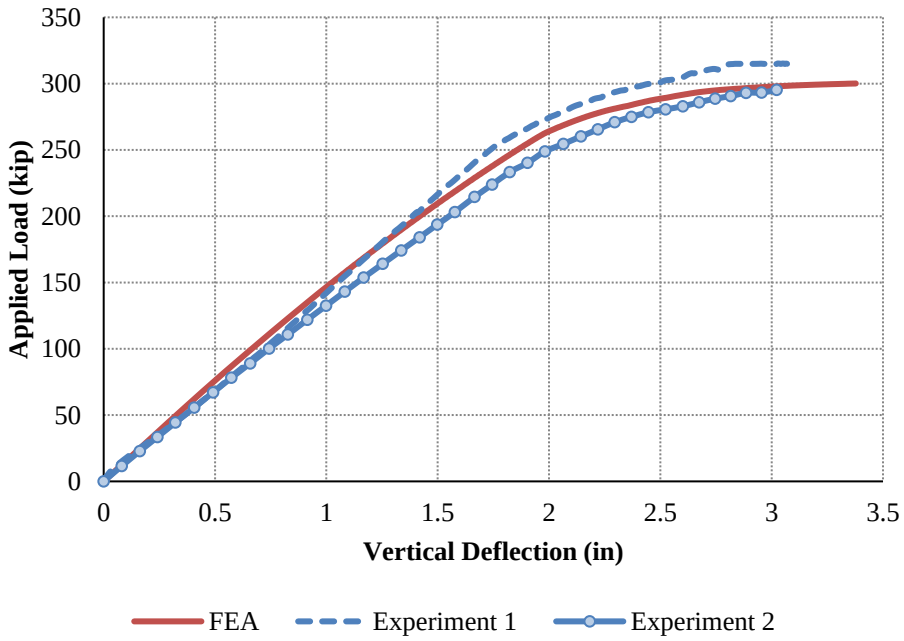

Figure 2:9: Comparison of Analytical and Experimental Results (Michaelson, 2014)

After the experimental results were verified against the analytical model, behavioral studies were performed to determine the applicability of the AASHTO LRFD specifications. Each girder configuration met the requirements to be considered as a box girder, and several of the configurations were determined to be compact. Comparisons were made to the analytical and experimental data, and it was determined the AASHTO LRFD specifications were conservative for calculating the nominal capacity of the section, and an equation that better fit data for nominal capacity was proposed.

A feasibility assessment was performed to determine if the proposed system could be economically competitive. In order to simplify the data set of possible configurations, plate widths outside the current industry standards were removed as options. The maximum span for each plate size was calculated and configurations not produced at that length were removed from the data set. Four standardized plate sizes were selected from this reduced plate matrix to be used in spans up to 80’-0” in length; however, the system was most competitive in spans up to 60’-0” in length. It should be noted that in the design of the system, a LLDF was assumed to be 1.0, so further work is necessary to accurately determine live load distribution.

2.3.2 Experimental Evaluation of Non-Composite Shallow Press-Brake-Formed Steel Tub Girders (Kelly, 2014)

In collaboration with Michaelson, Kelly (2014) furthered research efforts of stability and torsional behavior of non-composite press-brake-formed tub girders to determine the feasibility of a cast-in-place deck. The non-composite state is critical to understand as the girder must be able to withstand the full construction load, including wet concrete. To assess this condition, destructive flexural testing was performed, and a finite element model was developed.

Two specimens were tested in the laboratory using a servo-hydraulic actuator. The first specimen was fabricated from 84" x 7/16" HPS-50W weathering steel plate with a WT section bolted to the top flanges at midspan. Load was transferred to the WT section by a spreader beam and elastomeric pad. Elastic failure occurred at the critical load of 94 kips with a measured 2.25" of vertical deflection. The second specimen was fabricated from 84" x 7/16" HPS-50 plate but was hot-dip galvanized as a method of corrosion resistance. Unlike the first specimen, a noticeable initial twist due to fabrication was present and varied along the span of the girder as seen in Figure 2.10. Under flexural testing, the galvanized girder experienced lateral torsional buckling at a load of 33 kips and 0.73" of vertical deflection.

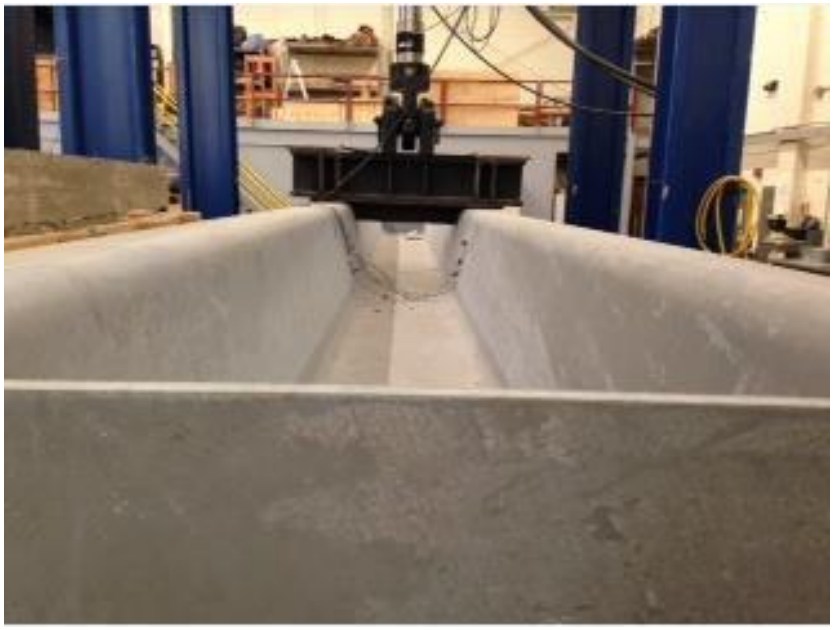

Figure 2:10: Initial Twist of Specimen #2 (Kelly, 2014)

A finite element model was developed to replicate the laboratory testing, and the results were compared to the measured experimental values as seen in Figure 2.11. The weathering steel specimen behaved nearly identical to the finite element model under the loading, while the galvanized specimen behaved similarly, until it reached the critical load of much less than the predicted value. This premature failure was largely attributed to second order effects due to the original deformity. To improve torsional stability under construction loads, it was recommended stay-in-place formwork be installed to each girder prior to erection.

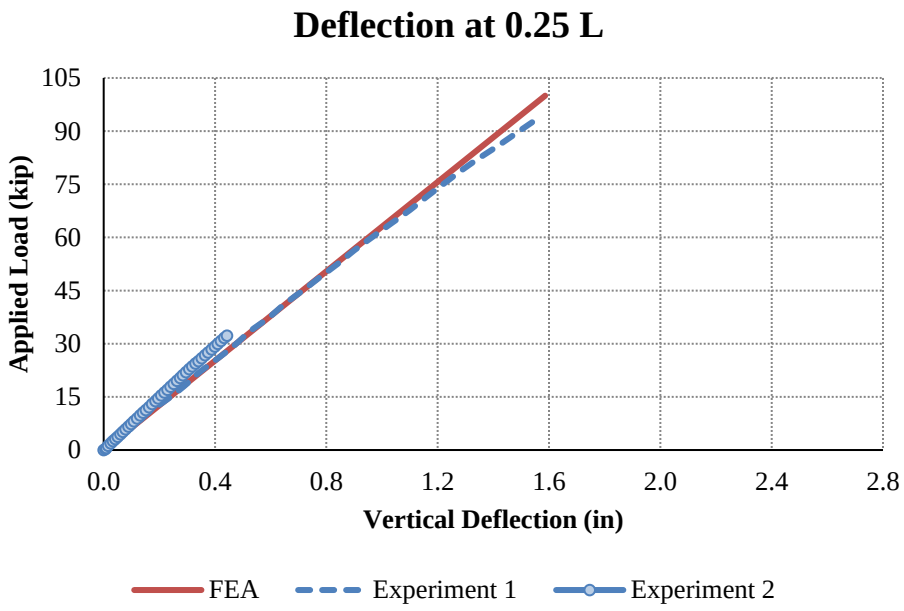

Figure 2:11: Deflection at Quarter Points (Kelly, 2014)

2.3.3 Evaluation of Modular Press-Brake-Formed Tub Girders with UHPC Joints (Kozhokin, 2016)

Research was extended by Kozhokin (2016) to evaluate the applicability of the press-brake-formed tub girder as a modular bridge component and the performance of joints between such modules. Following research from the Federal Highway Administration, ultra-high-performance concrete (UHPC) was chosen to be used for the closure pour between adjacent modules to develop durable connections. UHPC is a steel fiber reinforced Portland cement-based product with advantageous fresh and hardened properties. To ensure proper bonding between the

concrete deck and the UHPC joint, an exposed aggregate finish would be required. Techniques were assessed on sample slabs. The best results were produced by the application of a retarder to the shear key formwork and removal of the concrete paste using a wire brush (Figure 2.12).

Figure 2:12: Exposed Aggregate Finish of Shear Key Detail (Kozhokin, 2016)

After the appropriate approach was determined to produce the desired shear key detail, two full-scale modules were constructed to physically test the UHPC joint. Once the joint had cured, testing was performed by a servo-hydraulic actuator placed at midspan of one specimen along the girder's centerline. A steel plate replicating the contact area of a truck tire was attached to the actuator, and an elastomeric pad was placed between the deck and the steel plate. Loading was accomplished by the application of a Fatigue I moment due to a cyclic load of 67.43 kips over 2.8 million cycles and a Service II moment due to a static load of 90.78 kips applied at 10 predetermined cycle intervals. After approximately 1.6 million cycles, the concrete deck failed from punching shear. The actuator was moved to the adjacent, undamaged girder to continue testing. Subsequent testing found the UHPC joint satisfactorily transferred stress from the directly loaded girder to the indirectly loaded girder. Distribution factors were calculated, and a summary of the values are presented in Table 2.1.

Table 2.1: Summary of Distribution Factors (Kozhokin, 2016)

Average Distribution Factor		
Cycle Count	Directly Loaded Girder	Indirectly Loaded Girder
0	0.691	0.309
100,000	0.631	0.369
250,000	0.676	0.324
500,000	0.678	0.322
1,000,000	0.690	0.310
1,500,000	0.717	0.283
2,000,000	0.707	0.293
2,100,000	0.708	0.292
2,200,000	0.707	0.293
2,300,000	0.706	0.294
2,500,000	0.711	0.289
2,700,000	0.712	0.288
2,800,000	0.743	0.257

2.3.4 Field Performance Assessment of Press-Brake-Formed Steel Tub Girder Superstructures (Gibbs, 2017)

The first bridge to utilize the press-brake-formed tub girder concept developed by the SSSBA was installed in Buchanan County, Iowa in 2015. The bridge superstructure consisted of four tub girders constructed from 96” x 1/2” hot-dip galvanized plate. Unlike the original concept, this implementation employed the erection of non-composite girders topped with an 8 1/2” cast-

in-place deck and diaphragms between each girder to support the construction load. To further reduce the amount of time related to construction, Geosynthetic Reinforced Soil abutments were used. An overall view of the completed bridge is seen in Figure 2.13.

Figure 2:13: New Amish Sawmill Bridge (Gibbs, 2017)

Gibbs (2017), along with other researchers from WVU and MU, performed live load testing on site to further develop analytical models and verify AASHTO LRFD specifications could safely be used to design press-brake-formed tub girders. Upon arrival at the site, the girders were instrumented with Bridge Diagnostics, Inc. equipment to measure the strain in each of the girder's bottom flanges. A tandem-axle truck was positioned across the structure at various panel points, and the strain readings at each location were recorded. This strain data was used to calculate bottom flange bending stresses and LLDFs for single lane loaded and multiple lanes loaded conditions. A finite element model was developed, and LLDFs were calculated per AASHTO LRFD specifications; the LLDFs from all three methods were compared as seen in Figure 2.14. It should be noted, the stresses determined in the bottom flange by the finite element model were greater than those of the field testing. This was attributed to a difference in the boundary conditions as the

bridge was constructed with integral abutments, while the finite element model assumed simply supported boundary conditions. However, the LLDF's were similar to the experimental values. The experimental and finite element analysis (FEA) values were both significantly lower than those from AASHTO. Therefore, the AASHTO LRFD specifications were determined to be conservative in design applications for press-brake-formed tub girders.

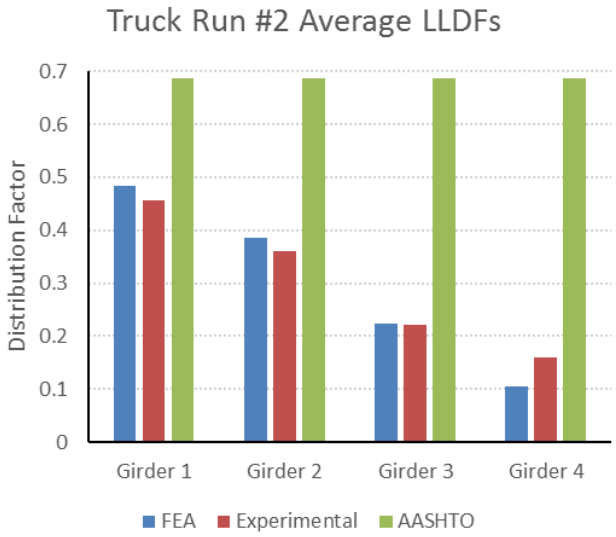

Figure 2:14: FEA v. Experimental v. AASHTO LLDFs (Gibbs, 2017)

2.3.5 Fatigue Performance of Uncoated and Galvanized Composite Press-Brake-Formed Tub Girders (Tennant, 2018)

Galvanic surface treatments are an effective means to provide corrosion resistance to steel members, but industry concern had arisen with the fatigue performance over the reheating of cold-formed members. Tennant (2018) examined the performance of two specimens with varying surface treatments; both girders were produced using ASTM A709 steel, but one was left uncoated (Figure 2.15), and the other was coated with a galvanic surface treatment (Figure 2.16). The composite system was fatigue loaded simulating a 75-year life in a rural environment. At a predetermined number of load cycles, a Service II load was applied to the system to observe the performance of the specimen. A combination of linear variable displacement transducers and strain gages were used to measure deflections that could be compared for each service loading interval.

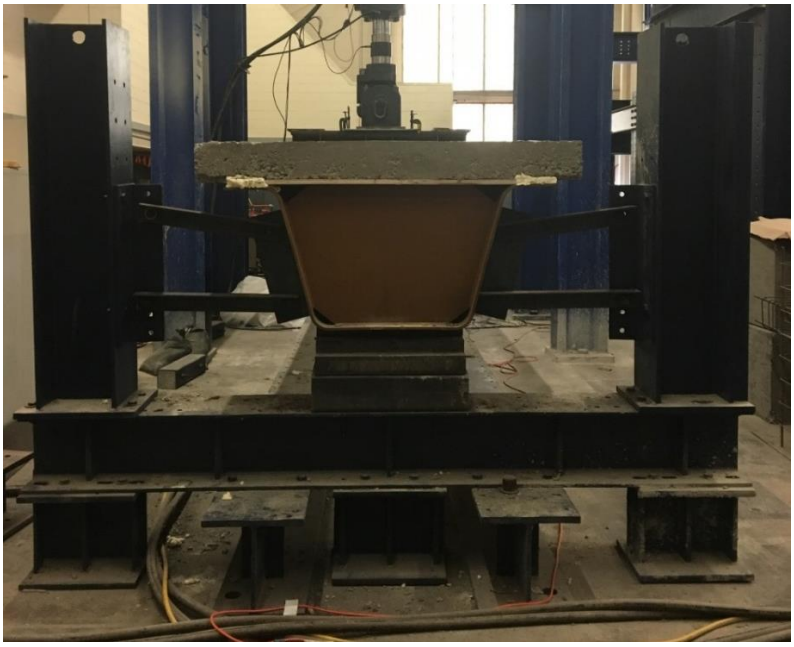

Figure 2:15: Uncoated Steel Girder Under Fatigue Loading (Tennant, 2018)

Figure 2:16: Galvanized Steel Girder (Tennant, 2018)

A 6” thick concrete deck was cast-in-place for each girder to become composite. Compressive testing of cylinder samples taken from casting reflected the deck on the galvanized girder had significantly lower compressive strength than the deck on the uncoated girder. To confirm precision, loads applied by the servo-hydraulic actuator were compared to loads calculated from the measured strain data, and the differences were small. The project concluded the heat of galvanization had no adverse effect on the fatigue performance of a press-brake-formed tub girder.

2.3.6 Field Performance and Rating Evaluation of a Modular Press-Brake-Formed Steel Tub Girder with a Steel Sandwich Plate Deck (Underwood, 2019)

The Cannelville Road Bridge in Muskingum County, Ohio was the second bridge built utilizing press-brake-formed tub girders. The bridge was composed of two modular units each made up of two press-brake-formed tub girders attached to a sandwich plate steel (SPS®) deck with bolts. SPS® decks are a thin, lightweight option particularly useful in areas with limited hydraulic openings. The tub girders were fabricated from 5/8” thick plate and were braced at various locations internally and externally. The entire unit was hot-dip galvanized to provide corrosion resistance. Figure 2.17 shows one of the modular units on site. Erection of most of the superstructure was placed in approximately 20 minutes, and the entire project used only 26 of the allotted 30 days from demolition of the old bridge to carrying traffic on the new bridge.

Figure 2:17: Cannelville Road Bridge Modular Unit (Underwood, 2019)

Underwood (2019) worked with researchers at WVU and MU to perform live load testing of the bridge to assess the applicability of AASHTO LRFD specifications for press-brake-formed tub girders topped with a SPS® deck. The structure was instrumented with Bridge Diagnostics, Inc. equipment and a tandem axle load truck was placed at predetermined grid points. The bottom flange strains of each girder and the weight of each wheel on the load truck were recorded.

A finite element model was produced to make comparisons to the data collected in the field. LLDFs were calculated for the finite element model and the experimental data and the results were compared to LLDFs calculated per the AASHTO LRFD specifications as seen in Figure 2.18. Inventory and operating load ratings for interior and exterior girders were computed from field data and the analytical model. Live load ratings were compared to AASHTO serviceability and strength requirements. As in other tests, the data reflected that the AASHTO LRFD specifications tend to be conservative and underpredict the performance of the press-brake-formed tub girder system; therefore, the provisions used safely model press-brake-formed tub girders.

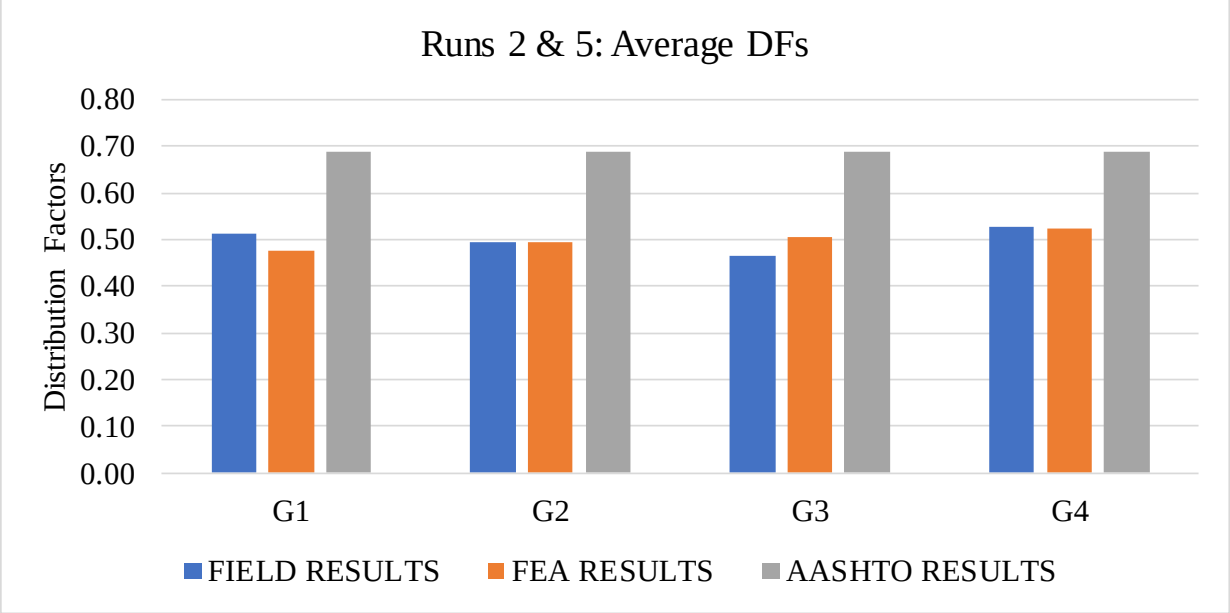

Figure 2:18: Field v. FEA v. AASHTO LLDFs (Underwood, 2019)

2.4 CURRENT AASHTO SPECIFICATIONS FOR TUB GIRDER DESIGN AND APPLICATION

AASHTO is the governing body regulated the practice of roadway design. AASHTO's presence extends into the design and analysis of bridge structures with the LRFD Bridge Design Specifications, a code manual that is updated approximately every three years based on improvements in behavioral understandings and to improve safety of the traveling public. Design under the LRFD philosophy accounts for varying levels of loadings that may be applied to structures and the varying capacity that members may have based on sound statistical evidence. The current AASHTO LRFD Bridge Design Specifications (hereafter referred to as AASHTO LRFD specifications), is the 8th edition which was published in September 2017. This section summarizes the relevant portions of the code related to the design of the Fourteen Mile Bridge.

2.4.1 Multiple Presence Factors

Multiple presence factors are empirical values used to investigate the extreme live load force effect by considering the probability of simultaneous lane occupation by the HL-93 design live load. Each design lane is defined to be 12'-0" in width or lesser if the traffic lanes are less than 12'-0". When calculating distribution factors per Articles 4.6.2.2 and 4.6.2.3, the appropriate multiple presence factor has already been included in the expressions and need not be taken into consideration. The values are based on an average daily truck traffic of 5,000 trucks in a single direction. Table 2.2 presents the multiple presence factors from the AASHTO LRFD specifications for each scenario of the number of lanes loaded. Multiple presence factors shall not be considered for the fatigue limit state where only a single design truck is applied.

Table 2.2: Multiple Presence Factors (AASHTO, 2017)

Number of Loaded Lanes	Multiple Presence Factors, *m*
1	1.20
2	1.00
3	0.85
>3	0.65

2.4.2 Beam-Slab Bridges – Live Load Distribution Factors

Provisions for calculated LLDFs in Article 4.6.2.2 require the cross-sections of bridges containing multiple boxes meet geometric criteria in Article 6.11.2.3. These specifications require the top flanges of adjacent girders must be at least 80% and not more than 120% of the top flange spacing of one of the girders. These distances are represented by *a* and *w*, respectively, in Figure 2.19. In addition, the inclination of web plate to the plane normal to the bottom flange shall be limited to 1 to 4. The provisions of Article 4.6.2.2 are only applicable in situations where the bearing lines are not skewed; in cases of skew at the supports, a more refined structural analysis must occur. Cantilevered overhang of the concrete deck including the curb and parapet is limited to either 60 percent of the interior spacing of the center of top flanges, *w*, or 6'-0".

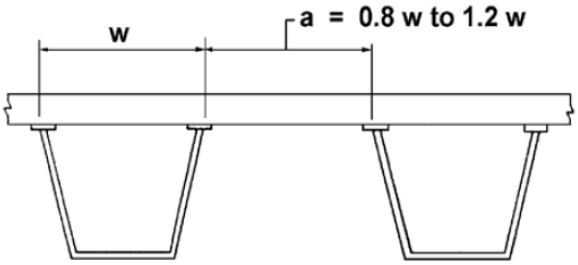

Figure 2:19: Center-to-Center Flange Distance (AASHTO, 2017)

If the cross-section of a bridge constructed from multiple boxes meets these criteria, Article 4.6.2.2 may be used to calculate the LLDFs. Article 4.6.2.2 refers to use of Table 4.6.2.2.2b-1 for multiple steel box girders with a concrete deck; the appropriate cross section is matched to the list provided in Table 4.6.2.2.1-1. For bridges constructed of multiple steel box girders topped with a concrete deck, only one equation for determining the LLDFs, regardless of the number of lanes loaded. The applicable expression is listed as Equation 2-1 and is valid for moment and shear in interior beams. Table 4.6.2.2.2d-1 specifies that Equation 2-1 may also be used for calculation of LLDFs in exterior beams. Multiple presence factors are already incorporated into the expression for the calculation of distribution factors by approximate means.

$$LLDF_{INT} = 0.05 + 0.85\left(\frac{N_L}{N_b}\right) + \frac{0.425}{N_L}$$ Equation 2-1

Where: $0.5 \leq \frac{N_L}{N_b} \leq 1.5$

N_L = number of design lanes

N_b = number of girders

2.4.3 Box-Section Flexural Members

This section details the relevant limit states and capacity requirements that must be checked in the design of box-section flexural members.

2.4.3.1 Cross Section Proportion Limits

Webs may be either vertical or inclined; the inclination of the web plates to the plane perpendicular to the bottom flange shall be limited to 1 to 4. In addition, the criteria of Equation 2-2 and Equation 2-3 must be met regarding web proportions.

For webs without longitudinal stiffeners:

$$\frac{D}{t_w} \leq 150$$ Equation 2-2

For webs with longitudinal stiffeners:

$$\frac{D}{t_w} \leq 300$$ Equation 2-2

Where: D = web depth (in)

t_w = web thickness (in)

Top flanges of tub sections shall meet the criteria specified in Equation 2-4, Equation 2-5, and Equation 2-6, regardless if the flange section is subjected to compression or tension.

$$\frac{b_f}{2t_f} \leq 12.0$$ Equation 2-4

$$b_f \leq D/6$$ Equation 2-5

$$t_f \geq 1.1t_w$$ Equation 2-6

Where: b_f = flange width (in)

t_f = flange thickness (in)

D = web depth measure along inclination (in)

t_w = web thickness (in)

2.4.3.2 Constructability

To ensure the geometry of the box section is maintained during construction, the section must be checked in various states to verify adequate capacity. Through investigation, it may be determined additional internal and/or external cross-frames may be temporarily required during construction or as a permanent fixture to support possible eccentric loads. Load factors for construction are taken from Article 3.4.2. Article 6.11.3 specifies the provisions of Article 6.10.3 are to be applied unless otherwise stated.

For sections in flexure, Articles 6.10.3.2.1 through 6.10.3.2.3 shall be applied to only the top flanges of tub sections. Equations 2-8, 2-10, and 2-11 shall be checked as applicable. The unbraced length is defined as the distance between interior cross-frames or diaphragms. Equation 2-9 shall not be checked in cases of either compact or noncompact webs and when $f_l = 0$. If the section contains a slender web, Equation 2-7 shall not be checked. The provisions specify non-composite sections with slender webs and flanges in compression shall also satisfy Equation 2-9.

For discretely braced flanges in compression:

$$f_{bu} + f_l \leq \phi_f R_h F_{yc}$$ Equation 2-7

$$f_{bu} + \frac{1}{3} f_l \leq \phi_f F_{nc}$$ Equation 2-8

$$f_{bu} \leq \phi_f F_{crw}$$ Equation 2-9

Where: ϕ_f = resistance factor for flexure specified in Article 6.5.4.2

f_{bu} = flange stress calculated without consideration of flange lateral bending determined as specified in Article 6.10.1.6 (ksi)

f_l = flange lateral bending stress determined as specified in Article 6.10.1.6 (ksi)

F_{crw} = nominal bend-buckling resistance for webs specified in Article 6.10.1.6 (ksi)

F_{nc} = nominal flexural resistance of the flange as specified in Article 6.10.8.2 (ksi), with the web load-shedding factor, R_b, taken as 1.0 for constructability

R_h = hybrid factor as specified in Article 6.10.1.10.1, R_h = 1.0 when f_{bu} does not exceed the specified yield strength of the web

F_{yc} = specified minimum yield strength of compression flange (ksi)

For discretely braced flanges in tension:

$$f_{bu} + f_l \leq \phi_f R_h F_{yt}$$ Equation 2-10

Where: F_{yt} = specified minimum yield strength of tension flange (ksi)

For continuously braced flanges in compression or tension:

$$f_{bu} \leq \phi_f R_h F_{yf}$$ Equation 2-11

Where: F_{yf} = specified minimum yield strength of flange (ksi)

For critical stages of construction, non-composite box flanges in compression must meet the criteria specified in Equation 2-12 and Equation 2-13.

$$f_{bu} \leq \phi_f F_{nc}$$ Equation 2-12

$$f_{bu} \leq \phi_f F_{crw}$$ Equation 2-13

For critical stages of construction, non-composite box flanges in tension and continuously braced box flanges in compression or tension must meet the criteria specified in Equation 2-14.

$$f_{bu} \leq \phi_f R_h F_{yf} \Delta$$ Equation 2-14

Where: $\Delta = \sqrt{1 - 3\left(\frac{f_v}{F_{yf}}\right)^2}$ Equation 2-15

$$f_v = \frac{T}{2A_o t_f}$$ Equation 2-16

f_v = St. Venant torsional shear stress in the flange due to the factored loads at the section under consideration (ksi)

T = internal torque due to the factored loads (kip-in)

A_0 = enclosed area within box section (in^2)

Requirements for shear strength during critical stages of construction are extended from the beam-slab provisions. Sections must meet the requirements of Article 6.10.3.3 in addition to Article 6.11.9 if applicable. Equation 2-17 specifies the requirements for webs of box sections.

$$V_u \leq \phi_v V_{cr}$$ Equation 2-17

Where: ϕ_v = resistance factor for shear as specified in Article 6.5.4.2

V_u = shear in the web at the section under consideration due to the factored permanent loads and factored construction loads applied to the non-composite section (kips)

V_{cr} = shear-yielding or shear buckling resistance per Article 6.10.9.3.3 (kip)

For inclined webs:

$$V_{ui} = \frac{V_u}{\cos(\theta)}$$ Equation 2-18

Where: V_{ui} = vertical shear due to factored loads along an inclined web (kip)

θ = angle of inclination of the web plate to vertical (degrees)

2.4.3.3 Service Limit State

Service limit states are employed to control deflection under typical live loads. Limited deflection not only provides user comfort, but it ensures adequate performance of bearings, joints, and other critical features of the bridge structure. Box sections must meet the provisions of Article 6.10.4, except in Equation 2-20, f_l shall be taken as zero, and Equation 2-21 shall not apply.

Elastic deformation limits are specified in Article 2.5.2.6, and when applying the relevant criteria, the vehicular live load taken from Article 3.6.1.3.2 shall include the dynamic load allowance, IM per Table 3.4.1-1. The provisions specify all design lanes should be loaded, and all components can be assumed to deflect uniformly. In cases where a bridge is skewed, a right cross section may be employed. The following deflection limit is to be considered for steel bridges:

- Vehicular load, general Span/800,
- Vehicular and pedestrian loads Span/1,000,
- Vehicular load on cantilever arms..... Span/300, and
- Vehicular and pedestrian loads on cantilever arms Span/375.

Figure 2:20 Live Load Deflection Limits (AASHTO, 2017)

Permanent deformations are governed by Article 6.10.4.2, and Service II load combinations per Table 3.4.1-1 shall apply. The criteria specified by Equations 2-19, 2-20, and 2-21 shall be met for flanges in flexure.

Top steel flange, composite sections

$$f_f \leq 0.95 R_h F_{yf} \qquad \text{Equation 2-19}$$

Bottom steel flange, composite sections

$$f_f + \frac{f_l}{2} \leq 0.95 R_h F_{yf} \qquad \text{Equation 2-20}$$

Both steel flanges, non-composite sections

$$f_f + \frac{f_l}{2} \leq 0.80 R_h F_{yf} \qquad \text{Equation 2-21}$$

Where: f_f = flange stress at the section under consideration due to the Service II loads calculated without consideration of flange lateral bending (ksi)

f_l = flange lateral bending stress at the section under consideration due to the Service II loads determined as specific in Article 6.10.1.6 (ksi)

R_h = hybrid factor as specified in Article 6.10.1.10.1

In addition to flange stress criteria, limits also apply to the web of the composite section. Except for sections in positive flexure in which the web satisfies Article 6.11.2.1.2, all sections shall satisfy Equation 2-22.

$$f_c \leq F_{crw} \qquad \text{Equation 2-22}$$

Where: f_c = compression flanges stress at section under consideration due to Service II loads calculated without consideration of flange lateral bending (ksi)

F_{crw} = nominal bend-buckling resistance for webs with or without longitudinal stiffeners, as applicable, determined as specified in Article 6.10.1.9 (ksi)

2.4.3.4 Fatigue and Fracture Limit State

Fatigue limits shall be considered to ensure cracks in steel members due to cyclic loading are limited and do not propagate. Article 6.10.5 specifies the general provisions that must be met, while Article 6.11.10 specifies criteria for shear connectors. In cases where the cross section of a bridge with multiple straight box girders does not meet the requirements of Article 6.11.2.3, longitudinal warping stress and transverse bending stress due to distortion shall be considered. Connection details shall be investigated per the specifications in Article 6.6.1 with the appropriate load combination for fatigue from Table 3.4.1-1.

Fatigue is separated into two categories, load-induced and distortion-induced. Load-induced fatigue is a result of the live load stresses present in members. In concrete deck casting scenarios, the long-term composite section shall be used when resisting dead loads, and the short-term composite section shall be used when resisting live loads. The provisions are only applicable to details with a net tensile stress; residual stresses are to be neglected in fatigue considerations.

For load-induced fatigue considerations, each detail shall satisfy:

$$\gamma(\Delta f) \leq (\Delta F)_n \qquad \text{Equation 2-23}$$

Where: γ = load factor as specified in Table 3.4.1-1 for the fatigue load combination

(Δf) = force effect, live load stress range due to the passage of the fatigue load as specified in Article 3.6.1.4 (ksi)

$(\Delta F)_n$ = nominal fatigue resistance specified in Article 6.6.1.2.5 (ksi)

For the Fatigue I load combination (infinite life), nominal fatigue resistance is computed as shown in Equation 2-24:

$$(\Delta F)_n = (\Delta F)_{TH} \qquad \text{Equation 2-24}$$

For the Fatigue II load combination (finite life), nominal fatigue resistance is computed as shown in Equation 2-25:

$$(\Delta F)_n = \left(\frac{A}{N}\right)^{\frac{1}{3}}$$ Equation 2-25

Where: $N = (365)(75)n(ADTT)_{SL}$ Equation 2-26

A = constant taken from table 6.6.1.2.5-1 (ksi^3)

n = number of stress range cycles per truck passage taken from Table 6.6.1.2.5-2

$(ADTT)_{SL}$ = single-lane ADTT as specified in Article 3.6.1.4

$(\Delta F)_{TH}$ = constant-amplitude fatigue threshold taken from Table 6.6.1.2.5-3 (ksi)

Distortion-induced fatigue limits are provided in Article 6.6.1.3. Load paths shall be sufficient to carry all intended and unintended forces provided by connecting transverse members to longitudinal members by either welding or bolting. Specifications are provided for transverse connection plates and lateral connection plates. In cases where the required load is unknown, the connection shall be designed to resist a 20.0 kip lateral load for straight bridges with no skew.

Fracture requirements are specified in Article 6.6.2. Members and components shall follow Table 6.6.2.1-1 to be classified as either primary or secondary. Primary members or components subject to a net tensile stress under the Strength I load combination shall be designated on the contract plans. All primary members and any members or components subject to net tensile stress under Strength I load combination shall require the performance of Charpy V-notch testing.

2.4.3.5 Strength Limit State

The strength limit state is employed to ensure the structure has adequate capacity to resist moments and shears generated during loading. Article 6.11.6 specifies the provisions that must be met. Applicable load combinations are taken from Table 3.4.1-1.

2.4.3.5.1 General Flexure Requirements

In box sections with holes in the tension flange at the section under consideration, the tension flange shall satisfy provisions of Article 6.10.1.8 and Equation 2-27.

$$f_t \leq 0.84\left(\frac{A_n}{A_g}\right)F_u \leq F_{yt} \qquad \text{Equation 2-27}$$

Where: A_n = net area of the tension flange determined as specified in Article 6.8.3 (in^2)

A_g = gross area of the tension flange (in^2)

f_t = stress on the gross area of the tension flange due to the factored loads calculated without consideration of flange lateral bending (ksi)

F_u = specified minimum tensile strength of the tension flange determines as specified in Table 6.4.1-1 (ksi)

Sections in straight bridges in positive flexure must meet the following criteria to be considered compact:

- The specified minimum yield strengths of flanges and web do not exceed 70.0 ksi
- The web satisfies the requirement of Article 6.11.2.1.2
- The section under consideration is part of a bridge that satisfies Article 6.11.2.3
- The box flange is fully effective as specified in Article 6.11.1.1
- The section satisfies the requirements of Article 6.11.7.1
- The section satisfies the web slenderness limit of Equation 2-28:

$$\frac{2D_{cp}}{t_w} \leq 3.76\sqrt{\frac{E}{F_{yc}}} \qquad \text{Equation 2-28}$$

Where: D_{cp} = depth of the web in compression at the plastic moment determined as specified in Article D6.3.2 (in)

E = modulus of elasticity of steel (ksi)

If the section does not meet these criteria, it will be considered noncompact and must satisfy the requirements of Article 6.11.7.2. Both compact and noncompact sections must satisfy ductile requirements of Article 6.10.7-3 and Equation 2-29:

$$D_p \leq 0.42D_t \qquad \text{Equation 2-29}$$

Where: D_p = distance from the top of the concrete deck to the neutral axis of the composite section (in)

D_t = total depth of the composite section (in)

2.4.3.5.2 Flexural Capacity of Composite Sections, Positive Flexure

For compact composite sections, Equation 2-30 shall be satisfied at the strength limit state. Lateral bending need not be considered in the compression flanges of the tub sections because the flanges are continuously supported by the concrete deck.

$$M_u \leq \phi_f M_n \qquad \text{Equation 2-30}$$

Where: ϕ_f = resistance factor for flexure as specified in Article 6.5.4.2

M_n = nominal flexural resistance of the section determined as specified in Article 6.11.7.1.2 (kip-in)

M_u = bending moment about the major axis of the cross-section due to factored loads at the section under consideration (kip-in)

Nominal flexural resistance of a section shall be calculated using the applicable equations: Equation 2-31 or Equation 2-32.

If $D_p \leq 0.1D_t$:

$$M_n = M_p \quad \text{Equation 2-31}$$

Otherwise:

$$M_n = M_p\left(1.07 - 0.7\frac{D_p}{D_t}\right) \quad \text{Equation 2-32}$$

Where: D_p = distance from the top of the concrete deck to the neutral axis of the composite section at the plastic moment (in)

D_t = total depth of the composite section (in)

M_p = plastic moment of the composite section as specified in Article D6.1 (kip-in)

It should be noted that Michaelson (2014) modelled several scenarios for the press-brake-formed tub girder and found Equation 2-32 from AASHTO did not accurately depict the nominal flexural resistance of the girders and was significantly conservative. The study recommended a similar expression with constants that better predicted capacity presented as Equation 2-33:

$$M_n = \begin{cases} M_p & D_p \leq 0.1D_t \\ M_p\left(1.0229 - 0.229\frac{D_p}{D_t}\right) & 0.1D_t < D_p \leq 0.42D_t \end{cases} \quad \text{Equation 2-33}$$

In cases where a continuous span is employed, the nominal flexural resistance of the section shall satisfy Equation 2-34.

$$M_n \leq 1.3R_hM_y \quad \text{Equation 2-34}$$

Where: M_n = nominal flexural resistance calculated per Equation 2-31 and Equation 2-32 as applicable(kip-in)

M_y = yield moment as determined by Article D6.2 (kip-in)

R_h = hybrid factor as determined by Article 6.10.1.10.1

For noncompact composite sections, Equation 2-35 shall be satisfied for compression flanges at the strength limit state.

$$f_{bu} \leq \phi_f F_{nc} \quad \text{Equation 2-35}$$

Where: ϕ_f = resistance factor for flexure as specified in Article 6.5.4.2

f_{bu} = longitudinal flange stress at the section under consideration calculated without consideration of flange lateral bending or longitudinal warping as applicable (ksi)

F_{nc} = nominal flexural resistance of the compression flange determined as specified in Article 6.11.7.2.2 and Equation 2-36 (kip-in)

$$F_{nc} = R_b R_h F_{yc} \quad \text{Equation 2-36}$$

Where: R_b = web load-shedding factor determined as specified in Article 6.10.1.10.2

R_h = hybrid factor determined as specified in Article 6.10.1.10.1

Equation 2-37 shall be satisfied for compression flanges at the strength limit state.

$$f_{bu} \leq \phi_f F_{nt} \quad \text{Equation 2-37}$$

Where: F_{nt} = nominal flexural resistance of the tension flange determined as specified in Article 6.11.7.2.2 (kip-in)

$$F_{nt} = R_h F_{yt} \Delta \quad \text{Equation 2-38}$$

Where: $\Delta = \sqrt{1 - 3\left(\frac{f_v}{F_{yf}}\right)^2}$ Equation 2-39

$$f_v = \frac{T}{2A_o t_f} \quad \text{Equation 2-40}$$

The maximum longitudinal compressive stress in the concrete deck at the strength limit state, determined as specified in Article 6.10.1.1.1d, shall not exceed $0.6f'_c$.

2.4.3.5.3 Flexural Capacity of Non-composite Sections

Compression flanges of box sections not made composite must satisfy Equation 2-41 at the strength limit state.

$$f_{bu} \leq \phi_f F_{nc} \qquad \text{Equation 2-41}$$

Where: ϕ_f = resistance factor for flexure as specified in Article 6.5.4.2

f_{bu} = longitudinal flange stress due to the factored loads at the section under consideration calculated without consideration of longitudinal warping (ksi)

F_{nc} = nominal flexural resistance of the flange as specified in Article 6.11.8.2 (ksi)

Nominal flexural resistance is computed by the following equations when flange longitudinal stiffeners are not used:

$$F_{nc} = F_{cb}\sqrt{1-\left(\frac{f_v}{\phi_v F_{cv}}\right)^2} \qquad \text{Equation 2-42}$$

Where: F_{cb} = nominal axial compression buckling resistance of the flange under compression alone, calculated per Equation 2-43 through Equation 2-45 as applicable (ksi)

If $\lambda_f \leq \lambda_p$ then:

$$F_{cb} = R_b R_h F_{yc} \Delta \qquad \text{Equation 2-43}$$

If $\lambda_p < \lambda_f \leq \lambda_r$ then:

$$F_{cb} = R_b R_h F_{yc}\left[\Delta - \left(\Delta - \frac{\Delta - 0.3}{R_h}\right)\left(\frac{\lambda_f - \lambda_p}{\lambda_r - \lambda_p}\right)\right] \quad \text{Equation 2-44}$$

If $\lambda_f > \lambda_r$ then:

$$F_{cb} = \frac{0.9ER_b k}{{\lambda_f}^2} \quad \text{Equation 2-45}$$

Where: F_{cv} = nominal shear buckling resistance of the flange under shear alone and is determined by Equation 2-46 through Equation 2-48 as applicable

If $\lambda_f \leq 1.12\sqrt{\frac{Ek_s}{F_{yc}}}$, then:

$$F_{cv} = 0.58F_{yc} \quad \text{Equation 2-46}$$

If $1.12\sqrt{\frac{Ek_s}{F_{yc}}} < \lambda_f \leq 1.40\sqrt{\frac{Ek_s}{F_{yc}}}$, then:

$$F_{cv} = \frac{0.65\sqrt{F_{yc}Ek_s}}{\lambda_f} \quad \text{Equation 2-47}$$

If $\lambda_f > 1.40\sqrt{\frac{Ek_s}{F_{yc}}}$, then:

$$F_{cv} = \frac{0.9Ek_s}{{\lambda_f}^2} \quad \text{Equation 2-48}$$

Where: λ_f = slenderness ratio of compression flange per Equation 2-49

$$\lambda_f = \frac{b_{fc}}{t_{fc}} \quad \text{Equation 2-49}$$

$$\lambda_p = 0.57\sqrt{\frac{Ek}{F_{yc}\Delta}} \quad \text{Equation 2-50}$$

$$\lambda_r = 0.95\sqrt{\frac{Ek}{F_{yr}}}$$ Equation 2-51

$$\Delta = \sqrt{1 - 3\left(\frac{f_v}{F_{yt}}\right)^2}$$ Equation 2-52

Where: f_v = St. Venant torsional shear stress n the flange due to the factored loads at the section under consideration per Equation 2-53 (ksi)

$$f_v = \frac{T}{2A_o t_f}$$ Equation 2-53

Where: F_{yr} = smaller of the compression-flange stress at the onset of nominal yielding, with consideration of residual stress effects, or the specified yield strength of the web determined per Equation 2-54 (ksi)

$$f_v = (\Delta - 0.3)F_{yc}$$ Equation 2-54

Where: k = plate-buckling coefficient for uniform normal stress = 4.0

k_s = plate-buckling coefficient for shear stress = 5.34

ϕ_f = resistance factor for flexure specified in Article 6.5.4.2

ϕ_v = resistance factor for shear specified in Article 6.5.4.2

b_{fc} = compression-flange width between webs (in)

A_o = enclosed area within the box section (in^2)

R_b =web load-shedding factor determined as specified in Article 6.10.1.10.2

R_h = hybrid factor determined as specified in Article 6.10.1.10.1

T = internal torque due to the factored loads (kip-in)

The nominal flexural resistance of a longitudinally stiffened compression flange shall be calculated in the same manner as the compression flange when flange longitudinal stiffeners are not used with the following substitutions:

- w shall be substituted for b_{fc}
- the plate-buckling coefficient for uniform normal stress, k, shall be taken as:
  - If n = 1, then:

$$k = \left(\frac{8I_s}{wt^3{}_{fc}}\right)^{\frac{1}{3}} \qquad \text{Equation 2-55}$$

  - If n =2, then:

$$k = \left(\frac{0.894I_s}{wt^3{}_{fc}}\right)^{\frac{1}{3}} \qquad \text{Equation 2-56}$$

$$1.0 \leq k \leq 4.0$$

- the plate-buckling coefficient for shear stress, k_s, shall be taken per Equation 2-57:

$$k_s = \frac{5.34 + 2.84\left(\frac{I_s}{wt^3{}_{fc}}\right)^{\frac{1}{3}}}{(n+1)^2} \leq 5.34 \qquad \text{Equation 2-57}$$

Where: I_s = moment of inertia of a single longitudinal flange stiffener about an axis parallel to the flange and taken at the base of the stiffener (in^4)

n = number of equally spaced longitudinal flange stiffeners

w = larger of the width of the flange between longitudinal flange stiffeners or the distance from a web to the nearest longitudinal flange stiffener (in)

Compression-flange longitudinal stiffeners shall satisfy the requirements specified in Article 6.11.11.2. Nominal flexural resistance of tension flanges of tub sections shall be determined in Equation 2-58.

$$F_{nt} = R_h F_{yt} \quad \text{Equation 2-58}$$

Where: R_h = hybrid factor determined as specified in Article 6.10.1.10.1

2.4.3.5.4 Shear Capacity

Shear resistance shall be defined by the provisions of Article 6.10.9 for single webs. In cases where the web is inclined, D in Article 6.10.9 shall be taken as the depth of the web plate measured along the inclination. Straight and curved web panels shall satisfy Equation 2-59 at the strength limit state.

$$V_u \leq \phi_v V_n \quad \text{Equation 2-59}$$

Where: ϕ_v = resistance factor for shear as specified in Article 6.5.4.2

V_u = factored shear in the web at the section under consideration (kip)

V_n = nominal shear resistance determined as specified in Article 6.10.9.2 and 6.10.9.3 for unstiffened and stiffened webs, respectively (kip)

Nominal shear resistance is computed by the following equations for unstiffened webs:

$$V_n = V_{cr} = CV_p \quad \text{Equation 2-60}$$

$$V_p = 0.58 F_{yw} D t_w \quad \text{Equation 2-61}$$

Where: C = ratio of the shear-buckling resistance to the shear yield strength determined by Equations 2-65, 2-66, and 2-67 with, k = 5.0

V_{cr} = shear-yielding or shear-buckling resistance (kip)

V_n = nominal shear resistance (kip)

V_p = plastic shear force (kip)

The nominal shear resistance of stiffened interior web panels is determined by Equations 2-63 and 2-64. The section proportions must satisfy Equation 2-61 and must meet the provisions of Article 6.10.9.1.

$$\frac{2Dt_w}{\left(b_{fc}t_{fc} + b_{ft}t_{ft}\right)} \leq 2.5 \qquad \text{Equation 2-62}$$

$$V_n = V_p\left[C + \frac{0.87(1-C)}{\sqrt{1+\left(\frac{d_o}{D}\right)^2}}\right] \qquad \text{Equation 2-63}$$

$$V_p = 0.58F_{yw}Dt_w \qquad \text{Equation 2-64}$$

Where: d_o = transverse stiffener spacing (in)

V_n = nominal shear resistance of the web panel (kip)

V_p = plastic shear force (kip)

C = ratio of shear-buckling resistance to shear yield strength

The ratio, C, shall be determined as specified by Equations 2-65 through 2-67:

If $\frac{D}{t_w} \leq 1.12\sqrt{\frac{Ek}{F_{yw}}}$, then:

$$C = 1.0 \qquad \text{Equation 2-65}$$

If $1.12\sqrt{\frac{Ek}{F_{yw}}} < \frac{D}{t_w} \leq 1.40\sqrt{\frac{Ek}{F_{yw}}}$, then:

$$C = \frac{1.12}{\frac{D}{t_w}}\sqrt{\frac{Ek}{F_{yw}}} \qquad \text{Equation 2-66}$$

If $\frac{D}{t_w} > 1.40\sqrt{\frac{Ek}{F_{yw}}}$, then:

$$C = \frac{1.57}{\left(\frac{D}{t_w}\right)^2}\left(\frac{Ek}{F_{yw}}\right)$$ Equation 2-67

Where: k = shear-buckling coefficient

$$k = 5 + \frac{5}{\left(\frac{d_o}{D}\right)^2}$$ Equation 2-68

If the section proportions do not satisfy Equation 2-62, Equation 2-69 shall be used to determine the nominal shear resistance.

$$V_n = V_p\left[C + \frac{0.87(1-C)}{\left(\sqrt{1+\left(\frac{d_o}{D}\right)^2} + \frac{d_o}{D}\right)}\right]$$ Equation 2-69

The nominal shear resistance of stiffened end panels shall be determined as specified in Equations 2-70 and 2-71.

$$V_n = V_{cr} = CV_p$$ Equation 2-70

$$V_p = 0.58F_{yw}Dt_w$$ Equation 2-71

Where: C = ratio of the shear buckling resistance to the shear yield strength determined by Equations 2-62 through 2-64.

V_{cr} = shear-yielding or shear-buckling resistance (kip)

V_p = plastic shear force (kip)

Transverse stiffener spacing for stiffened end panels, with or without longitudinal stiffeners, shall not exceed 1.5 times the section depth.

2.4.3.6 AASHTO Equation References

Table 2.3 includes a summary of the equations referenced and included in this chapter from the ASHTO LRFD Specifications with the appropriate AASHTO equation references.

Table 2.3: Chapter 2 Equation Legend (AASHTO, 2017)

Chapter 2 Equations	AASHTO 8th Edition
Equation 2-1	Table 4.6.2.2.2b-1
Equation 2-2	Equation 6.11.2.1.2-1
Equation 2-3	Equation 6.11.2.1.3-1
Equation 2-4	Equation 6.11.2.2-1
Equation 2-5	Equation 6.11.2.2-2
Equation 2-6	Equation 6.11.2.2-3
Equation 2-7	Equation 6.10.3.2.1-1
Equation 2-8	Equation 6.10.3.2.1-2
Equation 2-9	Equation 6.10.3.2.1-3
Equation 2-10	Equation 6.10.3.2.2-1
Equation 2-11	Equation 6.10.3.2.3-1
Equation 2-12	Equation 6.11.3.2-1
Equation 2-13	Equation 6.11.3.2-2
Equation 2-14	Equation 6.11.3.2-3
Equation 2-15	Equation 6.11.3.2-4
Equation 2-16	Equation 6.11.3.2-5
Equation 2-17	Equation 6.10.3.3-1
Equation 2-18	Equation 6.11.9-1
Equation 2-19	Equation 6.10.4.2.2-1
Equation 2-20	Equation 6.10.4.2.2-2
Equation 2-21	Equation 6.10.4.2.2-3
Equation 2-22	Equation 6.10.4.2.2-4
Equation 2-23	Equation 6.6.1.2.2-1
Equation 2-24	Equation 6.6.1.2.5-1
Equation 2-25	Equation 6.6.1.2.5-2
Equation 2-26	Equation 6.6.1.2.5-3

Table 2.3 (cont.): Chapter 2 Equation Legend (AASHTO, 2017)

Equation 2-27	Equation 6.10.1.8-1
Equation 2-28	Equation 6.11.6.2.2-1
Equation 2-29	Equation 6.10.7.3-1
Equation 2-30	Equation 6.11.7.1.1-1
Equation 2-31	Equation 6.10.7.1.2-1
Equation 2-32	Equation 6.10.7.1.2-2
Equation 2-34	Equation 6.10.7.1.2-3
Equation 2-35	Equation 6.11.7.2.1-1
Equation 2-36	Equation 6.11.7.2.2-1
Equation 2-37	Equation 6.11.7.2.1-2
Equation 2-38	Equation 6.11.7.2.2-5
Equation 2-39	Equation 6.11.7.2.2-6
Equation 2-40	Equation 6.11.7.2.2-7
Equation 2-41	Equation 6.11.8.1.1-1
Equation 2-42	Equation 6.11.8.2.2-1
Equation 2-43	Equation 6.11.8.2.2-2
Equation 2-44	Equation 6.11.8.2.2-3
Equation 2-45	Equation 6.11.8.2.2-4
Equation 2-46	Equation 6.11.8.2.2-5
Equation 2-47	Equation 6.11.8.2.2-6
Equation 2-48	Equation 6.11.8.2.2-7
Equation 2-49	Equation 6.11.8.2.2-8
Equation 2-50	Equation 6.11.8.2.2-9
Equation 2-51	Equation 6.11.8.2.2-10
Equation 2-52	Equation 6.11.8.2.2-11
Equation 2-53	Equation 6.11.8.2.2-12
Equation 2-54	Equation 6.11.8.2.2-13
Equation 2-55	Equation 6.11.8.2.3-1

Table 2.3 (cont.): Chapter 2 Equation Legend (AASHTO, 2017)

Equation 2-56	Equation 6.11.8.2.3-2
Equation 2-57	Equation 6.11.8.2.3-3
Equation 2-58	Equation 6.10.8.3-1
Equation 2-59	Equation 6.10.9.1-1
Equation 2-60	Equation 6.10.9.2-1
Equation 2-61	Equation 6.10.9.2-2
Equation 2-62	Equation 6.10.9.3.2-1
Equation 2-63	Equation 6.10.9.3.2-2
Equation 2-64	Equation 6.10.9.3.2-3
Equation 2-65	Equation 6.10.9.3.2-4
Equation 2-66	Equation 6.10.9.3.2-5
Equation 2-68	Equation 6.10.9.3.2-7
Equation 2-69	Equation 6.10.9.3.2-8
Equation 2-70	Equation 6.10.9.3.3-1
Equation 2-71	Equation 6.10.9.3.3-2

CHAPTER 3: DESIGN AND CONSTRUCTION OF THE FOURTEEN MILE BRIDGE

3.1 INTRODUCTION

This chapter details the design and construction of the Fourteen Mile Bridge in Lincoln County, West Virginia. This was the first installation of a bridge in West Virginia utilizing press-brake-formed tub girders. This bridge site has unique characteristics, such as significant skew and superelevation. The full bridge plans are in Appendix C of this report.

3.2 SUMMARY OF DESIGN AND CONSTRUCTION

The Fourteen Mile Bridge is a 58’-0” long, single span press-brake-formed tub girder bridge near the community of Ranger, West Virginia. The bridge carries traffic across Fourteenmile Creek on State Route Number 37. The bridge has a skew angle of 10° and a superelevation of 8%. Construction started in the spring of 2019 and completed on November 6, 2019 by Orders Construction Company. An aerial image of the bridge under construction is shown in Figure 3.1.

Figure 3:1: Aerial View of Bridge Under Construction

3.2.1 Fabrication of Modular Components

The press-brake-formed tub girders used in construction of the bridge were assembled in five fully composite modular components each brought to the site by truck and lifted into place by crane. This offsite manufacture enabled each step of the fabrication to be closely monitored and for progress to continue before the field would typically allow certain steps to be undertaken.

The five press-brake-formed tub girders began as 96” wide by 1/2” thick plate of AASHTO M270 steel shaped using a large capacity press-brake. Once formed, additional details such as shear studs, end bearing diaphragms, and mounting angles for the internal formwork were welded onto the steel tub. The entire assembly was hot-dipped galvanized for corrosion resistance. A photo of the galvanized press-brake-formed tub girder is seen in Figure 3.2.

Figure 3:2: Galvanized Tub Girder, Prior to Formwork Construction

Once the press-brake-formed tub girders were galvanized, the girder were shipped to Carr Concrete in Waverly, West Virginia where the formwork was assembled and a concrete deck was cast. The precaster used wooden studs and plywood to create the internal sacrificial formwork. Figure 3.3 shows a press-brake-formed tub girder module with the internal formwork.

Figure 3:3: Tub Girder with Completed Internal Formwork

While internal formwork was fabricated, reusable external formwork was constructed. The external formwork used a combination of steel formwork panels, wooden studs, and plywood. Upon completion of the external formwork, each press-brake-formed tub girder was placed into the forms (Figure 3.4) and the mats of rebar were added (Figure 3.5). A retardant was placed on the edges of the shear key detail on the external formwork where the UHPC joints would connect. This retardant allowed the concrete paste at the edge to be removed by a pressure washer, leaving exposed aggregate to which the UHPC could properly bond.

Figure 3:4: Isometric View of Reusable External Formwork

Figure 3:5: Close View of Rebar Placement at Semi-Integral Abutment End

Following the placement of the rebar, concrete casting began. The crew used two concrete buckets, so any downtime from waiting for more material was minimized, and the deck could be cast continuously. Once pouring was completed, the deck was finished, and a plastic sheet covering was applied, so the deck could cure. Figure 3.6 and Figure 3.7 show the casting of the concrete and finishing of the deck, respectively.

Figure 3:6: Casting of Fresh Concrete

Figure 3:7: Finished Concrete Deck

After the concrete had set, the external formwork was removed, and the next press-brake-formed tub girder was placed into the formwork. After the first two modules had been cast, a test fit was performed to ensure compatibility of the composite modules in the field. Figure 3.8 shows the test fit in the fabrication yard.

Figure 3:8: Test Fit of Two Precast Modules at Fabrication Yard

3.2.2 Installation of Modular Components

Once all five composite modules were completed, they were transported by truck to the bridge site and lifted into place by crane. The UHPC closure pours were cast, and the deck was diamond ground for the appropriate finish. In order to reduce traffic congestion during placement and the amount of time necessary to rent the cranes, each successive truck was staged. This allowed the next modular unit to be delivered and set in minimal time. A typical composite module loaded on a staged truck is shown in Figure 3.9.

Figure 3:9: Composite Module Delivered to Site

Two cranes operated in tandem to lift each composite module from the trailer to the abutment seats. Workers on the ground verified measurements for the first composite module as this placement defined further composite module positions. Figure 3.10 shows the placement of the first composite module, and Figure 3.11 shows the placement of the second composite module and the appropriate fit of the two.

Figure 3:10: Placement of First Composite Module On-Site

Figure 3:11: Verification of Fit of Adjacent Modules on Site

After all composite modules were placed, formwork was erected around the joints for the UHPC closure pours. The UHPC was mixed onsite with a pan mixer, then concrete buggies moved the concrete from the mixer to the bridge to place along the joints. The pouring of the UHPC is shown in Figure 3.12.

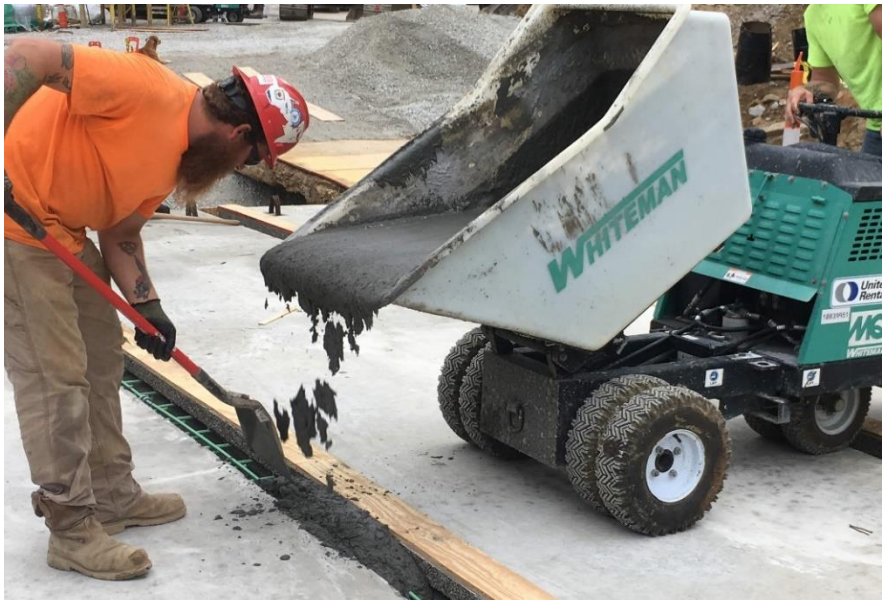

Figure 3:12: Pouring of UHPC Along Longitudinal Joint

After the UHPC set, the forms were removed, and a diamond grinder was used to adjust the deck profile as desired (Figure 3.13). This enabled a smooth transition from the cast-in-place concrete approach slab to the precast concrete deck modules.

Figure 3:13: Diamond Grinder Used to Finish Deck On-Site

3.2.3 Accelerated Bridge Construction Strategies

Several accelerated bridge construction (ABC) strategies were employed in this bridge replacement project to minimize project duration and improve the finished structure. Instead of a traditional cast-in-place deck for the bridge superstructure, the Fourteen Mile Bridge used five composite modules manufactured individually off site. By having the deck precast in a controlled shop environment, the contractor was able to closely monitor the application of the fresh concrete. The minimal difference between the pouring of each bucket of concrete ensured that no cold joints formed in the deck structure. The controlled shop environment was also beneficial for the curing process to allow the concrete to gain maximum strength. Once the composite modules were complete, they were transported by truck to the bridge site and the modules were placed directly from the trucks to the abutments. The removal of a staging yard for construction reduced the time spent handling material and the necessary footprint of the construction site. The choice of UHPC was advantageous for the closure pours due to the high compressive strength and the short amount of time required to develop full strength of UHPC.

CHAPTER 4: RESEARCH METHODS

4.1 INTRODUCTION

This chapter serves to provide an overview of the research methodology employed during the field evaluation of the Fourteen Mile Bridge. This includes descriptions of the field-testing equipment and finite element modeling, along with the data reduction approaches.

4.2 EXPERIMENTAL TESTING EQUIPMENT

This section details the pieces of field equipment used to assess the performance of the Fourteen Mile Bridge during the live load field test. Instrumentation and software were developed by Bridge Diagnostics, Inc. (BDI).

4.2.1 BDI Strain Transducers

BDI strain transducers (Figure 4.1) were chosen as the data sensors to measure strain during the live load field test. These gages are an appropriate choice for outdoor field tests because the gages are reusable and resistant to adverse weather conditions. Each gage is fully sealed to the elements, has been rated IP67 for dust and moisture resistance, and has an operating temperature range of -58°F to +185°F. Inside of each gage is a full Wheatstone bridge with four active 350Ω foil gages. The applicable range for strain measurements of the gage is ±2000με. Each gage is individually calibrated to meet National Institute of Standards and Technology specifications and has a variation in readings of less than ±1%. The BDI strain transducers attach to the surface of the steel member with reusable tabs that included a 1/4”-20 threaded mounting shaft. For this live load field test, Loctite HY 4070 Structural Repair Hybrid Adhesive was used to affix the transducers to the girder. More details on structure instrumentation are available in section 5.2.1.

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Figure 4:1: BDI Strain Transducer, Typical Application to Girder

4.2.2 STS-WiFi Data Acquisition System

In order to record the data measured with the strain transducers, BDI created the STS-WiFi Data Acquisition System. This system consists of nodes collecting data from various sensors and a base station serving as the interface between the nodes and the computer software. The STS-WiFi Data Acquisition System is especially useful for field testing where access to a power source is difficult or running cables between devices is limited. Sensors, such as a strain transducer, plug into one of the four connectors of the wireless four-channel node (Figure 4.2). These nodes transmit the data readings over a local wireless broadcast to the mobile base station as seen in Figure 4.3. Power is supplied to the wireless nodes and base station by rechargeable NiMH batteries. In cases where a source of continuous AC power is available, the wireless nodes may also be powered by a DC power adapter.

Figure 4:2: BDI STS-WiFi Wireless 4-Channel Node

Figure 4:3: BDI STS-WiFi Mobile Base Station

Even though the units are designed with the capability to wirelessly transmit data for use in applications with limited access, there is the option to use wired ethernet connections between each node and the base station. Like the strain transducers, BDI designed the base stations and wireless nodes to be able to resist dust and water. A weather seal and locking mechanism is provided on the access door to both the base station and wireless node. BDI also provided mounting locations on the wireless nodes and base station; these mounts were combined with high

strength magnets to affix the testing equipment to the outside of the girders in a sturdy and temporary fashion. To improve data reduction efforts, each piece of equipment in the BDI Data Acquisition System is equipped with a BDI “Intelliducer” chip. This chip allows the equipment to identify itself inside of the software package. The ease of installation and durable nature of the BDI system makes its use in field testing an appropriate choice.

4.2.3 Load Truck and Wheel Scales

The live load was produced by a loaded tandem axle dump truck provided by Lusher Trucking of Prichard, West Virginia (Figure 4.4). The total weight of the truck was measured prior to arrival on site. The weight of each wheel was measured on site using Haenni Wheel Load Weigher scales as seen in Figure 4.5. The wheel scales were provided by the Public Service Commission of West Virginia Transportation Enforcement Division.

Figure 4:4: Tandem Axle Dump Truck used for Live Load Test

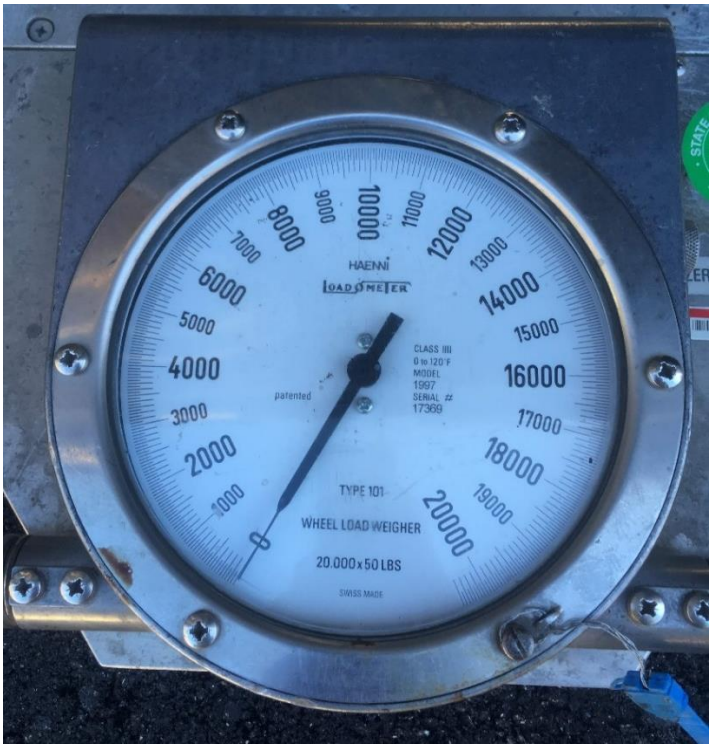

Figure 4:5: Haenni Wheel Load Weigher Scale

4.3 FINITE ELEMENT MODELING

This section details the process followed to conduct a finite element analysis to compare analytical values to the results from the field. Abaqus/CAE 6.14-1 (Dassault Systèmes, 2014) was used to develop a finite element model of the Fourteen Mile Bridge. Load simulating a tandem axle truck was applied and an analysis was conducted. Article 4.6.3.3 of the AASHTO LRFD specifications was used as a guide for the considerations in a refined analysis approach. Data from the model was used to compare the girder strains and LLDFs calculated from the field results.

4.3.1 Material Definitions

The Fourteen Mile Bridge superstructure consists of AASHTO M270 Grade 50 plate for the girders and Class H concrete for the deck. Due to the narrow widths of the UHPC closure pours, Class H concrete was assumed for the entire deck. Following AASHTO 6.4.1, the structural

steel had a modulus of elasticity of 29,000 ksi, a minimum yield strength of 50 ksi, and a Poisson's ratio of 0.3. The compressive strength of the concrete was 4,000 psi as stated in the design plans. Following AASHTO Article 5.4.2, the concrete had a modulus of elasticity of 3,640 ksi and a Poisson's ratio of 0.2. Linear elastic behavior was assumed in this analysis and all materials were assumed to be isotropic.

4.3.2 Element Selection

Due to the uniform geometry of the Fourteen Mile Bridge, quadrilateral shell elements were employed in the finite element model. Following the Abaqus/Standard User's Manual and work from previous analytical models of press-brake-formed tub girders (Gibbs, 2017; Underwood, 2019), S4R shell elements were chosen to be used. S4R elements are four-noded stress/displacement shell elements with reduced integration. These properties make S4R elements a suitable choice for a wide variety of uses. Comparison of analytical results to the field data indicated the element produced accurate results for finite element analysis.

4.3.3 Mesh Discretization

Following Article 4.6.3.3 of the AASHTO LRFD specifications, abrupt changes in the sizes or shapes of finite elements should be avoided, and the aspect ratio of finite elements and grid panels should not exceed 5.0. This controls the shapes used in the mesh and the relative element sizes.

The mesh discretization of the finite element model for the Fourteen Mile Bridge adhered to the guidelines set by AASHTO to produce accurate results. Each portion of the cross section was seeded to generate a desired number of elements. The typical mesh discretization for the cross section is presented in Figure 4.6. Nodes were spaced in the longitudinal dimension of the girders at 6" increments for 116 elements along the length of each girder. Both top flanges consist of two elements each, top and bottom bends consist of three elements each, webs consist of 12 elements each, and the bottom flange consists of 10 elements.

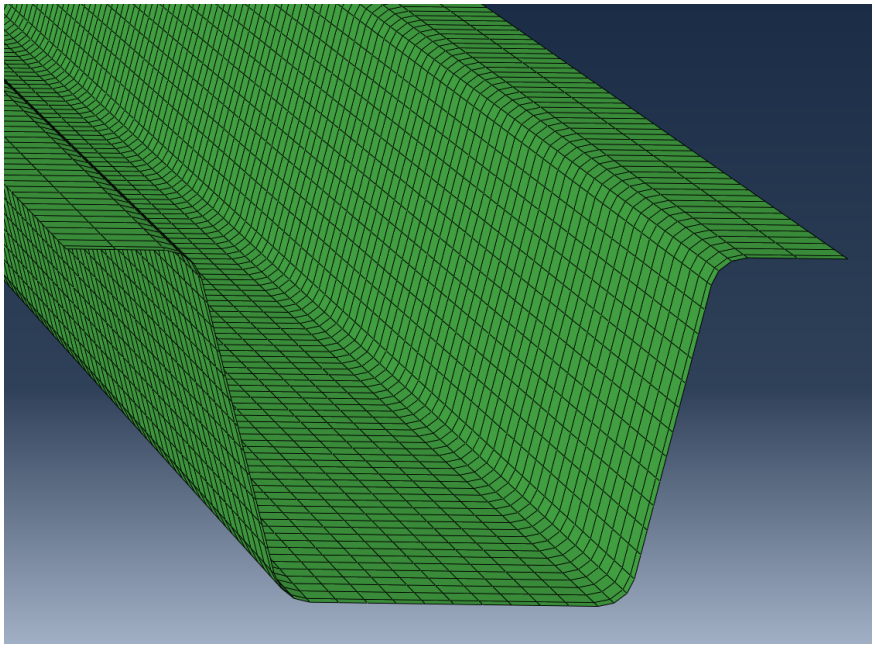

Figure 4:6: Typical Mesh Discretization for Each Tub Girder

Elements were grouped by similar geometries, and each was checked to verify the aspect ratios met the guidelines set by AASHTO. The results of this validation are presented in Table 4.1.

Table 4.1: Typical Aspect Ratio for Girder Elements

Geometry	Number of Elements	Depth, D (in)	Length, L (in)	Aspect Ratio (D/L)
Top Flange	2	3.00	3.74	0.80
Bend	3	3.00	1.21	2.48
Web	12	3.00	1.89	1.59
Bottom Flange	10	3.00	2.16	1.39

Seeding of the deck nodes in the longitudinal direction matched the 6” spacing used to seed the girder. However, for the multiple-point constraints to be collinear between deck and girder nodes, transverse spacings of nodes varied between 6.77” for exterior overhangs, 6.41” over each girder, and 5.77” for interior overhangs. Aspect ratios for each deck element met the AASHTO guidelines for advanced modeling techniques.

4.3.4 Boundary Conditions and Multiple Point Constraints

The boundary conditions of the Fourteen Mile Bridge were modeled as a "hinge-roller" simple span which limited horizontal and vertical displacement. The girders were restrained from lateral movement at the ends. All boundary conditions were applied to the nodes on the bottom flange of each girder. Multiple-Point Constraints are used to associate disconnected nodes of a finite element model to limit displacement between the two points. This feature is useful in the analysis of beam-slab bridges when the deck is composite where the deck and girders can be modeled to act together.

4.3.5 Application of Live Loading

Load placement on the finite element model simulated the loading performed in the field to maximize the strain in the bottom flange of each girder. Because the point loads were applied in the middle of elements and not at distinct nodes, the load from each wheel would need to be statically distributed to each node defining the element (Figure 4.7). The proportion of the applied load taken to each node was computed by Equations 4-1 through 4-4, which follows AASHTO Article 4.6.3.3.1 as the sum for each nodal load is statically equivalent to the applied load.

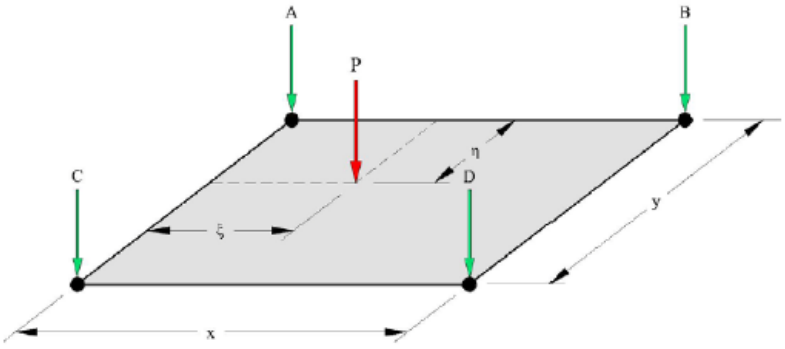

Figure 4:7: Nodal Distribution of Point Loads (Michaelson, 2010)

$$A = P\left(1 - \frac{\xi}{x}\right)\left(1 - \frac{\eta}{y}\right)$$ Equation 4-1

$$B = P\left(\frac{\xi}{x}\right)\left(1 - \frac{\eta}{y}\right)$$ Equation 4-2

$$C = P\left(1 - \frac{\xi}{x}\right)\left(\frac{\eta}{y}\right)$$ Equation 4-3

$$D = P\left(\frac{\xi}{x}\right)\left(\frac{\eta}{y}\right)$$ Equation 4-4

4.4 DATA REDUCTION METHODS

This section details the methods used to analyze the data collected in the field and from the finite element model used to calculate the LLDFs. Example calculations for the quarter span bending stress and LLDFs are also included. Structure instrumentation is further described in Section 5.2. Raw data from the field testing included the strain readings (measured in microstrain, με) and corresponding gage numbers. The five strain readings from each panel point were averaged to a single strain reading for each gage; the initial strain recorded from when the truck was located off the bridge was subtracted from the strain at each panel point. The location of each gage on the structure was determined from field notes, and the gages were grouped by girders. For simplicity, the truck passes were defined as the physical positions of the truck during live load testing and the truck runs were the positions that maximized the strains on targeted girders. More information on the distinction between truck passes and runs is provided in Section 5.2.2. The three gage measurements for each girder were averaged to obtain the strain at each panel point on each girder for each truck pass. The strains were subsequently linearly interpolated to determine the strain at each panel point for each truck run.

4.4.1 Computation of Quarter Span Bending Stresses

Recorded strain data was separated by girder and the readings were averaged to obtain a single strain value for each panel point measured in microstrain, με. These strain values were used in combination with Hooke's Law to compute the bending stress at the gage locations at quarter span. The strain values were averaged for each girder, then divided by 1e6 to convert to strains.

The values were multiplied by Young's Modulus of steel, E_s = 29,000 ksi. The resultant value is the stress in ksi at the quarter span for each girder. An example of these calculations for the selected data shown in Table 4.2 is presented below as Equations 4-5 and 4-6.

Table 4.2: Strain Values, Quarter Span Bending Stress

Truck Pass 4, Girder 3, Panel Point 5				
Panel Point		Strain in Gages, Girder 3 (με)		
x (ft)	x/L	G01	G02	G03
29	0.5	37.83	39.39	39.58

Average Strain in Girder 3:

$$\varepsilon_{avg} = \frac{\Sigma\varepsilon}{n} = \frac{37.83 + 39.39 + 39.58}{3} = 38.93\ \mu\varepsilon \qquad \text{Equation 4-5}$$

Application of Hooke's Law to Compute Bending Stress

$$\sigma = \frac{\varepsilon_{avg}}{1{,}000{,}000} * E_s = \frac{38.93}{1{,}000{,}000} * 29000 = \mathbf{1.13\ ksi} \qquad \text{Equation 4-6}$$

Where: n = number of gages

ε_{avg} = average bottom flange strain (με)

σ = bottom flange bending stress (ksi)

E_s = Young's Modulus of Steel (ksi)

4.4.2 Computation of Live Load Distribution Factors

The average girder strain for each panel point was used to calculate the LLDFs for each girder following Equation 4-7. The strain in each girder is divided by the total amount of strain in all girders. This value is multiplied by the number of applied design trucks and the multiple presence factor, which is described in Section 2.4.1. For the single lane loaded condition, the

multiple presence factor is taken as 1.2, and for the two lanes loaded condition, the multiple presence factor is taken as 1.0.

$$LLDF_{gi} = \frac{n\varepsilon_i}{\sum_{i=1}^{k} \varepsilon_i} * m \qquad \text{Equation 4-7}$$

Where: $LLDF_{gi}$ = distribution factor for a target "i'th" girder

ε_i = bottom flange static strain for a target "i'th" girder

n = number of applied design trucks

m = AASHTO multiple presence factor

k = number of girders

Sample calculations will first be shown for calculating the LLDFs for the single lane loaded condition at Panel Point 5 for Truck Pass 4 and Girder 2. This computation for the data shown in Table 4.3 is represented by Equation 4-8. In the case of multiple lanes loaded, strain data from separate passes must be superimposed to simulate the loading of two trucks. This means the strain would be the sum of the strain on a given girder due to each relevant pass. Data presented in Table 4.4 represents the average girder strain for each pass and the summation of girder strains for each respective girder. The two lanes loaded calculations are shown in Equation 4-9 for the summation of Panel Point 5 for Truck Pass 1 and 7 on Girder 1.

Table 4.3: Strain Values, Single Lane Loaded LLDF Sample Calculation

Truck Pass 4, Panel Point 5						
Panel Point		Girder Average Strain (με)				
x (ft)	x/L	G1	G2	G3	G4	G5
29	0.5	38.75	45.52	38.93	25.21	9.67

$$LLDF_{G2,PP5} = \frac{1.2 * (45.52)}{38.75 + 45.52 + 38.93 + 25.21 + 9.67} * 1 = \mathbf{0.346} \quad \text{Equation 4-8}$$

Table 4.4: Strain Values, Two Lanes Loaded LLDF Sample Calculation

Truck Pass 1, Panel Point 5						
Panel Point		Girder Average Strain (με)				
x (ft)	x/L	G1	G2	G3	G4	G5
29	0.5	64.28	59.56	35.36	17.46	6.42
Truck Pass 7, Panel Point 5						
Panel Point		Girder Average Strain (με)				
x (ft)	x/L	G1	G2	G3	G4	G5
29	0.5	26.81	39.31	47.95	46.40	28.26
Truck Pass 2+7, Panel Point 5						
Panel Point		Girder Average Strain (με)				
x (ft)	x/L	G1	G2	G3	G4	G5
29	0.5	91.09	98.88	83.31	63.86	34.68

$$LLDF_{G1,PP5} = \frac{1.0 * (91.09)}{91.09 + 98.88 + 83.31 + 63.86 + 34.68} * 2.0 = \mathbf{0.490} \quad \text{Equation 4-9}$$

LLDFs were calculated following AASHTO Article 4.6.2.2. The specifications within Article 4.6.2.2 are discussed earlier in Section 2.4.2 and Equation 4-10 represents the LLDF equation for steel box girders. In the AASHTO LRFD specifications, no differentiation is made

for the calculation of interior girder or exterior girder LLDFs, or for the number of design lanes loaded. Note the multiple presence factor is already taken into consideration by Equation 4-10.

$$LLDF = 0.05 + 0.85 * \frac{N_L}{N_b} + \frac{\mathbf{0.425}}{\boldsymbol{N_L}} \quad \text{Equation 4-10}$$

Where: N_L = number of design lanes as specified in Article 3.6.1.1.1

N_b = number of girders

$$0.5 \leq \frac{N_L}{N_b} \leq 1.5$$

In the case of the Fourteen Mile Bridge, there are five girders and two design lanes. As shown in Equation 4-11, the LLDF determined by the methods specified in the AASHTO LRFD specifications Article 4.6.2.2 is 0.603. It should be noted this bridge does not fall within the range of applicability. The calculation of N_L/N_b is 2/5, or 0.4, which is below the minimum requirement the equation may be utilized for. No provisions are described by AASHTO for steel box bridges that lie outside this range.

$$LLDF = 0.05 + 0.85 * \frac{2}{5} + \frac{0.425}{2} = \mathbf{0.603} \quad \text{Equation 4-11}$$

CHAPTER 5: FIELD TESTING OF THE FOURTEEN MILE BRIDGE

5.1 INTRODUCTION

This section details the loading and data recording process performed for the physical field testing of the Fourteen Mile Bridge in October 2019. Researchers from MU and WVU traveled to Ranger, West Virginia to perform a live load field test on the bridge. The goal of the field test was to compare measured strains due to physical loading to strains determined from analytical modeling to assess performance of the structure.

5.2 LIVE LOAD FIELD TEST ASSESSMENT

The field test of the Fourteen Mile Bridge was completed over two days. The first day was used to measure and apply instruments to the structure. The field testing and data collection was completed on the second day.

5.2.1 Structure Instrumentation

The BDI STS Wi-Fi Data Acquisition System was used to instrument the structure and record results. Nineteen gage locations were identified for this field test; three gages were located on the bottom of each girder (15 total) and one gage was located on each web of Girders 1 and 2. Gages were placed at quarter span to allow for easier access for preparation and removal. An overview of the gage layout is shown in Figure 5.1.

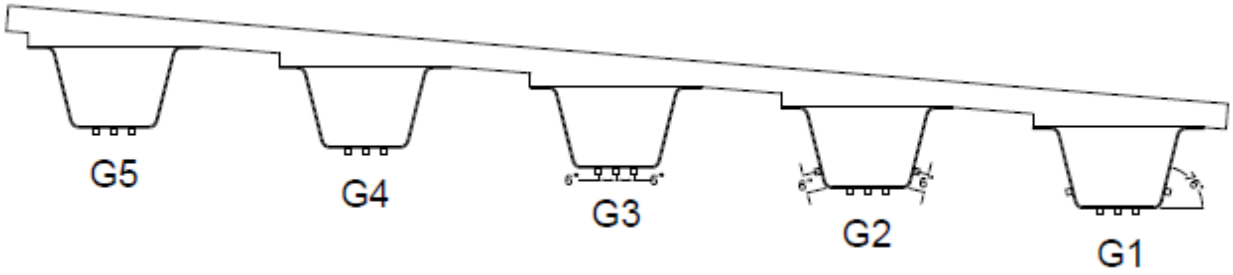

Figure 5:1: Gage Locations on Girders, Looking Upstation

To improve access to mark and prepare the girders and apply the instrumentation, an all-terrain aerial lift was supplied by the contractor for use during the field testing. The aerial lift is presented in Figure 5.2.

Figure 5:2: Aerial Lift Supplied by Contractor

Quarter span locations were determined by measuring the distance from the inside face of one precast abutment to the inside face of the other. This distance was 60'-6", which was divided by four to find quarter span. The resulting distance measured from the back-station abutment to quarter span was 13'-$7^{5}/_{16}$." A mark was made at quarter span for the transverse middle of each girder. Quarter points were also measured the along the bends of each girder; a square was used to

mark the resulting diagonal. The middle of the gages, as seen in Figure 5.3, is at an angle parallel to the skew. After this mark was made, measurements were made at 6” normal to the longitudinal direction at each side from the center and then 1.5” from each intersection point to determine the tab locations for the gages. The resulting grid of markings is seen in Figure 5.4. Web locations were measured using an angled rule; the web gages were placed 6” from the bottom flange measured along the inclination of the web. The web gage mounting points were determined in a similar fashion as the bottom flange mounting points. Typical web gage mounting locations are seen in Figure 5.5.

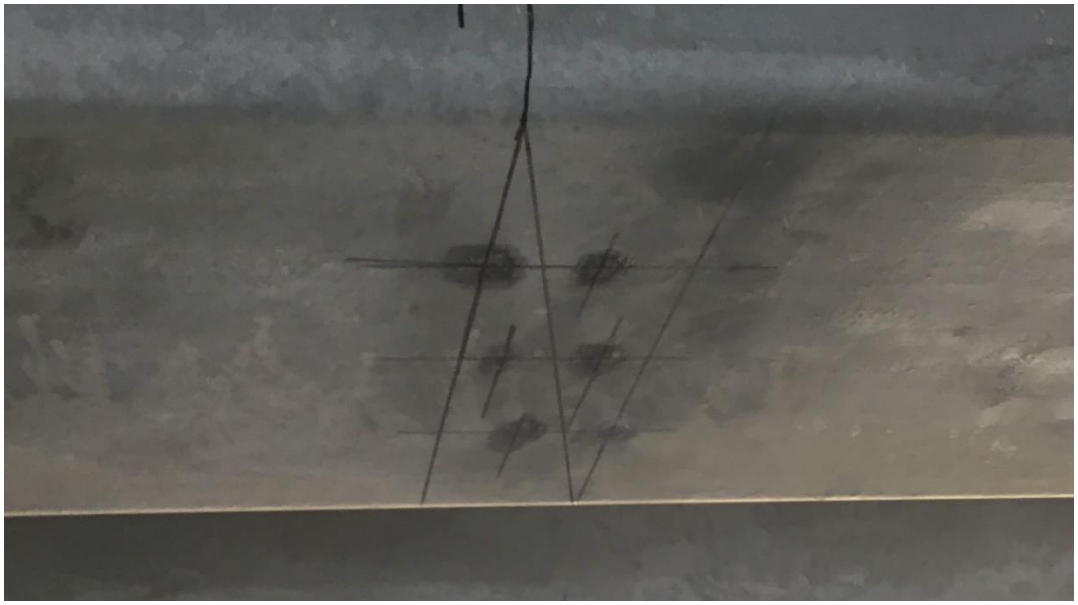

Figure 5:3: Centerline of Gages at Quarter Span, Looking Upstream

Figure 5:4: Typical Bottom Flange Gage Mounting Points, Looking Upstream

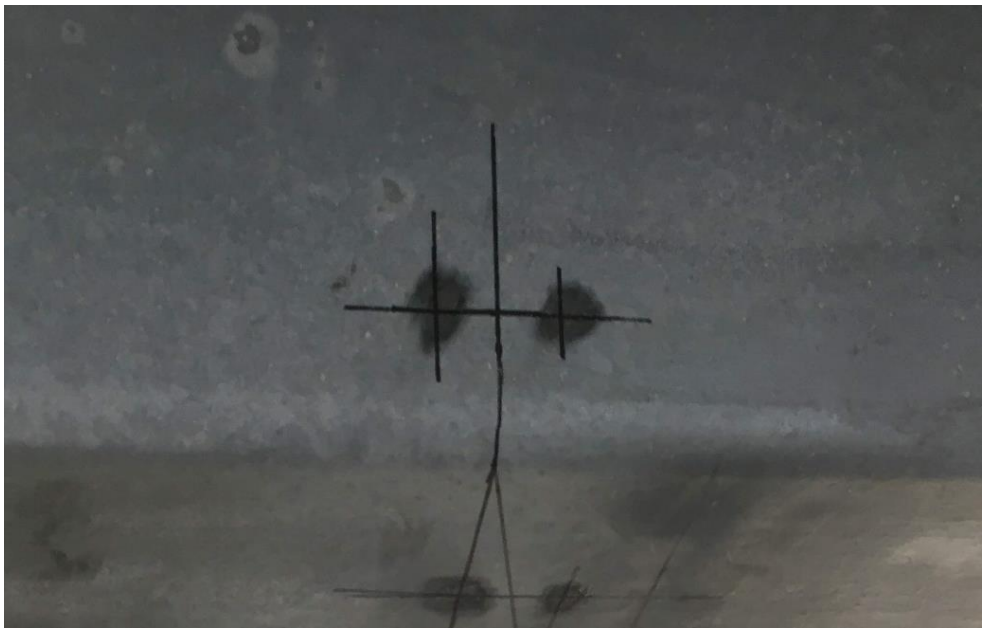

Figure 5:5: Typical Web Gage Mounting Points, Looking Downstream

After the gage locations had been marked, a battery-powered angle grinder with a wire brush attachment was used to buff the surface of the girder to allow the adhesive to bond to the bare steel. After the surface was prepared, the marks were replaced so the gages could be installed at the correct locations. A gage blank was used in combination with the tab jig provided by BDI to ensure correct spacing of the mounting locations. A small bead of Loctite® HY 4070 Superfast Fixture Structural Repair Hybrid Adhesive was applied to the bottom of each tab and uniform pressure was used to fix the tabs against the steel surface. Approximately 90 seconds after the initial contact, the adhesive set, and pressure could be released. Figure 5.6 shows the tab mounts in place on the girder.

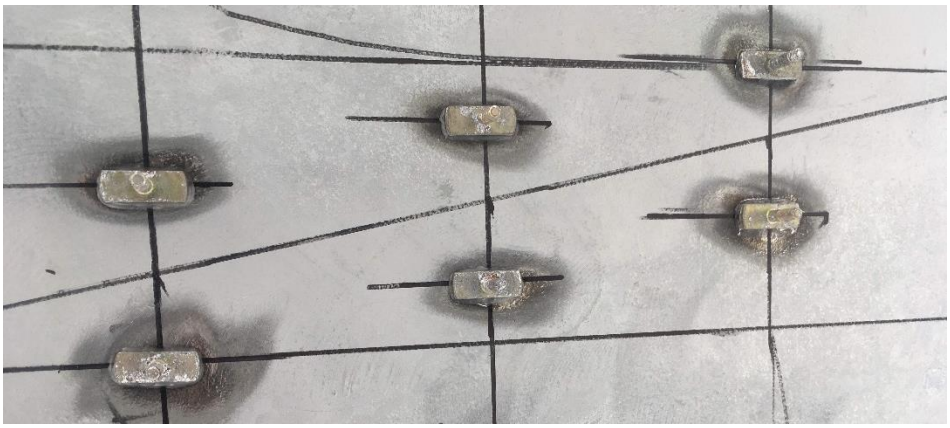

Figure 5:6: Typical Tab Mounting to Steel Surface

Approximately 20 minutes following the original application, the gage blank was removed, and the appropriate BDI strain transducer was installed based on the necessary cable length. The gages attached to the two tabs with 7/16” nuts tightened with a wrench until snug. The cables were connected to the appropriate wireless node. Nodes were attached to the surface of the steel using a magnetic mounting assembly. Figure 5.7 shows the gages installed on the girder.

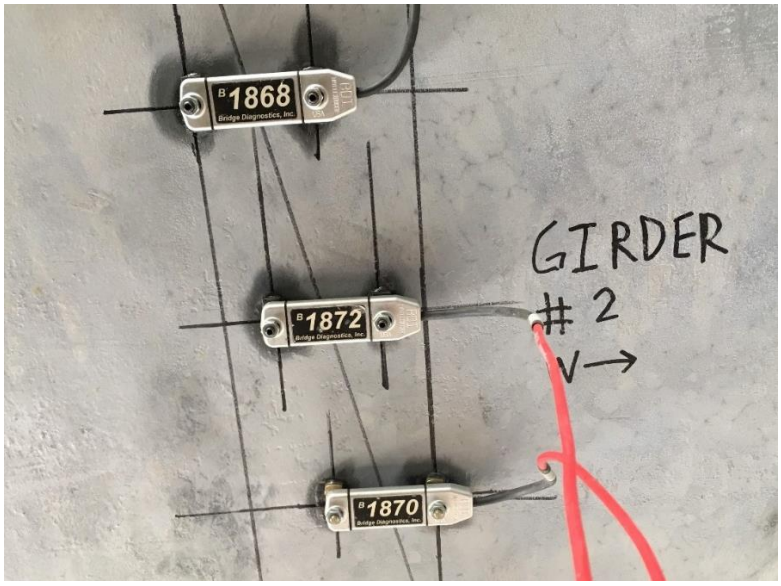

Figure 5:7: Typical View of Gages Installed on Bottom Flange, Looking Downstream

Because a portable generator was available, it was determined that using DC power adapters with the wireless nodes and base station would be an appropriate option. A wired ethernet cable connected one of the five nodes to the base station. Figure 5.8 shows an overview of the instrumentation once all connections were completed.

Figure 5:8: Overview of Instrumentation, Looking Backstation

5.2.2 Live Load Path Delineation

The second day of the study began with troubleshooting all connections and verifying the system recorded data correctly. The live load paths were developed from the AASHTO LRFD specifications for maximizing load on individual girders. Measurements to determine the panel points started with identification of the centerline of the road survey. A straight line was marked between both survey points. Subsequent parallel lines were measured in 2'-0" measurements, resulting in the last longitudinal marking located 2'-0" from the edge of the downstream parapet. In total, 13 longitudinal markings were made. To determine transverse locations, the distance between the survey points was measured and was broken into 10 equal panel points, each 6'-$^{5}/_{8}$" in length.

Delineation of load paths was accomplished by marking the deck by string and crayon. At 2'-0" increments from the centerline of road survey, nails were placed in the deck at the foam joints at the end of the precast modules. Yellow construction string lines were wrapped around the nails and care was taken to ensure the string was taut (Figure 5.9). Figure 5.10 shows several longitudinal markings with the construction string lines. In the transverse direction, blue crayon was used to mark the 10 panel points as seen in Figure 5.11.

Figure 5:9: Nail placement in Foam Joint with Construction String Line Wrapped Taut

Figure 5:10: Parallel Longitudinal Delineations on Deck with Construction String Line

Figure 5:11: Transverse Mark Completed with Blue Crayon

Once the markings had been placed on the deck, a grid was created with the intersections representing the panel points for each placement where the truck would be located. For the purpose of this study, passes will refer to the particular transverse spacing that the truck path is following, and panel point will refer to the truck's position in the longitudinal direction. This grid is indicated by Figure 5.12. It should be noted, due to the radius of curvature of the roadway, the truck would not be able to be placed at either the upstation or backstation end of the longitudinal pass for passes 12 and 13. Subsequently, there is no data from either pass.

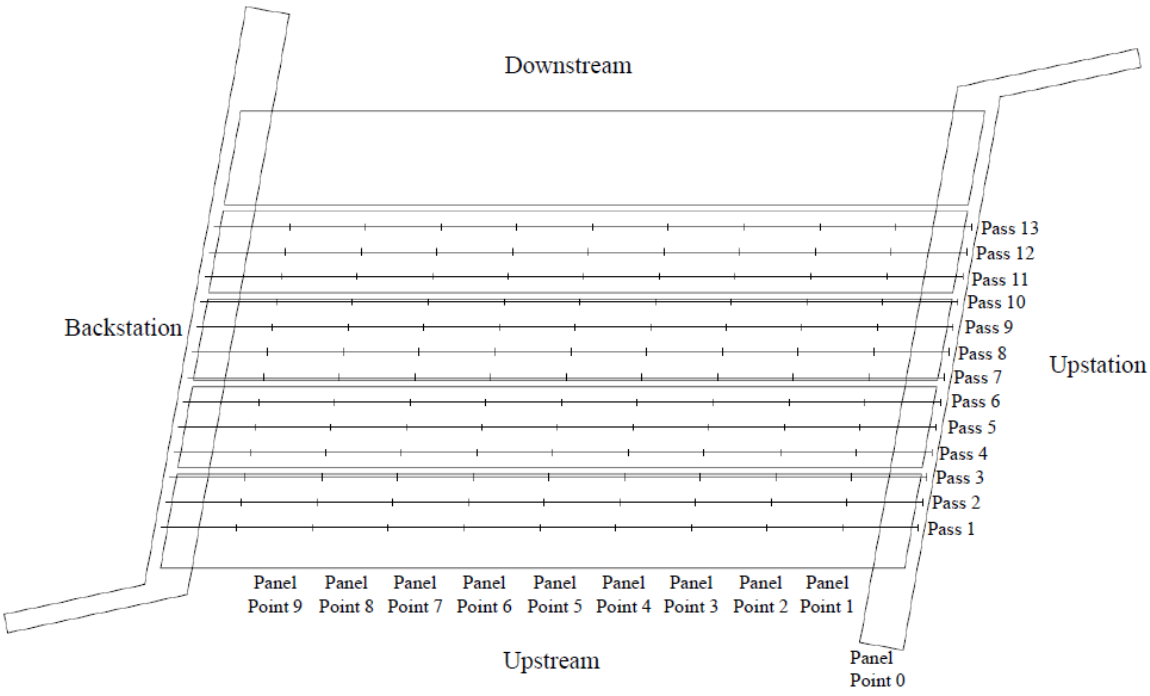

Figure 5:12: Plan View of Panel Point Grid

Referencing work from Gibbs on the Amish Sawmill Bridge (2017) and Underwood on the Cannelville Road Bridge (2019), these delineated truck passes were linearly interpolated to maximize loading on specific girders. Strain values from multiple passes could be added together for each respective girder to simulate the effects of multiple lane loaded scenarios. The following methodology was performed to determine the appropriate location of runs. All transverse distances were measured along the grade of the deck. Girder 1, an exterior girder, would have the strains maximized by having the truck run located 2'-0" from the inside edge of the downstream parapet.

To simulate the two lanes loaded scenario, a second truck located 12’-0”, the spacing of a design lane, away from the first truck run, or 14’-0”, from the inside edge of the downstream parapet. These two runs are shown in Figure 5.13, along with their distance to the inside edge of the downstream parapet as Runs 1 and 4, respectively. A similar procedure is followed for Girders 2 and 3. To maximize the strain for the single lane load in Girder 2, an interior girder, the truck run must be placed so the middle of the tire is along the centerline of Girder 1, 3’-$^{13}/_{16}$” from the inside edge of the downstream parapet, labeled as Run 2. To induce the multiple lane loaded scenario, the strains from Run 2 must be superimposed with Run 5, located 12’-0” in the upstream direction. Runs 3 and 6 are used to maximize strain from the single and multiple lanes loaded scenarios, respectively, for girder 3.

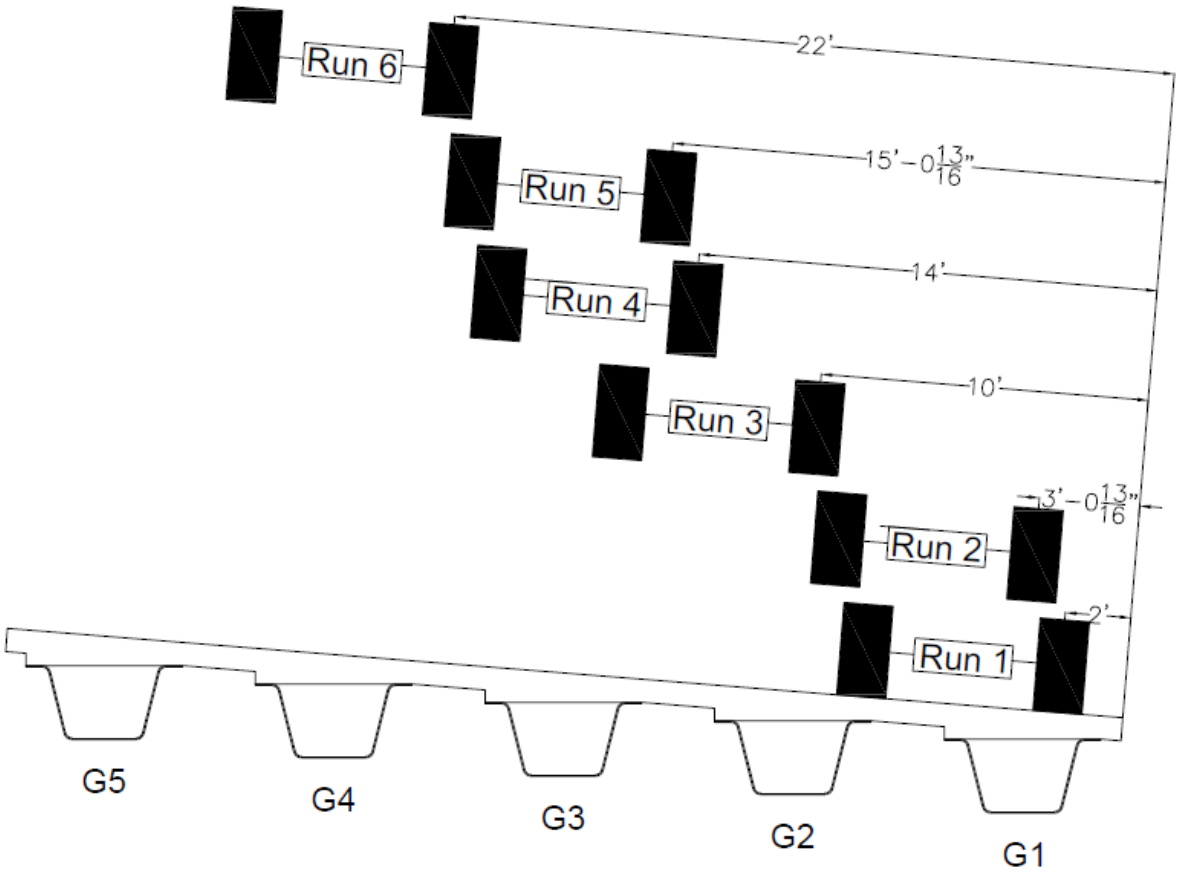

Figure 5:13: Live Load Truck Placement, Looking Upstation

5.2.3 Live Load Testing

Upon arrival of the tandem axle truck to the bridge site, testing began. The truck was deemed fit for use in the live load test due to the similarity with the HS-20 design load truck from AASHTO. The initial truck pass began at the downstream edge of the deck oriented in the direction of back station. Successive passes were worked in the upstream direction. Before the truck moved onto the bridge, the right edge of the front left tire, wheel 1, was lined up with the construction string line. Once the physical testing began, 10 Hz was chosen as the sample rate within the BDI Software to record strain values. Five measurements were taken before the bridge was loaded to serve as a baseline. The truck would be positioned at each panel point at the intersection of the sting line and crayon mark. A typical pass location can be seen in Figure 5.14. Once the truck stopped and the bridge returned to a static condition, five readings were taken. At the conclusion of the testing, each wheel was weighed and the geometry of the axle spacings were measured. Figure 5.15 shows the weight of each wheel along with the geometric configuration of the axles.

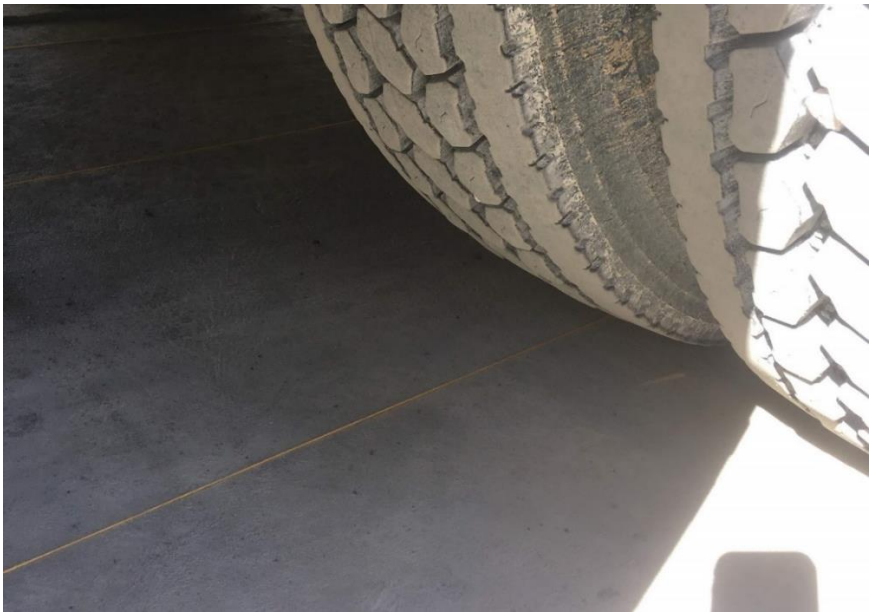

Figure 5:14: Typical Truck Pass Location

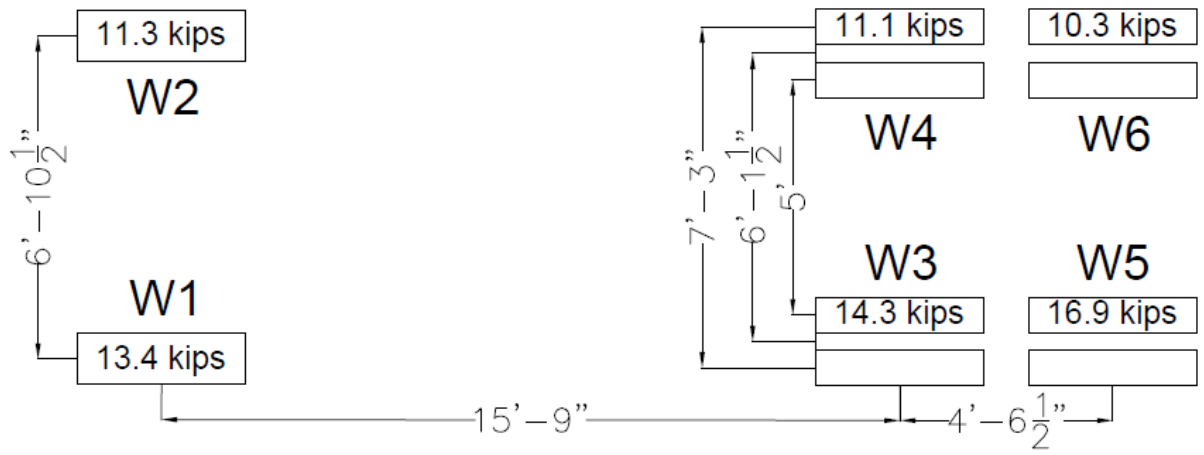

Figure 5:15: Truck Dimensions and Field Weight Measurements

CHAPTER 6: RESULTS AND ANALYSIS

6.1 INTRODUCTION

This chapter summarizes the results of the Fourteen Mile Bridge live load field test and compares the values to those computed by analytical models. LLDFs will be compared from the live load field test, the finite element analysis, and the AASHTO LRFD specification (2017).

6.2 COMPARISON OF RESULTS

This section presents the results determined from the live load field test and the finite element model. The raw data from the live load field test is included, and the subsequent LLDFs are discussed. Truck Run 1 will be the focus of this section. The full results for all truck runs with all relevant tables and charts are shown in Appendix A.

6.2.1 Live Load Field Test Results

The following section discusses the results collected from the live load field test of the Fourteen Mile Bridge. Data was collected with the BDI STS Wi-Fi Data Acquisition System, and data reduction was performed following the methods outlined in Section 4.4. The three strain readings across the bottom flange of each girder were averaged respectively to account for torsion; the strain readings from the webs were not used. Girder stresses at quarter span, where the gages were located, were computed and LLDFs were determined for comparison with the finite element model and AASHTO LRFD specifications. A sample of the raw strain data from Truck Run 1 is shown in Table 6.1.

Table 6.1: Measured Strain from Truck Run 1, Experimental

Truck Run 1, Measured Strain (Field)						
Panel Points		Average Bottom Flange Strain (με)				
x (ft)	x/L	G1	G2	G3	G4	G5
0	0	0	0	0	0	0
5.8	0.1	5.513	2.877	0.157	-1.270	-3.635
11.6	0.2	17.992	14.074	9.539	5.401	0.336
17.4	0.3	34.632	30.154	21.157	12.541	4.579
23.2	0.4	52.685	49.797	30.625	16.274	6.498
29	0.5	64.277	59.563	35.360	17.456	6.418
34.8	0.6	66.936	64.148	37.530	16.816	5.658
40.6	0.7	72.247	71.656	32.655	11.770	2.987
46.4	0.8	70.454	65.424	25.459	7.196	0.984
52.2	0.9	42.457	36.502	12.600	0.863	-2.546
58	1	0	0	0	0	0

6.2.1.1 Live Load Distribution Factors

The girder strains were used to calculate the LLDFs following the procedures discussed in Section 4.4.2. The multiple presence factor was applied following the AASHTO LRFD specifications. LLDFs were calculated for each panel point in the field test, but only the LLDFs at Panel Point 5 (0.5*L) were compared to the analytical model because that position would have the maximum effect of the truck on the girders. A sample of the calculated LLDFs for Truck Run 1 is presented in Table 6.2.

Table 6.2: Computed Live Load Distribution Factors from Truck Run 1, Experimental

Truck Run 1, Simplified Distribution Factors (Field)						
Panel Points		Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5
0	0	---	---	---	---	---
5.8	0.1	***1.514***	***0.790***	***0.043***	***-0.349***	***-0.998***
11.6	0.2	***0.380***	***0.297***	***0.201***	***0.114***	***0.007***
17.4	0.3	***0.336***	***0.293***	***0.205***	***0.122***	***0.044***
23.2	0.4	***0.338***	***0.319***	***0.196***	***0.104***	***0.042***
29	0.5	***0.351***	***0.325***	***0.193***	***0.095***	***0.035***
34.8	0.6	***0.350***	***0.336***	***0.196***	***0.088***	***0.030***
40.6	0.7	***0.378***	***0.375***	***0.171***	***0.062***	***0.016***
46.4	0.8	***0.416***	***0.386***	***0.150***	***0.042***	***0.006***
52.2	0.9	***0.472***	***0.406***	***0.140***	***0.010***	***-0.028***
58	1	---	---	---	---	---
Average		0.504	0.392	0.166	0.032	-0.094
MPF applied (1.2*PP5)		0.421	0.390	0.232	0.114	0.042
St. Dev.		0.381	0.154	0.052	0.147	0.340

6.2.2 Comparison of Analytical and Experimental Results

This section details the comparison between the results developed from the experimental data collected in the field and the analytical values determined from the finite element analysis. The deflected shape of the finite element model is shown in Figure 6.1 and additional information is provided in Section 4.3. Table 6.3 presents a comparison between the analytical and experimental LLDFs for each girder at Panel Point 5 for the single lane loaded condition of Truck

Run 1. Table 6.4 presents a similar comparison for the two lanes loaded condition of Truck Runs 1 and 4. Note the appropriate AASHTO multiple presence factor is applied in each scenario.

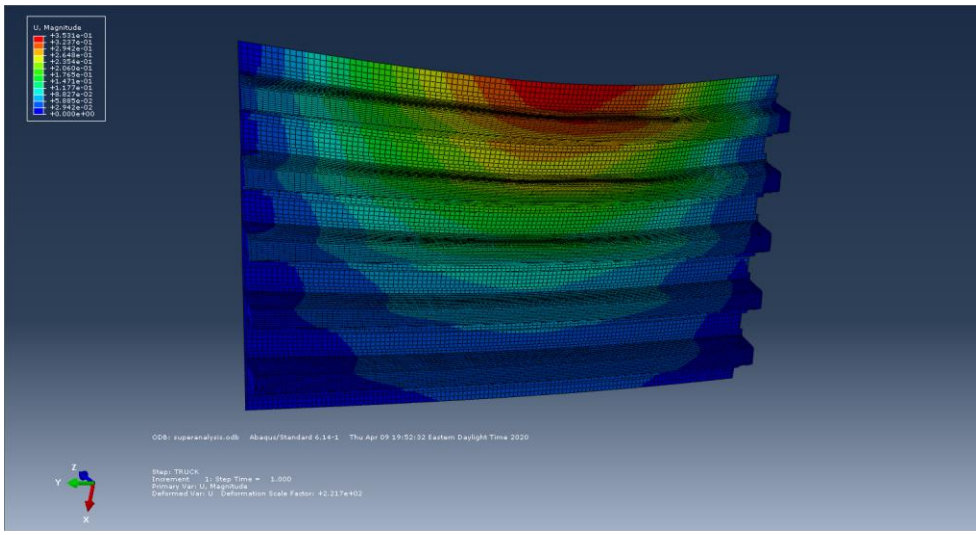

Figure 6:1: Deflected Shape of Finite Element Model, Truck Run 1, Panel Point 5

Table 6.3: Comparison of Field and FEA Live Load Distribution Factors, One Lane Loaded

Truck Run 1, Distribution Factors at Panel Point 5					
Girder	G1	G2	G3	G4	G5
Field Results	0.421	0.390	0.232	0.114	0.042
FEA Results	0.440	0.355	0.217	0.116	0.072

Table 6.4: Comparison of Field and FEA Live Load Distribution Factors, Two Lanes Loaded

Truck Run 1 & 4, Distribution Factors at Panel Point 5					
Girder	G1	G2	G3	G4	G5
Field Results	0.490	0.532	0.448	0.343	0.187
FEA Results	0.502	0.503	0.440	0.334	0.221

While the two methods produce similar results, some variance is still present. This may be partially due to varying boundary conditions. The Fourteen Mile Bridge utilized integral abutments as described in Section 3.2, which would yield similar results to a "fixed-fixed" end condition and a stiffer structure due to the decrease in rotation at the supports. There is not an adequate manner to model integral abutments in the finite element analysis, so simply supported ("hinge-roller") conditions were used in the analytical model. The results show the LLDFs are similar in both cases. Figure 6.2 presents a Q-Q plot reflecting the comparison of each girder's distribution factors at Panel Point 5. Note the R^2 value represents the correlation of the entire data set, both single and two-lane loaded scenarios.

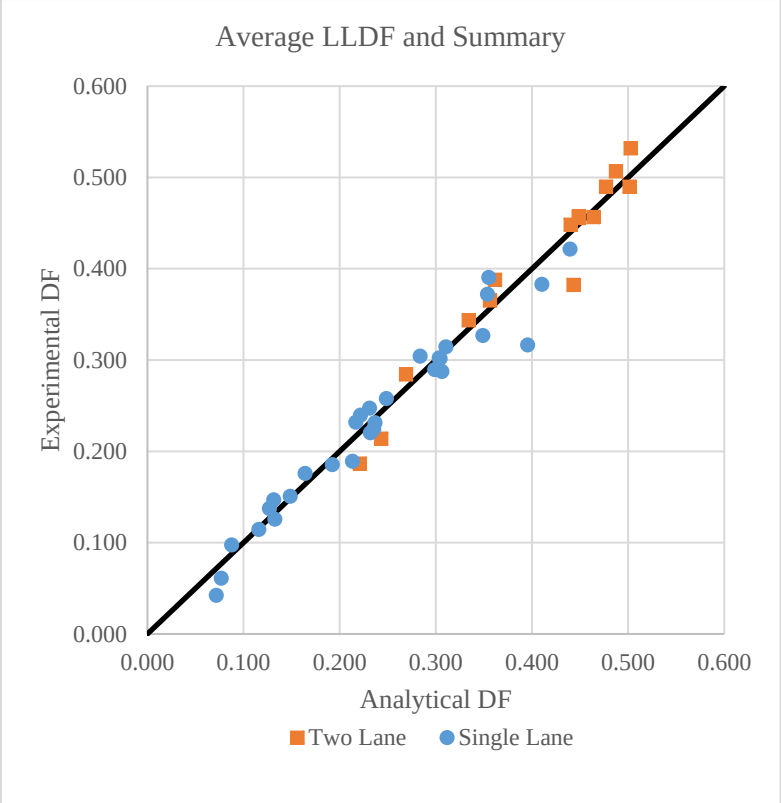

Figure 6:2: Comparison Between Analytical and Experimental Live Load Distribution Factors for Single and Two Lane Loaded Conditions

6.3 Comparison of Live Load Distribution Factors with AASHTO LRFD Specifications

This section will provide a comparison between LLDFs determined from the experimental data of the live load field test, the analytical data from the finite element model, and the relevant AASHTO LRFD specifications. LLDFs calculated with the expressions from the 2017 AASHTO LRFD specifications already take the multiple presence factors into consideration, so the comparison for each scenario will have the appropriate multiple presence factors applied. Calculations for the AASHTO LLDFs are presented in Section 4.4.2. Truck Run 1 will be used for comparison between the three methods for the single lane condition. Table 6.5 and Figure 6.3 provide a comparison of the three methods.

Table 6.5: Comparison of Field, FEA and AASHTO Live Load Distribution Factors, One Lane Loaded Truck Run 1

Truck Run 1, Distribution Factors at Panel Point 5					
Girder	G1	G2	G3	G4	G5
Field Results	0.421	0.390	0.232	0.114	0.042
FEA Results	0.440	0.355	0.217	0.116	0.072
AASHTO	0.603	0.603	0.603	0.603	0.603

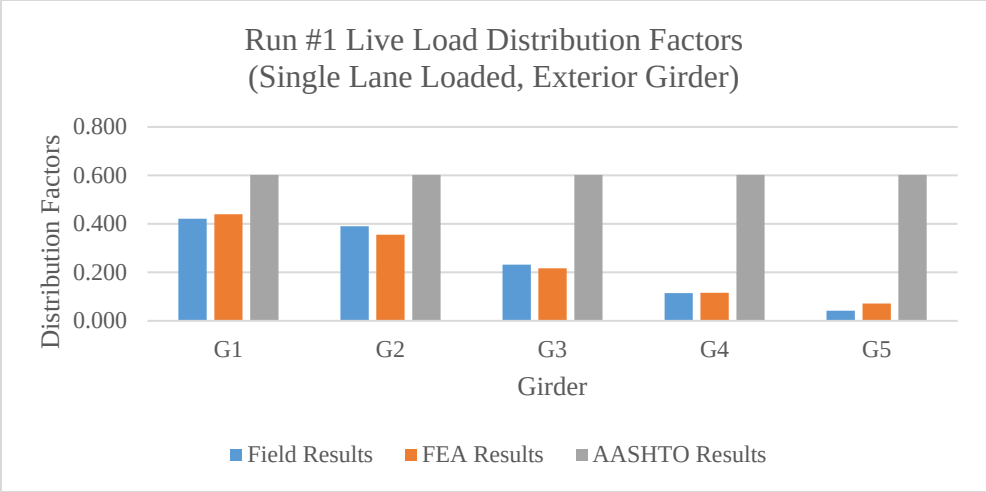

Figure 6:3: Comparison of Field, FEA and AASHTO Live Load Distribution Factors, One Lane Loaded Truck Run 1

LLDFs determined from the field test and the analytical model are similar; the AASHTO equations predict a much higher distribution factor for the single lane loaded condition. A comparison between the three methods for the two-lane loaded scenario is presented in Table 6.6 and Figure 6.4. Again, the LLDFs for both the analytical and experimental methods are close, but the AASHTO values are significantly higher. The discrepancy between AASHTO and the analytical and experimental methods is increased for girders further away from the placement of the load truck.

Table 6.6: Comparison of Field, FEA, and AASHTO Live Load Distribution Factors, Two Lanes Loaded Truck Run 1 and 4

Truck Run 1 & 4, Distribution Factors at Panel Point 5					
Girder	G1	G2	G3	G4	G5
Field Results	0.490	0.532	0.448	0.343	0.187
FEA Results	0.502	0.503	0.440	0.334	0.221
AASHTO	0.603	0.603	0.603	0.603	0.603

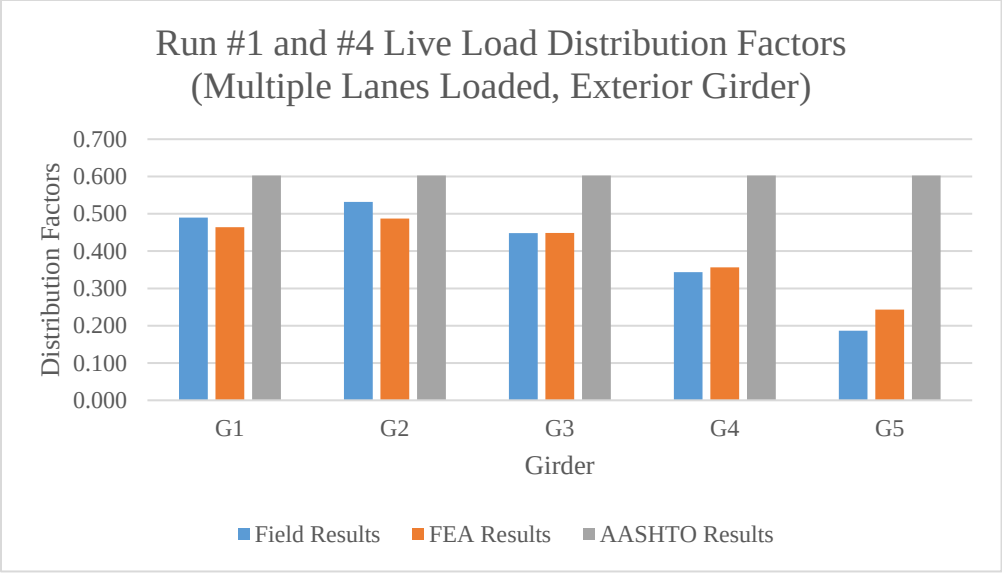

Figure 6:4: Comparison of Field, FEA, and AASHTO Live Load Distribution Factors, Two Lanes Loaded Truck Run 1 and 4

6.4 Conclusions

This chapter provided a summary of the results computed from the experimental data from the field test of the Fourteen Mile Bridge along with the finite element analysis performed. The data was used to calculate the LLDFs from the field test and the analytical model. The computed LLDFs were compared to the LLDFs calculated following the AASHTO LRFD specifications to assess the applicability of AASHTO in regards to press-brake-formed tub girders. The comparison showed minor differences in LLDFs between the finite element model and the experimental results, likely due to the differing boundary conditions. In all cases, the AASHTO LLDFs underpredicted the performance of the press-brake-formed tub girder and were more conservative than the experimental and analytical values. Therefore, AASHTO LLDFs may be safely used in the application of press-brake-formed steel tub girder bridges.

CHAPTER 7: QUALITATIVE ASSESSMENT OF BRACING EFFECTIVENESS AND TORSIONAL RESPONSE FOR NON-COMPOSITE TUB GIRDERS

7.1 INTRODUCTION

When press-brake-formed tub girders are used in conjunction with a precast reinforced concrete deck, the top flanges are fully supported during casting. In cases where a cast-in-place reinforced concrete deck is used, significant loading is placed on the top flanges. This can lead to instability issues as the open shape of the non-composite tub girder is susceptible to torsional effects. Bracing may be added either to the interior or exterior of the tub shape to control undesirable deflection. This chapter examines work performed by Kelly (2014) on non-composite behavior of press-brake-formed steel tub girders and evaluates different bracing scenarios from a qualitative view. Abaqus/CAE 6.14-1 (Dassault Systèmes, 2014) was utilized to create a finite element model for each scenario and a nonlinear analysis was performed. Program files from MATLAB (The Mathworks, Inc., 2020) were used to write the Abaqus input files, which are included in Appendix B of this report.

7.2 VERIFICATION WITH KELLY'S MODEL

7.2.1 Geometric Imperfections

A significant discrepancy in the critical load that led to buckling in the experiments performed by Kelly (2014) was attributed to geometric imperfections induced during the fabrication process of the press-brake-formed tub girder. Flange inclinations and web inclinations were recorded for each specimen (Figure 7.1 and 7.2).

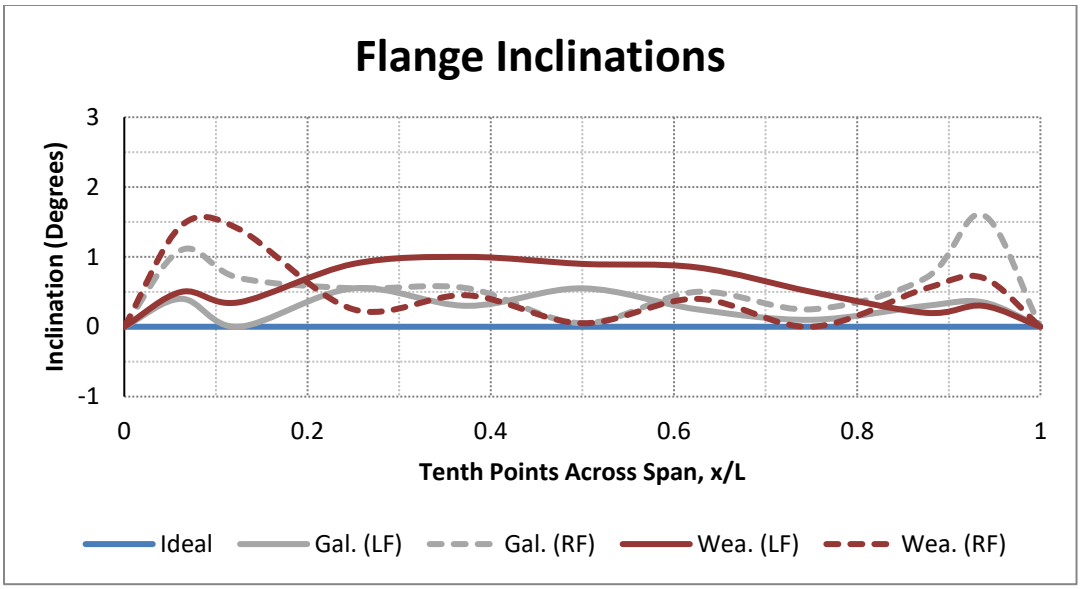

Figure 7:1: Flange Inclinations (Kelly, 2014)

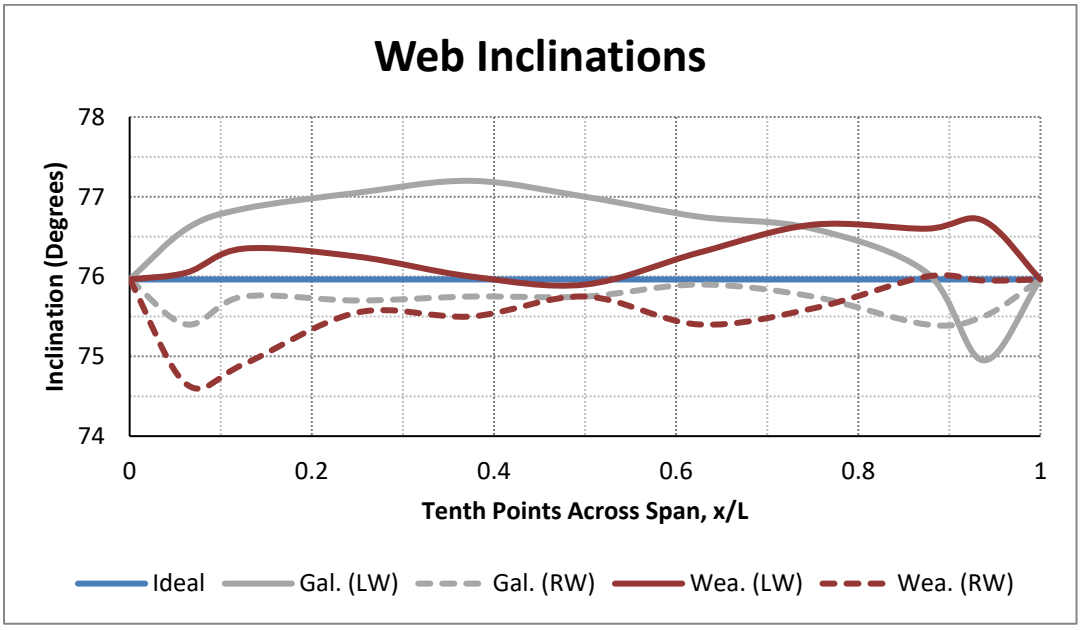

Figure 7:2: Web Inclinations (Kelly, 2014)

The finite element model was developed to induce imperfections onto the generated mesh based on user inputs. The geometric imperfections were separated into flange tilt, girder twist, and web out of flatness. Each of the geometric imperfections was modeled to follow a sine curve with the maximum amplitude and anchor points specified by the user to control the imperfection across the mesh. Figures 7.3 through 7.5 present an exaggerated view of the effect of flange tilt, girder twist, and web out of flatness, respectively.

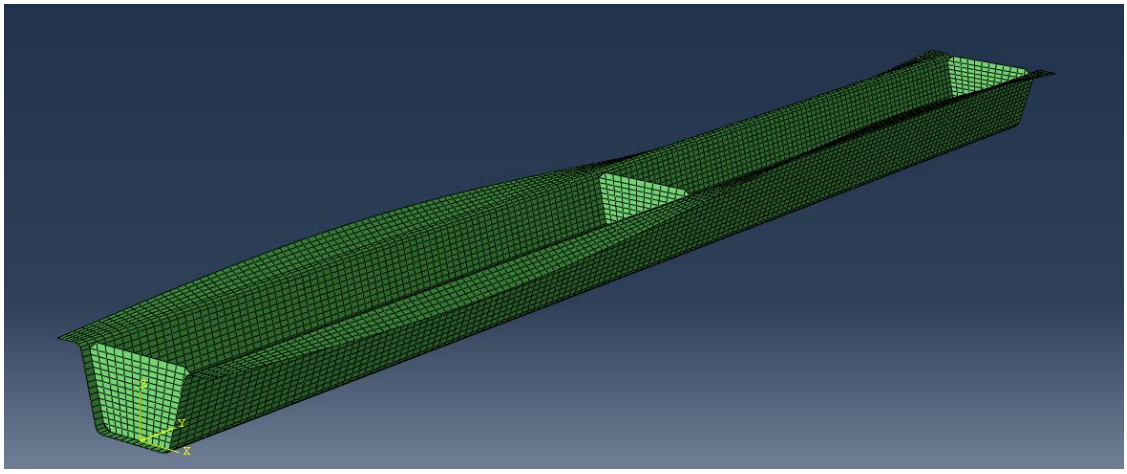

Figure 7:3: Tub Girder Modeled with Flange Tilt

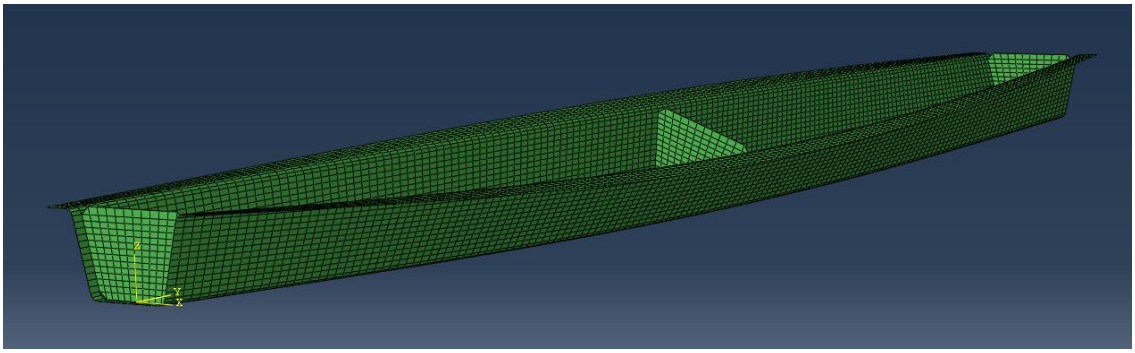

Figure 7:4: Tub Girder Modeled with Girder Twist

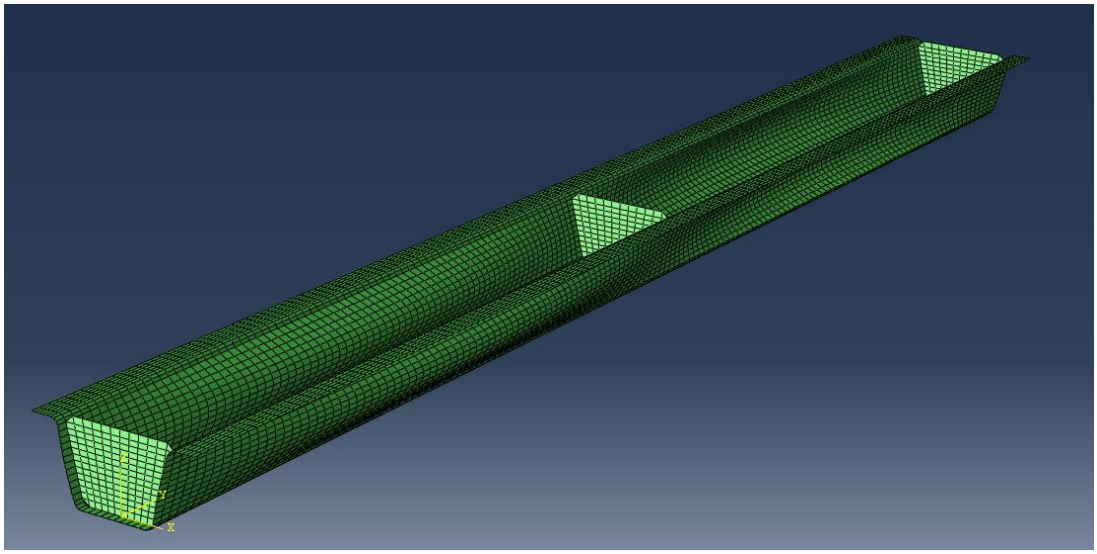

Figure 7:5: Tub Girder Modeled with Web Out of Flatness

To best fit the geometric imperfections recorded by Kelly (2014), only the flange tilt and girder twist were considered. Using the recorded data previously mentioned in Figures 7.1 and 7.2, the amplitude for each imperfection was determined. The peak values were input as 1° of flange tilt clockwise and 1° of girder twist clockwise. For both imperfections, the end supports were selected as the anchor points to best fit the model.

7.2.2 Material Modeling

To capture the behavior of a nonlinear analysis, steel material in the finite element model was modeled using an elastic-plastic constitutive law following work by Michaelson (2014) and Kelly (2014). A multilinear relationship (Galindez, 2009) was used to represent the stress-strain behavior of material modeling (Figure 7.6 and Table 7.1). The plastic material properties were a function of the true stress and strain, and these were input into the Abaqus input file.

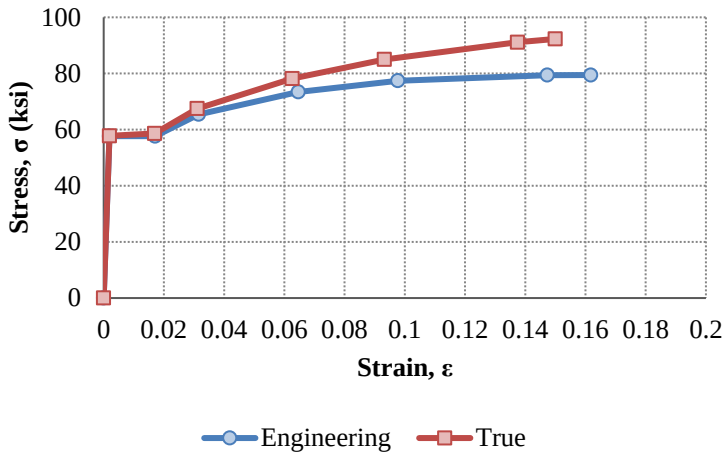

Figure 7:6: Multi-linear Stress-Strain Curve

Table 7.1: Expressions for Computing Steel Stress-Strain Behavior (Galindez, 2009)

Point	Strain	Stress
1	$\varepsilon_1 = \frac{\sigma_y}{E}$	$\sigma_1 = \sigma_y$
2	$\varepsilon_2 = \varepsilon_{st}$	$\sigma_2 = \sigma_y$
3	$\varepsilon_3 = \frac{1}{10}(\varepsilon_u - \varepsilon_{st}) + \varepsilon_{st}$	$\sigma_3 = \frac{E_{st}}{10}(\varepsilon_u - \varepsilon_{st}) + \sigma_y$
4	$\varepsilon_4 = \frac{2}{7}(\varepsilon_6 - \varepsilon_3) + \varepsilon_3$	$\sigma_4 = \frac{4}{7}(\sigma_6 - \sigma_3) + \sigma_3$
5	$\varepsilon_5 = \frac{2}{7}(\varepsilon_6 - \varepsilon_3) + \varepsilon_4$	$\sigma_5 = \frac{2}{7}(\sigma_6 - \sigma_3) + \sigma_4$
6	$\varepsilon_6 = \varepsilon_u - \frac{1}{10}(\varepsilon_u - \varepsilon_{st})$	$\sigma_6 = \left(\frac{\sigma_y}{\sigma_{0.2\%}}\right)\sigma_u - \frac{100}{E_{st}}(\varepsilon_u - \varepsilon_{st})$
7	$\varepsilon_7 = \varepsilon_u$	$\sigma_7 = \left(\frac{\sigma_y}{\sigma_{0.2\%}}\right)\sigma_u$

7.2.3 Element Selection

Abaqus (2014) provides complete geometric modeling capabilities with a variety of available element types. General shell elements with reduced integration (S4R) are used for modeling the steel girders in this study. As shown by several researchers (Barth, 1996; Yang, 2004; Roberts, 2004; Righman, 2005), S4R shell elements are very accurate in modeling the physical behavior of non-composite steel plate girders. These 4-node general-purpose elements are intended to provide accurate solutions for both thin and thick shells, using classical (Kirchoff) shell theory when appropriate for thin shells and (Mindlin) shell theory as the thickness increases.

These elements allow for finite membrane strains and rotations of the shell, change in shell thickness as a function of the membrane strain, and transverse shear deformation. Therefore, they are suitable for large-strain analysis involving inelastic deformation of materials. The S4R element is a first-order element having only one integration point used to form the element stiffness matrix. S4R elements offer many advantages over traditional shell elements, including strains and stresses computed at the integration points, providing optimal accuracy, and fewer integration points, resulting in reduced computing time and storage requirements.

The primary disadvantage of using reduced integration is that deformation modes which cause no strain at the integration points may develop. This may lead to inaccurate results if these zero-energy modes propagate through the structure in a phenomenon commonly known as hourglassing. However, this can be prevented by the user by introducing a small artificial stiffness associated with zero-energy deformation modes using the *SECTION CONTROLS command in an Abaqus input file (Kelly 2014; Michaelson, 2014).

7.2.4 Riks Loading Algorithm

The girders studied in this work are analyzed using the modified Riks algorithm available in Abaqus (2014). This solution method captures the nonlinear load deflection response of the finite element model at and beyond maximum loading. The modified Riks method is capable of obtaining a complete nonlinear solution and giving information on girder behavior in both loading and unloading regions (Yang, 2004).

It is assumed the loading is proportional and the response is smooth (no sudden bifurcations). Furthermore, this method uses the load magnitude as an additional unknown and solves simultaneously for loads and displacements. Because the progress of the solution is independent of the load increment, Abaqus uses the "arc length" to control the increment size. The arc length is the distance along the static equilibrium path in the load-displacement space. This value is initially proved by the user and later adjusted by the Abaqus automatic load increment algorithm, which is based on convergence rate.

The essence of this method is that the solution is viewed as the discovery of a single equilibrium path in a space defined by the nodal variables and loading parameter. The solution is found during each increment by moving a given distance along a tangent to the current solution point and searching for equilibrium in the plane, that not only passes through the point, but also is orthogonal to the same tangent line (Yang, 2004). The total path length is determined by the load magnitudes the user specifies. The user also determines the number of increments (Kelly, 2014).

7.2.5 Comparison with Kelly's Model

Once the finite element model was developed, an evaluation of an unbraced girder was performed as a benchmark with the experimental and analytical data that Kelly (2014) had recorded. A plot of the comparisons between the two analyses is presented in Figure 7.7. Note that little discrepancy exists between the two models; when full load is applied, approximately a 0.05" difference between the vertical displacement of each model exists. Therefore, this developed finite element model is suitable for use in comparison between bracing options and an unbraced girder.

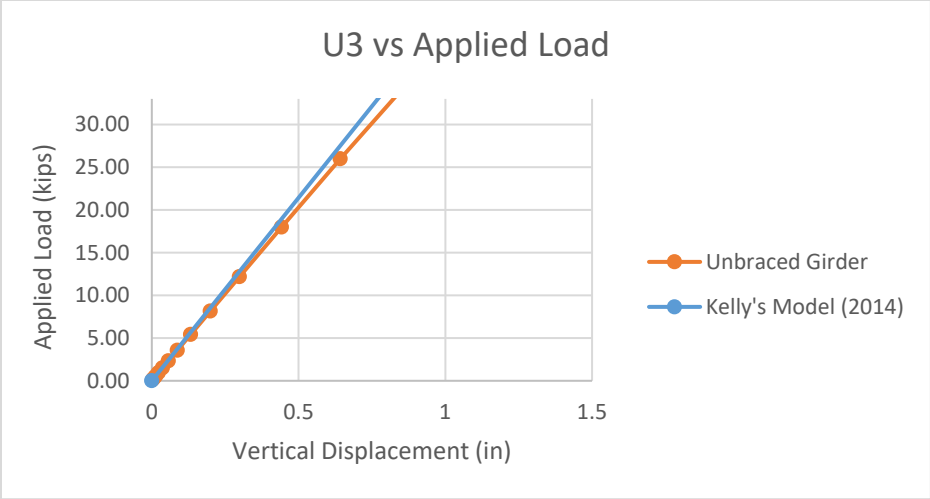

Figure 7:7: Vertical Deflection at Midspan for Unbraced Girder and Kelly (2014)

7.3 BRACING SCENARIOS

7.3.1 Internal Bracing Scenarios

Bracing schemes were examined for both the interior and exterior of the girder. Braces were modeled on a press-brake-formed tub girder constructed from an 84”x$^{7}/_{16}$” plate. Four different bracing scenarios were implemented, each using L4x4x$^{5}/_{8}$” angle for the brace members. Each transverse brace was spaced at three times the depth of the girder from one another, or 69”, in the case of the modeled girder. A visual representation of the four internal bracing scenarios is provided in Figure 7.8.

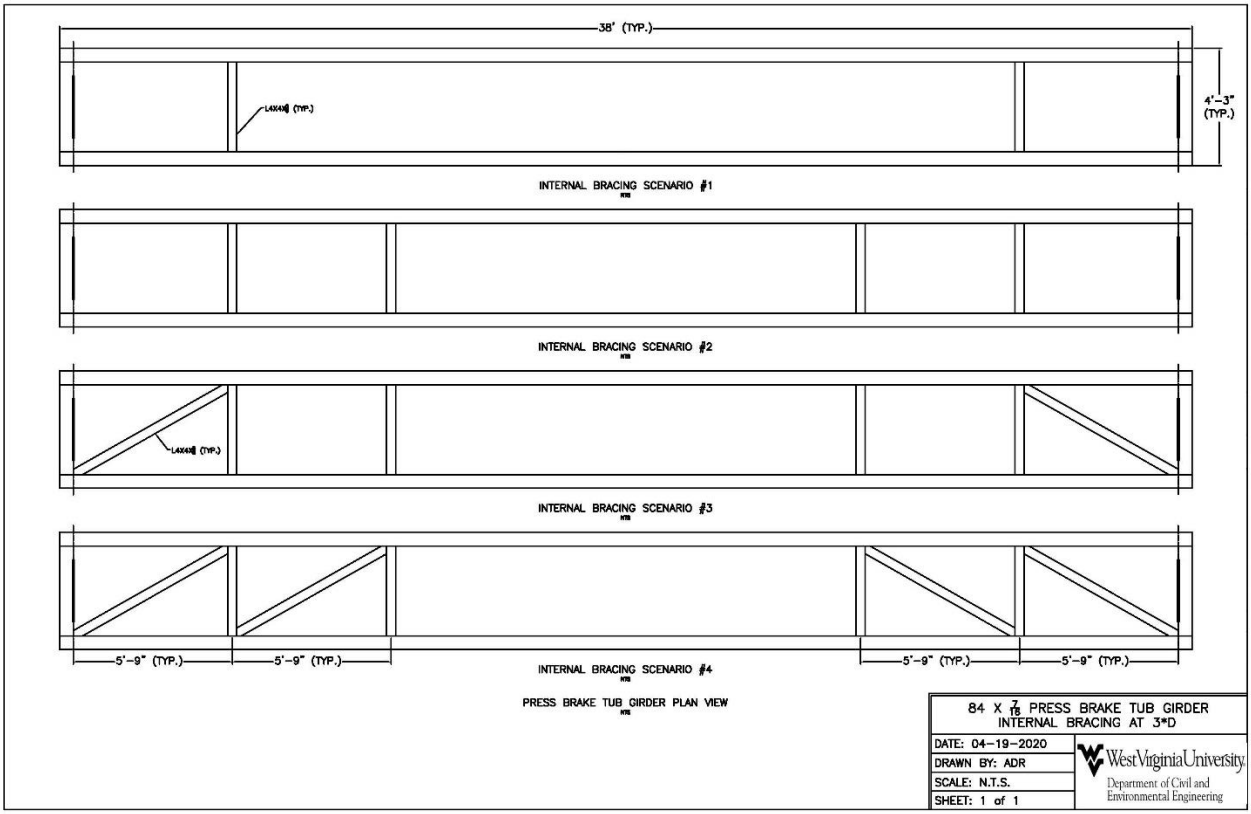

Figure 7:8: Internal Bracing Scenarios

7.3.2 External Bracing Scenarios

In addition to the internal bracing scenarios, three external bracing options were modeled. A press-brake-formed tub girder constructed from 84"x$^{7}/_{16}$" plate was used for each external bracing scenario, so adequate comparisons could be made. External braces were placed at midspan for scenario 1, third points for scenario 2, and quarter points for scenario 3. External bracing was modeled in Abaqus/CAE through the use of boundary conditions to provide lateral support at the locations of interest. A visual representation of the three external bracing scenarios is provided in Figure 7.9.

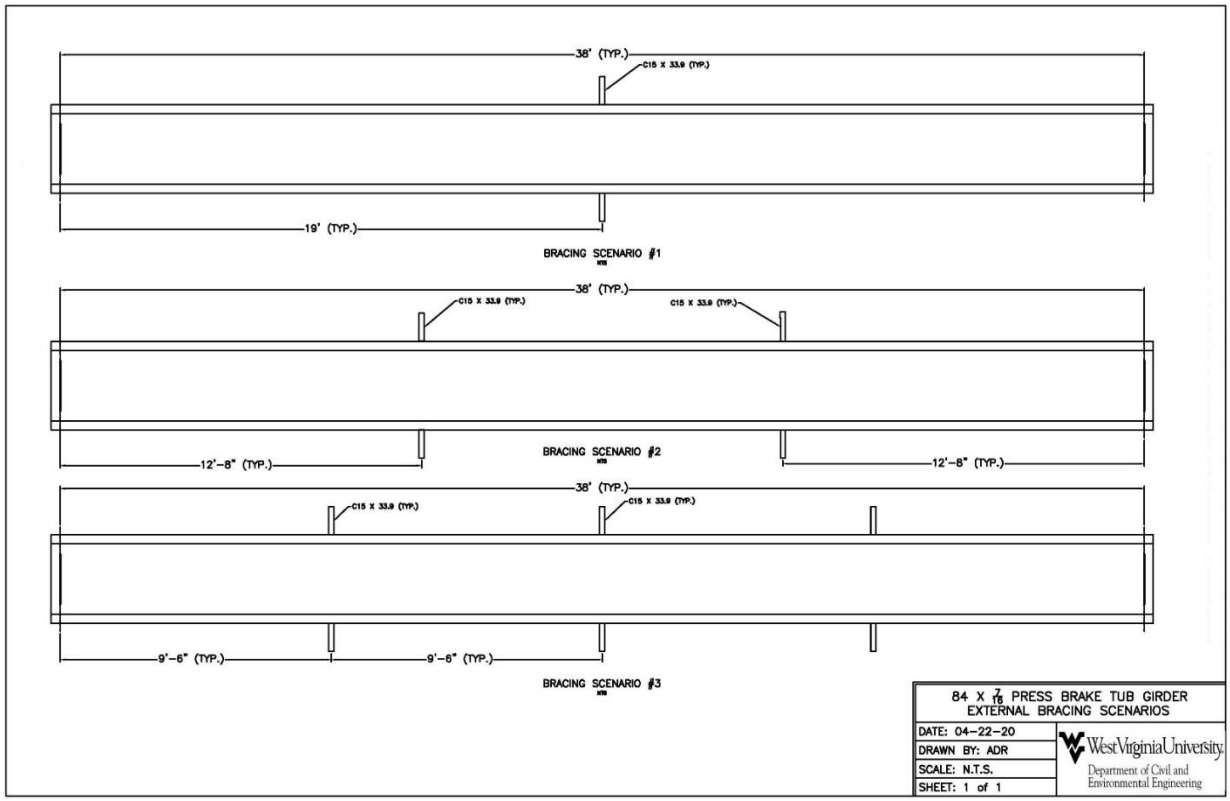

Figure 7:9: External Bracing Scenarios

7.4 RESULTS OF FINITE ELEMENT ANALYSIS

This section discusses the results achieved as a function of the finite element analysis. Both the set of internal braces and external braces were compared to the unbraced girder as a benchmark to assess resistance to torsion. Static Riks loading was applied to the structure and plots were developed from the load proportionality factors available in the Abaqus/CAE .dat file. For the purposes of these plots, U1 refers to the lateral displacement and U3 refers to the vertical displacement. The plots stop at 33 kips of applied load because this was the critical load to induce buckling in the unbraced girder in Kelly's experiment (2014).

7.4.1 Comparison of Internal Bracing Scenarios

The first analyses were performed on the internal bracing options. L4x4x$^{5}/_{8}$" angle was used for each interior bracing member and each member was modeled as a beam element in the finite element model. From the load proportionality factors, plots of U1 and U3 for each load increment were produced. Figure 7.10 shows the lateral displacement for each of the internal bracing options and Figure 7.11 shows the vertical displacement for each of the internal bracing options. It should be noted that while internal bracing has little effect on the vertical displacement at midspan, lateral displacement is reduced. Specifically, in the cases of internal bracing options where a diagonal brace is used, the decrease in lateral displacement is significant.

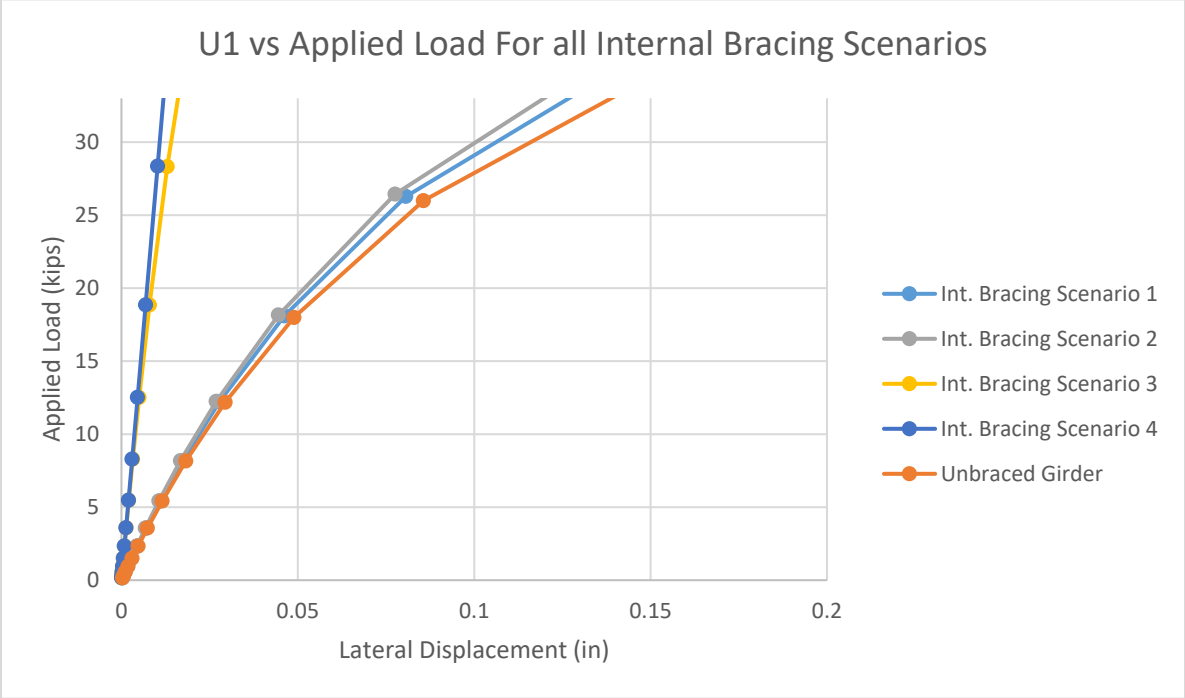

Figure 7:10: Lateral Displacement Comparison for Internal Bracing Scenarios

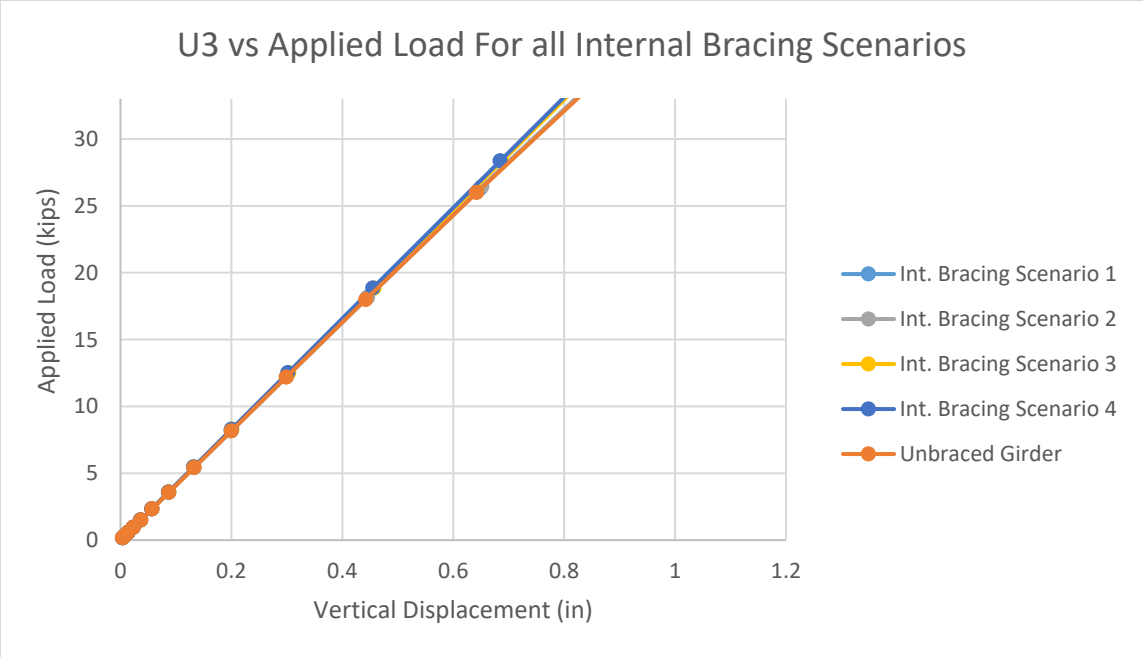

Figure 7:11: Lateral Displacement Comparison for Internal Bracing Scenarios

7.4.2 Comparison of External Bracing Scenarios

After the internal bracing analyses were completed, analyses were performed on the external bracing options. Lateral support was added at points of interest through boundary conditions at the web to resist lateral movement. From the load proportionality factors, plots of U1 and U3 for each load increment were produced. Figure 7.12 shows the lateral displacement for each of the external bracing options and Figure 7.13 shows the vertical displacement for each of the external bracing options. Similar to the internal bracing, external bracing has little effect on the vertical displacement at midspan. However, all three exterior bracing options have comparable resistance to lateral displacement, which differs significantly from the unbraced girder.

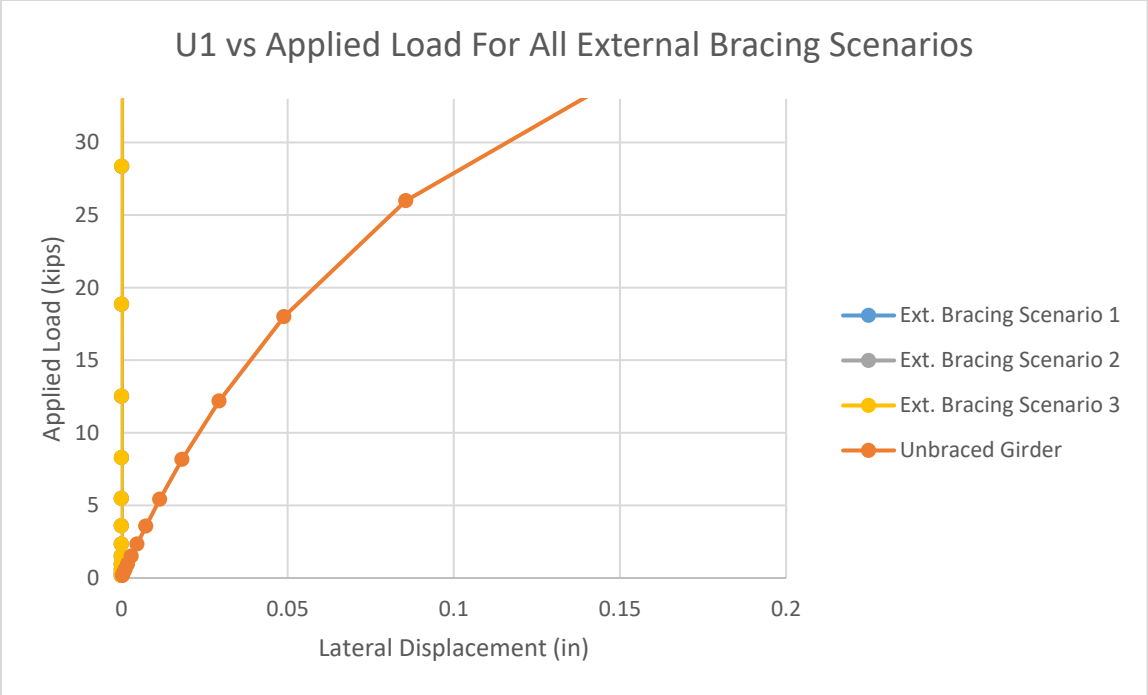

Figure 7:12: Lateral Displacement Comparison for External Bracing Scenarios

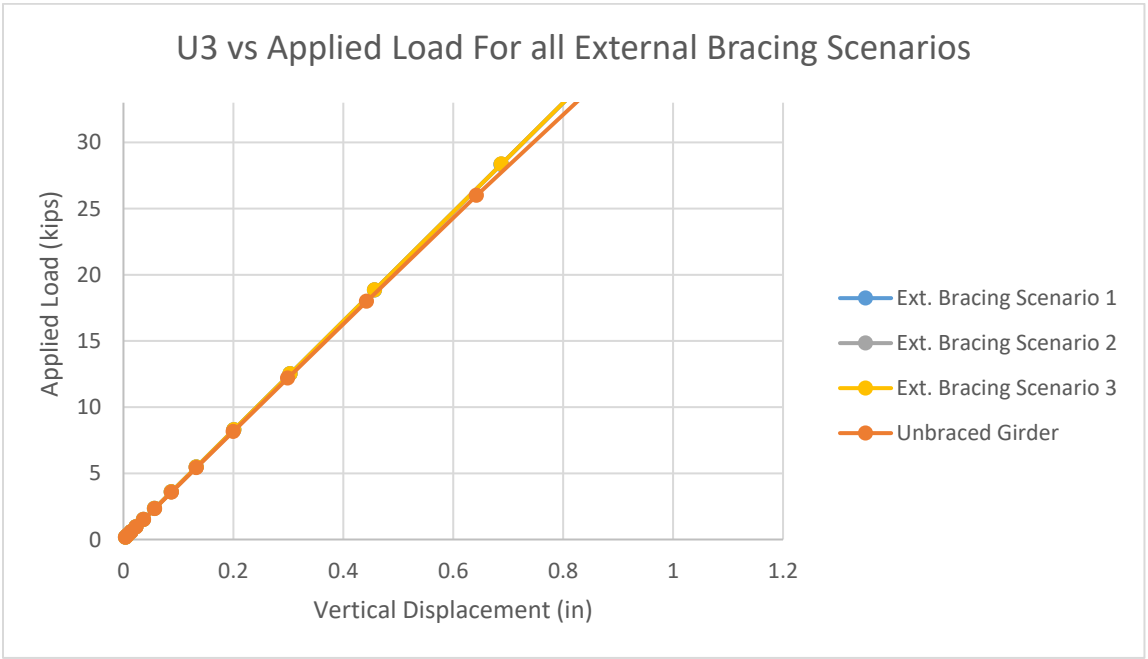

Figure 7:13: Vertical Displacement Comparison for External Bracing Scenarios

7.5 CONCLUSIONS

When employing a cast-in-place reinforced concrete deck in conjunction with press-brake-formed steel tub girders, it is important to consider the stability of the non-composite section under the effect of construction loading from placement of the wet concrete. Significant torsional amplification is possible, and the non-composite girder must have adequate lateral support to resist rotation and buckling. From the analyses ran, it was observed that the effect of diagonal struts for internal braces lead to a greater reduction in lateral displacement than the use of transverse braces alone. All external bracing options performed similar and each provided a significant reduction in lateral displacement. Further work is necessary to extend this initial qualitative modeling into sound reasoning for best practices for maintaining stability of the non-composite girder.

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS

8.1 PROJECT SUMMARY AND CONCLUSIONS

The scope of this report was to evaluate the field performance of a modular press-brake-formed steel tub girder topped with a precast reinforced concrete deck in an application including skew and significant superelevation and compare that to analytical testing through finite element analysis and expected performance determined by AASHTO LRFD specifications. Bottom flange strain was recorded, and the LLDFs were determined for each method. The LLDFs determined with the experimental data and the analytical results showed little discrepancy, but both were lower than the LLDFs computed per AASHTO LRFD specifications. However, AASHTO does not specify a different expression for the calculation of LLDFs in regards to interior and exterior girders or the loading of single or multiple lanes. In either case, the AASHTO LLDFs were conservative, and are therefore safe to use in the design of press-brake-formed-tub girder systems.

8.2 RECOMMENDATIONS FOR CONTINUED WORK

The following are recommended for future work in this area:

- Current manufacturing methods limit the span length of press-brake-formed steel tub girders to 80’-0”. Research could be performed to determine methods to increase span length and to determine the economic feasibility of longer spans.
- In cases where several spans are used, preferred detailing of the pier region should be examined to understand how the girders behave in the negative bending regions.
- Further work can investigate the ideal detailing and best practices for non-composite bracing of girders.
- Additional work could be performed to further define the lateral torsional buckling behavior of the press-brake-formed tub girders as a function of unbraced length.

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APPENDIX A: RESULTS FOR ALL TRUCK RUNS

This appendix includes the following: results, tables, and graphs, generated from both the live load field test and finite element analysis of the Fourteen Mile Bridge. The data presented is for all girders, for all load runs.

The following is the order that the data is presented:

- Live Load Distribution Factors (LLDFs)
    - Live Load Test Data
    - Finite Element Analysis
    - Results Comparison: Live Load Test Data vs. Finite Element Analysis
    - Results Comparison: Live Load, FEA, & AASHTO LRFD

A.1 LIVE LOAD DISTRIBUTION FACTORS

A.1.1 Live Load Field Test Results

Truck Run 1, Simplified Distribution Factors (Field)											
Panel Points		Averages (με)					Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5	G1	G2	G3	G4	G5
0	0	0	0	0	0	0	---	---	---	---	---
5.8	0.1	5.513	2.877	0.157	-1.270	-3.635	***1.514***	***0.790***	***0.043***	***-0.349***	***-0.998***
11.6	0.2	17.992	14.074	9.539	5.401	0.336	***0.380***	***0.297***	***0.201***	***0.114***	***0.007***
17.4	0.3	34.632	30.154	21.157	12.541	4.579	***0.336***	***0.293***	***0.205***	***0.122***	***0.044***
23.2	0.4	52.685	49.797	30.625	16.274	6.498	***0.338***	***0.319***	***0.196***	***0.104***	***0.042***
29	0.5	64.277	59.563	35.360	17.456	6.418	***0.351***	***0.325***	***0.193***	***0.095***	***0.035***
34.8	0.6	66.936	64.148	37.530	16.816	5.658	***0.350***	***0.336***	***0.196***	***0.088***	***0.030***
40.6	0.7	72.247	71.656	32.655	11.770	2.987	***0.378***	***0.375***	***0.171***	***0.062***	***0.016***
46.4	0.8	70.454	65.424	25.459	7.196	0.984	***0.416***	***0.386***	***0.150***	***0.042***	***0.006***
52.2	0.9	42.457	36.502	12.600	0.863	-2.546	***0.472***	***0.406***	***0.140***	***0.010***	***-0.028***
58	1	0	0	0	0	0	---	---	---	---	---
					DF @ 0.5L (PP 5)		0.351	0.325	0.193	0.095	0.035
					MPF Applied		0.421	0.390	0.232	0.114	0.042
					St. Dev.		0.381	0.154	0.052	0.147	0.340

Truck Run 2, Simplified Distribution Factors (Field)											
Panel Points		Averages (με)					Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5	G1	G2	G3	G4	G5
0	0	0	0	0	0	0	---	---	---	---	---
5.8	0.1	8.505	6.033	4.168	3.289	0.563	***0.377***	***0.267***	***0.185***	***0.146***	***0.025***
11.6	0.2	22.117	17.984	14.678	11.505	5.427	***0.308***	***0.251***	***0.205***	***0.160***	***0.076***
17.4	0.3	36.747	32.747	26.117	18.402	9.268	***0.298***	***0.266***	***0.212***	***0.149***	***0.075***
23.2	0.4	51.932	50.893	35.910	21.822	10.490	***0.304***	***0.298***	***0.210***	***0.128***	***0.061***
29	0.5	63.244	61.446	40.824	22.688	10.049	***0.319***	***0.310***	***0.206***	***0.114***	***0.051***
34.8	0.6	64.947	64.901	42.363	21.576	9.032	***0.320***	***0.320***	***0.209***	***0.106***	***0.045***
40.6	0.7	68.440	73.760	39.378	16.644	6.491	***0.334***	***0.360***	***0.192***	***0.081***	***0.032***
46.4	0.8	65.714	68.033	31.426	11.322	3.890	***0.364***	***0.377***	***0.174***	***0.063***	***0.022***
52.2	0.9	40.242	37.619	16.690	4.385	0.289	***0.406***	***0.379***	***0.168***	***0.044***	***0.003***
58	1	0	0	0	0	0	---	---	---	---	---
					DF @ 0.5L (PP 5)		0.319	0.310	0.206	0.114	0.051
					MPF Applied		0.383	0.372	0.247	0.137	0.061
					St. Dev.		0.037	0.049	0.016	0.040	0.025

Truck Run 3, Simplified Distribution Factors (Field)											
Panel Points		Averages (με)					Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5	G1	G2	G3	G4	53
0	0	0	0	0	0	0	---	---	---	---	---
5.8	0.1	10.424	8.054	6.671	8.875	7.108	***0.253***	***0.196***	***0.162***	***0.216***	***0.173***
11.6	0.2	19.645	16.209	14.286	17.690	13.036	***0.243***	***0.200***	***0.177***	***0.219***	***0.161***
17.4	0.3	26.596	25.038	24.290	26.307	16.946	***0.223***	***0.210***	***0.204***	***0.221***	***0.142***
23.2	0.4	32.323	37.612	39.361	34.264	19.479	***0.198***	***0.231***	***0.241***	***0.210***	***0.119***
29	0.5	38.505	50.209	50.322	39.875	20.914	***0.193***	***0.251***	***0.252***	***0.200***	***0.105***
34.8	0.6	40.285	53.099	54.568	41.034	19.320	***0.193***	***0.255***	***0.262***	***0.197***	***0.093***
40.6	0.7	34.296	58.382	63.334	36.887	14.382	***0.165***	***0.282***	***0.306***	***0.178***	***0.069***
46.4	0.8	26.985	56.118	57.170	29.157	9.991	***0.150***	***0.313***	***0.319***	***0.163***	***0.056***
52.2	0.9	17.820	33.427	31.944	18.003	5.581	***0.167***	***0.313***	***0.299***	***0.169***	***0.052***
58	1	0	0	0	0	0	---	---	---	---	---
					DF @ 0.5L (PP 5)		0.193	0.251	0.252	0.200	0.105
					MPF Applied		0.231	0.302	0.302	0.239	0.126
					St. Dev.		0.035	0.045	0.057	0.022	0.045

Truck Run 4, Simplified Distribution Factors (Field)											
Panel Points		Averages (με)					Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5	G1	G2	G3	G4	G5
0	0	0	0	0	0	0	---	---	---	---	---
5.8	0.1	7.419	6.902	4.758	6.622	7.862	***2.038***	***1.896***	***1.307***	***1.819***	***2.159***
11.6	0.2	14.049	14.062	11.014	14.329	15.004	***0.297***	***0.297***	***0.233***	***0.303***	***0.317***
17.4	0.3	19.815	22.314	20.415	24.759	21.447	***0.192***	***0.217***	***0.198***	***0.240***	***0.208***
23.2	0.4	24.036	31.182	35.360	38.414	25.988	***0.154***	***0.200***	***0.227***	***0.246***	***0.167***
29	0.5	26.808	39.315	47.951	46.401	28.264	***0.146***	***0.215***	***0.262***	***0.253***	***0.154***
34.8	0.6	26.434	41.748	49.072	47.439	26.622	***0.138***	***0.218***	***0.257***	***0.248***	***0.139***
40.6	0.7	21.341	39.722	58.573	49.935	20.828	***0.112***	***0.208***	***0.306***	***0.261***	***0.109***
46.4	0.8	14.110	33.535	57.812	42.109	14.042	***0.083***	***0.198***	***0.341***	***0.248***	***0.083***
52.2	0.9	6.266	19.831	28.734	21.032	5.861	***0.070***	***0.221***	***0.320***	***0.234***	***0.065***
58	1	0	0	0	0	0	---	---	---	---	---
					DF @ 0.5L (PP 5)		0.146	0.215	0.262	0.253	0.154
					MPF Applied		0.176	0.258	0.314	0.304	0.185
					St. Dev.		0.633	0.559	0.349	0.522	0.672

Truck Run 5, Simplified Distribution Factors (Field)											
Panel Points		Averages (με)					Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5	G1	G2	G3	G4	G5
0	0	0	0	0	0	0	---	---	---	---	---
5.8	0.1	6.770	6.963	5.457	6.900	8.822	***0.300***	***0.309***	***0.242***	***0.306***	***0.391***
11.6	0.2	13.043	13.785	11.549	14.346	16.233	***0.182***	***0.192***	***0.161***	***0.200***	***0.226***
17.4	0.3	18.791	22.109	21.456	25.369	23.667	***0.152***	***0.179***	***0.174***	***0.206***	***0.192***
23.2	0.4	22.567	29.653	35.506	39.254	28.584	***0.132***	***0.173***	***0.208***	***0.229***	***0.167***
29	0.5	24.876	36.364	47.468	47.821	31.227	***0.125***	***0.183***	***0.239***	***0.241***	***0.158***
34.8	0.6	23.978	38.349	48.333	49.065	29.739	***0.118***	***0.189***	***0.238***	***0.242***	***0.147***
40.6	0.7	19.898	36.238	57.930	54.053	24.878	***0.097***	***0.177***	***0.283***	***0.264***	***0.122***
46.4	0.8	14.699	31.272	58.569	48.251	19.207	***0.081***	***0.173***	***0.325***	***0.267***	***0.106***
52.2	0.9	8.868	20.593	32.454	26.639	11.212	***0.089***	***0.208***	***0.327***	***0.268***	***0.113***
58	1	0	0	0	0	0	---	---	---	---	---
					DF @ 0.5L (PP 5)		0.125	0.183	0.239	0.241	0.158
					MPF Applied		0.151	0.220	0.287	0.289	0.189
					St. Dev.		0.067	0.043	0.059	0.033	0.088

Truck Run 6, Simplified Distribution Factors (Field)											
Panel Points		Averages (με)					Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5	G1	G2	G3	G4	G5
0	0	0	0	0	0	0	---	---	---	---	---
5.8	0.1	4.692	6.266	7.309	7.581	10.082	***0.114***	***0.152***	***0.178***	***0.184***	***0.245***
11.6	0.2	9.066	12.474	14.712	15.602	20.162	***0.112***	***0.154***	***0.182***	***0.193***	***0.249***
17.4	0.3	12.042	17.365	22.484	26.079	31.446	***0.101***	***0.146***	***0.189***	***0.219***	***0.264***
23.2	0.4	14.500	21.298	30.378	41.059	44.683	***0.089***	***0.131***	***0.186***	***0.252***	***0.274***
29	0.5	16.202	24.443	37.352	54.404	52.674	***0.081***	***0.122***	***0.187***	***0.272***	***0.264***
34.8	0.6	16.196	24.853	40.422	57.132	54.459	***0.078***	***0.119***	***0.194***	***0.274***	***0.261***
40.6	0.7	11.886	19.162	36.254	63.694	54.936	***0.057***	***0.092***	***0.175***	***0.307***	***0.265***
46.4	0.8	7.708	12.997	29.689	62.683	47.209	***0.043***	***0.072***	***0.165***	***0.349***	***0.263***
52.2	0.9	5.491	8.489	20.109	37.463	28.538	***0.051***	***0.079***	***0.188***	***0.351***	***0.267***
58	1	0	0	0	0	0	---	---	---	---	---
					DF @ 0.5L (PP 5)		0.081	0.122	0.187	0.272	0.264
					MPF Applied		0.097	0.147	0.224	0.327	0.316
					St. Dev.		0.026	0.031	0.009	0.062	0.009

Truck Runs 1 and 4, Simplified Distribution Factors (Field)											
Panel Points		Averages (με)					Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5	G1	G2	G3	G4	G5
0	0	0	0	0	0	0	---	---	---	---	---
5.8	0.1	12.932	9.779	4.914	5.352	4.227	***0.348***	***0.263***	***0.132***	***0.144***	***0.114***
11.6	0.2	32.041	28.135	20.554	19.731	15.341	***0.277***	***0.243***	***0.177***	***0.170***	***0.132***
17.4	0.3	54.448	52.468	41.572	37.300	26.026	***0.257***	***0.248***	***0.196***	***0.176***	***0.123***
23.2	0.4	76.721	80.979	65.985	54.688	32.486	***0.247***	***0.261***	***0.212***	***0.176***	***0.105***
29	0.5	91.085	98.877	83.310	63.857	34.681	***0.245***	***0.266***	***0.224***	***0.172***	***0.093***
34.8	0.6	93.370	105.896	86.602	64.255	32.280	***0.244***	***0.277***	***0.226***	***0.168***	***0.084***
40.6	0.7	93.589	111.379	91.229	61.705	23.815	***0.245***	***0.292***	***0.239***	***0.162***	***0.062***
46.4	0.8	84.565	98.959	83.272	49.304	15.026	***0.255***	***0.299***	***0.251***	***0.149***	***0.045***
52.2	0.9	48.723	56.333	41.333	21.895	3.316	***0.284***	***0.328***	***0.241***	***0.128***	***0.019***
58	1	0	0	0	0	0	---	---	---	---	---
					DF @ 0.5L (PP 5)		0.245	0.266	0.224	0.172	0.093
					MPF Applied		0.490	0.532	0.448	0.343	0.187
					St. Dev.		0.034	0.027	0.038	0.017	0.038

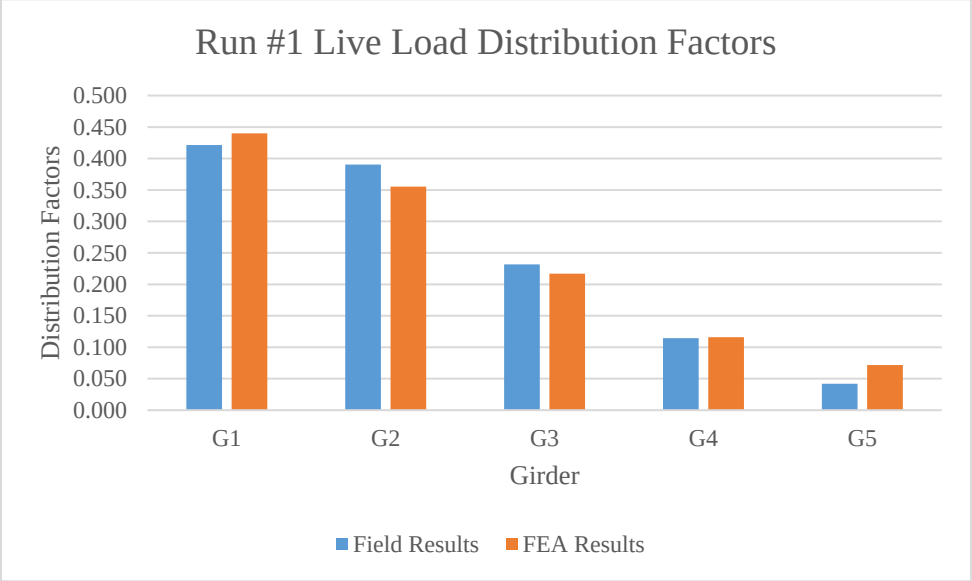
Truck Runs 2 and 5, Simplified Distribution Factors (Field)											
Panel Points		Averages (με)					Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5	G1	G2	G3	G4	G5
0	0	0	0	0	0	0	---	---	---	---	---
5.8	0.1	15.275	12.995	9.626	10.189	9.385	***0.266***	***0.226***	***0.167***	***0.177***	***0.163***
11.6	0.2	35.160	31.769	26.227	25.851	21.660	***0.250***	***0.226***	***0.186***	***0.184***	***0.154***
17.4	0.3	55.539	54.856	47.573	43.771	32.935	***0.237***	***0.234***	***0.203***	***0.187***	***0.140***
23.2	0.4	74.498	80.546	71.417	61.077	39.075	***0.228***	***0.247***	***0.219***	***0.187***	***0.120***
29	0.5	88.119	97.811	88.293	70.508	41.275	***0.228***	***0.253***	***0.229***	***0.183***	***0.107***
34.8	0.6	88.925	103.251	90.696	70.641	38.770	***0.227***	***0.263***	***0.231***	***0.180***	***0.099***
40.6	0.7	88.338	109.998	97.308	70.697	31.370	***0.222***	***0.277***	***0.245***	***0.178***	***0.079***
46.4	0.8	80.413	99.305	89.996	59.574	23.098	***0.228***	***0.282***	***0.255***	***0.169***	***0.066***
52.2	0.9	49.111	58.211	49.144	31.024	11.501	***0.247***	***0.293***	***0.247***	***0.156***	***0.058***
58	1	0	0	0	0	0	---	---	---	---	---
					DF @ 0.5L (PP 5)		0.228	0.253	0.229	0.183	0.107
					MPF Applied		0.457	0.507	0.457	0.365	0.214
					St. Dev.		0.014	0.025	0.030	0.010	0.038

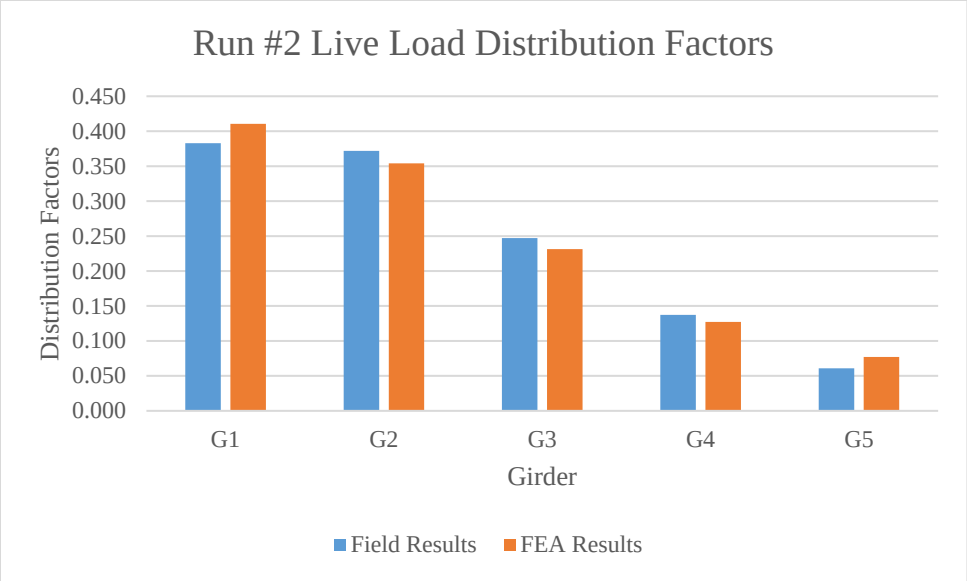
Truck Runs 3 and 6, Simplified Distribution Factors (Field)											
Panel Points		Averages (με)					Distribution Factors				
x (ft)	x/L	G1	G2	G3	G4	G5	G1	G2	G3	G4	G5
0	0	0	0	0	0	0	---	---	---	---	---
5.8	0.1	15.116	14.319	13.980	16.456	17.190	***0.196***	***0.186***	***0.181***	***0.214***	***0.223***
11.6	0.2	28.711	28.682	28.997	33.292	33.198	***0.188***	***0.188***	***0.190***	***0.218***	***0.217***
17.4	0.3	38.638	42.403	46.774	52.386	48.392	***0.169***	***0.185***	***0.205***	***0.229***	***0.212***
23.2	0.4	46.823	58.911	69.739	75.322	64.162	***0.149***	***0.187***	***0.221***	***0.239***	***0.204***
29	0.5	54.707	74.652	87.673	94.279	73.587	***0.142***	***0.194***	***0.228***	***0.245***	***0.191***
34.8	0.6	56.481	77.952	94.990	98.166	73.779	***0.141***	***0.194***	***0.237***	***0.245***	***0.184***
40.6	0.7	46.182	77.544	99.588	100.581	69.318	***0.117***	***0.197***	***0.253***	***0.256***	***0.176***
46.4	0.8	34.693	69.115	86.859	91.840	57.200	***0.102***	***0.203***	***0.256***	***0.270***	***0.168***
52.2	0.9	23.311	41.916	52.053	55.466	34.119	***0.113***	***0.203***	***0.252***	***0.268***	***0.165***
58	1	0	0	0	0	0	---	---	---	---	---
					DF @ 0.5L (PP 5)		0.142	0.194	0.228	0.245	0.191
					MPF Applied		0.284	0.388	0.456	0.490	0.382
					St. Dev.		0.033	0.007	0.028	0.020	0.022

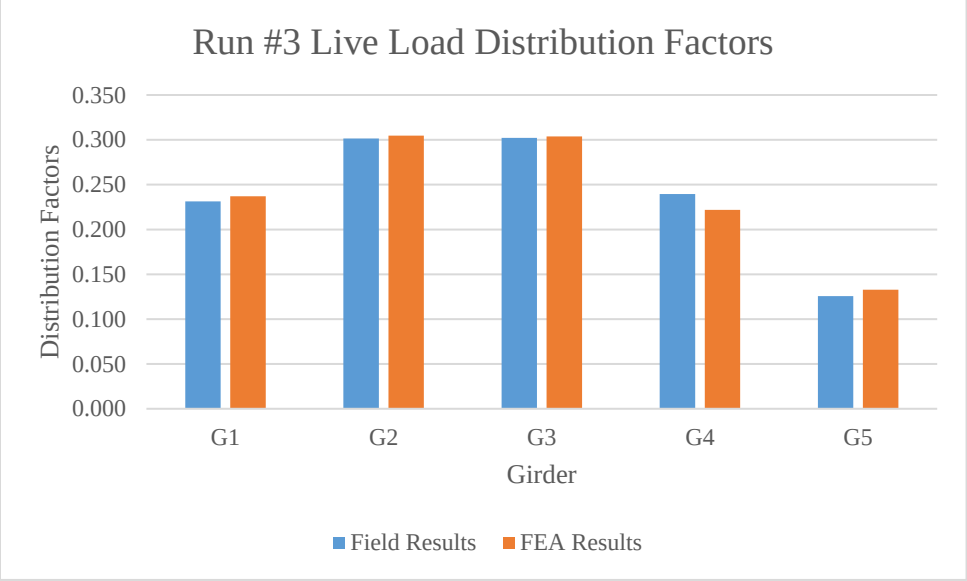
A.1.2 Finite Element Analysis Results

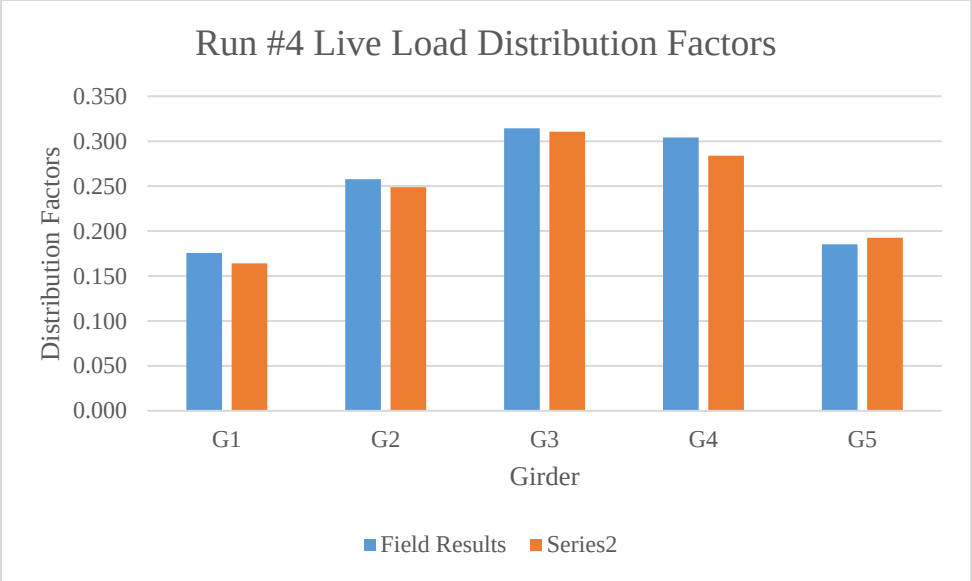
Summary of Live Load Distribution Factors (FEA)					
Truck Run	G1	G2	G3	G4	G5
Run 1	0.440	0.355	0.217	0.116	0.072
Run 2	0.411	0.354	0.231	0.127	0.077
Run 3	0.237	0.305	0.304	0.222	0.133
Run 4	0.164	0.249	0.311	0.284	0.193
Run 5	0.149	0.232	0.307	0.299	0.214
Run 6	0.088	0.132	0.236	0.349	0.396
Runs 1+4	0.502	0.503	0.440	0.334	0.221
Runs 2+5	0.464	0.487	0.449	0.356	0.243
Runs 3+6	0.269	0.362	0.449	0.477	0.443

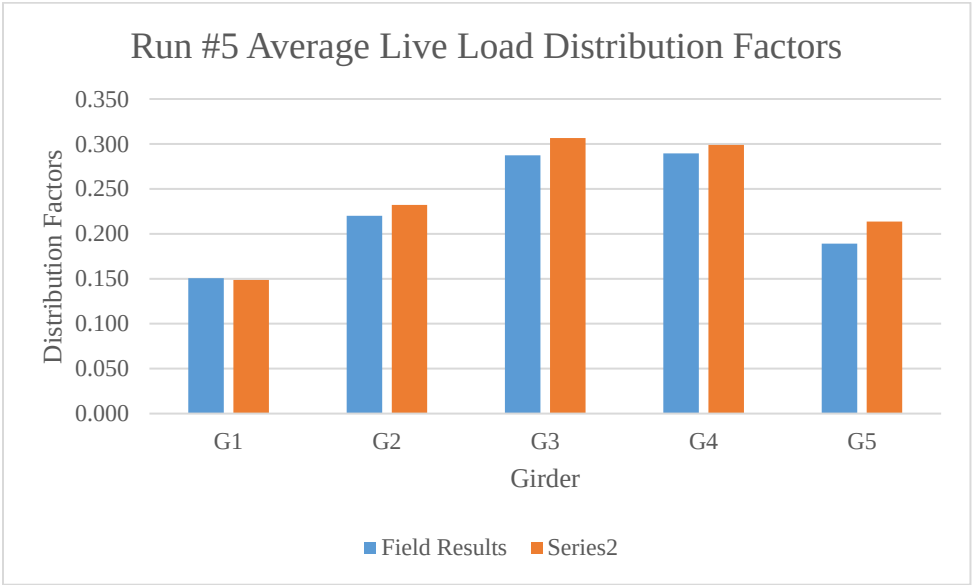
A.1.3 Results Comparison: Live Load Field Test vs. Finite Element Analysis

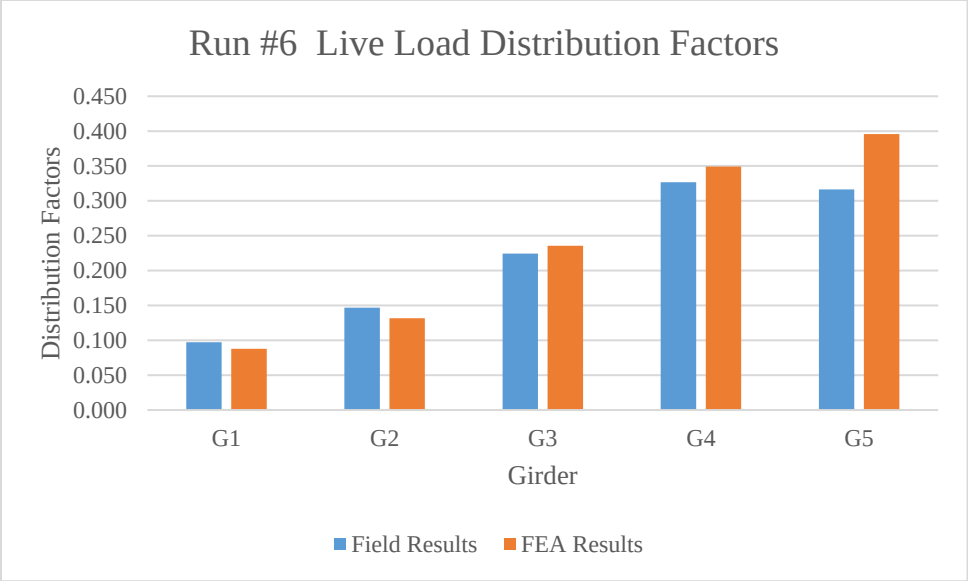


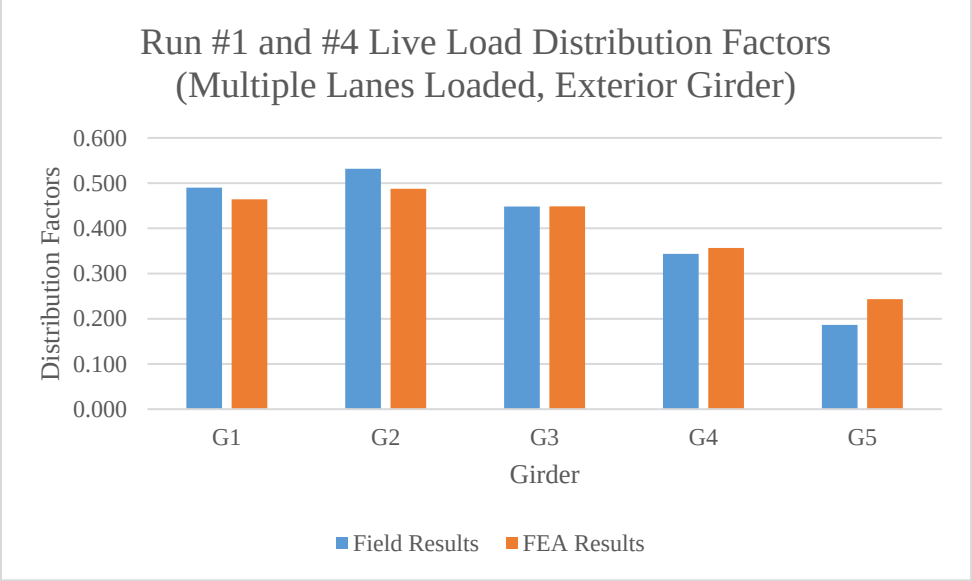

Run #2 Live Load Distribution Factors
Distribution Factors
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results

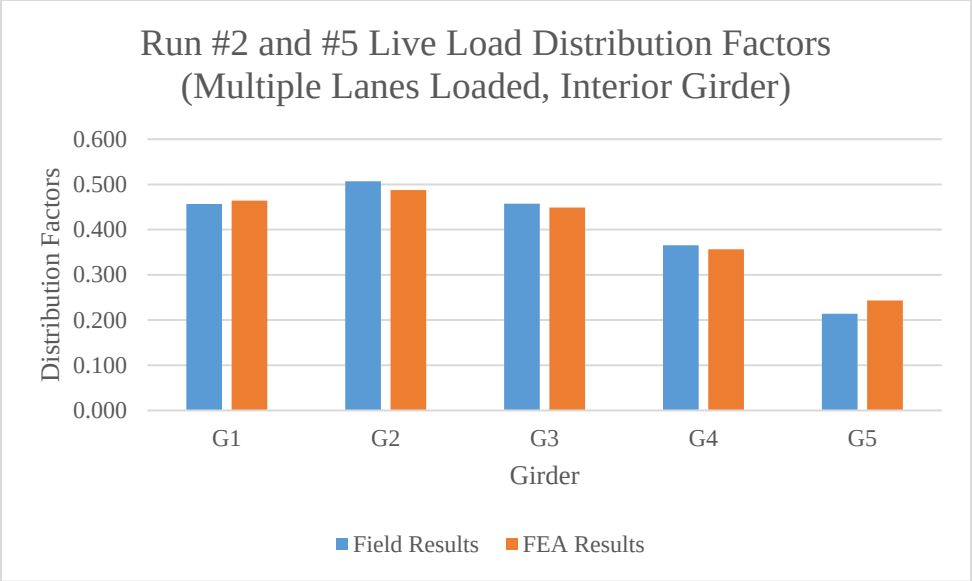

Run #3 Live Load Distribution Factors
Distribution Factors
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results

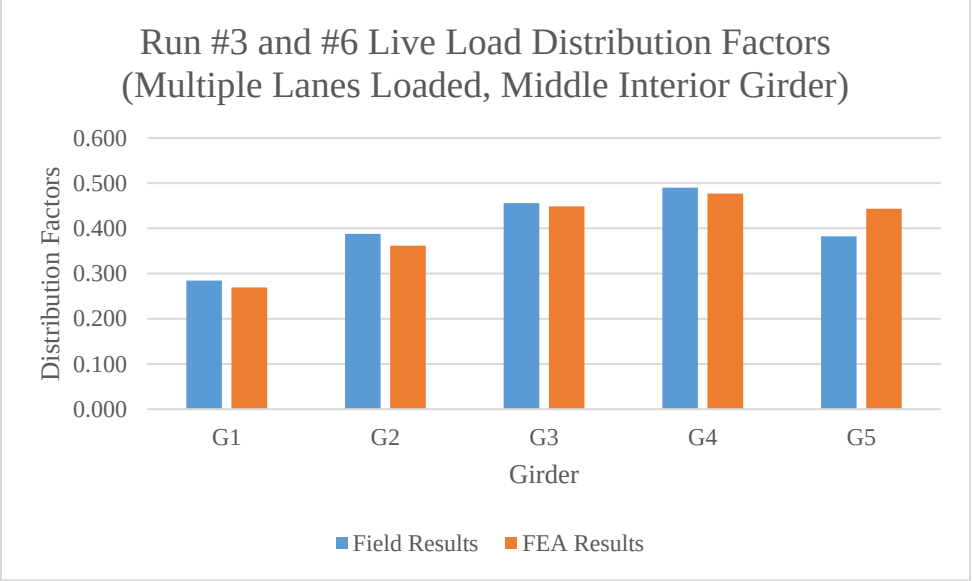

Run #4 Live Load Distribution Factors
Distribution Factors
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
G1
G2
G3
G4
G5
Girder
Field Results
Series2


Run #5 Average Live Load Distribution Factors
Distribution Factors
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
G1
G2
G3
G4
G5
Girder
Field Results
Series2

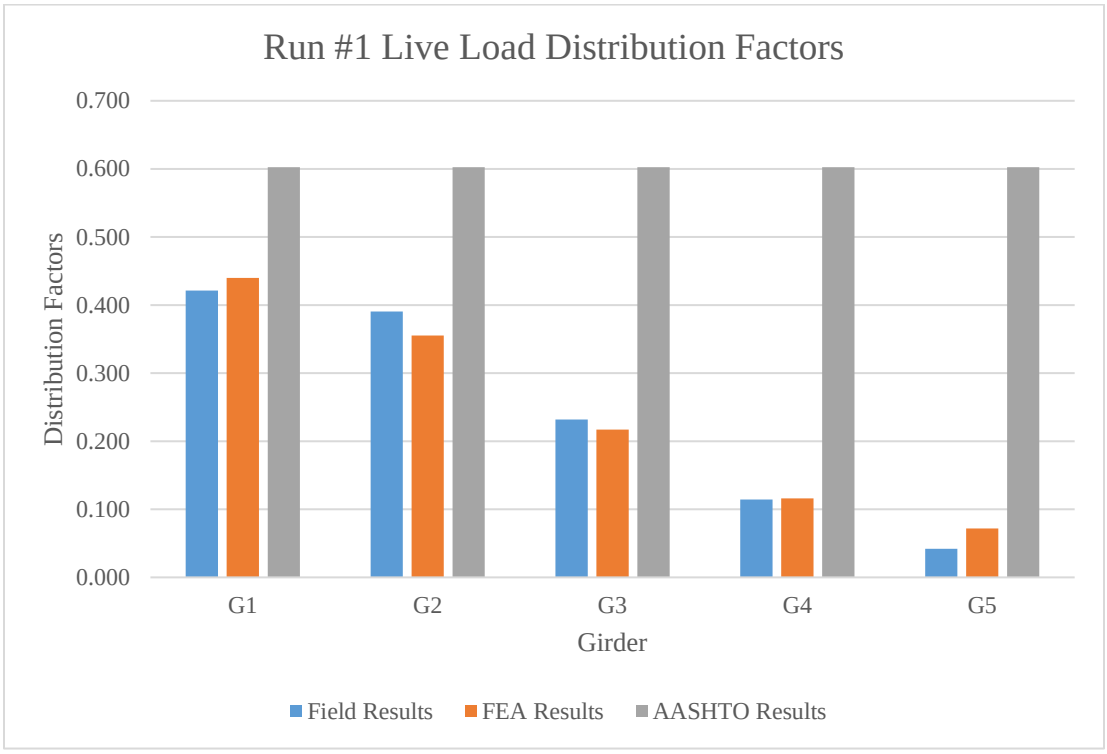

Run #6 Live Load Distribution Factors
Distribution Factors
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results

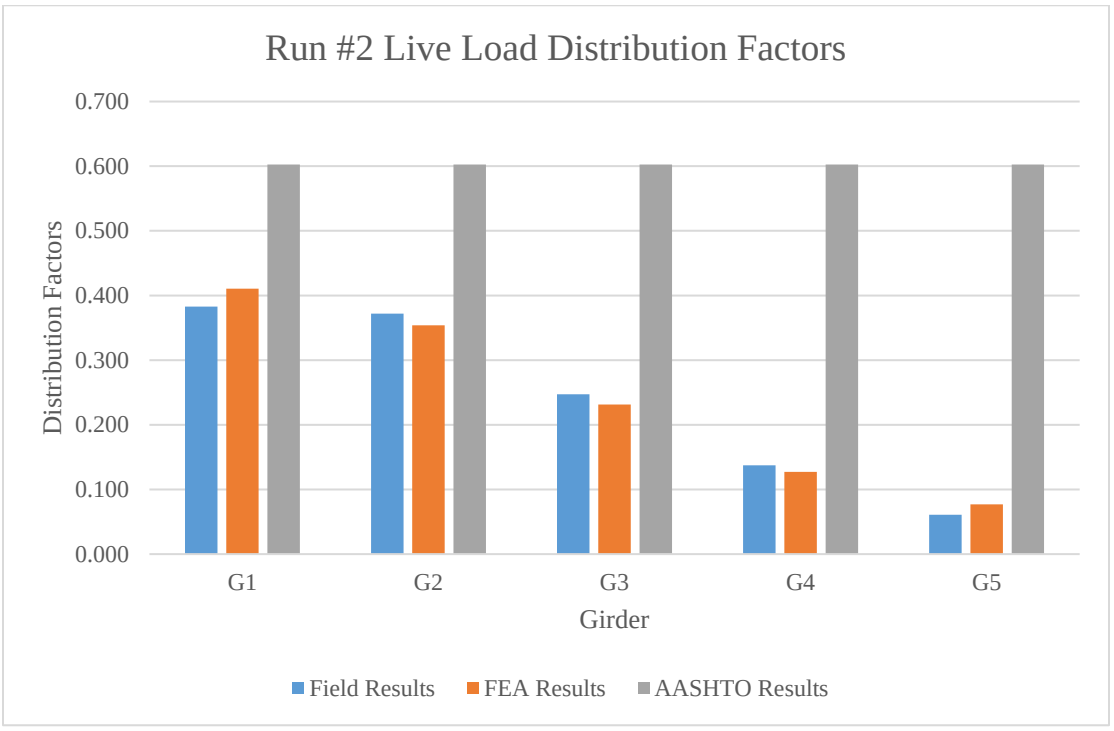

Run #1 and #4 Live Load Distribution Factors
(Multiple Lanes Loaded, Exterior Girder)
Distribution Factors
0.600
0.500
0.400
0.300
0.200
0.100
0.000
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results


Run #2 and #5 Live Load Distribution Factors
(Multiple Lanes Loaded, Interior Girder)
Distribution Factors
0.600
0.500
0.400
0.300
0.200
0.100
0.000
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results

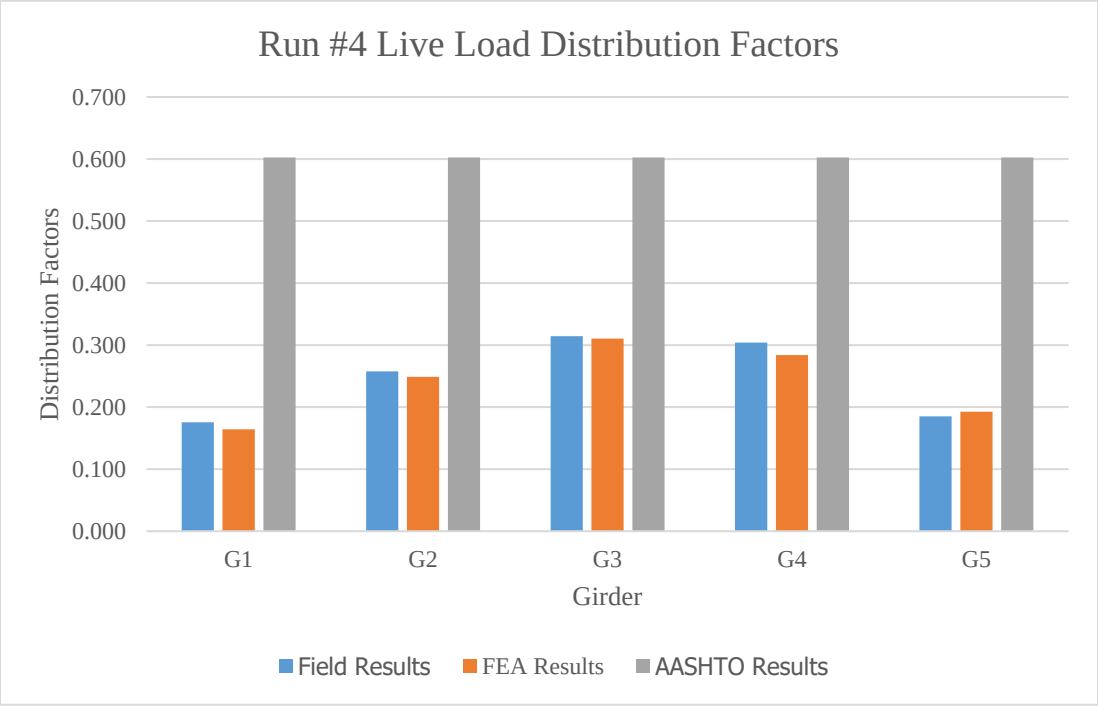

Run #3 and #6 Live Load Distribution Factors
(Multiple Lanes Loaded, Middle Interior Girder)
Distribution Factors
0.600
0.500
0.400
0.300
0.200
0.100
0.000
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results

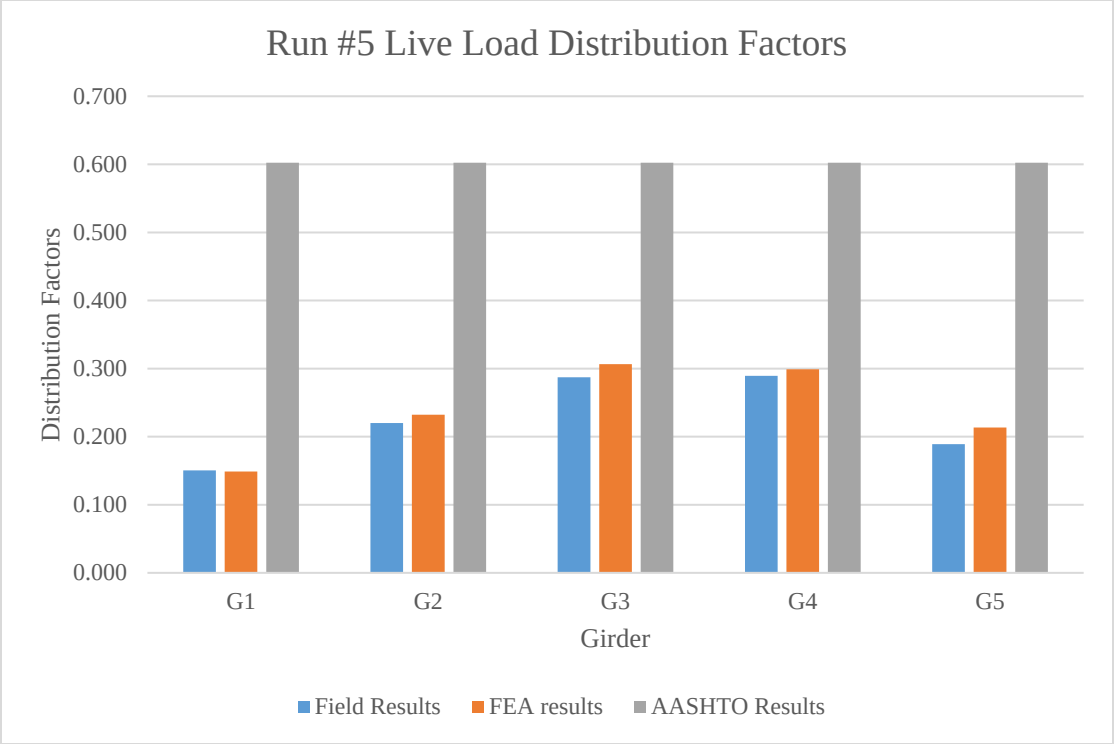
A.1.4 Results Comparison: Live Load Field Test, Finite Element Analysis, AASHTO Calculations

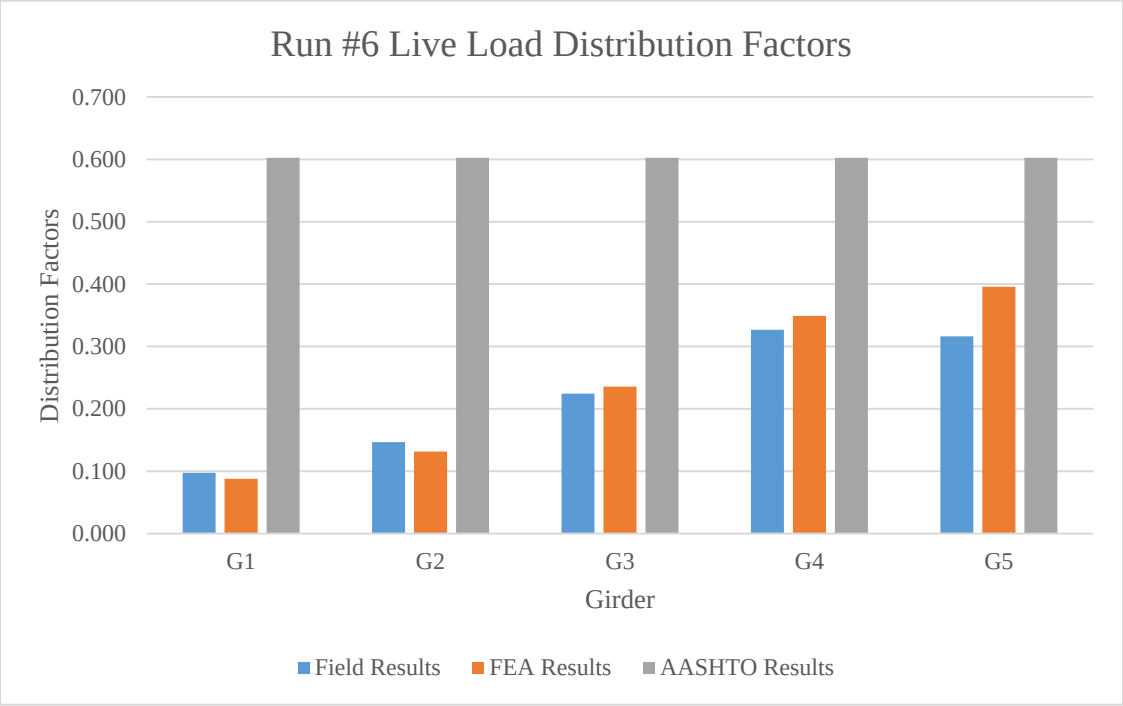


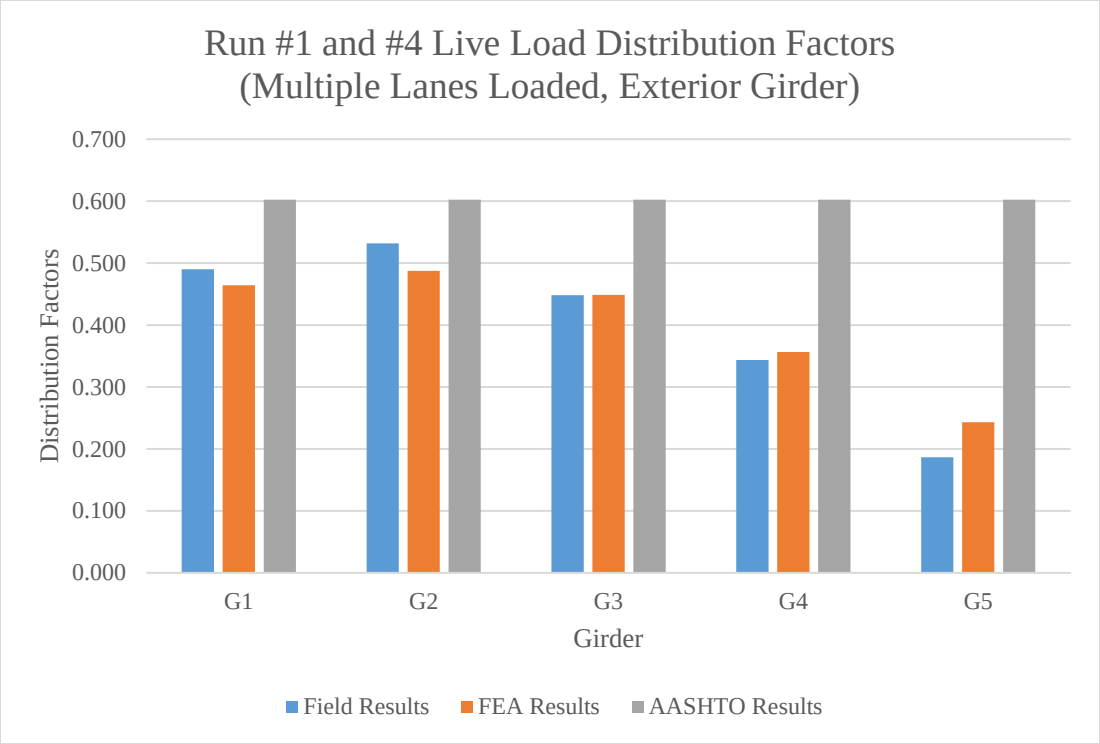


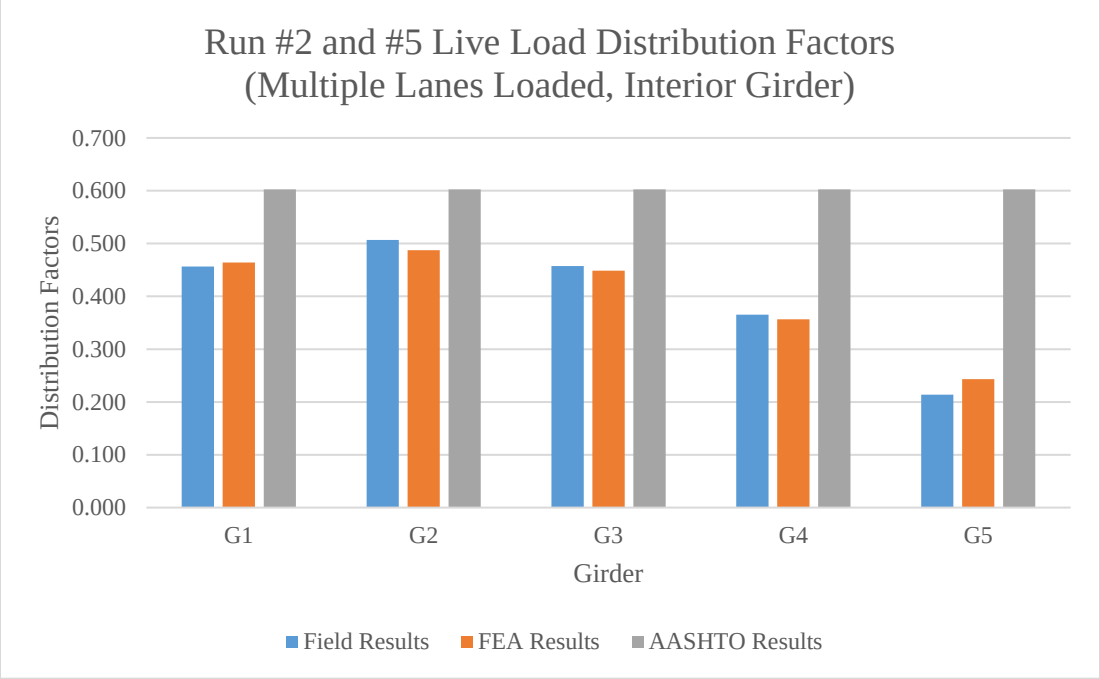

Run #3 Live Load Distribution Factors
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Distribution Factors
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results
AASHTO Results

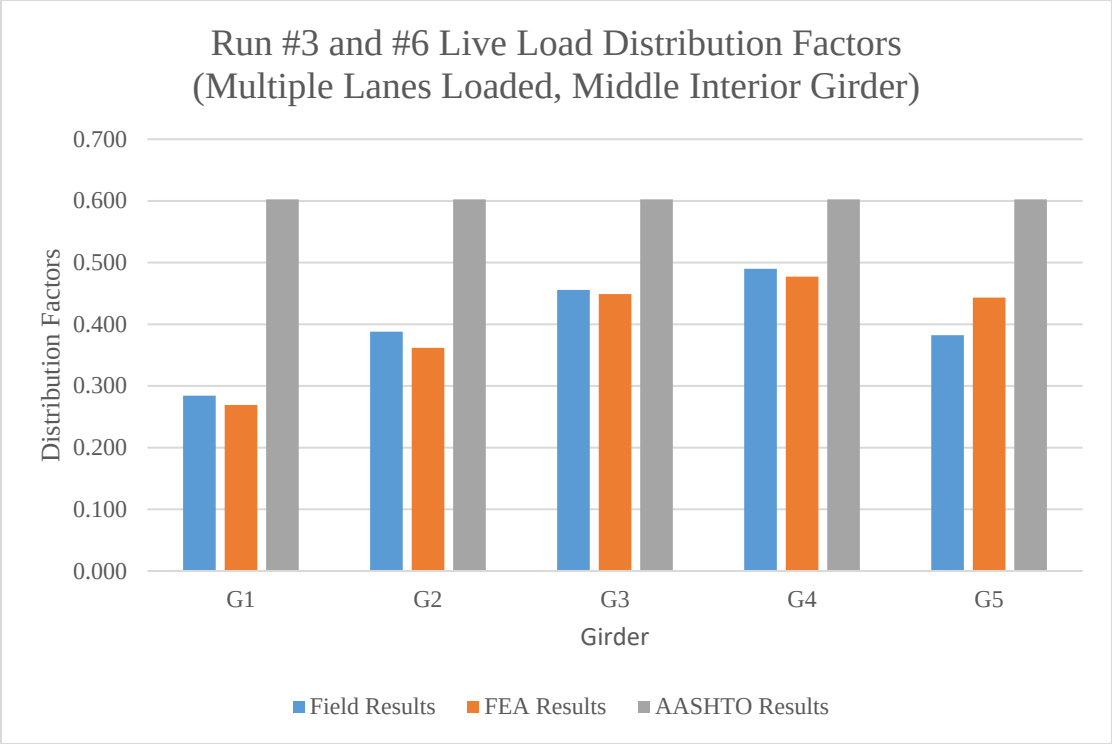

Run #4 Live Load Distribution Factors
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Distribution Factors
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results
AASHTO Results


Run #5 Live Load Distribution Factors
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Distribution Factors
G1
G2
G3
G4
G5
Girder
Field Results
FEA results
AASHTO Results


Run #6 Live Load Distribution Factors
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Distribution Factors
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results
AASHTO Results


Run #1 and #4 Live Load Distribution Factors
(Multiple Lanes Loaded, Exterior Girder)
Distribution Factors
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results
AASHTO Results


Run #2 and #5 Live Load Distribution Factors
(Multiple Lanes Loaded, Interior Girder)
Distribution Factors
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results
AASHTO Results


Run #3 and #6 Live Load Distribution Factors
(Multiple Lanes Loaded, Middle Interior Girder)
Distribution Factors
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
G1
G2
G3
G4
G5
Girder
Field Results
FEA Results
AASHTO Results

APPENDIX B: FINITE ELEMENT MODELING PROGRAM

This appendix documents the program written in MATALB (The Mathworks, Inc., 2020) that were used in this research. The program "noncompv2.m" is used to preprocess .inp files that Abaqus will read to produce a finite element model. User inputs are used to generate the nodes and elements for the model under investigation. An outline of each section of the program is presented below:

- Part 0 reads the data necessary to generate the finite element mesh.
- Part 1 defines the longitudinal node layout of the girder.
- Part 2 defines the transverse node layout of the girder.
- Part 3 combines Part 3 and 4 to generate the three-dimensional mesh of the steel press-brake-formed tub girder.
- Part 4 defines the transverse node layout for the stiffener.
- Part 5 uses Part 4 to generate the three-dimensional mesh of the stiffener plates.
- Part 6 alters the geometry to consider geometric imperfection 1, flange tilt.
- Part 7 determines the centroid and shear center of the assembly.
- Part 8 alters the geometry to consider geometric imperfection 2, girder twist.
- Part 9 alters the girder geometry to consider geometric imperfection 3, web out of flatness.
- Part 10 alters the geometry of the stiffener plate to consider geometric imperfection 3, web out of flatness.
- Part 11 applies the loading and boundary conditions to specified nodes.
- Part 12 writes the .inp file with the information from Parts 0 through 11.

The MATLAB file is as follows (inputs for material properties and geometric imperfections are outlined in chapter 7):

```
fclose('all');

clc

clear


% ========================================================================

% PART 0:  INPUT PARAMETERS

% ========================================================================


% 0.1 Girder Dimensions/Thicknesses

% ------------------------------------------------------------------------

L=38;            % span length [ft]

w=84;            % standard mill plate width [in]

t=7/16;           % plate thickness [in]

t_BRG=3/4;       % bearing plate thickness [in]

d=23;            % total girder depth [in]

btf=6;           % top flange width [in]

Load_ap=33;     % applied load at midspan [kip]      From Lindsay Kelly Test 2
(Galvanized Girder)


% 0.2 Stiffener/Diaphragm Locations and Imperfection Anchors [ft]

% ------------------------------------------------------------------------

%  - There must be at least three locations:  0.0L, 0.5L and 1.0L.

Loc_St=[0;1/2;1]*L;
```

```
% 0.3 Locations of Lateral Support [ft]
% ---------------------------------------------------------------------
%  - There must be at least two locations:  0.0L and 1.0L.
Loc_Lat=[0;1]*L;


% 0.4 Transverse Node Layout Parameters
% ---------------------------------------------------------------------
ne_bf=10;      % Number of elements along the bottom flange (MUST BE EVEN)
ne_w=12;       % Number of elements along the web
ne_b=03;       % Number of elements along the bend
ne_tf=05;      % Number of elements along the top flange (MUST BE EVEN)
le_L=3.0;      % Approximate length of element along the span [in]
Imp_Amp=1.0 ;     % Imperfection Magnitude Amplification Factor



% 0.5 Imperfection I - Flange Tilt
% ---------------------------------------------------------------------
%  - There must be at least two locations:  0.0L and 1.0L.
Imp_St1=[0;1]*L;     % Locations of imperfection [ft]
Imp_Mag1=Imp_Amp*btf*tan(1*pi/180);                    % Magnitude of maximum
imperfection [in]
Imp_Opt1=+1;                     % Option for imperfection orientation
                                 %   +1 for similar, -1 for opposite


% 0.6 Imperfection II - Girder Twist
```

```
% ------------------------------------------------------------------------
%  - There must be at least two locations:  0.0L and 1.0L.
Imp_St2=[0;1]*L;
% Imp_St2=[0;1/2;1]*L;            % Locations of imperfection [ft]
Imp_Mag2=Imp_Amp*1;                    % Magnitude of maximum twist angle
[deg]
Imp_Opt2=1;                      % Option for origin of twist angle
                                 %   0 for the centroid
                                 %   1 for the shear center
                                 %   0-1 for values between...

% 0.7 Imperfection III - Web Out of Flatness
% ------------------------------------------------------------------------
% Note:
%  - There must be at least two locations:  0.0L and 1.0L.
%  - There must be a location that matches each stiffener.
Imp_St3=[0;1/4;1/2;3/4;1]*L;     % Locations of imperfection [ft]
Imp_Mag3=Imp_Amp*0;                    % Magnitude of maximum imperfection
[in]
Imp_Opt3=-1;                     % Option for imperfection orientation
                                 %   +1 for similar, -1 for opposite

% ========================================================================
```

```
% PART 1:  LONGITUDINAL NODE LAYOUT
% ========================================================================


% 1.1 Anchor Points for Stiffeners and Imperfections
% ------------------------------------------------------------------------
Anchor_y=vertcat(Loc_St,Loc_Lat,Imp_St1,Imp_St2,Imp_St3)*12;
Anchor_y=unique(Anchor_y,'rows');
Anchor_y=sort(Anchor_y);


% 1.2 Number of Elements in Each Segment
% ------------------------------------------------------------------------
id_e_y=zeros((length(Anchor_y)-1),1);
for i=1:length(id_e_y)
    y1=Anchor_y(i);
    y2=Anchor_y(i+1);
    id_e_y(i)=round((y2-y1)/le_L);
    clear y1 y2
end
clear ans i


% 1.3 Node Numbers at the Ends of Each Segment
% ------------------------------------------------------------------------
id_n_y=zeros((length(id_e_y)+1),1);
id_n_y(1)=1;
for i=2:length(id_n_y)
```

```
    id_n_y(i)=id_n_y(i-1)+id_e_y(i-1);
end
clear ans i

% 1.4 Nodal Coordinates at the Ends of Each Segment
% ------------------------------------------------------------------------
node_y=zeros(id_n_y(end),1);
for i=1:length(id_e_y)
    y1=Anchor_y(i);
    y2=Anchor_y(i+1);
    ne_y=round((y2-y1)/le_L);
    i1=id_n_y(i);
    i2=id_n_y(i+1);
    node_y(i1:i2)=y1:((y2-y1)/ne_y):y2;
    clear i1 i2 ne_y y1 y2
end
clear ans i

% 1.5 Adding 3" Past Bearing Stiffeners & Rounding of Nodal Coordinates
% ------------------------------------------------------------------------
node_y=vertcat(-3,node_y,(L*12+3));
node_y=round(node_y*1e6)/1e6;
clear id_e_y id_n_y Anchor_y

% ========================================================================
```

```
% PART 2:  TRANSVERSE NODE LAYOUT (GIRDER)
% ========================================================================

% 2.1 General Paramters
% ------------------------------------------------------------------------
slope=04;                                % slope ratio of web
r=11/2*t;                                % bend rad. at mid-thickness [in]
theta=pi/2-atan(1/slope);                % bend angle [rad]
L_R=theta*r;                             % arc length of bend [in]
Web_z=d-t+2*r*(1/(sqrt(slope^2+1))-1); % Z-portion of straight web [in]
Web_x=Web_z/slope;                       % X-portion of straight web [in]
L_W=sqrt(Web_x^2+Web_z^2);               % length of straight web [in]
bbf=w-(4*L_R+2*L_W+2*btf);               % width of bottom flange [in]

% 2.2 Node Coordinates (Top Flange)
% ------------------------------------------------------------------------
n_tf_x=((0):(btf/ne_tf):(btf))'+2*r*sin(theta)+Web_x+bbf/2;
n_tf_z=zeros(ne_tf+1,1)+d-t;
n_tf_x1=-n_tf_x;
n_tf_z1=n_tf_z;
n_tf_x2=n_tf_x;
n_tf_z2=n_tf_z;
clear n_tf_x n_tf_z

% 2.3 Node Coordinates (Top Flange Bends)
```

```
% ------------------------------------------------------------------------

n_theta=(pi/2-theta):(theta/ne_b):(pi/2);

n_tb_x=-r*cos(n_theta)+2*r*sin(theta)+Web_x+bbf/2;

n_tb_z=r*sin(n_theta)-2*r*cos(theta)+Web_z+r;

n_tb_x1=-n_tb_x';

n_tb_z1=n_tb_z';

n_tb_x2=n_tb_x';

n_tb_z2=n_tb_z';

clear n_theta n_tb_x n_tb_z


% 2.4 Node Coordinates (Webs)

% ------------------------------------------------------------------------

n_w_x=((0):(Web_x/ne_w):(Web_x))'+r*sin(theta)+bbf/2;

n_w_z=((0):(Web_z/ne_w):(Web_z))'+2*r*(sin(theta/2))^2;

n_w_x1=-n_w_x;

n_w_z1=n_w_z;

n_w_x2=n_w_x;

n_w_z2=n_w_z;

clear n_w_x n_w_z


% 2.5 Node Coordinates (Bottom Flange Bends)

% ------------------------------------------------------------------------

n_theta=(3*pi/2):(theta/ne_b):(3*pi/2+theta);

n_bb_x=r*cos(n_theta)+bbf/2;

n_bb_z=r*sin(n_theta)+r;
```

```
n_bb_x1=-n_bb_x';

n_bb_z1=n_bb_z';

n_bb_x2=n_bb_x';

n_bb_z2=n_bb_z';

clear n_theta n_bb_x n_bb_z


% 2.6 Node Coordinates (Bottom Flange)

% ------------------------------------------------------------------------

n_bf_x=((-bbf/2):(bbf/ne_bf):(bbf/2))';

n_bf_z=zeros(ne_bf+1,1);


% 2.7 Concatenation of Node Coordinates

% ------------------------------------------------------------------------

nx1=vertcat(n_tf_x1,n_tb_x1,n_w_x1);

nx2=vertcat(n_bb_x1,n_bf_x,n_bb_x2);

nx3=vertcat(n_w_x2,n_tb_x2,n_tf_x2);

nx=vertcat(nx1,nx2,nx3);

nx=round(nx*1e6)/1e6;

nz1=vertcat(n_tf_z1,n_tb_z1,n_w_z1);

nz2=vertcat(n_bb_z1,n_bf_z,n_bb_z2);

nz3=vertcat(n_w_z2,n_tb_z2,n_tf_z2);

nz=vertcat(nz1,nz2,nz3);

nz=round(nz*1e6)/1e6;

node_cs=horzcat(nx,nz);

clear nx1 nx2 nx3
```

```
clear nz1 nz2 nz3

clear nx nz

node_cs=unique(node_cs,'rows');

node_x=node_cs(:,1);

node_z=node_cs(:,2);


% 2.8 Additional Clear Statements

% -------------------------------------------------------------------------

clear L_R L_W Web_x Web_z theta

clear n_tf_x1 n_tb_x1 n_w_x1 n_tf_z1 n_tb_z1 n_w_z1

clear n_bb_x1 n_bf_x n_bb_x2 n_bb_z1 n_bf_z n_bb_z2

clear n_w_x2 n_tb_x2 n_tf_x2 n_w_z2 n_tb_z2 n_tf_z2




% =========================================================================

% PART 3:  NODE & ELEMENT LAYOUT (GIRDER)

% =========================================================================


% 3.1 Node Matrix

% -------------------------------------------------------------------------

nn=((1):(1):(length(node_x)*length(node_y)))';

nx=repmat(node_x,length(node_y),1);

ny=repmat(node_y,1,length(node_x))';

ny=ny(:);

nz=repmat(node_z,length(node_y),1);
```

```
node_girder=horzcat(nn,nx,ny,nz);
clear nn nx ny nz


% 3.2 Element Matrix
% ------------------------------------------------------------------------
ne_x_girder=length(node_x)-1;  % number of girder elements [x-direction]
ne_y_girder=length(node_y)-1;  % number of girder elements [y-direction]
nn_x_girder=ne_x_girder+1;
element_girder=zeros(ne_x_girder*ne_y_girder,5);
element_girder(:,1)=1:(ne_x_girder*ne_y_girder);
for i=1:ne_y_girder
    k1=ne_x_girder*i-ne_x_girder+1;
    k2=ne_x_girder*i;
    n1a=nn_x_girder*i-ne_x_girder;
    n1b=nn_x_girder*i-1;
    n2a=nn_x_girder*i-(ne_x_girder-1);
    n2b=nn_x_girder*i;
    n3a=nn_x_girder*i+2;
    n3b=nn_x_girder*i+nn_x_girder;
    n4a=nn_x_girder*i+1;
    n4b=nn_x_girder*i+ne_x_girder;
    element_girder(k1:k2,2)=node_girder(n1a:n1b,1);
    element_girder(k1:k2,3)=node_girder(n2a:n2b,1);
    element_girder(k1:k2,4)=node_girder(n3a:n3b,1);
    element_girder(k1:k2,5)=node_girder(n4a:n4b,1);
    clear k1 k2 n1a n1b n2a n2b n3a n3b n4a n4b
```

```
end
clear ans i ne_x_girder ne_y_girder nn_x_girder


% 3.3 BC Identification
% ------------------------------------------------------------------------
bc_g1=(1:(ne_bf+1))+ne_tf+2*ne_b+ne_w;
bc_g2=bc_g1+length(node_cs(:,1))*(length(node_y)-1);
bc_g1=bc_g1+length(node_cs(:,1));
bc_g2=bc_g2-length(node_cs(:,1));




% ========================================================================
% PART 4:  TRANSVERSE NODE LAYOUT (STIFFENER)
% ========================================================================


theta=pi/2-atan(1/slope);              % bend angle [rad]
L_R=theta*r;                           % arc length of bend [in]
Web_z=d-t+2*r*(1/(sqrt(slope^2+1))-1); % Z-portion of straight web [in]
Web_x=Web_z/slope;                     % X-portion of straight web [in]
L_W=sqrt(Web_x^2+Web_z^2);             % length of straight web [in]
bbf=w-(4*L_R+2*L_W+2*btf);             % width of bottom flange [in]
n_w_z=((0):(Web_z/ne_w):(Web_z))'+2*r*(sin(theta/2))^2;


% Node Layouts Along the Top/Bottom of the Diaphragm (X-direction)
% ------------------------------------------------------------------------
```

```
st_px=Web_x+bbf/2;
n_top_x=((-st_px):(2*st_px/ne_bf):(st_px))';
n_bot_x=((-bbf/2):(bbf/ne_bf):(bbf/2))';
clear st_px

ns_x=length(n_top_x); % Number of unique stiffener nodes in the X-direction
ns_z=length(n_w_z)+1; % Number of unique stiffener nodes in the Z-direction
n_stiff=zeros(ns_x*ns_z,2);

% Node Layout for Generic Stiffener
% ------------------------------------------------------------------------
for i=1:ns_x
    x1=round(n_top_x(i)*1e6)/1e6;
    z1=round((d-t)*1e6)/1e6;
    x2=round(n_bot_x(i)*1e6)/1e6;
    z2=0;
    if x1~=x2
        % z = m*x + b
        m=(z2-z1)/(x2-x1);
        b=z1-m*x1;
        for j=1:ns_z
            if j<ns_z
                z_index=n_w_z(j);
            else
                z_index=d-t/2;
```

```
            end
            x_index=(z_index-b)/m;
            n_stiff((i-1)*ns_z+j,1)=x_index;
            n_stiff((i-1)*ns_z+j,2)=z_index;
            clear x_index z_index
        end
        clear m
    else
        % x = 0
        clear m b
        range=median(1:1:ns_x);
        for j=1:ns_z
            if j<ns_z
                z_index=n_w_z(j);
            else
                z_index=d-t/2;
            end
            n_stiff((range-1)*ns_z+j,1)=0;
            n_stiff((range-1)*ns_z+j,2)=z_index;
            clear z_index
        end
        clear j range
    end
    clear m b
end
clear ans i
```

```
clear x1 x2 z1 z2 z_index

n_stiff=round(n_stiff*1e6)/1e6;


% Additional Clear Statements

% ------------------------------------------------------------------------

clear L_R L_W Web_x Web_z theta

clear bbf




% ========================================================================

% PART 5:  NODE & ELEMENT LAYOUT (STIFFENER)

% ========================================================================


nn_girder=length(node_girder(:,1));

ne_stiff=(ns_z)*(length(n_bot_x)-1)+2*(length(n_w_z)-1);

rect_stiff=zeros(ne_stiff*length(Loc_St),5);

rect_stiff(:,1)=(1:1:length(rect_stiff(:,1)))';

rect_stiff(:,1)=rect_stiff(:,1)+length(element_girder(:,1));

tri_stiff=zeros(4*length(Loc_St),4);

tri_stiff(:,1)=(1:1:length(tri_stiff(:,1)))';

tri_stiff(:,1)=tri_stiff(:,1)+length(element_girder(:,1));

tri_stiff(:,1)=tri_stiff(:,1)+length(rect_stiff(:,1));


% Node Matrix
```

```
% ------------------------------------------------------------------------
node_stiff=zeros(length(n_stiff(:,1))*length(Loc_St),4);
for i=1:length(Loc_St)
    ind_stiff=((i-1)*length(n_stiff(:,1))+1):1:(i*length(n_stiff(:,1)));
    node_stiff(ind_stiff,2)=n_stiff(:,1);
    node_stiff(ind_stiff,3)=Loc_St(i)*12;
    node_stiff(ind_stiff,4)=n_stiff(:,2);
    clear ind_stiff
end
clear ans i
node_stiff(:,1)=(1:1:length(node_stiff(:,1)))'+nn_girder;
node_stiff=round(node_stiff*1e6)/1e6;


% Element Matrix
% ------------------------------------------------------------------------
for i=1:length(Loc_St)
    y_index=Loc_St(i)*12;          % Y-coordinate of individual stiff.
    cs_line=find(node_y==y_index); % Search for node loc. along girder


    ind_LW1=ne_tf+ne_b+1;  % ind_LW1 = stiff. node on the LW (start)
    ind_LW2=ind_LW1+ne_w;  % ind_LW2 = stiff. node on the LW (end)
    ind_BF1=ind_LW2+ne_b;  % ind_BF1 = stiff. node on the BF (start)
    ind_BF2=ind_BF1+ne_bf; % ind_BF2 = stiff. node on the BF (end)
    ind_RW1=ind_BF2+ne_b;  % ind_RW1 = stiff. node on the RW (start)
    ind_RW2=ind_RW1+ne_w;  % ind_RW2 = stiff. node on the RW (end)
```

```
ind_LW1=ind_LW1+(cs_line-1)*length(node_cs); % Shift for ith stiff.
ind_LW2=ind_LW2+(cs_line-1)*length(node_cs); % Shift for ith stiff.
ind_BF1=ind_BF1+(cs_line-1)*length(node_cs); % Shift for ith stiff.
ind_BF2=ind_BF2+(cs_line-1)*length(node_cs); % Shift for ith stiff.
ind_RW1=ind_RW1+(cs_line-1)*length(node_cs); % Shift for ith stiff.
ind_RW2=ind_RW2+(cs_line-1)*length(node_cs); % Shift for ith stiff.

nn_LW=(ind_LW1:1:ind_LW2)'; % nn_LW = left web nodes
nn_BF=(ind_BF1:1:ind_BF2)'; % nn_BF = bottom flange nodes
nn_RW=(ind_RW1:1:ind_RW2)'; % nn_RW = right web nodes

clear ind_LW1 ind_LW2 ind_BF1 ind_BF2 ind_RW1 ind_RW2

% First Vertical Row of Elements
% ------------------------------------------------------------------------
n1=nn_LW(2:1:end);
n1=n1(end:-1:1);
n2=(1:1:length(n_w_z(:,1))-1)';
n2=n2+nn_girder+(i-1)*ns_x*ns_z;
n3=(2:1:length(n_w_z(:,1)))';
n3=n3+nn_girder+(i-1)*ns_x*ns_z;
n4=nn_LW(1:1:(end-1));
n4=n4(end:-1:1);
es1=horzcat(n1,n2,n3,n4);
```

```
clear n1 n2 n3 n4


% Main Body of Elements
% ---------------------------------------------------------------------
es2=zeros((ne_w+2)*(length(nn_BF)-1),4);
for j=1:(length(nn_BF)-1)
    v1=(((j-1)*(ns_z)+1):1:(j*ns_z))';
    v1=v1+nn_girder+(i-1)*ns_x*ns_z;
    vn1=vertcat(nn_BF(j,1),v1);
    clear v1
    v2=((j*ns_z+1):1:((j+1)*(ns_z)))';
    v2=v2+nn_girder+(i-1)*ns_x*ns_z;
    vn2=vertcat(nn_BF(j+1,1),v2);
    clear v2
    n1=vn1(1:1:(end-1));
    n2=vn2(1:1:(end-1));
    n3=vn2(2:1:end);
    n4=vn1(2:1:end);
    es2((((j-1)*(ne_w+2)+1):1:(j*(ne_w+2))),:)=horzcat(n1,n2,n3,n4);
    clear vn1 vn2
end
clear ans j


% Last Vertical Row of Elements
% ---------------------------------------------------------------------
```

```
n1=((ns_z*(ns_x-1)+1):1:(ns_x*ns_z-2))';

n1=n1+nn_girder+(i-1)*ns_x*ns_z;

n2=nn_RW(1:1:(end-1));

n3=nn_RW(2:1:end);

n4=((ns_z*(ns_x-1)+2):1:(ns_x*ns_z-1))';

n4=n4+nn_girder+(i-1)*ns_x*ns_z;

es3=horzcat(n1,n2,n3,n4);

clear n1 n2 n3 n4


% All Rectangular Elements

% ---------------------------------------------------------------------

es=vertcat(es1,es2,es3);

rect_stiff(((i-1)*ne_stiff+1):1:(i*ne_stiff),(2:1:5))=es;

clear es es1 es2 es3


% All Triangular Elements

% ---------------------------------------------------------------------

t11=nn_BF(1);

t12=length(node_girder(:,1))+(i-1)*ns_x*ns_z+1;

t13=nn_LW(end);

t21=nn_LW(1);

t22=length(node_girder(:,1))+(i-1)*ns_x*ns_z+ns_z-1;

t23=length(node_girder(:,1))+(i-1)*ns_x*ns_z+ns_z;

t31=nn_BF(end);

t32=nn_RW(1);
```

```
    t33=length(node_girder(:,1))+(i-1)*ns_x*ns_z+(ns_x-1)*ns_z+1;

    t41=length(node_girder(:,1))+(i-1)*ns_x*ns_z+(ns_x-1)*ns_z++ns_z-1;

    t42=nn_RW(end);

    t43=length(node_girder(:,1))+(i-1)*ns_x*ns_z+(ns_x-1)*ns_z++ns_z;


    t1=[t11,t12,t13];

    t2=[t21,t22,t23];

    t3=[t31,t32,t33];

    t4=[t41,t42,t43];


    ele_t=[t1;t2;t3;t4];


    i1=(i-1)*4+1;

    i2=4*i;

    tri_stiff(i1:i2,2:4)=ele_t;


    clear t11 t12 t13 t21 t22 t23 t31 t32 t33 t41 t42 t43

    clear t1 t2 t3 t4

    clear i1 i2 ele_t

    clear nn_LW nn_BF nn_RW


end

clear ans i y_index nn_stiff ne_stiff nn_girder

clear cs_line n_bot_x n_top_x n_stiff n_w_x n_w_z ns_x ns_z
```

```
% ========================================================================
% PART 6:  IMPERFECTION I (FLANGE TILT)
% ========================================================================

% 6.1 Locating Nodes along Y-Axis
% ------------------------------------------------------------------------
index_imp1=zeros(length(Imp_St1),1);
for i=1:length(index_imp1)
    i1=Imp_St1(i)*12;
    i1=round(i1*1e6)/1e6;
    for j=1:length(node_y)
        if i1==node_y(j)
            index_imp1(i)=j;
        end
    end
    clear ans i1 j
end
clear ans i

% 6.2 Base Imperfection Vector (Magnitude = 1.0)
% ------------------------------------------------------------------------
base_imp1=zeros(length(node_y),1);
for i=1:(length(Imp_St1)-1)
    i1=index_imp1(i);
    i2=index_imp1(i+1);
```

```
    y1=node_y(i1);
    y2=node_y(i2);
    x_imp=node_y(i1:i2)-y1;
    y_imp=sin(pi*x_imp/(y2-y1));
    if mod(i,2)==0
        y_imp=-y_imp;
    else
        y_imp=+y_imp;
    end
    base_imp1(i1:i2)=y_imp;
    clear i1 i2 y1 y2 x_imp y_imp
end
clear ans i

L_imp1=Imp_St1(2)-Imp_St1(1);
L_imp2=(Imp_St1(end)-Imp_St1(end-1));

base_imp1(1)=-sin(pi*3/(L_imp1*12));

if mod((length(Imp_St1)-1),2)==0
    base_imp1(end)=+sin(pi*3/(L_imp2*12));
else
    base_imp1(end)=-sin(pi*3/(L_imp2*12));
end
clear L_imp1 L_imp2
```

```
% 6.3 Locating Flange Nodes & Scaling Functions
% ------------------------------------------------------------------------
imp1_node_x1=(1:(ne_tf+1))';
imp1_node_x2=((length(node_cs(:,1))-ne_tf):length(node_cs(:,1)))';
scale_imp1_x1=+(1:(-1/ne_tf):0);
if Imp_Opt1==+1
    scale_imp1_x2=+(0:(+1/ne_tf):1);
elseif Imp_Opt1==-1
    scale_imp1_x2=-(0:(+1/ne_tf):1);
end

imp1_node=zeros(length(node_cs(:,1)),1);
imp1_node(imp1_node_x1)=scale_imp1_x1;
imp1_node(imp1_node_x2)=scale_imp1_x2;

clear imp1_node_x1 imp1_node_x2
clear scale_imp1_x1 scale_imp1_x2

% 6.4 Applying Imperfections to Girder Nodes
% ------------------------------------------------------------------------
imp1_girder_x=zeros(length(node_girder(:,1)),1);
for i=1:length(node_y)
    i1=(i-1)*length(node_cs(:,1))+1;
    i2=(i-0)*length(node_cs(:,1))+0;
```

```
    imp1_girder_x(i1:i2)=base_imp1(i);
    clear i1 i2
end
clear ans i
imp1_girder_z=repmat(imp1_node,length(node_y),1);
imp1_girder=imp1_girder_x.*imp1_girder_z;
imp1_girder=imp1_girder*Imp_Mag1;
imp1_girder=round(imp1_girder*1e6)/1e6;

node_girder(:,4)=node_girder(:,4)+imp1_girder;
clear imp1_girder_x imp1_girder_z imp1_girder

% 6.5 Final Clear Statements
% ------------------------------------------------------------------------
clear base_imp1 imp1_node index_imp1



% ========================================================================
% PART 7:  CENTROID & SHEAR CENTER
% ========================================================================

% 7.1 Element Breakdown for Section Properties
% ------------------------------------------------------------------------
sne_tf=1;     % number of s.c. elements along the top flange
sne_b=100;    % number of s.c. elements along the bend
```

```
sne_w=1;       % number of s.c. elements along the web
sne_bf=1;      % number of s.c. elements along the bottom flange


% 7.2 Constant Values
% ------------------------------------------------------------------------
% theta = bend angle (rad)
% L_bend = length of the bend region (in)
% Dx = length of the x-portion inclined web (in)
% Dy = length of the y-portion inclined web (in)
% bbf = bottom flange width (in)
theta=pi/2-atan(1/slope);
L_bend=r*atan(slope);
Dx=2*r/(slope*sqrt(slope^2+1))+(d-t-2*r)/slope;
Dy=d-t-2*r*(1-1/sqrt(slope^2+1));
D=(2*r+(d-t-2*r)*sqrt(slope^2+1))/slope;
bbf=w-(4*L_bend+2*D+2*btf);


% 7.3 Node Layout - Top Flange
% ------------------------------------------------------------------------
n_tf_x=((0):(btf/sne_tf):(btf))'+2*r*sin(theta)+Dx+bbf/2;
n_tf_y=zeros(sne_tf+1,1)+d-t;


n_tf_x1=-n_tf_x;    n_tf_y1=n_tf_y;
n_tf_x2=+n_tf_x;    n_tf_y2=n_tf_y;
clear n_tf_x n_tf_y
```

```
% 7.4 Node Layout - Top Bend Regions
% ------------------------------------------------------------------------
n_theta=(pi/2-theta):(theta/sne_b):(pi/2);
n_tb_x=-r*cos(n_theta)+2*r*sin(theta)+Dx+bbf/2;
n_tb_y=r*sin(n_theta)-2*r*cos(theta)+Dy+r;

n_tb_x1=-n_tb_x';   n_tb_y1=n_tb_y';
n_tb_x2=+n_tb_x';   n_tb_y2=n_tb_y';
clear n_theta n_tb_x n_tb_y

% 7.5 Node Layout - Flat Web Regions
% ------------------------------------------------------------------------
n_w_x=((0):(Dx/sne_w):(Dx))'+r*sin(theta)+bbf/2;
n_w_y=((0):(Dy/sne_w):(Dy))'+2*r*(sin(theta/2))^2;

n_w_x1=-n_w_x;      n_w_y1=n_w_y;
n_w_x2=+n_w_x;      n_w_y2=n_w_y;
clear n_w_x n_w_y

% 7.6 Node Layout - Bottom Bend Regions
% ------------------------------------------------------------------------
n_theta=(3*pi/2):(theta/sne_b):(3*pi/2+theta);
n_bb_x=r*cos(n_theta)+bbf/2;
n_bb_y=r*sin(n_theta)+r;
```

```
n_bb_x1=-n_bb_x';   n_bb_x2=n_bb_x';
n_bb_y1=+n_bb_y';   n_bb_y2=n_bb_y';
clear n_theta n_bb_x n_bb_y

% 7.7 Node Layout - Bottom Flange
% ------------------------------------------------------------------------
n_bf_x=((-bbf/2):(bbf/sne_bf):(bbf/2))';
n_bf_y=zeros(sne_bf+1,1);

% 7.8 Node Layout - Concatenation
% ------------------------------------------------------------------------
nx1=vertcat(n_tf_x1,n_tb_x1,n_w_x1); ny1=vertcat(n_tf_y1,n_tb_y1,n_w_y1);
nx2=vertcat(n_bb_x1,n_bf_x,n_bb_x2); ny2=vertcat(n_bb_y1,n_bf_y,n_bb_y2);
nx3=vertcat(n_w_x2,n_tb_x2,n_tf_x2); ny3=vertcat(n_w_y2,n_tb_y2,n_tf_y2);

nx=vertcat(nx1,nx2,nx3);    ny=vertcat(ny1,ny2,ny3);
nx=round(nx*1e6)/1e6;       ny=round(ny*1e6)/1e6;
clear nx1 nx2 nx3 ny1 ny2 ny3

node=horzcat(nx,ny);
node=unique(node,'rows');
node(:,2)=node(:,2)+t/2;
node=round(node*1e6)/1e6;
clear nx ny
```

```
% 7.9 Node Layout - Clear Statements
% ------------------------------------------------------------------------
clear n_tf_x1 n_tb_x1 n_w_x1    n_tf_y1 n_tb_y1 n_w_y1
clear n_bb_x1 n_bf_x n_bb_x2    n_bb_y1 n_bf_y n_bb_y2
clear n_w_x2 n_tb_x2 n_tf_x2    n_w_y2 n_tb_y2 n_tf_y2
clear theta L_bend Dx Dy D bbf
clear sne_tf sne_b sne_w sne_bf


% 7.10 Fundamental Terms
% ------------------------------------------------------------------------
nnode=length(node(:,1)); % nnode = number of nodes
nele=nnode-1;            % nele = number of elements


% 7.11 Torsional Properties - Lengths & Area
% ------------------------------------------------------------------------
Lij=zeros(nele,1); % Lij = length of each element (in)
Aij=zeros(nele,1); % Aij = area of each element (in^2)
for i=1:nele
    xi=node(i,1);
    xj=node(i+1,1);
    yi=node(i,2);
    yj=node(i+1,2);
    Lij(i)=sqrt((xj-xi)^2+(yj-yi)^2);
    Aij(i)=t*Lij(i);
    clear xi xj yi yj
```

```
end
clear ans i
A=sum(Aij);         % A = area of cross-section (in^2)

% 7.12 Torsional Properties - Center-of-Gravity
% ------------------------------------------------------------------------
Qxij=zeros(nele,1); % Qxij = first moment of area about X-axis (in^3)
Qyij=zeros(nele,1); % Qyij = first moment of area about X-axis (in^3)
for i=1:nele
    xi=node(i,1);
    xj=node(i+1,1);
    yi=node(i,2);
    yj=node(i+1,2);
    Qxij(i)=(Aij(i)/2)*(xi+xj);
    Qyij(i)=(Aij(i)/2)*(yi+yj);
    clear xi xj yi yj
end
clear ans i
x_bar=sum(Qxij)/A;  % x_bar = X-axis centroid (in)
y_bar=sum(Qyij)/A;  % y_bar = Y-axis centroid (in)

% 7.13 Torsional Properties - Moments of Inertia
% ------------------------------------------------------------------------
pij=zeros(nele,1);   % pij = distances from elements to the C.G. (in)
Ixxij=zeros(nele,1); % Ixxij = X-axis element moment of inertia (in^4)
```

```
Iyyij=zeros(nele,1); % Iyyij = Y-axis element moment of inertia (in^4)
for i=1:nele
    xi=node(i,1)-x_bar;
    xj=node(i+1,1)-x_bar;
    yi=node(i,2)-y_bar;
    yj=node(i+1,2)-y_bar;
    pij(i)=(xi*yj-xj*yi)/Lij(i);
    Ixxij(i,1)=(Aij(i)/3)*(yi^2+yi*yj+yj^2);
    Iyyij(i,1)=(Aij(i)/3)*(xi^2+xi*xj+xj^2);
    clear xi xj yi yj
end
clear ans i
Iyy=sum(Iyyij);      % Iyy = Y-axis moment of inertia (in^4)

% 7.14 Torsional Properties - Unit Warping (C.G.)
% ------------------------------------------------------------------------
wij=zeros(nele,2); % wij = unit warp. with respect to the C.G. (in^2)
for i=1:nele
    if i==1
        wij(i,1)=0;
        wij(i,2)=pij(i)*Lij(i);
    else
        wij(i,1)=wij(i-1,2);
        wij(i,2)=wij(i,1)+pij(i)*Lij(i);
    end
end
```

```
clear ans i


% 7.15 Torsional Properties - Warping Products
% ------------------------------------------------------------------------
Iwxij=zeros(nele,1); % Iwxij = X-axis element warp. prod. (in^5)
for i=1:nele
    xi=node(i,1)-x_bar;
    xj=node(i+1,1)-x_bar;
    wi=wij(i,1);
    wj=wij(i,2);
    Iwxij(i,1)=(Aij(i)/3)*(wi*xi+wj*xj)+(Aij(i)/6)*(wi*xj+wj*xi);
    clear xi xj yi yj wi wj
end
clear ans i
Iwx=sum(Iwxij);      % Iwx = X-axis warping product of inertia (in^5)
Yo=-Iwx/Iyy;         % Yo = Y-axis shear center (in)


% 7.16 Final Clear Statements
% ------------------------------------------------------------------------
y_centroid=round(y_bar*1e6)/1e6;
y_shear=round(Yo*1e6)/1e6;


clear nnode nele node x_bar y_bar Yo
clear Lij Aij Qxij Qyij Ixxij Iyyij wij pij
clear A Iwxij Iwyij Iwx Iwy Ixx Iyy x_bar
```

```
% ========================================================================
% PART 8:  IMPERFECTION II (GIRDER TWIST, APPLICATION TO GIRDER)
% ========================================================================


% 8.1 Locating Nodes along Y-Axis
% ------------------------------------------------------------------------
index_imp2=zeros(length(Imp_St2),1);
for i=1:length(index_imp2)
    i1=Imp_St2(i)*12;
    i1=round(i1*1e6)/1e6;
    for j=1:length(node_y)
        if i1==node_y(j)
            index_imp2(i)=j;
        end
    end
    clear ans i1 j
end
clear ans i


% 8.2 Base Imperfection Vector
% ------------------------------------------------------------------------
base_imp2=zeros(length(node_y),1);
for i=1:(length(Imp_St2)-1)
```

```
    i1=index_imp2(i);
    i2=index_imp2(i+1);
    y1=node_y(i1);
    y2=node_y(i2);
    x_imp=node_y(i1:i2)-y1;
    y_imp=sin(pi*x_imp/(y2-y1));
    if mod(i,2)==0
        y_imp=-y_imp;
    else
        y_imp=+y_imp;
    end
    base_imp2(i1:i2)=y_imp;
    clear i1 i2 y1 y2 x_imp y_imp
end
clear ans i

L_imp1=Imp_St2(2)-Imp_St2(1);
L_imp2=(Imp_St2(end)-Imp_St2(end-1));

base_imp2(1)=-sin(pi*3/(L_imp1*12));

if mod((length(Imp_St2)-1),2)==0
    base_imp2(end)=+sin(pi*3/(L_imp2*12));
else
    base_imp2(end)=-sin(pi*3/(L_imp2*12));
```

```
end
clear L_imp1 L_imp2


% 8.3 Rotation of Cross-Section about Chosen Point
% ------------------------------------------------------------------------
adj_cs=y_shear*(Imp_Opt2)+y_centroid*(1-Imp_Opt2);
node_adj_cs=node_cs;
node_adj_cs(:,2)=node_adj_cs(:,2)-adj_cs;
rotated_cs=zeros(length(node_adj_cs(:,2)),2);
for i=1:length(node_adj_cs(:,1))
    x_i=node_adj_cs(i,1);
    y_i=node_adj_cs(i,2);
    c_i=cos(-pi*Imp_Mag2/180);
    s_i=sin(-pi*Imp_Mag2/180);
    RM=[c_i,-s_i;s_i,c_i];
    r_i=RM*[x_i;y_i];
    rotated_cs(i,:)=r_i';
    clear x_i y_i c_i s_i RM r_i xr_i yr_i
end
clear ans i


% 8.4 Applying Imperfections to Girder Nodes
% ------------------------------------------------------------------------
correct_cs=rotated_cs-node_cs;
correct_cs(:,2)=correct_cs(:,2)+adj_cs;
```

```
imp2_girder=zeros(length(node_girder(:,1)),3);
for i=1:length(node_y)
    i1=(i-1)*length(node_cs(:,1))+1;
    i2=(i-0)*length(node_cs(:,1))+0;
    imp2_girder(i1:i2,2)=correct_cs(:,1)*base_imp2(i);
    imp2_girder(i1:i2,4)=correct_cs(:,2)*base_imp2(i);
    clear i1 i2
end
clear ans i
imp2_girder=round(imp2_girder*1e6)/1e6;

node_girder(:,2)=node_girder(:,2)+imp2_girder(:,2);
node_girder(:,4)=node_girder(:,4)+imp2_girder(:,4);

clear correct_cs imp2_girder

% 8.5 Final Clear Statements
% ------------------------------------------------------------------------
clear index_imp2 node_adj_cs
clear rotated_cs



% ========================================================================
% PART 9:  IMPERFECTION II (GIRDER TWIST, APPLICATION TO STIFFENERS)
```

```
% ========================================================================

% 9.1 Base Imperfection Vector
% ------------------------------------------------------------------------
ns_rot=length(node_stiff(:,1))/length(Loc_St);
node_rawstiff=node_stiff((1:ns_rot),[2,4]);
node_rawstiff(:,2)=node_rawstiff(:,2)-adj_cs;

adjusted_stiff=zeros(length(node_rawstiff(:,1)),2);
for i=1:length(adjusted_stiff(:,1))
    x_i=node_rawstiff(i,1);
    y_i=node_rawstiff(i,2);
    c_i=cos(-pi*Imp_Mag2/180);
    s_i=sin(-pi*Imp_Mag2/180);
    RM=[c_i,-s_i;s_i,c_i];
    r_i=RM*[x_i;y_i];
    adjusted_stiff(i,:)=r_i';
    clear x_i y_i c_i s_i RM r_i xr_i yr_i
end
clear ans i

% 9.2 Rotation Magnitudes at the Stiffeners
% ------------------------------------------------------------------------
mag_rotation=zeros(length(Loc_St),1);
for i=1:length(mag_rotation)
```

```
    ind_mag=Loc_St(i)*12;
    ind_mag=round(ind_mag*1e6)/1e6;
    for j=1:length(node_y)
        if ind_mag==node_y(j)
            mag_rotation(i)=base_imp2(j);
        end
    end
    clear ans j
end
clear ans i


% 9.3 Imperfections at all Stiffeners
% ------------------------------------------------------------------------
correct_stiff=adjusted_stiff-node_rawstiff;
correct_stiff(:,2)=correct_stiff(:,2);
imp2_stiff=zeros(length(node_stiff(:,1)),2);
for i=1:length(mag_rotation)
    i1=(i-1)*length(correct_stiff(:,1))+1;
    i2=(i-0)*length(correct_stiff(:,1))+0;
    imp2_stiff(i1:i2,1)=correct_stiff(:,1)*mag_rotation(i);
    imp2_stiff(i1:i2,2)=correct_stiff(:,2)*mag_rotation(i);
    clear i1 i2
end
clear ans i
imp2_stiff=round(imp2_stiff*1e6)/1e6;
node_stiff(:,2)=node_stiff(:,2)+imp2_stiff(:,1);
```

```
node_stiff(:,4)=node_stiff(:,4)+imp2_stiff(:,2);


% 9.4 Final Clear Statements
% ------------------------------------------------------------------------
clear base_imp2 node_rawstiff adjusted_stiff correct_stiff
clear ind_mag mag_rotation
clear y_shear y_centroid adj_cs ns_rot




% ========================================================================
% PART 10:  IMPERFECTION III (WEB OUT-OF-FLATNESS)
% ========================================================================


% 10.1 Locating Nodes along Y-Axis
% ------------------------------------------------------------------------
index_imp3=zeros(length(Imp_St3),1);
for i=1:length(index_imp3)
    i1=Imp_St3(i)*12;
    i1=round(i1*1e6)/1e6;
    for j=1:length(node_y)
        if i1==node_y(j)
            index_imp3(i)=j;
        end
    end
```

```
    clear ans i1 j
end
clear ans i


% 10.2 Base Imperfection Vector (Longitudinal)
% ------------------------------------------------------------------------
base_imp3=zeros(length(node_y),1);
for i=1:(length(Imp_St3)-1)
    i1=index_imp3(i);
    i2=index_imp3(i+1);
    y1=node_y(i1);
    y2=node_y(i2);
    x_imp=node_y(i1:i2)-y1;
    y_imp=sin(pi*x_imp/(y2-y1));
    if mod(i,2)==0
        y_imp=-y_imp;
    else
        y_imp=+y_imp;
    end
    base_imp3(i1:i2)=y_imp;
    clear i1 i2 y1 y2 x_imp y_imp
end
clear ans i


L_imp1=Imp_St3(2)-Imp_St3(1);
```

```
L_imp2=(Imp_St3(end)-Imp_St3(end-1));


base_imp3(1)=-sin(pi*3/(L_imp1*12));


if mod((length(Imp_St3)-1),2)==0
    base_imp3(end)=+sin(pi*3/(L_imp2*12));
else
    base_imp3(end)=-sin(pi*3/(L_imp2*12));
end
clear L_imp1 L_imp2


% 10.3 Base Imperfection Vector (Transverse)
% ------------------------------------------------------------------------
slope=04;                                % slope ratio of web
r=11/2*t;                                % bend rad. at mid-thickness [in]
Web_z=d-t+2*r*(1/(sqrt(slope^2+1))-1); % Z-portion of straight web [in]
Web_x=Web_z/slope;                       % X-portion of straight web [in]
L_W=sqrt(Web_x^2+Web_z^2);               % length of straight web [in]
clear Web_x Web_z


ni_wx=((0):(L_W/ne_w):(L_W))';
ni_wy=sin(pi*ni_wx/L_W);


new_1=1+ne_tf+ne_b;
new_2=new_1+ne_w;
```

```
new_3=new_2+2*ne_b+ne_bf;

new_4=new_3+ne_w;

base_twist=zeros(length(node_cs(:,1)),1);

base_twist(new_1:new_2)=ni_wy;

if Imp_Opt3==+1

    base_twist(new_3:new_4)=+ni_wy;

elseif Imp_Opt3==-1

    base_twist(new_3:new_4)=-ni_wy;

end

clear new_1 new_2 new_3 new_4 ni_wx ni_wy


% 10.4 Base Imperfection Vector (Girder)

% ------------------------------------------------------------------------

base_girder=zeros(length(node_girder(:,1)),1);

for i=1:length(node_y)

    i1=(i-1)*length(base_twist(:,1))+1;

    i2=(i-0)*length(base_twist(:,1))+0;

    base_girder(i1:i2)=base_twist*base_imp3(i);

    clear i1 i2

end

clear ans i


base_trig=zeros(length(node_girder(:,1)),2);

t_comp_x=cos(atan(1/slope));

t_comp_z=sin(atan(1/slope));
```

```
base_trig(:,1)=base_girder*t_comp_x;

base_trig(:,2)=base_girder*t_comp_z;

base_trig=base_trig*Imp_Mag3;

base_trig=round(base_trig*1e6)/1e6;

clear t_comp_x t_comp_z


% 10.5 Imperfection Application and Clear Statements

% ------------------------------------------------------------------------

node_girder(:,2)=node_girder(:,2)+base_trig(:,1);

node_girder(:,4)=node_girder(:,4)+base_trig(:,2);

clear base_imp3 base_girder base_twist base_trig index_imp3 L_W




% ========================================================================

% PART 11:  LOADING, BOUNDARY CONDITIONS & DATA COLLECTION

% ========================================================================


% 11.1 Loading Applied at Midspan

% ------------------------------------------------------------------------

nn_l_stiff=length(node_stiff(:,1))/length(Loc_St);

for i=1:length(Loc_St)

     si=round(Loc_St(i)*12*1e6)/1e6;

     Ls=round(L*12/2*1e6)/1e6;

    if si==Ls
```

```
        stiff_index=i;
    end
    clear si Ls
end
clear ans i

k1=(stiff_index-1)*nn_l_stiff+1;
k2=(stiff_index-0)*nn_l_stiff+0;
single_stiff=node_stiff((k1:k2),:);
single_stiff=round(single_stiff*1e6)/1e6;
imp_loadstiff=imp2_stiff((k1:k2),:);
imp_loadstiff=round(imp_loadstiff*1e6)/1e6;
clear k1 k2

single_stiff(:,2)=single_stiff(:,2)-imp_loadstiff(:,1);
single_stiff(:,4)=single_stiff(:,4)-imp_loadstiff(:,2);
single_stiff=round(single_stiff*1e6)/1e6;

z_max=max(single_stiff(:,4));

search_stiff=zeros(nn_l_stiff,4);
for i=1:nn_l_stiff
    if single_stiff(i,4)==z_max
        search_stiff(i,:)=single_stiff(i,:);
    end
```

```
end
clear ans i

load_stiff=search_stiff(any(search_stiff,2),:); % removes zero rows
load_stiff=load_stiff(:,1);

load_mag=zeros(length(load_stiff),1);
load_mag=load_mag+1;
load_mag(1)=1/2;
load_mag(end)=1/2;
load_mag=load_mag/sum(load_mag);
load_mag=-load_mag*Load_ap;
load_mag=round(load_mag*1e6)/1e6;

load=zeros(length(load_stiff),3);
load(:,1)=load_stiff;
load(:,2)=3;
load(:,3)=load_mag;

clear nn_l_stiff stiff_index single_stiff search_stiff z_max
clear load_stiff load_mag imp2_stiff

% 11.2 Boundary Conditions
% ------------------------------------------------------------------------
bc_i1=1+ne_tf+ne_b;
```

```
bc_i2=bc_i1+ne_w;

bc_i3=bc_i2+2*ne_b+ne_bf;

bc_i4=bc_i3+ne_w;

bc_g3=vertcat((bc_i1:bc_i2)',(bc_i3:bc_i4)');

clear bc_i1 bc_i2 bc_i3 bc_i4


ind_bcx=zeros(length(Loc_Lat(:,1)),1);

for i=1:length(Loc_Lat)

    index_lat=Loc_Lat(i)*12;

    index_lat=round(index_lat*1e6)/1e6;

    for j=1:length(node_y)

        if index_lat==node_y(j)

            ind_bcx(i)=j;

        end

    end

    clear ans j

    clear index_lat

end

clear ans i


node_bcx=zeros(length(Loc_Lat(:,1))*length(bc_g3),1);

for i=1:length(ind_bcx)

    i1=(i-1)*length(bc_g3(:,1))+1;

    i2=(i-0)*length(bc_g3(:,1))+0;

    mult_bc=(ind_bcx(i)-1)*length(node_cs(:,1));
```

```
    node_bcx(i1:i2)=bc_g3+mult_bc;
    clear i1 i2 mult_bc
end
clear ans i

node_bcy=bc_g1';
node_bcz=vertcat(bc_g1',bc_g2');

clear ind_bcx
clear bc_g1 bc_g2 bc_g3



% ========================================================================
% PART 12:  ABAQUS INPUT FILE
% ========================================================================

% 12.1 Input File Creation & Heading
% ------------------------------------------------------------------------
inputfile=strcat('noncompositeimpv2intbrace','.inp');
fid=fopen(inputfile,'wt');
fprintf(fid,'** Gregory K. Michaelson, Ph.D., P.E.\n');
fprintf(fid,'** Karl E. Barth, Ph.D.\n');
fprintf(fid,'** %s\n',datestr(now,0));
fprintf(fid,'**\n');
clear date
```

```
fprintf(fid,'** BRIDGE/GIRDER PARAMETERS\n');
fprintf(fid,'** ----------------------------------------------------\n');
fprintf(fid,'** Span Length [ft]                    = ');
fprintf(fid,'%10.6f\n',L);
fprintf(fid,'** Std. Mill Plate Width [in]          = ');
fprintf(fid,'%10.2f\n',w);
fprintf(fid,'** Std. Mill Plate Thickness [in]      = ');
fprintf(fid,'%10.6f\n',t);
fprintf(fid,'** Bearing Plate Thickness [in]        = ');
fprintf(fid,'%10.6f\n',t_BRG);
fprintf(fid,'** Total Steel Girder Depth [in]       = ');
fprintf(fid,'%10.2f\n',d);
fprintf(fid,'** Top Flange Width [in]               = ');
fprintf(fid,'%10.2f\n',btf);
fprintf(fid,'**\n');
fprintf(fid,'** FINITE ELEMENT MODELING PARAMETERS\n');
fprintf(fid,'** ----------------------------------------------------\n');
fprintf(fid,'** No. of Elements along the Bottom Flange  = ');
fprintf(fid,'%10.0f\n',ne_bf);
fprintf(fid,'** No. of Elements along the Web            = ');
fprintf(fid,'%10.0f\n',ne_w);
fprintf(fid,'** No. of Elements along Bend Regions       = ');
fprintf(fid,'%10.0f\n',ne_b);
fprintf(fid,'** No. of Elements along the Top Flange     = ');
fprintf(fid,'%10.0f\n',ne_tf);
fprintf(fid,'** Longitudinal Element Length [in]         = ');
```

```
fprintf(fid,'%10.2f\n',le_L);
fprintf(fid,'**\n');


% 12.2 Nodes
% ------------------------------------------------------------------------
fprintf(fid,'*NODE\n');
for i=1:length(node_girder(:,1))
    fprintf(fid,'%10.0f,%15.6f,%15.6f,%15.6f\n',node_girder(i,:)');
end
clear ans i node_girder
for i=1:length(node_stiff(:,1))
    fprintf(fid,'%10.0f,%15.6f,%15.6f,%15.6f\n',node_stiff(i,:)');
end
clear ans i node_stiff


% 12.3 Elements
% ------------------------------------------------------------------------
fprintf(fid,'*ELEMENT, TYPE=S4R, ELSET=GIRDER\n');
for i=1:length(element_girder(:,1))
    fprintf(fid,'%10.0f,%10.0f,%10.0f,%10.0f,%10.0f\n',element_girder(i,:)');
end
clear ans i element_girder
fprintf(fid,'*ELEMENT, TYPE=S4R, ELSET=STIFFENER\n');
for i=1:length(rect_stiff(:,1))
    fprintf(fid,'%10.0f,%10.0f,%10.0f,%10.0f,%10.0f\n',rect_stiff(i,:)');
```

```
end
clear ans i rect_stiff
fprintf(fid,'*ELEMENT, TYPE=S3R, ELSET=STIFFENER\n');
for i=1:length(tri_stiff(:,1))
    fprintf(fid,'%10.0f,%10.0f,%10.0f,%10.0f\n',tri_stiff(i,:)');
end
clear ans i tri_stiff

% 12.4 Sets for Boundary Conditions & Data Collection
% -------------------------------------------------------------------------
fprintf(fid,'*NSET, NSET=BCX\n');
for i=1:length(node_bcx(:,1))
    fprintf(fid,'%10.0f,\n',node_bcx(i,:)');
end
clear ans i node_bcx
fprintf(fid,'*NSET, NSET=BCY\n');
for i=1:length(node_bcy(:,1))
    fprintf(fid,'%10.0f,\n',node_bcy(i,:)');
end
clear ans i node_bcy
fprintf(fid,'*NSET, NSET=BCZ\n');
for i=1:length(node_bcz(:,1))
    fprintf(fid,'%10.0f,\n',node_bcz(i,:)');
end
clear ans i node_bcz
```

```
% 12.5 MPCs & Boundary Conditions
% ------------------------------------------------------------------------
fprintf(fid,'*BOUNDARY\n');
fprintf(fid,'       BCX,         1\n');
fprintf(fid,'       BCY,         2\n');
fprintf(fid,'       BCZ,         3\n');


% 12.6 Materials & Section Sets
% ------------------------------------------------------------------------
%Steel Material Model  Added 04/15/2020


E=29559.160900899;      % modulus of elasticity (ksi)
ssy=60.9620413788773;   % static yield strength (ksi)
s02=63.05;              % offset yield strength (ksi)
est=0.0178825333333333; % strain at the onset of strain hardening
Est=1033.46262739326;   % strain hardening modulus (ksi)
su=84.3821008182302;    % tensile strength (ksi)
eu=0.131645626079353;   % strain at the tensile strength


e1=ssy/E;   e2=est;     e3=(eu-est)/10+est;
s1=ssy;     s2=ssy;     s3=Est*(eu-est)/10+ssy;


e6=eu-(eu-est)/10;                      e7=eu;
s6=(ssy/s02)*su-(100*(eu-est))/Est;     s7=(ssy/s02)*su;
```

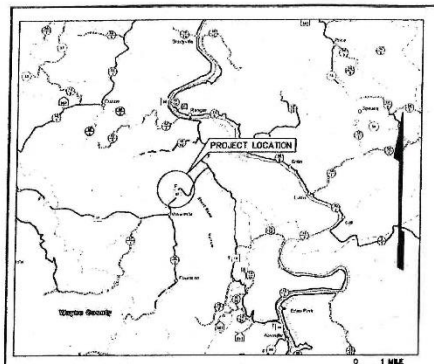
```
e4=2*(e6-e3)/7+e3;      e5=2*(e6-e3)/7+e4;

s4=4*(s6-s3)/7+s3;      s5=2*(s6-s3)/7+s4;


e_eng=[e1;e2;e3;e4;e5;e6;e7];

s_eng=[s1;s2;s3;s4;s5;s6;s7];


e_true=log(1+e_eng);

e_true=e_true-e_true(1);

s_true=s_eng.*(1+e_eng);


steel=horzcat(s_true,e_true);


%End of addition 04/15/2020


fprintf(fid,'*MATERIAL, NAME=STEEL\n');

fprintf(fid,'*DENSITY\n');

fprintf(fid,'%10.6e\n',(0.49/(12^3))/386.08858267716533);

fprintf(fid,'*ELASTIC\n');

fprintf(fid,'%10.0f,%10.2f\n',[29000,0.3]);

fprintf(fid,'*PLASTIC \n');

for i=1:length(steel(:,1))

    fprintf(fid,'%12.3f, %12.7f',steel(i,:)');

    fprintf(fid,'\n');

end
```

```
%end of addition 04/15/2020
fprintf(fid,'*SHELL SECTION, ELSET=GIRDER, MATERIAL=STEEL\n');
fprintf(fid,'%10.6f\n',t);
fprintf(fid,'*SHELL SECTION, ELSET=STIFFENER, MATERIAL=STEEL\n');
fprintf(fid,'%10.6f\n',t_BRG);


% 12.7 Static Step & Load Application
% ------------------------------------------------------------------------
% fprintf(fid,'*STEP, NAME=LOAD, NLGEOM=NO, INC=1\n');
% fprintf(fid,'*STATIC\n');
% fprintf(fid,'%10.0f,%10.0f,%10.6f,%10.0f\n',[1,1,1e-5,1]);
% fprintf(fid,'*CLOAD\n');
% for i=1:length(load(:,1))
%     fprintf(fid,'%10.0f,%10.0f,%10.6f\n',load(i,:)');
% end
% clear ans i load
% fprintf(fid,'*OUTPUT, HISTORY, VARIABLE=PRESELECT\n');
% fprintf(fid,'*OUTPUT, FIELD, VARIABLE=PRESELECT\n');
% % fprintf(fid,'*EL PRINT, ELSET=DF, FREQUENCY=1, POSITION=CENTROIDAL\n');
% % fprintf(fid,'       S22\n');
% fprintf(fid,'*END STEP');


% 12.7 Static Riks Step and Load Application (04/16/2020)
% ------------------------------------------------------------------------
fprintf(fid,'*STEP, NLGEOM=YES, INC=2000 \n');
```

```
fprintf(fid,'*STATIC, RIKS \n');
fprintf(fid,'%10.4f, %10.2f, %10.7f, %10.1f, %10.1f',[0.005,1,1e-7,2,1]);
fprintf(fid,'\n');
%fprintf(fid,'*NODE PRINT, FREQUENCY=1, NSET=DEFL-CL \n');
%fprintf(fid,'U3, \n');
fprintf(fid,'*CLOAD, OP=NEW \n');
for i=1:length(load(:,1))
    %fprintf(fid,'%15.0f, %15.0f, %15.6f,',cload(i,:)');
    %fprintf(fid,'\n');
    fprintf(fid,'%10.0f,%10.0f,%10.6f\n',load(i,:)');   %From static general
end
clear ans i load
fprintf(fid,'*OUTPUT, HISTORY, VARIABLE=PRESELECT\n');      %From old code
fprintf(fid,'*OUTPUT, FIELD, VARIABLE=PRESELECT\n');        %From Old code
fprintf(fid,'*END STEP');


%End Added Code (04/16/2020)



% 12.8 Close Input File
% --------------------------------------------------------------------
fclose('all');
clear ans fid inputfile
```

APPENDIX C: FOURTEEN MILE BRIDGE DESIGN PLANS

The following appendix includes the detail plans from J.B. Turman Engineering, PLLC for the Fourteen Mile Bridge. These plans are not the final construction plans on file with the West Virginia Division of Highways. Note that these plans have been converted from their original 11”x17” format to 8 ½” x 11” for presentation in this report.

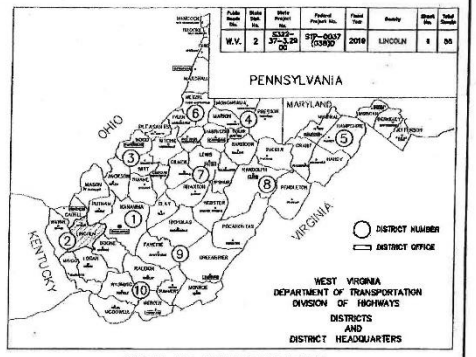


WEST VIRGINIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLANS FOR CONSTRUCTION
OF
STATE HIGHWAY

FEDERAL PROJECT NO. STP-0037(038)D
STATE PROJECT NO. S322-37-3.29 00
STATE ROUTE NO. 37
LAUREL HILL DISTRICT
LINCOLN COUNTY

FOURTEEN MILE BR REP

	Station		Station		f.t.		mile(s)
Roadway	102+00.00	to	103+31.61	=	131.61	=	0.025
Bridge	103+31.61	to	103+92.37	=	60.76	=	0.012
Roadway	103+92.37	to	105+40.00	=	147.63	=	0.028
			Total Project Length	=	340.00	=	0.085



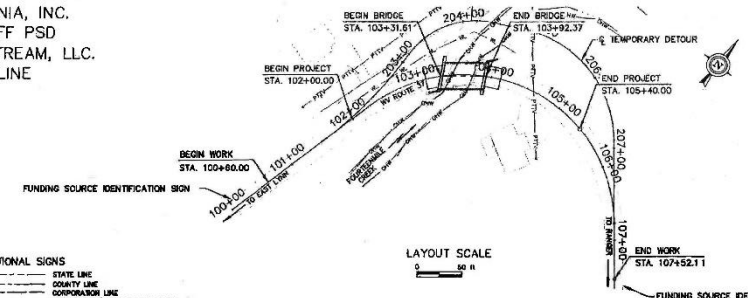
Public Route No.	State Unit No.	State Project	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W.V.	2	S322-37-3.29 00	STP-0037 (038)D	2018	LINCOLN	1	88

UTILITIES

AMERICAN ELECTRIC POWER COMPANY
FRONTIER WEST VIRGINIA, INC.
BRANCHLAND-MIDKIFF PSD
CORE APPALACHIA MIDSTREAM, LLC.
CRANBERRY PIPELINE

TYPE OF CONSTRUCTION

GRADE, DRAIN, PAVE, PAVEMENT MARKINGS & BRIDGE NO. 11374



LAYOUT SCALE
0 50 ft

J.B. TURMAN ENGINEERING, PLLC

JAMES B. TURMAN
REGISTERED
15695
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER

JAMES B. TURMAN P.E. NO. 15695 — DATE 7/6/18

SCALES
PLAN HOR. 0 20 ft
PROFILE VERT. 0 5 ft
HOR. 0 20 ft

DESIGN DESIGNATION
A.D.T. 2013 = 1011
A.Q.T. 2033 = 1042
D.H.V. = N/A
D = N/A
T = N/A
V = 55 mph

CONVENTIONAL SIGNS
STATE LINE
COUNTY LINE
CORPORATION LINE
PROPOSED R/W & EASEMENT LINE
EXISTING R/W LINE
PROPERTY LINE
EXISTING FENCE
PROPOSED FENCE
EDGE OF STREAM
PROPOSED GUARD RAIL
EXISTING GUARD RAIL
RAILROAD
GAS LINE
WATER LINE
TELEPHONE LINE
ELECTRIC LINE
TELEPHONE POLE
POWER POLE
COMBINED POWER AND TELEPHONE POLE
TREE
SHRUB
RIGHT OF WAY MARKER

INDEX TO SHEETS

NO.	DESCRIPTION
1	TITLE SHEET
2	TYPICAL SECTIONS
3	GENERAL NOTES
4	SUMMARY OF QUANTITIES
5	QUANTITY TABLES
6	GEOMETRIC LAYOUT
7	SUPERELEVATION DIAGRAM AND TABLE
8-9	MAINTENANCE OF TRAFFIC
10-11	PLAN SHEETS
12-13	PROFILE SHEETS
14	SIGNING & PAVEMENT MARKING GENERAL NOTES
15-47	BRIDGE NO. 11374
48-88	CROSS SECTIONS

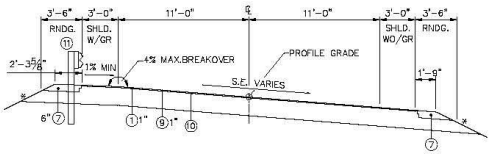
SCALE	REVISIONS	DATE	BY

July 13 2018
I HEREBY CERTIFY THAT THIS IS A CORRECT COPY OF THE PLANS OF PROJECT S322-37-3.29 00, STP-0037(038)D
EXECUTIVE SECRETARY

RECOMMENDED: PROJECT ENGINEER
RECOMMENDED FOR APPROVAL: STATE HIGHWAY ENGINEER
APPROVED: COMMISSIONER OF HIGHWAYS

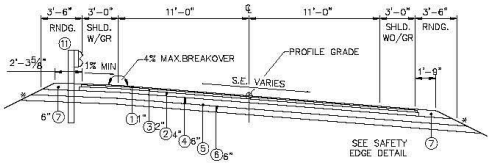
PROJECT NO. S322-37-3.29 00, STP-0037(038)D

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	2	86



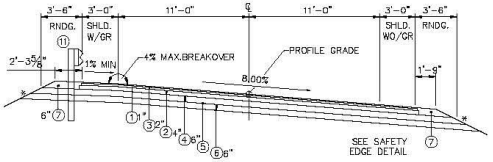
WV 37 – SUPERELEVATED SECTION CURVE RIGHT

STA. 100+60.00 TO STA. 102+00.00
STA. 105+40.00 TO STA. 107+52.11



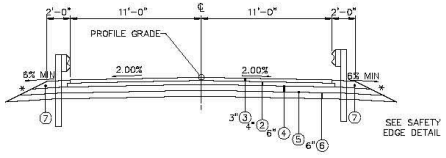
WV 37 – SUPERELEVATED SECTION CURVE RIGHT

STA. 102+00.00 TO STA. 102+58.12



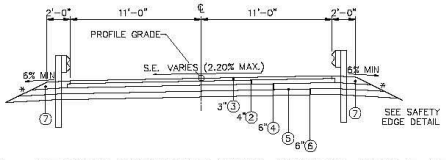
WV 37 – SUPERELEVATED SECTION CURVE RIGHT

STA. 102+58.12 TO STA. 103+11.61
STA. 104+12.37 TO STA. 105+40.00



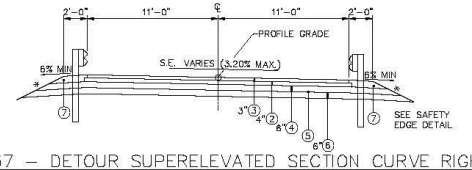
WV 37 – DETOUR CROWN SECTION

STA. 203+01.25 TO STA. 203+13.69
STA. 204+41.33 TO STA. 204+83.36
STA. 206+89.36 TO STA. 208+00.00



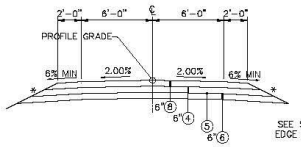
WV 37 – DETOUR SUPERELEVATED SECTION CURVE LEFT

STA. 201+56.81 TO STA. 203+01.25



WV 37 – DETOUR SUPERELEVATED SECTION CURVE RIGHT

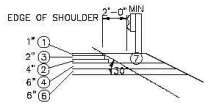
STA. 203+13.69 TO STA. 204+41.43
STA. 204+83.36 TO STA. 206+89.36



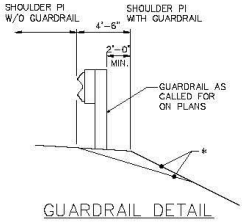
DRIVEWAY – DETOUR CROWN SECTION

STA. 300+97.62 TO STA. 301+15.59

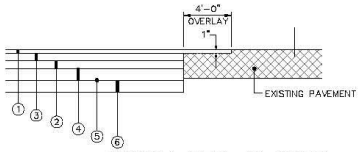
* SLOPES VARY – SEE CROSS SECTIONS



SAFETY EDGE



GUARDRAIL DETAIL



TYPICAL HEEL-IN DETAIL

ITEM	DESCRIPTION	UNITS
(1) 401002-020 (OR-021)	MARSHALL ASPHALT WEARING COURSE, STONE OR GRAVEL (OR SLAG), TYPE 1	TN
(2) 401001-020 (OR-021)	MARSHALL ASPHALT BASE COURSE, STONE OR GRAVEL (OR SLAG), TYPE 1	TN
(3) 401001-023 (OR-024)	MARSHALL ASPHALT BASE COURSE, STONE OR GRAVEL (OR SLAG), TYPE 2	TN
(4) 307001-000	AGGREGATE BASE COURSE, CLASS 1	CY
(5) 207034-000	FABRIC FOR SEPARATION	SY
(6) 207002-000	SUBGRADE	CY
(7) 307001-000	AGGREGATE BASE COURSE, CLASS 10	CY
(8) 307001-000	AGGREGATE BASE COURSE, CLASS 3	CY
(9) 415006-001	STANDARD MILLING	SY
(10) 408002-001	ASPHALT MATERIAL	GA
(11) 607001-001	TYPE 1 GUARDRAIL, CLASS I	LF

NOTE: THE PAVEMENT MIX DESIGN ON THIS PROJECT SHALL BE MARSHALL MEDIUM MIX DESIGN. THE TERM MEDIUM REFERS TO EQUIVALENT SINGLE AXLE LOADS (ESAL'S) AND DOES NOT REFLECT THE QUALITY OF THE ASPHALT. THE DESIGN ESAL VALUE FOR THIS PROJECT IS 1,620,000.

P.O. Box 483
Barboursville, WV 25504
www.jbtengineering.com
304-733-1335

J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

TYPICAL SECTION

GENERAL NOTES

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	3	86

GOVERNING SPECIFICATIONS:

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS, STANDARD SPECIFICATIONS, ROADS AND BRIDGES, ADOPTED 2017, AS AMENDED BY THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION. DIVISION OF HIGHWAYS, SUPPLEMENTAL SPECIFICATIONS, DATED JANUARY 1, 2018, THE CONTRACT DOCUMENTS, AND THE CONTRACT PLANS ARE THE GOVERNING PROVISIONS APPLICABLE TO THIS PROJECT.

STANDARD DETAILS:

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS. STANDARD DETAILS BOOK, VOLUME I, DATED MAY , 2016 & VOLUME II, DATED JANUARY 1, 1994, AND VOLUME III, DATED AUGUST 1, 1999 SHALL APPLY TO THIS PROJECT.

DRAINAGE:

ALL CULVERTS, INLETS AND OTHER DRAINAGE ITEMS ON THIS PROJECT HAVE BEEN LOCATED AS AVAILABLE INFORMATION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ESTABLISHING THE EXACT LOCATION AND ELEVATION OF ALL DRAINAGE ITEMS AND, AFTER REVIEW AND APPROVAL BY THE ENGINEER, MAKE ANY NECESSARY ADJUSTMENTS IN THE FIELD TO INSURE PROPER DRAINAGE.

UTILITIES:

THE LOCATIONS OF ALL KNOWN UTILITIES ARE SHOWN ON THE CONTRACT PLANS BASED ON THE BEST AVAILABLE INFORMATION FROM EXISTING PLANS AND FIELD INFORMATION. THE CONTRACTOR SHALL CALL MISS-UTILITY PLUS ANY UTILITIES COMPANIES NOT COVERED BY MISS-UTILITY, AND HAVE ALL EXISTING UTILITIES FIELD LOCATED BY THE OWNER OR OWNER REPRESENTATIVE PRIOR TO CONSTRUCTION. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ASCERTAIN THE STATUS AND LOCATION OF EACH UTILITY WHEN PERFORMING WORK WHICH MAY AFFECT THESE FACILITIES, INCLUDING PROBING, EXCAVATION, OR ANY OTHER PRECAUTION REQUIRED TO CONFIRM A UTILITY'S LOCATION. IN THE EVENT OF DAMAGE OR DISRUPTION TO UTILITIES WHICH ARE ACTIVE AND ARE TO REMAIN IN SERVICE, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY AN OFFICIAL OF THE AFFECTED UTILITY AND LEND ALL POSSIBLE ASSISTANCE IN RESTORING SERVICE. THE CONTRACTOR SHALL ASSUME ALL COSTS ASSOCIATED WITH THE REPAIR AND INTERRUPTION OF SUCH SERVICES.

VERIFICATION OF DIMENSIONS:

THE CONTRACTOR IS RESPONSIBLE FOR VERIFICATION OF ALL PLAN AND ELEVATION DIMENSIONS PRIOR TO ORDERING MATERIALS FOR THE CONSTRUCTION OF THE VARIOUS BID ITEMS ON THIS PROJECT. THE CONTRACTOR IS TO REPORT ANY DEVIATIONS TO THE ENGINEER PRIOR TO COMMENCEMENT OF WORK.

FERTILIZER, SEEDING AND MULCHING:

ALL DISTURBED SOIL AREAS ARE TO BE SEEDED, MULCHED AND FERTILIZED. MATERIALS AND WORK SHALL BE AS SPECIFIED IN SECTIONS 642 & 652 OF THE STANDARD SPECIFICATIONS. TESTING WILL NOT BE REQUIRED ON THOSE ITEMS WHEN PURCHASED FROM A REPUTABLE DEALER.

WORKING HOURS:

THE CONTRACTOR SHALL BE PROHIBITED FROM WORKING WITHIN 600 FEET OF ANY RESIDENCE BETWEEN THE HOURS OF 10:00 PM AND 6:00 AM. ALL CONSTRUCTION EQUIPMENT POWERED BY AN INTERNAL COMBUSTION ENGINE SHALL BE EQUIPPED WITH A PROPERLY MAINTAINED MUFFLER.

WATER QUALITY:

THE CONTRACTOR WILL BE RESPONSIBLE FOR WATER QUALITY THROUGHOUT THE DURATION OF THE CONSTRUCTION. THE PROJECT ENGINEER WILL WORK CLOSELY WITH THE PROJECT SUPERINTENDENT. THE CONTRACTOR WILL BE RESPONSIBLE FOR THE FOLLOWING;

1. DEVELOPING AND IMPLEMENTING AN EFFECTIVE EROSION CONTROL PLAN.
2. DIRECTING THE CONSTRUCTION, OPERATION AND DISMANTLING OF TEMPORARY EROSION CONTROL FEATURES.
3. IMPLEMENTING REMEDIAL ACTION REQUIRED TO REPAIR FAILING EROSION AND SEDIMENTATION CONTROL FEATURES.
4. IMPLEMENTING STORM AND WINTER SHUTDOWN PROCEDURES.
5. WILL SHAPE EARTHWORK PRIOR TO THE SUSPENSION OF GRADING OPERATIONS EACH DAY IN A MANNER THAT WILL PERMIT STORM RUNOFF WITH MINIMAL EROSION.
6. EROSION CONTROL FEATURES INSTALLED BY THE CONTRACTOR WILL BE OPERATED AND MAINTAINED IN AN ACCEPTABLE CONDITION.

IN STREAM WORK:

THE IN STREAM USE OF EQUIPMENT IS TO BE KEPT TO A MINIMUM. NO IN STREAM WORK SHALL BE CONDUCTED DURING THE SPAWNING SEASON OF APRIL 1 THROUGH JUNE 30. GREEN CONCRETE SHALL NOT BE PUT INTO THE STREAM.

WASTE MATERIAL:

ALL MATERIAL REMOVED AND NOT REUSED IN THE CONSTRUCTION OF THE PROJECT SHALL BE REMOVED FROM THE PROJECT SITE AND DISPOSED OF BY THE CONTRACTOR. THE COST OF THIS WORK WILL BE INCLUDED IN VARIOUS BID ITEMS ON THIS PROJECT. THE DISPOSAL OF WASTE MATERIAL SHALL BE IN ACCORDANCE WITH SECTION 207.6.3 OF THE SPECIFICATIONS.

EROSION AND SEDIMENT CONTROL:

DETAILS NOT SHOWN IN THE PLANS SHALL BE IN ACCORDANCE WITH THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS EROSION AND SEDIMENT CONTROL MANUAL, DATED MARCH 1, 2003. IN THE EVENT THAT TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES ARE REQUIRED DUE TO THE CONTRACTOR'S NEGLIGENCE, CARELESSNESS, OR FAILURE TO INSTALL PERMANENT CONTROLS AS PART OF THE WORK OR ORDERED BY THE ENGINEER, SUCH WORK SHALL BE PERFORMED BY THE CONTRACTOR AT HIS OWN EXPENSE.

THE FIRST ORDER OF WORK FOR THE CONTRACTOR IS TO INSTALL SEDIMENT CONTROL STRUCTURES, SILT FENCES, ETC., TO ESTABLISH EROSION CONTROL AT THE EARLIEST POSSIBLE DATE. INITIAL CLEARING AND GRUBBING IS TO ONLY BE WHAT IS NECESSARY IN ORDER TO ACCOMPLISH THESE OPERATIONS.

IN ADDITION, THE CONTRACTOR IS TO NAME AN INDIVIDUAL TO REVIEW THE EROSION CONTROL FEATURES AT A MINIMUM OF ONCE A WEEK DURING PERIODS OF HEAVY PRECIPITATION AND/OR ACTIVE CONSTRUCTION AND ONCE A MONTH DURING WINTER SHUTDOWN TO ASSESS THE SUCCESS OF THE EROSION CONTROL FEATURES, REVEGETATION EFFORTS, AND SEE THAT REPLACEMENT, CLEANING, AND/OR INSTALLATION OF ADDITIONAL FEATURES IF NECESSARY ARE CARRIED OUT.

PERIODIC INSPECTIONS WILL BE CONDUCTED BY A REPRESENTATIVE OF THE WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION (WVDEP) OFFICE OF WATER RESOURCES TO ENSURE THAT THE REQUIREMENTS OF THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT ARE BEING FULFILLED. REPRESENTATIVES OF OTHER RESOURCE AGENCIES MAY CONDUCT PERIODIC INSPECTIONS THROUGHOUT THE LIFE OF THE CONTRACT.

ELEVATIONS:

ALL ELEVATIONS SHOWN REFER TO THE US COAST & GEODETIC SURVEY.
THE HORIZONTAL DATUM IS BASED NAD 83 WV SOUTH STATE PLANE WHILE THE VERTICAL DATUM IS NAVD 88.
ALL MAPPING WAS PERFORMED ON WV SOUTH STATE PLANE.

COORDINATES:

COORDINATES SHOWN ON THESE PLANS ARE WEST VIRGINIA STATE PLANE COORDINATES NAD 83.
GRID FACTORS ARE NOT REQUIRED WHEN MAKING FIELD MEASUREMENTS.

VERIFICATION OF PROFILE:

THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE EXISTING GROUND LINE AS SHOWN ON THE PROFILES PRIOR TO THE START OF ANY CONSTRUCTION. ANY DISCREPANCIES SHALL IMMEDIATELY BE REPORTED TO THE PROJECT ENGINEER.

GUARDRAIL:

GUARDRAIL INSTALLATION WILL BE AS DIRECTED IN VOLUME I OF THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS STANDARD DETAILS BOOK.

PAVEMENT UNDERCUT:

WHEN MATERIAL IS ENCOUNTERED AT SUBGRADE ELEVATION WHICH CANNOT BE COMPACTED TO THE REQUIRED DENSITY AS DETERMINED BY THE ENGINEER IT SHALL BE UNDERCUT TO A MINIMUM OF TWO (2) FEET AND MEASURED AND PAID FOR AS ITEM NO. 207001-001 "UNCLASSIFIED EXCAVATION" AND DISPOSED OF AS DIRECTED BY THE ENGINEER. THE VOLUME EXCAVATED SHALL THEN BE BACKFILLED WITH SELECT EMBANKMENT, THE TOP SIX (6) INCHES OF BACKFILL SHALL BE MADE IN ACCORDANCE WITH THE SPECIFICATIONS, SECTION 207.9 – SUBGRADE.

PAVEMENT MARKINGS NOTES:

1. EDGE LINES SHALL BE CENTERED 6" FROM THE EDGE OF THE PAVEMENT.
2. ALL MARKINGS SHALL BE CONTINUOUS AND CONSISTENT WITH EXISTING MARKINGS WHERE THEY JOIN.
3. NO MARKINGS SHALL BE PLACED ON EXPANSION JOINTS OR STRUCTURES OR ON LONGITUDINAL CONSTRUCTION JOINTS UNLESS SO DIRECTED BY THE ENGINEER.

SAFETY EDGE:

THE PLACEMENT OF SAFETY EDGE IS REQUIRED ON THIS PROJECT. THE SAFETY EDGE SHALL HAVE AN ANGLE OF 30° MEASURED FROM THE HORIZONTAL. ATTACH A DEVICE TO THE PAVER SCREED TO CONFINE THE MATERIAL AT THE END GATE AND EXTRUDE THE ASPHALT MATERIAL IN A WEDGE SHAPE. USE OF A SINGLE PLATE STRIKE OFF WILL NOT BE ALLOWED. NO ADDITIONAL COMPENSATION OR MEASUREMENT WILL BE ALLOWED FOR THE PLACEMENT OF SAFETY EDGE.

VALUE ENGINEERING:

THIS IS A RESEARCH PROJECT WITH WVU AND MARSHALL THAT WILL UTILIZE TUB GIRDERS WITH PRECAST DECK PANELS AND ULTRA HIGH PERFORMANCE CONCRETE (UHPC) CLOSURE POURS. IT IS IMPERATIVE THAT THIS PROJECT USE TUB GIRDERS AND UHPC. FOR THAT REASON, NO VALUE ENGINEERING PROPOSALS WILL BE ACCEPTED FOR THE SUPERSTRUCTURE.

PAVEMENT MIX DESIGN:

THE PAVEMENT DESIGN MIX ON THIS PROJECT SHALL BE MARSHALL MEDIUM MIX DESIGN. THE DESIGN ESAL'S VALUE ON THIS PROJECT IS 1,620,000. THE TERM MEDIUM REFERS TO EQUIVALENT SINGLE AXLE LOADS (ESAL'S) AND DOES NOT REFLECT THE QUALITY OF THE ASPHALT.

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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GENERAL NOTES

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	4	85

SUMMARY OF ESTIMATED QUANTITIES

ITEM	ALT	DESCRIPTION	UNIT	QUANTITY
		ROADWAY ITEMS		
201001-000		CLEARING AND GRUBBING	LS	1
204001-000		MOBILIZATION	LS	1
207001-001		UNCLASSIFIED EXCAVATION	CY	4394
207002-000		SUBGRADE	CY	546
207034-000		FABRIC FOR SEPARATION	SY	3363
211001-000		UNCLASSIFIED BORROW EXCAVATION	CY	3698
307001-000		AGGREGATE BASE COURSE, CLASS 1	CY	1462
307001-000		AGGREGATE BASE COURSE, CLASS 3	CY	98
307001-000		AGGREGATE BASE COURSE, CLASS 10	CY	120
406002-001		ASPHALT MATERIAL	GAL	131
415005-001		STANDARD MILLING	SY	1095
502001-012		12 IN PORTLAND CEMENT CONCRETE APPROACH SLAB	SY	125
607001-001		TYPE 1 GUARDRAIL, CLASS I	LF	75
607006-001		THRIE BEAM GUARDRAIL BRIDGE TRANSITION	EA	4
607037-001		BUFFER END	EA	1
607065-001		FLARED END TERMINAL	EA	3
636005-001		TEMPORARY STRUCTURE FOR MAINTAINING TRAFFIC	LS	1
636007-001		ERADICATION OF PAVEMENT MARKINGS	LF	300
636008-002		TEMPORARY PAVEMENT MARKINGS – PAINT 6 IN	LF	692
636011-001		TRAFFIC CONTROL DEVICE	UN	6770
636012-010		PROJECT TRAFFIC CONTROL DEVICE CLEANING	EA	1
636013-001		INDIVIDUAL TRAFFIC CONTROL DEVICE CLEANING	EA	98
636014-001		FLAGGER	HR	360
636019-001		TEMPORARY GUARDRAIL BARRIER	LF	791
636022-001		CHANGEABLE MESSAGE SIGN	DAY	28
636025-001		WARNING LIGHTS, TYPE B	DAY	2920
638002-001		RIGHT OF WAY MARKER	EA	6
639001-001		CONSTRUCTION LAYOUT STAKE	LS	1
640002-001		LARGE FIELD OFFICE AND STORAGE BUILDING	MO	12
640003-001		BUILDING EQUIPMENT	LS	1
642004-003		SEED MIXTURE D	LB	49
642005-001		MULCH, STRAW OR HAY	TN	1.46
642006-001		FERTILIZER	TN	0.37
642010-001		AGRICULTURAL LIMESTONE	TN	1.09
642012-001		SILT FENCE	LF	2373
642031-001		DITCH CHECK	EA	11
642040-001		INLET PROTECTION	EA	1
645001-001		PRIMARY REINFORCEMENT, 2400 LB/FT	SY	2072
652001-001		AGRICULTURAL LIMESTONE	TN	1.09
652002-001		FERTILIZER, 10-20-10	TN	0.37
652002-002		FERTILIZER, UREA FORMALDEHYDE	TN	0.11
652003-001		SEED MIXTURE C-2	LB	49
652004-001		STRAW OR HAY MULCH	TN	1.46

SUMMARY OF ESTIMATED QUANTITIES

ITEM	ALT	DESCRIPTION	UNIT	QUANTITY
657005-001		2.00 LB CHANNEL POST	LF	32
661001-001		0.080 IN FLAT SHEET SIGN	SF	12
663001-026		EDGE LINE, TYPE II – 6 IN	LF	692
663002-040		CENTERLINE, TYPE II – 6 IN	LF	692
		ROADWAY ALTERNATIVES		
401001-020	AA1	MARSHALL ASPHALT BASE COURSE, SG, TYPE 1	TN	395
401001-021	AA2	MARSHALL ASPHALT BASE COURSE, S, TYPE 1	TN	376
401001-023	BB1	MARSHALL ASPHALT BASE COURSE, SG, TYPE 2	TN	249
401001-024	BB2	MARSHALL ASPHALT BASE COURSE, S, TYPE 2	TN	237
401002-020	CC1	MARSHALL ASPHALT WEARING COURSE, SG, TYPE 1	TN	101
401002-021	CC2	MARSHALL ASPHALT WEARING COURSE, S, TYPE 1	TN	96
		BRIDGE NO. 11.374		
203001-000		DISMANTLING STRUCTURE	LS	1
212001-000		STRUCTURE EXCAVATION	CY	308
218006-000		FOUNDATION PROTECTION	CY	248
601002-001		CLASS B CONCRETE	CY	113
601003-001		CLASS K CONCRETE	CY	10
601800-001		ULTRA HIGH PERFORMANCE CONCRETE	CY	5
602001-001		REINFORCING STEEL BAR	LB	15,369
602002-001		EPOXY COATED REINFORCING STEEL BAR	LB	2,615
615029-001		NON-GUIDED BEARING, ELASTOMERIC	EA	10
616005-019		HP14X117 STEEL BEARING PILE, PRE-DRILLED AND DRIVEN	LF	364
639001-001		CONSTRUCTION LAYOUT STAKE	LS	1
698001-001		PREFABRICATED BRIDGE ELEMENT SUPERSTRUCTURE	EA	5

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SUMMARY OF QUANTITIES

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	5	86

PAVING QUANTITIES

STATION	STATION	ITEM 207002-000 SUBGRADE	ITEM 207034-000 FABRIC FOR SEPARATION	ITEM 307001-000 AGGREGATE BASE COURSE, CLASS 1	ITEM 307001-000 AGGREGATE BASE COURSE, CLASS 3	ITEM 307001-000 AGGREGATE BASE COURSE, CLASS 10	ITEM 401001-020 MARSHALL ASPHALT BASE COURSE, STONE OR GRAVEL, TYPE 1	ITEM 401001-023 MARSHALL ASPHALT BASE COURSE, STONE OR GRAVEL, TYPE 2	ITEM 401002-020 MARSHALL ASPHALT WEARING COURSE, STONE OR GRAVEL, TYPE 1	ITEM 408002-001 ASPHALT MATERIAL	ITEM 415005-001 STANDARD MILLING	REMARKS
		CY	SY	CY	CY	CY	TN	TN	TN	GAL	SY	
WV 37												
100+50.00	107+52.11	173	978	163	0	77	167	82	101	131	1095	
REINFORCED BACKFILL ABUT 1		–	–	477	–	–	–	–	–	–	–	
REINFORCED BACKFILL ABUT 2		–	–	476	–	–	–	–	–	–	–	
DETOUR (37 & DRIVEWAY)												
202+62.84	207+37.74	253	1599	236	0	43	228	167	–	–	–	
300+11.00	301+79.00	71	457	64	57	–	–	–	–	–	–	
DRIVEWAY												
400+15.00	401+35.95	51	329	46	41	–	–	–	–	–	–	
PROJECT TOTALS		548	3363	1462	98	120	395	249	101	131	1095	

BORROW COMPUTATIONS

UNCLASSIFIED BORROW EXCAVATION (FROM GRADING SUMMARY – ROADWAY) = = 5 C.Y.
UNCLASSIFIED BORROW EXCAVATION (FROM GRADING SUMMARY – DETOUR) = = 3211 C.Y.
TOTAL UNCLASSIFIED BORROW EXCAVATION = 3216 C.Y.

SELECT EMBANKMENT AVAILABLE (FROM TABLE "PROBABLE SOURCE OF SELECT EMBANKMENT") = 0 C.Y.

EMBANKMENT NEEDED = 3216 C.Y.

UNCLASSIFIED EMABANKMENT REQUIRED TO MEET
EMBANKMENT REQUIREMENTS WITH 15% SHRINKAGE FACTOR:

ITEM 211001 UNCLASSIFIED EXCAVATION NEEDED = 3216 X 1.15 = 3698 C.Y.

GRADING SUMMARY

STATION	STATION	ITEM 207001-001 TOTAL UNCLASSIFIED EXCAVATION	UNSUITABLE EXCAVATION	USABLE EXCAVATION	SHRINK OR SWELL	ADJUSTED EXCAVATION	UNCLASSIFIED EMBANKMENT	SELECT EMBANKMENT	TOTAL EMBANKMENT	EXCESS (+) OR BORROW (–)	REMARKS
WV 37		CY	CY	CY		CY	CY	CY	CY	CY	
101+00.00	107+40.00	1046	1046	0	NA	1046	5	0	5	–5	
DETOUR PLACEMENT											
202+29.03	207+80.00	137	137	0		137	3211	0	3211	–3211	
DETOUR REMOVAL											
202+29.03	207+29.03	3211	3211	0		3211	0	0	0	+3211	
PROJECT TOTALS		4394	4394	0	NA	4394	3216	0	3216	–5	

TEMPORARY POLLUTION CONTROL

LOCATION STATION	LOCATION STATION	SEEDING AND MULCHING AREA AC	642004-003 SEED MIXTURE D LB	642005-001 MULCH STRAW OR HAY TN	642006-001 FERTILIZER TN	642010-001 AGRICULTURAL LIMESTONE TN	642012-001 SILT FENCE LF	642031-001 DITCH CHECK EA	642040-001 INLET PROTECTION EA	REMARKS
101+00.00	107+40.00	0.18	12	0.36	0.09	0.27	1154	3	0	MAINLINE
202+29.03	207+80.00	0.55	37	1.10	0.28	0.82	1219	8	1	DETOUR
PROJECT TOTALS		0.73	49	1.46	0.37	1.09	2373	11	1	

GUARDRAIL SUMMARY

LOCATION STATION	LOCATION STATION	ITEM 607001-001 TYPE 1 GUARDRAIL LENGTH (LF) LEFT	ITEM 607001-001 TYPE 1 GUARDRAIL LENGTH (LF) RIGHT	ITEM 607001-001 TYPE 1 GUARDRAIL CLASS	607006-001 THRIE BEAM GUARDRAIL BRIDGE TRANSITION	607055-001 FLARED END TERMINAL	607066-001 TANGENT END TERMINAL	607037-001 BUFFER END SECTION	REMARKS
102+85.57	103+25.70		12.5	1	1	1			
103+91.81	104+33.07		12.5	1	1	1			
103+18.41	103+34.62	37.5		1	1			1	
103+92.71	104+26.58	12.5		1	1	1			
PROJECT TOTALS		50	25		4	3		1	

CLEARING & GRUBBING

STATION	STATION	AREA SF	AREA ACRES
101+00.00	107+40.00	19,325	0.443
202+29.03	207+80.00	23,887	0.548
PROJECT TOTALS		43,212	0.991

SEEDING AND MULCHING

LOCATION STATION	LOCATION STATION	SEEDING AND MULCHING AREA AC	652001-001 AGRICULTURAL LIMESTONE TN	652002-001 FERTILIZER 10-20-10 TN	652002-002 FERTILIZER UREA FORM.ALD. TN	652003-001 SEED MIXTURE B, C-1, C-2 LB	652004-001 STRAW OR HAY MULCH TN	REMARKS
101+00.00	107+40.00	0.18	0.267	0.089	0.027	12	0.357	MAINLINE
202+29.03	207+80.00	0.55	0.823	0.274	0.082	37	1.097	DETOUR
PROJECT TOTALS		0.73	1.09	0.37	0.11	49	1.46	

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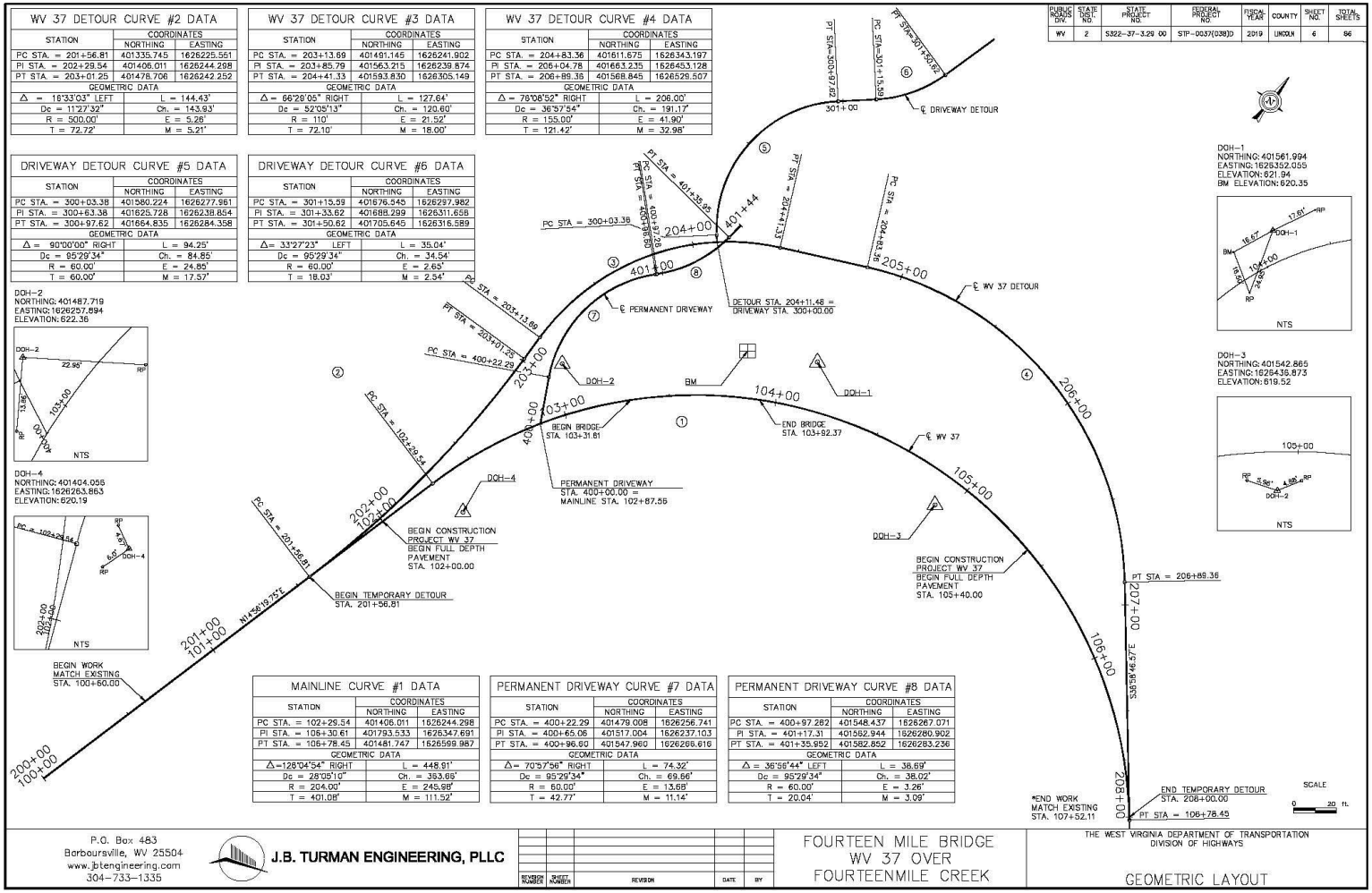
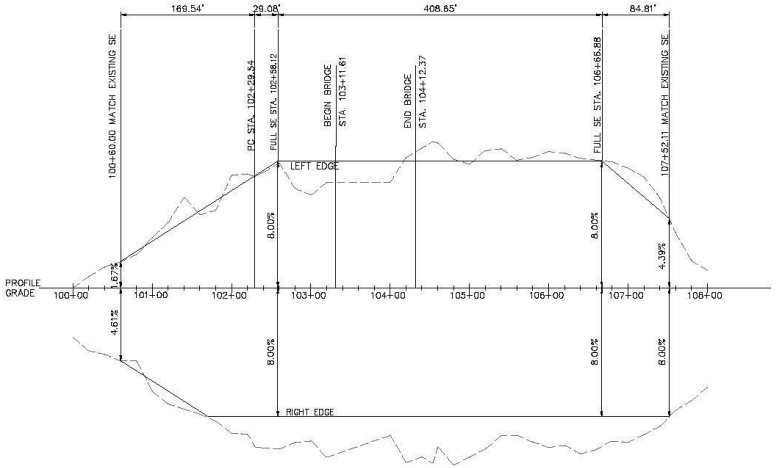
QUANTITY TABLES


WV 37 DETOUR CURVE #2 DATA
STATION | COORDINATES NORTHING | EASTING
PC STA. = 201+56.81 | 401335.745 | 1626225.561
PI STA. = 202+29.54 | 401406.011 | 1626244.298
PT STA. = 203+01.25 | 401478.706 | 1626242.252
GEOMETRIC DATA
Δ = 16°33'03" LEFT | L = 144.43'
Dc = 11°27'32" | Ch. = 143.93'
R = 500.00' | E = 5.26'
T = 72.72' | M = 5.21'
WV 37 DETOUR CURVE #3 DATA
STATION | COORDINATES NORTHING | EASTING
PC STA. = 203+13.69 | 401491.145 | 1626241.902
PI STA. = 203+85.79 | 401563.215 | 1626239.874
PT STA. = 204+41.33 | 401593.830 | 1626305.149
GEOMETRIC DATA
Δ = 66°28'05" RIGHT | L = 127.64'
Dc = 52°05'13" | Ch. = 120.60'
R = 110' | E = 21.52'
T = 72.10' | M = 18.00'
WV 37 DETOUR CURVE #4 DATA
STATION | COORDINATES NORTHING | EASTING
PC STA. = 204+83.36 | 401611.675 | 1626343.197
PI STA. = 206+04.78 | 401663.235 | 1626453.128
PT STA. = 206+89.36 | 401568.845 | 1626529.507
GEOMETRIC DATA
Δ = 76°08'52" RIGHT | L = 206.00'
Dc = 36°57'54" | Ch. = 191.17'
R = 155.00' | E = 41.90'
T = 121.42' | M = 32.98'
DRIVEWAY DETOUR CURVE #5 DATA
STATION | COORDINATES NORTHING | EASTING
PC STA. = 300+03.38 | 401580.224 | 1626277.961
PI STA. = 300+63.38 | 401625.728 | 1626238.854
PT STA. = 300+97.62 | 401664.835 | 1626284.358
GEOMETRIC DATA
Δ = 90°00'00" RIGHT | L = 94.25'
Dc = 95°29'34" | Ch. = 84.85'
R = 60.00' | E = 24.85'
T = 60.00' | M = 17.57'
DRIVEWAY DETOUR CURVE #6 DATA
STATION | COORDINATES NORTHING | EASTING
PC STA. = 301+15.59 | 401676.545 | 1626297.982
PI STA. = 301+33.62 | 401688.299 | 1626311.658
PT STA. = 301+50.62 | 401705.645 | 1626316.589
GEOMETRIC DATA
Δ= 33°27'23" LEFT | L = 35.04'
Dc = 95°29'34" | Ch. = 34.54'
R = 60.00' | E = 2.65'
T = 18.03' | M = 2.54'
PUBLIC ROADS DIV. | STATE DIST. NO. | STATE PROJECT NO. | FEDERAL PROJECT NO. | FISCAL YEAR | COUNTY | SHEET NO. | TOTAL SHEETS
WV | 2 | S322-37-3.29 00 | STP-0037(038)D | 2019 | LINCOLN | 6 | 66
DOH-1
NORTHING: 401561.994
EASTING: 1626352.055
ELEVATION: 621.94
BM ELEVATION: 620.35
NTS
DOH-2
NORTHING: 401487.719
EASTING: 1626257.894
ELEVATION: 622.36
NTS
DOH-3
NORTHING: 401542.865
EASTING: 1626436.873
ELEVATION: 619.52
NTS
DOH-4
NORTHING: 401404.055
EASTING: 1626263.863
ELEVATION: 620.19
NTS
PT STA=300+97.62
PC STA=301+15.59
PT STA=301+50.62
301+00
℄ DRIVEWAY DETOUR
PI STA = 401+38.95
PC STA = 400+97.28
PT STA = 401+35.95
401+44
PT STA = 204+11.33
PC STA = 204+83.36
204+00
205+00
PC STA = 300+03.38
401+00
℄ WV 37 DETOUR
℄ PERMANENT DRIVEWAY
DETOUR STA. 204+11.48 =
DRIVEWAY STA. 300+00.00
PC STA = 203+13.69
PT STA = 203+01.25
PC STA = 400+22.29
203+00
400+00
DOH-2
BM
DOH-1
104+00
103+00
BEGIN BRIDGE
STA. 103+31.81
END BRIDGE
STA. 103+92.37
℄ WV 37
206+00
PC STA = 102+29.54
202+00
102+00
DOH-4
PERMANENT DRIVEWAY
STA. 400+00.00 =
MAINLINE STA. 102+87.55
BEGIN CONSTRUCTION
PROJECT WV 37
BEGIN FULL DEPTH
PAVEMENT
STA. 102+00.00
105+00
DOH-3
BEGIN CONSTRUCTION
PROJECT WV 37
BEGIN FULL DEPTH
PAVEMENT
STA. 105+40.00
PC STA = 201+56.81
N14°56'19.75"E
BEGIN TEMPORARY DETOUR
STA. 201+56.81
PT STA = 206+89.36
207+00
S38°58'46.57"E
106+00
201+00
101+00
200+00
100+00
BEGIN WORK
MATCH EXISTING
STA. 100+60.00
*END WORK
MATCH EXISTING
STA. 107+52.11
END TEMPORARY DETOUR
STA. 208+00.00
PT STA = 106+78.45
208+00
SCALE
0 20 ft.
MAINLINE CURVE #1 DATA
STATION | COORDINATES NORTHING | EASTING
PC STA. = 102+29.54 | 401406.011 | 1626244.298
PI STA. = 106+30.61 | 401793.533 | 1626347.691
PT STA. = 106+78.45 | 401481.747 | 1626599.987
GEOMETRIC DATA
Δ=128°04'54" RIGHT | L = 448.91'
Dc = 28°05'10" | Ch. = 393.66'
R = 204.00' | E = 245.98'
T = 401.08' | M = 111.52'
PERMANENT DRIVEWAY CURVE #7 DATA
STATION | COORDINATES NORTHING | EASTING
PC STA. = 400+22.29 | 401479.008 | 1626256.741
PI STA. = 400+65.06 | 401517.004 | 1626237.103
PT STA. = 400+96.60 | 401547.960 | 1626266.616
GEOMETRIC DATA
Δ= 70°57'56" RIGHT | L = 74.32'
Dc = 95°29'34" | Ch. = 69.66'
R = 60.00' | E = 13.68'
T = 42.77' | M = 11.14'
PERMANENT DRIVEWAY CURVE #8 DATA
STATION | COORDINATES NORTHING | EASTING
PC STA. = 400+97.282 | 401548.437 | 1626267.071
PI STA. = 401+17.31 | 401562.944 | 1626280.902
PT STA. = 401+35.952 | 401582.852 | 1626283.236
GEOMETRIC DATA
Δ = 36°56'44" LEFT | L = 38.69'
Dc = 95°29'34" | Ch. = 38.02'
R = 60.00' | E = 3.26'
T = 20.04' | M = 3.09'
P.O. Box 483
Barboursville, WV 25504
www.jbtengineering.com
304-733-1335
J.B. TURMAN ENGINEERING, PLLC
REVISION NUMBER | SHEET NUMBER | REVISION | DATE | BY
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOMETRIC LAYOUT

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	7	86



SUPERELEVATION TABLE

STATION	LEFT EP ELEV.	CORR.	WIDTH	RATE	PROFILE GRADE	RATE	WIDTH	CORR.	RIGHT EP ELEV.	REMARKS
100+60	623.88	0.18	11.000	0.0167	623.70	-0.0461	11.0000	-0.51	623.19	MATCH EXISTING S.E.
100+80	623.85	0.25	11.000	0.0231	623.60	-0.0525	11.0000	-0.58	623.02	
101+00	623.82	0.32	11.000	0.0295	623.50	-0.0589	11.0000	-0.65	622.85	
101+20	623.69	0.39	11.000	0.0359	623.30	-0.0653	11.0000	-0.72	622.58	
101+40	623.67	0.47	11.000	0.0423	623.20	-0.0717	11.0000	-0.79	622.41	
101+60	623.57	0.53	11.000	0.0486	623.04	-0.0781	11.0000	-0.86	622.18	
101+80	623.52	0.61	11.000	0.0550	622.91	-0.0800	11.0000	-0.88	622.03	
102+00	623.46	0.68	11.000	0.0614	622.78	-0.0800	11.0000	-0.88	621.90	
102+20	623.40	0.75	11.000	0.0678	622.65	-0.0800	11.0000	-0.88	621.77	
102+40	623.34	0.82	11.000	0.0742	622.52	-0.0800	11.0000	-0.88	621.64	
102+56.12	623.28	0.88	11.000	0.0800	622.40	-0.0800	11.0000	-0.88	621.52	BEGIN FULL S.E.
102+60	623.27	0.88	11.000	0.0800	622.39	-0.0800	11.0000	-0.88	621.51	
102+80	623.15	0.88	11.000	0.0800	622.27	-0.0800	11.0000	-0.88	621.39	
103+00	623.04	0.88	11.000	0.0800	622.16	-0.0800	11.0000	-0.88	621.28	
103+20	622.93	0.88	11.000	0.0800	622.05	-0.0800	11.0000	-0.88	621.17	
103+40	622.81	0.88	11.000	0.0800	621.93	-0.0800	11.0000	-0.88	621.05	
103+60	622.70	0.88	11.000	0.0800	621.82	-0.0800	11.0000	-0.88	620.94	
103+80	622.58	0.88	11.000	0.0800	621.70	-0.0800	11.0000	-0.88	620.82	
104+00	622.47	0.88	11.000	0.0800	621.59	-0.0800	11.0000	-0.88	620.71	
104+20	622.35	0.88	11.000	0.0800	621.47	-0.0800	11.0000	-0.88	620.59	
104+40	622.24	0.88	11.000	0.0800	621.36	-0.0800	11.0000	-0.88	620.48	
104+60	622.13	0.88	11.000	0.0800	621.25	-0.0800	11.0000	-0.88	620.37	
104+80	622.01	0.88	11.000	0.0800	621.13	-0.0800	11.0000	-0.88	620.25	
105+00	621.87	0.88	11.000	0.0800	620.99	-0.0800	11.0000	-0.88	620.11	
105+20	621.72	0.88	11.000	0.0800	620.84	-0.0800	11.0000	-0.88	619.96	
105+40	621.56	0.88	11.000	0.0800	620.68	-0.0800	11.0000	-0.88	619.80	
105+60	621.41	0.88	11.000	0.0800	620.53	-0.0800	11.0000	-0.88	619.65	
105+80	621.25	0.88	11.000	0.0800	620.37	-0.0800	11.0000	-0.88	619.49	
106+00	621.08	0.88	11.000	0.0800	620.20	-0.0800	11.0000	-0.88	619.32	
106+20	620.98	0.88	11.000	0.0800	620.10	-0.0800	11.0000	-0.88	619.22	
106+40	620.88	0.88	11.000	0.0800	620.00	-0.0800	11.0000	-0.88	619.12	
106+60	620.68	0.88	11.000	0.0800	619.80	-0.0800	11.0000	-0.88	618.92	
106+56.88	620.60	0.88	11.000	0.0800	619.72	-0.0800	11.0000	-0.88	618.84	END FULL S.E.
106+80	620.42	0.82	11.000	0.0744	619.60	-0.0800	11.0000	-0.88	618.72	
107+00	620.12	0.72	11.000	0.0658	619.40	-0.0800	11.0000	-0.88	618.52	
107+20	619.93	0.63	11.000	0.0573	619.30	-0.0800	11.0000	-0.88	618.42	
107+40	619.74	0.54	11.000	0.0488	619.20	-0.0800	11.0000	-0.88	618.32	
107+52.11	619.663	0.48	11.000	0.0439	619.18	-0.0800	11.0000	-0.88	618.30	MATCH EXISTING S.E.

SCALE

0 60 ft.

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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SUPERELEVATION DIAGRAM

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	8	86

TEMPORARY TRAFFIC CONTROL SUMMARY OF QUANTITIES

ITEM NO.	DESCRIPTION	QUANTITY	
		UNIT	TOTAL
636002-002	AGGREGATE FOR MAINTAINING TRAFFIC, SLAG	TON	–
636002-001	AGGREGATE FOR MAINTAINING TRAFFIC, STONE OR GRAVEL	TON	–
636003-001	BITUMINOUS MATERIAL FOR DUST PALLATIVE	GAL	–
636004-001	CALCIUM CHLORIDE FOR DUST PALLATIVE	TON	–
636005-001	TEMPORARY STRUCTURES FOR MAINTAINING TRAFFIC	LS	–
636006-001	PILOT TRUCK AND DRIVER	DAY	–
636007-001	ERADICATION OF PAVEMENT MARKING	LF	–
636008-001	TEMPORARY PAVEMENT MARKINGS – PAINT 4-IN SOLID LINE, TYPE VIC	LF	–
636009-001	TEMPORARY PAVEMENT MARKINGS – TAPE 4-IN SOLID LINE, TYPE VIC	LF	–
636010-003	TEMPORARY RAISED PAVEMENT MARKER	EA	–
636011-001	TRAFFIC CONTROL DEVICES	UNIT	6770
636012-010	PROJECT TRAFFIC CONTROL DEVICE CLEANING	EA	1
636013-001	INDIVIDUAL TRAFFIC CONTROL DEVICE CLEANING	EA	98
636014-001	FLAGGER	HR	360
636014-002	TRAFFIC DIRECTOR	HR	–
636015-001	TEMPORARY GUARDRAIL CHANNELIZATION DEVICE	LF	–
636017-004	TEMPORARY BARRIER, TL-2, I	LF	–
636017-005	TEMPORARY BARRIER, TL-3, I	LF	–
636016-001	REMOVE AND RESET TEMP. GUARDRAIL CHANNELIZATION DEVICE	LF	–
636017-001	TEMPORARY CONCRETE BARRIER	LF	–
636017-002	DOH FURNISHED TEMPORARY CONCRETE BARRIER	LF	–
636018-001	REMOVE AND RESET TEMPORARY CONCRETE BARRIER	LF	–
636018-002	REMOVE AND RESET DOH FURNISHED TEMP. CONCRETE BARRIER	LF	–
636018-003	REMOVE AND RESET TEMPORARY BARRIER	LF	–
636019-001	TEMPORARY GUARDRAIL BARRIER	LF	791
636020-001	REMOVE AND RESET TEMPORARY GUARDRAIL BARRIER	LF	–
636021-001	ELECTRIC ARROW	DAY	–
636022-001	CHANGEABLE MESSAGE SIGN	DAY	28
636023-001	TEMPORARY TRAFFIC SIGNAL	LS	–
636024-001	TEMPORARY PIPE FOR MAINTAINING TRAFFIC	LF	–
636025-001	WARNING LIGHTS, TYPE A	DAY	–
636025-001	WARNING LIGHTS, TYPE B	DAY	2920
636025-001	WARNING LIGHTS, TYPE C	DAY	–
636026-001	TEMPORARY LIGHTING, 01	LS	–
636026-001	TEMPORARY LIGHTING, 02	LS	–
636028-001	SHADOW VEHICLE	DAY	–
639030-001	SPEED MONITORING TRAILER	DAY	–
636060-001	TEMPORARY IMPACT ATTENUATING DEVICE	EA	–
636060-002	REMOVE AND RESET ATTENUATOR DEVICE	EA	–
663005-011	STOP LINE, TYPE V – 24 IN.	LF	–
664006-010	GLARE BARRIER, TYPE V	LF	–

TEMPORARY TRAFFIC CONTROL DEVICE QUANTITIES

DEVICE	DESCRIPTION	VALUE IN UNITS	TOTAL QUANT.	TOTAL UNITS
* 1	SIGNS ON PORTABLE MOUNTS AND BARRICADES. (TOTAL SIGN AREA 16 S.F. OR GREATER.)	170	–	–
* 2	SIGNS ON PORTABLE MOUNTS AND BARRICADES. (TOTAL SIGN AREA LESS THAN 16 S.F.)	80	–	–
* 3	SIGNS ON PERMANENT POSTS. (TOTAL SIGN AREA 16 S.F. OR GREATER.)	180	12	2160
* 4	SIGNS ON PERMANENT POSTS. (TOTAL SIGN AREA LESS THAN 16 S.F.)	90	15	1350
** 5	BARRICADES – TYPE I	35	–	–
** 6	BARRICADES – TYPE II	60	–	–
** 7	BARRICADES – TYPE III	90	10	900
** 8	DRUMS	60	39	2340
9	CONES	5	–	–
10	VERTICAL PANELS OR GROUND MOUNTED DELINEATORS	10	2	20
11	BARRIER OR GUARDRAIL MOUNTED DELINEATORS (TO BE BID INCIDENTAL TO THE COST OF THE BARRIER OR GUARDRAIL)	0	–	–
12	TEMPORARY OVERLAYS AND TEMPORARY OVERSIZE SIGNS (INCLUDES 4 GIVE'EM A BRAKE SIGNS + 4 MAX FINES SIGNS)	300	–	–
13	CHANNELIZER CONES	40	–	–
DELINEATORS * – ORANGE SIGN SHEETING TO BE REFLECTIVE FLOURESCENT ORANGE, TYPE V ** – BARRICADES AND DRUM SHEETING TO BE 6" FLEXIBLE HIGH INTENSITY, TYPE III		TOTAL		6770

SEQUENCE OF CONSTRUCTION

PHASE 1:
INSTALL TEMPORARY TRAFFIC CONTROL DEVICES FOR CASE A3. CONSTRUCT THE WV 37 DETOUR, DRIVEWAY DETOUR AND TEMPORARY BRIDGE. MAINTAIN TRAFFIC ALONG THE EXISTING ALIGNMENT. USE CASE A4 AND FLAGGING TO TIE-IN THE DETOUR TO THE EXISTING ROADWAY.

PHASE 2:
REMOVE CASE A3 AND INSTALL TEMPORARY TRAFFIC CONTROL DEVICES FOR CASE A12. SHIFT TRAFFIC TO THE DETOUR. DISMANTLE THE EXISTING BRIDGE AND CONSTRUCT THE NEW BRIDGE, APPROACHES AND ROADWAY.

PHASE 3:

REMOVE CASE A12. SHIFT TRAFFIC TO NEWLY CONSTRUCTED WV 37. USE CASE A3 AND A6 TO PERFORM LANE AT A TIME OPERATIONS WHILE CONSTRUCTING FULL DEPTH REPLACEMENT TIE-IN, OVERLAY OPERATIONS AND PERMANENT DRIVEWAY CONSTRUCTION. PERFORM FINAL SEEDING AND MULCHING, REMOVE ALL TRAFFIC CONTROL DEVICES AND OPEN ROADWAY.

TEMPORARY TRAFFIC CONTROL NOTES

1. TEMPORARY TRAFFIC CONTROL SHALL BE IN ACCORDANCE WITH SECTION 636 OF THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS STANDARD SPECIFICATIONS ROADS AND BRIDGES, ADOPTED 2017, AS AMENDED BY THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DEPARTMENT OF HIGHWAYS, SUPPLEMENTAL SPECIFICATIONS DATED JANUARY 1, 2018, THE CONTRACT DOCUMENTS, THE CONTRACT PLANS, AND THE "MANUAL ON TEMPORARY TRAFFIC CONTROL FOR STREETS AND HIGHWAYS" 2006, AND THE TRAFFIC PLAN FOR INDIVIDUAL SEGMENTS AS DESCRIBED IN THE PLANS.
2. ACCESS TO ALL HOUSES AND BUSINESSES SHALL BE MAINTAINED AT ALL TIMES.
3. THE CONTRACTOR SHALL MAINTAIN WORKING STORM DRAINAGE SYSTEMS THROUGH THE WORK AREAS AT ALL TIMES DURING CONSTRUCTION. THE WORKING SYSTEM MAY CONSIST OF THE EXISTING STORM DRAINAGE SYSTEM, THE PROPOSED SYSTEM, OR A COMBINATION THEREOF. DRAINAGE PIPES FOR THE PROPOSED SYSTEMS SHALL BE CONSTRUCTED IN SECTIONS LENGTHS NECESSARY TO MAINTAIN THE LANES OF TRAFFIC INDICATED IN THE TEMPORARY TRAFFIC CONTROL PLANS. UNDERDRAINS AND SLOPE WALLS THAT DISCHARGE INTO THE MEDIAN SHALL BE INCLUDED IN THE WORKING DRAINAGE SYSTEM.
4. THE CONTRACTOR MUST RESTORE ANY PAVED, LANDSCAPED, CURBED AND SIDEWALK AREAS DISTURBED DURING CONSTRUCTION ACTIVITIES TO ITS ORIGINAL CONDITION AND TO THE SATISFACTION OF THE ENGINEER.
5. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO COORDINATE TRAFFIC CONTROL WITH ANY ADJACENT CONSTRUCTION PROJECT. THIS COORDINATION SHALL BE DONE SO THAT ANY CLOSURE SHALL NOT CONFLICT WITH ANY OTHER CLOSURE AND ALSO TO ENSURE THAT THE CONTRACTORS ARE AGREED ON IN REFERENCE TO WORKING PLANS AND STORAGE AREAS. THIS PLAN OF COORDINATION SHALL BE PRESENTED TO THE ENGINEER IN WRITING FOR HIS APPROVAL.
6. WINTER SHUTDOWN: THE PROJECT AREA AND ATTENDANT ROADWAY (TRAVEL LANES AND SHOULDERS, ETC.) SHALL BE LEFT IN A "SQUARED OFF"/EASILY TRAVERSABLE, SAFE CONDITION THAT IS PRE-AGREED TO BY THE ENGINEER, SUCH WILL INCLUDE, BUT NOT LIMITED TO, PAVEMENT MARKINGS (TEMPORARY PAVEMENT MARKINGS), SIGNING, ETC. AS NOTED ON THE PLANS AND AS APPROPRIATE. TRAFFIC CONTROL DEVICES THAT ARE NOT NEEDED OR DESIRED SHALL EITHER BE REMOVED OR COVERED AND ALL SUCH SHALL BE BID INCIDENTAL TO ITEM 636011-001, TRAFFIC CONTROL DEVICE.
7. TYPE "B" WARNING LIGHTS: TYPE "B" WARNING LIGHTS SHALL BE INSTALLED ON ALL LEAD-IN SIGNS ALONG MAINLINE AND SIDE ROADS. THESE LIGHTS SHALL BE BID AS ITEM 636025-001, WARNING LIGHTS, TYPE "B".
8. REFLECTIVE SHEETING ON ALL TEMPORARY CONTROL DEVICES SHALL BE OF NEW CONDITION AT THE BEGINNING OF THE PROJECT LIFE. NIGHT VISIBILITY AND LEGIBILITY SHALL BE MAINTAINED. ANY TRAFFIC CONTROL ITEMS FOUND TO HAVE INADEQUATE SHEETING AT ANY TIME THROUGHOUT THE DURATION OF THE PROJECT WILL BE REMOVED AT THE DISCRETION OF THE ENGINEER IN THE FIELD. COSTS FOR CORRECTIONS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
9. FLAGGER: WHEN WORK IS PERFORMED AT NIGHT WITH A FLAGGER, THE FLAGGER STATIONS SHALL BE ADEQUATELY ILLUMINATED. COST SHALL BE INCIDENTAL TO ITEM 636014-001, FLAGGER.
10. DURING EACH STEP OF CONSTRUCTION, THE CONTRACTOR SHALL COVER ALL SIGNS WHICH ARE NOT APPROPRIATE TO THE CONTRACTOR'S TRAFFIC RESTRICTIONS. WHEN COVERING EXISTING SIGNS THE CONTRACTOR HAS THE OPTION OF USING:
    A. THIN WOOD OVERLAY (E.G. PLYWOOD)
    B. TAKING SIGNS DOWN AND REINSTALLING WHEN APPROPRIATE
    ANY DAMAGES CAUSED BY ABOVE NAMED SHALL BE REPAIRED/REPLACED TO ORIGINAL CONDITIONS AT CONTRACTOR'S EXPENSE. ALL ABOVE OPERATIONS SHALL HAVE 100% SIGN COVERAGE AND BE BID INCIDENTAL TO ITEM 636011-001, TRAFFIC CONTROL DEVICE.
11. COORDINATION WITH MEDIA: BEFORE THE CONTRACTOR PROCEEDS WITH ANY LANE CLOSURES, HE SHALL COORDINATE SUCH WITH THE DIVISION OF HIGHWAYS SO THAT THEY NOTIFY TELEVISION, RADIO, NEWSPAPERS, HOSPITALS, FIRE DEPARTMENTS, SCHOOLS, EMERGENCY VEHICLES, ETC. AS APPROPRIATE.

TTCP-1

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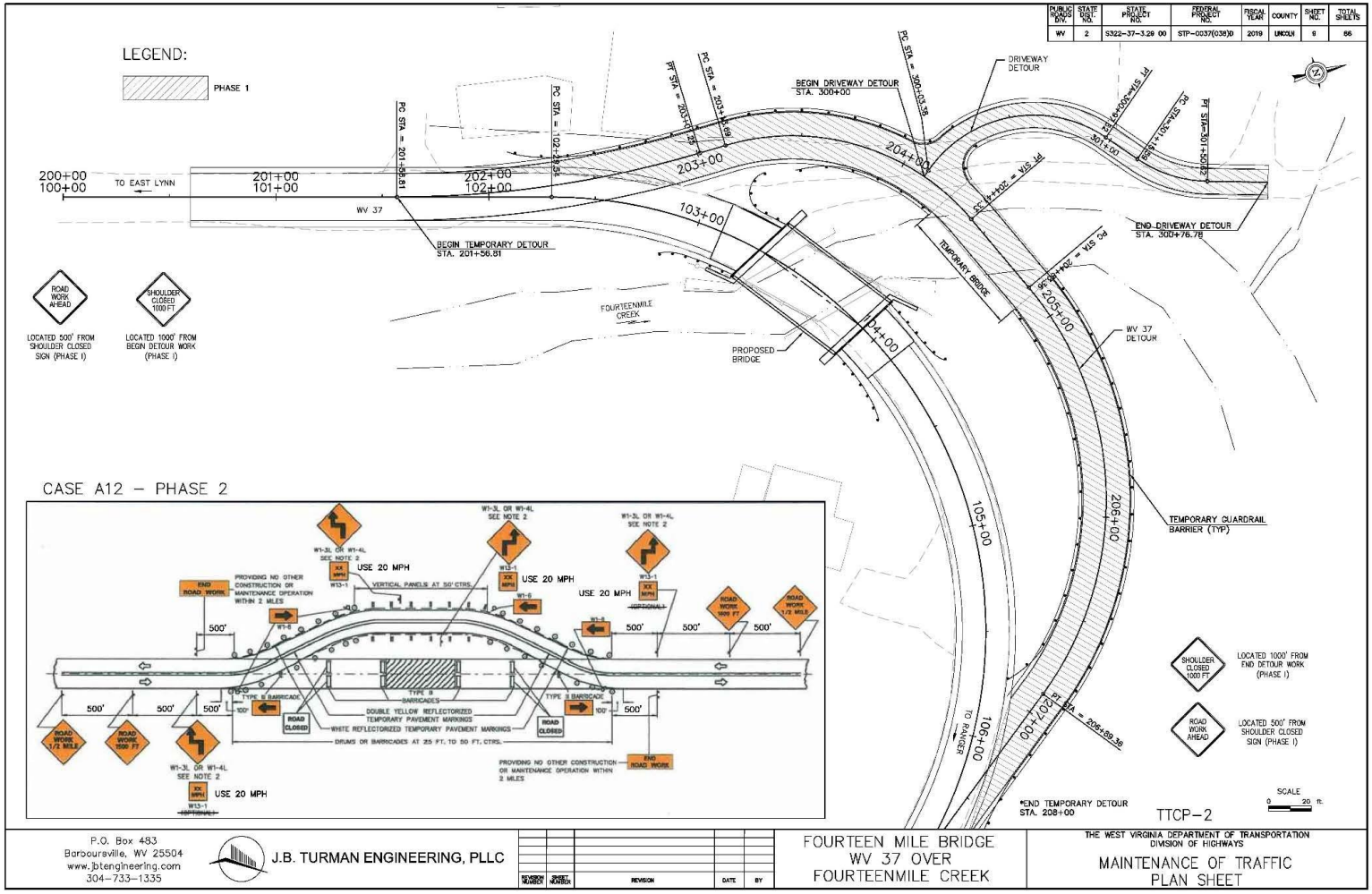
J.B. TURMAN ENGINEERING, PLLC

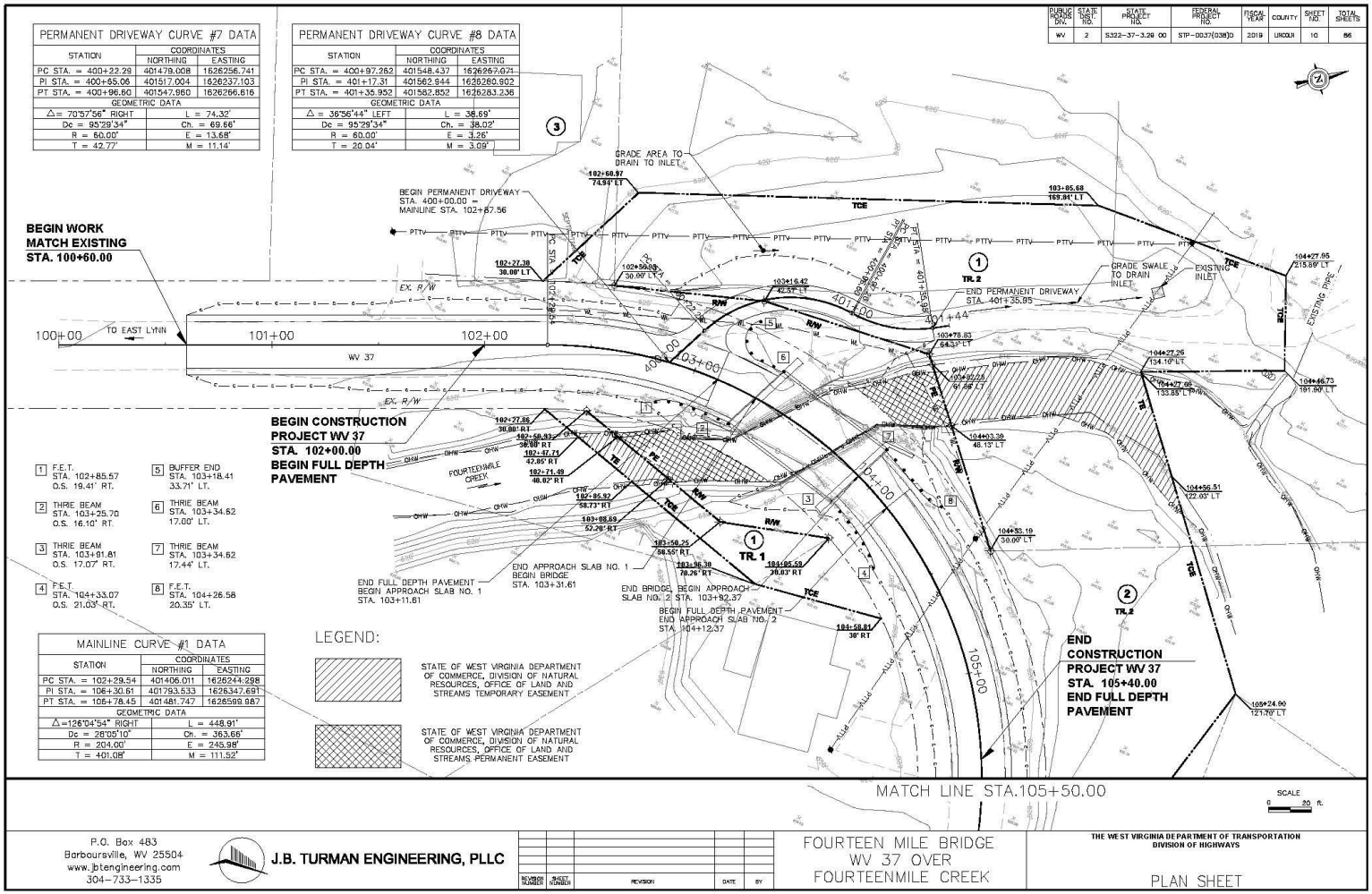
REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

MAINTENANCE OF TRAFFIC PLAN SHEET


PUBLIC ROADS DIV. | STATE DIST. NO. | STATE PROJECT NO. | FEDERAL PROJECT NO. | FISCAL YEAR | COUNTY | SHEET NO. | TOTAL SHEETS
WV | 2 | S322-37-3.29 00 | STP-0037(038)D | 2019 | LINCOLN | 9 | 66
LEGEND:
PHASE 1
200+00
100+00
TO EAST LYNN
201+00
101+00
202+00
102+00
203+00
204+00
205+00
206+00
207+00
103+00
104+00
105+00
106+00
WV 37
BEGIN TEMPORARY DETOUR STA. 201+56.61
BEGIN DRIVEWAY DETOUR STA. 300+00
DRIVEWAY DETOUR
END DRIVEWAY DETOUR STA. 300+76.78
TEMPORARY BRIDGE
PROPOSED BRIDGE
FOURTEENMILE CREEK
WV 37 DETOUR
TEMPORARY GUARDRAIL BARRIER (TYP)
*END TEMPORARY DETOUR STA. 208+00
TO RALEIGH
ROAD WORK AHEAD
LOCATED 500' FROM SHOULDER CLOSED SIGN (PHASE I)
SHOULDER CLOSED 1000 FT
LOCATED 1000' FROM BEGIN DETOUR WORK (PHASE I)
LOCATED 1000' FROM END DETOUR WORK (PHASE I)
LOCATED 500' FROM SHOULDER CLOSED SIGN (PHASE I)
CASE A12 – PHASE 2
USE 20 MPH
PROVIDING NO OTHER CONSTRUCTION OR MAINTENANCE OPERATION WITHIN 2 MILES
VERTICAL PANELS AT 50' CTRS.
TYPE III BARRICADE
DOUBLE YELLOW REFLECTORIZED TEMPORARY PAVEMENT MARKINGS
WHITE REFLECTORIZED TEMPORARY PAVEMENT MARKINGS
DRUMS OR BARRICADES AT 25 FT. TO 50 FT. CTRS.
ROAD CLOSED
END ROAD WORK
ROAD WORK 1000 FT
ROAD WORK 1/2 MILE
500'
100'
SCALE 0 20 ft.
TTCP-2
P.O. Box 483
Barboursville, WV 25504
www.jbtengineering.com
304-733-1335
J.B. TURMAN ENGINEERING, PLLC
REVISION NUMBER | SHEET NUMBER | REVISION | DATE | BY
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MAINTENANCE OF TRAFFIC
PLAN SHEET



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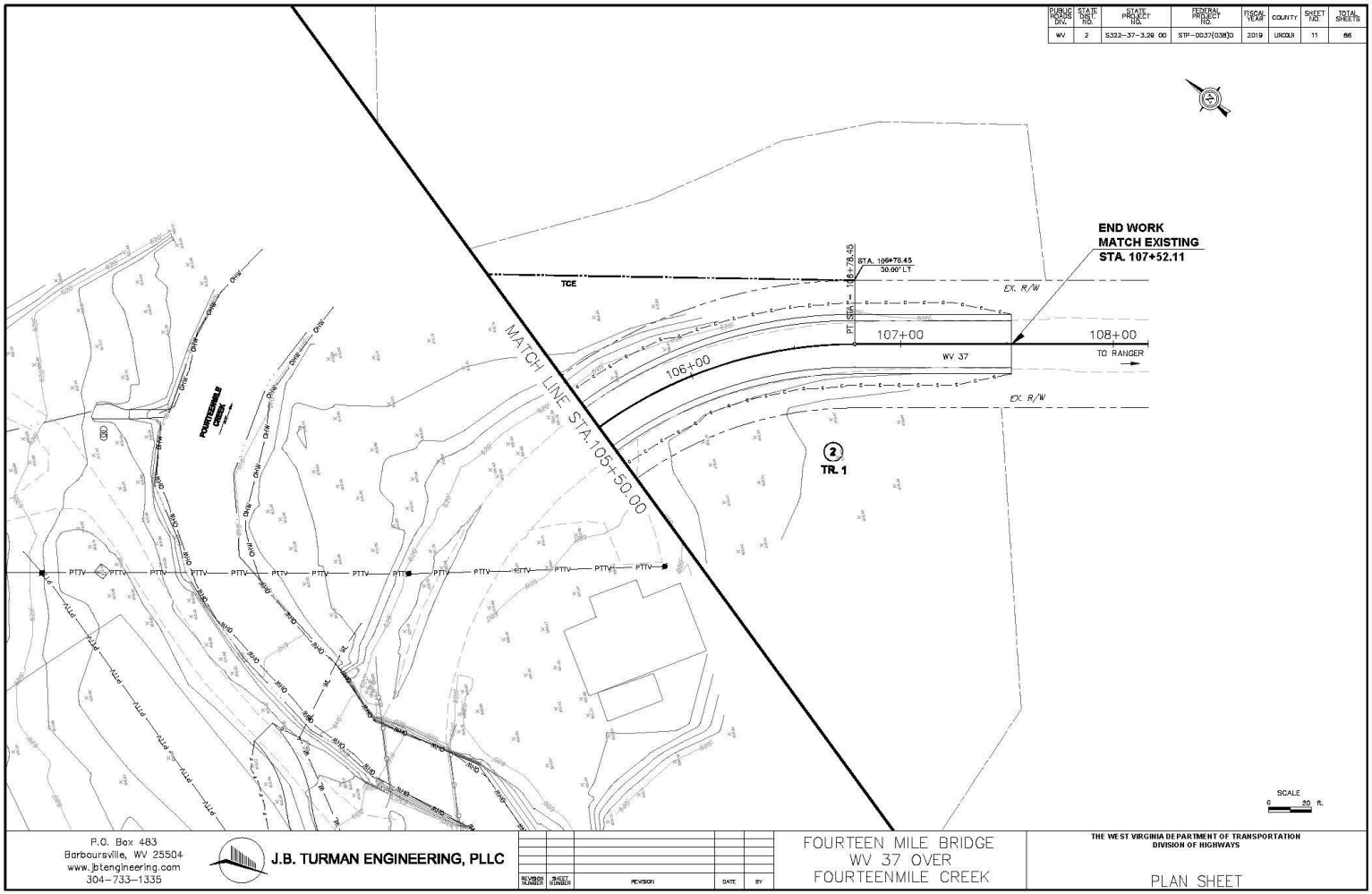
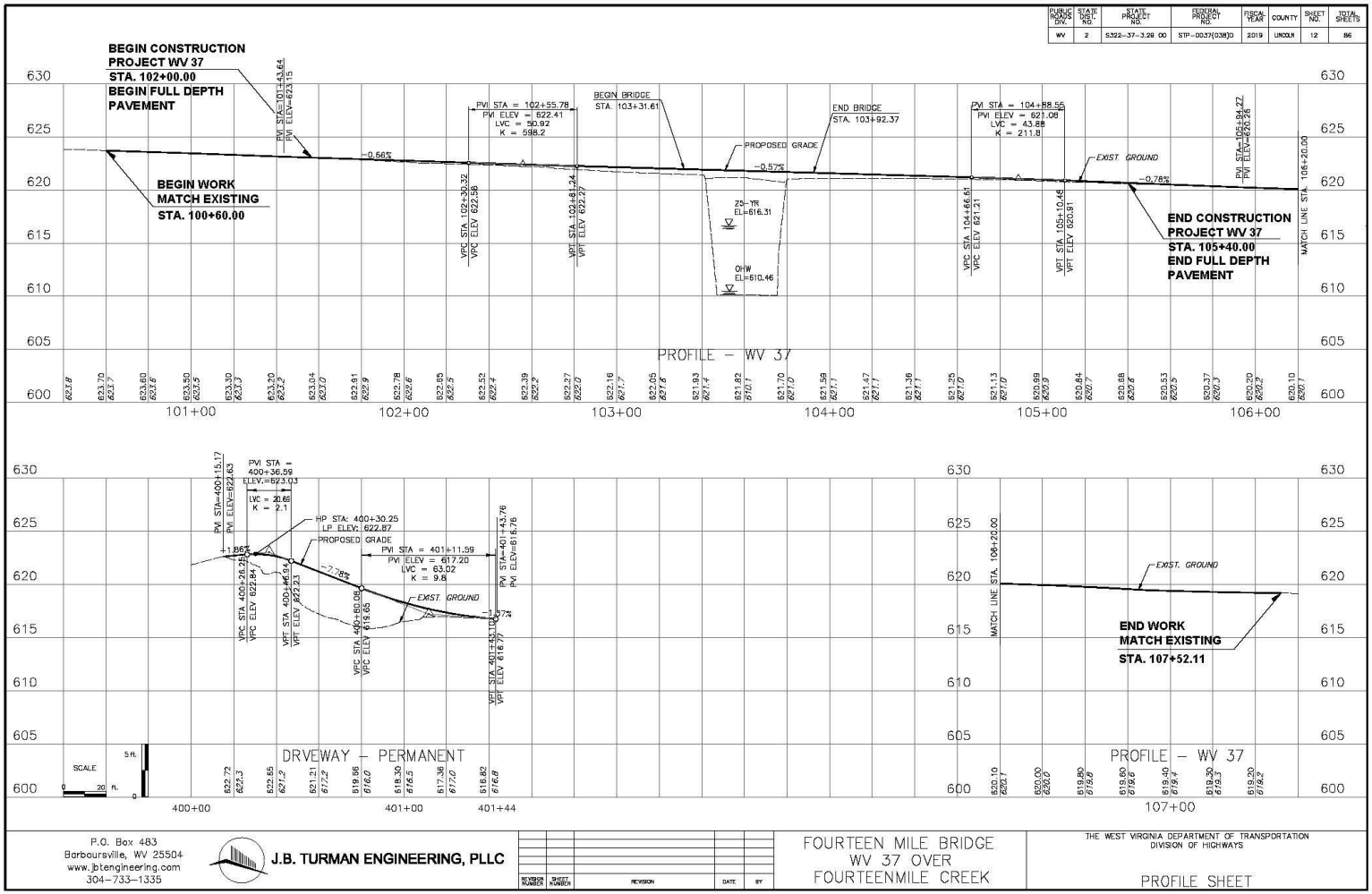
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

PLAN SHEET


PUBLIC ROADS DIV.
STATE DIST. NO.
STATE PROJECT NO.
FEDERAL PROJECT NO.
FISCAL YEAR
COUNTY
SHEET NO.
TOTAL SHEETS
WV
2
S322-37-3.29 00
STP-0037(038)D
2019
LINCOLN
11
86
END WORK
MATCH EXISTING
STA. 107+52.11
STA. 106+78.45
30.00' LT
TCE
EX. R/W
107+00
108+00
TO RANGER
WV 37
106+00
EX. R/W
MATCH LINE STA.105+50.00
FOURTEENMILE CREEK
2
TR. 1
SCALE
0
20 ft.
P.O. Box 483
Barboursville, WV 25504
www.jbtengineering.com
304-733-1335
J.B. TURMAN ENGINEERING, PLLC
REVISION NUMBER
SHEET NUMBER
REVISION
DATE
BY
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLAN SHEET


PUBLIC ROADS DIV. | STATE DIST. NO. | STATE PROJECT NO. | FEDERAL PROJECT NO. | FISCAL YEAR | COUNTY | SHEET NO. | TOTAL SHEETS
WV | 2 | S322-37-3.29 00 | STP-0037(038)D | 2019 | LINCOLN | 12 | 86
BEGIN CONSTRUCTION PROJECT WV 37 STA. 102+00.00 BEGIN FULL DEPTH PAVEMENT
BEGIN WORK MATCH EXISTING STA. 100+60.00
PVI STA=101+43.64 PVI ELEV=623.15
PVI STA = 102+55.78 PVI ELEV = 622.41 LVC = 50.92 K = 598.2
BEGIN BRIDGE STA. 103+31.61
END BRIDGE STA. 103+92.37
PROPOSED GRADE
-0.66%
-0.57%
-0.78%
EXIST. GROUND
PVI STA = 104+88.56 PVI ELEV = 621.08 LVC = 43.88 K = 211.8
PVI STA=105+64.42 PVI ELEV=620.26
25-YR EL=616.31
OHW EL=610.46
VPC STA 102+32.32 VPC ELEV 622.38
VPT STA 102+81.24 VPT ELEV 622.27
VPC STA 104+66.61 VPC ELEV 621.21
VPT STA 105+10.46 VPT ELEV 620.91
END CONSTRUCTION PROJECT WV 37 STA. 105+40.00 END FULL DEPTH PAVEMENT
MATCH LINE STA. 106+20.00
PROFILE - WV 37
101+00
102+00
103+00
104+00
105+00
106+00
PVI STA=400+15.17 PVI ELEV=622.63
PVI STA 400+36.59 ELEV.=623.03 LVC = 20.68 K = 2.1
HP STA: 400+30.25 LP ELEV: 622.87
PROPOSED GRADE
+1.86%
-2.78%
PVI STA = 401+11.59 PVI ELEV = 617.20 LVC = 63.02 K = 9.8
PVI STA=401+43.76 PVI ELEV=616.76
-1.57%
EXIST. GROUND
VPC STA 400+26.25 VPC ELEV 622.84
VPT STA 400+44.64 VPT ELEV 622.23
VPC STA 400+60.08 VPC ELEV 619.65
VPT STA 401+43.10 VPT ELEV 616.77
DRVEWAY - PERMANENT
SCALE 5 ft. 0 20 ft. 0
400+00
401+00
401+44
MATCH LINE STA. 106+20.00
EXIST. GROUND
END WORK MATCH EXISTING STA. 107+52.11
PROFILE - WV 37
107+00
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Barboursville, WV 25504
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REVISION NUMBER | SHEET NUMBER | REVISION | DATE | BY
FOURTEEN MILE BRIDGE
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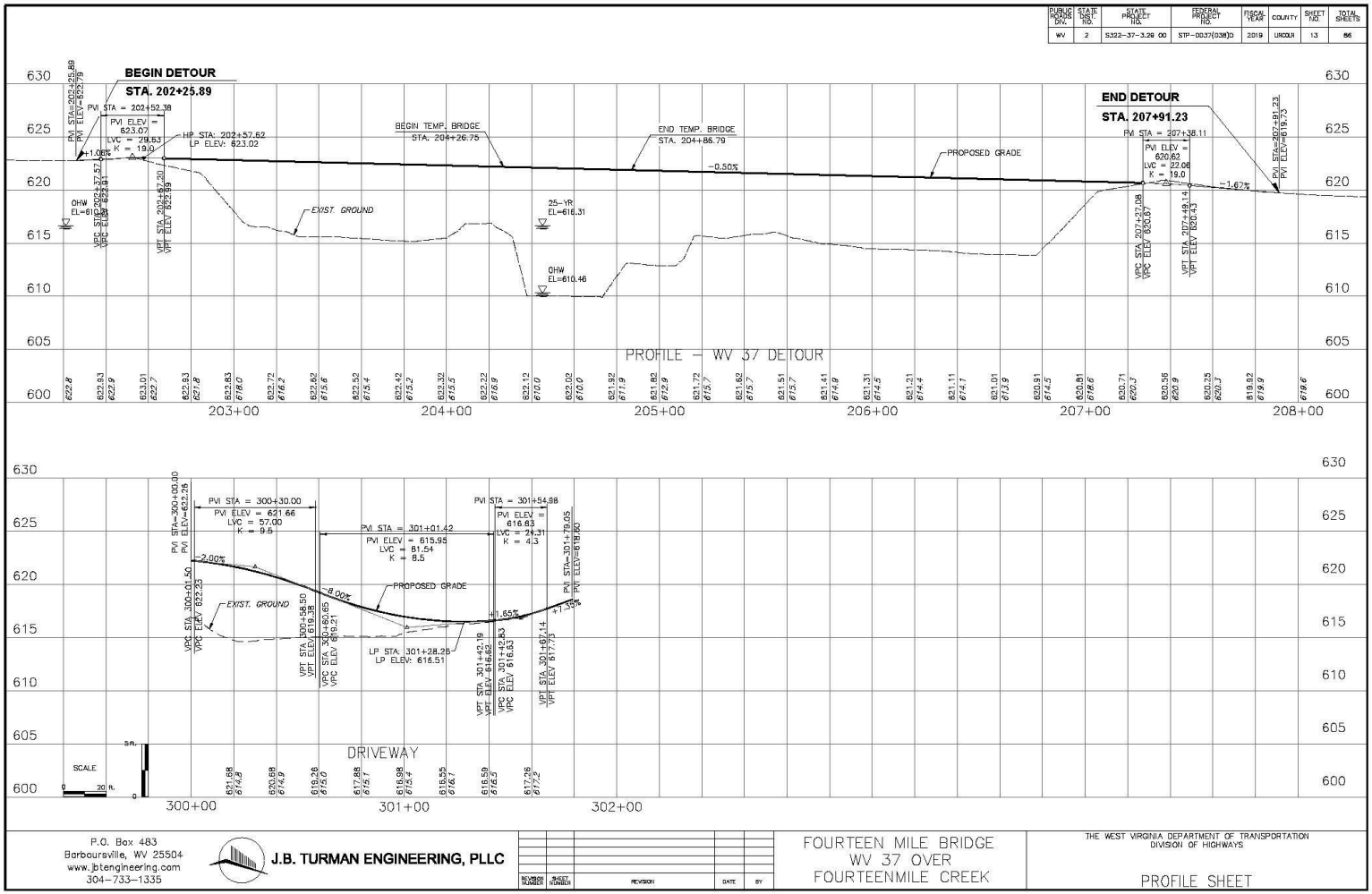
DIVISION OF HIGHWAYS
PROFILE SHEET


PUBLIC ROUTE DIV.
STATE DIST. NO.
STATE PROJECT NO.
FEDERAL PROJECT NO.
FISCAL YEAR
COUNTY
SHEET NO.
TOTAL SHEETS
WV
2
S322-37-3.29 00
STP-0037(038)D
2019
LINCOLN
13
86
BEGIN DETOUR
STA. 202+25.89
END DETOUR
STA. 207+91.23
PROFILE – WV 37 DETOUR
EXIST. GROUND
PROPOSED GRADE
BEGIN TEMP. BRIDGE
STA. 204+26.75
END TEMP. BRIDGE
STA. 204+86.79
25-YR
EL=616.31
OHW
EL=610.46
OHW
EL=610.37
-0.50%
-1.67%
203+00
204+00
205+00
206+00
207+00
208+00
DRIVEWAY
-2.00%
-8.00%
+1.65%
300+00
301+00
302+00
SCALE
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WV 37 OVER
FOURTEENMILE CREEK
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PROFILE SHEET

GENERAL NOTES

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	14	86

GENERAL SPECIFICATIONS

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS, STANDARD SPECIFICATIONS, ROADS AND BRIDGES, ADOPTED 2017, AS AMENDED BY THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS, SUPPLEMENTAL SPECIFICATIONS, DATED JANUARY 1, 2018, THE CONTRACT DOCUMENTS, AND THE CONTRACT PLANS ARE THE GOVERNING PROVISIONS APPLICABLE TO THIS PROJECT.

STANDARD DETAILS

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS, STANDARD DETAILS BOOK, VOLUME 1, DATED MAY, 2016 & VOLUME II, DATED JANUARY 1, 1994, SHALL APPLY TO THIS PROJECT. REVISED STANDARD DRAWINGS LISTED IN THE TABLE ON THIS SHEET, WITH THEIR CORRESPONDING DATE, SUPERSEDE THE AFOREMENTIONED STANDARD DETAILS. STANDARD DETAIL DRAWINGS CAN BE FOUND AT http://www.transportation.wv.gov/highways/engineering/pages/details.aspx. and http://www.transportation.wv.gov/highways/engineering/pages/publications.aspx.

REVISED STANDARD DRAWINGS USED

DRAWING	DATE REVISED
TEM-1	01/29/10
TEM-2 (SHEET 1 OF 2)	01/29/10
TEM-2 (SHEET 2 OF 2)	01/29/10
TEM-3	01/29/10
TEM-4	11/22/13

CONSTRUCTION LAYOUT STAKES

CONSTRUCTION LAYOUT STAKES FOR SIGNING SHALL BE INCIDENTAL TO THE CONTRACT AMOUNT BID AND INCLUDED IN THE VARIOUS SIGNING ITEMS.

CORNERS

CORNERS OF ALL SHEET ALUMINUM SHALL BE ROUNDED; HOWEVER, CORNERS OF ALUMINUM SIGN FACES (EXTRUDED OR OVERLAY) SHALL NOT BE ROUNDED. FABRICATED SIGNS WITH DIRECT APPLIED COPY (BLUE, GREEN, OR BROWN BACKGROUND) SHALL HAVE A 1-1/2" CORNER RADIUS ON THE ALUMINUM BLANK.

BOLT TIGHTENING

A CALIBRATED DEVICE ACCEPTABLE TO THE ENGINEER SHALL BE PROVIDED BY THE CONTRACTOR TO ENSURE THE STIPULATED TORQUE AND/OR TENSION THAT IS SET FORTH BY THE PLANS.

REFLECTIVE SHEETING

BACKGROUND MATERIAL (WHITE, GREEN, BLUE, BROWN, RED) FOR SIGNS IN THIS PROJECT SHALL BE REFLECTIVE SHEETING, TYPE ASTM III, TYPE ASTM IX OR TYPE ASTM XI FLUORESCENT YELLOW SHEETING SHALL BE USED ON ALL STANDARD WARNING SIGNS INSTALLED IN THIS PROJECT EXCEPT WHERE NOTED. IN ADDITION, EITHER TYPE ASTM IX OR TYPE ASTM XI FLUORESCENT YELLOW SHEETING SHALL BE USED ON ALL YELLOW EXTRUDED PANELS.

ALL DEMOUNTABLE WHITE LEGEND AND BORDER, AND DEMOUNTABLE SHIELDS FOR GUIDE SIGNS SHALL BE EITHER TYPE ASTM IX OR TYPE ASTM XI SHEETING. ALL SHEETING USED IN THIS PROJECT MUST HAVE SUCCESSFULLY COMPLETED 3 YEARS IN THE AASHTO/NTPEP OUTDOOR REFLECTIVE SHEETING PERFORMANCE TESTING PROGRAM.

TYPE ASTM XI SHEETING APPROVED BY THE WVDOH SHALL BE ALLOWED AS AN EQUAL SUBSTITUTE TO TYPE ASTM IX SHEETING ON ALL SIGNS, DELINEATORS, OR REFLECTIVE SUPPORT STRIPS INDICATED HEREIN REQUIRING TYPE ASTM IX.

DEMOUNTABLE COPY AND BORDERS
DEMOUNTABLE COPY AND BORDERS SHALL NOT BE POSITIONED ON ANY SIGN FACE BY MEANS OF TAPE OR GLUE. ALL DEMOUNTABLE COPY AND BORDERS SHALL BE ATTACHED TO THE SIGN FACE USING APPROVED RIVETS ONLY.

DEMOUNTABLE COPY USED IN THIS PROJECT SHALL BE FABRICATED FROM 0.080 INCH THICK ALUMINUM SHEETS CONFORMING TO ASTM B 209 ALLOY 6061-T6 OR 5052-H38 MEETING THE REQUIREMENTS OF SECTION 661.

IDENTIFICATION CODES AND DECALS

AN IDENTIFICATION CODE SHALL BE PLACED ON ALL SIGNS WITH SCREENED MESSAGES THAT ARE MANUFACTURED FOR THE DIVISION OF HIGHWAYS. THE CODE SHALL CONSIST OF THE LETTERS "WVDH" WITH AN ABBREVIATED FORM OF MONTH AND YEAR OF FABRICATION DIRECTLY BELOW. IT SHALL ALSO INCLUDE AN ABBREVIATED NAME OF THE SHEETING MANUFACTURER AND THE INK MANUFACTURER.

EACH LINE OF LETTERS OR NUMERALS SHALL BE 1/4 INCH HIGH, NO GREATER THAN ONE INCH IN LENGTH AND OF THE SAME COLOR AS THAT BEING SCREENED. THE CODE SHALL BE PLACED ON THE LOWER RIGHT HAND EDGE OF THE SIGN. THE CODE SHALL BE CONTAINED IN THE BORDER, BUT MAY EXTEND INTO THE MARGIN AND/OR THE SIGN AREA. A SIGN IDENTIFICATION DECAL SHALL BE APPLIED TO THE LOWER RIGHT HAND CORNER (FACING BACK OF SIGN) OF ALL FLAT SHEET SIGNS STATING THE MONTH AND YEAR OF INSTALLATION. EXTRUDED PANEL SIGNS AND FABRICATED FLAT SHEET SIGNS WITH DIRECT APPLIED COPY SHALL HAVE TWO SEPARATE DECALS APPLIED TO THE LOWER RIGHT HAND CORNER (FACING BACK OF SIGN), ONE STATING THE MONTH AND YEAR OF INSTALLATION AND THE OTHER STATING THE MANUFACTURER OF THE SHEETING. SEE CONTRACT PLANS FOR DECAL DETAILS.

SIGN FABRICATION

ALL SIGNS SHALL BE FABRICATED IN ACCORDANCE WITH THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS "SIGN FABRICATION MANUAL" 2005 EDITION, "DESIGN GUIDE FOR SIGNING", LATEST EDITION, AND THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS STANDARD SPECIFICATION ROADS AND BRIDGES, LATEST EDITION.

SIGN PUNCHING

SIGNS 60" OR MORE IN HEIGHT SHALL HAVE THREE RIBS. THE THIRD RIB SHALL BE MOUNTED ALONG THE HORIZONTAL CENTERLINE. A THIRD SET OF HOLES SHALL BE PUNCHED ON THESE SIGNS ALONG THE HORIZONTAL CENTERLINE AND IN LINE WITH THE OTHER SET OF HOLES.

WHERE NOTED IN THE CONTRACT PLANS, SIGNS SHALL BE PUNCHED IN ACCORDANCE WITH THE SPECIAL DETAILS INCLUDED IN THE CONTRACT PLANS.

HARDWARE

ON ALL FLAT SHEET SIGNS THE MOUNTING HARDWARE SHALL BE OF A VANDAL-RESISTANT DESIGN. THE FABRICATOR SHALL SUPPLY FIVE (5) PIECES OF MATERIAL TO THE DIVISION OF HIGHWAYS FOR TESTING PRIOR TO THE MANUFACTURE OF SIGNS. THE DIVISION OF HIGHWAYS ALSO RESERVES THE RIGHT TO RANDOM TEST THIS MATERIAL AFTER SHIPMENT TO THE PROJECT.

BOLT: 5/16" X 3" X 18. BOLT HEAD TO BE ROUND, DOME WITH ONE-WAY SLOT. BOLT SHALL HAVE A 2 INCH MINIMUM THREAD AND BE MANUFACTURED OF STEEL IN ACCORDANCE WITH ASTM A-307.

NUT: CONE SHAPED WITH HEX SHAPED DRIVE HEAD DESIGNED TO SHEAR OFF AT A PREDETERMINED TORQUE OF NO LESS THAN 4FT/LBS AND NO GREATER THAN 8FT/LBS WHEN USING MATERIALS, CONTROLS, SOILS AND TESTING MP NO. 661.20.00. NUT SHALL BE MANUFACTURED OF STEEL IN ACCORDANCE WITH ASTM A-563, GRADE A.

COATING ON BOTH NUT AND BOLT SHALL BE IN ACCORDANCE WITH ASTM B-766, CLASS B, TYPE 2 (CADMIUM DICHROMATE). THREAD FIT ON NUT AND BOLT SHALL ALLOW WORKERS TO ASSEMBLE HARDWARE WITH THEIR FINGERS BEFORE TIGHTENING.

PAVEMENT MARKING GENERAL NOTES

ALL 6" SOLID WHITE EDGE LINES, LANE LINES, AND CENTERLINES SHALL BE TYPE II PAVEMENT MARKING MATERIAL.

EDGE LINES SHALL BE CENTERED 6" FROM EDGE OF RAMP PAVEMENT OR LANE AS APPLICABLE.

ALL MARKINGS SHALL BE CONTINUOUS AND CONSISTENT WITH EXISTING MARKINGS WHERE THEY JOIN.

NO MARKINGS SHALL BE PLACED ON EXPANSION JOINTS ON STRUCTURES OR ON LONGITUDINAL CONSTRUCTION JOINTS UNLESS SO DIRECTED BY THE ENGINEER.

SUMMARY OF QUANTITIES

ITEM NUMBER	DESCRIPTION	UNITS	QUANTITY
657008-001	2.00 LB CHANNEL POST	LF	32.00
661001-001	0.080 IN FLAT SHEET SIGN	SF	12.00
663001-026	EDGE LINE, TYPE II - 6 IN WHITE	LF	692
663002-040	CENTERLINE, TYPE II - 6 IN	LF	692

SIGN ASSEMBLIES

SIGNING QUANTITIES

ASSEMBLY NUMBER	SIGN NUMBER	PROPOSED LOCATION	EXISTING LOCATION	PLAN SHT. NO.	FABRICATION DET. SHT. NO.	SIGN DISPOSITION	POSITION IN RELATION TO LANES	SIGN							SUPPORTS										FOUNDATIONS		
										FLAT SIGN							U-CHANNEL							A-572, GRADE 50						
								LENGTH FT.	WIDTH FT.	.080 S.F.	.100 S.F.	.080 OVERLAY S.F.	EXTRUDED PANEL S.F.	INTERNALLY ILLUMINATED S.F.	INSTALL REUSED SIGN S.F.	2.00 #/FT.	3.00 #/FT.	4.00BB #/FT.	6.00BB #/FT.	POST REMOVAL	REUSE EXISTING POSTS	REUSE EXISTING STUDS	S4x7.7 L.F.	W6x12 L.F.	W8x18 L.F.	W10x22 L.F.	DIA. FEET	DEPTH FEET	CLASS B CONC. REINF. C. Y.
1	XS-2L	104+84.72 17.00 LT	--	11		NEW	LT	1.0	3.0	3.00						8.0													
2	XS-2R	104+75.22 17.29 RT	--	11		NEW	RT	1.0	3.0	3.00						8.0													
3	XS-2R	104+91.82 17.07 RT	--	11		NEW	RT	1.0	3.0	3.00						8.0													
4	XS-2L	104+82.71 17.44 LT	--	11		NEW	LT	1.0	3.0	3.00						8.0													
TOTALS										12.0						32.0													

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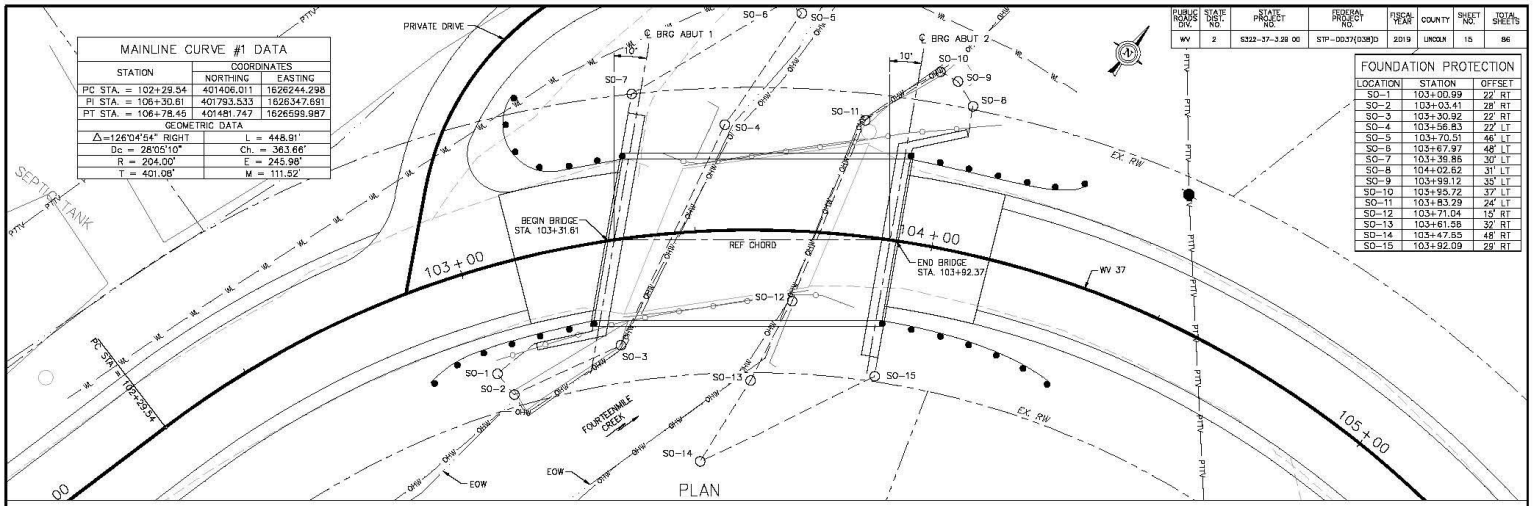
J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

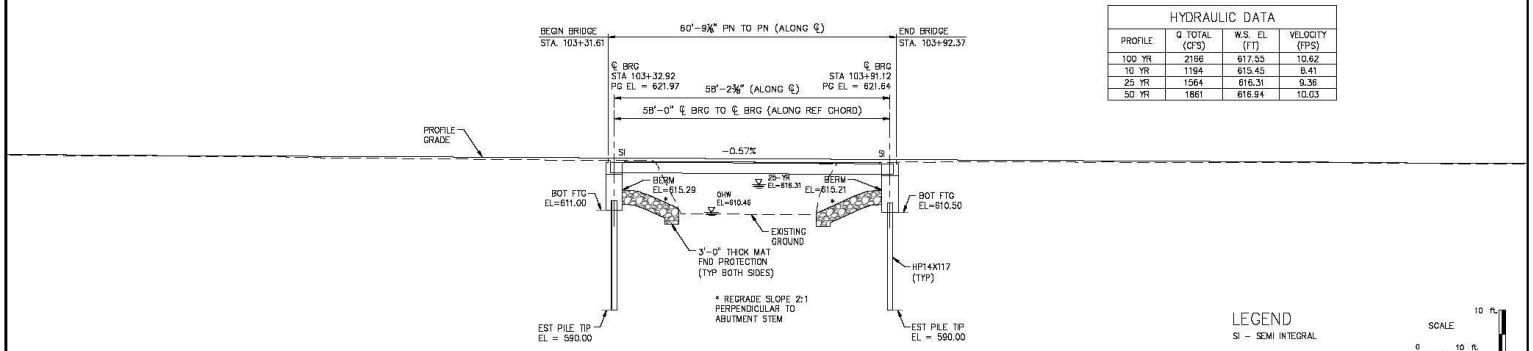
SIGNING & PAVEMENT MARKING
GENERAL NOTES



MAINLINE CURVE #1 DATA		
STATION	COORDINATES	
	NORTHING	EASTING
PC STA. = 102+29.54	401406.011	1626244.298
PI STA. = 106+30.61	401793.533	1626347.691
PT STA. = 106+78.45	401481.747	1626599.987
GEOMETRIC DATA		
△=126°04'54" RIGHT	L = 448.91'	
Dc = 28°05'10"	Ch. = 363.66'	
R = 204.00'	E = 245.98'	
T = 401.08'	M = 111.52'	

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	15	86

FOUNDATION PROTECTION		
LOCATION	STATION	OFFSET
SO-1	103+00.99	22' RT
SO-2	103+03.41	28' RT
SO-3	103+30.92	22' RT
SO-4	103+56.83	22' LT
SO-5	103+70.51	46' LT
SO-6	103+67.97	48' LT
SO-7	103+39.86	30' LT
SO-8	104+02.62	31' LT
SO-9	103+99.12	35' LT
SO-10	103+95.72	37' LT
SO-11	103+83.29	24' LT
SO-12	103+71.04	15' RT
SO-13	103+61.56	32' RT
SO-14	103+47.55	48' RT
SO-15	103+92.09	29' RT



HYDRAULIC DATA			
PROFILE	Q TOTAL (CFS)	W.S. EL (FT)	VELOCITY (FPS)
100 YR	2156	617.55	10.62
10 YR	1194	615.45	8.41
25 YR	1564	616.31	9.36
50 YR	1861	616.94	10.03

LEGEND
SI - SEMI INTEGRAL

SCALE
0 10 ft.
10 ft.
0

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
P.O. Box 483
Barboursville, WV 25504
www.jbtengineering.com

DESIGNED	DATE	CHECKED	DATE
BT	6 JUL 18	BDM	6 JUL 18
DRAWN	DATE	REVIEWED	DATE
BT	6 JUL 18	BDM	6 JUL 18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GENERAL PLAN AND ELEVATION

SHEET B1 OF B33

11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	15	86

ABBREVIATIONS:

AASHTO	= AMERICAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIALS.
ABUT	= ABUTMENT
BF	= BACK FACE
BOS	= BOTTOM OF SLAB
B OR BOT	= BOTTOM
BRG	= BEARING
BTWN	= BETWEEN
CJ	= CONSTRUCTION JOINT
CLR	= CLEAR
CTR	= CENTER
CY	= CUBIC YARD
DIA	= DIAMETER
EA	= EACH
EF	= EACH FACE
EL	= ELEVATION
EOW	= EDGE OF WATER
EQ	= EQUAL
ES	= EACH SIDE
EXP	= EXPANSION
FF	= FRONT FACE
FS	= FIELD SPLICE
FTG	= FOOTING
GA	= GAUGE
HS	= HIGH STRENGTH
ID	= INSIDE DIAMETER
INT	= INTEGRAL
LB	= POUND
LF	= LINEAR FOOT
LRFD	= LOAD RESISTANCE FACTOR DESIGN
LS	= LUMP SUM
MAT	= MATERIAL
MAX	= MAXIMUM
MIN	= MINIMUM
NF	= NEAR FACE
OD	= OUTSIDE DIAMETER
PSI	= POUND PER SQUARE INCH
PVC	= POLY VINYL CHLORIDE
R	= RADIUS
RCJ	= ROUGHEND CONSTRUCTION JOINT
REQ'D	= REQUIRED
SER	= SERIES
SF	= SQUARE FOOT
SIP	= STAY-IN-PLACE
SPA	= SPACES
SQ	= SQUARE
STA	= STATION
T	= TOP
T&B	= TOP & BOTTOM
TOS	= TOP OF SLAB
TYP	= TYPICAL
VC	= VERTICAL CURVE
VCJ	= VERTICAL CONSTRUCTION JOINT
WP	= WORKING POINTS

INDEX TO SHEETS

PROJECT NUMBER	SHEET NUMBER	REVISION	DATE	BY

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BT	6 JUL 18	BDM	6 JUL 18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

INDEX OF DRAWINGS
AND ABBREVIATIONS

SHEET
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11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	17	66

GENERAL NOTES

GOVERNING SPECIFICATIONS

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS STANDARD SPECIFICATIONS, ROADS AND BRIDGES ADOPTED YEAR 2017, AS AMENDED BY THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION, DIVISION OF HIGHWAYS, SUPPLEMENTAL SPECIFICATIONS, DATED JANUARY 1, 2018, THE CONTRACT DOCUMENTS, AND THE CONTRACT PLANS ARE THE GOVERNING PROVISIONS APPLICABLE TO THIS PROJECT.

DESIGN

THE DESIGN IS IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, CUSTOMARY U.S. UNITS, SEVENTH EDITION, 2014 AND 2015-2016 INTERIMS. BRIDGE HAS BEEN DESIGNED FOR A LIVE LOAD CAPACITY OF 2 LANES OF HL-93 LOAD. THE SUPERSTRUCTURE HAS BEEN DESIGNED AS A COMPOSITE SECTION FOR THE FULL LENGTH OF THE BRIDGE. ¾" OF CONCRETE DECK SLAB THICKNESS HAS BEEN REMOVED FROM SECTION PROPERTIES FOR DESIGN TO PROVIDE FOR GRINDING, GROOVING, AND SACRIFICIAL SURFACE. THE DESIGN PROVIDES FOR PERMANENT METAL DECK FORMS (15 PSF INCLUDING CONCRETE) AND A FUTURE WEARING SURFACE (25 PSF). FUTURE WEARING SURFACE IS NOT INCLUDED IN THIS CONTRACT.

DESIGN UNIT STRESSES

CONCRETE:

CLASS 'B'	f'c = 3,000 PSI	n = 9
CLASS 'H'	f'c = 4,000 PSI	n = 8
CLASS 'K'	f'c = 4,000 PSI	n = 8
UHPC	f'c = 15,000 PSI	n = 6

STRUCTURAL STEEL:

AASHTO M270 GRADE 50 fy = 50,000 PSI

REINFORCING STEEL:

AASHTO M31 GRADE 60 fy = 60,000 PSI

ALL BARS IN THE SLAB, BARRIERS, SEMI-INTEGRAL ABUTMENT DIAPHRAGMS AND TO THE EXTENT INDICATED WITH THE SUFFIX "E" SHALL BE EPOXY COATED. PRIOR TO CONCRETE PLACEMENT, DAMAGED EPOXY COATING SHALL BE REPAIRED BY THE CONTRACTOR.

CONCRETE

THE SUBSTRUCTURE AND APPROACH SLAB CONCRETE SHALL BE CLASS B CONCRETE. THE SUPERSTRUCTURE AND END DIAPHRAGM CONCRETE SHALL BE CLASS H CONCRETE, & CLASS K CONCRETE PARAPETS. WATER-REDUCING RETARDING ADMIXTURE IN ACCORDANCE WITH SECTION 601.2 OF THE STANDARD SPECIFICATIONS WILL BE USED IN ALL CLASS H CONCRETE IN THE SUPERSTRUCTURE. COST OF ADMIXTURE TO BE INCLUDED IN THE UNIT PRICE BID FOR CLASS H CONCRETE. RETARDER WILL NOT BE REQUIRED FOR TEMPERATURES BELOW 50 DEGREES FAHRENHEIT. THE CONTRACTOR'S ATTENTION IS CALLED TO THE TEST REQUIREMENTS FOR RETARDER ADMIXTURE. THE CONCRETE SHALL BE PLACED IN THE SEQUENCE SHOWN IN THE PLANS.

CONCRETE SHALL BE CURED IN ACCORDANCE WITH SECTION 601.12 OF THE STANDARD SPECIFICATIONS, EXCEPT THAT A SEVEN DAY WET CURE SHALL BE REQUIRED. THE CONTRACTOR IS PROHIBITED FROM REDUCING THE CURING TIME AS OUTLINED IN SECTION 601.12.1 OF THE STANDARD SPECIFICATIONS. THE CONTRACTOR SHALL NOT BE PERMITTED TO ADD ADDITIONAL AMOUNT OF CEMENT TO THE APPROVED MIX DESIGN IN ORDER TO OBTAIN HIGH EARLY STRENGTH AND/OR REDUCE CURE TIME.

ALL CONCRETE SHALL BE FINISHED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION 601 OF THE SPECIFICATIONS. CHAMFER ALL EXPOSED EDGES ¾" BY ¾" ON SUPERSTRUCTURE AND 1" BY 1" ON SUBSTRUCTURE UNLESS OTHERWISE NOTED.

NO CONSTRUCTION EQUIPMENT WITH AN AXLE LOAD GREATER THAN 20,000 LBS. (20 KIPS) SHALL BE PERMITTED ON THE SLAB AT ANY TIME. NO CONSTRUCTION EQUIPMENT OR LOADS THAT ARE NOT REQUIRED TO COMPLETE THE SLAB, PARAPETS OR OTHER APPURTENANCES SHALL BE ALLOWED ON THE BRIDGE DECK.

REINFORCING STEEL BARS

EMBEDMENT DIMENSIONS FOR REINFORCING ARE CLEAR DIMENSIONS UNLESS OTHERWISE SHOWN OR NOTED. BAR SPACING IS GIVEN TO CENTERLINE OF BAR. LAP ALL REINFORCEMENT A MINIMUM OF 30 BAR DIAMETERS UNLESS OTHERWISE NOTED IN THE PLANS. THE CLEAR DISTANCE BETWEEN REINFORCING STEEL AND THE FACE OF CONCRETE SHALL BE AS FOLLOWS, UNLESS OTHERWISE SHOWN ON THE DRAWINGS.

– TOP OF SLAB	2½"
– BOTTOM OF SLABS	1½"
– FOOTINGS & CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH	3"
– ALL OTHER LOCATIONS	2"

COST OF REINFORCING STEEL BARS SHALL BE INCLUDED UNDER ITEM 602001-001. COST OF EPOXY COATED REINFORCING STEEL BARS SHALL BE INCLUDED UNDER ITEM 602002-001.

STRUCTURAL STEEL

PRESS BREAK GIRDER SHALL BE MADE OUT OF 96" WIDE BY ⅜" THICK PLATE OF STEEL MEETING AASHTO M270 GRADE 50 AS SPECIFIED IN THE PLANS.

PRESS BREAK GIRDERS SHALL BE GALVANIZED IN ACCORDANCE WITH AASHTO M232.

ANCHOR BOLTS, NUTS AND WASHERS MAY BE MANUFACTURED FROM ORDINARY MILD STEEL AND SHALL BE HOT-DIPPED GALVANIZED ACCORDING TO AASHTO M232 AFTER FABRICATION. THE FABRICATOR'S SHOP DRAWINGS SHALL IDENTIFY THE MATERIAL SPECIFICATIONS AND GRADE FOR EACH ITEM AND ARE SUBJECT TO APPROVAL OF THE ENGINEER.

PREFORMED EXPANSION JOINT FILLER

PREFORMED EXPANSION JOINT FILLER FOR VERTICAL JOINTS IN THE PARAPETS SHALL BE SPONGE RUBBER, TYPE 1, CONFORMING TO ARTICLE 708.1.1 OF THE STANDARD SPECIFICATIONS. COST TO BE INCLUDED IN THE UNIT PRICE BID FOR THE APPROPRIATE CONCRETE ITEM FOR PAYMENT.

SPECIAL PROVISIONS

THE FOLLOWING IS A PARTIAL LIST OF SPECIAL PROVISIONS. SEE THE PROPOSAL FOR A COMPLETE LIST.

SECTION 601: ULTRA HIGH PERFORMANCE CONCRETE
SECTION 615: STEEL STRUCTURES – ELASTOMERIC BEARING ASSEMBLIES
SECTION 645: REINFORCED SOIL SLOPES
SECTION 698: PREFABRICATED BRIDGE ELEMENTS AND SYSTEMS
1. STEEL SUPERSTRUCTURE MODULES

BLAST CLEANING AND PAINTING

UPON COMPLETION OF ALL FABRICATION OPERATIONS IN THE SHOP, AND BEFORE SHIPMENT TO THE PROJECT SITE, ALL WEATHERING STEEL BRIDGE COMPONENTS SHALL BE BLAST CLEANED TO A NEAR WHITE SURFACE CONDITION ACCORDING TO SSPC-SP 10. PRIOR TO THE START OF ANY BLAST CLEANING, ALL OIL, GREASE, CUTTING FLUIDS, OR OTHER FOREIGN MATTER SHALL BE REMOVED FROM THE SURFACES OF THE STEEL BY SOLVENT CLEANING ACCORDING TO SSPC-SP 1.

THE MEMBERS OR PORTIONS OF MEMBERS LISTED BELOW SHALL BE BLAST CLEANED AND SHOP PAINTED ACCORDING TO SECTION 686 OF THE STANDARD SPECIFICATIONS, PAINTING STEEL STRUCTURES. USING THE ZINC RICH, LOW VOC SYSTEM, SECTION 711.22. APPLY THE FULL PAINT SYSTEM IN THE FABRICATION SHOP, EXCEPT FAYING SURFACES OF HIGH STRENGTH BOLTED CONNECTIONS, WHICH SHALL BE SHOP PAINTED WITH PRIMER ONLY. THE COLOR OF THE FINAL TOP COAT SHALL BE 20062 ACCORDING TO FEDERAL STANDARD 595 AND THE GLOSS AT ANGLE OF 60 DEGREES SHALL NOT EXCEED 25.

FOR ABUTMENTS, PAINT THE ENDS OF THE GIRDERS AND ALL OTHER STRUCTURAL COMPONENTS ENCASED IN THE CONCRETE ABUTMENT PLUS ONE ADDITIONAL FOOT IN LENGTH.

AREAS OF THE SHOP APPLIED PAINT SYSTEM WHICH ARE DAMAGED DURING ERECTION AND HIGH STRENGTH BOLTED CONNECTION AREAS THAT WERE ONLY PRIME PAINTED SHALL BE PROPERLY CLEANED AND PAINTED ACCORDING TO SECTION 686 OF THE STANDARD SPECIFICATIONS, PAINTING STEEL STRUCTURES, AND TO THE SATISFACTION OF THE ENGINEER.

AFTER COMPLETION OF ALL TIGHTENING OPERATIONS, MECHANICALLY GALVANIZED FASTENERS SHALL BE SOLVENT CLEANED AND FIELD PAINTED AS SPECIFIED FOR THE STRUCTURAL STEEL.

INCLUDE CLEANING AND PAINTING COSTS IN ITEM 615001-001, STEEL SUPERSTRUCTURE.

IDENTIFICATION MARKING STEEL MEMBERS

ALL STEEL MILL AND FABRICATOR IDENTIFICATION MARKINGS FOR STEEL PLATES, SHAPES, OR FABRICATED MEMBERS SHALL BE BY METAL TAGS, SOAPSTONE, OR SOME OTHER READILY REMOVABLE MATERIAL; OR, SHALL BE MARKED IN AN AREA OF THE COMPLETED MEMBER WHICH WILL BE ENCASED OR COVERED WITH CONCRETE. MARKING METHODS AND LOCATIONS ARE SUBJECT TO APPROVAL OF THE ENGINEER.

DO NOT USE PAINT OR WAX-BASED CRAYONS FOR MARKING.

HANDLING AND STORING STEEL MEMBERS

STEEL MEMBERS MUST NOT BE GOUGED, SCRATCHED, DENTED, OR ALLOWED TO RUB AGAINST OTHER MEMBERS THAT WOULD RESULT IN DAMAGE TO THE BLAST CLEANED PROFILE OF THE STEEL. MEMBERS SHALL BE HANDLED USING SOFTENERS AND SLINGS INSTEAD OF CHOKERS AND CHAINS.

STORE MEMBERS IN THE FABRICATION SHOP AND ON THE PROJECT SITE IN SUCH A MANNER AS TO BE KEPT FREE AND CLEAN OF ALL FOREIGN SUBSTANCES SUCH AS GREASE, OIL, MORTAR AND CONCRETE, SPLATTER, CHALK AND CRAYON MARKS, PAINT, AND DIRT. ALL STORAGE MUST BE ABOVE GROUND AND SLOPED TO ALLOW FREE DRAINAGE OF MELTED SNOW, RAINWATER, AND DEW. IF THE MEMBERS ARE STORED FOR PERIODS LONGER THAN THREE MONTHS, THE MEMBERS MUST BE PLACED ON METAL SUPPORTS. FOR PERIODS OF STORAGE UP TO 3 MONTHS, MEMBERS MAY BE PLACED ON CLEAN, UNTREATED, WOOD TIMBERS.

STORE PLATE GIRDERS AND ROLLED BEAMS WITH THE WEB IN THE UPRIGHT POSITION. THE MEMBERS MAY BE STACKED PROVIDED METAL OR WOOD SUPPORTS, AS NOTED ABOVE, SEPARATE INDIVIDUAL MEMBERS. UNDER NO CIRCUMSTANCES SHALL MEMBERS BE NESTED TOGETHER OR BUNDLED.

DO NOT ALLOW TREATED LUMBER OR TREATED TIMBER TO CONTACT STEEL MEMBERS. CONTACT WITH CLEAN, UNTREATED LUMBER OR TIMBER WILL NOT DAMAGE THE STEEL MEMBERS.

FINAL CLEANUP OF STRUCTURAL STEEL SURFACES

UPON COMPLETION OF ALL CONCRETE CURING OPERATIONS, THE CONTRACTOR SHALL CLEAN ALL STEEL SURFACES TO REMOVE ALL GREASE, OIL, CONCRETE RESIDUE, DIRT, AND OTHER FOREIGN SUBSTANCES TO THE SATISFACTION OF THE ENGINEER.

CLEANING MAY BE BY HIGH PRESSURE WATER, POWER OR HAND WIRE BRUSHING, OR BY BRUSH-OFF BLAST CLEANING ACCORDING TO SSPC-SP 7. CLEANING SHALL BE FOLLOWED BY A CLEAN WATER RINSE TO REMOVE ALL RESIDUES OF DETERGENTS AND CLEANERS IF THEY WERE USED. ALL GREASE AND OIL SHALL BE REMOVED PRIOR TO THE CLEAN WATER RINSE BY SOLVENT CLEANING.

DO NOT USE ACIDS TO REMOVE STAINS.

INCLUDE COSTS FOR FINAL CLEANUP OF STEEL SURFACES IN ITEM 615001-001, STEEL SUPERSTRUCTURE.

PROTECTION OF CONCRETE SUBSTRUCTURE

BEFORE PLACING ANY STEEL SUPERSTRUCTURE MEMBERS ON THE CONCRETE SUBSTRUCTURE UNITS, THE CONTRACTOR SHALL COAT ALL EXPOSED AREAS OF THE ABUTMENT WITH AN APPROVED SILANE BASED CONCRETE SEALER. PREPARATION OF SURFACES, APPLICATION RATES, AND METHODS SHALL BE AS RECOMMENDED BY THE SILANE MANUFACTURER.

THE CONTRACTOR SHALL TAKE APPROPRIATE MEASURES TO PROTECT THE CONCRETE SUBSTRUCTURE FROM RUST STAINING DURING CONSTRUCTION AND CURING OF SUPERSTRUCTURE CONCRETE. WATER RUNOFF FROM CONCRETE CURING OPERATIONS SHALL BE DEFLECTED AWAY FROM THE STEEL GIRDERS AND SHALL NOT DRAIN ONTO THE SUBSTRUCTURE CONCRETE AFTER CONTACTING THE WEATHERING STEEL.

UPON COMPLETION OF ALL SUPERSTRUCTURE CONCRETE CURING OPERATIONS, THE CONTRACTOR SHALL REMOVE ALL RUST STAINS FROM SUBSTRUCTURE UNITS USING PROPRIETARY CHEMICAL STAIN REMOVERS OR MILD ACID ETCHING ABRASIVE BLAST CLEANING MAY BE USED TO SUPPLEMENT THE OTHER CLEANING METHODS IF THE STAINED AREAS ARE SEVERE OR EXTENSIVE. ALL CLEANING METHODS SHALL BE SUBJECT TO APPROVAL OF THE ENGINEER.

RE-COAT ALL AREAS WHERE RUST STAINS WERE REMOVED, REGARDLESS OF THE CLEANING METHOD USED, WITH AN APPROVED SILANE BASED CONCRETE SEALER AS SPECIFIED ABOVE.

INCLUDE THE COST OF SILANE COATING, PROTECTING, CLEANING, AND RE-COATING SUBSTRUCTURE UNITS IN ITEM 601002-001, CLASS B CONCRETE.

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GENERAL NOTES SHEET (1 OF 2)

SHEET 83 OF 833

11374

GENERAL NOTES CONTINUED

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	18	66

WELDED STUD SHEAR CONNECTORS

THE WELDED SHEAR STUDS SHALL BE INSTALLED IN ACCORDANCE WITH SECTION 615.3.3, EXCEPT AS FOLLOWS: "THE CONTRACTOR MAY SHOP INSTALL SHEAR STUDS TO THE BEAM OR GIRDER FOR THE PURPOSE OF ATTACHING A WORKER FALL PROTECTION SYSTEM. ONLY THE SHEAR STUDS REQUIRED TO PROPERLY INSTALL AND SUPPORT THE WORKER FALL PROTECTION SYSTEM MAY BE INSTALLED IN THE SHOP. THE REMAINING SHEAR STUDS FOR AN INDIVIDUAL ROW ACROSS THE BEAM OR GIRDER FLANGE MAY ALSO BE INSTALLED IN THE SHOP. ALL SHOP INSTALLED SHEAR STUDS SHALL BE SHOWN ON THE SHOP DRAWINGS.

THE FIELD INSTALLATION OF THE WELDED STUD SHEAR CONNECTORS SHALL NOT COMMENCE PRIOR TO THE INSTALLATION OF THE DECK FORMS IN THE AREA SURROUNDING THE WELDED STUD SHEAR CONNECTORS. OVERHANGING DECK FORMS MAY BE INSTALLED AFTER THE WELDED STUD SHEAR CONNECTORS ARE INSTALLED. THE WELDED STUD SHEAR CONNECTORS AND DECK FORMS SHALL BE INSTALLED IN A SEQUENCE THAT PERMITS WORKERS ACCESS THROUGH THE DECK AREA WITHOUT WALKING THROUGH INSTALLED WELDED STUD SHEAR CONNECTORS."

CONSTRUCTION JOINTS

ROUGHENED SURFACES MAY BE USED IN LIEU OF KEYS FOR HORIZONTAL CONSTRUCTION JOINTS, UNLESS NOTED.

BACKFILL

THE CONTRACTOR SHALL BACKFILL AROUND THE SUBSTRUCTURE AS SOON AS POSSIBLE AFTER REMOVAL OF FORMS AND FALSEWORK, AND SLOPE TO DRAIN IN ACCORDANCE WITH SUBSECTION 212.10. COST OF 6" DIAMETER PERFORATED AND NONPERFORATED PIPE UNDERDRAIN AND FILTER FABRIC SHALL BE INCLUDED IN VARIOUS BRIDGE ITEMS.

APPROACH SLABS

THE APPROACH SLABS ARE TO BE IN ACCORDANCE WITH SECTION 502 EXCEPT AS NOTED.

REINFORCING STEEL BARS IN THE APPROACH SLABS ARE TO BE EPOXY COATED AND IN ACCORDANCE WITH AASHTO M31, GRADE 60.

THE FOLLOWING APPROACH SLAB RELATED ITEMS ARE INCLUDED IN THE ROADWAY ESTIMATE OF QUANTITIES:

PAYMENT FOR CLASS B CONCRETE FOR THE APPROACH SLABS, EPOXY COATED REINFORCING STEEL BARS IN THE UPPER AND LOWER MATS OF THE APPROACH SLAB, TRANSVERSE JOINT AT THE ABUTMENT AND JOINT SEALER MATERIAL, POLYETHYLENE SHEET (DOUBLE LAYER), SLEEPER SLAB, AND EXPANSION AT SLEEPER SLAB ARE INCLUDED IN ITEM 502001-012, 12" PORTLAND CEMENT CONCRETE APPROACH SLAB.

PAYMENT FOR AGGREGATE BASE COURSE IS INCLUDED IN ITEM 307001-001.

ELASTICIZED EXPANDED POLYSTYRENE (EPS)

EPS MATERIAL SHALL BE PLACED AT TOLERANCES OF PLUS OR MINUS ¼ INCH FOR EACH DIMENSION.

THE EPS MATERIAL SHALL BE ATTACHED TO CONCRETE SURFACES WITH AN ADHESIVE COMPATIBLE WITH THE EPS MATERIAL. THE CONCRETE SURFACE SHALL BE THOROUGHLY DRY AND CLEAN PRIOR TO THE APPLICATION OF THE ADHESIVE.

THE EPS MATERIAL AND ADHESIVE SHALL BE APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

ALL MATERIAL AND WORK FOR THE EPS MATERIAL SHALL BE CONSIDERED INCIDENTAL TO ITEM 845001-001, PRIMARY REINFORCMENT, 2400 LB/FT.

EXISTING STRUCTURE

THE EXISTING STRUCTURE SHALL BE DISMANTLED AND DISPOSED IN ACCORDANCE WITH SECTION 203 OF THE STANDARD SPECIFICATIONS.

ALL MATERIAL REMOVED FROM THE BRIDGE SHALL BECOME PROPERTY THE CONTRACTOR AND SHALL BE REMOVED FROM THE STATE RIGHT-OF-WAY.

THE CONTRACTOR SHALL USE EXTREME CAUTION IN KEEPING DEBRIS FROM FALLING DURING DISMANTLING. ANY FALLEN DEBRIS SHALL BE REMOVED IMMEDIATELY.

ANY AND ALL STEEL REINFORCING AND CONCRETE DEBRIS IN EXCESS OF 8" NOMINAL SIZE SHALL BE REMOVED FROM THE STREAM.

SHOP DRAWINGS

SHOP DRAWING REVIEW AND APPROVAL SHALL BE IN ACCORDANCE WITH DD-102.

BRIDGE PILING

THE MAXIMUM FACTORED PILE LOAD IS 375 KIPS (STR I). ALL STEEL PILES SHALL BE HP14X117 STEEL BEARING PILES, PREDRILLED AND DRIVEN, AND SHALL MEET AASHTO M270, GRADE 50, REQUIREMENTS. HARDENED STEEL PILE POINTS SHALL BE USED. THE TARGET CAPACITY IS 750 KIPS PER PILE AT REFUSAL ON BEDROCK.

REFUSAL IS DEFINED IN BLOWS PER 1 INCH (BPI) OF PENETRATION TO THE TARGET BPI AS LISTED IN THE FOLLOWING TABLE, PROVIDED THAT DRIVING SHOULD BE TERMINATED IN ANY EVENT AT 20 BLOWS PER ¼" TO AVOID DAMAGING THE PILES.

HAMMER	ENERGY RATING (FT-LBS)	FUEL SETTING	TARGET BPI
APE 30-42	74,419	MAX-3	9
APE D19-42	47,126	MAX-3	15
ICE 42S	42,000	MAX	15
PILECO 25-32	58,406	MAX-3	15
PILECO 30-32	70,066	MAX-3	10

IF THE CONTRACTOR ELECTS TO USE A HAMMER THAT IS NOT INCLUDED IN THE ABOVE TABLE OR IF A DIFFERENT FUEL SETTING THAN THOSE LISTED ABOVE IS USED, THE CONTRACTOR SHALL SUBMIT DRIVING CRITERIA USING A WAVE EQUATION ANALYSIS, SUCH AS GRLWEAP. THE DRIVING CRITERIA SHALL BE SUBMITTED TO THE ENGINEER AT LEAST 14 DAYS PRIOR TO INSTALLATION OF THE FIRST PILE AND SHALL INCLUDE THE FUEL SETTING(S), STROKE HEIGHT, THE REQUIRED BLOWS PER 1 INCH OF PENETRATION TO ACHIEVE THE TARGET CAPACITY, AND THE MAXIMUM DRIVING STRESS AT REFUSAL. A MINIMUM OF 9 BPI MAY BE ALLOWED AS PRACTICAL REFUSAL BY THE ENGINEER BASED ON THE WAVE EQUATION ANALYSIS. THE ANALYSIS SHALL DEMONSTRATE THAT THE TARGET CAPACITY CAN BE ACHIEVED WITHOUT DAMAGING THE PILES OR EXCEEDING 45 KSI MAXIMUM COMPRESSIVE STRESS.

ANY WAVE EQUATION ANALYSIS PERFORMED BY THE CONTRACTOR AND ASSOCIATED COSTS DUE TO DELAYS, DRIVING EQUIPMENT, OR MOBILIZATION SHALL BE AT THE CONTRACTOR'S EXPENSE. THE COST OF PILE POINTS AND SAND BACKFILL SHALL BE INCLUDED IN ITEM 616005-018, HP14X117 STEEL BEARING PILES, PRE-DRILLED AND DRIVEN.

STRUCTURE EXCAVATION

STRUCTURE EXCAVATION QUANTITIES THROUGH EARTH FILL SHALL BE MEASURED FROM THE BOTTOM OF FOOTING TO THE ORIGINAL GROUND LINE, 18 INCHES OUTSIDE THE NEAT LINE OF THE FOOTING. NO EXCAVATION WILL BE CLASSIFIED AS WET OR ROCK EXCAVATION.

FISH SPAWN

INSTREAM WORK IS NOT PERMISSIBLE DURING THE WARM WATER FISH SPAWNING SEASON, APRIL 1 THROUGH JUNE 30, EXCEPT AS MAY BE AUTHORIZED BY THE WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION, DIVISION OF WATER AND WASTE MANAGEMENT, AND THE DEPARTMENT OF NATURAL RESOURCES, WILDLIFE RESOURCES SECTION.

FOUNDATION PROTECTION

THE FOUNDATION PROTECTION AT THE ABUTMENTS SHALL BE IN ACCORDANCE WITH SECTION 218.4 OF THE STANDARD SPECIFICATION. ALL COST AND LABOR SHALL BE PAID FOR UNDER ITEM 218006-000, FOUNDATION PROTECTION.

BRIDGE PLATE

INSTALL A NEW BRIDGE PLATE ON THE ROADWAY FACE AT THE RIGHT BARRIER AT ABUTMENT 1 AS DIRECTED BY THE ENGINEER.

GEOTECHNICAL INFORMATION

GEOTECHNICAL INFORMATION IS PROVIDED WITH THESE PLANS AND SHALL BE CONSIDERED AS A PART OF THE CONTRACT DOCUMENTS. THE INFORMATION PRESENTED IS BASED IN PART ON SMALL DIAMETER TEST BORINGS AND SHOULD BE CONSIDERED AS APPROXIMATE.

TEMPORARY BRIDGE

THE CONTRACTOR SHALL ERECT AND MAINTAIN A TEMPORARY BRIDGE AT THE LOCATION SHOWN ON THE PLANS PRIOR TO CLOSING THE EXISTING BRIDGE. IT SHALL BE MAINTAINED UNTIL THE NEW BRIDGE IS OPEN TO TRAFFIC. THE BRIDGE LENGTH SHALL BE DETERMINED BY APPLYING THE FOLLOWING MINIMUM SUPERSTRUCTURE ELEVATION AND NET WATERWAY OPENING.

A MINIMUM NET WATERWAY OPENING OF 226 SQ FT SHALL BE MAINTAINED BELOW ELEVATION 614.33. THE STREAM BANK SLOPES SHALL BE LIMITED TO A MAXIMUM OF 1.5 HORIZONTAL TO 1 VERTICAL.

THE STRUCTURE SHALL BE DESIGNED FOR A HL-93 LIVE LOADING. THE USE OF USED MATERIAL IS ACCEPTABLE, SUCH MATERIAL SHALL BE INSPECTED VISUALLY BY THE ENGINEER PRIOR TO ITS USE. THE DESIGN AND PLANS FOR THE TEMPORARY BRIDGE STRUCTURE SHALL BE STAMPED BY A WEST VIRGINIA PE AND SUBMITTED TO THE ENGINEER FOR APPROVAL BEFORE BEGINNING CONSTRUCTION.

AFTER THE NEW BRIDGE IS OPEN TO TRAFFIC, THE CONTRACTOR SHALL REMOVE THE TEMPORARY STRUCTURE AND EMBANKMENTS FROM THE SITE. MATERIAL SHALL REMAIN THE PROPERTY OF THE CONTRACTOR.

ERECTION, MAINTAINANCE AND REMOVAL OF THE STRUCTURE SHALL BE PAID FOR UNDER ITEM 636005-001, TEMPORARY STRUCTURE FOR MAINTAINING TRAFFIC.

VALUE ENGINEERING

THIS IS A RESEARCH PROJECT WITH WVU AND MARSHALL THAT WILL UTILIZE PRESS BRAKE TUB GIRDERS WITH A PRECAST DECK AND ULTRA HIGH PERFORMANCE CONCRETE (UHPC) CLOSURE POURS. IT IS IMPERATIVE THAT THIS PROJECT USE PRESS BRAKE TUB GIRDERS AND UHPC. FOR THAT REASON, NO VALUE ENGINEERING PROPOSALS WILL BE ACCEPTED FOR THE SUPERSTRUCTURE.

PROJECT VIDEO RECORDING

IT IS BROUGHT TO THE CONTRACTORS ATTENTION THAT ONE CAMERA SUPPLIED BY STEEL MARKET DEVELOPMENT INSTITUTE (SMDI) WILL RECORD THE PROJECTS TOTAL DURATION FOR SPECIFIC USE IN THE CREATION OF A TIME LAPSE VIDEO. ADDITIONALLY, SMDI WILL SUPPLY THE ASSOCIATED DATA PLAN FOR THE CAMERA.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING A STEEL SIGN POST A MINIMUM OF 16 FEET ABOVE GROUND IN AN AREA WHERE THE CAMERA HAS AN UNOBSTRUCTED SITE LINE TO THE PROJECT. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR SUPPLYING THE POWER SOURCE AND MAINTENANCE. THIS RESPONSIBILITY SHALL BEGIN WITH THE INSTALLATION OF THE SIGN POST AND CONTINUE FOR THE LIFE OF THE PROJECT. MAINTENANCE SHALL INCLUDE BUT NOT BE LIMITED TO ACTS OF VANDALISM, NORMAL WEAR, SUPPORT POST AND MISCELLANEOUS ITEMS FOR THIS INSTALLATION. ALL COST AND LABOR FOR THIS WORK SHALL BE PAID FOR IN VARIOUS BID ITEMS.

STRAIN GAUGE

AS PART OF THE PROJECT, PROFESSORS FROM WVU AND MARSHALL WILL BE GIVEN ACCESS TO THE SITE FOR INSTALLATION OF STRAIN GAUGE(S) ON THE TUB GIRDERS.

SUPERSTRUCTURE ASSEMBLY

CAREFUL ATTENTION SHALL BE TAKEN DURING THE LIFTING OF THE MODULES TO ENSURE LIFTING STRESSES ARE KEPT AT A MINIMUM. A SPREAD BEAM SUPPLIED AND DESIGNED TO HANDLE THE LOAD IS RECOMMENDED FOR THE CONTRACTOR TO USE DURING LIFTING. THE CONTRACTOR SHALL SUBMIT WORKING DRAWINGS AND CALCULATIONS PREPARED AND SEALED BY A WEST VIRGINIA LICENSED PROFESSIONAL ENGINEER TO THE ENGINEER FOR THE LIFTING AND SETTING OF MODULES FOR APPROVAL. CRANE CAPACITIES SHALL ALSO BE INCLUDED IN THE SUBMISSION DEMONSTRATING ADEQUATE LIFT CAPACITIES.

ITEMS THAT WILL BE PAID INCIDENTAL TO ITEM 698001-001 "PREFABRICATED BRIDGE ELEMENT SUPERSTRUCTURE" ARE LISTED BELOW.

1. SHOP DRAWINGS
2. FABRICATION OF TUB GIRDERS, INCLUDING SHEAR STUDS, DIAPHRAGMS, INSPECTION HATCH, GALVANIZING, CLASS H CONCRETE, EPOXY REBAR, DIAMOND GRINDING, GROOVING & WEEP DRAINS
3. TRANSPORT OF TUB GIRDERS TO PRECASTER
4. ALL PANEL INSERTS FOR LIFTING AND FORM SUPPORTS FOR PRECASTING
5. MODULE TRANSPORT AND STORAGE
6. MODULE ERECTION

DIAMOND GRINDING

UPON COMPLETION OF THE DECK LONGITUDINAL CLOSURE POURS, THE CONTRACTOR SHALL DIAMOND GRIND THE DECK A MAXIMUM OF ½" AND GROOVE. DIAMOND GRIND THE BRIDGE DECK FOR PROFILE IMPROVEMENTS. A DECK ELEVATION TABLE HAS BEEN PROVIDED IN THE PLANS. DIAMOND GRINDING OF THE DECK SHALL NOT BEGIN UNTIL THE UHPC CLOSURE POUR CONCRETE HAS REACHED THE SPECIFIED MINIMUM COMPRESSIVE STRENGTH OF 15 KSI.

CONTRACTOR TO BID DIAMOND GRINDING BASED ON THE TYPE OF COURSE AGGREGATE IN THE CONCRETE MIX FOR BRIDGE DECKS. FOR PLANT FABRICATING OF PRECAST ELEMENTS. COURSE AGGREGATE SHALL BE IN ACCORDANCE WITH SECTION 601 OF THE SPECIFICATIONS.

PRECAST CONCRETE FABRICATION TOLERANCES

LENGTH	= ¾"
WIDTH	= ¼"
DEPTH	= ¼"
LOCAL SMOOTHNESS OF ANY SURFACE	= ¼" IN 10 FEET

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GENERAL NOTES SHEET (2 OF 2)

SHEET B4 OF B33

11374

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PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	1	S303-3-38.48 00	NFA-2117(026)D	2019	LINCOLN	19	86

ESTIMATE OF QUANTITIES

ITEM	DESCRIPTION	UNIT	QUANTITY
203001-000	DISMANTLING STRUCTURE	LS	1
212001-000	STRUCTURE EXCAVATION	CY	308
218006-000	FOUNDATION PROTECTION	CY	248
601002-001	CLASS B CONCRETE	CY	113
601003-001	CLASS K CONCRETE	CY	10
601800-001	ULTRA HIGH PERFORMANCE CONCRETE	CY	5
602001-001	REINFORCING STEEL BAR	LB	15,369
602002-001	EPOXY COATED REINFORCING STEEL BAR	LB	2,615
615029-001	NON-GUIDED BEARING, ELASTOMERIC	EA	10
615005-019	HP14X117 STEEL BEARING PILE, PRE-DRILLED AND DRIVEN	LF	364
639001-001	CONSTRUCTION LAYOUT STAKE	LS	1
698001-001	PREFABRICATED BRIDGE ELEMENT SUPERSTRUCTURE	EA	5

THE FOLLOWING ITEMS ARE INCLUDED IN BID ITEM 698001-001:
1. SHOP DRAWINGS
2. FABRICATION OF PRESS BRAKE TUB GIRDERS, INCLUDING SHEAR STUDS, DIAPHRAGMS, INSPECTION HATCH, GALVANIZING, CLASS H CONCRETE, EPOXY REBAR, DIAMOND GRINDING, GROOVING & WEEP DRAINS
3. TRANSPORT OF PRESS BRAKE TUB GIRDERS TO PRECASTER
4. ALL PRECAST INSERTS FOR LIFTING AND FORM SUPPORTS FOR PRECASTING
5. MODULE TRANSPORT AND STORAGE
6. MODULE ERECTION

SEE SPECIAL PROVISION FOR ITEM 601800-001, ULTRA HIGH PERFORMANCE CONCRETE

DESC. / LOCATION	212001-000 STRUCTURE EXCAVATION	218006-000 FOUNDATION PROTECTION	601002-001 CLASS B CONCRETE	601003-001 CLASS K CONCRETE	602001-001 REINFORCING STEEL BAR	602002-001 EPOXY COATED REINFORCING STEEL BAR
	CY	CY	CY	CY	LB	LB
ABUTMENT 1	155	115	57	0	7,537	0
ABUTMENT 2	153	133	56	0	7,832	0
SUPERSTRUCTURE	0	0	0	10	0	2,615
TOTAL	308	248	113	10	15,369	2,615

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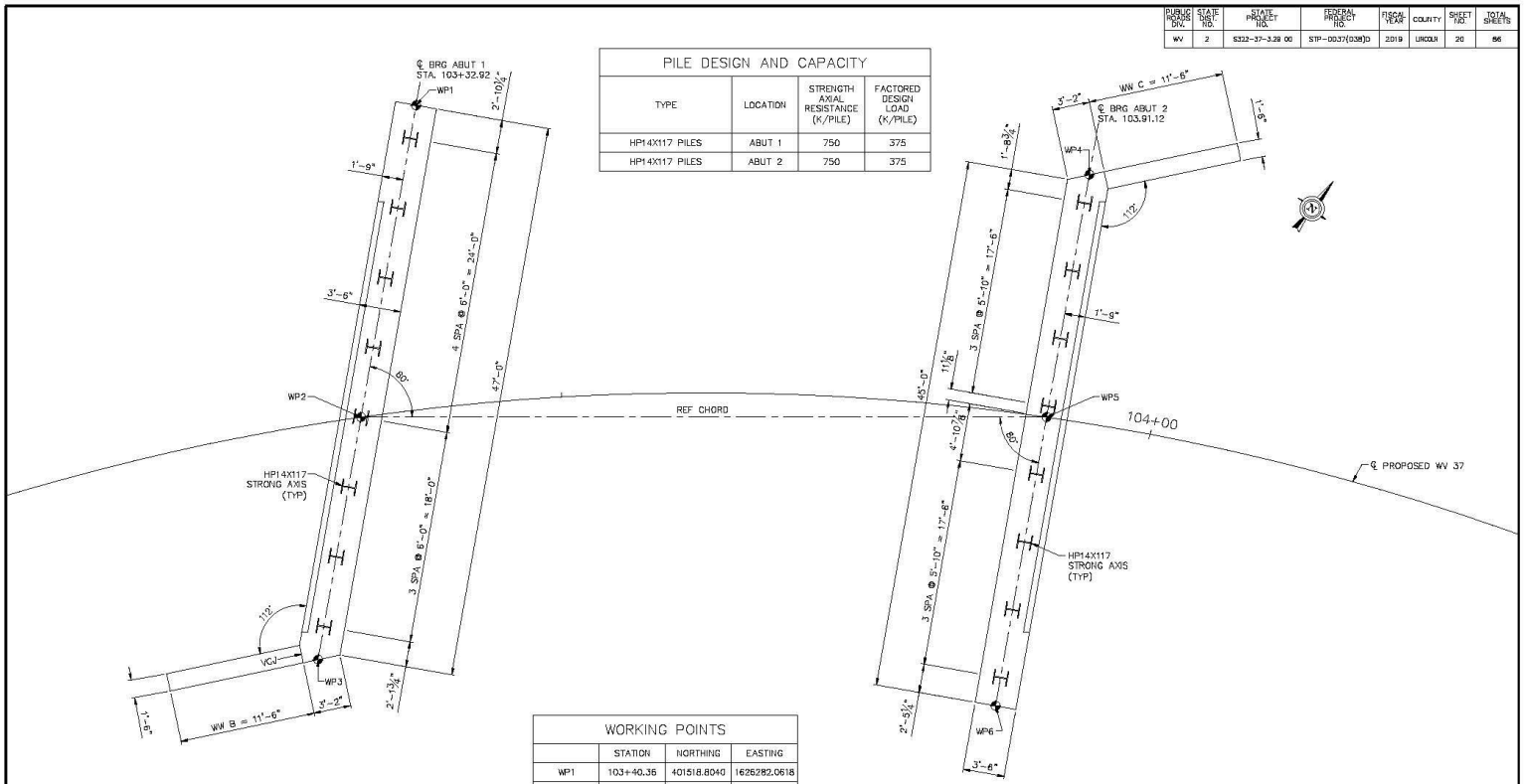
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
ESTIMATE OF
BRIDGE QUANTITIES

SHEET
B5 OF B33
11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	20	86



PILE DESIGN AND CAPACITY

TYPE	LOCATION	STRENGTH AXIAL RESISTANCE (K/PILE)	FACTORED DESIGN LOAD (K/PILE)
HP14X117 PILES	ABUT 1	750	375
HP14X117 PILES	ABUT 2	750	375

WORKING POINTS

	STATION	NORTHING	EASTING
WP1	103+40.36	401518.8040	1626282.0618
WP2	103+32.92	401495.0728	1626294.6007
WP3	103+25.72	401476.6249	1626304.3480
WP4	103+91.73	401549.1098	1626330.6510
WP5	103+91.12	401530.6619	1626340.3983
WP6	103+90.22	401508.6990	1626352.0028

NOTES:

1. FOR ABUTMENT AND WINGWALL DETAILS SEE SHEETS B7 THRU B13.
2. FOR PILING GENERAL NOTES SEE SHEET B4.

SCALE

0 4 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
P.O. Box 483
Barboursville, WV 25504
www.jbtengineering.com

DESIGNED	DATE	CHECKED	DATE
BT	6 JUL 18	BDM	6 JUL 18
DRAWN	DATE	REVIEWED	DATE
BT	6 JUL 18	BDM	6 JUL 18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

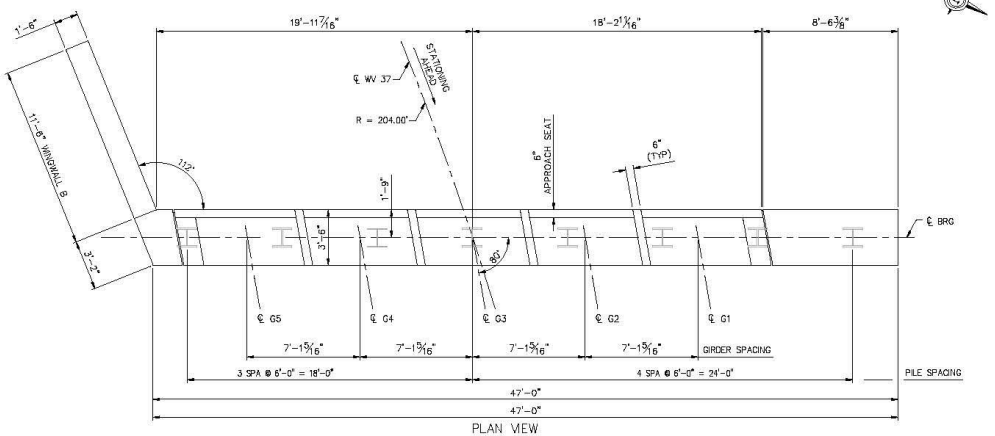
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

FOUNDATION LAYOUT

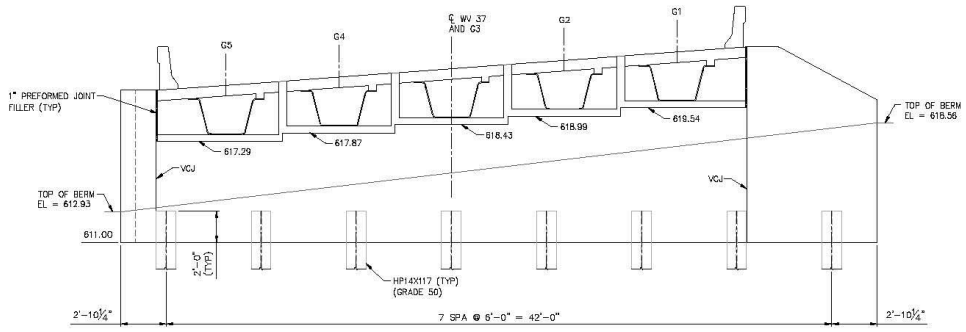
SHEET
B6 OF B33

11374

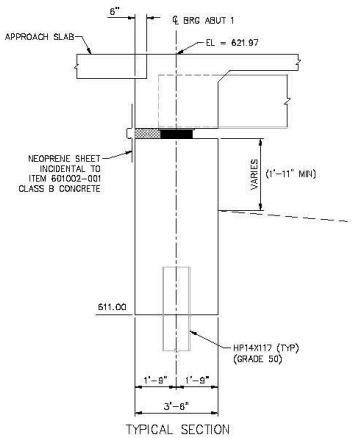
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	21	86



PLAN VIEW



ELEVATION VIEW



TYPICAL SECTION

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
P.O. Box 483
Barboursville, WV 25504
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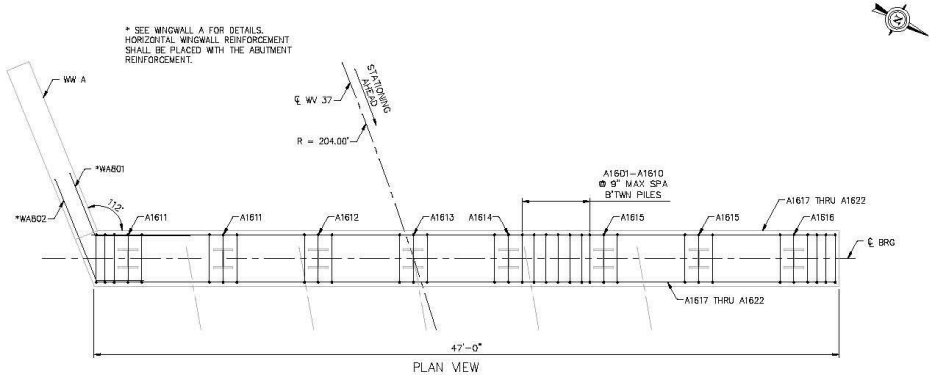
FOURTEEN MILE BRIDGE
WV 37 OVER FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

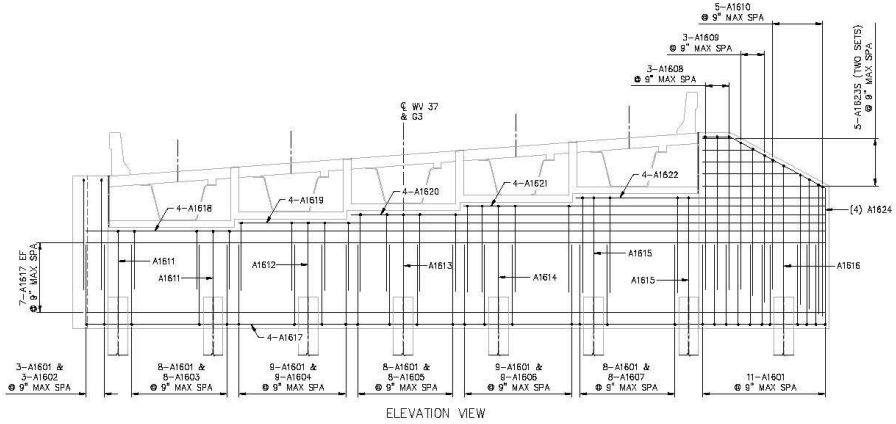
ABUTMENT 1
PLAN AND ELEVATION

SHEET
87 OF 833
11374

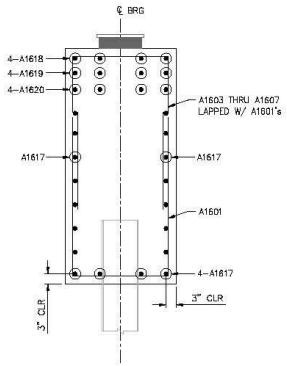
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	22	86



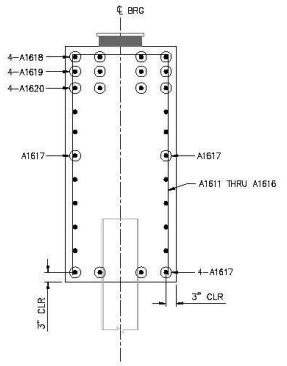
PLAN VIEW



ELEVATION VIEW



TYPICAL SECTION BETWEEN PILES
NTS



TYPICAL SECTION AT PILE
SHOWN AT ℄ OF G3
NTS

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
P.O. Box 483
Barboursville, WV 25504
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FOURTEEN MILE BRIDGE
WV 37 OVER FOURTEENMILE CREEK

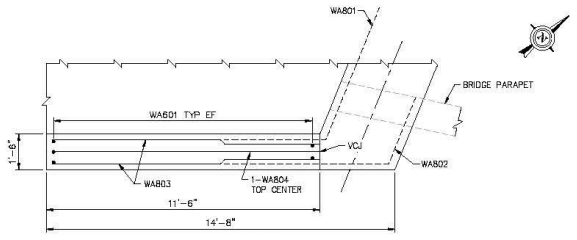
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

ABUTMENT 1 DETAILS

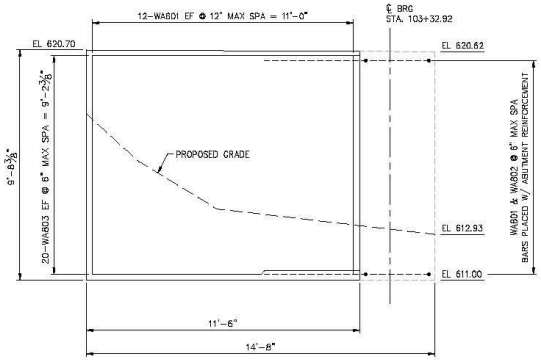
SHEET
88 OF 833

11374

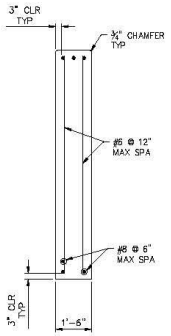
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	23	86



WINGWALL A PLAN



WINGWALL A ELEVATION
(ALONG OUTSIDE FACE OF WALL)



WINGWALL TYPICAL

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

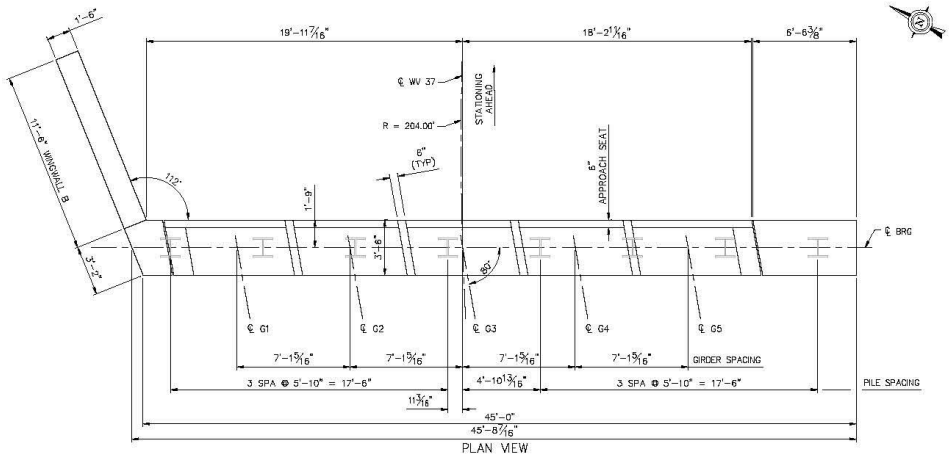
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

WINGWALL A

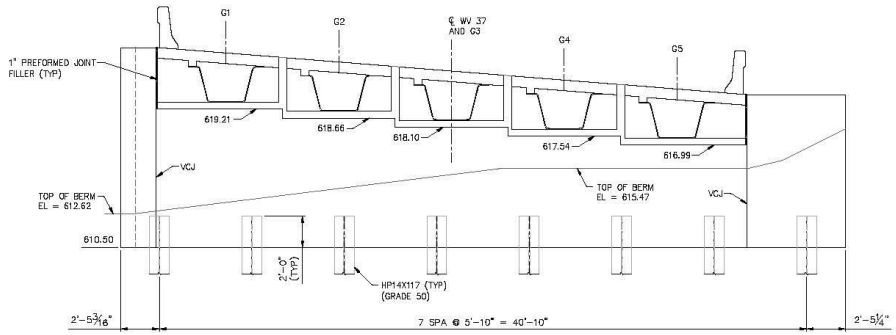
SHEET
89 OF 833

11374

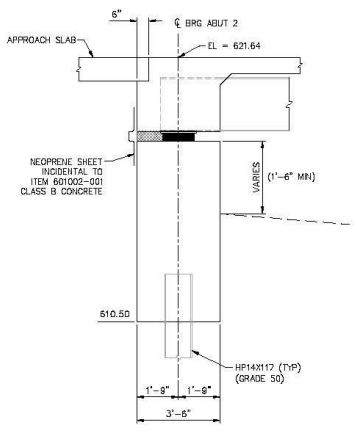
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	24	86



PLAN VIEW



ELEVATION VIEW



TYPICAL SECTION

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY	J.B. TURMAN ENGINEERING, PLLC P.O. Box 483 Barboursville, WV 25504 www.jbtengineering.com	DESIGNED BT	DATE 6 JUL 18	CHECKED BDM	DATE 6 JUL 18
						DRAWN BT	DATE 6 JUL 18	REVIEWED BDM	DATE 6 JUL 18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

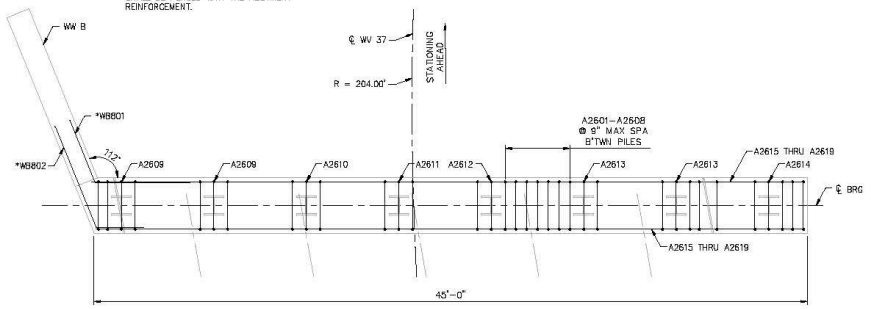
ABUTMENT 2
PLAN AND ELEVATION

SHEET
B10 OF B33

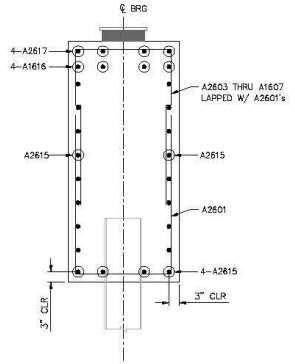
11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	25	86

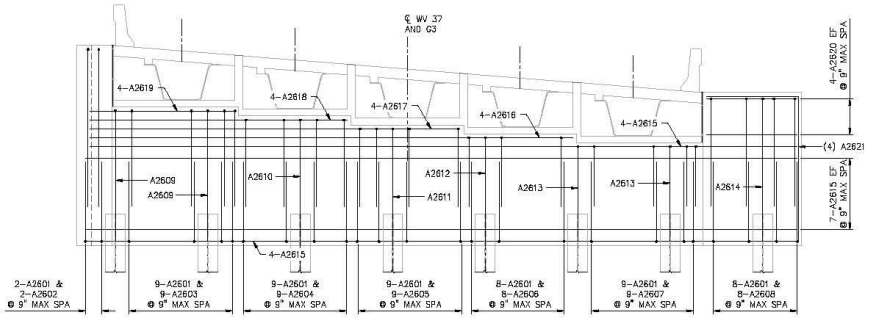
* SEE WINGWALL B FOR DETAILS. HORIZONTAL WINGWALL REINFORCEMENT SHALL BE PLACED WITH THE ABUTMENT REINFORCEMENT.



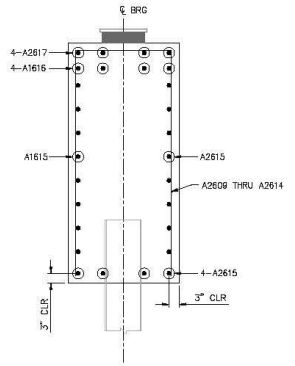
PLAN VIEW



TYPICAL SECTION BETWEEN PILES
NTS



ELEVATION VIEW



TYPICAL SECTION AT PILE
SHOWN AT ℄ OF G3
NTS

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J.B. TURMAN ENGINEERING, PLLC
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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

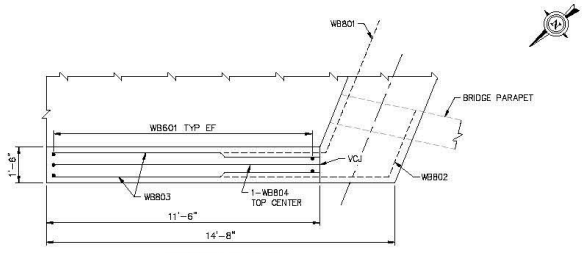
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

ABUTMENT 2
DETAILS

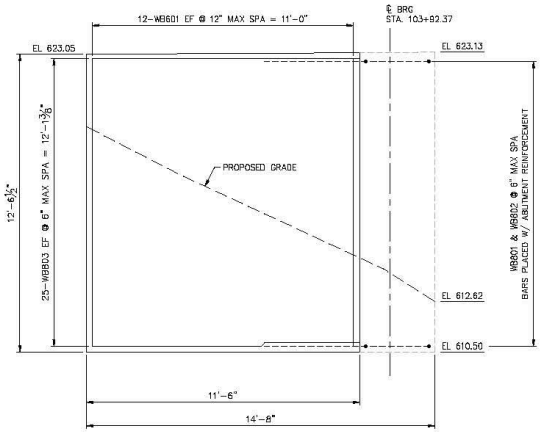
SHEET
B11 OF B33

11374

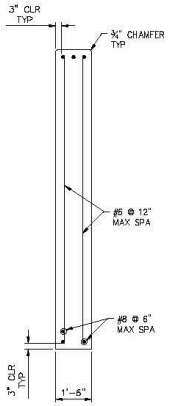
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	26	86



WINGWALL B PLAN



WINGWALL B ELEVATION
(ALONG OUTSIDE FACE OF WALL)



WINGWALL TYPICAL

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
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Barboursville, WV 25504
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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

WINGWALL B

SHEET
B12 OF B33

11374

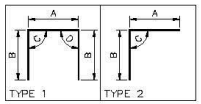
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	27	86

ABUTMENT AND WINGWALL REINFORCEMENT

MARK	TYPE	NUMBER REQUIRED	LENGTH (FT)	602001-001	602002-001	DIMENSION A	B	C	D
ABUTMENT NO. 1									
A1601	1	55	13' – 0"	1094		3' – 0"	5' – 0"	90°	90°
A1602	1	3	16' – 10"	76		3' – 0"	6' – 11"	90°	90°
A1603	1	8	10' – 4"	125		3' – 0"	3' – 8"	90°	90°
A1604	1	9	11' – 8"	156		3' – 0"	4' – 3"	90°	90°
A1605	1	8	12' – 8"	153		3' – 0"	4' – 10"	90°	90°
A1606	1	9	13' – 10"	187		3' – 0"	5' – 5"	90°	90°
A1607	1	8	15' – 0"	181		3' – 0"	6' – 0"	90°	90°
A1608	1	3	22' – 4"	101		3' – 0"	9' – 8"	90°	90°
A1609	1	3	21' – 6"	97		3' – 0"	9' – 3"	90°	90°
A1610	1	5	19' – 4"	146		3' – 0"	8' – 2"	90°	90°
A1611	1	2	14' – 8"	45		3' – 0"	5' – 10"	90°	90°
A1612	1	1	15' – 10"	24		3' – 0"	6' – 5"	90°	90°
A1613	1	1	16' – 10"	26		3' – 0"	6' – 11"	90°	90°
A1614	1	1	18' – 0"	28		3' – 0"	7' – 6"	90°	90°
A1615	1	2	19' – 0"	58		3' – 0"	8' – 0"	90°	90°
A1616	1	1	23' – 0"	35		3' – 0"	10' – 0"	90°	90°
A1617	STR	18	46' – 5"	1258					
A1618	STR	4	46' – 6"	280					
A1619	STR	4	37' – 0"	223					
A1620	STR	4	29' – 10"	180					
A1621	STR	4	22' – 8"	137					
A1622	STR	4	15' – 8"	95					
A1623S	STR	2 EACH MARK	VARIES FROM 1' – 10" TO 7' – 6" BY 1' – 9"	71					
A1624	1	4	17' – 1"	103				152°	118°
TOTAL				4879	0				
ABUTMENT NO. 2									
A2601	1	54	13' – 0"	1055		3' – 0"	5' – 0"	90°	90°
A2602	1	2	22' – 10"	69		3' – 0"	9' – 11"	90°	90°
A2603	1	9	15' – 0"	203		3' – 0"	6' – 0"	90°	90°
A2604	1	9	14' – 0"	190		3' – 0"	5' – 6"	90°	90°
A2605	1	9	12' – 10"	174		3' – 0"	4' – 11"	90°	90°
A2606	1	8	11' – 8"	141		3' – 0"	4' – 4"	90°	90°
A2607	1	9	10' – 6"	142		3' – 0"	3' – 9"	90°	90°
A2608	1	8	16' – 6"	199		3' – 0"	6' – 9"	90°	90°
A2609	1	2	19' – 6"	59		3' – 0"	8' – 3"	90°	90°
A2610	1	1	18' – 4"	28		3' – 0"	7' – 8"	90°	90°
A2611	1	1	17' – 2"	26		3' – 0"	7' – 1"	90°	90°
A2612	1	1	16' – 0"	25		3' – 0"	6' – 6"	90°	90°
A2613	1	2	15' – 0"	46		3' – 0"	6' – 0"	90°	90°
A2614	1	1	21' – 0"	32		3' – 0"	9' – 0"	90°	90°
A2615	STR	22	44' – 6"	1471					
A2616	STR	4	30' – 5"	183					
A2617	STR	4	23' – 4"	141					
A2618	STR	4	16' – 3"	98					
A2619	STR	4	9' – 1"	55					
A2620	STR	8	5' – 9"	70					
A2621	2	4	14' – 11"	90		5' – 9"	9' – 2"	90°	
TOTAL				4497	0				

ABUTMENT AND WINGWALL REINFORCEMENT

MARK	TYPE	NUMBER REQUIRED	LENGTH (FT)	602001-001	602002-001	DIMENSION A	B	C	D
WINGWALL A									
WA601	STR	24	9' – 2"	331					
WA801	2	20	10' – 3"	548		4' – 3"	6' – 0"	112°	
WA802	2	20	9' – 11"	530		6' – 11"	3' – 0"	112°	
WA803	STR	40	11' – 3"	1202					
WA804	1	1	17' – 3"	47		11' – 3"	3' – 0"	90°	90°
TOTAL				2658	0				
WINGWALL B									
WB601	STR	24	12' – 2"	438					
WB801	2	25	10' – 3"	685		4' – 3"	6' – 0"	112°	
WB802	2	25	9' – 11"	662		6' – 11"	3' – 0"	112°	
WB803	STR	50	11' – 3"	1502					
WB804	1	1	17' – 3"	47		11' – 3"	3' – 0"	90°	90°
TOTAL				3335	0				



TYPE 1 TYPE 2

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

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BT	6 JUL 18	BDM	6 JUL 18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

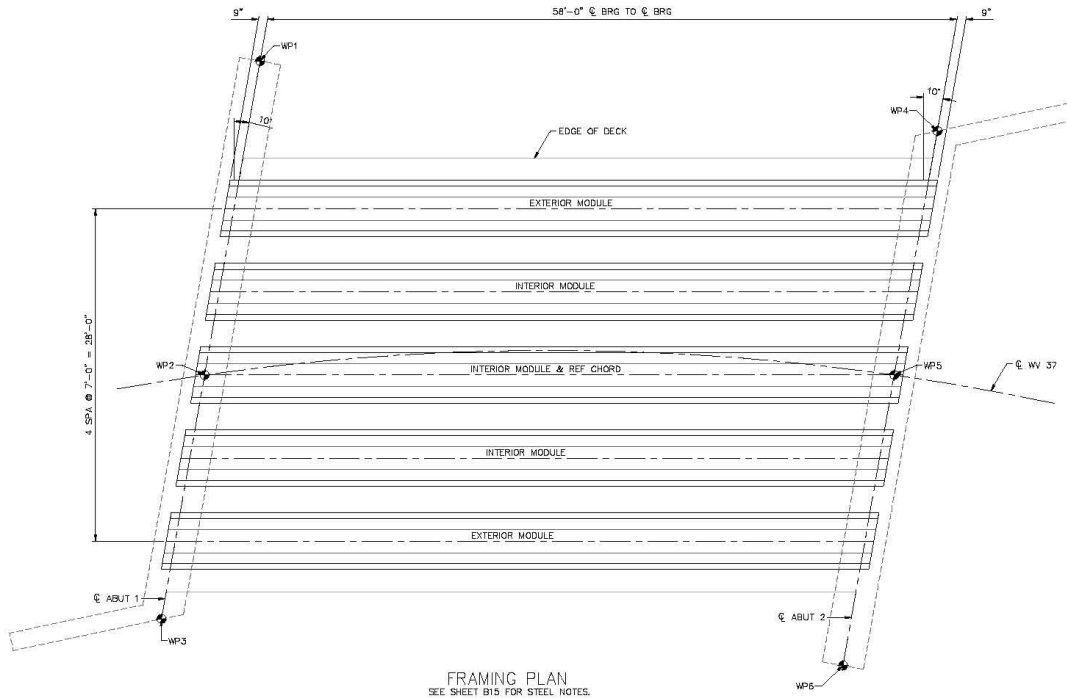
ABUTMENT AND WINGWALL REINFORCING

SHEET B13 OF B33

11374

201

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	28	86



FRAMING PLAN
SEE SHEET B15 FOR STEEL NOTES.

SCALE
0 4 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

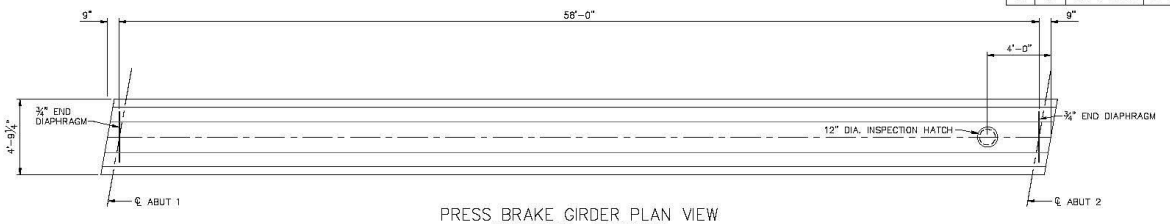
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

FRAMING PLAN

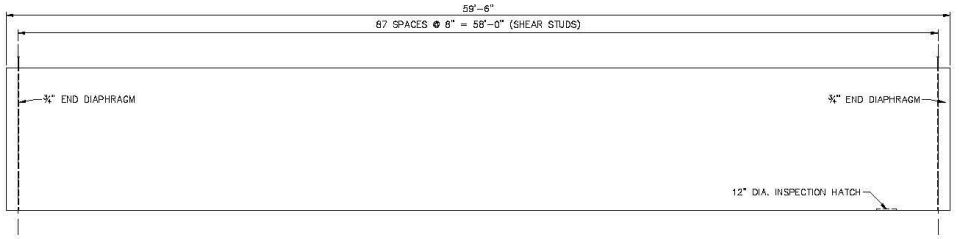
SHEET
B14 OF B33

11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	29	56



PRESS BRAKE GIRDER PLAN VIEW
GIRDER A SHOWN – OTHERS SIMILAR

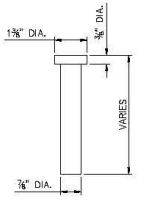


PRESS BRAKE GIRDER ELEVATION VIEW
GIRDER A SHOWN – OTHERS SIMILAR
VERTICAL EXAGGERATION 4X

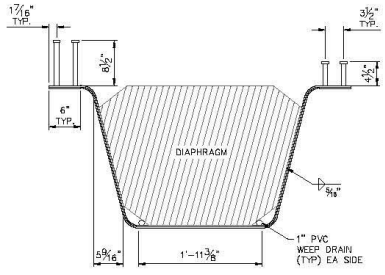
SCALE
0 3 ft.

NOTES:

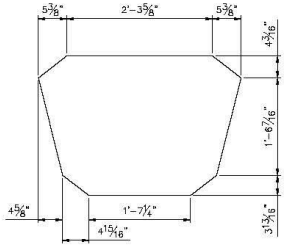
1. PRESS BRAKE GIRDER TO BE MADE OUT OF A 96" WIDE BY ½" THICK PLATE OF STEEL WHICH SHALL CONFORM TO AASHTO M270 (GRADE 50).
2. DIAPHRAGMS SHALL BE WELDED TO THE GIRDERS WITH 5/16" FILLET WELDS ON ALL THREE SIDES WITH AN E70XX ELECTRODE.
3. SEE SHEET B-16 FOR INSPECTION HATCH DETAILS.
4. PRESS BRAKE GIRDERS SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM 123.
5. ALL WELDING INCLUDING ANY WELDING THAT MAY BE REQUIRED FOR STAY-IN-PLACE FORMS ON GIRDER SHALL TAKE PLACE PRIOR TO GALVANIZING.



STUD DETAIL
NTS



SECTION VIEW
NTS



DIAPHRAGM DETAILS
NTS

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
P.O. Box 483
Barboursville, WV 25504
www.jbtengineering.com

DESIGNED	DATE	CHECKED	DATE
BT	6 JUL 18	BDM	6 JUL 18
DRAWN	DATE	REVIEWED	DATE
BT	6 JUL 18	BDM	6 JUL 18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

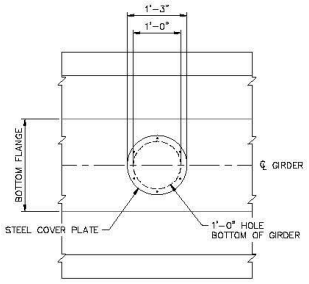
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GIRDER ELEVATION

SHEET
B15 OF B33

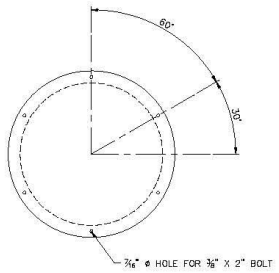
11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	30	86

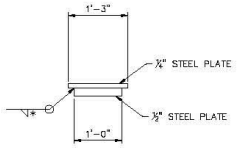


INSPECTION HATCH PLAN VIEW
GIRDER A SHOWN – OTHERS SIMILAR

NOTES:
1. WELD BOLT HEADS TO 15" DIA. PLATE ON INSIDE OF GIRDER WITH THREADS PROTRUDING THROUGH THE BOTTOM FLANGE. PLACE ⅜" NUTS ON BOLTS.
2. SIX (6) BOLTS TOTAL POSITIONED 60 DEGREES FROM EACH OTHER.
3. HATCH SHALL BE ORIENTED ON THE BEAM SO THAT THE 12" PLATE FITS IN THE 12" HOLE AND THE NUTS FOR THE BOLTS ARE TIGHTENED FROM UNDER THE GIRDER.
4. ALL PARTS OF THE HATCH SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM 123.



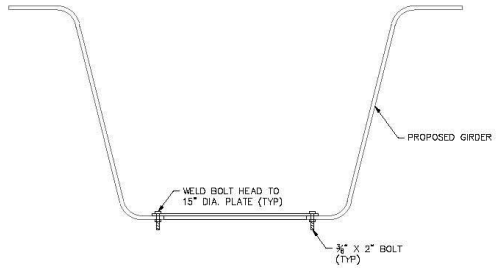
INSPECTION HATCH BOLT DETAIL PLAN VIEW
NTS



INSPECTION HATCH ELEVATION VIEW
NTS – EXAGGERATED VERTICALLY

* WELD SIZES	
PLATE THICKNESS	WELD SIZE
< ¾"	¼"
≥ ¾"	5/16"

ALL WELDS SHALL CONFORM TO THE 2015 WELDING CODE ANSI/AASHTO/AWS D1.5



INSPECTION HATCH BOLT DETAIL ELEVATION VIEW
NTS

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

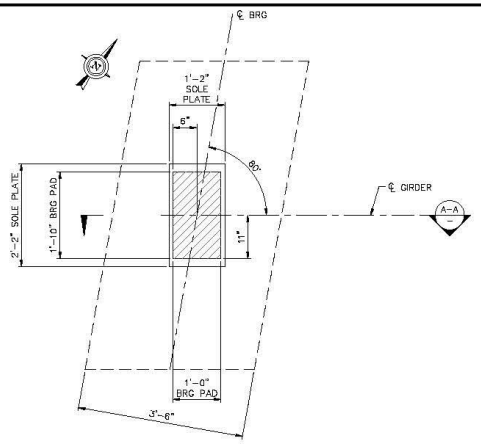
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

MISCELLANEOUS STEEL DETAILS

SHEET
B16 OF B33

11374

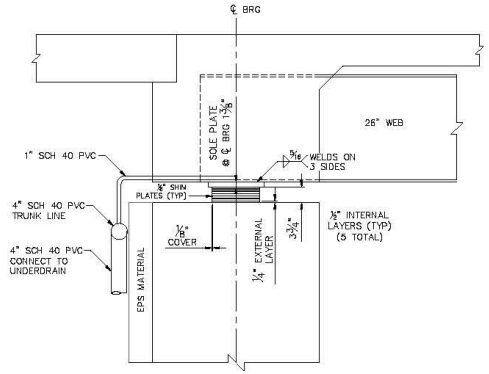
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	31	86



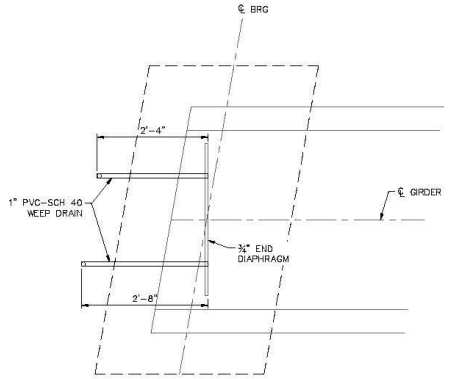
PLAN VIEW BEARING
ABUTMENT 1 SHOWN, ABUTMENT 2 OPPOSITE HAND

NOTES:

1. PROVIDE ELASTOMER WITH A SHEAR MODULUS G=130 PSI +/- 15% AT 73° F.
2. BEARINGS SHALL BE SUBJECT TO TESTING REQUIREMENTS IN ACCORDANCE WITH AASHTO LRFD CONSTRUCTION SPECIFICATION SECTION 18, CORRESPONDING TO DESIGN METHOD B.
3. MATERIALS SHALL CONFORM TO AASHTO M251 (STANDARD SPECIFICATIONS FOR PLAIN AND LAMINATED ELASTOMERIC BRIDGE BEARINGS). STEEL SHIMS SHALL BE ASTM A1011, GRADE 50 (MIN).
4. EPOXY/GRIT COATING SHALL BE APPLIED TO THE BOTTOM SURFACE OF THE SOLE PLATE AND TO THE TOP SURFACE OF THE CONCRETE, THAT IS IN CONTACT WITH THE ELASTOMERIC PAD, PLUS AN ADDITIONAL ½" IN ALL DIRECTIONS. SEE SPECIAL PROVISIONS FOR ADDITIONAL DETAILS.
5. CAUTION SHALL BE EXERCISED WHERE A FIELD WELD WILL BE MADE WHILE ELASTOMERIC BEARING PAD IS IN CONTACT WITH METAL. IN NO CASE SHALL THE ELASTOMER BE EXPOSED TO INSTANTANEOUS TEMPERATURES GREATER THAN 200° F. ANY DAMAGE TO THE ELASTOMERIC BEARINGS DUE TO WELDING WILL BE CAUSE FOR REJECTION. TEMPERATURES SHALL BE DETERMINED BY TEMPERATURE INDICATING PENCILS OR OTHER SUITABLE MEANS.
6. SIDES OF SOLE PLATE THAT ARE NOT WELDED SHALL BE CAULKED WITH A MATERIAL MATCHING THE COLOR OF THE STEEL.
7. THE SOLE PLATE SHALL MEET THE REQUIREMENTS OF AASHTO M270, GRADE 50.
8. THE ELASTOMERIC PAD SHALL BE PAID FOR UNDER ITEM 615029-001, NON-GUIDED BEARINGS, ELASTOMERIC.
9. BEARINGS SHALL BE VERTICAL AT TEMPERATURE BETWEEN 40° AND 80° F.



ELEVATION



PLAN VIEW WEEP DRAINS

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

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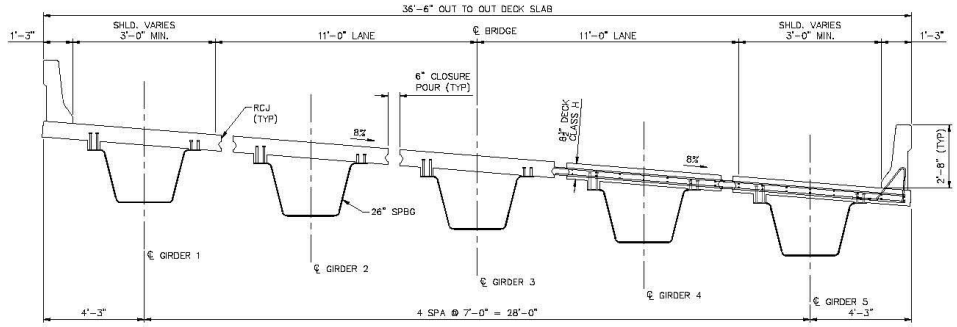
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

BEARING DETAILS

SHEET
B17 OF B33
11374

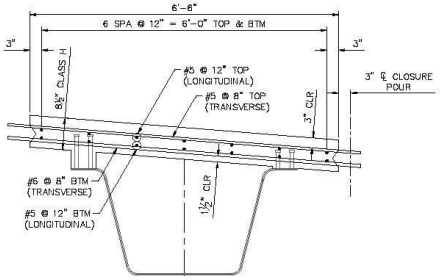
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	32	86



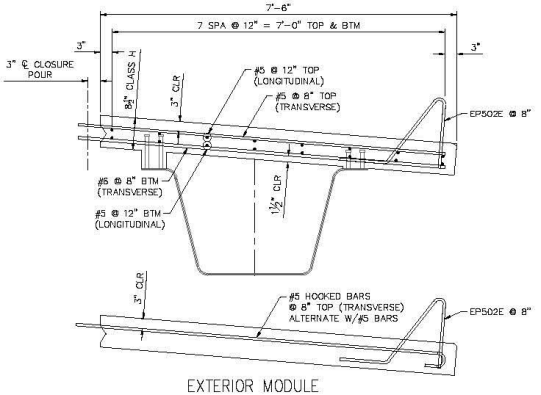
TYPICAL SECTION
LOOKING STATION AHEAD
NTS

NOTES:

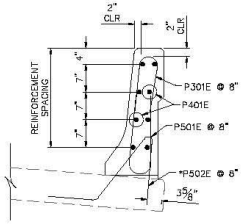
1. PRECASTING TO INCLUDE THE DECK AND CONCRETE DIAPHRAGM AT THE ABUTMENT.
2. PRECAST DECK THICKNESS TO BE 8½", ALLOWING ½" FOR DIAMOND GRINDING, SEE SHEET B4 FOR DIAMOND GRINDING NOTE.
3. FORMS FOR THE PRECAST UNIT SHALL CONSIST OF REMOVABLE FORMS FOR ANY SECTION THAT OVERHANGS THE GIRDER.
4. STAY-IN-PLACE METAL DECKING SHALL BE USED OVER THE GIRDER TO ALLOW FOR IN SERVICE INSPECTION OF THE INTERIOR OF THE GIRDER. ALTERNATIVE CLEAR SPAN FORMING METHODS MAY BE SUBMITTED TO THE PROJECT ENGINEER FOR APPROVAL. IF ANY PIECES OF THE FORM WORK NEEDS TO BE WELDED TO THE GIRDERS, ITEMS SHALL BE WELDED TO THE GIRDERS BEFORE THE GIRDERS ARE GALVANIZED. ALL FALSE WORK MUST BE STAMPED BY A LICENSED WEST VIRGINIA ENGINEER.
5. 6 INCH CLOSURE POURS WILL BE COMPLETED USING ULTRA HIGH PERFORMANCE CONCRETE.
6. PARAPET WALLS TO BE CONSTRUCTED IN THE FIELD.



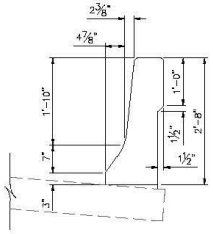
INTERIOR MODULE



EXTERIOR MODULE



PARAPET REINFORCING ON BRIDGE
*P502E TO BE PLACED WITH EXTERIOR MODULE PRECASTING



PARAPET DIMENSIONS ON BRIDGE

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

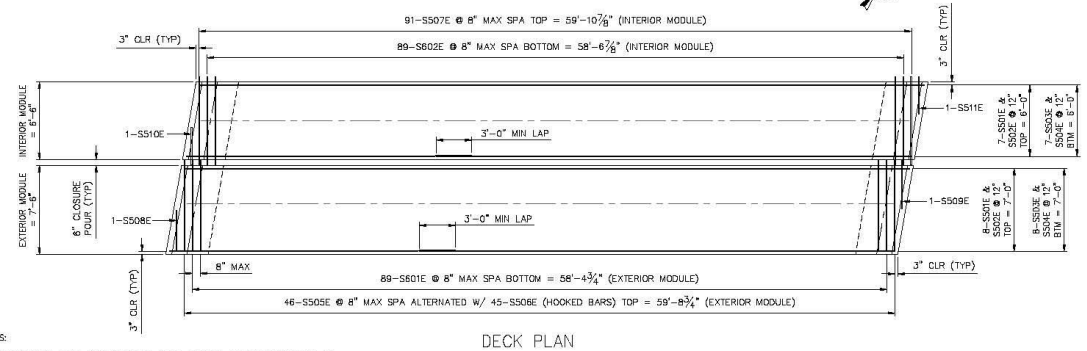
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DECK TYPICAL SECTION

SHEET
B18 OF B33

11374

PUBLIC HOUSE DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	33	86

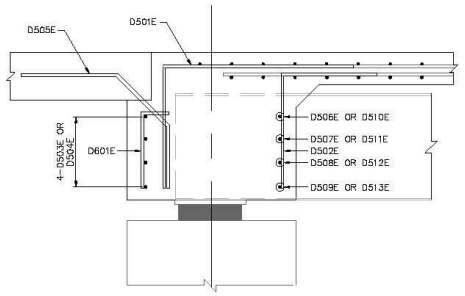


DECK PLAN

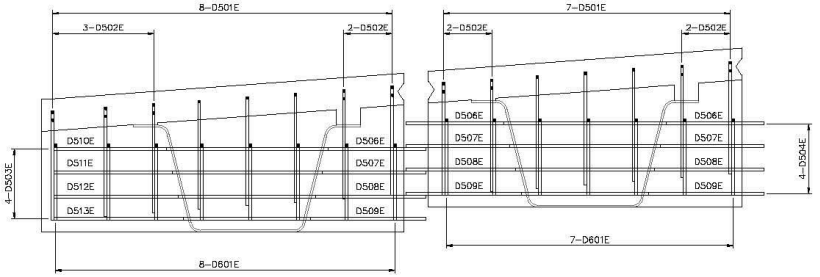
NOTES:

1. CONTRACTOR SHALL USE CAUTION WHEN SETTING PRECAST MODULES AS TO NOT CAUSE DAMAGE TO THEM.
2. ULTRA HIGH PERFORMANCE CONCRETE SHALL BE UTILIZED IN THE CLOSURE POURS.
3. LOCATION AND TYPE OF LIFTING LOOPS ON THE PRECAST MODULES SHALL BE SELECTED AND PLACED AT THE DISCRETION OF THE CONTRACTOR. THERE SHALL BE A MINIMUM OF FOUR PICK POINTS FOR EACH MODULE. THE WEIGHT CAPACITY OF THE LIFTING LOOPS SHALL HAVE A MINIMUM FACTOR OF SAFETY OF TWO. LIFTING LOOP LOOPS AND THEIR LOCATION SHALL BE SUBMITTED WITH THE SHOP DRAWINGS.

SCALE
0 4 ft.



DIAPHRAGM DETAIL



EXTERIOR MODULE
DIAPHRAGM ELEVATION

INTERIOR MODULE
DIAPHRAGM ELEVATION

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DECK PLAN

SHEET
B19 OF B33

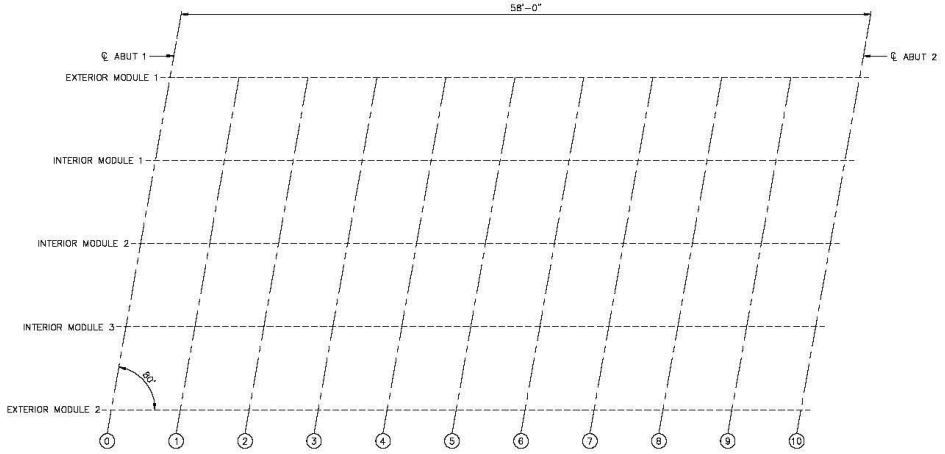
11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	34	66

DECK ELEVATIONS					
	EXTERIOR MODULE 1	INTERIOR MODULE 1	PROFILE GRADE INTERIOR MODULE 2	INTERIOR MODULE 3	EXTERIOR MODULE 2
LOCATION	ELEVATION	ELEVATION	ELEVATION	ELEVATION	ELEVATION
ABUT 1 – 0	623.08	622.53	621.97	621.41	620.86
1	623.05	622.50	621.94	621.38	620.83
2	623.01	622.46	621.90	621.34	620.79
3	622.98	622.43	621.87	621.31	620.76
4	622.95	622.40	621.84	621.28	620.73
5	622.92	622.37	621.81	621.25	620.70
6	622.88	622.33	621.77	621.21	620.66
7	622.85	622.30	621.74	621.18	620.63
8	622.82	622.27	621.71	621.15	620.60
9	622.78	622.23	621.67	621.11	620.56
ABUT 2 – 10	622.75	622.20	621.64	621.08	620.53

DECK NOTE:

DECK ELEVATIONS REFLECT THE FINAL DECK ELEVATIONS AFTER DIAMOND GRINDING HAS BEEN PERFORMED. SEE GENERAL NOTES FOR ADDITIONAL DETAILS ON DIAMOND GRINDING.



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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DECK ELEVATIONS

SHEET
B20 OF B33

11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	35	86

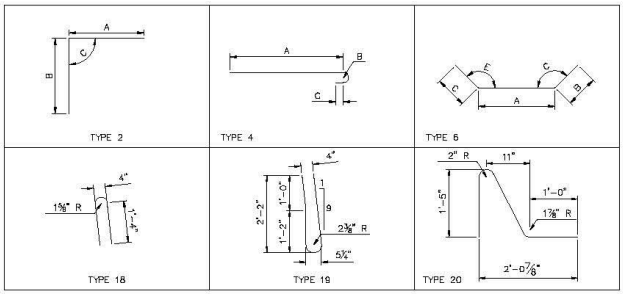
PRECAST SLAB REINFORCEMENT

MARK	TYPE	NUMBER REQUIRED	LENGTH (FT)	602001-001	602002-001	DIMENSION A	B	C	D
EXTERIOR MODULE 1									
S501E	STR	8	40' – 0"		334				
S502E	STR	8	24' – 1"		201				
S503E	STR	8	40' – 0"		334				
S504E	STR	8	22' – 4"		187				
S505E	STR	46	7' – 9"		372				
S506E	4	45	8' – 3"		388	7'–6 1/2"	1 5/8"	3"	
S508E	STR	1	3' – 5"		4				
S509E	STR	1	4' – 2"		5				
S601E	STR	89	7' – 9"		1037				
TOTAL				0	2862				
EXTERIOR MODULE 2									
S501E	STR	8	40' – 0"		334				
S502E	STR	8	24' – 1"		201				
S503E	STR	8	40' – 0"		334				
S504E	STR	8	22' – 4"		187				
S505E	STR	46	7' – 9"		372				
S506E	4	45	8' – 3"		388	7'–6 1/2"	1 5/8"	3"	
S508E	STR	1	3' – 5"		4				
S509E	STR	1	4' – 2"		5				
S601E	STR	89	7' – 9"		1037				
TOTAL				0	2862				
INTERIOR MODULE 1									
S501E	STR	7	40' – 0"		293				
S502E	STR	7	24' – 1"		176				
S503E	STR	7	40' – 0"		293				
S504E	STR	7	22' – 4"		164				
S507E	STR	91	7' – 5"		704				
S510E	STR	1	3' – 2"		4				
S511E	STR	1	3' – 2"		4				
S612E	STR	89	7' – 5"		992				
TOTAL				0	2630				
INTERIOR MODULE 2									
S501E	STR	7	40' – 0"		293				
S502E	STR	7	24' – 1"		176				
S503E	STR	7	40' – 0"		293				
S504E	STR	7	22' – 4"		164				
S507E	STR	91	7' – 5"		704				
S510E	STR	1	3' – 2"		4				
S511E	STR	1	3' – 2"		4				
S612E	STR	89	7' – 5"		992				
TOTAL				0	2630				
INTERIOR MODULE 3									
S501E	STR	7	40' – 0"		293				
S502E	STR	7	24' – 1"		176				
S503E	STR	7	40' – 0"		293				
S504E	STR	7	22' – 4"		164				
S507E	STR	91	7' – 5"		704				
S510E	STR	1	3' – 2"		4				
S511E	STR	1	3' – 2"		4				
S612E	STR	89	7' – 5"		992				
TOTAL				0	2630				

PRECAST DIAPHRAGM AND PARAPET REINFORCEMENT

MARK	TYPE	NUMBER REQUIRED	LENGTH (FT)	602001-001	602002-001	DIMENSION A	B	C	D	E
EXTERIOR MODULE DIAPHRAGM										
D501E	2	8	6' – 7"		55	4'–0"	2'–7"			
D502E	2	5	4' – 5"		24	2'–0"	2'–5"			
D503E	STR	4	7' – 10"		33					
D505E	6	8	4' – 10"		41	1'–6"	2'–0"	135^	1'–4"	135^
D506E	STR	1	2' – 0"		3					
D507E	STR	1	2' – 1"		3					
D508E	STR	1	2' – 2"		3					
D509E	STR	1	2' – 3"		3					
D601E	2	8	2' – 3"		28	1'–8"	7"			
TOTAL				0	205					
INTERIOR MODULE DIAPHRAGM										
D501E	2	7	6' – 7"		49	4'–0"	2'–7"			
D502E	2	4	4' – 5"		19	2'–0"	2'–5"			
D504E	STR	4	5' – 6"		23					
D505E	6	7	4' – 10"		36	1'–6"	2'–0"	135^	1'–4"	135^
D506E	STR	2	2' – 0"		5					
D507E	STR	2	2' – 1"		5					
D508E	STR	2	2' – 2"		5					
D509E	STR	2	2' – 3"		5					
D601E	2	7	2' – 3"		24	1'–8"	7"			
TOTAL				0	171					
PARAPET										
P301E	18	186	2' – 10"		199	SEE	DIAGRAM			
P401E	STR	16	40' – 0"		428					
P402E	STR	16	24' – 0"		257					
P501E	18	186	4' – 8"		906	SEE	DIAGRAM			
P502E	20	186	4' – 3"		825	SEE	DIAGRAM			
TOTAL				0	2615					

1 – EXTERIOR MODULE DIAPHRAGM SHOWN, 2 TOTAL
1 – INTERIOR MODULE DIAPHRAGM SHOWN, 3 TOTAL



REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
P.O. Box 483
Barboursville, WV 25504
www.jbtengineering.com

DESIGNED	DATE	CHECKED	DATE
BT	6 JUL 18	BDM	6 JUL 18
DRAWN	DATE	REVIEWED	DATE
BT	6 JUL 18	BDM	6 JUL 18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

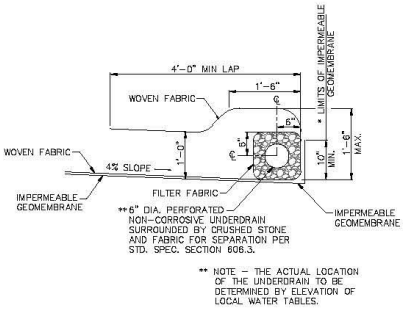
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SUPERSTRUCTURE
REINFORCING

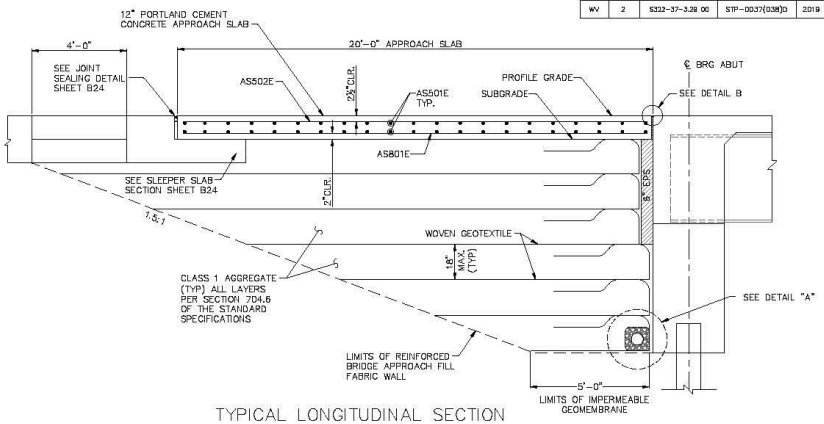
SHEET
B21 OF B33

11374

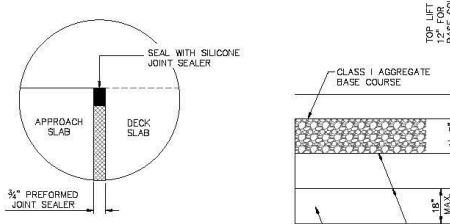
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	36	86



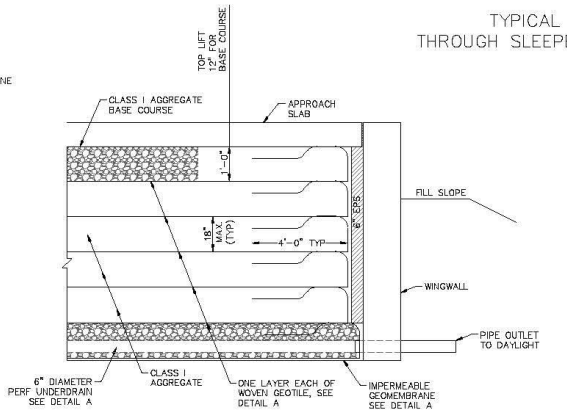
DETAIL A



TYPICAL LONGITUDINAL SECTION
THROUGH SLEEPER SLAB AND APPROACH SLAB



DETAIL B



TYPICAL TRANSVERSE SECTIONS
THROUGH APPROACH SLAB

NOTES

1. REINFORCED SOIL BEHIND ABUTMENT AND UNDER APPROACH ROADWAY IS TO BE CONSTRUCTED USING AGGREGATE BASE COURSE, CLASS I, ITEM 307001-001.
2. EXCAVATE AS NECESSARY TO CONSTRUCT THE REINFORCED SOIL BEHIND ABUTMENT. EXCAVATION SHALL BE INCIDENTAL TO ITEM 645001-001 PRIMARY REINFORCEMENT 2400 LB/FT. NOTIFY THE ENGINEER WHEN FOUNDATION EXCAVATION IS COMPLETE. DO NOT PLACE GEOMEMBRANE OR FILTER FABRICS UNTIL OBTAINING APPROVAL OF THE EXCAVATION DEPTH AND FOUNDATION MATERIAL.
3. PROVIDE BIAXIAL WOVEN POLYPROPYLENE GEOTEXTILE REINFORCEMENT IN ACCORDANCE WITH 645.2.1 OF WVDOH STANDARD SPECIFICATIONS ITEM 645001-001 PRIMARY REINFORCEMENT, 2400 LB/LF. UNIT FOR THE PAY ITEM IS SY AND INCLUDED IN THE ROADWAY ESTIMATES. REQUIREMENT FOR LONG TERM DESIGN STRENGTH (LTDS) REFERENCED IN 645.2.1 IS REPLACED BY WIDE TENSILE STRENGTH AT ULTIMATE WITH A MINIMUM AVERAGE ROLL VALUE OF 2400 LB/FT AT 25% STRAIN. REQUIREMENT FOR BACKFILL MATERIAL IDENTIFIED IN 645.2.2 IS REPLACED BY AGGREGATE BASE COURSE, CLASS I, ITEM 307001-001.
4. OVERLAP ADJACENT FABRICS A MINIMUM OF 18" SUCH THAT OVERLAPS ARE PARALLEL TO THE ROADWAY CENTERLINE. CONTACT THE ENGINEER WHEN INTERFERENCE WITH EXISTING STRUCTURE OR UTILITIES.
5. INSTALL WOVEN FABRICS WITH THE MACHINE DIRECTION (MD) PARALLEL TO THE ROADWAY CENTERLINE. THE MD IS THE DIRECTION OF THE LENGTH OR LONG DIRECTION OF THE ROLL. DO NOT SPLICE OR DEVELOP WOVEN FABRICS IN THE MD SUCH THAT SPLICES OR OVERLAPS ARE PERPENDICULAR TO THE ROADWAY CENTERLINE. INSTALL WOVEN FABRICS WITH THE ORIENTATION, DIMENSION, AND NUMBER OF LAYERS SHOWN ON THE PLANS. WRAP WOVEN FABRICS AS SHOWN.
6. PLACE CLASS I AGGREGATE IN 6 INCH LIFTS, DO NOT OPERATE HEAVY EQUIPMENT ON GEOTEXTILE UNTIL THEY ARE COVERED WITH AT LEAST 8" OF CLASS I AGGREGATE, USE ONLY HAND OPERATED COMPACTION EQUIPMENT WITHIN 3 FT. OF THE ABUTMENT OR WINGWALLS. AT A DISTANCE GREATER THAN 3 FT. OF THE ABUTMENTS OR WINGWALLS, COMPACT IN ACCORDANCE WITH SECTION 307 OF THE STANDARD SPECIFICATIONS.
7. IMPERMEABLE MEMBRANE SHALL BE 20 MIL THICKNESS AND SHALL MEET REQUIREMENT OF SPECIFICATIONS SECTION 211.3.1.C HDPE OR LLDPE IMPERVIOUS CORE AND SHALL BE INCIDENTAL TO ITEM 645001-001.
8. ELASTICIZED EXPANDED POLYSTYRENE (EPS) SHALL BE IN ACCORDANCE WITH SPECIAL PROVISION 645 REINFORCED SOIL SLOPES AND SHALL BE INCIDENTAL TO ITEM 645001-001.

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

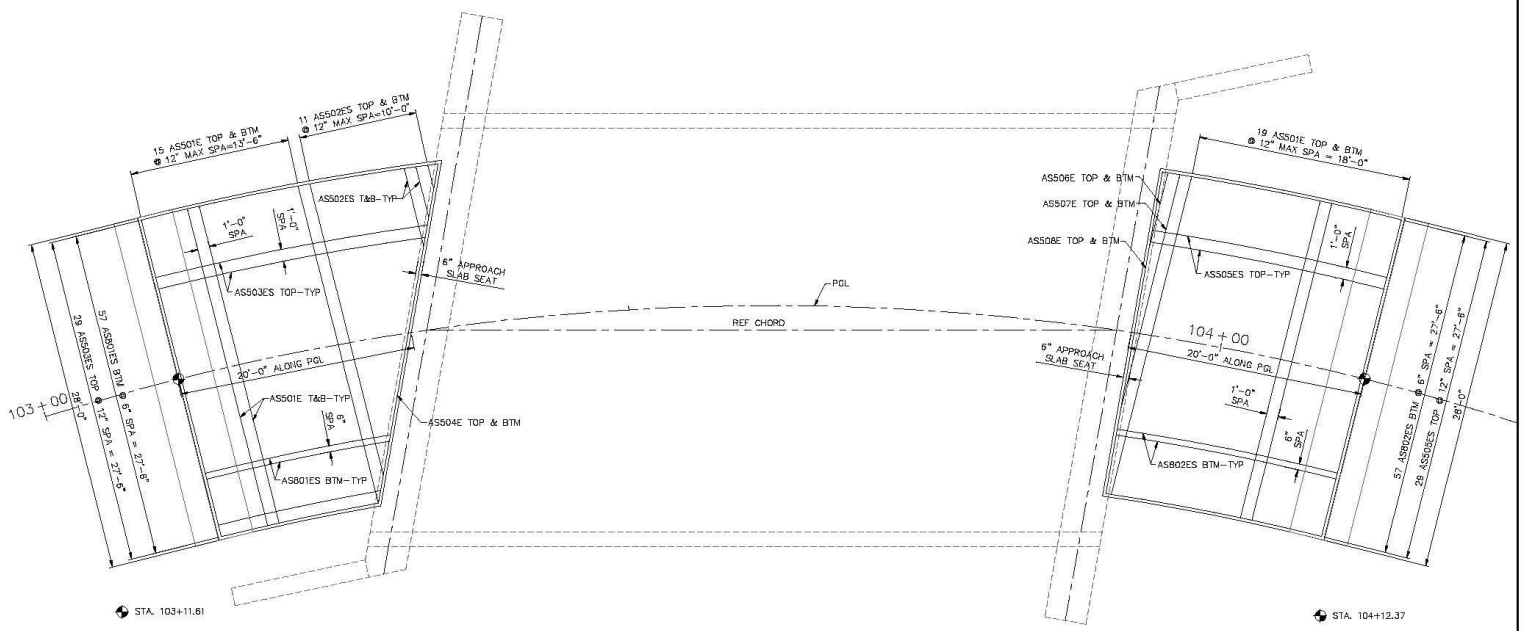
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

APPROACH
BACKFILL DETAILS

SHEET B22 OF B33

11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(036)D	2019	LINCOLN	37	86



ABUTMENT 1 APPROACH SLAB

ABUTMENT 2 APPROACH SLAB

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

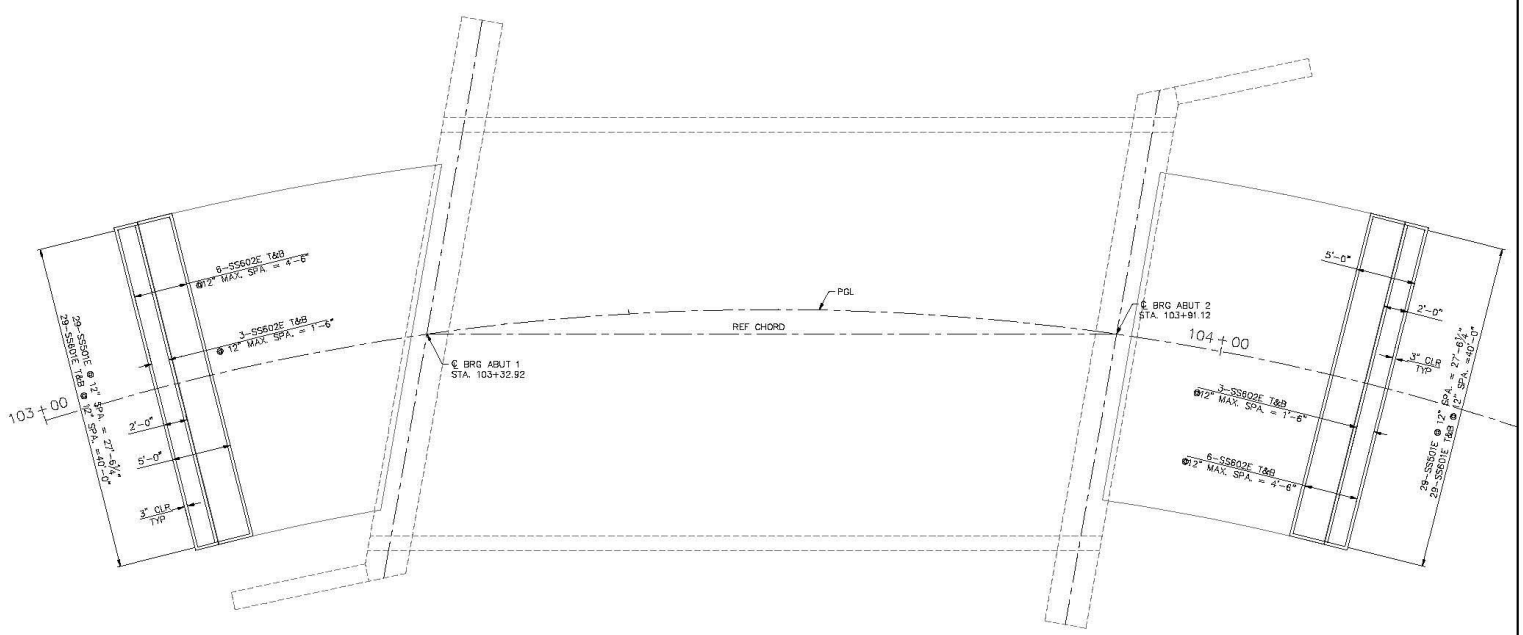
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

APPROACH SLAB PLAN

SHEET
B23 OF B33

11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(036)D	2019	LINCOLN	38	86



ABUTMENT 1 SLEEPER SLAB

ABUTMENT 2 SLEEPER SLAB

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FOURTEEN MILE BRIDGE
WV 37 OVER
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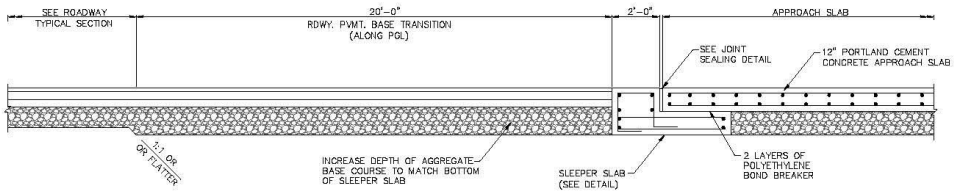
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SLEEPER SLAB PLAN

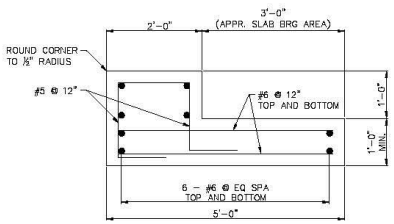
SHEET
B24 OF B33

11374

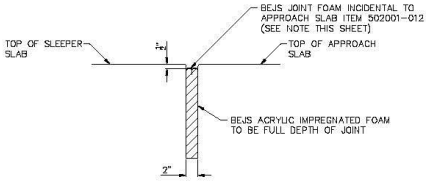
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	38	86



SLEEPER SLAB ROADWAY APPROACH



SLEEPER SLAB SECTION



JOINT SEALING DETAIL

NOTES

SLEEPER SLAB DESIGN NOTES

1. CLASS B CONCRETE FOR THE SLEEPER SLAB SHALL BE IN ACCORDANCE WITH SECTION 601 OF THE SPECIFICATIONS.
2. THE TOP OF THE SLEEPER SLAB SHALL FOLOOW THE CROSS SLOPE AND GRADE OF ROADWAY AND FINISHED ACCORDING TO 601.11.4 OF THE STANDARD SPECIFICATIONS. REINFORCING STEEL BARS SHALL BE EPOXY COATED IN ACCORDANCE WITH SECTION 602 OF THE SPECIFICATIONS.
3. ALL JOINT MATERIALS SHALL BE IN ACCORDANCE WITH SECTION 708 OF THE STANDARD SPECIFICATIONS.
4. LENGTH OF SLEEPER SLAB SHALL BE THE SAME AS THE WIDTH OF THE APPROACH SLAB.
5. ALL WORK ASSOCIATED WITH THE SLEEPER SLAB SHALL BE INCIDENTAL TO ITEM 502001 UNLESS OTHERWISE SHOWN ON THE SHEET.
6. IF FREE DRAINING BASE IS SPECIFIED, AN OUTLET PIPE SHALL BE PLACED AT LOW POINTS OF THE CROSS SLOPE.
7. IF CLASS I AGGREGATE IS SPECIFIED, DRAIN TO LOW POINTS OF THE CROSS SLOPE.

SLEEPER SLAB NOTES

1. EXCAVATION FOR SLEEPER SLAB SHALL BE CAREFULLY MADE AFTER COMPACTED ABUTMENT EMBANKMENT IS IN PLACE. THE SLEEPER SLAB SHALL BE FOUNDED ON COMPACTED MATERIAL AS SHOWN ON THE DETAILS. NO LOOSE BACKFILL SHALL BE ALLOWED. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT THE SLEEPER SLAB FROM TEMPORARY LOADINGS OR ANY CONDITION WHICH COULD CAUSED MOVEMENT OR UNEVEN SETTLEMENT TO THE SLEEPER SLAB.
2. TO PERMIT UNHINDERED LONGITUDINAL MOVEMENT OF THE SLEEPER SLAB, ACCURATELY CONTROL THE SURFACE OF THE SUBBASE COARSE TO FOLLOW AND BE PARALLEL TO THE ROADWAY GRADE AND CROSS SLOPE. PRIOR TO PLACEMENT OF THE REINFORCEMENT, PLACE TWO LAYERS OF OF POLYETHYLENE BOND BREAKER AT THE BOTTOM OF THE APPROACH SLAB FOR THE FULL LENGTH AND WIDTH OF THE APPROACH SLAB. PROVIDE BOND BREAKER THAT IS 6 MIL THICK, AND PROVIDE 2'-0" LAPS.
3. 2" NOMINAL EMSEAL BEJS JOINT SYSTEM CAPABLE OF A MAXIMUM OPENING OF 3" AND A MINIMUM OF 1". INSTALL WHEN TEMPERATURE IS BETWEEN 40° AND 80° F.

SEAL INSTRUCTION

1. SEE MANUFACTURER'S INSTALLATION RECOMMENDATIONS AND SPECIFICATIONS.

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SLEEPER SLAB DETAILS

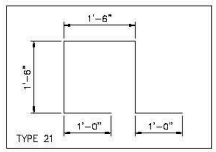
SHEET
B25 OF B33

11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	40	86

APPROACH SLAB AND SLEEPER SLAB REINFORCEMENT

						DIMENSION			
MARK	TYPE	NUMBER REQUIRED	LENGTH (FT)	602001-001	602002-001	A	B	C	D
ABUTMENT NO. 1 APPROACH SLAB									
AS501E	STR	30	27' - 6"		861				
AS502ES	STR	2 EACH MARK	VARIES FROM 2' - 1" TO 25' - 4" BY 2' - 4"		315				
AS503ES	STR	2 EACH MARK	VARIES FROM 13' - 6" TO 25' - 6" BY 0' - 5 1/4"		1180				
AS504E	STR	1	29' - 1"		31				
AS801ES	STR	1 EACH MARK	VARIES FROM 13' - 6" TO 25' - 6" BY 0' - 2 1/2"		2968				
TOTAL				0	5355				
ABUTMENT NO. 2 APPROACH SLAB									
AS501E	STR	19	27' - 6"		545				
AS505ES	STR	1 EACH MARK	VARIES FROM 18' - 7" TO 20' - 6" BY 0' - 0 3/4"		592				
AS506E	STR	1	6' - 6"		7				
AS507E	STR	1	20' - 4"		22				
AS802ES	STR	1 EACH MARK	VARIES FROM 18' - 7" TO 20' - 6" BY 0' - 0 1/2"		2975				
TOTAL				0	4141				
SLEEPER SLAB 1									
SS501E	21	29	5' - 0"		152				
SS601E	STR	58	4' - 6"		393				
SS602E	STR	18	27' - 7"		746				
TOTAL				0	1291				
SLEEPER SLAB 2									
SS501E	21	29	5' - 0"		152				
SS601E	STR	58	4' - 6"		393				
SS602E	STR	18	27' - 7"		746				
TOTAL				0	1291				



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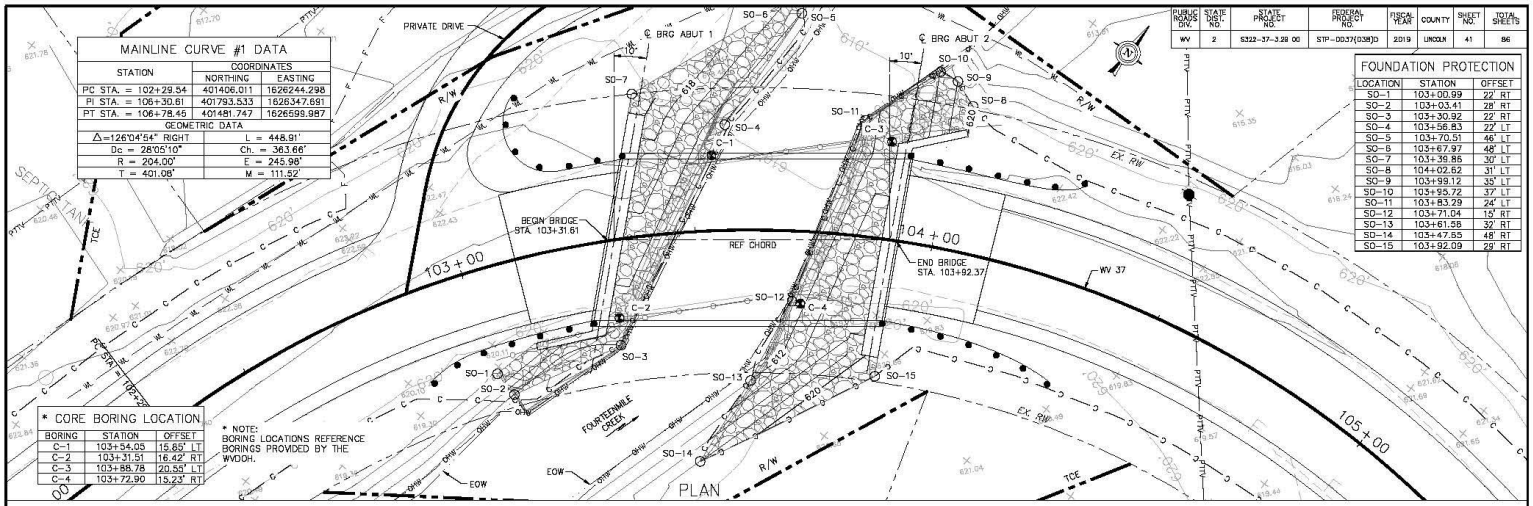
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

APPROACH SLAB AND SLEEPER SLAB REINFORCING

SHEET
B26 OF B33

11374



MAINLINE CURVE #1 DATA		
STATION	COORDINATES	
	NORTHING	EASTING
PC STA. = 102+29.54	401406.011	1626244.298
PI STA. = 106+30.61	401793.533	1626347.691
PT STA. = 106+78.45	401481.747	1626599.987
GEOMETRIC DATA		
△=126°04'54" RIGHT	L = 448.91'	
Dc = 28°05'10"	Ch. = 363.66'	
R = 204.00'	E = 245.98'	
T = 401.08'	M = 111.52'	

* CORE BORING LOCATION		
BORING	STATION	OFFSET
C-1	103+54.05	15.85' LT
C-2	103+31.51	16.42' RT
C-3	103+88.78	20.55' LT
C-4	103+72.90	19.23' RT

* NOTE: BORING LOCATIONS REFERENCE BORINGS PROVIDED BY THE WVDOH.

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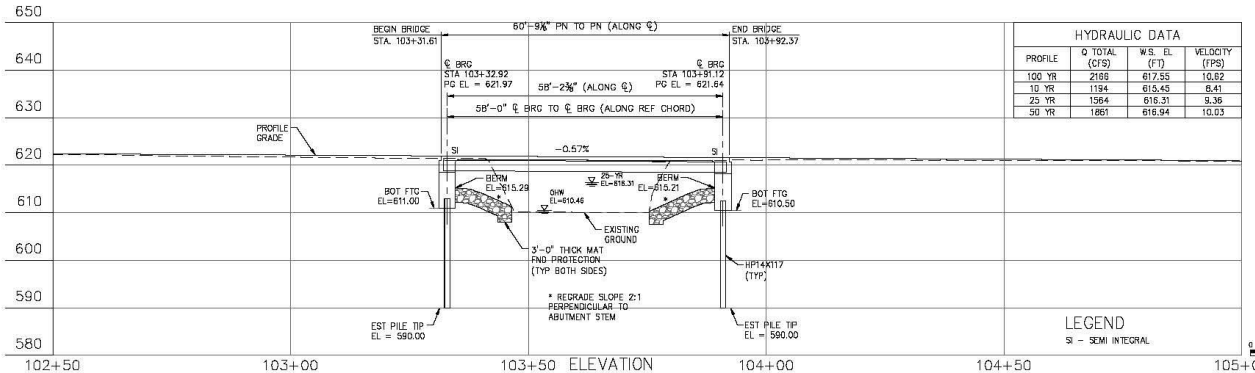
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	41	86

FOUNDATION PROTECTION		
LOCATION	STATION	OFFSET
SO-1	103+00.99	22' RT
SO-2	103+03.41	28' RT
SO-3	103+30.92	22' RT
SO-4	103+56.83	22' LT
SO-5	103+70.51	46' LT
SO-6	103+67.97	48' LT
SO-7	103+39.86	30' LT
SO-8	104+02.62	31' LT
SO-9	103+99.12	35' LT
SO-10	103+95.72	37' LT
SO-11	103+83.29	24' LT
SO-12	103+71.04	15' RT
SO-13	103+61.56	32' RT
SO-14	103+47.55	48' RT
SO-15	103+92.09	29' RT



HYDRAULIC DATA			
PROFILE	Q TOTAL (CFS)	W.S. EL (FT)	VELOCITY (FPS)
100 YR	2186	617.55	10.82
10 YR	1194	615.45	8.41
25 YR	1564	616.31	9.36
50 YR	1861	616.94	10.03

LEGEND
SI - SEMI INTEGRAL

SCALE 10 ft. 0 10 ft.

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SITUATION PLAN

SHEET
827 OF 833
11374

PUBLIC ROADS DIV.	STATE SEC. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	42	86

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
Divisions of Highways

Engineering Division
Geotechnical Unit - Bldg 5, Room A-650
1900 Kanawha Blvd. E., Charleston, WV 25305
Office: (304)558 2885, FAX: (304)558 4344

Materials Control, Soils and Testing Division
Subsurface Investigation Group
190 Dry Branch Rd., Charleston, WV 25306
Office: (304)558 9684, FAX: (304)558 0253

Field Log
C-1

DATE S TAC RECEIVED

Project Name FOURTEEN MILE BRIDGE — Project Number S322-37-3.29
Boring Location Station: 207+41 Offset: 15.4 ft. Lt. CL — Elevation (ft.) 621.85-ft Actual
Date Started 9/15/2016 County Lincoln Inspector None — Lat. and Long 8.809662E+07°N 8.218918E+07°W
Date Completed 9/15/2016 District Enter The County in the County Field — Entered By ZMG — Driller / Company Garrison

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, grain size, structures, moisture, consistency)	SAMPLE Type	INT Depth	Run Rec.	Blows Cnt (N-Value)	HCSI	RQD	Additional Notes	RMR (Total)
621.85	0.0	Brown FILL: sand,gravel,small cobbles, dry, loose		0.0-5.0						
616.85	5.0			5.0-6.5	1.5 ft. 0.7 ft. 47 %	2-3-2 (5)				
615.35	6.5	Brown FILL: sand,gravel,small cobbles, dry, loose		6.5-10.0						
611.85	10.0			10.0-11.5	1.5 ft. 1.5 ft. 100 %	10-6-3 (9)				
610.35	11.5	Brown FILL: sand,gravel,small cobbles, loose		11.5-15.0						
606.85	15.0	Brown GRAVEL AND SAND: sand,gravel,small cobbles, medium dense		15.0-16.5	1.5 ft. 1.5 ft. 100 %	6-9-7 (16)				
605.35	16.5	Brown GRAVEL AND SAND: sand,gravel,small cobbles, medium dense		16.5-20.0						
601.85	20.0	Brown GRAVEL AND SAND: sand,gravel,small cobbles, medium dense		20.0-21.5	1.5 ft. 1.5 ft. 100 %	9-7-6 (13)				
600.35	21.5	Brown GRAVEL AND SAND: sand,gravel,small cobbles, medium dense		21.5-25.0						
596.85	25.0	Grey GRAVEL AND SAND: loose		25.0-26.5	1.5 ft. 1.5 ft. 100 %	6-4-4 (8)				
595.35	26.5	Grey GRAVEL AND SAND: loose		26.5-30.0						
591.85	30.0	Grey SILTSTONE: extremely hard		30.0-30.5	0.5 ft. 0.5 ft. 100 %	50/0.5				
591.35	30.5	Grey SILTSTONE: hard ABUTMENT 1 PILE TIP ELEVATION = 590.00		30.5-35.5	5.0 ft. 5.0 ft. 100 %		4	2.0 ft. 40 %		

Rig No. 841-021
Rig Type Skid
Core Size NQ
Core Barrel Solid
Hammer Auto

Remarks
DRILLED @ STA:2+05 OFF:12.4' LT CL

Sampling Method
Shelby Tube, Solid Auger, Split Spoon, Hollow Auger, Rock Core, Tricone

Water Level Observations
Immediate 11.0 ft.
At Completion 6.5 ft.
After 1 Hrs. 10.5 ft.
Before Coring NA ft.
Backfilled Cutting ft.

Page 1 of 2

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
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Date Completed 9/15/2016 District Enter The County in the County Field — Entered By ZMG — Driller / Company Garrison

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, grain size, structures, moisture, consistency)	SAMPLE Type	INT Depth	Run Rec.	Blows Cnt (N-Value)	HCSI	RQD	Additional Notes	RMR (Total)
586.35	35.5	Grey SILTSTONE: hard		35.5-40.5	5.0 ft. 5.0 ft. 100 %		4	0.0 ft. 0 %		
581.35	40.5	BORING COMPLETED AT 40.5 ft.								

Rig No. 841-021
Rig Type Skid
Core Size NQ
Core Barrel Solid
Hammer Auto

Remarks
DRILLED @ STA:2+05 OFF:12.4' LT CL

Sampling Method
Shelby Tube, Solid Auger, Split Spoon, Hollow Auger, Rock Core, Tricone

Water Level Observations
Immediate 11.0 ft.
At Completion 6.5 ft.
After 1 Hrs. 10.5 ft.
Before Coring NA ft.
Backfilled Cutting ft.

Page 2 of 2

NOTE:
THE BORING LOG(S) HAVE BEEN PROVIDED BY THE WVDOH.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
P.O. Box 283
Barboursville, WV 25504
www.jbturmaneng.com

DESIGNED	DATE	CHECKED	DATE
BT	6 JUL '18	BDW	6 JUL '18
DRAWN	DATE	REVIEWED	DATE
BT	6 JUL '18	BDW	6 JUL '18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

BORING LOG SHEET (1 OF 4)

SHEET B28 OF B33

11374

PUBLIC ROADS DIV.	STATE SEC. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	43	86

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
Divisions of Highways

Engineering Division
Geotechnical Unit - Bldg 5, Room A-650
1900 Kanawha Blvd. E., Charleston, WV 25305
Office: (304)558 2885, FAX: (304)558 4344

Materials Control, Soils and Testing Division
Subsurface Investigation Group
190 Dry Branch Rd., Charleston, WV 25306
Office: (304)558 9684, FAX: (304)558 0253

Field Log

C-2

DATE ISSUED / DATE REVISED

Project Name	FOURTEEN MILE BRIDGE			Project Number	S322-37-3.29
Boring Location	Station: 1+84.55	Offset: 16.7 ft. Rt. CL		Elevation (ft.)	618-ft Actual
Date Started	9/20/2016	County Lincoln	Inspector None	Lat. and Long.	0°N 0°W
Date Completed	9/20/2016	District Enter The County in the County Field	Entered By NRB	Driller / Company	Bird

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, grain size, structures, moisture, consistency	SAMPLE Type	INT Depth	Run Rec.	Blows Cnt (N-Value)	HCSI	RQD	Additional Notes	RMR (Total)
618.00	0.0	Grey COBBLES AND SAND: moist, medium dense		0.0-5.0						
613.00	5.0	Grey COBBLES AND SAND: moist, medium dense		5.0-6.5	1.5 ft. 1.2 ft. 80 %	3-4-10 (14)				
611.50	6.5	Grey COBBLES AND SAND: moist, medium dense		6.5-10.0						
608.00	10.0	Brown and grey SILT: and concrete, wet, hard		10.0-10.2	0.2 ft. 0.2 ft. 100 %	50/0.2	3		0.8 ft. 100 %	
607.80	10.2	Grey CONCRETE: medium hard		10.2-11.0	0.8 ft. 0.8 ft. 100 %					
607.00	11.0	Brown COBBLES AND SAND: wet, medium dense		11.0-15.0						
603.00	15.0	Brown COBBLES AND SAND: wet, medium dense		15.0-16.5	1.5 ft. 1.5 ft. 100 %	4-12-16 (28)				
601.50	16.5	Brown COBBLES AND SAND: wet, very dense		16.5-20.0						
598.00	20.0	Grey SANDSTONE: very dense		20.0-21.5	1.5 ft. 1.5 ft. 100 %	16-26-30 (56)				
596.50	21.5	Brown SAND: wet, very dense		21.5-24.0						
594.00	24.0	Brown and grey SAND: and siltstone, wet, hard		24.0-24.7	0.7 ft. 0.7 ft. 100 %	20-50/0.2				
593.30	24.7	Grey SILTSTONE: medium hard		24.7-30.7	6.0 ft. 5.7 ft. 95 %		3		2.6 ft. 43 %	
587.30	30.7	ABUTMENT 1 PILE TIP ELEVATION = 590.00 Grey SILTSTONE: medium hard		30.7-35.7	5.0 ft. 4.5 ft. 90 %		3		0.0 ft. 0 %	

Rig No. 841-022
Rig Type Skid
Core Size NQ
Core Barrel Solid
Hammer Auto

Remarks

Sampling Method
Shelby Tube, Solid Auger, Split Spoon, Hollow Auger, Rock Core, Tricone

Water Level Observations
Immediate Dry ft.
At Completion 12.0 ft.
After 0 Hrs. 12.0 ft.
Before Coring NA ft.
Backfilled Cutting ft.

Page 1 of 2

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
Divisions of Highways

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Materials Control, Soils and Testing Division
Subsurface Investigation Group
190 Dry Branch Rd., Charleston, WV 25306
Office: (304)558 9684, FAX: (304)558 0253

Field Log

C-2

DATE ISSUED / DATE REVISED

Project Name	FOURTEEN MILE BRIDGE			Project Number	S322-37-3.29
Boring Location	Station: 1+84.55	Offset: 16.7 ft. Rt. CL		Elevation (ft.)	618-ft Actual
Date Started	9/20/2016	County Lincoln	Inspector None	Lat. and Long.	0°N 0°W
Date Completed	9/20/2016	District Enter The County in the County Field	Entered By NRB	Driller / Company	Bird

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, grain size, structures, moisture, consistency	SAMPLE Type	INT Depth	Run Rec.	Blows Cnt (N-Value)	HCSI	RQD	Additional Notes	RMR (Total)
582.30	35.7	Grey SILTSTONE: medium hard ***(LAYER CONTINUED DESCRIPTION REPEATED)*** BORING COMPLETED AT 35.7 ft.								

Rig No. 841-022
Rig Type Skid
Core Size NQ
Core Barrel Solid
Hammer Auto

Remarks

Sampling Method
Shelby Tube, Solid Auger, Split Spoon, Hollow Auger, Rock Core, Tricone

Water Level Observations
Immediate Dry ft.
At Completion 12.0 ft.
After 0 Hrs. 12.0 ft.
Before Coring NA ft.
Backfilled Cutting ft.

Page 2 of 2

NOTE:
THE BORING LOG(S) HAVE BEEN PROVIDED BY THE WVDOH.

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J.B. TURMAN ENGINEERING, PLLC
P.O. Box 283
Barboursville, WV 25504
www.jbturmaneng.com

DESIGNED	DATE	CHECKED	DATE
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DRAWN	DATE	REVIEWED	DATE
BT	6 JUL '18	BDW	6 JUL '18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

BORING LOG SHEET (2 OF 4)

SHEET
B29 OF B33
11374

PUBLIC ROADS DIV.	STATE SEC. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	44	86

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
Divisions of Highways

Engineering Division
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Materials Control, Soils and Testing Division
Subsurface Investigation Group
190 Dry Branch Rd., Charleston, WV 25306
Office: (304)558 9684, FAX: (304)558 0253

Field Log
C-3

DATE & TIME RECORDED

Project Name	FOURTEEN MILE BRIDGE			Project Number	S322-37-3.29
Boring Location	Station: 2+42.22	Offset: 19.9 ft. Lt. CL		Elevation (ft.)	621.08-ft Actual
Date Started	9/15/2016	County: Lincoln	Inspector: None	Lat. and Long.	0°N 0°W
Date Completed	9/15/2016	District: Enter The County in the County Field	Entered By: NRB	Driller / Company	Bird

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, grain size, structures, moisture, consistency	SAMPLE Type	INT Depth	Run Rec.	Blows Cnt (N-Value)	HCSI	RQD	Additional Notes	RMR (Total)
621.08	0.0	Grey and brown COBBLES AND SAND; dry, loose		0.0-5.0						
616.08	5.0	Grey and brown COBBLES AND SAND; dry, loose		5.0-6.5	1.5 ft. 0.4 ft. 27 %	7-3-2 (5)				
614.58	6.5	Brown COBBLES AND SAND: dry, loose		6.5-10.0						
611.08	10.0	Brown COBBLES AND SAND: dry, loose		10.0-11.5	1.5 ft. 1.1 ft. 73 %	4-2-4 (6)				
609.58	11.5	Brown COBBLES AND SAND: wet, medium dense		11.5-15.0						
606.08	15.0	Brown COBBLES AND SAND: wet, medium dense		15.0-16.5	1.5 ft. 1.0 ft. 67 %	6-7-8 (15)				
604.58	16.5	Brown COBBLES AND SAND: wet, medium dense		16.5-20.0						
601.08	20.0	Brown COBBLES AND SAND: wet, medium dense		20.0-21.5	1.5 ft. 1.5 ft. 100 %	8-12-10 (22)				
599.58	21.5	Grey COBBLES AND SAND: wet, dense		21.5-25.0						
596.08	25.0	Grey COBBLES AND SAND: wet, dense		25.0-26.5	1.5 ft. 1.5 ft. 100 %	5-10-22 (32)				
594.58	26.5	Grey COBBLES AND SAND: wet, dense		26.5-29.0						
592.08	29.0	Grey COBBLES AND SAND: wet, hard		29.0-30.5	1.5 ft. 1.0 ft. 67 %	9-16-50/0.5				
590.58	30.5	Grey SILTSTONE: medium hard ABUTMENT 2 PILE TIP ELEVATION = 590.00		30.5-35.5	5.0 ft. 4.8 ft. 96 %		3	1.6 ft. 32 %		

Rig No. 841-022
Rig Type Skid
Core Size NQ
Core Barrel Solid
Hammer Auto

Remarks

Sampling Method
Shelby Tube, Solid Auger, Split Spoon, Hollow Auger, Rock Core, Tricone

Water Level Observations
Immediate Dry ft.
At Completion 9.0 ft.
After 0.5 Heaved in @ ft.1
Before Coring NA ft.
Backfilled Cutting ft.

Page 1 of 2

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
Divisions of Highways
Field Log
C-3

DATE & TIME RECORDED

Project Name	FOURTEEN MILE BRIDGE			Project Number	S322-37-3.29
Boring Location	Station: 2+42.22	Offset: 19.9 ft. Lt. CL		Elevation (ft.)	621.08-ft Actual
Date Started	9/15/2016	County: Lincoln	Inspector: None	Lat. and Long.	0°N 0°W
Date Completed	9/15/2016	District: Enter The County in the County Field	Entered By: NRB	Driller / Company	Bird

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, grain size, structures, moisture, consistency	SAMPLE Type	INT Depth	Run Rec.	Blows Cnt (N-Value)	HCSI	RQD	Additional Notes	RMR (Total)
585.58	35.5	Grey SILTSTONE: medium hard		35.5-39.7	4.2 ft. 3.2 ft. 76 %		3	0.9 ft. 21 %		
581.38	39.7	Grey SILTSTONE: medium hard		39.7-44.7	5.0 ft. 5.0 ft. 100 %		3	0.4 ft. 8 %		
576.38	44.7	BORING COMPLETED AT 44.7 ft.								

Rig No. 841-022
Rig Type Skid
Core Size NQ
Core Barrel Solid
Hammer Auto

Remarks

Sampling Method
Shelby Tube, Solid Auger, Split Spoon, Hollow Auger, Rock Core, Tricone

Water Level Observations
Immediate Dry ft.
At Completion 9.0 ft.
After 0.5 Heaved in @ ft.1
Before Coring NA ft.
Backfilled Cutting ft.

Page 2 of 2

NOTE:
THE BORING LOG(S) HAVE BEEN PROVIDED BY THE WVDOH.

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Barboursville, WV 25504
www.jbturmaneng.com

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BT	6 JUL '18	BDW	6 JUL '18
DRAWN	DATE	REVIEWED	DATE
BT	6 JUL '18	BDW	6 JUL '18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

BORING LOG SHEET (3 OF 4)

SHEET
B30 OF B33
11374

PUBLIC ROADS DIV.	STATE SEC. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	45	86

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
Divisions of Highways

Engineering Division
Geotechnical Unit - Bldg 5, Room A-650
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Field Log
C-4

DATE S.I.HAS REVISED

Project Name	FOURTEEN MILE BRIDGE			Project Number	S322-37-3.29
Boring Location	Station: 2+26.08	Offset: 15.8 ft. Rt. CL		Elevation (ft.)	619.30-ft Actual
Date Started	9/21/2016	County Lincoln	Inspector None	Lat. and Long.	0°N 0°W
Date Completed	9/21/2016	District Enter The County in the County Field	Entered By NRB	Driller / Company	Bird

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, grain size, structures, moisture, consistency	SAMPLE Type	INT Depth	Run Rec.	Blows Cnt (N-Value)	HCSI	RQD	Additional Notes	RMR (Total)
619.30	0.0	Brown COBBLES AND SAND: dry, loose		0.0-5.0						
614.30	5.0	Brown COBBLES AND SAND: dry, loose		5.0-6.5	1.5 ft. 1.0 ft. 67 %	1-2-2 (4)				
612.80	6.5	Brown SAND: dry, loose		6.5-10.0						
609.30	10.0	Brown SAND: dry, loose		10.0-11.5	1.5 ft. 1.2 ft. 80 %	2-5-1 (6)				
607.80	11.5	Brown COBBLES AND SAND: moist, medium dense		11.5-15.0						
604.30	15.0	Brown COBBLES AND SAND: moist, medium dense		15.0-16.5	1.5 ft. 1.5 ft. 100 %	7-8-5 (13)				
602.80	16.5	Grey COBBLES AND SAND: wet, medium dense		16.5-20.0						
599.30	20.0	Grey COBBLES AND SAND: wet, medium dense		20.0-21.5	1.5 ft. 0.9 ft. 60 %	10-11-15 (26)				
597.80	21.5	Grey COBBLES AND SAND: wet, medium dense		21.5-25.0						
594.30	25.0	Grey COBBLES AND SAND: wet, loose		25.0-26.5	1.5 ft. 0.4 ft. 27 %	5-4-4 (8)				
592.80	26.5	Grey COBBLES AND SAND: wet, loose		26.5-28.5						
590.80	28.5	Grey COBBLES AND SAND: with siltstone, wet, hard		28.5-28.6	0.1 ft. 0.1 ft. 100 %	50/0.1				
590.70	28.6	Recovered fragments: medium hard		28.6-33.6	5.0 ft. 3.6 ft. 72 %		3	0.0 ft. 0 %		
		ABUTMENT 2 PILE TIP ELEVATION = 590.00								
585.70	33.6	Grey SILTSTONE: medium hard								

Rig No.	841-022		
Rig Type	Skid		
Core Size	NQ		
Core Barrel	Solid		
Hammer	Auto		

Remarks

Sampling Method
Shelby Tube — Solid Auger
Split Spoon — Hollow Auger
Rock Core — Tricone

Water Level Observations
Immediate Dry ft.
At Completion 11.0 ft.
After 0 Hrs. 11.0 ft.
Before Coring NA ft.
Backfilled Cutting ft.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
Divisions of Highways

Engineering Division
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Field Log
C-4

DATE S.I.HAS REVISED

Project Name	FOURTEEN MILE BRIDGE			Project Number	S322-37-3.29
Boring Location	Station: 2+26.08	Offset: 15.8 ft. Rt. CL		Elevation (ft.)	619.30-ft Actual
Date Started	9/21/2016	County Lincoln	Inspector None	Lat. and Long.	0°N 0°W
Date Completed	9/21/2016	District Enter The County in the County Field	Entered By NRB	Driller / Company	Bird

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, grain size, structures, moisture, consistency	SAMPLE Type	INT Depth	Run Rec.	Blows Cnt (N-Value)	HCSI	RQD	Additional Notes	RMR (Total)
		Grey SILTSTONE: medium hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***		33.6-38.6	5.0 ft. 4.8 ft. 96 %		3	0.0 ft. 0 %		
580.70	38.6	BORING COMPLETED AT 38.6 ft.								

Rig No.	841-022		
Rig Type	Skid		
Core Size	NQ		
Core Barrel	Solid		
Hammer	Auto		

Remarks

Sampling Method
Shelby Tube — Solid Auger
Split Spoon — Hollow Auger
Rock Core — Tricone

Water Level Observations
Immediate Dry ft.
At Completion 11.0 ft.
After 0 Hrs. 11.0 ft.
Before Coring NA ft.
Backfilled Cutting ft.

NOTE:
THE BORING LOG(S) HAVE BEEN PROVIDED BY THE WVDOH.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
P.O. Box 283
Barboursville, WV 25504
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DRAWN	DATE	REVIEWED	DATE
BT	6 JUL '18	BDW	6 JUL '18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

BORING LOG SHEET (4 OF 4)

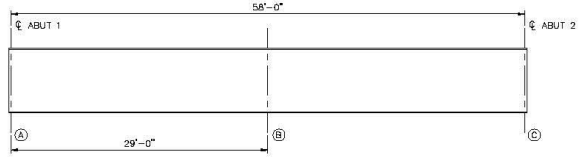
SHEET
B31 OF B33
11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S332-37-3.29 00	STP-0037(038)D	2019	LINCOLN	46	86

			TOP FLANGE			BOTTOM FLANGE			WEB			NON-COMPOSITE (GIRDER ONLY)		3n COMPOSITE FOR POSITIVE MOMENT (GIRDER AND CONCRETE WITH 3n MODULAR RATIO)		1n COMPOSITE FOR POSITIVE MOMENT (GIRDER AND CONCRETE WITH 1n MODULAR RATIO)		DESIGN SERVICE MOMENT AND SHEAR							
MEMBER	SPAN	SECTION LOCATION	WIDTH (IN)	THICKNESS (IN)	YIELD STRENGTH (KSI)	WIDTH (IN)	THICKNESS (IN)	YIELD STRENGTH (KSI)	DEPTH (IN)	THICKNESS (IN)	YIELD STRENGTH (KSI)	S-TOP FLG (IN^3)	S-BTM FLG (IN^3)	S-TOP FLG (IN^3)	S-BTM FLG (IN^3)	S-TOP FLG (IN^3)	S-BTM FLG (IN^3)	DC1 MOMENT (K-FT)	DC1 SHEAR (K)	DC2 MOMENT (K-FT)	DC2 SHEAR (K)	DW MOMENT (K-FT)	DW SHEAR (K)	FACTORED MOMENT CAPACITY (K-FT)	FACTORED SHEAR CAPACITY (K)
EXTERIOR	1	A	6	0.5	50	29.79	0.5	50	26	0.5	50	306	443	1705	663	7405	734	0.00	26.80	0.00	3.59	0.00	4.96	3295	389
	1	B	6	0.5	50	29.79	0.5	50	26	0.5	50	306	443	1705	663	7405	734	390.00	0.00	52.70	0.00	72.90	0.00	3295	389
	1	C	6	0.5	50	29.79	0.5	50	26	0.5	50	306	443	1705	663	7405	734	0.00	−26.80	0.00	−3.46	0.00	−4.78	3295	389
INTERIOR	1	A	6	0.5	50	29.79	0.5	50	26	0.5	50	306	443	1560	656	6259	729	0.00	24.90	0.00	3.47	0.00	4.80	3295	389
	1	B	6	0.5	50	29.79	0.5	50	26	0.5	50	306	443	1560	656	6259	729	362.00	0.00	51.80	0.00	71.60	0.00	3295	389
	1	C	6	0.5	50	29.79	0.5	50	26	0.5	50	306	443	1560	656	6259	729	0.00	−24.90	0.00	−3.59	0.00	−4.96	3295	389

			LIVE LOAD MOMENTS AND SHEARS (REFINED ANALYSIS)													
			HL-93		T3		SU4		SU5		SU6		SU7		WV-2S2	
MEMBER	SPAN	SECTION LOCATION	LL+I MOMENT (K-FT)	LL+I SHEAR (K)	LL+I MOMENT (K-FT)	LL+I SHEAR (K)	LL+I MOMENT (K-FT)	LL+I SHEAR (K)	LL+I MOMENT (K-FT)	LL+I SHEAR (K)	LL+I MOMENT (K-FT)	LL+I SHEAR (K)	LL+I MOMENT (K-FT)	LL+I SHEAR (K)	LL+I MOMENT (K-FT)	LL+I SHEAR (K)
EXTERIOR	1	A	−19	53	−12	31	−14	34	−15	38	−15	39	−15	40	−14	38
	1	B	689	32	407	21	471	−23	514	−24	571	23	622	21	443	23
	1	C	3	−60	2	−36	2	−40	2	−44	2	−46	2	−48	2	−42
INTERIOR	1	A	−18	41	−12	25	−13	27	−14	29	−13	30	−13	32	−13	29
	1	B	584	−30	349	20	395	23	431	24	477	21	517	19	374	−22
	1	C	−7	−46	−4	−28	4	−30	4	−33	4	−35	5	−36	−5	−33

			DESIGN LOAD RATING (HL-93)		LEGAL LOAD RATING					
MEMBER	LIMIT STATE		INVENTORY (RF)	OPERATING (RF)	T3	SU4	SU5	SU6	SU7	WV-2S2
EXTERIOR	STRENGTH I	FLEXURE	2.18	2.83	4.62	3.99	3.66	3.29	3.02	4.25
		SHEAR	3.70	4.80	7.82	7.22	6.46	6.29	6.14	6.46
INTERIOR	STRENGTH I	FLEXURE	2.61	3.39	5.47	4.83	4.43	4.00	3.69	5.10
		SHEAR	4.83	6.26	9.90	9.16	8.53	8.25	7.73	8.53



GIRDER ELEVATION

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

J.B. TURMAN ENGINEERING, PLLC
P.O. Box 483
Barboursville, WV 25504
www.jbtengineering.com

DESIGNED	DATE	CHECKED	DATE
BT	6 JUL 18	BDM	6 JUL 18
DRAWN	DATE	REVIEWED	DATE
BT	6 JUL 18	BDM	6 JUL 18

FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GIRDER RATING

SHEET
B32 OF B33

11374

PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	47	86

PROCEDURE FOR DETERMINING LRFR LOAD RATINGS

PERMIT LOAD RATING PROCEDURE FOR ROUTINE (ANNUAL) PERMITS:

1. OBTAIN THE LL+IM SHEAR AND MOMENTS FOR EACH VEHICLE TO BE RATED WERE DETERMINED USING REFINED ANALYSIS.
2. CALCULATE THE RATING FACTORS.
3. THE LOAD RATING IS THEN CALCULATED BY MULTIPLYING THE GROSS WEIGHT OF THE TRUCK, IN TONS, BY THE CRITICAL (LOWEST) RATING FACTOR FOR THAT TRUCK CONSIDERING ALL LOCATIONS ACROSS THE BRIDGE.

GENERAL LOAD RATING EQUATION

$$RF = \frac{C - (\gamma_{DC})(DC) - (\gamma_{DW})(DW)}{\gamma_{(LL+I)}}$$

EQUATION FOR STRENGTH LIMIT STATES

RESISTANCE FACTOR ϕ = 1.0, FOR FLEXURE AND SHEAR

CONDITION FACTOR ϕ_c = 1.0, FOR NEW STRUCTURES

SYSTEM FACTOR ϕ_s = 1.0, FOR MULTI-GIRDER BRIDGE

DESIGN LOAD RATING - STRENGTH I LIMIT STATE

FLEXURE

CAPACITY, C = $(\phi)(\phi_c)(\phi_s)(\phi_f)$ Mn

$$RF = \frac{C - (\gamma_{DC})(M_{DC}) - (\gamma_{DW})(M_{DW})}{\gamma_L(M_{LL+I})}$$

$M_{DC} = M_{DC1} + M_{DC2}$

SHEAR

CAPACITY, C = $(\phi)(\phi_c)(\phi_s)(\phi_v)$ Vn

$$RF = \frac{C - (\gamma_{DC})(V_{DC}) - (\gamma_{DW})(V_{DW})}{\gamma_L(V_{LL+I})}$$

$V_{DC} = V_{DC1} + V_{DC2}$

LEGAL LOAD RATING

THE INVENTORY DESIGN LOAD RATING PRODUCED RATING FACTORS GREATER THAN 1.0. THIS INDICATES THAT THE BRIDGE HAS ADEQUATE LOAD CAPACITY TO CARRY ALL LEGAL LOADS WITHIN LRFD EXCLUSION LIMITS AND NEED NOT BE SUBJECT TO LEGAL LOAD RATINGS.

LIMIT STATE	DEAD LOAD	DEAD LOAD	DESIGN LOAD		LEGAL LOAD
			INVENTORY	OPERATING	
STRENGTH I	1.25	1.50	1.75	1.35	1.40
SERVICE II	1.25	1.50	1.35	1.00	1.30

EXAMPLE

γ_{DC} = 1.25
γ_{DW} = 1.50
γ_L = 1.40

FLEXURE INTERIOR GIRDER @ POINT "B" FOR T3

Mn = 3296 K-FT
M_{DC1} = 362 K-FT
M_{DC2} = 52 K-FT
M_{DW} = 72 K-FT

$$RF = \frac{(1)(1)(1)(3296) - 1.25[(ABS)(362+52)] - 1.5[(ABS)(72)]}{(1.40)(349)}$$

RF = 5.47

SHEAR INTERIOR GIRDER @ POINT "A" FOR T3

Vn = 389 K
V_{DC1} = 26.8 K
V_{DC2} = 3.59 K
V_{DW} = 4.96 K

$$RF = \frac{(1)(1)(1)(389) - 1.25[(ABS)(26.8+3.59)] - 1.5[(ABS)(4.96)]}{(1.40)(25)}$$

RF = 9.82

NOTES

1. LOAD RATING ANALYSIS PERFORMED USING LRFR METHOD FOUND IN AASHTO MANUAL FOR BRIDGE EVALUATION, 2ND EDITION, WITH INTERIMS.
2. BRIDGE DESIGNED USING REFINED ANALYSIS TO DETERMINE LIVE LOAD MOMENTS AND SHEARS.
3. CONVERSION FACTORS ARE DEVELOPED TO RELATE THE REFINED ANALYSIS LIVE LOAD MOMENTS AND SHEARS TO LINE GIRDER ANALYSIS WITH A LIVE LOAD DISTRIBUTION FACTOR OF 1.0 LANES. VALUES SHOWN IN THE TABLE WERE CALCULATED USING THE MDX SOFTWARE.
4. IF SIGNIFICANT SECTION LOSS HAS OCCURRED, RECALCULATE THE GIRDERS, DIAPHRAGMS AND DETAILS. DECK CONCRETE, HAUNCHES AND STAY-IN-PLACE FORMS AND INCLUDE THE EFFECTS OF THE POURING SEQUENCE. THESE LOADINGS EFFECTS ARE RESISTED BY THE NON-COMPOSITE GIRDER.
5. DC2 MOMENTS AND SHEARS ARE DUE TO THE WEIGHT OF THE PARAPETS. THESE LOADINGS ARE RESISTED BY LONG-TERM COMPOSITE GIRDER.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

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FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

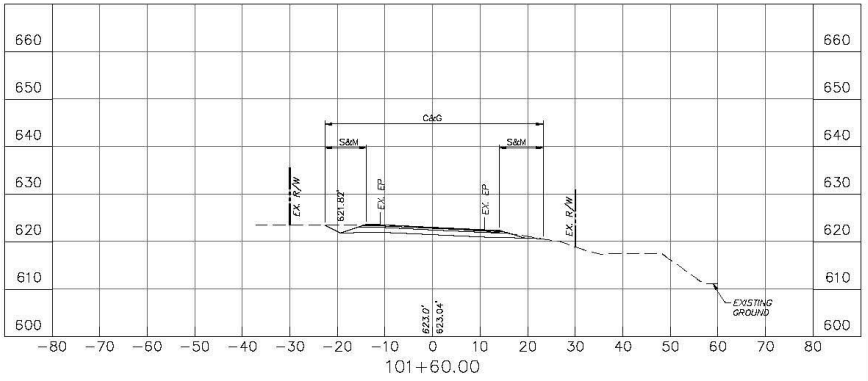
GIRDER RATING EXAMPLE

SHEET
B33 OF B33

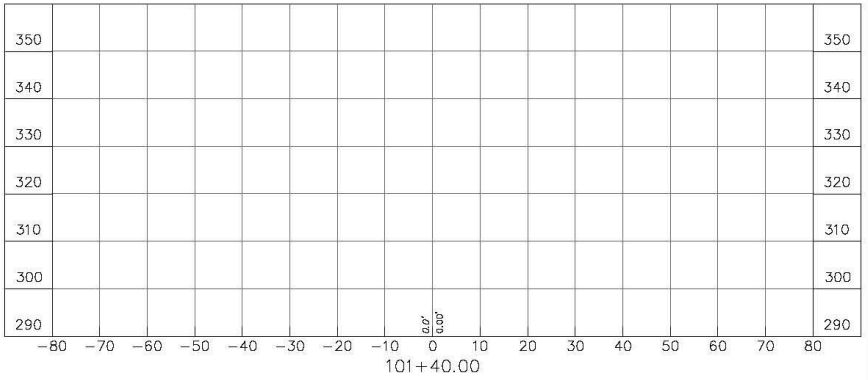
11374

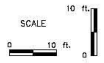
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	48	85

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
101+60		18		46		59		--		0		--	
	20		180		460		21.85		--		0		--
101+40		0		0		0		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
101+40		0		0		0		--		0		--	
	20		0		0		0		--		0		--
101+20		0		0		0		--		0		--	





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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

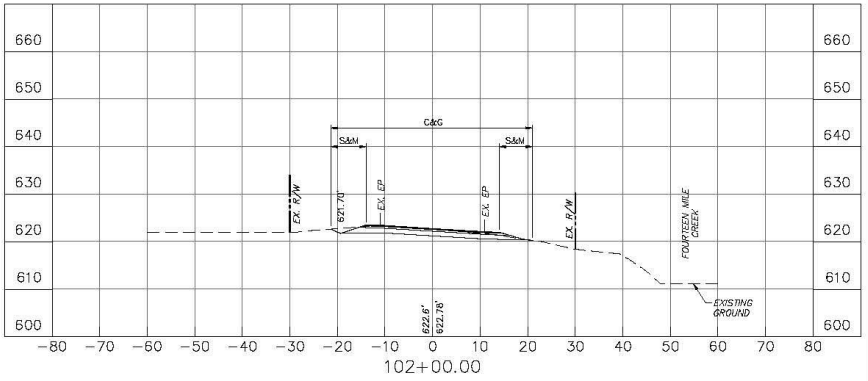
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

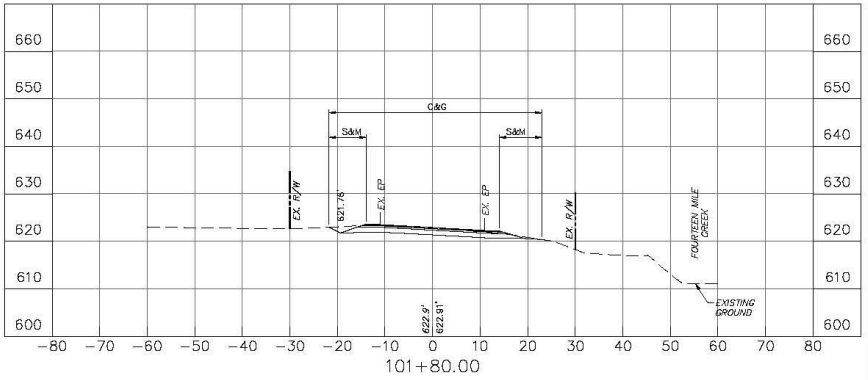
CROSS SECTIONS

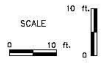
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	49	85

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
102+00		14		42		58		--		0		--	
	20		310		870		43.33		--		0		--
101+80		17		45		59		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
101+80		17		45		59		--		0		--	
	20		350		910		43.70		--		0		--
101+60		18		46		59		--		0		--	





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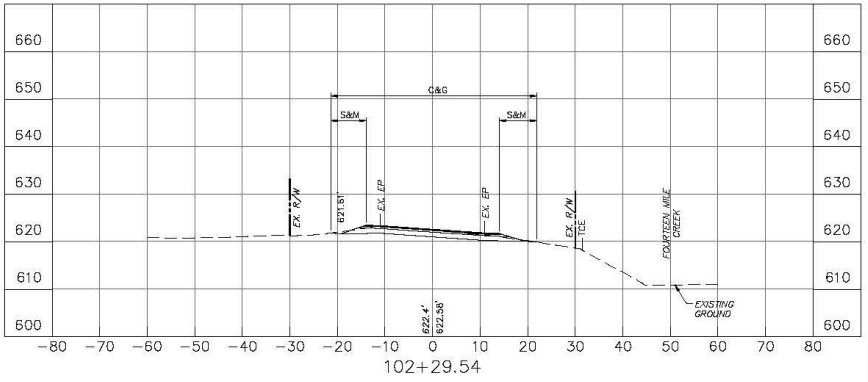
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CROSS SECTIONS

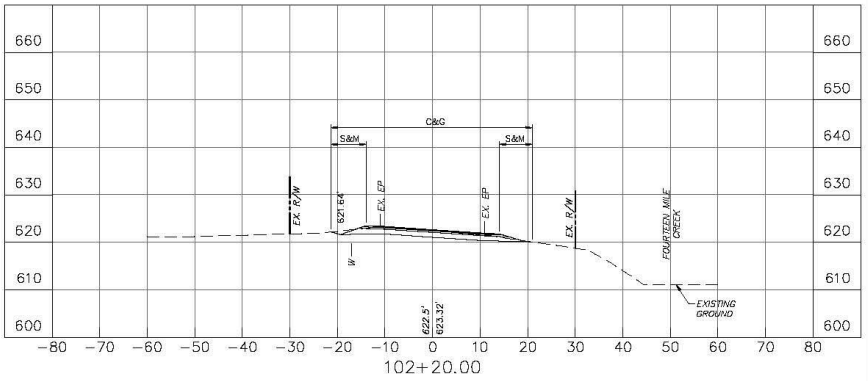
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	50	85

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
102+29.54		15		43		53		--		0		--	
	9.54		143.10		405.45		19.43		--		0		--
102+20		15		42		57		--		0		--	

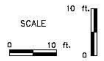


102+29.54

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
102+20		15		42		57		--		0		--	
	20		290		840		42.59		--		0		--
102+00		14		42		58		--		0		--	



102+20.00



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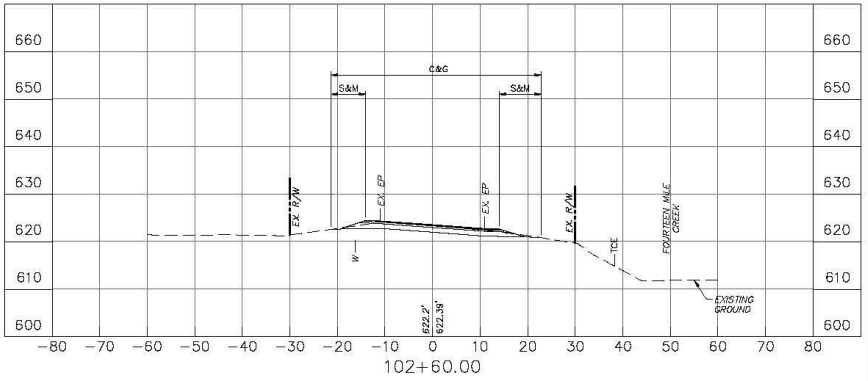
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CROSS SECTIONS

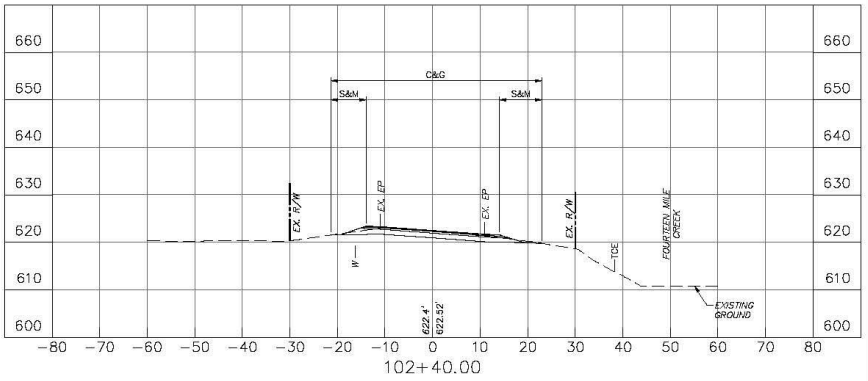
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	51	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
102+60		16		44		53		--		0		--	
	20		300		860		39.26		--		0		--
102+40		16		44		53		--		0		--	

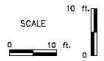


102+60.00

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
102+40		16		44		53		--		0		--	
	10.46		162.13		455.01		20.53		--		0		--
102+29.54		15		43		53		--		0		--	



102+40.00



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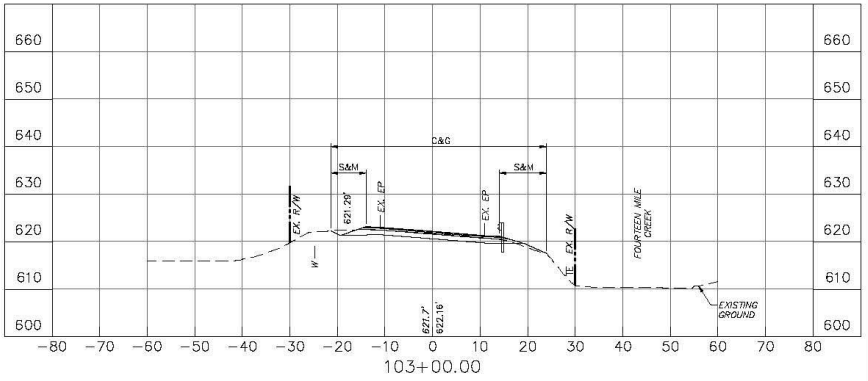
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

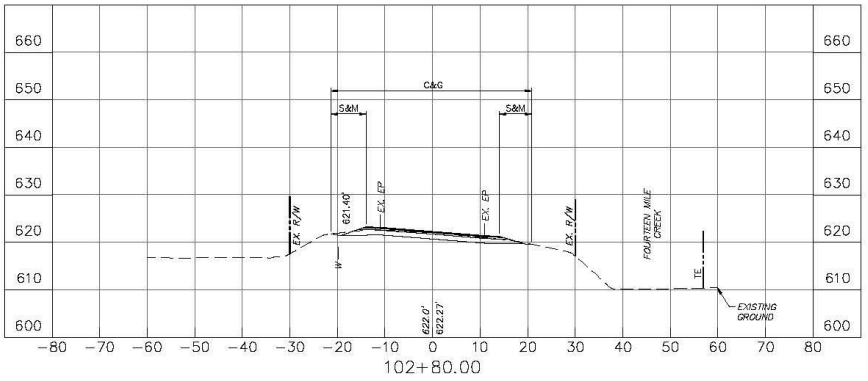
CROSS SECTIONS

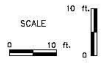
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	52	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
103+00		17		45		58		--		2		--	
	20		310		870		41.11		--		0.74		--
102+80		14		42		53		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
102+80		14		42		53		--		0		--	
	20		310		870		39.26		--		0		--
102+60		17		45		53		--		0		--	





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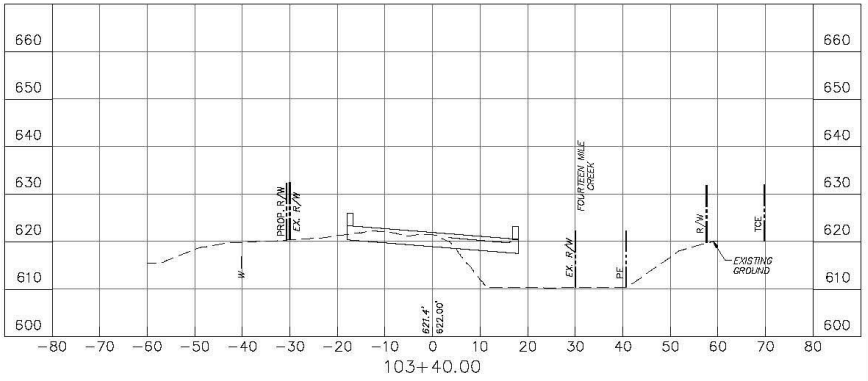
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

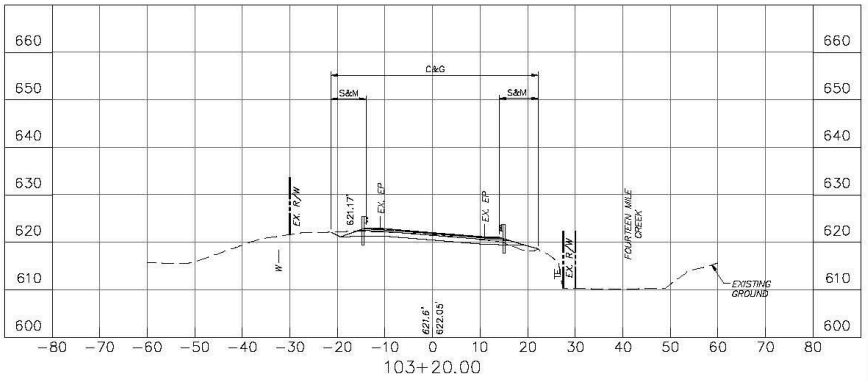
CROSS SECTIONS

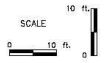
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	53	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
103+40		0		0		0		--		0		--	
	20		160		440		12.96		--		1.85		--
103+20		16		44		35		--		5		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
103+20		16		44		35		--		5		--	
	20		330		890		34.44		--		2.59		--
103+00		17		45		58		--		2		--	





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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

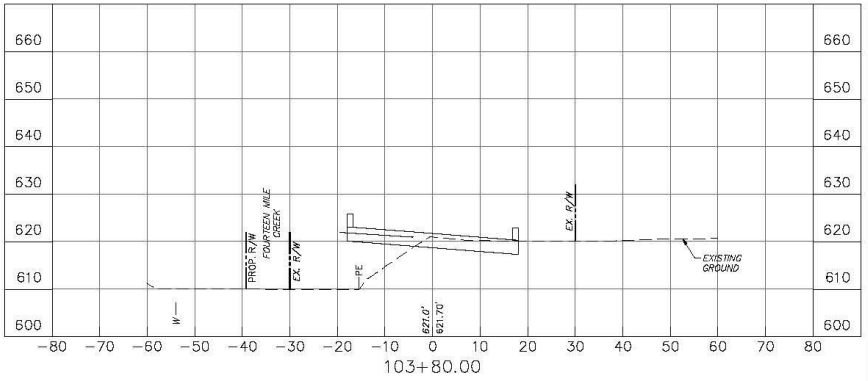
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

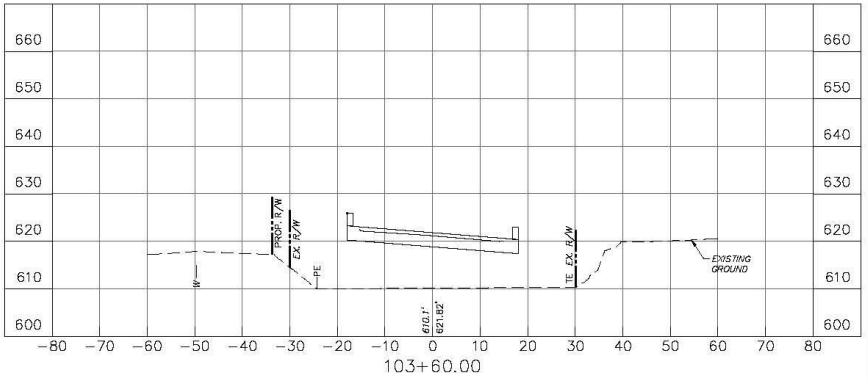
CROSS SECTIONS

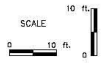
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	54	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
103+80		0		0		0		--		0		--	
	20		0		0		0		--		0		--
103+60		0		0		0		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
103+60		0		0		0		--		0		--	
	20		0		0		0		--		0		--
103+40		0		0		0		--		0		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

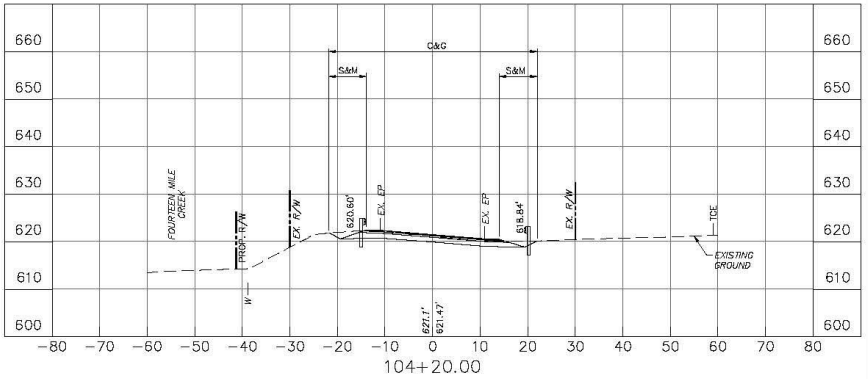
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

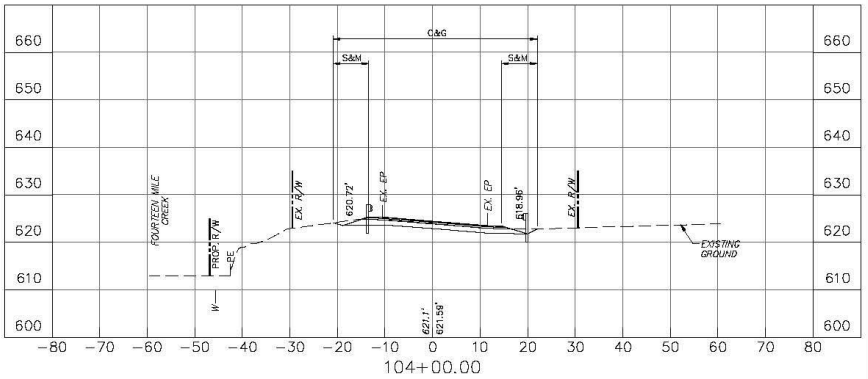
CROSS SECTIONS

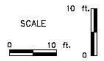
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	55	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
104+20		16		44		53		--		0		--	
	20		310		870		39.26		--		0		--
104+00		15		43		53		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
104+00		15		43		53		--		0		--	
	20		150		430		19.63		--		0		--
103+80		0		0		0		--		0		--	





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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

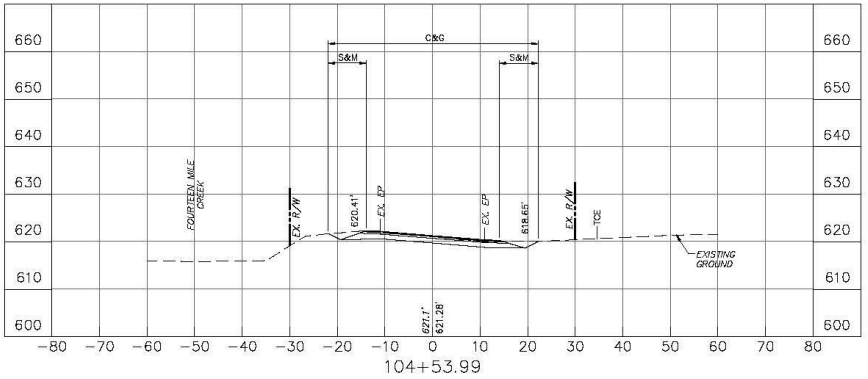
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CROSS SECTIONS

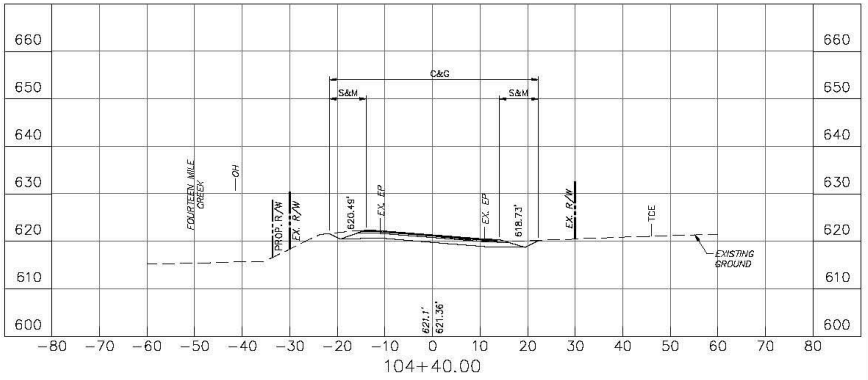
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	56	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
104+53.99		16		44		53		--		0		--	
	13.99		223.84		615.56		27.46		--		0		--
104+40		16		44		53		--		0		--	

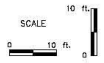


104+53.99

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
104+40		16		44		53		--		0		--	
	20		320		880		39.26		--		0		--
104+20		16		44		53		--		0		--	



104+40.00



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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

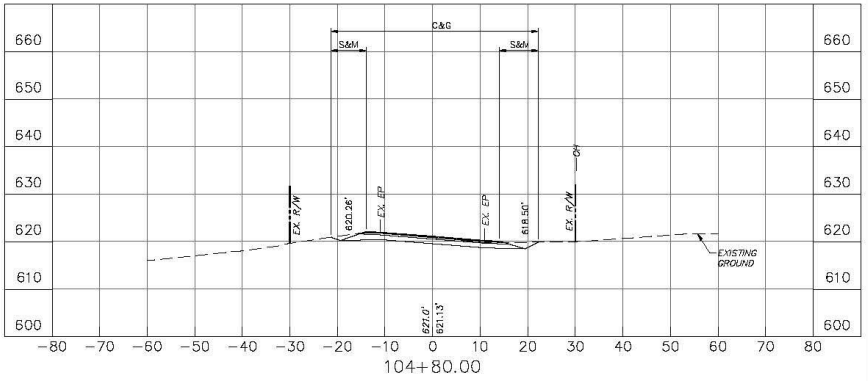
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

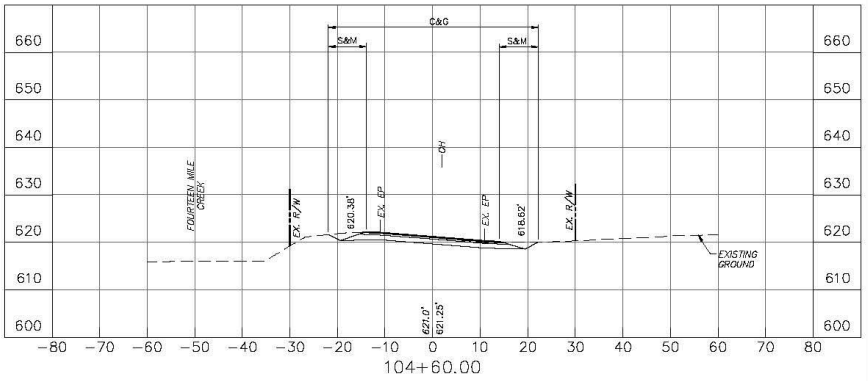
CROSS SECTIONS

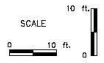
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	57	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
104+80		16		44		53		--		0		--	
	20		320		880		39.26		--		0		--
104+60		16		44		53		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
104+60		16		44		53		--		0		--	
	6.01		96.16		264.44		11.80		--		0		--
104+53.99		16		44		53		--		0		--	





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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

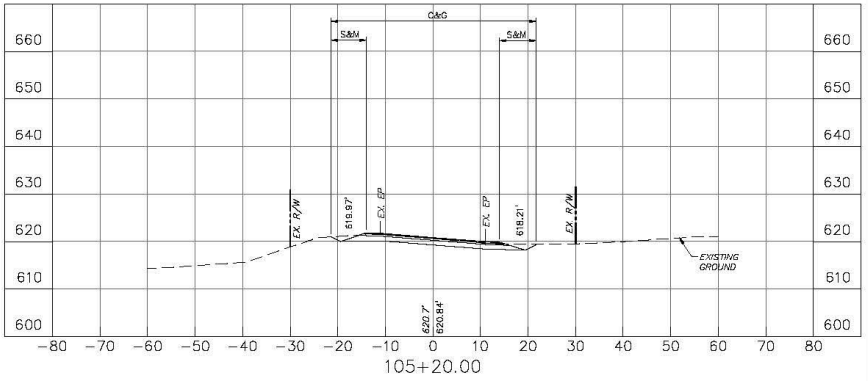
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

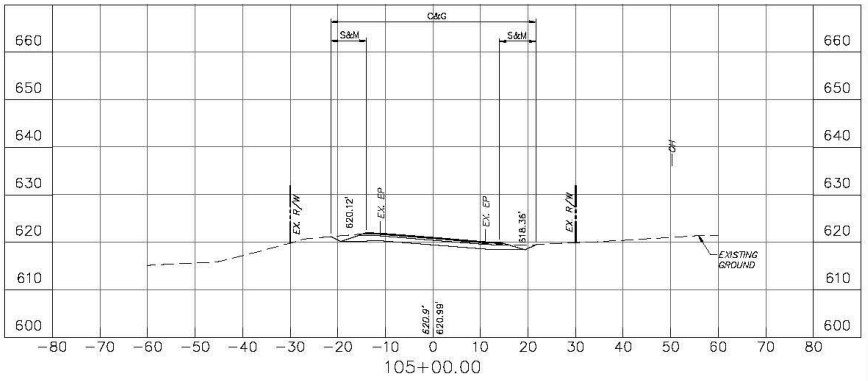
CROSS SECTIONS

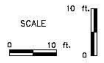
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	58	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
105+20		15		43		53		--		0		--	
	20		300		860		39.26		--		0		--
105+00		15		43		53		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
105+00		15		43		53		--		0		--	
	20		310		870		39.26		--		0		--
104+80		16		44		53		--		0		--	





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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

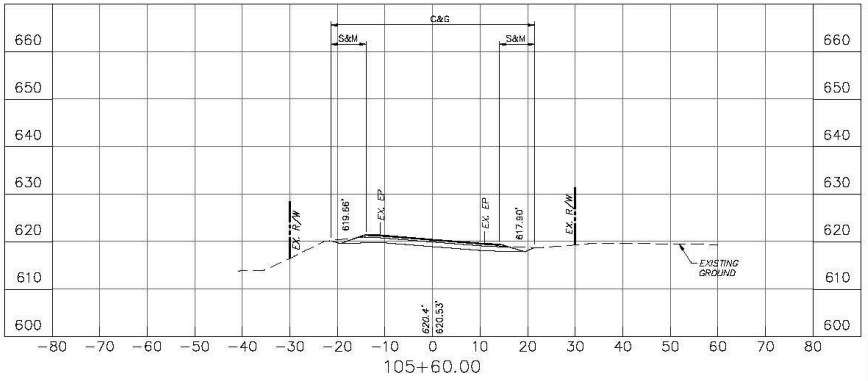
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

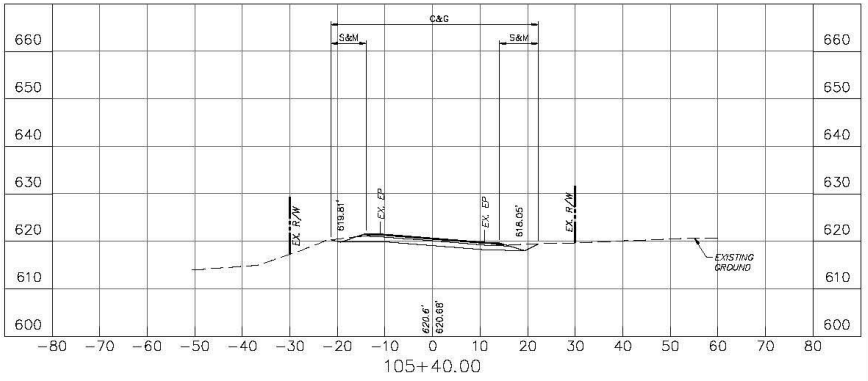
CROSS SECTIONS

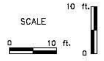
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	59	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
105+60		15		43		53		--		0		--	
	20		310		870		39.26		--		0		--
105+40		16		44		53		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
105+40		16		44		53		--		0		--	
	20		310		870		39.26		--		0		--
105+20		15		43		53		--		0		--	





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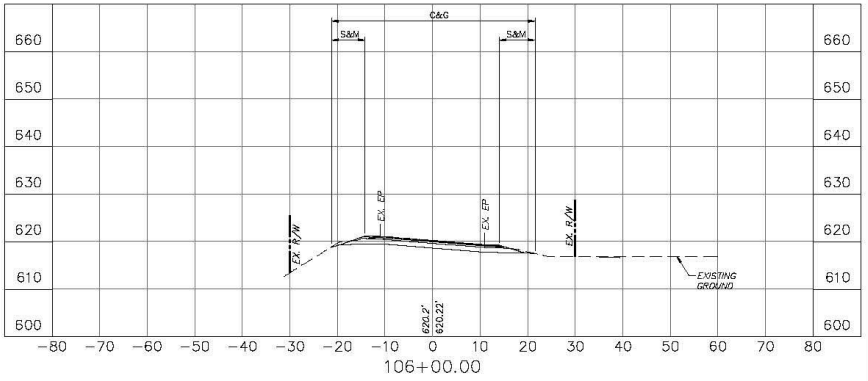
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

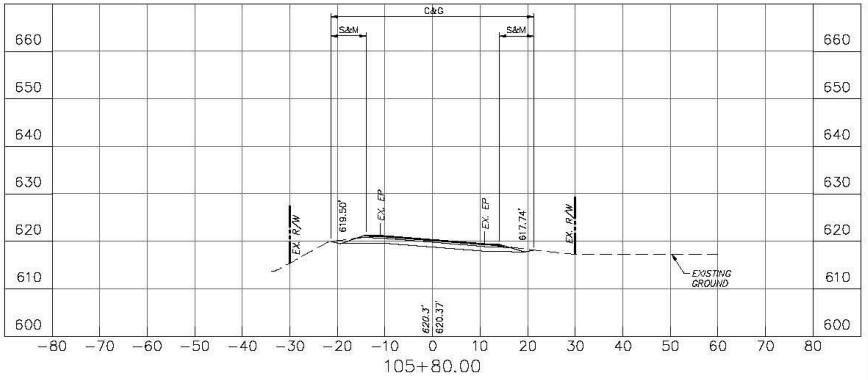
CROSS SECTIONS

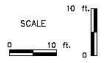
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	80	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
106+00		15		43		53		--		0		--	
	20		300		860		39.26		--		0		--
105+80		15		43		53		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
105+80		15		43		53		--		0		--	
	20		300		860		39.26		--		0		--
105+60		15		43		53		--		0		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

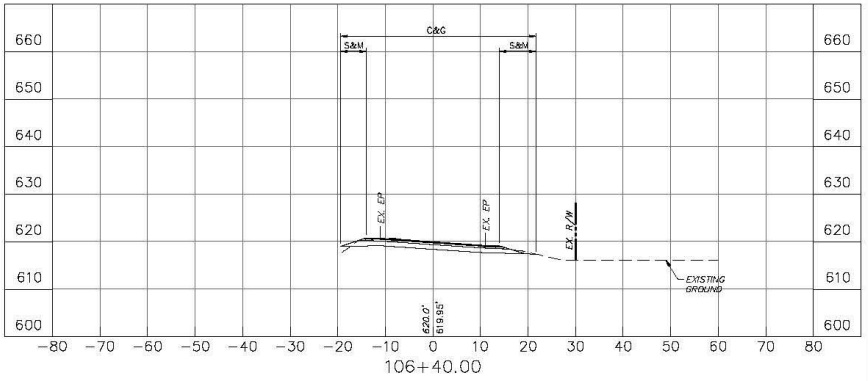
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CROSS SECTIONS

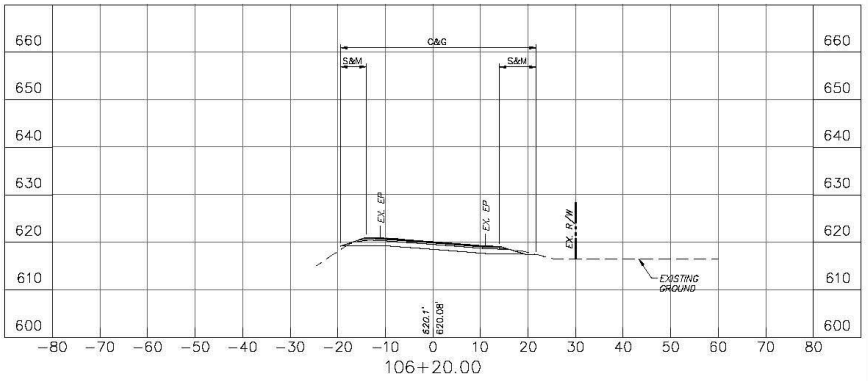
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	61	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
106+40		13		41		53		--		0		--	
	20		260		820		39.26		--		0		--
106+20		13		41		53		--		0		--	

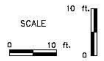


106+40.00

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
106+20		13		41		53		--		0		--	
	20		280		840		39.26		--		0		--
106+00		15		43		53		--		0		--	



106+20.00



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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

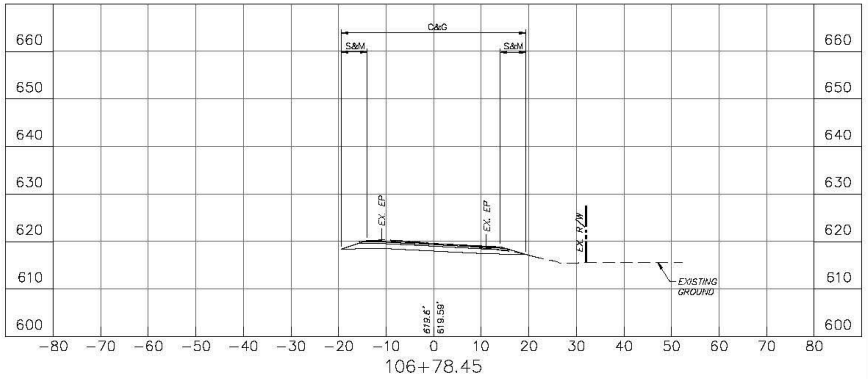
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CROSS SECTIONS

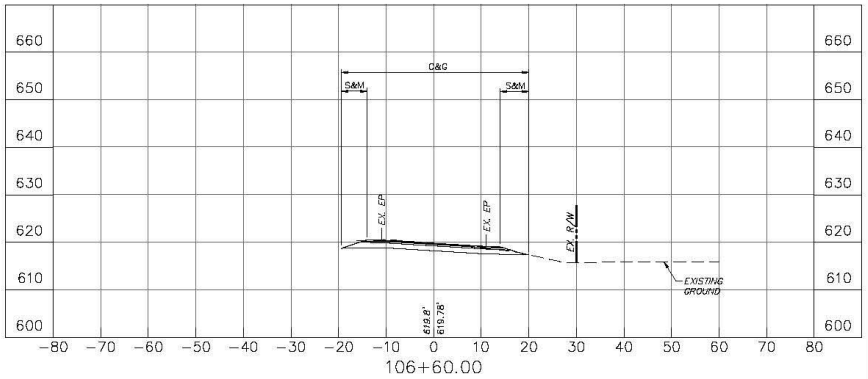
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	82	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
106+78.45		11		39		53		--		0		--	
	28.45		202.95		719.55		36.22		--		0		--
106+60		11		39		53		--		0		--	

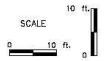


106+78.45

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
106+60		11		39		53		--		0		--	
	20		240		800		39.26		--		0		--
105+40		13		41		53		--		0		--	



106+60.00



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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

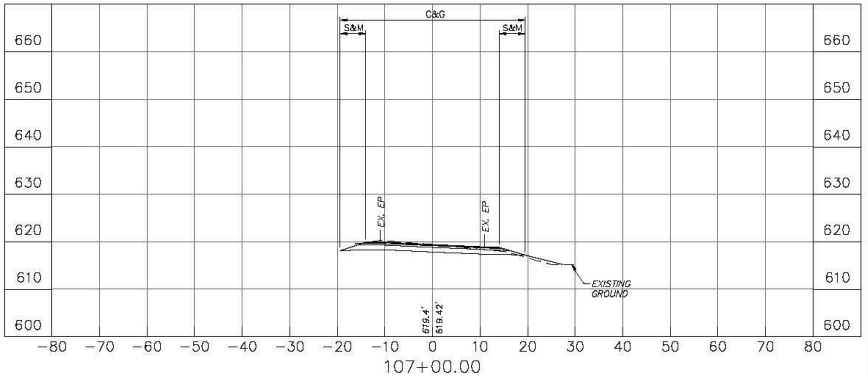
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

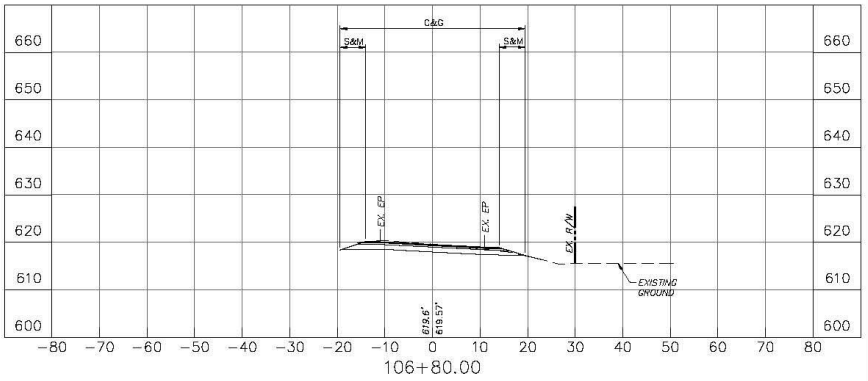
CROSS SECTIONS

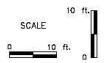
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	83	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
107+00		11		39		53		--		0		--	
	20		220		780		39.26		--		0		--
106+80		11		39		53		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
106+80		11		39		53		--		0		--	
	1.55		17.05		60.45		3.04		--		0		--
106+78.45		11		39		53		--		0		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

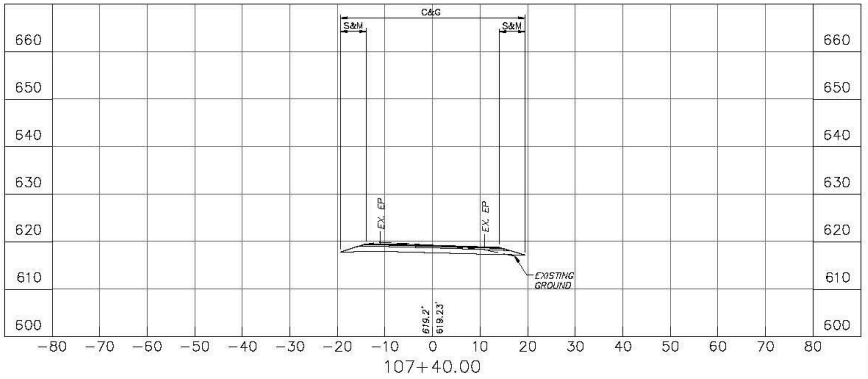
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CROSS SECTIONS

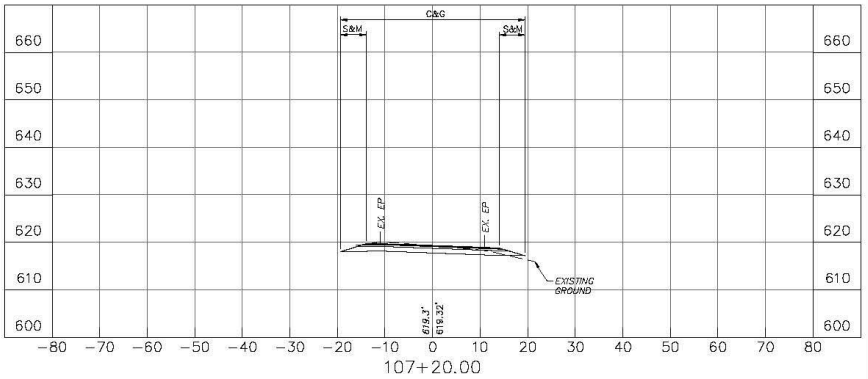
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	54	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
107+40		11		39		53		--		0		--	
	20		220		780		39.26		--		0		--
107+20		11		39		53		--		0		--	

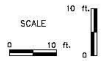


107+40.00

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
107+20		11		39		53		--		0		--	
	20		220		780		39.26		--		0		--
107+00		11		39		53		--		0		--	



107+20.00



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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

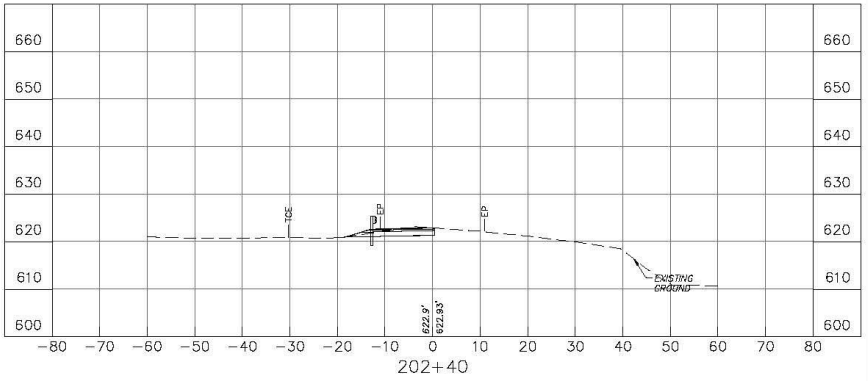
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

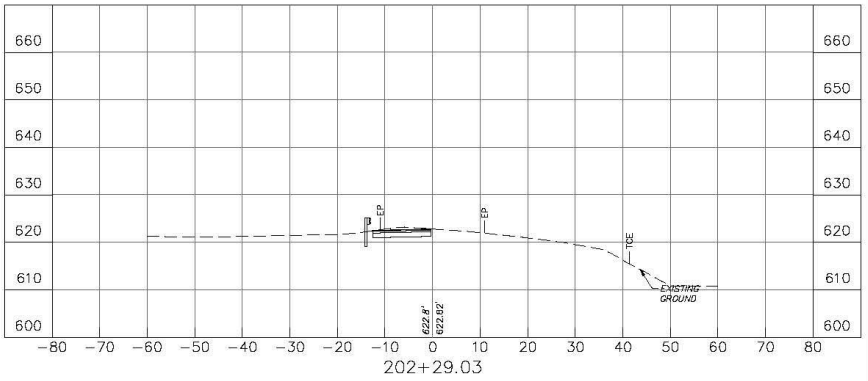
CROSS SECTIONS

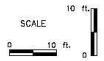
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	85	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
202+40		0		0		20.86		--		0		--	
	10.97		0		0		8.81		--		0		--
202+29.03		0		0		22.49		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
202+29.03		0		0		22.49		--		0		--	
	9.03		0		0		4.57		--		0		--
202+20		0		0		0		--		0		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

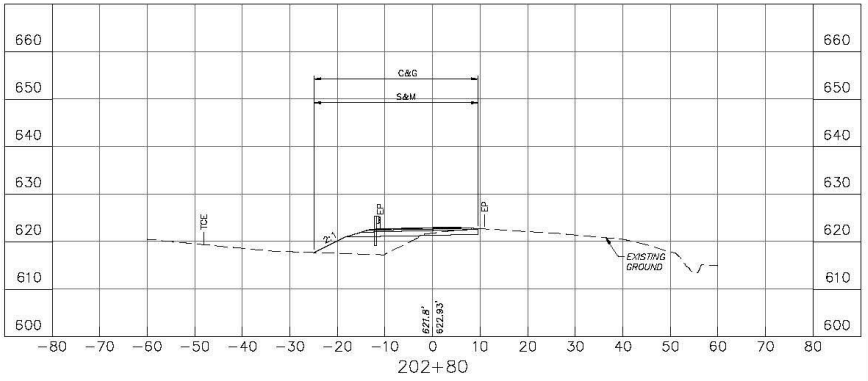
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DETOUR
CROSS SECTIONS

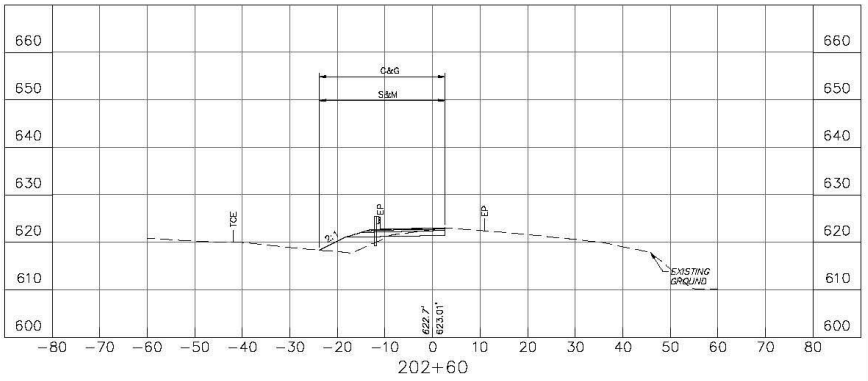
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	55	55

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
202+80		34.42		34.42		8.86		--		57.15		--	
	20		608.40		608.40		7.11		--		30.90		--
202+60		26.42		26.42		10.35		--		26.19		--	

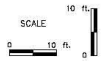


202+80

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
202+60		26.42		26.42		10.35		--		26.19		--	
	20		264.20		264.20		11.56		--		9.70		--
202+40		0		0		20.86		--		0		--	



202+60



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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

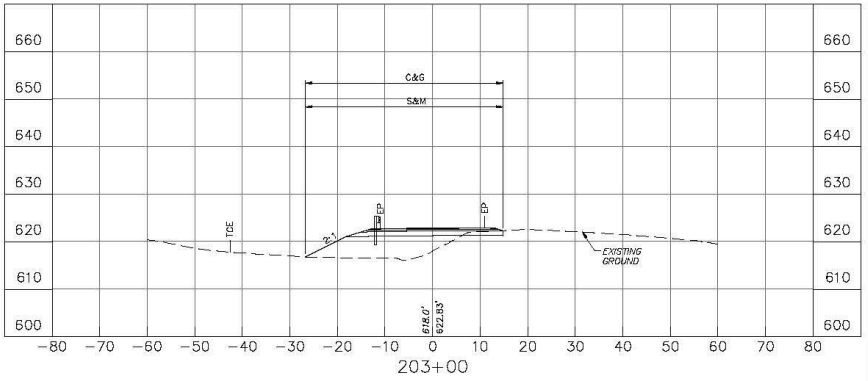
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

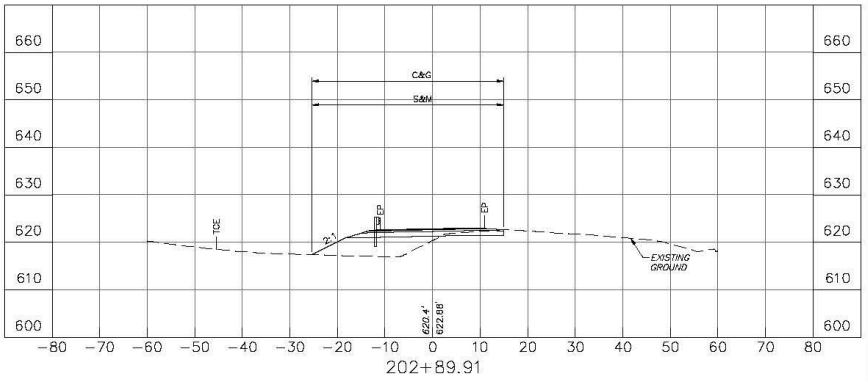
DETOUR
CROSS SECTIONS

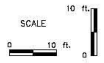
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	67	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
203+00		41.59		41.59		6.37		--		112.77		--	
	10.09		413.24		413.24		2.94		--		35.59		--
202+89.91		40.32		40.32		9.35		--		77.71		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
202+89.91		40.32		40.32		9.35		--		77.71		--	
	9.91		370.34		370.34		3.34		--		24.77		--
202+80		34.42		34.42		8.86		--		57.25		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

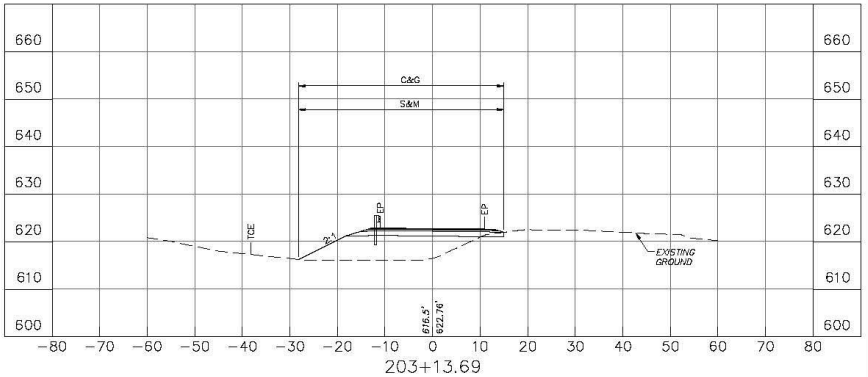
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DETOUR
CROSS SECTIONS

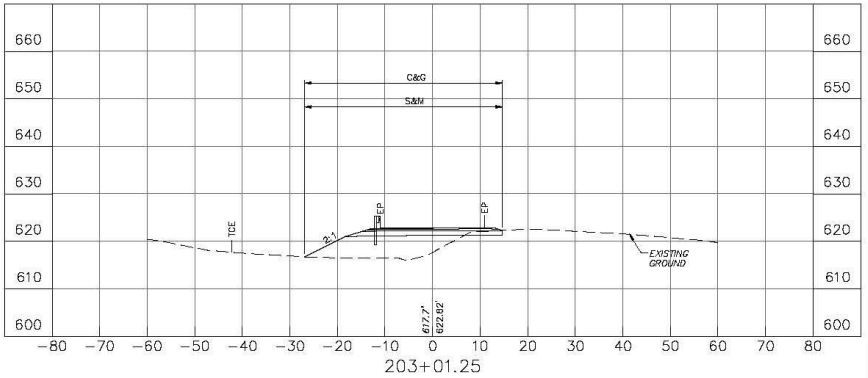
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	68	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
203+13.69		43.19		43.19		2.81		--		146.54		--	
	12.44		527.58		527.58		2.02		--		60.70		--
203+01.25		41.63		41.63		5.96		--		116.95		--	

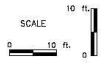


203+13.69

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
203+01.25		41.63		41.63		5.96		--		116.95		--	
	1.25		52.01		52.01		0.29		--		5.32		--
203+00		41.59		41.59		6.37		--		112.77		--	



203+01.25



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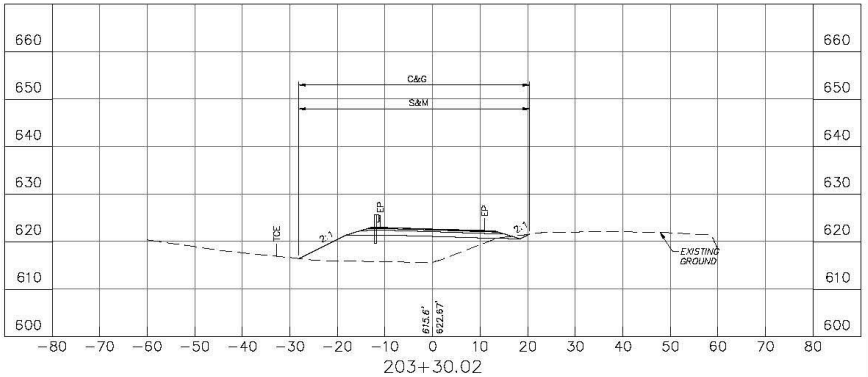
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DETOUR
CROSS SECTIONS

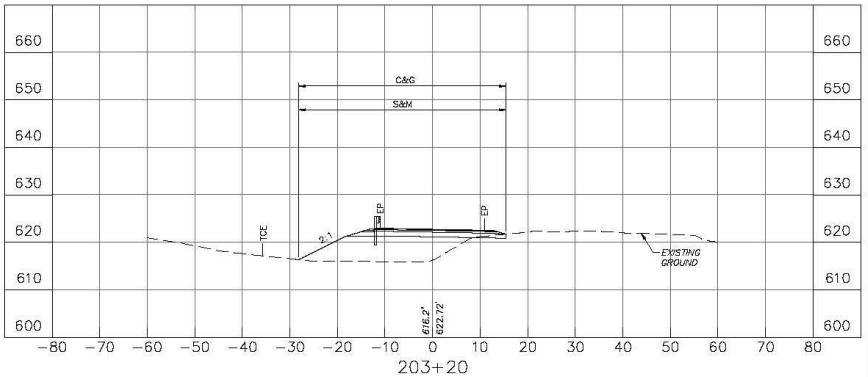
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	69	85

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
203+30.02		48.53		48.53		2.79		--		167.00		--	
	10.02		461.12		461.12		1.11		--		57.96		--
203+20		43.51		43.51		3.21		--		145.37		--	

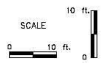


203+30.02

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
203+20		43.51		43.51		3.21		--		145.37		--	
	6.31		273.54		273.54		0.70		--		34.11		--
203+13.69		43.19		43.19		2.81		--		146.54		--	



203+20



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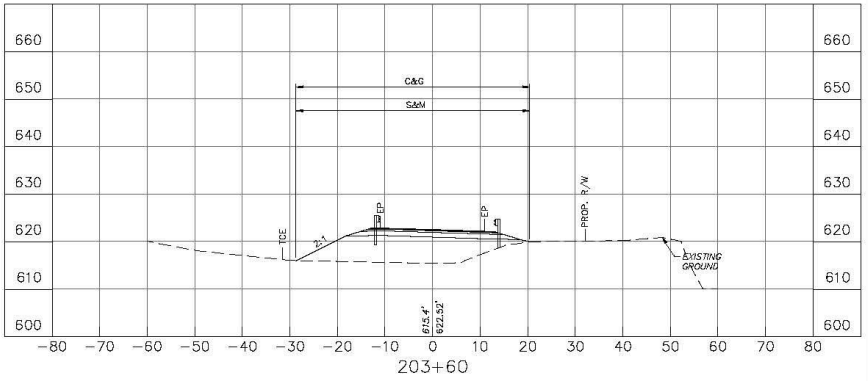
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

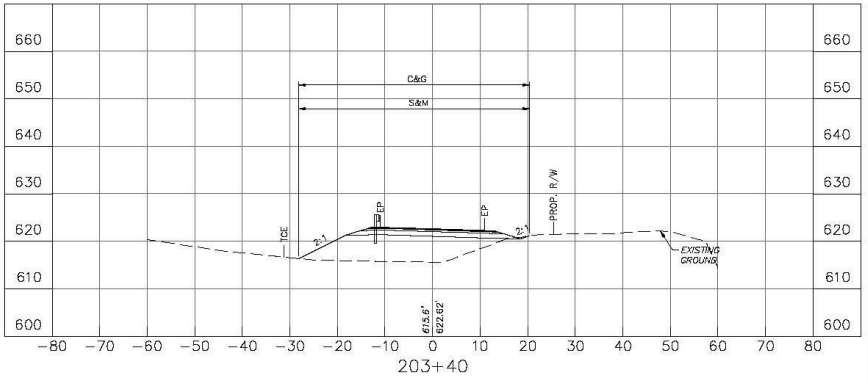
DETOUR
CROSS SECTIONS

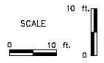
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	70	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
203+60		49.11		49.11		0		--		194.75		--	
	20		976.70		976.70		0.30		--		137.71		--
203+40		48.56		48.56		0.82		--		177.05		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
203+40		48.56		48.56		0.82		--		177.05		--	
	9.98		484.48		484.48		0.67		--		63.59		--
203+30.02		48.53		48.53		2.79		--		167.00		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

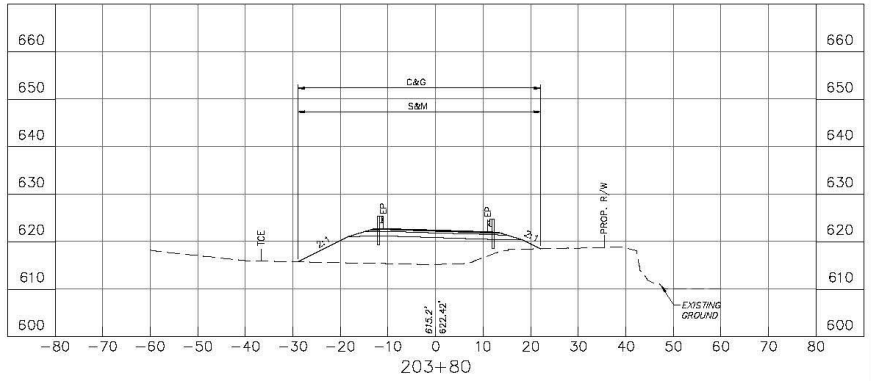
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

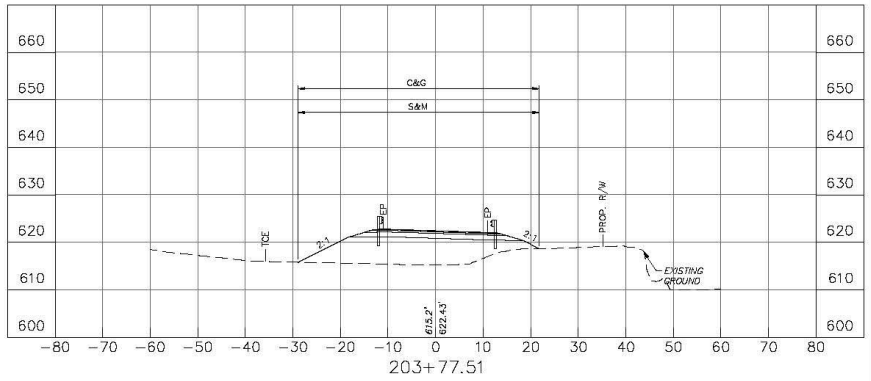
DETOUR
CROSS SECTIONS

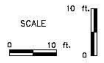
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	71	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
203+80		51.06		51.06		0		--		211.30		--	
	2.49		126.75		126.75		0		--		19.41		--
203+77.51		50.75		50.75		0		--		209.59		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
203+77.51		50.75		50.75		0		--		209.59		--	
	17.51		874.27		874.27		0		--		131.11		--
203+60		49.11		49.11		0		--		194.75		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

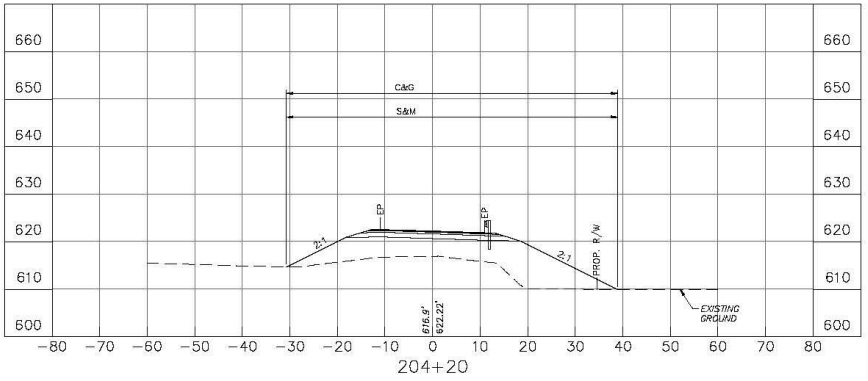
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

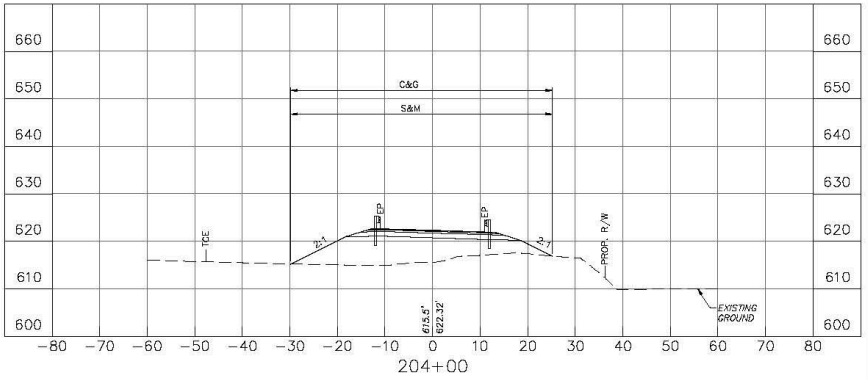
DETOUR
CROSS SECTIONS

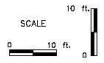
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	72	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
204+20		69.72		69.72		0		--		304.42		--	
	20		1247.60		1247.60	0	0	--	--		193.00		--
204+00		55.04		55.04		0		--		216.68		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
204+00		55.04		55.04		0		--		216.68		--	
	20		1061		1061	0	0	--	--		158.51		--
203+80		51.06		51.06		0		--		211.30		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

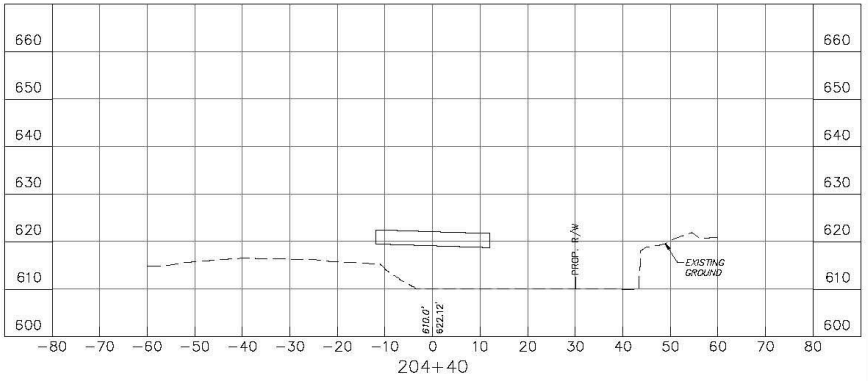
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DETOUR
CROSS SECTIONS

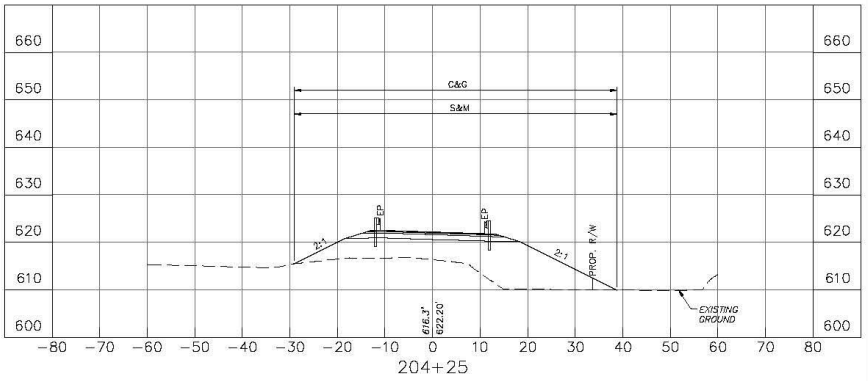
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	73	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
204+40		0		0		0		--		0		--	
	15		508.88		508.88		0		--		90.63		--
204+25		67.85		67.85		0		--		326.26		--	

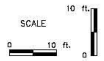


204+40

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
204+25		67.85		67.85		0		--		326.26		--	
	5		343.93		343.93		0		--		58.40		--
204+20		69.72		69.72		0		--		304.42		--	



204+25



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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

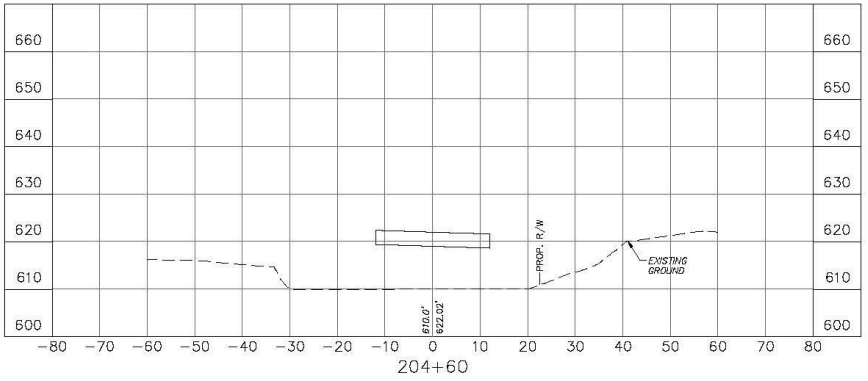
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

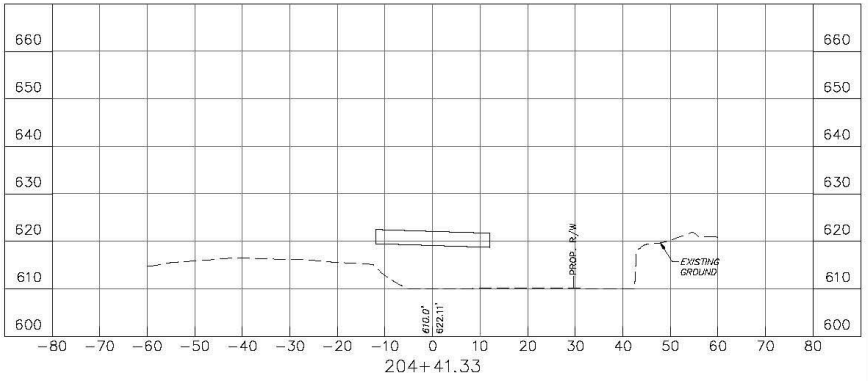
DETOUR
CROSS SECTIONS

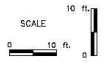
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	74	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
204+60		0		0		0		--		0		--	
	18.67		0		0		0		--		0		--
204+41.33		0		0		0		--		0		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
204+41.33		0		0		0		--		0		--	
	1.33		0		0		0		--		0		--
204+40		0		0		0		--		0		--	





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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

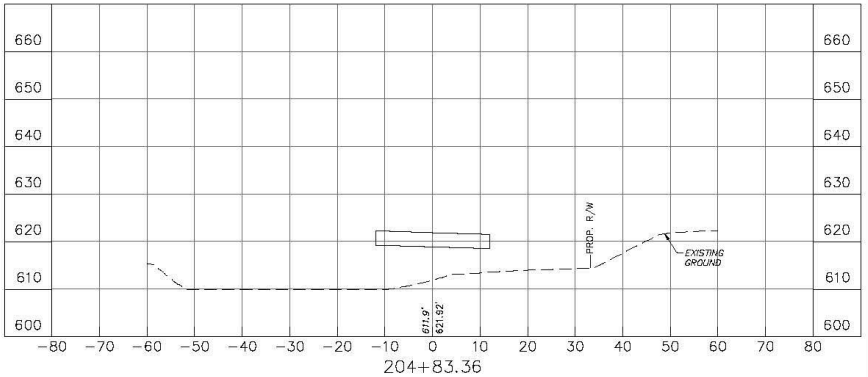
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DETOUR
CROSS SECTIONS

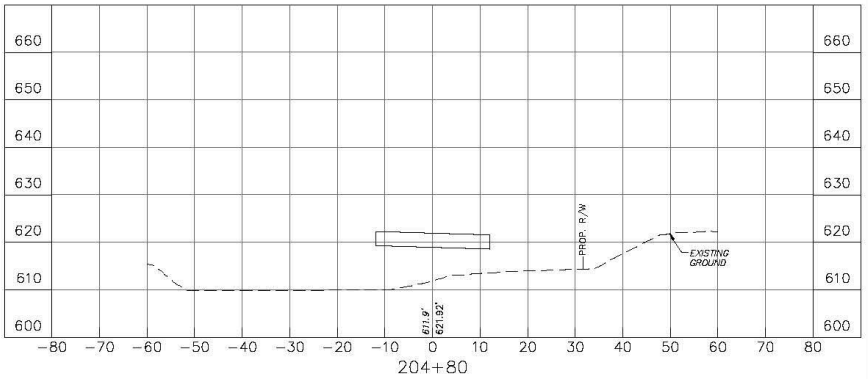
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	75	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
204+83.36		0		0		0		--		0		--	
	3.36		0		0		0		--		0		--
204+80		0		0		0		--		0		--	

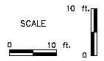


204+83.36

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
204+80		0		0		0		--		0		--	
	20		0		0		0		--		0		--
204+60		0		0		0		--		0		--	



204+80



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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

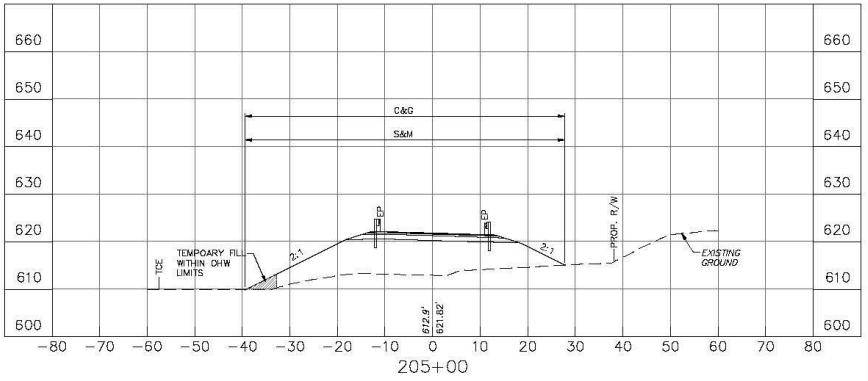
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DETOUR
CROSS SECTIONS

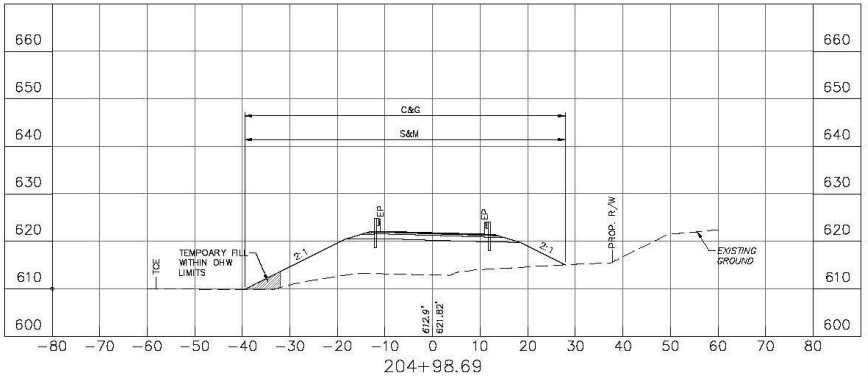
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	76	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
205+00		67.31		67.31		0		--		354.36		--	
	1.31		44.09		44.09		0		--		8.60		--
204+98.69		67.36		67.36		0		--		360.44		--	

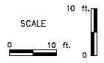


205+00

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
204+98.69		67.36		67.36		0		--		360.44		--	
	15.33		516.31		516.31		0		--		102.32		--
204+83.36		0		0		0		--		0		--	



204+98.69



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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

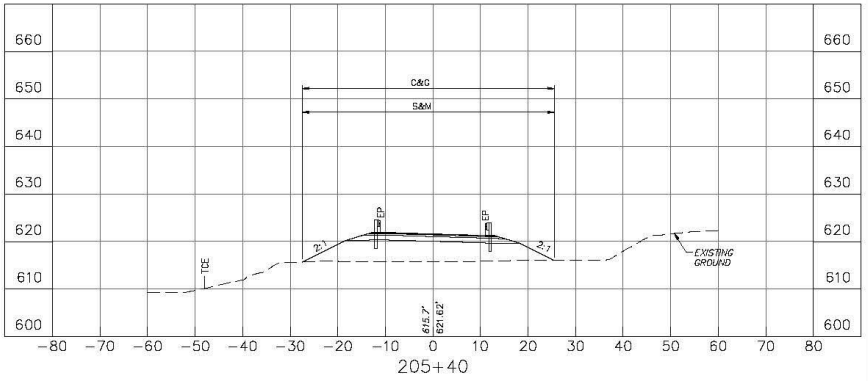
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

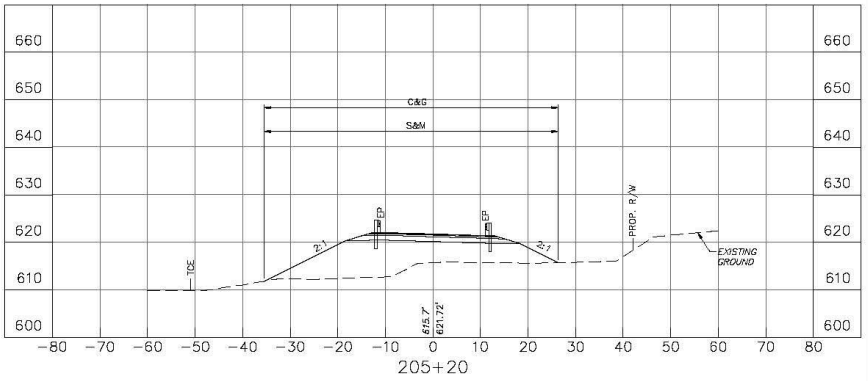
DETOUR
CROSS SECTIONS

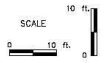
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	77	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
205+40		53.01		53.01		0		--		188.01		--	
	20		1149		1149		0		--		174.76		--
205+20		61.89		61.89		0		--		283.83		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
205+20		61.89		61.89		0		--		283.83		--	
	20		1292		1292		0		--		236.37		--
205+00		67.31		67.31		0		--		354.36		--	





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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

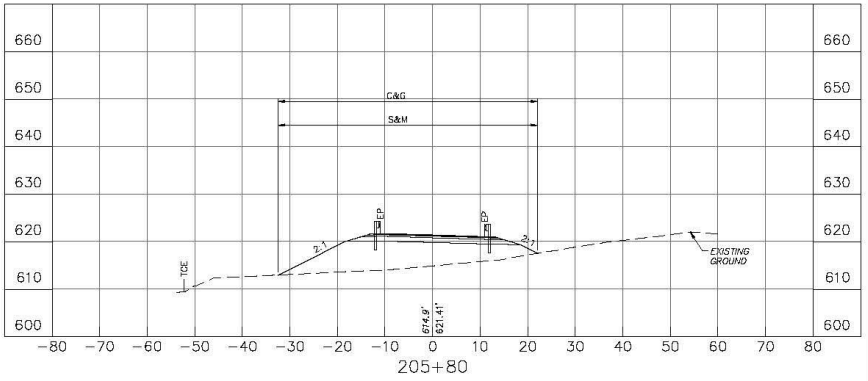
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

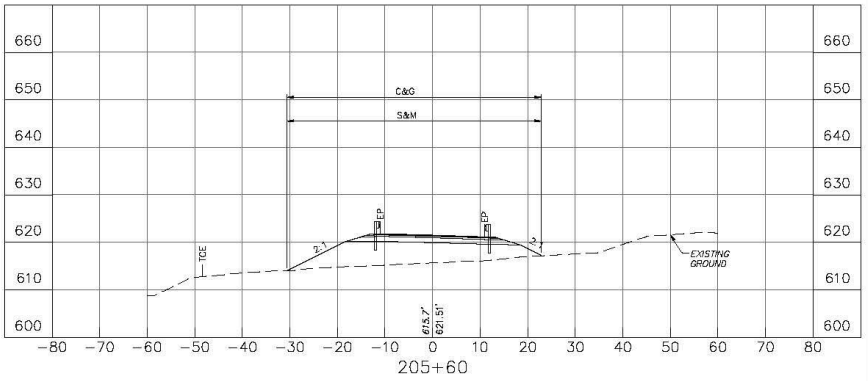
DETOUR
CROSS SECTIONS

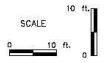
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	78	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
205+80		54.53		54.53		0		--		226.79		--	
	20		1080.90		1080.90		0		--		154.87		--
205+60		53.56		53.56		0		--		191.36		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	SF	CY	SF	CY	SF	CY	SF	CY
	FT	FT	SF	FT	SF								
205+60		53.56		53.56		0		--		191.36		--	
	20		1065.70		1065.70		0		--		140.51		--
205+40		53.01		53.01		0		--		188.01		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

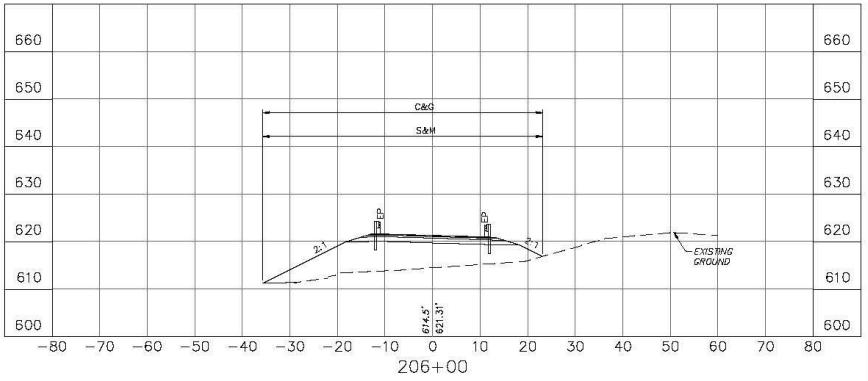
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

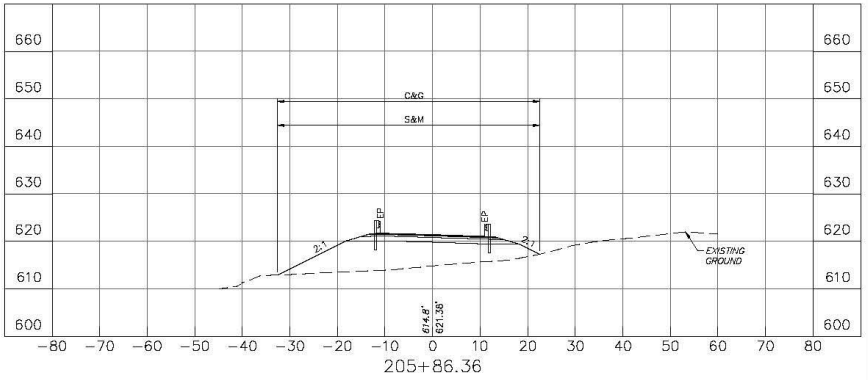
DETOUR
CROSS SECTIONS

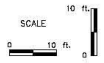
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	79	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
206+00		58.84		58.84		0		--		263.47		--	
	13.64		776.73		776.73		0		--		125.67		--
205+86.36		55.05		55.05		0		--		234.06		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
205+86.36		55.05		55.05		0		--		234.06		--	
	6.36		348.46		348.46		0		--		54.28		--
205+80		54.53		54.53		0		--		226.79		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

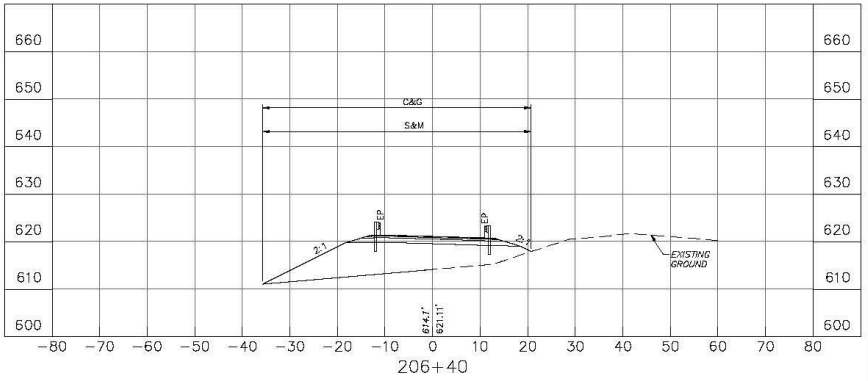
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

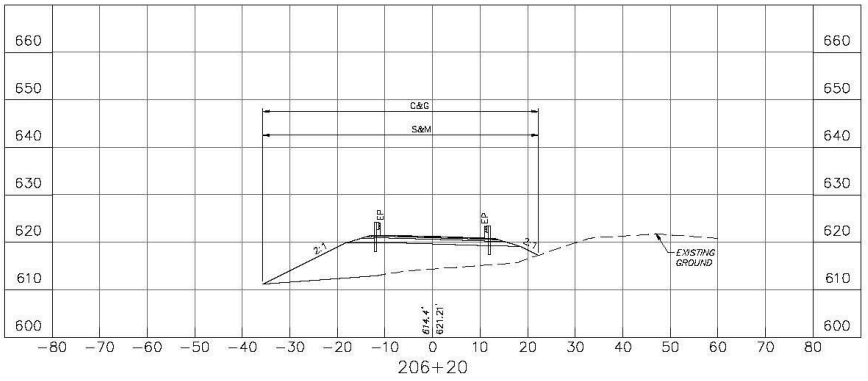
DETOUR
CROSS SECTIONS

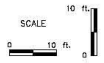
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	80	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH FT	WIDTH FT	AREA SF	WIDTH FT	AREA SF	SF	CY	SF	CY	SF	CY	SF	CY
206+40		56.36		56.36		0		--		257.61		--	
	20		1142.20		1142.20		0		--		194.38		--
206+20		57.86		57.86		0		--		267.21		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH FT	WIDTH FT	AREA SF	WIDTH FT	AREA SF	SF	CY	SF	CY	SF	CY	SF	CY
206+20		57.86		57.86		0		--		267.21		--	
	20		1167		1167		0		--		196.55		--
206+00		58.84		58.84		0		--		263.47		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

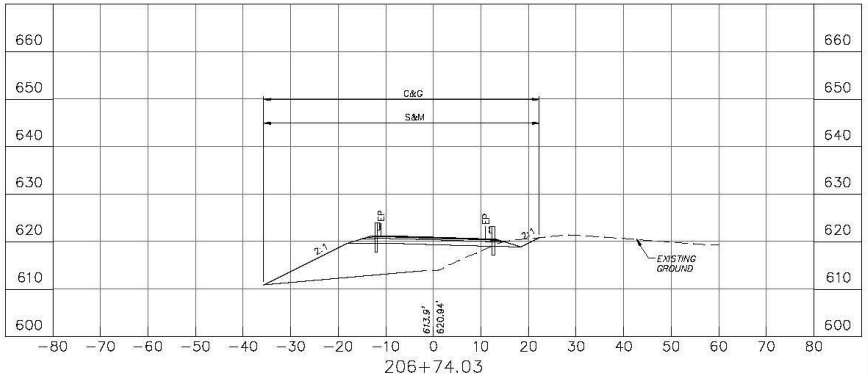
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DETOUR
CROSS SECTIONS

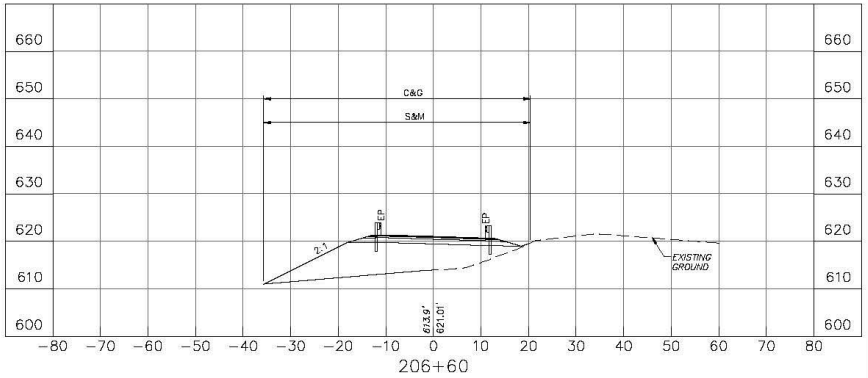
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	81	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
206+74.03		57.93		57.93		9.16		--		212.77		--	
	14.03		799.64		799.64		2.38		--		118.96		--
206+60		56.06		56.06		0		--		245.11		--	

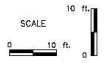


206+74.03

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
206+60		56.06		56.06		0		--		245.11		--	
	20		1124.20		1124.20		0		--		186.19		--
206+40		56.36		56.36		0		--		257.61		--	



206+60



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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

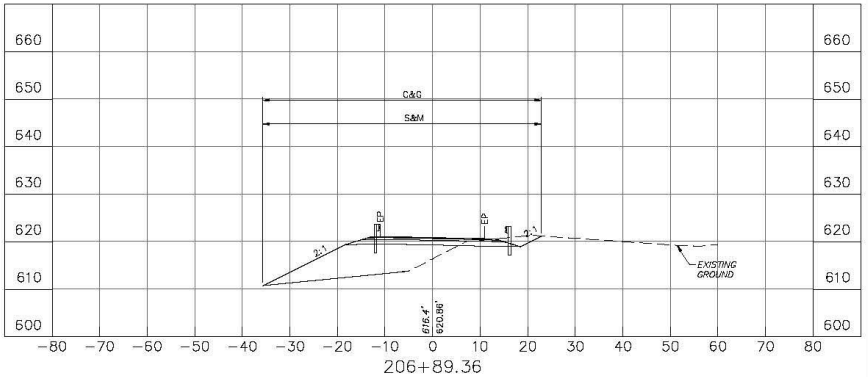
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DETOUR
CROSS SECTIONS

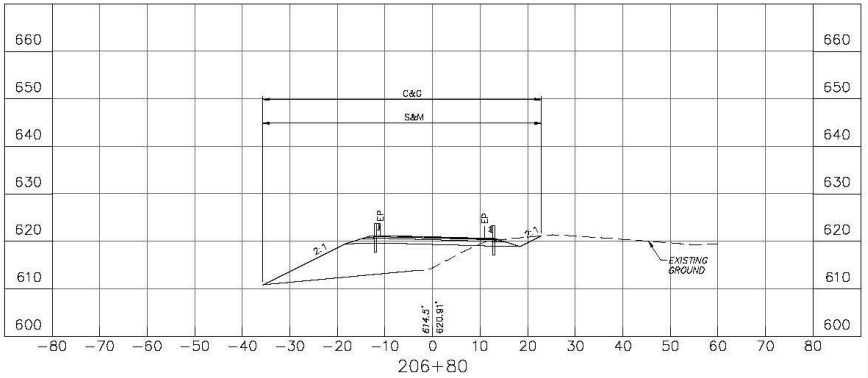
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	82	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
206+89.36		58.56		58.56		22.83		--		173.41		--	
	9.36		548.12		548.12		6.57		--		64.19		--
206+80		58.56		58.56		15.07		--		196.90		--	

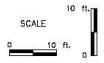


206+89.36

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
206+80		58.56		58.56		15.07		--		196.90		--	
	5.97		347.72		347.72		2.68		--		45.29		--
206+74.03		57.93		57.93		9.16		--		212.77		--	



206+80



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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

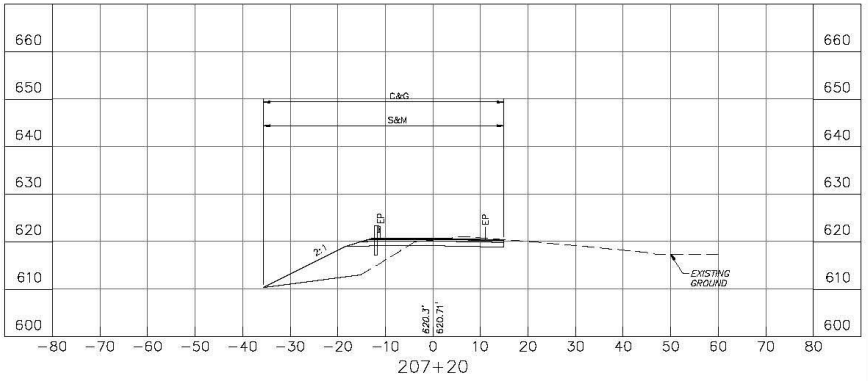
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

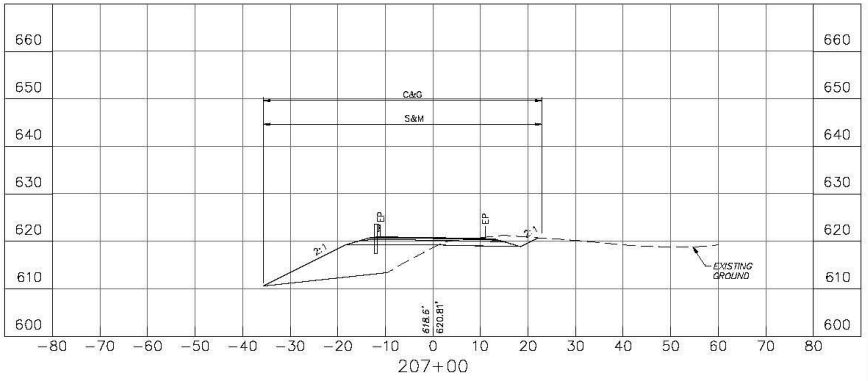
DETOUR
CROSS SECTIONS

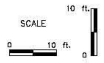
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	83	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
207+20		50.54		50.54		31.09		--		106.19		--	
	20		1091		1091		23.06		--		93.30		--
207+00		58.56		58.56		31.16		--		145.72		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
207+00		58.56		58.56		31.16		--		145.72		--	
	10.64		623.08		623.08		10.64		--		62.88		--
206+89.36		58.56		58.56		22.83		--		173.41		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

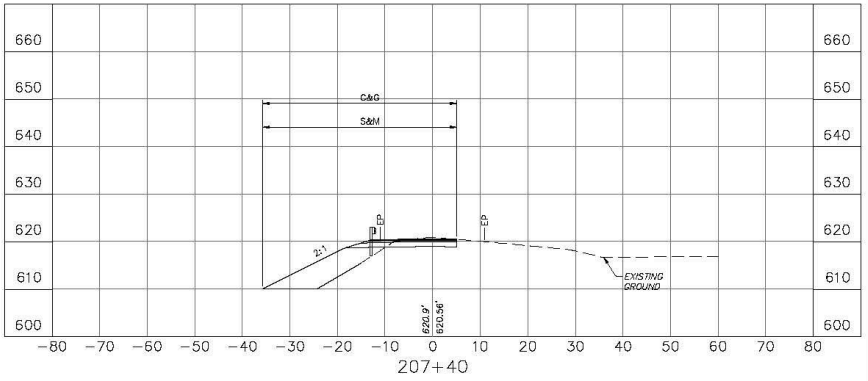
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

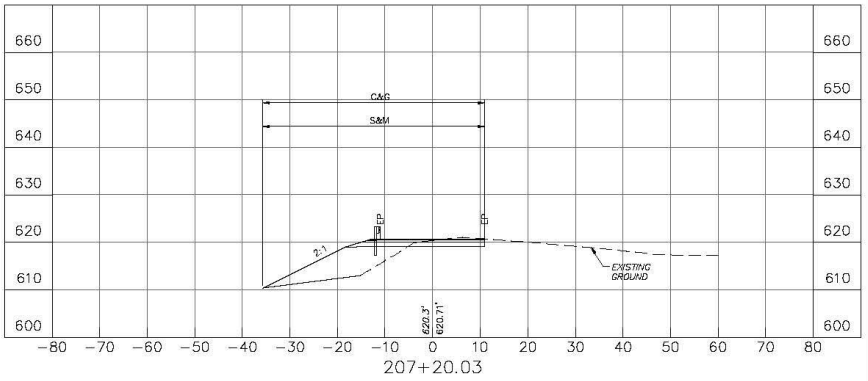
DETOUR
CROSS SECTIONS

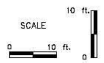
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	84	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
207+40		40.71		40.71		22.53		--		87.06		--	
	19.97		871.29		871.29		16.61		--		71.44		--
207+20.03		46.55		46.55		22.38		--		106.12		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
207+20.03		46.55		46.55		22.38		--		106.12		--	
	0.03		1.46		1.46		0.03		--		0.06		--
207+20		50.54		50.54		31.09		--		106.19		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

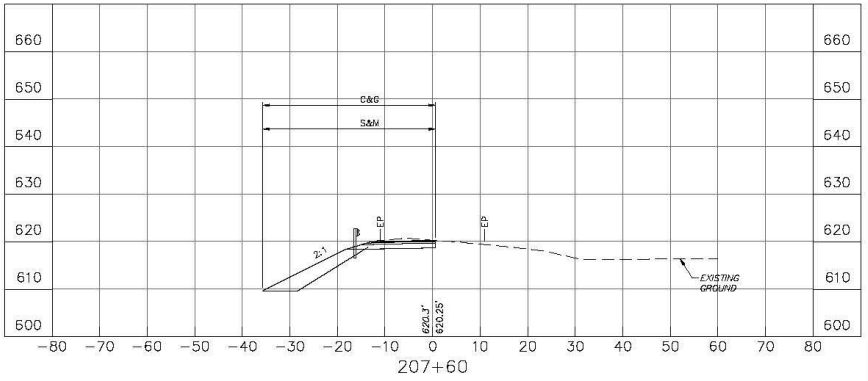
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

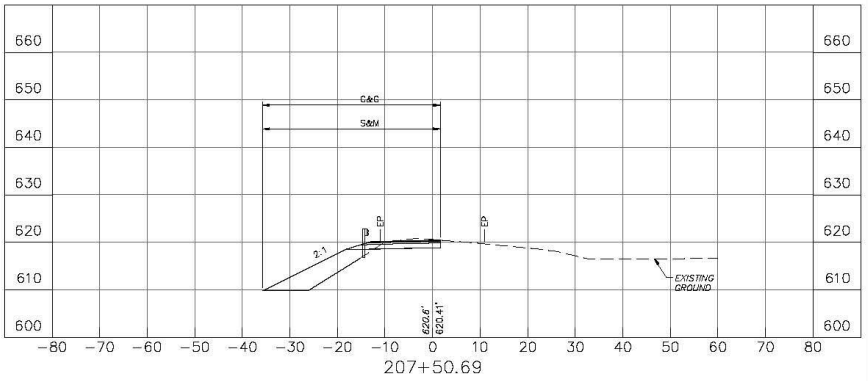
DETOUR
CROSS SECTIONS

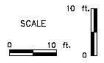
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	85	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
207+60		36.21		36.21		25.66		--		49.15		--	
	9.31		342.10		342.10		8.29		--		20.08		--
207+50.69		37.28		37.28		22.41		--		67.30		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
STATION	LENGTH	WIDTH	AREA	WIDTH	AREA	UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
	FT	FT	SF	FT	SF	SF	CY	SF	CY	SF	CY	SF	CY
207+50.69		37.28		37.28		22.41		--		67.30		--	
	10.69		416.86		416.86		8.90		--		30.56		--
207+40		40.71		40.71		22.53		--		67.06		--	





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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

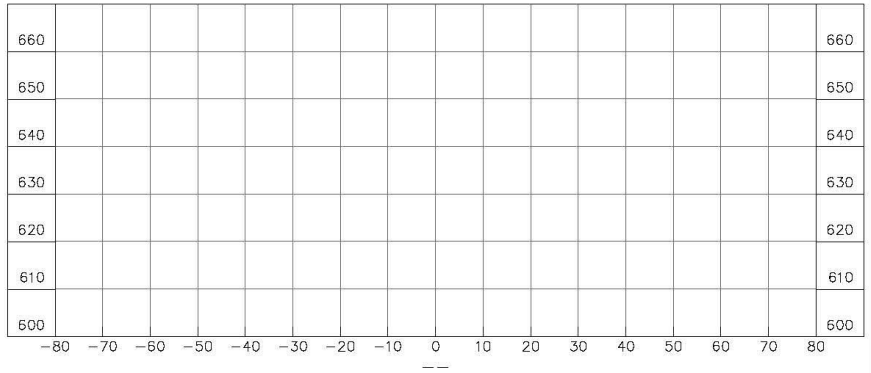
FOURTEEN MILE BRIDGE
WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

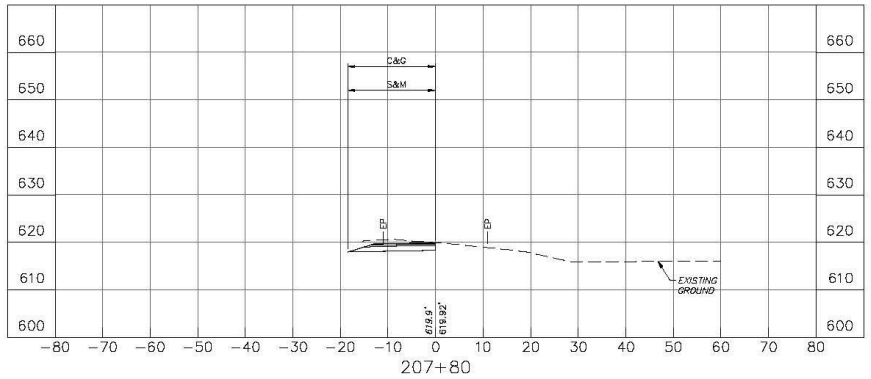
DETOUR
CROSS SECTIONS

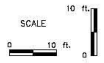
PUBLIC ROADS DIV.	STATE DIST. NO.	STATE PROJECT NO.	FEDERAL PROJECT NO.	FISCAL YEAR	COUNTY	SHEET NO.	TOTAL SHEETS
WV	2	S322-37-3.29 00	STP-0037(038)D	2019	LINCOLN	86	86

LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH FT	WIDTH FT	AREA SF	WIDTH FT	AREA SF	SF	CY	SF	CY	SF	CY	SF	CY
--		--	--	--	--	--	--	--	--	--	--	--	--
	--		--		--		--		--		--		--
--		--		--		--		--		--		--	



LOCATION		SEEDING & MULCHING		CLEARING & GRUBBING		EXCAVATION				EMBANKMENT			
						UNCLASSIFIED		UNSUITABLE		UNCLASSIFIED		SELECT EMBANKMENT	
STATION	LENGTH FT	WIDTH FT	AREA SF	WIDTH FT	AREA SF	SF	CY	SF	CY	SF	CY	SF	CY
207+80		18.31		18.31		24.34		--		0		--	
	20		545.20		545.20		18.52		--		18.20		--
207+60		36.21		36.21		25.66		--		49.15		--	





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J.B. TURMAN ENGINEERING, PLLC

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

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WV 37 OVER
FOURTEENMILE CREEK

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DETOUR
CROSS SECTIONS